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U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDIES

FINAL REPORT

VOLUME 1 OF 4

MACROECONOMICS

PROJECT SF/NIR/88/001

baldo & c.
CONSULTING ENGINEERS

PREAMBLE

The Nigerian Industrial Development Bank Limited (N.I.D.B.) is the premier industrial development finance institution in Nigeria and plays a central role in the concerted effort at industrial restructuring. The N.I.D.B. receives foreign currency funds from the World Bank and the European Investment Bank and local currency from the local capital market to be further lent to individual manufacturing investment projects.

After a long period of lending to essential consumer goods import substitution projects, the Bank formulated a new strategy in 1980. The strategy gave new emphasis to intermediate and capital goods production as well as to local resource-based products. However, the new strategy has not yet been fully realized because of risk aversion and conservatism of local entrepreneurs, NIDB's own shortage of in-house promotional expertise and the inadequacy of information and statistics.

Recent economic developments have increased the urgency of restructuring the industrial sector. In this respect, NIDB has drawn up a ten-year (1988-1997) Investment Programme of Industrial Transformation which has gone a step further than that for 1981-1985 in terms of the strategic nature of the projects to be promoted, which is focused on the

- Agro-based sub-sector

- Chemical sub-sector

- Engineering sub-sector

The Bank's ten years programme is in line with the Federal Government Structural Adjustment Programme (SAP) and the second Tier Foreign Exchange Market (SFEM, now FEM) which is the SAP's central tool.

The primary objective of SAP is to deregulate the economy and make it more efficient through the removal of economic distortions. SAP policy measures, particularly the more realistic exchange rate resulting from FEM, have provided an environment which is conducive to the restructurating of manufacturing sector. It is expected that the present policy environment will continue long time to make its restructuring impact enduring.

INTRODUCTION

The N.I.D.B. decided, for implementing its ten-year investment programme, to apply for the assistance of UNIDO and, through this Organization, to be provided with the services of a consulting firm, recruited to conduct studies on the three selected subsectors.

Baldo & C. Consulting Engineers was appointed as the consultant firm.

A team of multidiscipline experts visited Nigeria for collecting information and data related to the Country, in general and to the three subsectors in particular. The team was assisted by NIDB, which provided the experts with all information and data available within its Departments.

Moreover, NIDB assured, for each discipline, the assistance of experienced staff members for the data gathering throughout Nigeria and for the visits to factories, farms, private and Public Entities.

At the end of this stage, the gathered information and data were processed at Baldo 's Headquarters and an Interim Report was worked out and submitted both to UNIDO and NIDB for their considerations.

It contained a macro-economic survey of Nigeria and a preliminary evaluation of opportunities which were discussed in Lagos with NIDB and UNIDO representatives. Baldo was asked to review the report taking into account some fundamental aspects that play a very important role in selecting the projects for which studies have to be undertaken.

The next chapters provide information and data that led to the preparation of 22 opportunity studies contained in the volumes

2 - AGRO-BASED SUBSECTOR

3 - CHEMICAL SUBSECTOR

4 - ENGINEERING SUBSECTOR

This volume 1 is divided into 4 sections.

a) Section 1, dealing with the Country's macroeconomics

b) Section 2, dealing with Agro-based Subsector Analysis

c) Section 3, dealing with Chemical Subsector Analysis

d) Section 4, dealing with Engineering Subsector Analysis.

Hereunder is the table showing the salient data of the 22 selected projects for which opportunity studies have been carried out in agreement with both UNIDO and NIDB.

LIST AND SALIENT DATA OF SELECTED PROJECTS

Projects	Investments (MS)			Manpower	I.R.R. %	B.E.P. %	Local inputs %
	L.C.	F.C.	total				
A - AGRO-BASED INDUSTRY							
1. Conversion of Palm-oil in Methylester	3.8	4.7	8.5	53	22.49	35	92
2. Glycerol from Methylester	1.3	1.2	2.5	37	20.32	45	99
3. Palm-oil	1.9	1.7	2.6	79	27.94	22	100
4. Cocoa Processing Plant	4.8	6.7	11.5	56	22.55	27	100
5. Tomato processing Plant	2.1	3.4	5.5	130	36.1	15	100
6. Sorghum Malting Plant	4.4	6.8	11.2	70	20.87	33	100
7. Citrus Concentrate Juice	2.2	3.2	5.4	89	18.48	36	100
B - CHEMICAL INDUSTRY							
1. Chlor-Alkali Plant	3.77	9.23	13	145	11.26	62	40
2. Calcium Hypochlorite	2.5	5.8	8 3	93	17.06	43	95
3. Calcium Carbide	3.2	6.5	9.7	90	18.54	42	70
4. Sulphuric Acid	2.6	2.3	4.9	54	18.31	41.5	18
5. U.F. Glue	4.2	6.4	10.6	53	25.97	22	50
6. Bone based Chemicals	2.6	3.1	5.7	150	30.6	23	100
7. Sodium Sulphate	4.6	10.2	14.8	75	14.4[illegible]	48	70
C - ENGINEERING INDUSTRY							
1. Small tractors	4	4	8	127	16.97	29	25
2. Diesel Engines	1.5	2	3.5	52	16.55	33.8	5
3 Agricultural Handtools	1.8	2.8	4.6	73	17.26	38	30
4. Cement Industry Spare Parts	3.5	5.5	9	150	18.50	32	15
5. Textile Industry Spare Parts	0.95	0.85	1.8	48	21.65	35	70
6. Shock Absorbers	0.85	1.1	1.95	23	13.91	40	8
7. Contact Sets	0.70	1.15	1.85	27	23.48	25	5
8. Domestic Pumps	0.97	1	1.97	33	30.28	16	5

SECTION 1

COUNTRY'S MACRO ECONOMICS

TABLE OF CONTENT

1. ECONOMIC STRUCTURE

Official sources indicate that real GDP growth was an unexpected 4.1% in 1988 but the outlook for the Nigerian economy in 1989 is still gloomy in the face of escalating domestic prices, weakening of aggregate domestic demand and continued uncertainty in the international oil market. The half year report of the Central Bank of Nigeria (CBN) indicates, in the first six months of 1988, increases on an annual basis of 3.7% and 8.3% respectively in agriculture and industry. However, there were still serious shortage of goods. In terms of capacity utilization, manufacturing activity rose by only 2.9% to 41.7% in comparison with the same period 1987, while employment declined by 2.8%. The year 1987, to which most of the latest available data are referred, began in an atmosphere of economic uncertainty following the introduction of the Structural Adjustment Programme (SAP) in July 1986 and the Second-tier Foreign Exchange Market (SFEM), now FEM, on September 26, 1986. Although FEM is only one of the main concrete measures embodied in SAP, the combined impact of the two on the economy could be described as revolutionary in view of the fundamental changes they have induced. All available indicators of economic performance reveal that the year 1987 was a difficult one for consumers and producers alike, as costs and prices escalated to high levels. The high costs and prices deflated demand for goods and services and depressed capacity utilization in the manufacturing sector, generating high unemployment. Nevertheless, the overall performance of the economy in 1987 showed some improvement over the preceding year. Real GDP increased by 1.2% as against the decline of 2.1% in 1986 (Table 1.1).

(Table 1.1) - Gross Domestic Product (GDP) at 1984 constant factor cost (N Billion)[1]

	(1)	(2)	(3)	Percentage share in total			Percentage change between	
Activity sector	1985	1986*	1987**	1985	1986	1987	(1)&(2)	(2)&(3)
Agriculture	17.52	18.00	17.92	23.53	24.69	24.29	2.74	0.44
Livestock	5.86	5.92	6.01	7.87	8.12	8.15	1.20	1.52
Forestry	2.29	2.29	2.29	3.08	3.14	3.10	0.00	0.00
Fishing	1.34	1.25	1.29	1.80	1.71	1.75	-6.72	3.20
Crude Petroleum	11.65	10.91	9.94	15.64	14.97	13.47	-6.35	-8.89
Mining & Quarrying	0.29	0.20	0.21	0.39	0.27	0.28	-31.03	5.00
Manufacturing	4.23	4.23	4.65	5.68	5.80	6.30	0.00	9.93
Utilities	0.39	0.39	0.41	0.52	0.53	0.56	0.00	5.13
Buldg & Constr.	1.05	0.90	0.92	1.41	1.23	1.25	-14.29	2.2
Transport	3.10	3.10	3.21	4.16	4.25	4.35	0.00	3.55
Communication	0.10	0.10	0.10	0.13	0.14	0.14	0.00	0.00
Wholesale&Ret.Trade	19.80	18.81	19.75	26.59	25.80	26.77	-5.00	5.00
Hotels&Restaurants	0.21	0.20	0.21	0.28	0.27	0.28	-4.76	5.00
Finance&Insurance	1.30	1.40	1.55	1.75	1.92	2.10	7.69	10.71
Real ests&Busin.Serv.	0.20	0.21	0.22	0.27	0.29	0.30	5.00	4.76
Housing	2.36	2.36	2.43	3.17	3.24	3.29	0.00	2.97
Producers Gov.Serv.	2.78	2.63	2.66	3.73	3.61	3.61	-5.40	1.14
Total	**74.47**	**72.90**	**73.77**	**100.00**	**100.00**	**100.00**	**-2.11**	**1.19**

(*) Revised (**) Fed. Min. of Finance and Economic Development Estimates

With an estimated annual population growth rate of more than 3%, the achievement of a sustained growth rate of GDP in excess of the population's has to be the most focal point, in view of the fact that the country's 1987 GDP per capita represented only 59.3% of its level in 1977 (Table 1.2).

[1] Source FOS - Federal Office of Statistics, Lagos

(Table 1.2) - Nigeria: GDP and GDP per capita, 1977-1987 (at constant 1977 prices)[2]

Year	GDP (N billion)	Growth rate (per cent)	capita GDP (Naira)	Growth rate (per cent)
1977	32.1	7.0	405	10.9
1978	30.2	-5.9	370	-8.6
1979	32.2	6.6	380	2.7
1980	30.8	-4.3	355	-6.5
1981	29.9	-2.9	335	-5.6
1982	29.9	0.0	325	-2.9
1983	27.4	-8.4	290	-10.7
1984	25.9	-5.4	255	-12.0
1985	26.2	1.2	260	1.9
1986	25.3	-3.4	245	-5.7
1987	25.6	1.2	240	-2.0

1.1 AGRICULTURE

The agriculture sector (together with livestock, forestry and fishing) employs about 60% of the total labour force and accounts for about 40% of GDP. This percentage declined significantly over time, due to the agriculture slower growth in respect to the other sectors.

In 1987 agriculture sector suffered some set-back, as a result of poor harvest following the adverse weather conditions. Provisional estimate (Table 1.3) shows an overall decline in the agricultural production index during 1987 of -1.8%, in contrast to an increase of 6.6% in 1986.

(Table 1.3) - Agricultural production Index (1975 = 100)[3]

	Weights	1985*	1986*	1987**	%changes between	
		(a)	(b)	(c)	(a)&(b)	(b)&(c)
1.Crops	66.2	97.1	104.6	100.4	7.7	-4.0
(a) Staples	51.6	88.9	98.6	93.3	10.9	-5.4
(b) Other crops	14.6	126.3	125.9	128.7	-0.3	2.2
2.Livestock	13.6	106.8	110.7	113.0	3.7	2.1
3.Fish	9.2	51.8	60.7	84.3	17.2	38.9
4.Forestry	11.0	110.6	110.7	114.2	0.1	3.2
Aggregate Index	**100.0**	**95.8**	**102.1**	**100.3**	**6.6**	**-1.8**

* Revised ** Provisional

Compared with a substantial stability in 1986, the output of staple food crops dropped by about 5.4% while cash crops rose by 2.2% (mainly cocoa, soya-bean, cottonseed). Livestock production increased by 2.1%. Fish production continued its positive trend recording a 38.9% rise, due mainly to artisan and inshore fishing development programme.

After two years of steady positive growth, all crops experienced a slight decline due to the incidence of pest and disease infestations, except rice and wheat which experienced a modest increase (Table 1.4).

[2] Source: Government of Nigeria, Annual Abstract of Statistics, various issues

[3] Different Sources: FOS, Lagos - FAO Production Yearbook - Central Bank of Nigeria Annual Agriculture Survey - MOA annual report and returns

(Table 1.4)-Estimated major agriculture commodities output ('000 Tons) unless otherwise stated [4]

CROPS	1984	1985	1986	1987	% changes between		
	(a)	(b)	(c)	(d)	(a)&(b)	(b)&(c)	(c)&(d)
Staples							
Maize	1058	1190	1336	1202	12.5	12.3	-10.0
Millet	3349	3648	4111	3905	10.0	11.6	-5.0
Sorghum	4608	4991	5455	5182	8.3	9.3	-5.0
Rice	157	196	283	297	24.8	44.4	4.9
Wheat		113	132	139		16.8	5.3
Acha		25	27	26		8.0	-3.7
Beans	477	611	732	688	28.1	19.8	-6.0
Cassava	1209	1378	1564	1486	14.0	13.5	-5.0
Potato		43	46	45		7.0	-2.2
Yam	4600	4738	5209	4886	3.0	9.9	-6.2
Cocoyam		232	373	354		60.8	-5.1
Plantain	1086	1113	1127	1071	2.5	1.3	-5.0
Vegetables		1254	1293	1241		3.1	-4.0
Other Crops							
Melon	143	147	153	145	2.8	4.1	-5.2
Groundnut	591	621	640	657	5.1	3.1	2.7
Benniseed	31	35	35	34	12.9	0.0	-2.9
Coconut	101	102	104	105	1.0	2.0	1.0
Sheanut	99	100	103	104	1.0	3.0	1.0
Soyabeans	43	114	100	107	165.1	-12.3	7.0
Cottonseed	108	46	30	32	-57.4	-34.8	6.7
Palm Kernel	340	360	350	353	5.9	-2.8	0.9
Cocoa	140	110	100	105	-21.4	-9.1	5.0
Coffee		6	6	6			
Rubber	199	58	60	51	-70.9	3.4	-15.0
Sugar Cane	821	862	897	852	5.0	4.1	-5.0
Palm Wine		4882	4940	4951		1.2	0.2
Tobacco		25	25	26			4.0
Livestock							
Poultry	62	64	67	56	3.2	4.7	-16.4
Goat meat	177	186	192	206	5.1	3.2	7.3
Lamb Mutton	65	66	68	75	1.5	3.0	10.3
Beef	199	212	223	232	6.5	5.2	4.0
Pork	28	31	33	34	10.7	6.5	3.0
Milk	164	172	180	182	4.9	4.7	1.1
Eggs	380	390	399	332	2.6	2.3	-16.8
Fish							
Artisan coastal & brackish catch	228	140.9	1372	143.1	-38.2	-2.6	4.3
Inland lakes&rivers	92	60 5	107	233.1	-34.2	76.9	117.9
Fish Farm&Inshore	22	38.8	37.2	15.7	76.4	-4.1	-37.8
Ind.Coastal/shrimps	25						
Shrimps		1.5	1.6	1.3		6.7	-18.8
Distant Water		61.7	65.2	85.8		5.7	31.6
Forestry ('000 m^3)							
Roundwood	89843	92538	92562	95524	3.0		3.2
Sawnwood	900	910	926	939	1.1	1.8	1.4
Wood Panels	110	113	118	118	2.7	4.4	
Paper&paperboards	12	13	14	14	8.3	7.7	

[4] Different Sources: FOS, Lagos - FAO Production Yearbook - Central Bank of Nigeria Annual Agriculture Survey - MOA annual report and returns

It is clear that, given the precarious state of the sector and the positive population growth rate, much more needs to be done to achieve the objective of a steady self-sufficiency in food. Self-sufficiency for the various food commodities is not the only goal of Nigeria's agricultural policy which, at present, is also concerned with the attainment of the following objectives:

- increase the production of agricultural raw materials to meet the growing needs of an expanding industrial sector. In pursuance of this objectives industries which use imported agricultural raw materials have been directed by government to get themselves involved in promotion of the local production of their agricultural raw materials;
- increased production and processing of export crops with a view to increasing their foreign exchange capacity and further diversifying the country's export base and sources of foreign exchange earnings;
- modernization of agricultural production, processing, storage and distribution, through the infusion of improved technology and management so that the sector can be more responsive to the demand resulting from developments in other sectors of the Nigerian economy;
- improvement in the quality of life of rural dwellers through the provision of social amenities like potable water and improved health and educational facilities;
- improvement in protection of agricultural land resources from drought, desert encroachment, soil erosion and flood.

The above stated targets are supposed to be pursued by the activities of already existing agricultural institutions such as the River Basins and Rural Development Authorities (RB & RDAs), the Agricultural Development Project (ADPs), the Directorate of Food, Roads and Rural Infrastructure and the Special Agricultural Programmes for School. In this respect agricultural production will probably get a boost when the second Multi-State Agricultural Development Project (MSADP), costing $ 125 mn over four years, gets under way. The four states that will benefit from the project are Gongola, Kwara, Niger and Bauchi[5].

Although a central feature of the ADP pattern is the reliance on the small-scale farmer as the centre-piece of an incremental food production strategy, many difficulties have been encountered. Presently, more emphasis is given to the improvement of the relations between State governments and ADP administration, in order to avoid duplication of efforts .In 1987 there was a moderate increase in the scope of the activities undertaken by the ADPS. If infrastructure investments remained in negative trend (due mainly to the activities of the Directorate of Food, Roads and Rural Infrastructure set up in 1986), sales of farm inputs, such as fertilizers and pesticides ,and sales of machinery equipment, such as tractors, showed a good performance (**Table 1.5**).

Table 1.5 - Agricultural Development Projects Operations (ADPs)[6]

	1985*	1986*	1987**	% change between	
	(a)	(b)	(c)	(a)&(b)	(b)&(c)
Infrastructure constructed					
(a) Roads (km)	1317	1602	914	21.6	-42.9
(b) Earth dams, Boreholes Tube-wells and Wash-bores (No)	2222	949	1069	-57.3	12.6
(c) Farm service centres (No)	274	55	52	-79.9	-5.5
Farm inputs supplied					
(a) Fertilizer (tonnes)	301098	182486	286580	-39.4	57.0
(b) Seed (tonnes)	937	8077	1938	762.0	-76.0
(c) Tractors (No)	114	155	250	36.0	61.3
(d) Other farm implements	5794	6459	452	11.5	-93.0

* Revised **Provisional

(5) The start-up of this ADP leaves only the four states in the west of the country (Lagos, Ogun, Ondo and Oyo) without similar schemes.

(6) Source: compiled from Central Bank of Nigeria returns & National Agricuture Survey

Data released from the Federal Office of Statistics (FOS) point out that only 4 crops out of 11 (Cotton, Maize, Melon, Cocoyam) recorded in 1987/88 a positive growth rate of the yield per hectare (Table 1.6), in comparison with the previous year.

(Table 1.6) - Nigeria Major Crops Yield (kg/ha) (77/78 - 87/88)[7]

Crop \ Year	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87 (1)	87/88 (2)	%Growth (1+2)
Millet	**835**	**1070**	**919**	**868**	**786**	**680**	**838**	**909**	**988**	**1034**	**631**	**-38.97**
Guinea Corn	956	698	1041	1123	1112	1008	999	1081	1031	1119	828	-25.99
Groundnut	**790**	**987**	**1006**	**837**	**645**	**797**	**909**	**874**	**767**	**821**	**682**	**-16.87**
Beans	265	241	514	362	524	488	402	397	457	565	411	-27.28
Yam	**11544**	**12272**	**10538**	**10664**	**10757**	**11024**	**9517**	**10278**	**12098**	**11997**	**11147**	**-7.08**
Cotton	960	1050	919	674	848	1412	1161	1179	667	988	1300	31.63
Maize	**1274**	**921**	**1155**	**1407**	**1491**	**11926**	**971**	**1139**	**1174**	**1007**	**1173**	**16.47**
Cassava	14646	9017	11074	9277	8197	11363	10870	11812	10389	12923	10197	-21.09
Rice	**1665**	**2348**	**2083**	**1484**	**1957**	**2137**	**1868**	**3220**	**2198**	**3311**	**2213**	**-33.15**
Melon	866	803	1010	1132	815	941	1264	1037	1708	1284	1360	5.89
Cocoyam	**4807**	**5351**	**3778**	**5102**	**3924**	**5256**	**5750**	**6270**	**5828**	**6903**	**7550**	**9.37**

(1) Revised.
(2) Provisional.

1.2 MANUFACTURING INDUSTRY

1.2.1 Overall performance and major constraints

In spite of the results of the latest half year report from Central Bank of Nigeria that show, during the 2nd quarter 1988 a marked improvement in the output index of the manufacturing sector (Table 1.7), (+7.1%) over its level in the corresponding '87 qrt. and (+6.1%) over the first '88 qrt., large industrial segments are still adversely affected by a number of difficulties:

a) Rise in production costs, due to the Naira devaluation and to tariffs on imported raw materials.

On the average, the cost of imported raw materials in the first half 1988 rose by about 61% over its level in the corresponding period of the previous year. There was also a remarkable rise of 42% in the average cost of local raw materials: this was essentially the result of the inflationary pressures in the economy as all sectors adjusted prices to reflect the exchange rate of the Naira. High costs of raw materials and spare parts had an immediate effect on installed capacity utilization.

(7) source: FOS, National integrated survey of Households, Rural, and agriculture sample survey 1980/1981, Lagos 1983

(Table 1.7) - Quarterly index of industrial production: 1987-1988 (1972 = 100) [8]

Industry	2nd quarter	1st quarter	2nd quarter	% changes between	
	1987 (a)	1988 (b)	1988 (c)	(a)&(c)	(b)&(c)
Manufacturing	431.4	435.5	462.2	7.1	6.1
Mining	68.9	74.8	76.0	10.3	1.6
Electricity	514.0	522.9	564.6	9.8	8.0
Total of sectors	195.5	200.0	211.2	8.0	5.6
Capacity Utiliz.(d)	40.5	40.8	41.7		

(a)= Revised (b) = Provisional (c)= Estimates (d)= Percent

According to the Central Bank of Nigeria (CBN) of 200 manufacturing firms in the Lagos Area, capacity utilization rose, in the first quarter 1988, only to an average of about 39%, while employment declined by 1.7% over the level recorded in the first quarter 1987 (Table 1.8).

Table 1.8 - 1988 First quarter survey of manufacturing sub-sector [9]

Items	1st qrt 1987	4th qrt 1987	1st qrt 1988	% change between	
	(a)	(b)	(c)	(a)&(c)	(b)&(c)
1.Installed capacity utiliz. rates (%)	35.1	38.7	38.8	3.7	0.1
2.Value of production (*)	315.5	374.9	397.1	25.9	5.9
3.Total value of raw mat. used (*)	278.3	322.3	338.1	21.5	4.9
Value of imported raw mat. used(*)	182.1	167.8	205.6	12.9	22.5
Value of loc. sourced raw mat. (*)	96.2	154.5	132.5	37.7	-14.2
4.Sales (*)	458.2	684.3	654.6	42.9	-4.3
5.Inventories of raw materials (*)	458.9	502.7	461.1	0.5	-8.3
6.Inventories of finished goods (*)	284	183.8	209.9	-26.1	14.2
7.Total investment expenditure (*)	145.3	103.3	113.7	-21.7	10.1
Machinery & equipment (*)	108.7	45.9	64	-41.1	39.4
Spare parts (*)	14.9	32.9	33.7	126.2	2.4
Repairs & maintenance (*)	21.7	24.5	16	-26.3	-33.7
8.Sources of fund invested (*)	145.3	103.3	113.7	-21.7	10.1
Company's own funds (*)	60.1	85.2	95.5	58.9	12.1
Local banks (*)	85.2	18.1	18.2	-78.6	0.6
9.Total number of employment (*)	22076	21496	21706	-1.7	1.0

(*) value in million Naira

As expected, capacity utilization was higher in the subgroups less dependent on imports. Highest, at 81.3 per cent capacity utilization was tyres and tubes industry. Capacity utilization was above 40 per cent in the sub-groups; textiles (69.1%), soap and perfumes (58.0%), cement and cement products (55.0%), miscellaneous food preparation (55.0%), sugar confectionery (52.5%), beer and stout (51.1%), other chemical and petroleum products (46.8%), paper products (45.8%). Other sub groups such as radio/TV and communications equipment, drugs and medicine, meat and dairy, operated between 25-39 per cent of their installed capacities.

[8] Different sources: FOS, CBN surveys, NNPC, NEPA

[9] source : CBN - Economic and Financial Review, 1988 Figures refer to survey of 200 manufacturing firms in the Lagos Area, 54.0 per cent of which responded to survey questionnaires

Capacity utilization rate was particularly low in the sub-groups: paints is (21.2%), auto assembly (9.0%), and glass products (4.0%). During the first quarter of 1988, the value of locally sourced raw materials used in production was lower by 14.2 per cent compared with the last quarter of 1987. The decline was mainly attributable to cement and cement products and to plastic products. The total value of raw materials utilized by a selected sample of firms increased by 21.5 and 4.9 per cent over the raw materials utilized in the first and fourth quarters of 1987 respectively. Imported raw materials accounted for 60 per cent of the value of total raw materials used, thus showing the continued strong dependency of the manufacturing sector on imported inputs.

The results are confirmed by the index of manufacturing production **(Table 1.9)**.

(Table 1.9) - Manufacturing production Index (Base 1972 = 100) [10]

Year	Sugar Confectionary	Soft drinks	Beer & Stout	Cigarettes	Cotton textil	Synth Fabric	Foot wear	Paints	Refine Petrol Prod	Cement	Roof sheets	Vehic Assy	soap & deterg	Radio & TV	TOTAL
1982	78.5	1006.0	509.3	0.0	285.5	1175.0	32.0	474.3	353.4	272.8	243.3	5463.3	412.8	467.0	432.7
1983	58.3	873.0	306.1	0.0	144.8	1262.0	53.8	211.1	255.7	96.6	106.8	2068.3	383.8	558.6	319.0
1984	47.2	921.6	419.4	0.0	103.9	639.4	51.3	243.1	251.7	60.9	113.2	689.3	171.0	334.1	280.8
1985	42.5	785.4	489.3	0.0	110.0	340.2	41.8	177.2	358.8	303.8	285.1	1344.1	178.3	367.9	336.6
1986*	30.5	559.4	617.4	0.0	44.0	666.8	32.7	140.1	301.0	328.5	525.9	629.0	181.4	181.4	232.5
1987**	28.3	510.0	639.0	0.0	145.4	668.0	34.4	151.4	306.8	332.5	431.3	670.8	185.2	84.1	340.2
1985															
1st quarter	53.0	845.1	517.5	0.0	111.1	357.2	55.6	179.6	344.5	306.7	376.7	1803.1	202.8	400.1	349.2
2nd quarter	42.3	773.2	684.7	0.0	116.1	315.3	44.2	216.9	286.0	296.2	330.4	1511.2	232.3	381.9	359.0
3rd quarter	40.8	717.1	413.5	0.0	109.0	374.6	40.3	149.6	389.0	285.4	168.7	1120.7	150.4	458.2	329.5
4th quarter	33.8	806.2	341.5	0.0	127.9	313.7	27.4	163.2	415.0	327.0	265.0	941.6	127.0	231.5	308.5
1986															
1st quarter	34.1	755.9	868.2	0.0	74.9	311.5	33.2	142.9	319.2	315.8	342.1	836.5	171.8	182.2	387.4
2nd quarter	32.2	648.2	624.3	0.0	55.1	390.7	28.8	131.4	294.0	317.3	453.3	888.9	102.7	194.1	308.0
3rd quarter	31.1	522.5	494.5	0.0	17.9	1044.5	34.5	144.4	307.8	348.4	339.9	553.2	220.0	182.6	302.4
4th quarter	27.4	310.8	482.6	0.0	28.2	920.5	34.1	141.7	279.7	332.5	968.4	237.5	230.9	178.1	290.0
1987															
1st quarter	28.8	690.1	878.6	0.0	128.9	358.8	40.0	163.4	232.6	319.4	270.8	812.2	175.4	112.5	359.0
2nd quarter	29.9	591.8	631.8	0.0	151.8	450.1	28.6	143.5	288.7	321.2	372.2	863.2	104.9	70.9	322.0
3rd quarter	23.8	477.1	499.7	0.0	146.1	1203.2	34.3	150.8	329.7	352.8	279.0	537.2	224.6	69.0	334.2
4th quarter	25.5	283.7	487.7	0.0	154.9	1060.0	33.9	147.9	376.3	336.5	795.1	230.7	235.7	84.1	345.7

[10] Different sources : FOS statistics and CBN survey

Obviously, branches with large domestic value added have performed relatively better than assembly type of activities highly import-dependents such as vehicle assembly and electrical machinery. Beer, cement and soap and detergents (Table 1.9) were the only industrial products that recorded a positive growth trend during the 1984-1987 period.

Table 1.10 - Percentage share of imports in industrial inputs, mid-1987 [11]

Sub-sector of manufacturing	percent of imports in industrial inputs
Food, beverages, tobacco	34.8
Wood and wood products	22.4
Non-metallic minerals	23.5
Textile and wearing apparel	47.6
Chemicals and pharmaceuticals	55.8
Industrial plastic and rubber	79.4
Basic & fabricated metal products	50.3
Vehicles	78.2
Electrical machinery	80.7
Paper products	60.1

b) Continued liquidity constraints, as a result of the relatively high rates of interest.

This has inevitably made borrowing from the bank by manufacturers, too costly and unattractive, particularly in view of the decline in the rate of return of manufacturing investment, estimated by the Manufacturers Association of Nigeria to be on the average less than 10%.

c) Weak domestic demand

This problem derives from a number of factors among which are:

- liquidity squeeze;

- high cost-price effects of Foreign Exchange Market;

- consumer resistance, especially because of the general reduction of tariffs on imported finished goods that made the imported substitute cheaper and more readily available.

d) Smuggling

Large scale smuggling of banned goods constituted a major problem for a number of manufacturing sub-sectors during 1987-1988. Of particular significance is the smuggling of wheat and wheat flour, vegetable oils and rice, triggered by 1987 government imports ban of wheat in order to encourage the milling and the use of local cereals. Various flour mills in the country went ahead and made substantial investment to convert their plants for maize milling. The large scale smuggling of wheat flour has not only vitiated government's policy on local sourcing of raw materials, it has also put the enormous investment by flour millers in jeopardy. Furthermore, investments in local wheat growing became completely unattractive with a loss of about 60,000 jobs in the flour milling and bakery industry. The same situation applies to a number of other local industries.

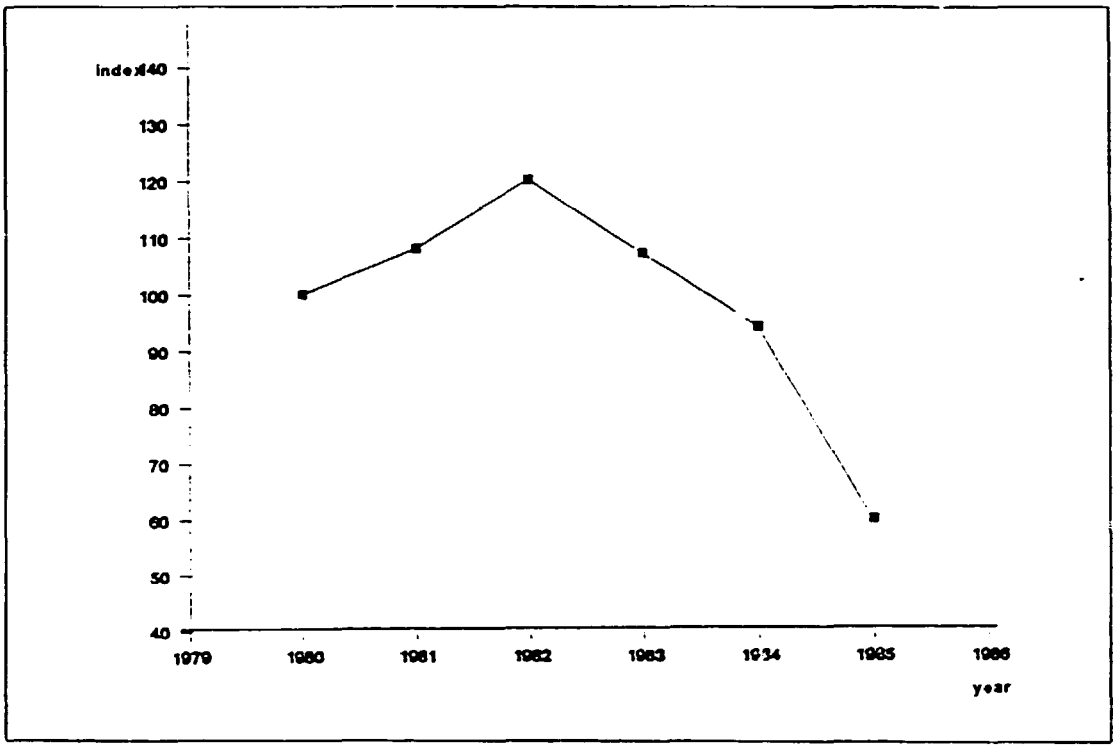
[11] source : Manufacturers Association of Nigeria, Sample survey of Manufacturing sector, June 1987

e) Inadequate infrastructural facilities

The inefficient supply of infrastructural facilities such as water, power, communications and transportation, effectively handicapped manufacturing industries through disruption of operations as well as additional expenditure to provide their own services. Unrelieved financial constraints were a major critical limitation on construction activities and thus, improvements in the services.

The above mentioned bottlenecks have inevitably affected labour productivity: data released from World Bank indicate a sharp fall of the real aggregated manufacturing output per employee during the period 1982-1985 (Graph 1.1).

(Graph 1.1) - Output per employee (Base 1980 = 100)



A further breakdown of manufacturing, based on data supplied by UNIDO, shows the performance across the sub-sectors during the period 1975-85 (Table 1.11). Only 13 of the 25 branches surveyed recorded an average positive labour productivity growth: in particular wood products (+10.2%), industrial chemicals (+16%) and rubber (+14.5%).

Table 1.11 - Indicators of industrial growth, by branch of manufacturing[12]

Description (ISIC)	Growth of added value at '80 prices	Growth of employment	Growth of added value per employee
	1975-1985	1975-1985	1975-1985
Food products (311)	3.19	-0.28 (b)	3.63 (b)
Beverages (313)	12.59	13.27 (b)	3.05 (b)
Tobacco (314)	-2.58 (c)	18.79 (b)	-18.34 (b)
Textiles (321)	3.05	-0.21 (b)	6.18 (b)
Wearing apparel, except footwear (332)	10.20 (d)	11.70 (b)	-4.93 (d)
Leather products (323)	11.01 (d)	15.40 (b)	0.66 (d)
Footwear, except rubber or plastic (324)	-1.83	6.70 (b)	-7.06 (b)
Wood products, except furniture (331)	11.63 (c)	1.54 (b)	10.19 (b)
Furniture, except metal (332)	10.20 (d)	9.26 (b)	-9.05 (d)
Paper and products (341)	6.70 (e)	3.49 (b)	-1.22 (e)
Printing and publishing (342)	10.20 (d)	9.50 (b)	3.71 (d)
Industrial chemicals (351)	19.91 (c)	5.37 (b)	15.99 (b)
Other chemicals (352)	-1.38	4.29 (b)	-0.59 (b)
Petroleum refineries (353)		-3.87 (a)	
Misc.petroleum and coal products (354)	7.48 (f)	8.31 (b)	-6.40 (d)
Rubber products (362)	2.28	-8.27 (b)	14.45 (b)
Plastic products (356)	10.20 (d)	12.19 (b)	-21.88 (d)
Pottery, china, earthenware (361)	10.20 (d)	-20.76 (b)	13.09 (d)
Glass and products (362)	10.20 (d)	1.26 (b)	1.26 (d)
Other non-metallic mineral prod. (369)	11.24	5.20 (b)	8.03 (b)
Iron and steel (371)		49.10 (b)	
Non-ferrous metals (372)	-8.29 (c)	15.39 (b)	-20.60 (b)
Fabricated metal products (381)	4.68 (f)	4.32 (b)	-5.66 (f)
Machinery, except electrical (382)	-1.72	21.97 (b)	-14.24 (b)
Electric machinery (383)	1.84	15.75 (b)	0.12 (b)
Transport equipment (384)	3.16	16.13 (b)	-3.95 (b)
Professional & scientific equipm. (385)		-37.49 (b)	
Other manufactured products (390)	10.20 (d)	-2.44 (b)	3.43 (d)

notes : (a) 1981-1983 (b) 1975-1983 (c) 1975-1984 (d) 1975-1980 (e) 1975-1982 (f) 1975-1981

Average value added growth rates varied greatly among the branches: industrial chemicals, beverages and wood products enjoyed the highest rates. Negative rates were recorded by non ferrous metals (-8.3%), tobacco (-2.6%), footwear (-1%) and other chemicals (-1.4%).

The highest growth rates of employment referred to iron and steel (+49.1%) and mechanical machinery (+22%), while pottery and rubber declined respectively by 20.8% and 8.3%.

A further overview of the manufacturing sector performance is also given in (Table 1.12 A B & C), where quantities of domestic production of selected items, covering the period 1983-1987, are reported.

[12] source: UNIDO: Industrial Development Review Series: NIGERIA (Dec. 1988)

(Table 1.12 A) - Domestic Production of selected consumer goods (volume/quantity)[13]

description	years					Average			% variation		Growth rate
	1983	1984	1985	1986	1987	83-85 (a)	84-86 (b)	85-87 (c)	(b)&(c)	(a)&(c)	86-87
Food & drinks											
Flour(*)	812965	526412	840510	351658	78750	726629	572860	423639	-26.0	-41.7	-77.6
Sugar(*)	33767	28799	25954	18610	35295	29507	24454	26620	8.9	-9.8	89.7
Biscuits(*)	31079	20085	37888	12357	28659	29684	23443	26301	12.2	-11.4	131.9
Beer(**)	7515676	7954740	7397653	10160146	6695124	7622690	8504146	8084274	-4.9	6.1	-34.1
Softdr.(**)	5494620	5799733	4942940	3350352	6329136	5412431	4697675	4874143	3.8	-9.9	88.9
Alcohols(**)	43150	32463	13545	15539	18293	29729	29516	15792	-23.0	-46.9	17.7
Dairy(***)	-	-	-	-	495101	-	-	-	-	-	-
Electrical Equipment (No)											
refrigerators	186898	141908	93147	78688	59102	140651	104581	76979	-26.4	-45.3	-24.9
record players	51367	11061	12865	18176	5583	25098	14034	12208	-13.0	-51.4	-69.3
loudspeakers	232621	60914	64655	48788	36386	119397	58119	49943	-14.1	-58.2	-25.4
radiocass.	320351	154884	177360	171273	81582	217532	167839	143405	-14.6	-34.1	-52.4
aircond.	42664	29146	31048	26805	13435	34287	29000	23763	-18.1	-30.7	-49.9
tv sets	271957	88105	71172	84372	34146	143745	81216	63230	-22.1	-56.0	-59.5
cables(1.000)	-	-	-	-	21741	-	-	-	-	-	-
Textiles (1000 m2)											
cotton txt	337659	229785	267824	101578	323184	281756	203062	230862	13.7	-18.1	218.2
synth. fabr	60266	26776	17040	33403	191812	34694	25740	80752	213.7	132.8	474.2
knitted fabr(*)	3208	3111	2729	6552	8804	3016	4131	6028	45.9	99.9	34.4
garnments(dozen)	-	-	-	-	126146	-	-	-	-	-	-

Notes: (*) = Tons (**) = Hectolitres (***) = litres

(Table 1.12 B) - Domestic Production of selected capital goods (volume/quantity)[13]

description	years					Average			% variation		Growth rate
	1983	1984	1985	1986	1987	83-85 (a)	84-86 (b)	85-87 (c)	(b)&(c)	(a)&(c)	86-87
Vehicle Assembly(units)											
Motorcycles	117432	36725	21991	15574	10400	58716	24697	15922	-35.5	-72.9	-32.4
Passenger Cars	61521	n.a.	51945	17954	8606	-	-	26168	-	-	-52.1
Pickups	11.296	6531	10421	6150	3747	9416	7701	6773	-12.1	-28.1	-39.1
Other comm.Vehicles	10121	n.a.	3447	1702	2865	-	-	2671	-	-	68.3
Trailers, tippers	-	-	-	-	-	-	-	-	-	-	-
Busses&Lorries	-	-	-	-	-	-	-	-	-	-	-

(13) source: FOS, Lagos

(13) source: FOS, Lagos

(Table 1.12 C) - Domestic Production of selected intermediate goods volume/quantity)[13]

description	years					Average			% variation		Growth Rate
	1983	1984	1985	1986	1987	83-85 (a)	84-86 (b)	85-87 (c)	(b)&(c)	(a)&(c)	86-87
Building Materials											
Paints('000 l)	25368	39087	21906	17318	19518	25787	23104	19581	-15.2	-24.1	12.7
Cement('000 m^3)	2755	2182	3372	3624	3085	2770	3059	3360	9.8	21.3	-14.9
Tiles('000 m^2)	1718	1883	1307	1941	1649	1636	1410	1332	-5.5	-18.6	58.4
Roofing(T)	92148	90512	28027	420692	124629	70232	179747	191119	6.3	172.1	-70.4
Steel&Lrods(T)	-	-	-	-	232890	-	-	-	-	-	-
Wire&wire pr.(T)	-	-	-	-	25724	-	-	-	-	-	-
UPVCpipes&fit(T)	379	4345	2523	3359	5880	2416	3409	3921	15.0	62.3	75.1
Petroleum & Chem Prod.											
Soap&Deterg(T)	239268	-	157667	77702	213712	-	-	149694	-	-	-
Matches('000 box)	866344	434696	234263	537617	486329	511768	402192	419403	4.3	-18.0	-9.5
Lubricants (T)	96177	117621	176191	129281	161610	129996	141031	155694	10.4	19.8	25.0
Batteries (No)	-	-	-	-	63649	-	-	-	-	-	-
Paper conversion											
Books (Gross)	58805	31362	56386	462624	657755	48851	183457	392255	113.8	703.0	42.2
Packages('000bandle)	1361	5180	4933	7208	10751	3825	5774	7631	32.2	99.5	49.2
Corr.cartons(T)	45944	39044	78237	82555	19150	54742	66612	59981	-10.0	9.6	-76.8
Paper Bags(T)	2062	5565	7489	24326	1410	5372	12460	11075	-11.1	106.2	-94.2
Tissue (T)	1727	5061	7152	7091	6908	4647	6435	7050	9.6	51.7	-2.6

Among consumers goods, textiles recorded the highest growth rates in 1987. Foods and drinks showed some fluctuations in the period under survey; nevertheless sugar confectionery, biscuits and soft drinks experienced a satisfactory performance in 1987 in comparison with the previous year. All electrical items, as expected, fell sharply, due to the negative impact of bans on imported raw materials and severe foreign exchange shortages. Similar negative trend was shown by capital goods, that can be duly regarded as the products most hit by the crisis situation.

As for intermediate products, petrochemicals enjoyed the best performance, while building material's uneven trend highlighted the lack of an integrated productive structure of the construction industry that continued to be severely constrained in 1987.

(13) source: FOS, Lagos

1.2.2 **Distribution of manufacturing establishments in Nigeria: a location analysis**

Nigerian industrial landscape is characterized by the existence of rather narrow range of industries, usually of consumer and durable consumer goods types, and by their concentration in few locations.

This paragraph assesses the relative position of these sub-areas in the industrial development process.

This assessment derives from standard industrial location analysis techniques with the use of *location* and *specialization indices*.

The *location index* measures the relation between the proportional share of a state in one industrial activity and its proportional share in a base of activities.

It is defined by this formula:

$$L_{ij} = [X_{ij}/X_{.j}] / [X_{i.}/X_{..}]$$

where

X_{ij} = is the level of activity by industry type j and state i

$X_{.j}$ = Sum of X_{ij}'s for $_i$ from [1 to m]

$X_{i.}$ = Sum of X_{ij}'s for $_j$ from [1 to n]

$X_{..}$ = Sum of X_{ij}'s for $_i$ from [1 to m] and for $_j$ from [1 to n]

The minimum value of the location index is zero while there is no upper limit to the maximum value. A location index of 1.0 stands for a state with a "fair" share within an industry group.

The *Specialization Index* (S.I.) measures the degree of concentration of an industrial activity referred to other activities within a certain state, and compares it with the concentration of the same activity within the whole nation. It is defined as:

$$S.I. = [q^{(x)} - q^{(a)}] / [1-q^{(a)}] q^{(x)} + [1 - q^{(x)}] q^{(a)}$$

where

$q^{(x)}$ = is the level of activity by a certain industry over total industrial activity in the state considered

$q^{(a)}$ = is the Level of activity of the same industry over total industrial activity in the whole nation.

Unlike the *location index*, the *specialization index* defines a specific variation range (between -1 and +1) and satisfies the following conditions:

if $q^{(x)} = q^{(a)}$ then S.I. = 0

if $q^{(x)} < q^{(a)}$ then S.I. < 0

if $q^{(x)} > q^{(a)}$ then S.I. > 0

The data base provided by the Federal Ministry of Industries is expressed in number of establishments. The structure of Nigerian industry is shown in the next **Table 1.13** . Outlining policy trends based only on one variable, namely the number of the establishments, was the only step possible at present.

Table 1.13 - Distribution of Manufacturing industries in Nigeria (n. of establishments), 1988[14]

INDUSTRY	STATE OF LOCATION																					TOTAL
	AKWA	ANAMBRA	BAUCHI	BENDEL	BENUE	BORNO	CROSS R.	GONGOLA	IMO	KADUNA	KANO	KATSINA	KWARA	LAGOS	NIGER	OGUN	ONDO	OYO	PLATEAU	RIVERS	SOKOTO	
FOOD & BEVERAGES	12	48	5	38	18	12	23	9	63	15	62	2	16	96	3	21	21	19	12	20	6	522
Slaughtery		1	3	2		4					2		1	8			1	1	3	3	2	31
Dairy						1	2			2				9		1		3	2			20
Preserved Fr & veg		1	1						1		10			5								18
Preserved fish				3																1		4
oil & fats	10	11	1	10		3	16		46	2	11	1	4	6		3	2			1	1	128
grainmill prod		20		2	16	2	1	6	7	1	2			1	3		1	3	1	11		77
sugar fact & refin								1			6		3	4				1	1			16
cocoa, choc&confect											17			7					1			25
Misc food prep		1		1						1				17		4	1	3	1			29
animal feed		5		9			3	1	5	2	1		4	6		5	14		1		1	57
alcohols		2											1	6				1		1		11
breweries	1	4		5	1				3	2	2		1	6		3		4	1	1		34
softdrinks	1	3	1	6	1	2	1	1	1	5	11	1	2	21		5	2	3	1	2	2	72
TEXT.,APPAREL&LEATHE	1	55	1	53	5	2	6	0	125	4	60	2	4	147	0	16	5	8	4	45	6	550
knitting mills		8									11		2	34		7				1		63
carpets&rugs				3		1	1				3			11		4	1	2			1	27
app,footware	1	47	1	50	5	1	5		123	3	15		2	72		2		6	1	44	1	379
tannery&leather prod									2	1	31	2		30		3	4	1	3		4	81
WOOD&WOOD PRODUCTS	9	56	3	52	17	10	12	19	24	9	15	2	13	67	3	6	6	21	16	61	6	427
wood&cork products	4	10		9			6		3					1				1		1		35
furniture&fixture	5	46	3	43	17	10	6	19	21	9	15	2	13	66	3	6	6	20	16	60	6	392
PAPER&PAPER PRODCTS	0	4	0	5	0	0	2	0	3	2	3	0	1	46	0	10	1	2	1	2	0	32
pulp&paperboards&box		4		5			2		3	2	3		1	46		10	1	2	1	2		32
CHEMICALS,PETROLEUM, RUBBER & PLASTIC	3	12	0	26	0	0	7	0	19	1	25	0	1	98	0	7	3	13	5	10	0	227
fertilizers&pesticid				1						1	3			4						1		10
paints,vernishes&laq		4							1		2			16		4		1				28
drugs&medicines		1		4					6		2		1	23					1	4		42
soap&cosmetics	3	1		1					10		12			47		2		3	4	3		86
tiles & tubes		5		3					1		2			7		1		6		1		26
other rubber.product		1		17			7		1		4			1				3		1		35
NON METAL MINERAL PRODUCTS	0	7	1	2	1	0	1	0	0	0	1	0	0	3	0	2	0	0	0	1	2	21
cement		7	1	2	1		1				1			3		2				1	2	21
BASIC METAL IND.STRY	0	2	0	2	0	0	0	0	0	1	1	1	2	17	0	0	0	1	1	1	0	29
iron&steel		2		2						1	1	1	2	17				1	1	1		29
ELEC,METAL& COMMUNIC EQUIP&MACHINERY	37	13	3	43	0	13	11	4	42	14	53	0	14	224	0	16	1	26	10	79	2	605
Cutlery	2	3		19		3	2	1	1		13		3	34					1	2		84
metal furniture	7	2		4		1	2	2	6	1	19		3	29		1		5	5	9	1	97
metal struct. prodct	28	6	1	15		6	5	1	34	7	17		6	74		5		11	3	58	1	278
agricult. mach&equip						2				1				2				1				6
spec.industy mach*													1	2				2				5
industry mach&equip														6			1	2				9
miscell equip& mach		1								1				36		4		1		3		46
shipbuilding&repair				2		1	2							7						4		16
transport equip**		1	2	2					1	3	2			12		2		2	1			28
motorcycle manuf.										1	2		1	7		1				2		14
scientific instrum.														2		1						3
watches & clocks				1										13		2		2		1		19
STATE TOTAL	62	197	14	221	41	37	62	32	276	46	220	7	51	698	6	78	34	90	49	219	22	2463

* mills, graters & machine tools
** cars , trucks commercial vehicules & auto parts & components

(14) source: Federal Ministry of Industries

In 1988 the number of industrial establishments in Nigeria reached 2444 . Lagos State accounted for 685 out of 2444 equivalent to 28%. Other four states Imo, Kano, Bendel and Rivers had more than 200 establishments each with a cumulative percentage of 38.2% over the total.

On the lower end of the scale stand Bauchi, Katsina and Niger States with respectively 14,7 and 6 establishments, confirming the non even distribution of manufacturing activities.

In addition to absolute values, **Table 1.14** summarizes absolute location index by state, calculated using state populations as general base. Only 7 states (Anambra, Bendel, Cross River, Imo, Lagos, Ogun and Rivers) out of 21 had a degree of industrialization higher than the nation's, while Katsina, Niger, Bauchi and Sokoto recorded very low values.

Table 1.14 - Location index of manufacturing activities in Nigeria using population as general base (1987)[15]

STATE	Location index
Akwa Ibom	0.56
Anambra	1.26
Bauchi	0.13
Bendel	2.05
Benue	0.39
Borno	0.28
Cross River	1.51
Gongola	0.28
Imo	1.73
Kaduna	0.64
Kano	0.88
Katsina	0.07
Kwara	0.69
Lagos	7.68
Niger	0.13
Ogun	1.13
Ondo	0.29
Oyo	0.39
Plateau	0.56
Rivers	2.91
Sokoto	0.11

[15] source: derived from table 1.14

Relative levels of industrialization are also expressed by comparing each state's location quotient with the Lagos State index, which is assumed equal to 100.

Table 1.15 - Levels of industrialization in Nigeria[16]

STATE	Industrialization level
Akwa Ibom	7.32
Anambra	16.38
Bauchi	1.72
Bendel	26.73
Benue	5.05
Borno	3.69
Cross River	19.63
Gongola	3.67
Imo	22.47
Kaduna	8.32
Kano	11.44
Katsina	0.86
Kwara	8.94
Lagos	100.00
Niger	1.66
Ogun	14.65
Ondo	3.72
Oyo	5.11
Plateau	7.28
Rivers	37.91
Sokoto	1.45

[16] source: derived from table 1.14

The level of specialization of the states is the second index to be taken into consideration jointly with the location index. The specialization index in **Table 1.16** shows a low level of specialization, with the exception of some high values relating to States having very few establishments (Sokoto, Bauchi, Niger).

Table 1.16 - Specialization Coefficient of Nigerian Manufacturing industries [17]

State	Food & bever.	Textiles garmn. leather	Wood furniture	paper print	Chemic. petrol rubber plastic	Non-metal mineral products (cement)	Basic metal industries	Met.prod. machines & elec equip.
Akwa Ibom	-0.06	-0.89	-0.11	0.00	-0.34	0.00	0.00	0.65
Anambra	0.09	0.14	0.39	-0.25	-0.22	0.62	-0.08	-0.63
Bauchi	0.47	-0.58	0.13	0.00	0.00	0.80	0.00	-0.07
Bendel	-0.13	0.04	0.19	-0.20	0.13	0.03	-0.13	-0.14
Benue	0.48	-0.35	0.54	0.00	0.00	0.49	0.00	0.00
Borno	0.28	-0.67	0.27	0.00	0.00	0.00	0.00	0.26
Cross River	0.37	-0.46	0.06	-0.02	0.11	0.31	0.00	-0.19
Gongola	0.18	0.00	0.75	0.00	0.00	0.00	0.00	-0.38
Imo	0.04	0.48	-0.38	-0.52	-0.16	0.00	0.00	-0.27
Kaduna	0.28	-0.51	0.07	0.13	-0.64	0.00	0.30	0.16
Kano	0.18	0.13	-0.49	-0.43	0.11	-0.31	-0.45	0.00
Katsina	0.19	0.16	0.31	0.00	0.00	0.00	0.87	0.00
Kwara	0.25	-0.55	0.24	-0.27	-0.67	0.00	0.55	0.09
Lagos	-0.25	-0.03	-0.32	0.35	0.24	-0.33	0.36	0.17
Niger	0.57	0.00	0.65	0.00	0.00	0.00	0.00	0.00
Ogun	0.17	-0.04	-0.42	0.63	0.00	0.51	0.00	-0.17
Ondo	0.71	-0.25	0.01	-0.07	0.00	0.00	0.00	-0.82
Oyo	0.00	-0.44	0.19	-0.20	0.25	0.00	-0.03	0.08
Plateau	0.09	-0.53	0.39	-0.25	0.05	0.00	0.27	-0.10
Rivers	-0.46	-0.05	0.29	-0.58	-0.36	-0.31	-0.45	0.28
Sokoto	0.16	0.13	0.28	0.00	0.00	0.84	0.00	-0.52

If we consider an index of 0,35 or more to indicate some degree specialization, a number of trends emerge from table 1.16:

- wooden furniture (Anambra State and Gongola State)
- Cement Industry (Anambra State, 7 Industries out of 21 nation wise)
- Textiles (Imo State)
- Paper products (Lagos State)
- Iron & Steel Industries (Lagos State)
- Structural metal products (Akwa, Ibom State)
- Food Products, mainly animal feeds (Ondo State)
- Paper products (Ogun State).

[17] source: derived from table 1.14

2. CONSUMPTION AND INVESTMENT

The evolution of Nigeria's industrial structure has been heavily influenced by tariffs, quantitative restrictions and exchange-rate management. Up to 1986 Nigeria had an exchange rate which tended to depress the level of manufactured exports.

During the 1960's, many manufacturing enterprises, particularly foreign ones, grew up behind high protectionist barriers. Nigerian manufacturing enterprises remained domestically oriented, mainly concentrated in the large urban centres of Lagos, Kano and Kaduna.

Consumer goods industries dominate the manufacturing sector with a share of more than 50% of the value added. Private consumption share in total GDP expenditure fell from 70.2% in 1981 to 52.5% in 1987 (see tables 2.1 and 2.2).

Table 2.1-(1981-1987) Gross Domestic Product Expenditure (per cent) at constant (1984) prices [18]

Category	1981	1982	1983	1984	1985	1986	1987
Export goods & NFS*	12.68	12.76	12.06	13.39	13.66	11.38	37.95
Import goods & NFS*	19.13	14.10	9.59	7.13	7.11	4.86	2.99
Gross domestic investm.	17.29	12.81	9.87	4.42	5.43	6.05	3.77
-Fixed capital formation	18.11	14.53	10.94	6.05	5.90	5.49	4.17
-Changes in stock	-0.82	-1.72	-1.07	-1.63	-0.47	0.56	-0.40
Consumption	89.16	88.53	87.66	89.31	88.02	87.43	61.27
-Public consumption	9.99	9.67	10.40	9.71	9.32	9.03	8.76
-Private consumption	79.17	78.86	77.26	.79.60	78.69	78.40	52.51
GDP at market prices	100.00	100.00	100.00	100.00	100.00	100.00	100.00

* Non Factor Services

Table 2.2 - Gross domestic investment and consumption at constant (1984) prices (N million)[19]

Category	1981	1982	1983	1984	1985	1986	1987	% Change 1981-87
Gross domest.invest.	13895.00	10327.00	7577.00	3156.00	4187.00	4775.00	2972.40	-37.75
Fixed cap.form.	14552.00	11709.00	8396.00	4316.00	4551.00	4336.00	3286.00	-24.21
Changes in stock	-657.00	-1382.00	-819.00	-1160.00	-364.00	439.00	-314.00	
Consumption	71647.21	71336.58	67249.61	63686.25	67853.46	68986.26	48267.74	-30.03
Public consumpt.	8031.00	7789.00	7975.00	6925.00	7187.00	7127.00	6900.94	-3.17
Priv. consumpt.	63616.21	63547.58	59274.61	56761.25	60666.46	61859.26	41366.80	-33.13

Private consumption between 1981 and 1987 fell by -33.1%, as result of the high retail prices of domestic staples and of the rise in cost on both imported and locally sourced raw materials. The decrease of private consumption has turned out to be a result of a specific policy: by the end of 1986, it was clear that real incomes were falling as prices kept rising in an environment of restrictive monetary, credit, fiscal and budgetary policies.

However, the imperatives of SAP, in particular, the need to strengthen the demand associated with wage freeze, led the government to undertake policies directed primarily at increasing investment rather than consumption.

[18] Source FOS Federal Office of Statistics, Lagos
[19] Source FOS Federal Office of Statistics, Lagos

In order to encourage foreign investors and channel them into agriculture, earnings from new foreign investments in agriculture, were declared tax free. There was also a 5% reduction in company income tax and an upward revision of interest rates on savings account.

Only during the year 1988 consumer demand improved slightly, thanks to wage and salaries revision in some establishments. It still remained very weak due to the loss in real income, in the short term, following the structural adjustment programme.

As for fixed capital formation, in 1987 it accounted for 4.17% of total expenditure while in 1981 and 1985 its share was respectively 18.1 and 5.9%.

The absolute value in real terms shows (**Table 2.2**) a high negative growth rate of 24.2% in 1986-1987, while the composition of gross capital formation described in (**table 2.3**) highlights the gradual fall of all types of assets in the period 1981-1986.

Table 2.3 - Gross Capital Formation at constant purchasers' 1984 value (N million)[20]

Type of assets	1981	1982	1983	1984	1985	1986
Construction*	6602.00	6076.00	4936.00	2320.00	2316.00	2522.00
Land improvement	802.00	429.00	437.00	131.00	224.00	187.00
Transport equipment	3234.00	2189.00	1312.00	752.00	832.00	540.00
Machinery & equipment	3890.00	2997.00	1688.00	1094.00	1163.00	1067.00
Breeding stock	24.00	18.00	23.00	19.00	16.00	20.00
Gross fixed capital form.	14552.00	11709.00	8396.00	4316.00	4551.00	4336.00
Increase in stocks	-657.00	-1382.00	-819.00	-1160.00	-364.00	439.00
Gross capital formation	13895.00	10327.00	7577.00	3156.00	4187.00	4775.00

* Comprises: Residential Building. Non-Residential Building: Other Construction except Land improvement

The implication is that the private sector was supposed to take the lead in investment spending. Since the industrialists were already facing high costs (interest and exchange rates in particular) and weak effective demand, investment spending by the private sector operators could not have been high. Indeed, several industrialists who had embarked upon expansion programmes were frustrated by a high exchange rate quadrupling the estimated cost of machinery and equipment. In response, many on-going investment programmes have been suspended and all new proposals shelved.

In the longer term, a new enterprise promotion decree is designed to have a positive effect on the country's poor investment climate. Till now latest figures referring to the Central Bank Survey show that, if on the one hand, in the first quarter of 1988, investment expenditure on machinery and equipment has increased by 39.4% compared with the last quarter of 1987, on the other hand, it declined by 41.1% below the level of the first quarter of 1987.

[20] Source FOS Federal Office of Statistics, Lagos

3. EMPLOYMENT AND WAGES

3.1 EMPLOYMENT EVALUATION

The unemployment in Nigeria is a basic character of the structure of the economy of the country.

Figures from Federal Office of Statistics indicate that Government direct efforts seem to have slightly reduced the job queues both in urban and rural areas (tables 3.1, 3.2, 3.3)

Table 3.1 -National unemployment rates (June 1985-June 1988)[21]

Surveys	Year	Composite National	Urban Rate	Rural Rate
June	1985	4.3	8.7	3.0
September	1985	n.a.	n.a.	n.a.
December	1985	6.1	9.8	5.2
March	1986	6.3	9.1	5.6
June	1986	6.1	11.0	4.9
September	1986	5.3	10.0	4.1
December	1986	5.3	9.1	4.6
March	1987	4.5	8.7	3.5
June	1987	6.0	10.6	4.9
September	1987	7.4	12.2	6.2
December	1987	7.0	9.8	6.1
March	1988	5.1	7.3	4.6
June	1988	4.5	7.2	3.9

n.a. = not available

[21] Source : FOS Federal Office of Statistics, Lagos - Labour Force survey, June 1988

Table 3.2 - Urban Unemployment rates by State, Nigeria, June 1987-June 1988

URBAN State	June 1987	September 1987	December 1987	March 1988	June 1988
All Nigeria	10.6	12.2	9.8	7.3	7.2
Akwa-Ibom	-	-	-	-	10.7
Anambra	11.9	6.1	4.0	13.3	5.6
Bauchi	*	6.9	5.7	0.8	2.2
Bendel	22.0	32.4	21.5	16.8	15.2
Benue	14.5	10.4	12.2	9.3	9.2
Borno	8.2	6.0	4.3	6.5	2.8
Cross River	21.0	14.5	10.7	13.0	6.0
Gongola	9.1	3.0	5.9	7.6	4.5
Imo	25.9	19.4	17.1	14.0	15.3
Kaduna	3.2	19.8	11.2	4.0	11.6
Kano	*	2.3	*	*	0.6
Katsina	-	-	-	-	6.5
Kwara	6.7	5.8	3.1	4.6	6.5
Lagos	1.2	7.1	8.5	5.5	2.6
Niger	9.3	5.1	3.8	3.0	1.2
Ogun	7.1	14.6	8.3	8.0	1.4
Ondo	12.5	14.7	13.7	9.5	7.1
Ogo	10.4	10.4	4.9	11.9	5.4
Plateau	8.9	16.1	9.8	11.3	12.5
Rivers	19.7	21.8	22.7	23.5	14.0
Sokoto	10.0	4.1	10.7	10.0	7.3

Table 3.3 - Unemployment rates by State,Nigeria, June 87-June 88

RURAL State	June 1987	September 1987	December 1987	March 1988	June 1988
All Nigeria	4.9	6.2	6.1	4.6	3.9
Akwa-Ibom	n.a.	n.a.	n.a.	n.a.	9.2
Anambra	1.9	6.9	4.9	3.3	9.3
Bauchi	0.9	0.6	4.0	1.6	0.7
Bendel	1.1	7.2	10.7	4.4	5.4
Benue	3.0	2.3	9.6	1.4	1.8
Borno	*	*	5.3	8.0	2.1
Cross River	6.5	8.8	9.2	3.8	9.9
Gongola	4.0	7.5	5.2	5.3	1.3
Imo	12.9	13.6	11.3	12.2	7.6
Kaduna	0.9	2.3	*	*	1.4
Kano	*	*	*	0.3	1.5
Katsina	n.a.	n.a.	n.a.	n.a.	1.1
Kwara	1.5	1.7	1.3	2.8	0.9
Lagos	5.1	4.2	4.1	3.3	1.0
Niger	4.2	7.1	4.3	*	1.6
Ogun	1.4	*	0.4	4.0	1.7
Ondo	6.3	7.1	3.9	4.5	7.1
Ogo	2.8	4.8	2.9	3.2	1.5
Plateau	2.9	10.9	7.9	7.3	3.9
Rivers	13.7	16.3	14.7	8.7	5.7
Sokoto	2.7	*	1.7	*	0.7

* = less than 0.1 % n.a. = not available

As at June 1988, rural unemployment rate was estimated at 3.9% as against 4.9% for the corresponding period in the previous year. Urban unemployment was estimated at 7.2% as against 10.6% for the corresponding period in 1987. Composite unemployment by mid-year was estimated to have dropped from 6% to 4.5% compared to the corresponding period in 1987. Even so, the unemployment problem is still outstanding, as employment needs to rise at least by 2-3% p.a. simply to keep pace with labour force growth (table 3.4).

(table 3.4) - Labour Force projection distribution indices (1977- 1988)[22]

Distribution	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Total labour(Millions)	30.5	31.0	31.9	32.2	33.2	24.0	34.9	35.5	36.1	37.2	38.4	39.3
Sector Labour Force Distribution in %												
Agriculture	62.3	61.5	60.6	60.0	59.5	59.0	58.3	58.0	57.8	61.1	60.0	58.9
Mining&quarrying	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.5	0.5
Manufact&Process	16.8	16.9	16.9	17.0	17.3	17.7	18.0	18.1	18.2	13.6	10.3	10.5
Bldg & construct.	0.9	1.0	1.0	1.1	1.1	1.1	1.2	1.2	1.2	0.9	1.0	1.0
Elec.Gas & Water	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.6	1.2	1.3
Distribution	13.5	14.1	14.9	15.2	15.4	15.5	15.7	15.9	16.0	15.0	16.5	17.0
Transp. & Communic.	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.0	1.5	1.5
Services	5.4	5.4	5.5	5.5	5.5	5.5	5.6	5.6	5.6	7.4	9.0	9.3
Total	100	100	100	100	100	100	100	100	100	100	100	100

During the latest years developments in several fronts directly influenced the level of unemployment in the economy:

a) Rural-urban migration problem:

The rural areas in developing countries are often characterized as areas of massive under-utilization of labour power despite an apparent low level of unemployment. The observation that the marginal product of labour in rural areas of developing countries is zero, has often been used to explain the easy pull and attraction of urban development to total labour. Migration has thus become a serious factor in urban unemployment. This suggests serious effort at rural development, first to increase the marginal product of labour and secondly to minimize the pull effect of urban development on rural labour. Besides, high rural unemployment rates are also raising doubts about the general belief that rural production process is highly labour intensive. The high cost of labour in the rural area is making it more rational for both large-scale farmers, farming cooperatives and even the peasant farmers to substitute chemicals and tractors for farm labour.

b) Reduction in aggregate demand:

Deregulating prices, exchange rate, interest rate, and prices of goods produced by major public enterprises in the infrastructural and basic goods sub-sectors, resulted in generalized increases in production costs of all goods and services nation-wide. High costs were passed on to prices and this, coupled with prevailing wage freeze (after an abortive attempt to deregulate the labour market), led to weak effective demand. Deteriorating effective demand led to high inventory of finished goods and the corresponding reduction in industrial capacity utilization. The associated retrenchments and plant closures, along with the freeze in public sector employment in conformity with the restrictive government budgetary policy led to an increase of unemployment.

[22] Source : National manpower Board - Federal Ministry of National Planning , Lagos

c) Distortions of the supply side:

Decrease of production has not been just a result of fall in demand but also a result of the ability of firms to import raw materials and capital equipment because of high cost of foreign and high interest rates.

d) Educational level:

In the past, unemployment was a problem associated mainly with primary and secondary schools drop outs who, although lacking in requisite skills, drifted to urban centres in search of wage employment.
This excess of unskilled labour in the Nigerian urban sector was also accompanied by shortage of some essential skill. Such shortage which was a major constraint on the implementation of development projects was due largely to deficiencies in nation's educational and wage policies. These policies were not sufficiently geared towards meeting the country's unemployment. Unlike the 1960's and 1970's, unemployment is no longer confined to the category of unskilled labour. There has been in the last few years a sharp and unprecedented rise in the rate of unemployment (mainly in urban areas) among university graduates and other skilled manpower (Table 3.5).

(table 3.5)-Unemployed Distrib. (in %) by Education Level & by Sector-Nig. June 87-June 88[23]

	URBAN					RURAL				
Education level	June 1987	Sept 1987	Dec 1988	March 1988	June 1988	June 1987	Sept 1987	Dec 1988	March 1988	June 1988
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
No School	9.4	8.8	17.0	12.2	17.6	15.4	16.5	17.7	14.4	21.4
Primary	7.5	7.2	9.5	13.7	12.9	28.2	22.5	22.5	20.4	32.8
Secondary	78.1	77.7	66.5	69.6	62.4	49.6	60.7	59.9	62.4	42.7
Post Sec.	5.0	6.3	7.0	4.5	7.1	6.8	0.8	0.8	2.8	3.1

In this respect, latest figures on the occupation profile of the employees, even if rather out of date, reveal some interesting details.

Among the urban population, the percentage of those in the professional, technical and administrative and managerial group accounted for between 19% and 26% from 1980 to 1984. Between 1980 and 1982 over 50% of working age (the population of 15 years and above) were clerical, sales, services and related workers; between 1983 and 1985, the percentage of this occupational group had fallen to less than 50%. Similarly, there was an increase in production and related workers etc. in the early years from 10% in 1980/81 to 11.0% in 1982/83 only to fall to 5% and 8% in the later years. New workers, seeking employment and others unspecified accounted for between 3% and 7% of the working population during the 5 year period.

In the rural sector, persons in the professional, technical, administrative and managerial occupation increased steadily from 10% in 1980/81 to 17% in 1983/84 and then fell to 15% in 1984/85. Clerical, sales, services and related workers did not increase their strength over the years. This occupation category accounted for about a third of the working age persons throughout the period. Similarly the agricultural, animal husbandry, fishermen and hunters accounted for about two fifths of the working age persons. New workers seeking employment and others unspecified made up between 3% and 4% of the working age persons (tables 3.6 - 3.7 below).

[23] Source : FOS Federal Office of Statistics, Lagos - Labour Force survey, June 1988

Table 3.6 - Percentage distribution of persons aged 15 years and above in average (URBAN) household by occupational group 1980/81, 1981/82, 1982/83, 1983/84 and 1984/85[24]

Occupation	1980/81	1981/82	1982/83	1983/84	1984/85
Professional, technical administrative and managerial	19.3	21.0	19.6	26.1	24.8
Clerical, sales, services & related workers	53.6	53.1	53.2	48.8	46.0
Agricultural animal husbandry, fishermen & hunters	7.4	8.6	8.6	8.4	11.2
Product. & related workers, transport equipment operators, shoe makers	10.3	10.6	11.0	5.4	8.0
Labourers not elsewhere classified	5.7	2.2	2.2	8.8	3.3
New workers,seeking employment workers not reporting and occupation	3.7	4.5	5.4	2.5	6.7
TOTAL	100.0	100.0	100.0	100.0	100.0

Table 3.7 - Percentage distribution of persons aged 15 years and above in average (RURAL) household by occupational group 1980/81, 1981/82, 1982/83, 1983/84 and 1984/85[25]

Occupation	1980/81	1981/82	1982/83	1983/84	1984/85
Professional, technical administrative and managerial	10.5	143.2	14.5	16.8	14.9
Clerical, sales, services & related workers	35.4	33.3	34.2	37.2	34.4
Agricultural, animal husbandry, fishermen & hunters	45.7	47.6	43.6	37.5	43.3
Product. & related workers, transport equipment operators, shoe makers	3.0	1.9	2.6	2.6	1.9
Labourers not elsewhere classified	1.9	1.3	0.6	1.7	1.2
New workers,seeking employment workers not reporting and occupation	3.5	2.7	4.5	4.2	4.3
TOTAL	100.0	100.0	100.0	100.0	100.0

[24] Source: Social Statistics in Nigeria, 1985
[25] Source: Social Statistics in Nigeria, 1985

3.2 WAGE POLICY

In 1987, under the Structural Adjustment Program (SAP), there was a continuation of the wage freeze which had since 1982 been used as an instrument of economic stabilization. Given the prevalent economic environment, it was thought the reduction in real wages could serve as an effective instrument for the generation of employment opportunities.

In February 1987, in pursuance to the deregulation strategy of SAP, government amended the Minimum Wage Act by raising the exemption limit from establishments employing 50 persons to those employing 500 persons. The amendment was conceived as a structural adjustment measure to remove some of the distortions in the labour market and improve its flexibility and efficiency. The downward pressure on wages that would result from the implementation of the policy was expected to have a significant positive impact on the employment of unskilled labour.

This subtle attempt to apply the "price solution" to Nigeria's unemployment problem was abandoned in April 1987 with the repeal of the amendment to the Minimum Wage Act. The abandonment was due to the serious implications of the policy for social justice and industrial harmony. The strategy was also deficient because it ignored the vital causal relationship that could exist between real wages and labour productivity and efficiency.

Quite unexpectedly, the employers also signalled disapproval saying the deregulating of the labour market at a time of high unemployment, would bring down wages; falling wages in an environment of weak effective demand would further worsen the situation. Even before SAP, however, real earnings per employee showed a sharp fall during the period 1980-85:

Index of real earnings per employee (1980=100)[26]					
1980	1981	1982	1983	1984	1985
100	94.0	101.5	74.9	42.3	41.8

Latest official figures issued by the Federal Office of Statistic of Lagos are only updated to 1983/84: the per capita income trend during 1980-83 indicates a general rise among the various categories of the population in the early years and then a general slump in 1983-84:

Per capita income (Naira/month)[27]				
	1980/81	1981/82	1982/83	1983/84
Urban household	49.97	54.44	64.30	56.37
Wage earner	59.81	74.60	86.19	75.51
Self employed	46.40	46.41	52.48	47.81
Rural household	33.15	41.02	45.62	38.84
Wage earner	48.25	69.78	87.92	65.91
Self employed	31.63	39.29	42.85	37.02

As for sector income (tables 3.8 - 3.9) average monthly income of urban wage earner rose from N. 254.00 in 1980/81 to N. 290.00 in 1983/84, cash income component constituting over 90% of all incomes. Average monthly income of the self employed urban household, less than the counterpart urban wage earner, rose from N. 188.00 in 1980/81 to N. 196.00. Both in real and absolute terms the self employed urban household income in 1983/84 falls well below the wage earner per 1981/82 income level.

(26) Source: World Bank, World Tables 1987

(27) Source: Federal Office of Statistics - General Household survey, 1985

Table 3.8 - Average monthly household income by source & by employment status 1980/81-1982/84 (URBAN)

NATURE OF INCOME (URBAN)	WAGE EARNERS								SELF EMPLOYED							
	Amount in Naira				Distribution in Percent				Amount in Naira				Distribution in Percent			
	80/81	81/82	82/83	83/84	80/81	81/82	82/83	83/84	80/81	81/82	82/83	83/84	80/81	81/82	82/83	83/84
Basic Cash Income	205.74	218.61	220.23	222.52	81.13	84.69	81.63	76.74	140.25	134.80	125.83	133.42	74.44	74.28	72.21	67.90
Other cash income	33.51	22.87	30.54	45.08	13.21	8.86	11.32	15.55	25.62	20.22	21.05	32.66	13.60	11.14	12.05	16.62
Total Cash income	239.25	241.48	250.77	267.60	94.34	93.55	92.95	92.29	165.87	155.02	146.88	166.08	88.04	85.42	84.29	84.52
Consumption from own product	0.93	2.66	1.78	2.84	0.37	1.03	0.66	0.98	7.04	9.44	10.26	10.94	3.74	5.20	5.89	5.57
Income in Kind	2.29	1.86	1.92	3.36	0.90	0.72	0.71	1.16	2.85	3.16	2.79	4.64	1.51	1.74	1.60	2.36
Imputed rent	11.12	12.13	15.32	16.15	4.39	4.70	5.68	5.57	12.64	13.87	14.32	14.83	6.71	7.64	8.22	7.55
Total Non-cash income	14.34	16.65	19.02	22.35	5.66	6.45	7.05	7.71	22.53	26.47	27.37	30.41	11.96	14.58	15.71	15.48
TOTAL ALL INCOMES	253.59	258.13	269.79	289.95	100.00	100.00	100.00	100.00	188.40	181.49	174.25	196.49	100.00	100.00	100.00	100.00

Table 3.9 - Average monthly household income by source & by employment status 1980/81-1982/84 (RURAL)

NATURE OF INCOME (RURAL)	WAGE EARNERS								SELF EMPLOYED							
	Amount in Naira				Distribution in Percent				Amount in Naira				Distribution in Percent			
	80/81	81/82	82/83	83/84	80/81	81/82	82/83	83/84	80/81	81/82	82/83	83/84	80/81	81/82	82/83	83/84
Basic Cash Income	169.69	152.99	173.12	207.27	76.12	65.64	71.86	74.17	67.44	72.21	77.69	92.63	54.12	48.24	49.95	52.35
Other cash income	25.10	53.28	28.95	34.57	11.26	22.86	12.02	12.37	14.23	18.04	18.30	21.07	11.42	12.05	11.76	11.91
Total Cash income	194.79	206.27	202.07	241.84	87.38	88.50	83.88	86.54	81.67	90.25	95.99	113.70	65.54	60.29	61.71	64.26
Consumption from own product	15.24	12.21	20.26	15.48	6.84	5.24	8.41	5.54	29.54	43.67	43.12	44.57	23.70	29.17	27.72	25.19
Income in Kind	3.01	3.89	4.26	6.26	1.35	1.67	1.77	2.24	4.09	5.40	5.21	5.56	3.28	3.61	3.35	3.14
Imputed rent	9.87	10.71	14.31	15.87	4.43	4.59	5.94	5.68	9.32	10.37	11.23	13.11	7.48	6.93	7.22	7.41
Total Non-cash income	28.12	26.81	38.83	37.61	12.62	11.50	16.12	13.46	42.95	59.44	59.56	63.24	34.46	39.71	38.29	35.74
TOTAL ALL INCOMES	222.91	233.08	240.90	279.45	100.00	100.00	100.00	100.00	124.62	149.69	155.55	176.94	100.00	100.00	100.00	100.00

Source: FOS - Federal Office of Statistics - Social Statistics in Nigeria, 1985

Average monthly income for rural earner was N. 223.00 in 1980/81 rising to N. 279.00 in 1983/84. The rural self employed has continued to earn the least income over the years. In 1980/81, his monthly income was only N. 125.00. By 1983/84 it had risen to N. 177.00, both well below 1980 income levels. About 60% of his income is cash, 25% represents consumption from own production and the rest is imported income.

It is also interesting to see the distribution of monthly household income by education level and by age of head of household (tables 3.10 - 3.11).

Table 3.10 - Household monthly income distribution by education level of head of household 1983/84[28]

Educational level of head					
Urban Income group (N)	**no school**	**primary**	**secondary**	**post secondary**	**total**
All groups	**100%**	**100%**	**100%**	**100%**	**100%**
Below N 100	42.3	20.19	25.53	5.96	31.11
100-199	38.13	42.47	10.99	8.09	33.28
200-299	13.38	22.85	36.88	24.25	19.6
300-499	4.72	10.01	18.8	34.47	10.58
500 and above	1.47	4.38	7.8	27.23	5.43
Median income	120	170	237	335	157
Total sample	1293	639	282	235	2449
Rural Income group (N)	**no school**	**primary**	**secondary**	**post secondary**	**total**
All groups	**100%**	**100%**	**100%**	**100%**	**100%**
Below N 100	69.08	43.11	23.49	41.09	61.11
100-199	23.31	38.12	30.02	4.11	25.42
200-299	4.23	8.8	26.17	24.66	7.07
300-499	2.41	5.86	12.75	30.14	4.55
500 and above	0.97	4.11	7.38	-	1.85
Median income	62	118	189	222	82
Total sample	1656	341	149	73	2219

[28] Source: Federal Office of Statistics - Social Statistics 1985

Table 3.11 - Household monthly income Percentage distribution by age group of household head 83/84[29]

Age Group					
Urban Income group (N)	**15-29**	**30-44**	**45-59**	**over 60**	**total**
All groups	%	%	%	%	%
Below N 100	30.4	23.62	33.69	56.44	31.11
100-199	37.39	36.8	31.26	16.67	33.28
200-299	21.4	20.48	18.06	17.42	19.6
300-499	8.11	12.18	11.22	6.44	10.58
500 and above	2.7	6.92	5.77	3.03	5.43
Median income	152	172	152	89	157
Total sample household	442	1084	629	264	2449
Rural Income group (N)	**15-29**	**30-44**	**45-59**	**over 60**	**total**
All groups	%	%	%	%	%
Below N 100	56.68	60.07	61.04	65.5	61.11
100-199	26.72	26.46	26.37	21.4	25.42
200-299	10.53	7.15	6.37	6.12	7.07
300-499	6.07	4.17	4.3	4.8	4.55
500 and above	-	2.15	1.92	2.18	1.85
Median income	89	83	82	76	82
Total sample household	247	839	675	458	2219

Very high is the percentage (41%) of rural head of household with post-secondary schooling level whose income is below N. 100.

The percentage of the correspondent urban head of household is much lower: 6%. On the whole, about 65% of urban head of household recorded a monthly income below N. 200 (86% for rural).

In terms of age group, the percentage of rural head of household aged 30-44 with an income below N. 100 is almost three times higher than the urban (60.1% against 23.6%), while is about double in the age group 45-59.

3.2.1 Fringe benefits and employment contract[30]

Current wage policy in Nigeria considers a number of different economic treatment based essentially on amount, type and quality of fringe-benefits, namely:

1. Leave allowances :
(for a leave of 4-5 weeks to a maximum of 6 weeks):
- Senior employees: 5% of annual salary
- Senior graduates: 8 1/3% of annual salary

2. Transport
New car or car contribution at 50% of bank interest or contribution of Naira 100-200/month

[29] Source: Federal Office of Statistics - Social Statistics 1985
[30] figures reported during interviews

3. Housing
- Major companies provide accommodation in company owned-blocks.
- Some other provide rents that may vary from Naira 40.000 up to Naira 200.000 per annum.
- For employees (generally managers) with own house or apartment, company may provide accommodation contribution, ranging from 5.000 up to 40.000 Naira/year, or rent subsidy up to 20-25% of salary.

4. Retirement benefits as:
- pure pension based on provisions given monthly by the company from its pension fund. Some pensions include an employee contribution up to 5-10% of salary (contributory pensions);
- additional life insurance paid by the employer up to 10-15% of employee salary;
- gratuity equal to an amount of monthly salary for each year of service. Monthly salary considered in the gratuity may vary from 2 weeks (1/2 monthly salary) up to 6 weeks (1 1/2 monthly salary).

5. Medical scheme
- Health care and medical assistance are given free to all employees. Senior employees have medical assistance also for wife and up to 4 children.

6. Year end bonus
- 13th month salary.

7. Others

- Mission allowances, from a minimum of Naira 20-40/day for junior up to much larger allowances for seniors;
- sick leave (checked by a company doctor) for 12 working days. More serious cases may have a sick leave up to 3 months at full salary and additional three months at 50% of the salary;
- women have a maternity leave of 6 weeks before birth and 6 weeks after. The government ensure 100% salary whilst some private employers allow 50% of monthly salary;
- in case of redundancy dismissal the gratuity is almost always equal to 4 weeks for every year worked;
- shift allowance is an additional salary of 10-15% of basic hour;
- partial infirmity due to working accidents is paid to a maximum of 54 months of salary (permanent 100% infirmity);
- for fatal accidents an allowance equal to 42 months salary is paid to dependents plus all funeral expenses.

Basic salaries vary considerably depending on sectors of activity. Generally speaking, employees of oil industries, breweries, chemical industries and banks are paid better than the average. These sectors may pay up to 10-20% more than other sectors. Textile and metal workers may be taken as average treatment. Employers associations expect lower salaries to increase.

Average salary may be considered (April 1989) as follows:

- unskilled workers (minimum)	:	Naira	125/month
- unskilled workers (max)	:	Naira	150-200/month
- unskilled out-workers	:	Naira	10/day
- semi-skilled	:	Naira	250-500/month
- skilled	:	Naira	300-700/month
- senior	:	Naira	600-1000/month

4 MONEY AND PRICES

Current monetary policy is characterized by the gradual adoption of strategies aimed at achieving a stimulating reflation of the economy already started in 1988.

The Government is still maintaining cautious monetary policies, as the new budget announced a continuation of the monetary squeeze for 1989, with the target for money supply (M1) growth set at 14.8 per cent. This follows the 15 per cent target in 1988, which should be seen in the context of actual domestic inflation of upwards of 30 per cent. Domestic bank credit to the private sector will be restricted to 10.7 per cent growth in 1989, compared with a 13.3 per cent target in 1988.

In the year 1987 the authorities relied heavily on the monetary policy to realize the objectives of SAP.

Government focused its monetary and credit policies on the following issues:

a) Restrictive credit policy, setting maximum rates of growth of the aggregate credit and the money supply at 4.4% and 11.8% respectively. The year 1987 experienced the lowest annual growth rate in aggregate domestic credit in the history of the Nigerian economy.

b) Interest rate de-regulation: banks were allowed to fix freely their rates of interest both on deposits and loans with a Central Bank Minimum Re-discount Rate raised in August 1987 from 12.5 to 15 per cent (reduced to 12.75 in December). Interest rates were raised twice in the year: the cumulative effect of the two rounds of increases was that the average rate of interest rose both in nominal and real terms. From 11.5 per cent maximum lending rate in December 1986, it rose to 15 per cent in January 1987 and to as high as 21 per cent in some banks in August with most banks lending rates close to 18%.

c) De-regulation of Inter-bank transaction in foreign market exchange: banks were allowed to charge freely their margins on the autonomous foreign exchange transactions they make between one bank and the other.

On the whole, the high cost of borrowing and repressed monetary growth not only reduced real money balances, but also delayed real growth, leading to stagflation.

Price related policies in the year 1987 were directly linked to monetary development within the de-regulation framework achieved by SAP.

By the end of 1986, ex-factory prices have been deregulated including those of the so-called essential commodities. Similarly, the economy-wide effects of a 97.5% increase in the price of gasoline (petrol) have become very visible as every one pointed to the policy as the primary reason for increasing prices.

In the meanwhile, in spite of high interest rates, depreciating exchange rate has automatically reflected on market prices for the import dependent goods. Prices of domestic staples also increased somewhat as producers of these goods needed more money to buy the import dependent final goods.

High cost of transportation and other infrastructural services increased distribution costs, that inevitably were passed on to prices.

Deregulating prices and interest rate, sharp exchange rate depreciation and rising prices of goods, produced by major public enterprises in the infrastructural and basic goods sub-sectors, led to generalized increase in production costs of all goods and services nation-wide.

As a result, by the end of 1987, cost of all basic industrial and infrastructural goods and services went up by several folds and correspondingly urban and rural composite consumer price indices maintained steady upward trend (**see tables 4.1 - 4.2 - 4.3**).

Table 4.1 - Composite Consumer Price index (base year 1975 = 100)[31]

	All items	Food	Drinks & Kola	Tobacco	Accom Fuel Light	HH goods & other Purchase	Clothes	Transp.	Other Serv
1987 Average	*561.6*	*541.9*	*457.5*	*767.5*	*378.1*	*839.1*	*787.8*	*478.0*	*1015.9*
1988 Average	*776.5*	*824.7*	*479.8*	*829.5*	*357.3*	*863.9*	*871.4*	*552.9*	*1091.5*
Dec 1987	590.8	576.4	450.5	778.1	365.1	840.2	820.3	499.5	1030.4
Jan 1988	611.4	605.4	459.0	773.0	338.0	847.4	839.5	518.4	1041.3
Feb 1988	631.2	630.3	458.5	779.2	324.8	831.6	829.6	504.7	1045.7
Mar 1988	662.0	670.4	446.1	780.6	329.0	832.2	818.4	506.6	1078.6
Apr 1988	715.6	744.8	455.0	818.0	352.8	799.1	832.3	541.4	1073.4
May 1988	745.4	784.1	458.5	830.5	349.3	810.5	829.8	548.5	1068.0
Jun 1988	784.2	882.7	466.7	867.4	346.3	837.4	865.6	563.8	1088.2
Jul 1988	824.7	887.6	473.7	840.9	359.3	842.3	866.4	550.5	1119.1
Aug 1988	873.7	957.2	475.7	866.0	365.4	847.6	855.3	562.1	1108.7
Sep 1988	863.5	938.5	485.8	860.9	367.8	875.0	886.8	573.4	1111.1
Oct 1988	852.1	915.5	507.7	812.9	373.3	920.2	924.8	570.5	1113.4
Nov 1988	874.4	941.0	517.0	951.6	372.2	940.0	946.1	591.9	1110.4
Dec 1988	879.3	938.8	553.5	872.5	409.8	983.2	961.6	603.1	1140.0

Table 4.2 - Urban Consumer Price index (base year 1975 = 100)[32]

	All items	Food	Drinks & Kola	Tobacco	Accom Fuel Light	HH goods & other Purchase	Clothes	Transp.	Other Serv
1987 Average	*581.6*	*652.5*	*360.4*	*515.6*	*414.4*	*723.9*	*623.8*	*363.4*	*527.0*
1988 Average	*739.5*	*902.5*	*405.8*	*570.6*	*441.5*	*775.7*	*709.3*	*385.4*	*568.5*
Dec 1987	603.8	682.1	361.1	524.1	418.3	721.8	642.1	406.6	542.5
Jan 1988	624.1	721.7	358.0	530.6	427.9	723.3	646.9	370.8	582.9
Feb 1988	635.1	735.1	362.9	536.0	425.6	735.3	652.1	375.9	548.9
Mar 1988	655.7	771.2	364.6	543.1	428.9	740.3	666.1	377.9	550.6
Apr 1988	685.8	820.5	368.6	553.3	436.6	739.3	683.5	307.4	550.6
May 1988	721.8	879.2	387.2	570.5	441.4	745.9	696.3	390.3	555.1
Jun 1988	748.1	920.7	399.6	578.3	438.2	760.5	699.1	391.4	560.0
Jul 1988	778.0	967.0	401.9	579.9	444.9	796.6	720.9	395.1	562.6
Aug 1988	801.3	1006.4	409.1	574.0	445.0	778.6	719.2	397.4	573.4
Sep 1988	799.3	999.5	424.6	588.6	442.6	796.2	731.4	395.7	576.0
Oct 1988	800.6	993.2	447.8	588.6	446.3	811.5	755.2	399.0	586.4
Nov 1988	798.3	994.1	456.7	587.2	459.2	825.8	765.4	404.2	585.2
Dec 1988	825.5	1021.4	488.5	617.0	461.8	855.6	775.8	419.2	590.3

(31) Source: Federal Office of Statistics
(32) Source: Federal Office of Statistics

Table 4.3 - Rural Consumer Price index (base year 1975 = 100)[33]

	All items	Food	Drinks	Tobacco	Accom Fuel Light	HH goods & other Purchase	Clothes	Transp.	Other Serv
1987 Average	*558.8*	*526.4*	*471.1*	*802.8*	*373.0*	*855.2*	*810.9*	*494.0*	*1084.5*
1988 Average	*781.6*	*808.9*	*490.2*	*865.8*	*345.5*	*876.3*	*894.1*	*575.5*	*1164.8*
Dec 1987	589.0	561.5	463.0	813.7	357.6	856.8	845.3	512.5	1098.9
Jan 1988	609.6	589.1	473.2	807.0	325.3	864.8	866.5	539.1	1105.6
Feb 1988	630.6	615.6	471.9	813.3	310.7	845.1	854.5	522.7	1115.4
Mar 1988	663.0	656.2	457.6	813.9	315.0	845.1	839.8	524.6	1152.6
Apr 1988	719.7	734.2	467.2	856.0	341.1	807.5	853.1	563.1	1146.7
May 1988	748.7	770.8	468.5	866.9	336.4	819.7	848.6	570.7	1139.9
Jun 1988	789.3	819.3	476.1	907.9	333.4	848.2	888.9	588.1	1162.3
Jul 1988	831.2	876.5	483.8	877.5	347.3	848.6	886.8	572.3	1197.1
Aug 1988	883.8	950.2	485.1	906.9	354.2	857.2	874.3	585.1	1183.8
Sep 1988	872.5	930.0	494.4	899.1	357.4	886.1	908.6	598.3	1186.2
Oct 1988	859.3	904.5	516.6	844.3	363.0	935.5	948.6	594.3	1187.3
Nov 1988	885.1	933.6	525.5	888.7	360.0	956.0	971.5	618.2	1184.0
Dec 1988	886.8	927.3	562.6	908.3	402.5	1001.2	987.7	628.9	1217.1

Throughout 1988 prices continued to rise, due largely to the impact of the poor agricultural harvest in 1987 and the inflationary policy stance of the federal government.

Table 4.4 shows that the fourth 1988 composite quarterly average index rose by 280.6 points (47.7%) in comparison with the corresponding quarter 1987. The upward movement resulted from increases in all the subgroups indices, but particular attention must be paid to food. The composite food index in December 1988 increased by 62.8% when compared with the corresponding index for the same month the preceding year, with an urban and rural indices rises of respectively +49.7% and +75.1%.

It is also interesting to look at the price index trend of transport: the urban index recorded a slight increase of 3.1% over the level of the previous year, while the correspondent rural index showed a sharp + 22.7%.

For the year 1989, the inflation will probably by exacerbated as the budget measures feed through the domestic economy, notably fuel price rises and tariff increases. Inflationary build up, on the other hand, should be moderated by sluggish domestic demand and poor import growth as foreign exchange inflows remain scarce.

(33) Source: Federal Office of Statistics

Table 4.4 - Composite consumer price index (base year 1975 = 100)[34]

	All items	Fuel	Food	Drinks	Tobacco	Clothing	H.H. Goods	Transp.	Other Serv.
1976	123.0	109.0	122.0	132.0	143.0	135.0	145.0	139.0	148.0
1977	143.0	127.0	146.0	150.0	183.0	141.0	137.0	141.0	146.0
1978	167.0	131.0	172.0	154.0	186.0	176.0	147.0	158.0	156.0
1979	186.0	167.0	186.0	176.0	203.0	219.0	156.0	196.0	178.0
1980	205.0	170.0	200.0	188.0	229.0	270.0	182.0	197.0	235.0
1981	248.0	173.0	250.0	193.0	264.0	314.0	195.0	202.0	283.0
1982	267.0	180.0	272.0	208.0	278.0	335.0	213.0	224.0	296.0
1983	328.0	240.0	336.0	236.0	318.0	398.0	328.0	271.0	357.0
1984	458.0	270.0	479.0	290.0	436.0	543.0	165.0	316.0	497.0
1985	484.0	258.0	499.0	380.0	549.0	610.0	542.0	357.0	612.0
1986	509.7	362.5	499.2	421.4	672.7	704.3	709.0	422.2	834.4
1987	561.6	378.1	541.9	457.5	767.5	787.8	839.1	478.0	1015.9
1988	776.5	357.3	824.7	479.8	829.5	871.4	863.9	552.9	1091.5
1987 average									
1st qrt	541.4	393.9	518.0	463.0	751.0	767.5	842.5	443.1	1010.2
2nd qrt	548.1	382.6	524.5	458.3	748.3	795.5	838.3	463.1	1008.9
3rd qrt	569.0	374.3	551.2	453.8	787.0	783.3	836.2	500.9	1014.5
4th qrt	588.0	361.5	573.8	457.8	783.8	805.1	839.4	504.7	1030.1
1988 average									
1st qrt	634.9	330.6	635.4	454.5	777.6	829.2	837.1	509.9	1055.2
2nd qrt	784.4	349.5	803.9	460.1	838.9	842.6	815.7	551.2	1076.5
3rd qrt	854.0	364.2	927.8	478.4	85.9	869.5	855.0	562.0	1113.0
4th qrt	868.6	385.1	931.8	526.1	845.7	944.2	947.8	588.5	1121.3

[34] Source: Federal Office of Statistics

5 FOREIGN TRADE

Since the downturn in oil exports began in 1981, Nigeria's external trade transactions have been in the doldrums. The recession which accompanied the collapse of oil fortunes considerably reduced activities in an economy with a high import dependency ratio.

The outlook for Nigeria's external accounts in 1989 will be determined for the future by the fluctuations of the international oil market; the non-oil sector, notably cocoa, has made important gains in the aftermath of the liberalization of producer prices, but still accounted for less than 5 per cent of total export receipts in 1987.

With a marginally higher Opec production quota of 1,355 million barrels/day and domestic consumption of around 250 million barrels/day, Nigeria in theory has an exportable surplus of some 1.1 mn barrels/day. The latest Economist Intelligence Unit (EIU) figures indicate an average price, during 1989, of $ 14.50 a barrel and a Nigerian petroleum export revenue forecast around 5,850 million US dollars.

Non-oil earnings were projected in the same 1989 budget at the higher level of 1,3 billion US dollars in line with the government's target for non-oil private sector receipts and the expectation that the new exchange rate regime is effective in curbing illegal activities.

Considering that the budget seems conservative in its oil forecast and ambitious in relation to non-oil earnings and using the EIU figures referred to above, the 1989 exports forecast estimated at $ 6.95 billions.

With imports restricted to $ 5 billions Nigeria's trade surplus will decline to around $ 1.95 billions.

Although the government can reasonably count on a substantial reduction in debt interest payments in the aftermath of successful re-scheduling by London and Paris Clubs of creditors, the 2.004 billion US dollars earmarked for such payments in the budget will result in a current account deficit of around 400 million US dollars.

Tab 5.1 - Forecast summary (external) ($ billions)[35]

	1986(a)	1987(a)	1988(b)	1989(c)
Merchandise exports fob				
of which: petroleum	6.20	7.20	6.20	5.85
Merchandise imports cif	4.40	4.50	4.60	5.00
Current account balance	0.40	1.60	-0.50	-0.40
Aver. exch-rate (N per$)	1.35	4.01	4.45	8.00

Notes : (a): Actual; (b): Estimate; (c): Forecast

Latest official figures of Nigeria's balance of payments refer to 1987 and indicate a moderate surplus of N 152.6 million in contrast to a deficit of N 776.4 million recorded in 1986 (**Table 5.2**) Foreign trade balance, however, remains unhealthy for three main reasons:

[35] Source : EIU Economists Intelligence Unit

Table 5.2 - Balance of payments (N million)

Items	1982	1983	1984	1985	1986	1987
Current Account						
Exports, goods and IFS	9453.6	7957.1	9369.0	12137.0	9389.4	31493.8
Oil	8601.6	7333.3	8871.6	11223.6	8368.4	28739.0
Non-oil merchandise	622.3	418.5	267.3	497.2	552.1	1500.9
Non factor services	229.7	205.3	230.1	416.2	468.9	1253.9
Imports, goods and NFS	11483.8	7872.8	6718.5	8162.3	7267.4	19396.1
Merchandise	9090.1	62243.0	5299.0	6655.7	5476.6	16392.5
Non-factor services	2393.0	1629.8	1419.5	1506.6	1790.8	3003.6
Resource-balance	-2029.5	84.3	2650.5	3974.7	2122.0	12097.7
Net-factor income	-786.8	-618.5	-892.5	-1527.3	-1282.1	-5373.5
Receipts	148.4	74.5	40.2	72.5	98.7	184.1
Payments	935.2	693.0	932.7	1599.8	1580.8	5557.6
-Interest on MLT loan	457.6	435.6	712.9	712.9	980.5	987.2
-others	477.6	257.4	219.8	619.3	393.6	595.6
Net transfers	-289.4	-285.8	-253.8	-232.0	-240.4	-96.2
Current account balance	-3105.7	-820.0	1504.2	2215.4	599.5	6628.0
Capital Account						
Direct foreign Invest. (net)	290.0	264.3	144.5	434.1	338.8	275.7
Portfolio investment			207.3	783.0	151.6	4353.1
Net MLT borrowing	720.3	1092.1	-331.5	-1255.7	-1564.9	1664.6
Other long-term net	16.5	17.4	248.4	-396.5	-436.2	-190.7
Net short-term capital	204.6	-1102.8	-1391.4	-1336.9	664.9	-8922.8
Capital account balance	1231.4	271.0	-1122.7	-1772.0	845.8	-6149.3
Net change in reserves	1398.3	301.3		349.1	776.4	-152.6
Net errors & omissions	476.0	247.7	-26.7	-94.3	-530.1	-326.1
internat.reserves level	1398.3	301.3	377.7	605.1	1951.1	1045.0
SDRs	147.3	0.4		40.0	2.4	
Net position in IMF	331.4		22.9			
Foreign exchange	919.6	300.9		-565.1	-1948.7	-1045.0
Gold			354.8			

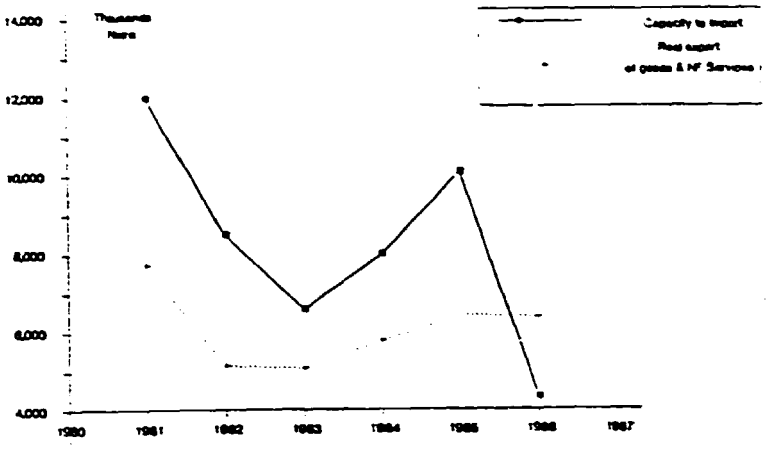
Note: Exports are valued FOB; gold is valued at Official price

a) Low level of reserves: Central Bank of Nigeria's records indicate that foreign exchange inflow dropped from $ 26 bn in 1980 to $ 12 bn in each of 1982 and 1985 and to as low as $ 7 bn and $ 7.8 bn respectively in 1986 and 1987. The depressed foreign exchange earnings resulted from the fall in prices of oil (accounting for 95% of total export) that partially recovered in 1987 increasing from $ 14.85 per barrel in 1986 to an average of $ 18.92 per barrel.

b) Debt service obligations: Nigeria has accumulated a huge foreign debt (estimated in 1988 at between $ 23 billion and $ 25 billion), which has worsened relations between the country and its traditional trade creditors. Although some success was achieved in bilateral re-scheduling arrangements, negotiations with both the Paris and the London Clubs of creditors have been stalled by a number of obstacles.

c) Deterioration of international terms of trade: according to the World Bank's data, while the real value of Nigerian export of goods and services declined by about 2% in 1986 in comparison with the previous year, it decreased by 50% when adjusted for terms of trade (i.e. deflated by the import price index) (**Graph 5.1**). In other words, capacity to import generated by exports was less than half of what it had been in 1985.

(Graph 5.1) - Nigerian Trend of international terms of trade



As regards the foreign trade structure, the current account in 1987 increased significantly largely as a result of improved merchandise trade performance, but the rise reflected the depreciation of the value of the Naira which boosted the local currency values of both imports and exports. In fact, although in 1987 total nominal imports and exports were nearly three times the corresponding values in each of the years 1982-86 (Table 5.3 and 5.4), from the export side only palm kernels, timber and plywood and rubber showed a quantity increase (Table 5.5). Oil shipment, on the contrary, dropped from 56.8 m/t to 53.3 m/t indicating a percentage decrease of 6%.

(Table 5.3) - Composition of Imports by Commodity Sections (1980-1987)[36]

	1980		1981		1982		1983		1984		1985		1986		1987	
	million naira	%	million naira	%	million naira	%	million naira	%	million naira	%	million naira	%	million naira	%	million naira	%
SITC Sections																
Food&Live Animals	1049.0	12.8	1820.2	14.4	1642.2	16.2	1296.7	19.8	843.2	18.8	940.6	17.0	802.3	13.4	1646.4	10.5
Bevrages & Tocacco	12.8	0.2	16.5	0.1	16.4	0.2	13.1	0.2	10.4	0.2	7.4	0.1	14.5	0.2	27.1	0.2
Raw mater.(excl oil)	164.1	2.0	218.9	1.7	207.7	2.0	204.4	3.1	187.5	4.2	274.8	5.0	193.9	3.2	702.7	4.5
Fuels&lubricants	118.7	1.4	151.1	1.2	151.1	1.5	53.0	0.8	60.3	1.3	48.0	0.9	32.0	0.5	67.2	0.4
Oils & Fuels	96.3	1.2	128.7	1.0	151.4	1.5	105.6	1.6	101.8	2.3	55.7	1.0	124.8	2.1	57.8	0.4
Chemicals	881.0	10.7	1220.4	9.7	981.6	9.7	714.0	10.9	656.4	14.6	868.9	15.7	1039.0	17.4	2650.5	16.9
Manufactured Goocs	1929.4	23.5	2540.7	20.2	2137.0	21.1	1477.1	22.5	846.0	18.8	1263.5	22.8	1237.1	20.7	3940.6	25.1
Machinery&Equipment	3363.1	40.9	5548.1	44.0	4169.9	41.1	2366.0	36.1	1604.4	35.7	1892.8	34.2	2277.8	38.1	5999.6	38.2
Misc.manuf. articles	590.0	7.2	947.7	7.5	642.3	6.3	316.6	4.8	171.2	3.8	176.0	3.2	246.3	4.1	596.2	3.8
Others	12.7	0.2	10.2	0.1	36.6	0.4	9.2	0.1	8.1	0.2	9.2	0.2	7.3	0.1	10.0	0.1
TOTAL IMPORTS	8217.1	100	12602.5	100	10136.2	100	6555.7	100	4489.3	100	5536.9	100	5974.7	100	15698.1	100
By End Use																
Food	1142.8	13.9	19 ?.8	15.5	1794.5	17.8	1415.4	21.6	946.4	21.1	995.2	18.0	935.4	15.7	1710.7	10.9
Other Consumer Goods	1436.8	17.5	21 .6	17.2	1444.5	14.4	1251.9	19.1	329.4	7.4	606.8	11.0	683.2	11.4	2040.7	13.0
Raw Materials	2073.8	25.3	2600.4	20.6	2297.8	22.8	1124.6	17.2	1316.8	29.4	1795.2	32.4	1762.3	29.5	4954.5	31.6
Capital Goods	3335.3	40.7	5278.7	41.9	4075.5	40.5	2322.2	35.5	1719.8	38.4	1546.5	28.0	2318.6	38.9	6540.7	41.7
Others	215.7	2.6	590.5	4.7	451.2	4.5	432.4	6.6	168.6	3.8	584.0	10.6	267.9	4.5	441.1	2.8
TOTAL IMPORTS	8204.4	100	12593.0	100	10063.5	100	6546.5	100	4481.0	100	5527.7	100	5967.4	100	15687.7	100

(36) Source : FOS Federal Office of Statistics, Lagos

(Table 5.4) - Destination and Value of Exports at Current Prices (1987)[37]

destination	1981		1982		1983		1984		1985		1986		1987	
	million naira	%	million naira	%	million naira	%	million naira	%	million naira	%	million naira	%	million naira	%
PETROLEUM	10665.7	96.86	8922.4	97.02	7290.2	94.22	8657.7	94.73	11275.0	96.20	8328.7	92.36	28154.4	95.19
France	918.2	8.34	1367.9	14.87	1529.2	19.76	1848.1	20.22	1887.8	16.11	1340.6	14.82	2252.0	7.61
Germany	637.5	5.79	661.0	7.19	835.7	10.80	870.3	9.52	818.5	6.98	586.2	6.48	1342.7	4.54
Netherlands	1221.3	11.09	614.7	6.68	564.7	7.30	1084.9	11.87	1355.4	11.56	885.3	9.79	2992.4	10.12
UK	33.1	0.30	124.4	1.35	198.9	2.57	256.3	2.80	411.5	3.51	273.5	3.02	210.2	0.71
Other EEC	601.3	5.46	1285.4	13.98	985.7	12.74	1464.3	16.02	1923.4	16.41	745.1	8.24	1800.5	6.09
Total EEC	3411.4	30.98	4053.4	44.07	4114.2	53.17	5523.9	60.44	6396.6	54.57	3830.7	42.34	8597.8	29.07
USA	3889.3	35.32	2960.3	32.19	1784.5	23.06	1193.8	13.06	2025.1	17.28	3067.6	33.91	13795.5	46.64
Other West. Wrld	2754.7	25.02	1553.3	16.89	914.1	11.81	1615.5	17.68	1577.7	13.46	1039.2	11.49	4064.7	13.74
All others	610.3	5.54	355.4	3.86	477.4	6.17	324.5	3.55	1275.6	10.88	391.2	4.32	1696.4	5.74
COCOA&COCOA BUTTER	196.0	1.78	168.5	1.83	257.5	3.33	228.6	2.50	239.1	2.04	415.5	4.59	777.9	2.63
OTHER 1ERY COMMOD.	85.9	0.78	33.9	0.37	42.3	0.55	240.6	2.63	200.4	1.71	183.0	2.02	436.1	1.47
MANUFACTURED GOODS	63.9	0.58	72.1	0.78	147.1	1.90	12.4	0.14	6.3	0.05	120.3	1.33	209.5	0.71
TOTAL EXPORTS	11011.5	100.0	9196.9	100.0	7737.1	100.0	9139.3	100.0	11720.8	100.0	9047.5	100.0	29577.9	100.0

(Table 5.5) - Major Export Commodities 1983-1987[38]

COMMODITY	Unit of Qty	quantity('000)					value ('000,000 Naira)					Average Unit Value (naira)					Percentage of Total Exports				
		1987	1986	1985	1984	1983	1987	1986	1985	1984	1983	1987	1986	1985	1984	1983	1987	1986	1985	1984	1983
Ground nut	Tons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground nut Oil	Tons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ground nut Cake	Tons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cocoa beans	Tons	143	148	93	131	206	732.0	370.7	182.1	192.6	232.4	5118.9	2504.7	1958.1	1470.2	1128.2	2.5%	4.1%	1.6%	2.1%	3.0%
Cocoa butter	Tons	9	9	11	7	10	46.0	44.8	46.8	25.4	25.4	7666.7	4977.8	4254.5	3771.4	2540.0	0.2%	0.5%	0.4%	0.3%	0.3%
Cocoa powder&cake	Tons	5	15	12	13	12	12.0	9.4	10.3	9.4	2.8	2000.0	626.7	858.3	723.1	233.3	*	0.1%	0.1%	0.1%	*
crude petroleum	Tons	53356	56791	63456	55212	46553	28154	8328.7	11275	8657.7	7290.2	527.7	146.7	177.7	156.8	156.6	95.2%	92.1%	96.2%	94.8%	94.2%
palm kernel	Tons	134	61	32	42	54	46.0	7.5	6.2	9.2	11.7	343.3	123.0	193.8	219.0	220.4	0.2%	0.1%	0.1%	0.1%	0.2%
palm kernel oil	Tons	-	-	6	8	8	-	-	3.3	4.7	3.9	-	-	550.0	587.5	487.5	-	-	*	0.1%	0.1%
palm kern. cake/meal	Tons	17	8	14	1	8	5.0	3.6	0.6	0.1	3.8	294.1	75.0	42.9	100.0	100.0	*	*	*	*	*
palm oil	Tons	*	*	-	-	-	*	*	-	-	-	*	*	-	-	-	*	*	-	-	-
rubber	Tons	99	58	6	6	9	107.0	33.3	3.8	2.9	3.7	1091.8	568.4	633.3	483.3	462.5	0.4%	0.4%	*	*	*
raw cotton	Tons	-	-	-	-	-	-	3.2	-	-	*	-	-	-	-	-	-	*	-	-	-
cotton seeds	Tons	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
tin metal	Tons	*	-	0.4	1	1	5.0	1.3	4.1	11.6	7.1	*	*	10250	11600	7100	*	*	*	0.1%	0.1%
hides & skins	Tons	3	0.2	*	*	*	12.0	0.4	0.4	0.5	0.5	4000.0	2000.0	*	*	*	*	*	*	*	*
coffee	Tons	1		*	*	3	3.0	0.3	0.2	0.1	4.5	3000.0	*	*	*	1500	*	*	*	*	0.1%
timber & plywood	cu/ft	1271	157	-	*	-	12.3	0.7	-	*	*	9.7	4.5	-	*	*	*	*	*	*	*
TOTAL MAJOR EXPORTS							29134	8798	11533	8915	7583						98.5%	97.2%	98.4%	97.7%	98.0%
OTHER COMMODITIES							443.6	249.9	188.0	212.9	154.2						1.5%	2.8%	1.6%	2.3%	2.0%
TOT DOMESTIC EXPORT							29578	9048	11721	9128	7737						100%	100%	100%	100%	100%

* indicates negligeable

Imports have not changed much since 1983: machinery and equipment account for over 35%, food declined sharply from 21% in 1984, to 18%, 16% and 11%, respectively in 85-86-87,(Table 5.2). During 1987, imports declined because of the effect of measures undertaken and of the devaluation of the dollar. Nigeria earns most of its foreign exchange in dollars against oil and the Naira is more tied to the dollar, than to any other foreign currency. At the same time, Nigeria's external trade is mainly with non-dollar based economies, mostly Europe: in 1987 UK and W - Germany accounted for about 30% of imports. It is a double jeopardy, for while Nigeria has to pay more dollars abroad for the same value of good and services, at home they had been paying more Naira to buy the same amount of dollars. This situation did not facilitate planning for Nigerian businessmen in 1987 and indeed forced many to raise prices even when consumer buying power was obviously ebbing.

(37) Source : FOS Federal Office of Statistics, Lagos

(38) Source : FOS Federal Office of Statistics, Lagos - Review of External Trade 1987

6 ECONOMIC POLICIES

6.1 INVESTMENT POLICY

In order to achieve an accelerated pace of industrial development, government requires that proposals for the establishment and operation of industries in Nigeria must take into account the following objectives:

a) Providing greater employment.

b) Increasing export of manufactured goods.

c) Favouring dispersal of industries.

d) Improving the technological skills and capability available in the country.

e) Increasing local content of industrial output.

f) Attracting foreign capital.

g) Increasing private sector participation in the manufacturing sector.

h) Privatization policy.

With these objectives in mind the Federal Government, which has exclusive power in the fields of company taxation and tariff policy, offers special incentives to industrial enterprises where such incentives are considerd necessary in the overall economic interest in Nigeria. These incentives are embodied in the following measures:

A. *Industrial development (income tax relief) act 1958 - as amended by decree n. 22 of 1971*

The object of the Act is to encourage the establishment and development of such industries that the Government may consider to be beneficial to Nigeria and assistance to which would be in the public interest. By making relief from Income Tax possible during the early years of public companies engaged in pioneer industries, this Act is designed to attract capital to Nigeria in the development of its natural resources and the expansion of its industrial capacity.

Before benefits provided by the Act can be obtained, it is necessary that the industry or the products which it is proposed to establish, develop or produce should be declared a pioneer industry or a pioner product.

The tax relief period of a pioneer company shall not exceed three years in the first instance; at the end of the three years the tax relief period may be extended:

a) for a period of one year and thereafter for another period of one year, or

b) for one period of two years.

In granting extension of tax relief period some of the points considered are as follows:

a) the rate of expansion, standard of efficiency and the level of development of the company

b) the implementation of any scheme

i) for the utilization of local raw material in the processes of the company, and

ii) for the training and development of Nigerian personnel in the relevant industry

c) the relative importance of the industry in the economy of the country.

d) the need for the expansion, having regard to the location of the industry, and

e) such other relevant matters as may be required.

If losses are incurred during the tax holiday, a further extension may be given. For such accounting period within the tax holiday in which a loss incurred, the tax relief period is extended by the same period.

There is also provision for capital expenditure, and the type which normally attracts relief from income tax and which is incurred in a tax relief period, to be written off wholly from the taxable profit arising after the period.

As a corollary to the exemption from tax on profit earned by the company in its tax relief period, shareholders can be exempted from tax on dividend up to the amount of such profit. For the time being, below are listed the schedule of pioneer industries and main pioneer products as announced by the Federal Ministry of Industries:

Schedule of:

Pioneer Industries	**Main Pioneer Products**
1. Cultivation and processing of food and fruits, crops, vegetable and fruits tomato	Preserved, canned foodstuffs tea, coffee, refined sugar, puree/juice, etc.
2. Manufacture of cocoa products cocoa	Cocoa powder, cocoa butter, cake, chocolates, cocoa wine
3. The processing of oilseeds	Coconut oil, meal, cake; shell and shell flour, cotton-seed, oil, meal, cake; flour and lint; lecethin; benniseed oil, meal and cake; essential oil, meal and cake; castor-seed oil, meal and cake cashew-nut, oil, meal and cake, sun-flower-seed oil, meal and cake, kernel cake.
4. Integrated Dairy Production	Butter, cheese, fluid milk, milk powder, icecream (by products-Livestock, minor edible dairy products)
5. Cattle and other Livestock Ranching	Livestock
6. Bone Crushing	Glue, gelatine, bone meal, bone flour, crush bone, oil grease and tallow.
7. a. Deepsea trawling and processing	Preserved sea foods, fish and shrimps, fishmeals
b. Coastal fishing and shrimping c. Inland lake fishing and processing	Refined edible salt (sodium chloride); crude salt
8. Manufacture of salt	
9. Mining of lead/zinc ores by underground mining methods	Lead-zinc ores
10. The manufacture of iron and steel from iron ore	Iron and steel products

11. Manufacture of products made wholly mainly of metal	Pipes and tubes, Nuts, or Bolts, Rivets, Washers, Screws, Nails, Wire, Extruded metal sections
12. Manufacture of machinery involving local manufacture of a substancial proportion of components thereof	Office and industrial machinery equipment and apparatus (whether or not electrical)
13. Manufacture of goods made wholly or partly or rubber	Tyres, tubes, compounded rubber sheeting camelback, rubber solution, rubber flooring compound, rubber flooring
14. Manufacture of nets from local raw materials	Fishing nets, mosquito nets and related products
15. The processing of local wheat-flour milling	Flour and offal
16. Oil palm plantation and processing	Palm oil, palm kernel, offals
17. Rubber plantation and processing	Rubber
18. Gum Arabic plantation and processing	Gum Arabic
19. Integrated wood projects	Furniture, decorative veneer, blackboard, particle board, sawn-timber, plywood
20. Manufacture of fertilizers	Superphosphate and nitrogenous fertilizers
21. Commercial vehicles manufacture	Commercial vehicles

B. *Approved User Scheme*

The scheme was based on the recommendation of a commitee set up to advise on the stimulation of Nigerian industry by giving it relief from import duty and tariff protection. The scheme allows for either exemption from import duty or grants a concessionary low rate of import duty on materials brought into Nigeria for use in the manufacture or processing of goods or in the provision of services, provided that certain conditions are fulfilled.

To qualify for relief under the Approved User Scheme an applicant must satisfy the Federal Government that it is impossible to provide the goods or services in question at prices low enough to compete with the imported equivalent; or that the imported finished article bears a lower proportion of import duty than the materials imported to manufacture the same article in Nigeria.
The Federal Government must also be satisfied that any relief to be made is to the overall economic advantage of Nigeria having regard to certain criteria.

As with income tax relief, import duties relief is intended as a measure of temporary assistance in order to enable a new industry to become established in Nigeria, or for an already established industry to be developed on a scale suitable to the country's overall economic requirements.

The exemption from import duty or a granting of a concessionary lower rate of import duty may not apply to any articles which are manufactured locally and which an approved manufacturer can purchase from this source but which he chooses to import. benefits under Approved User Scheme can be varied by budgetary announcement and embodied in tariff amendments

C. *Companies income Tax Act (Accelerated Depreciation)*

This Act grants to companies a much quicker write-down of their capital assets in the early years of production so as to enable them to amortise their capital assets during their formative years and so build up liquid reserves at an early date. The capital allowances involved are as follows:

Qualifying Expenditure in respect of	Initial Allowance %	Annual Allowance %
a) Building Expenditure	5	10
b) Industrial Building Expenditure	15	10
c) Mining Expenditure	20	10
d) Plant Expenditure (excluding furniture and fittings)	20	10
e) Furniture and Fittings	15	10
f) Motor vehicle Expenditure	25	10
g) Plantation Equipment Expenditure	20	33,5
h) Housing Estate Expenditure	20	10
i) Ranching and Plantation Expenditure	25	15
j) Research & Development Expenditure	75	12.5

This act has been also amended in order to encourage potential and existing investors and entrepreneurs. Henceforth the following reliefs and regulations shall apply:

a) Corporate Tax Rate is 40% from 1987

b) Penalty for failure to pay on due date is 10% per annum of the outstanding amoung

c) Section 49(3) of the companies Income Tax Act requires companies to submit detailed tax computations along with their returns and audited accounts and Industrial Inspectorate Department Acceptance Certificate;

d) When tax payer wants to appeal against a court decision, the disputed tax shall be paid. The body of Appeal Commissioners as well as the courts have been empowered to impose a penalty of 10% where an appeal proves to be frivolous or groundless,

e) Power to obtain information by a tax authority on banks' customers which has been provided in the Income Tax Management Act is also applicable to Companies Income Tax Act 1979.

D. *Approved Status*

Foreign investors in the Nigeria economy are required to obtain Approved Status for their original investment in order to ensure future unimpeded repatriation of their capital, dividends, etc. Approved Status is a recognition that the original investment comes into the country from

abroad in the form of equity either by way of cash and/or parts, equipment and machinery. Approved Status can be granted in principle or as final.

E. *Tax relief for Research and Development*

Industrial establishment are expected to engage in Research and Development (R&D) for the improvement of their processes and products. Up to 120% of expenses on R&D are tax deductable, provided that such R&D activities are carried out in Nigeria and are connected with the business from which income or profit is derived. For the purpose of R&D on local raw materials, 140% of expenses are allowed. Where the research is long term, it will be regarded as a capital expenditure and will be written off against profits. In administering this tax relief, the Federal Ministry of finance shall consult the Federal ministry of Science and Technology to determine the genuinity of such R&D activities. The results of such research could be patented and protected in accordance with internationnaly accepted industrial property rights.

F. *Tax relief for Investments in Economically Disadvantaged Local Government Areas*

Entrepreneurs who invest in economically disadvantaged local government areas are entitled to special income tax and other concessions. These include:

a) Seven years income tax concessions under the pioneer status scheme

b) Special concession by relevant State Governments

c) Additional 5% over and above the initial capital depreciation allowance under the Company Income Tax Act (Accelerated Capital Depreciation)

For the purpose of administering these incentives, the country has been grouped into the following zones:

Zone 1 Industrially and economically developed Local Government Areas

Zone 2 Less industrially and economically developed Local Government Areas

Zone 3 least industrially and economically developed Local Government Areas

Less industrially and economically developed and least industrially and economically developed Local Government Areas are defined in terms of inadequancies of:

- industrial production in gross and per capital basis available

- social and economic infrastructures

- level of labour market development

G. *Double Taxation (Income Tax Act 1979)*

By Decree No. 4 1985 (Miscellaneous Taxation Provisions) the Income Tax Act of 1979 was amended. The effect of the amendment was to eliminate double taxation on investment income.

6.2 FISCAL POLICY

Nigeria's fiscal policy has barely enough time to reflect national development imperatives after attaining political independence when the oil sector assumed prominence in the national economy.

With the rapid escalation of oil prices and the resulting oil boom, the need to adopt a fiscal policy designed to promote saving and investment was not ascribed the importance it deserved in a developing country.

A critical look at the existing structure of taxation in Nigeria would show that the country's fiscal policy has not been geared towards the encouragement of induviduals to save and invest. Personal income tax is so progressive on the total net income that it gives no preferential treatment to savings. The emphasis of the existing taxation policy, on the ability to pay and the resulting highly progressive taxation turns out to be detrimental to initiative and effort.

In 1987 some adjustments in income taxes have been made in order to enhance disposable income.

The maximum tax rate to be paid was lowered from 70 per cent to 55 percent, but in the final analysis, the tax relief did not seem to amount to much, since the real benefits from the reductions in the tax rates would benefit mostly those within the range of taxable income of N. 30,000 and above to which very few employees, and probably none in the public sector, belonged.

Current income tax structure is given int he following table.

Income to be taxed		Rate of Tax	Per cent
For every naira of the first	N 2,000	10 K per N	10
For every naira of next	N 2,000	15 K per N	15
For every naira of next	N 2,000	20 K per N	20
For every naira of next	N 2,000	25 K per N	25
For every naira of next	N 2,000	30 K per N	30
For every naira of next	N 5,000	35 K per N	35
For every naira of next	N 5,000	40 K per N	40
For every naira of next	N 10,000	45 K per N	45
For every naira of next	N 10,000	50 K per N	50
For every naira of income over	N 40,000	55 K per N	55

Similarly, in the interest of savings and investment, the existing tax incentive on dividends is rather restrictive. The tax exemption is restricted to profits accruing the foreign capital participation only and also discriminates against certain productive and essential sectors.

For the free dividends, an individual or company deriving dividends from any company enjoys tax free dividends for 3 years if:

1) the paying company is incorporated in Nigeria;

2) the equity participation is imported into Nigeria between 1st January 1987 and 31 December 1992;

3) recipient's equity in the company constitues not less than 10% of the company's share capital.
In addition to (1), (2) and (3) above, if the company paying the dividends is engaged in agricultural production within Nigeria or processing of such Nigerian agricultural products produced within Nigeria or the production of petrochemicals or Liquefied natural Gas, the tax free period shall be 5 years.

Relatedly, the present witholding tax of 15 percent on dividend and interests appears to be contradictory to the objective of promoting savings and investment for rapid economic recovery and growth.

As for companies income tax, the taxation of company profits in Nigeria is also capable of discouraging investment. Corporate savings and investment account for a considerable proportion of the national production effort. Considering Nigeria's economic environment, companies have been penalised by a corporate tax rate of 40% (lowered in 1987 from 45%) that didn't encourage them to meet the investment challenges of SAP and to play an effective tole in the national effort at privatization.

In the area of indirect taxation, considerable progress has been made towards evolving an appropriate tariff structure in line with the current imperatives of the national economy. The new tariff structure has been designed to provide reasonable levels of protection to domestic industries. Some stability has been built into it in the sense that a new tariff measure is expected to last for a period of seven years.

Non-essential items have been prohibited from being imported into the country, and all imported commodities which have local substitues now attract extra landing charges equivalent to the excise duty on such local substitutes. This is designed to remove the disadvantage imposed by excise duty on locally produced goods.

Most excisable items are final and luxury goods. The number of such excisable products has been reduced from 412 to 182. All intermediate products have been removed from the excise list. It is hoped that this trend will be maintained until the tariff structure that will best serve the purpose of economic recovery and growth is evolved.

6.3 TARIFF POLICY

As part of the SAP framework, in 1987-1988 Nigeria developed a more liberal import policy and a comprehensive set of incentives to encourage exports.

In accordance with the SAP's principles, the Nigerian government abolished import and export licences, dissolved Nigeria's six agricultural boards, ended most price controls and reduced the list of banned imports from 74 to 18 product (Tab. E.3.1)[1].

Tab. E.3.1

SCHEDULE 3

IMPORT PROHIBITION LIST (TRADE)

1. Cigarettes (2402.10 to 2002.90)

2. Live or dead poultry, that is, fowls, ducks, geese, turkeys and guinea fowls excluding grand-parent and foundation stocks for research and multiplication purposes (0105.11 to 0105.99 and 0205.10 to 0205.50).

3. Vegetables, including tomato puree and paste, roots and tubers, fresh or dried, whole or sliced cut or powdered and sago pitch (0604.99, 0701.10 to 0714.90, 2001.10 to 2005.90, 2103.20).

4. Processed wood (4404.00, 4407.10 to 4413.00) excluding wood in the rough, roughly squared or half squared but not further manufactured (4401.10 to 4403.99). Furniture and furniture products (9401.10 to 9401.90) 9403.10 to 9406.00).

5. Eggs in the shell, including those for hatching (0407.00).

6. Fruits fresh or preserved and fruit juices (0801.10 to 0814.00, 2006.00 and 2008.11 to 2008.99)(2009.11 to 2009.90).

[1] In 1989 the government budget revised customs restrictions, with the removal of cigarette, jewellery and particle boards from the list of prohibited items. They will, however, attract high rates of duty, at 200, 100 and 50 per cent respectively.

7. Textile fabrics of all types and articles thereof Chapter 50 to 63 but excluding.
   a) Nylon Tyre cord (5902.10 to 5902.90);
   b) Multifilament Nylon chafer fabric and tracing cloth; (5111.20 and 5112.20; 5901.10 to 5901.90);
   c) Fire resistant mattress tickings (5903.10 to 5903.90)
   d) Narrow fabrics of 5906.10 to 5806.40 trimmings and linings of (5903.10 to 5903.90, 5908.00, 5808.10 to 5808.90).
   e) Mosquito netting materials; (5608.19 and 5608.90);
   f) Gloves for industrial use (6116.10 to 6116.99);
   g) Made-up fishing nets (5608.11);
   h) Canvas Fabric for the manufacture of fan belt (5907.00 and 5908.00)

8. Domestic articles and wares made of plastic materials excluding babies's feeding bottles (3918.10 and 3918.90, 3922.10 to 3922.10 and 3924.90).

9. Evian and similar waters, hot drinks and beverages, Beer and Stout (2201.10 to 2203.00), malt and barley (1003.00 and 1107.10 - 1107.20)

10. Articles of jewellery and precious metals (7112.10 to 7118.90).

11. Rice and rice products (1006.10 to 1006.40)

12. Maize and maize products (1005.10 to 1005.90)

13. Wheat and wheat products (1101.00 to 1103.29)

14. All sparkling wines including champagne (2204.10 to 2204.29)

15. Gaming machines (9504.10 and 9504.30)

16. Vegetable oils excluding linseed and castor oils used as industrial raw materials 1515.11, 1515.19 and 1515.30

17. Aluminium sulphate including alum (2833.22 and 2833.30)

18. Retreated and used tyres (4012.10, 4012.20 and 4012.90)

Tab. E.3.1 bis

SCHEDULE 4

GOODS: THE IMPORTATION OF WHICH IS ABSOLUTELY PROHIBITED

1. Air pistol

2. Airmail photographic printing paper

3. Base or counterfeit coin of any country

4. Beads composed of inflammable celluloid or other similar substances

5. Blanck invoices

6. Coupons for foreign football pools or other betting arrangementss

7. Cowriers

8. Exhausted tea or tea mixed with other substances. For the purposes of this item, "exhausted tea" means any tea.

9. Evian and similar waters, soft drinks and beverages, Beer and stout (2201.10 to 2203.00), malt and barley (1003.00 and 1107.10 - 1107.20)

10. Articles of jewellery and precious metals (7112.10 to 7118.90)

11. Rice and rice products (1006.10 to 1006.40)

12. Maize and maize products (1005.10 to 1005.90)

13. Wheat and wheat products (1101.00 to 1103.29)

14. All sparkling wines including champagne (2204.10 to 2204.29)

15. Gaming Machines (9504.10 and 9504.30)

16. Vegetable oils excluding linseed and castor oils used as industrial raw materials 1515.11, 1515.19 and 1515.30

17. Aluminium sulphate including alum (2833.22 and 2833.30)

18. Retreaded and used tyres (4012.10, 4012.20 and 4012.90)

19. Spirits

1) Other than
a) alcoholic bitters, liqueurs, cordials and mixtures admitted as such in his discretion by the Director
b) brandy, i.e. a spirit
i) distilled in grape-growing countries from fermented grape juice and from no other materials, and
ii) stored in wood for a period of three years
c) drugs and medicinal spirits admitted as such in his discretion by the Director
d) gin, i.e. a spirit
i) produced by distillation from a mixed mash of cereal grains only saccharified by the diastase of malt and then flavoured by re-distillation with juniper berries and other vegetable ingredients and of a brand which has been notified as an approved brand by notice in the Gazette and in containers labelled with the name and address of the owner of the band;
or
ii) produced by distillation at least three times in a post-still from a mixed mash of barley, rye and maize saccharified by the diastase of malt and then rectified by re-distillation in a postestill after the addition of juniper berries and other vegetable materials;
e) methylated or denatured spirits, i.e.
i) mineralised methylated spirit mixed as follows: - to every ninety parts by volume of spirits nine and one-half parts by volume of wood naphtha and one part by volume of crude tyridine and to every 445 litres of the mixture 1.7 litres of mineral naphtha or petroleum oil and not less than 0.7 grammes by weight of pwdered aniline dye (methylviolet) and so in proportion for nay quantity less than 445 litres; and
ii) industrial methylated spirits imported under licence from the Director and mixed as follows.
to every ninety-five parts by volume of spirits five parts by volume of wood naphtha and also one-half of one parts by volume of the mixture; and
iii) spirit denatured for a particular purpose in such manner as the Director in any special circumstance may permit;
f) perfumed spirits;
g) rum, i.e. a spirit
i) distilled direct from sugar-cane products in sugar-cane frowing countries; and
ii) stored in wood for a period if three years
h) spirits imported for medical of cientific ourposes, subject to such conditions as the Directory may prescribe;

i) spirits totally unifit for use as potable spirits admitted to entry as such int he discretion by the Director; and
j) whisky, i.e. a spirit
i) obtained by distillation from a mash or cereals grains saccharified by the diastase of malt; and
ii) stored in wood for a period of three years.

2) Containing more than forty-eight and one-half oer centum of opure alcohol by volume except denatured, medicated and permed spirits, and such other spirits which the Director, in his discretion, may allow to be imported subject to such conditions as he may see fit to impose.

A comprehensive tariff review to formulate proposals for a more permanent, lower and uniform structure of tariffs and excise duty was completed in December 1987. To avoid imposing undue hardships on existing enterprises from a sudden change in tariffs, and to provide producers and consumers with a longer policy time horizon within which to make decisions, the new tariff schedule has been phased over a period of 7 years (Annex A).

The Government has also transferred the duty assessment and collection functions from the Customs and Excise Department to the banking system. The overall tariff strcture is a significant improvement in terms of providing a more certain policy environment within which to make decisions and appropriate signals to investors on efficient resource allocation.

protection of domestic industry has been ensured not only by setting up a high tariff wall but also by promoting a series of imprtant incentive measures for the exporting enterproses.

These incentive measures have been given legal backing by the Export (incentives and Miscellaneous provisions) Decree N. 18 of 11th July, 1986. The incentives under reference are:

1) Currency retention scheme

An exporter is allowed 100% retentions of his foreign exchange earnings in his domicialry bank account in Nigeria. The amount so retained may be used to pay for specified export-related activities.

2) Export development fund

The export development fund shall be used to provide financial assistance to private exporting companies to cover part of the initial expenses in respect of export promotion activities.

3) Export expansion grant fund

The export expansion fund shall be used to provide cash inducement for exporters who have exported a minimum of N 50,000 worth of semi-manufactured products.

4) Export adjustment scheme fund

An export adjustment scheme fund has been established to serve as a supplementary export subsidy. Proceeds will be used to compensate exporters for:

a. high costs of production arising from infrastructural deficiencies;

b. purchasing commodities at prices higher than prevailing world market prices by fixed by government;

c. other factor-beyond the control of the exporter.

5) Re-discounting of short-term bills for export

This facility will enable all exporters to re-discount their short-term bills under a scheme provide for in the Central Bank of Nigeria (CBN)(Amendment) Act 1967.

6) Import duty drawback

Under the Customs (duty drawback) Regulations 1959, importers can claim repayment of import duty paid for materials used in producing export goods. Repayment will be made in full if materials are imported for use in the production of goods which are exported. In the case of certain composite goods which contain wholy or partly duty-paid ingredients, the Customs and Excise Department may grant bonafide applicants a "fixed rate" drawback on proof of exportation of such goods or their disposal in an approved manner. The objective of the duty drawback is to encourage the production of various export goods as a means to diversify the economy away from oil. To encourage non-oil export development and to enable exporters complete effectively on international markets, a duty drawback scheme involving duty suspension for qualifying exporters backed by bankers' guarantees, has been put in place.

7) Capital allowance

An additional annual capital allowance of 5 per cent is given on plant and machinery for "manufacturing exporters" (those that export at least 50 per cent of their annual turnover) provided that the product has at least 40 per cent local raw materials content or 35 per cent value added.

8) Tax relief on interest income

The Companies Income Tax Act 1979 has also been amended to grant tax relief on interest accruing from any loans granted to aid investment in export-oriented industries.

9) Export credit guarantee and insurance shceme

In order to make Nigerian products complete effectively in the international market as well as to ensure genuine exporters against some political and other risks including default in payment, the government has approved the establishment of an export credit guarantee and insurance scheme. Exporters will also be in a position to grant their customers some credit facilities.

7. IDENTIFICATION OF INVESTMENT OPPORTUNITIES

The following aspects of the economic policy will play an important role in the selection of the projects the NIDB may be considering for the implementation of its Investment Programme of Industrial Transformation.
They are:

a) The shortage of foreign exchange, as a major constraint to industrial development financing. Industries, in need of foreign currency necessary to import raw materials and spare parts are obliged to participate in auctions, which, most of the times do not succeed in providing the amounts required and always result in increasing the rate of exchange.

b) The current strong emphasis of Government's industrialization policy on the promotion of small and medium scale industries, which NIDB must reflect in its operations.

c) The current privatization policy of the Government which implies that the private sector has an increasing role to play in the industrialization process. The difficulties in getting foreign currency and the high interests requested by the banks for the loans, however, will discourage many potential investors.

d) The existing sources of funds for industrial financing which impose a ceiling on the size of projects that could benefit such as NERFUND, SME and NIDB's other sources such as ADB.

SECTION 2

AGRO-BASED SUB-SECTOR ANALYSIS

TABLE OF CONTENT

5r./51/52

AGRO-BASED INDUSTRIES

Nigeria is primarily an agrarian economy. Agriculture was the main stay of the economy and the major earner of foreign exchange before the oil boom. Despite the large scale neglect of the sub-sector during the oil euphoria, it still accounts for over 30 per cent of the G.D.P. The potential for self sufficiency, export creation and employment expansion in the sub-sector is very considerable. There has been a reawakening to this potential in recent years following the economic recession. The expansion of the sector has featured prominently in the SAP economic reform objectives. It is the new policy of the Federal Government to expand agriculture for self-reliance in food production, supplying raw materials to the agro-allied industrialized sub-sector and generation of adequate surplus to boost non-oil exports.

Incentives are being given to the sector and there are strong indications already that the response is positive. Peasant output is improving, while plantation agriculture is expanding.

The existing linkage between the agricultural and industrial sectors of the economy is extremely weak. Now that agriculture is improving, manufacturing has to respond by processing agricultural produce for the mutual benefit of the two sectors.

Such linkage will reduce the import-dependence of the local manufacturing sector and will minimize the loss of agricultural produce during and after harvest, due to inadequate storage facilities.

In the following chapters some agro-based industries will be explored for investment opportunities. The analysis will include, whenever possible, information on the international situation, mainly in those countries having environmental conditions similar to those of Nigeria.

A. OIL PALM

A.1 OUTLOOK OF OIL PALM IN THE WORLD

A.1.1 ENVIRONMENTAL CONDITIONS

The oil-palm (*Elaeis Guineensis*) is an African tree growing in a belt situated between latitude 16 degrees North and 12 degrees South of the Equator.

In the following presentation, the term oil-palm stands for tree, while palm oil stands for the extract in general.

The original world distribution of oil-palm trees which was mainly in West Africa is now changed, as two countries Malaysia and Indonesia alone produce 75% of palm-oil world production. Among African countries the most important are Ivory Coast, Cameroon, Benin, Zaire and Nigeria.

A.1.2 VARIETIES AND GRADING

The wild grove oil palm may reach even 25 meters high. Farming subspecies are limited to about 12 meters to facilitate exploitation.

Varieties are more morphological subspecies related to the site origin: oil palms have been spread in Central and South America (North Brazil, Guyana, Mexico, Costa Rica, Columbia) in the Antilles, in South East Asia (Malaysia, Indonesia).

Quality of palm-oil is graded according to physical and chemical characteristics. The most important one, the "free fatty acid content", indicates whether the extracted oil is edible or not.It is expressed in percentage and a palm oil is considered edible if free fatty acid content is lower that 5%; in some cases it may reach as much as 15 % .

Oil palm fruit is formed by two main parts:

- the pulp which is the fleshy part of the fresh fruit surrounding the kernel

- the kernel.

Oil may be extracted from both parts:

- the pulp oil content may be in a range between 40 and 70 % of total weight according to variety.

- the kernel extracted oil stays in a range between 48 and 51% of total weight.

World-wide clones rich of pulp and small kernel size are predominant. Only recently kernel oil is regarded with more interest for margarine and other food industries. Kernel oil, being a lauric-acid oil, has also a wide use in industry, mainly detergents and synthetic rubbers.

A.1.3 AGRONOMIC CONSIDERATIONS

Oil palm is comparatively a very interesting tree crop for oil extraction: one hectare of Oil Palm extracts as much oil as 6 hectares of Ground-Nuts or 10 to 12 hectares of Soyabeans.

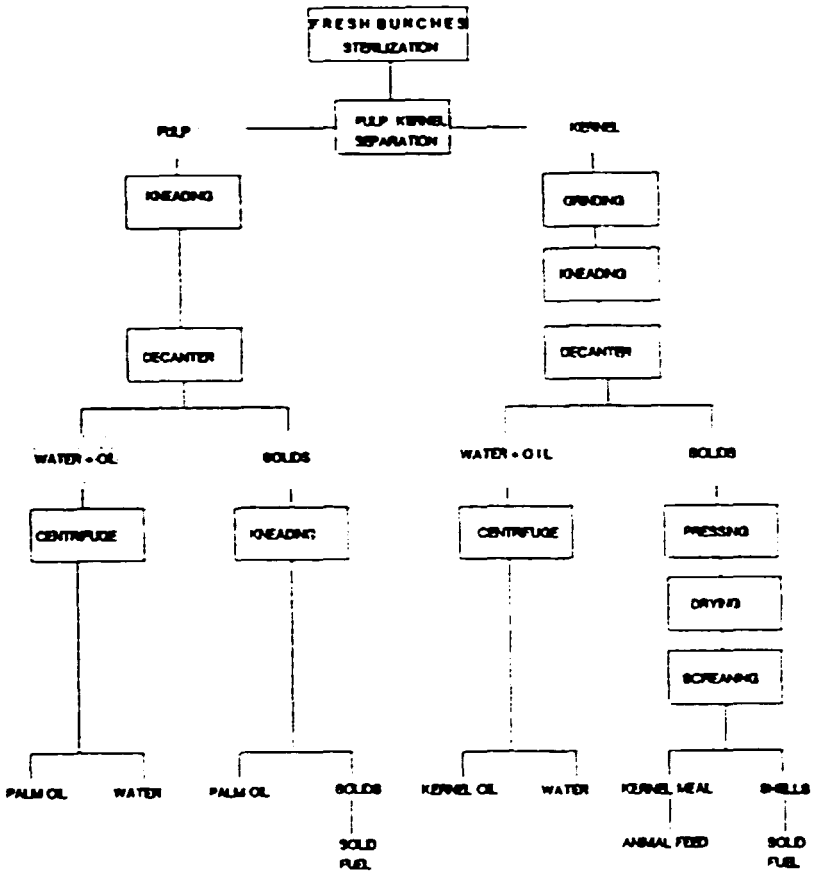
Selected varieties in Malaysia reach yields above 25 Tons/ha of Fresh Fruit Bunches (FFB).

A.1.4 PROCESSING AND MAIN PRODUCTS

The fruits of the oil palm are often processed locally in the origin countries, whilst the palm kernels are exported to the countries where the oil is consumed. Oil is extracted by means of presses or solvent.

Margarine is the major use of the palm-oil in the food industry, soap & detergents manufacturing comes next.

A.1.4.1 Processing flow-diagram (for palm-oil and palm-kernel oil)



A.1.5 WORLD PRODUCTION & TRADE

Palm & Palm kernel oil world production , excluding USSR & China, is estimated in 1985(1)

- Palm Oil	1,200,000 tons/year
- Kernel Palm oil	400,000 tons /year

Published prices in May 1989 were the following:

- Palm Oil(Malaysia-Sumatra)	400 $/Ton Cif London
- Palm Kernel Oil (Malaysia)	530 $/Ton Cif London
- Palm Kernel (Nigeria)	250 $/Ton Cif London

(1) Source: Stock Exchange Bulletin Commodity Year Book

A.2 OIL PALM IN NIGERIA

A.2.1 ASSESSMENT OF OIL PALM PLANTATIONS IN NIGERIA

The climatic conditions of Nigeria are generally favourable to oil-palm, that grows in the whole Southern Nigeria. The oil palm belt includes the States of Oyo, Ogun, Lagos, Ondo, Bendel, Anambra, Imo, Rivers, Akwa-Ibom, Cross River and Benue. The estimated land surface of the oil palm plantations, shared into wild grove, Government estates and smallholdings are shown in the following table, along with the palm potential produces, referred to year 1985.[2] .The second table herebelow shows the estimated land surface and potential palm-oil and kernel-oil production per State, referred to year 1985.[3](FFB = Fresh Fruit Bunches)

	hectares	FFB tons	palmoil tons	p.kern.oil tons	Total oil tons
Wild grove	2,400,000	4,800,000	432,000	240,000	672,000
Government Estates	71,891	718,410	143,682	35,920	179,602
Smallholders	96,782	938,792	187,756	46,940	234,696
100% exploitation		6,457,202	763,438	322,860	1,086,298
70% exploitation		4,520,041	534,406	226,000	760,408

	Wild Grove			Government Estates			Small holdings		
States	Land Surface (ha)	Yield (Ton of ffb) (a)	Potential Palm-oil product. (Ton) (b)	Land Surface (ha)	Yield (Ton of ffb) (c)	Potential Palm-oil product. (Ton) (d)	Land Surface (ha)	Yield (Ton of ffb) (e)	Potential Palm-oil product. (Ton) (f)
Anambra	250,000	500,000	45,000	2,572	25,720	5,144	9,049	87,775	17,555
Cr.River	600,000	1,200,000	108,000	17,491	174,910	34,982	46,555	451,583	90,316
Rivers	160,000	320,000	28,800	12,657	126,570	25,314	7,095	68,821	13,764
Imo	450,000	900,000	81,000	8,119	81,190	16,238	24,727	239,853	47,970
Bendel	115,000	230,000	20,700	14,459	144,590	28,918	5,916	57,385	11,477
Ondo	90,000	180,000	16,100	11,688	116,380	23,276	1,610	15,617	3,123
Ogun	150,000	300,000	27,000	4,498	44,980	8,996	1,134	11,000	2,200
Benue	135,000	370,000	33,300	407	4,070	814	293	2,842	568
Oyo	400,000	800,000	72,000				404	3,998	783
TOTAL	2,400,000	4,800,000	432,000	71,891	718,410	143,682	96,783	938,792	187,756

The following assumptions were taken into consideration in the above tables:

For wild grove oil palm:
a) yield = 2 tons FFB/hectare
b) extraction rate = 9% for palm-oil; 5% for kernel.
For Government estates:
c) yield = 10 tons FFB/hectare
d) extraction rate = 20% for palm-oil; 5% for kernel.
For smallholders' plantations:
e) yield = 9,7 tons FFB/hectare
f) extraction rate = 20% for palm-oil; 5% for kernel.

[2] Source: Ferderal Department of Agriculture, Benin City, Nigeria
[3] Source: Monitoring and Evaluation Unit Annual Report 1986

A.2.2 AVERAGE YIELD IN NIGERIA

Although soils, rainfall, temperature and sunshine hours in Nigeria are generally favourable to oil-palm, the maximum actual yield for the plantations range from 8 to 14 tons of fresh fruit bunches (FFB) per hectare (against 25-30 in Malaysia) .

The main deficiencies which lead to the low yields of the Nigerian oil palm plantations can be summarized as follows:

- potassium and nutrients deficiency of the soil;
- dry season, involving water deficit in the range of 200-400 mm. per year. In Malaysia rainfall is more evenly distributed over the year.
- average sunshine hours are rather low and delay fruit ripening thus reducing the oil content;
- infestation of the plantations by noxious weeds, specially the "*Eupatarium Odoratum*", which seriously compete with the oil palm for soil nutrients;
- intercropping with food crops carried out by smallholders. This practice prevents the spread of noxious weeds, but reduces significantly the yield.
- with regard to the wild palm grove (dura species), which does not require any husbandry, farmers harvest only when the prices are attractive.

Excluding soil deficiencies which could be to some extent counteracted by fertilizer applications, the other natural environmental constraints mean that, even under the best of husbandry practices, Nigeria unfortunately cannot compete with Malaysia.

A.2.3 EXTENSION OF ESTATES

As far as the smallholders are concerned, the estimated average area of plantations is 1.5-2.0 hectares. The State estates are much larger, reaching in some cases thousands of hectares (above 15,000 ha. for Risonpalm Estate owned by the Rivers State Government). State estates are generally equipped with its own oil milling plant.

A.2.4 QUALITY OF THE PRODUCTS

A.2.4.1 Varieties present in Nigeria

The main varieties of the oil palm are two:

- "*Dura*", which is the wild grove palm, naturally growing in the tropical forest belt.
- "*Tenera*", which has been more recently planted in the State estates and in the smallholders' plantations.

The average weight of oil extract and kernel referred to the relevant FFB weight:

Variety	Palm oil	kernel
Tenera	20%	4%
Dura	9%	5%

Kernel oil extracted from kernel reaches 40 % of weight in both cases.

A.2.4.2 Quality of the palm-oil

At present a lot of smallholders press their own palm fruits into oil by means of very simple machinery. This kind of processing goves low yields and poor quality of the oil extracted (oxidation, unrefined oil) and consequently the market prices are rather low.

A.2.5 FEDERAL AND STATE POLICIES

Nigeria's constitution makes the States responsible for agricultural development, eventhough in practice the Federal Government has a major role by establishing overall sectorial policies and by funding specific programs through various organisms. One of its Departments, the Federal Department of Agriculture (FDA) has a Tree Crops Division which formulates programs and oversees the implementation of tree crop development, in which the oil palm is included. As a consequence of its statement on Agricultural policy of January 1987, the Federal Government banned the import of a wide range of agricultural commodities, to promote self-sufficiency. Other policy measures included the abolition of the agricultural tariffs to improve incentives for private sector activity. In January 1989 the Federal Government published a new list of banned items, reaffirming the ban on imports of vegetable oil, with the purpose of stimulating local vegetable oil production. Special loans have recently been made to palm oil and palm kernel c mills. New interventions in the oil-palm sector have been planned in recent years by the Federal Government together with the Nigerian Development Bank (NIDB), the World Bank and the FAO.

It is worth mentioning that the World Bank prepared a Tree Crops Project, designed to assist in meeting shorter-terms needs for increasing processing capacity in both palm oil and rubber, medium-term needs for rehabilitation and longer-term needs for planting higher yielding oil palm. The project is detailed described in a report published in 1988.

The public sector will be co-ordinated by ADAPALM (see page 63), whilst the extension units and agencies will be controlled by State Governments in each of the 10 Southern concerned States. According to these recent projects 10,000 hectares of mono crop oil palm plantations will be newly planted. Additional 30,000 intercrop hectares will be replanted.

A.2.5.1 National Research Institutes

NIFOR, the Nigerian Institute for Oil Palm Research, which was established in 1939 under the supervision of the Ministry of Science and Technology, carries out its support for oil palm and other tree crops development. Its aim is to undertake research, to provide planting materials and techniques and to develop low-cost technologies for processing palm fruit which ensure high extraction rates of good quality palm-oil. Furthermore NIFOR produces sprouted seeds of good quality to supply State and plantation nurseries.

A.2.6 AGRONOMIC CONSIDERATIONS

A.2.6.1 Fertilizers

Potassium and nitrogen are important for oil palm fruiting. In the Southern Nigerian soils are generally low in nutrients and potassium deficiency is common. Presently oil palm plantations use very little quantity of fertilizers. FAO (Food and Agriculture Organization) recommends the following rates:

type of fertilizer	1st year kg/ha	2nd year kg/ha	3rd year kg/ha
ammomium sulphate	130	130	260
sulphate of potash	100	130	260

A.2.6.2 Parasites

The most serious problem in growing oil palm is the invasion of weeds, particularly "*Eupatarium Odoratum*". A minor problem is the control of leaf diseases and pests. Chemical treatment of weeds is effective but expensive. In order to reduce costs, however, manual control of "*Eupatarium*" can be effective with early establishment of leguminous cover crops soon after mechanical land clearing. In some areas of Nigeria a little coleopter "*Coelaenomenodera elaeidis*" is noxious for the palm leaves.

In Nigeria fungicides are normally needed in the monocrop plantations, just as in the early years. This is an advantage for Nigeria against S-American and S-E Asian, that may favour to a certain extent oil palm rehabilitation in Nigeria.

A.2.6.3 Mechanization and Irrigation

At present, mechanization is rarely used in the wild grove plantations. Smallholders generally don't have any mechanical equipment and only rare private farms, as wide as 20 hectares or more may have some old tractors. A limited number of State holdings do have tractors and trucks. With regard to the extension programs of existing oil palm plantations and to replanting, the main equipment to be foreseen consists in 60-70 HP tractors, at a rate of one unit for every 30-40 hectares.These tractors should be equipped with a trailer having 3-4 tons capacity. In order to improve the yield, irrigation is recommended during dry seasons. Water is supplied by artesian wells, one for every 50 hectares. Irrigation means such as pumps, pipes, and sprayers should also be foreseen.

A.2.6.4 Manpower

According to the FAO recommendations manpower required is as follows:

activity	manhour/ha/year	manhour/ha/year
- Felling and burning	150	
- Lining and pegging	5	
- Clearing of rows	7	7
- Holing	5	
- Planting	8	
- Fixing wire collars	3	
- Planting cover crop	8	8
- Maintenance	32	32
- Harvesting	0	25
-Total	218	72

A.2.6.5 Technical service

The oil-palm rehabilitation project will involve a training program for about 400 technicians over a period of 4-5 years, that means about 80 technicians per year. Each technician will cover about 250-300 hectares of plantations.

A.2.7 PALM-OIL PRICES AND REVENUES

A.2.7.1 Palm oil prices

Palmoil prices are referred to the weight of the Crude Palm Oil indicated as CPO. The millgate price jumped from 800 Naira/Ton in 1983 up to 1600 Naira/Ton in 1984. In 1986, world prices dropped to 217 $/Ton from 717 $/Ton in 1970, in constant 1985 prices, while in Nigeria prices remained around 2,000 Naira/Ton. In 1987, due to high imports, carry-over stocks, and over-production, prices in Nigeria fell to 1,300 Naira/Ton.

In 1988 prices in Nigeria came back to 2,000-2,200 Naira/Ton, which was almost 10 % higher than the corresponding 410 $/Ton CIF London.

The World Bank in its report of 1988 concerning the Tree Crops Project in Nigeria, projected prices, expressed in 1989 constant US $, as follows:

1989	448 $/Ton
1995	632 $/Ton
2000	617 $/Ton

A.2.7.1 Palm Kernel prices

In 1988, palm kernel prices reached 2,000 Naira/Ton (farm gate delivered) from 750 Naira/Ton in 1987 and 450 Naira/Ton in 1986. The corresponding export market price level was much lower than 1,400 Naira/Ton or equivalent to 210 $/Ton FOB Warri (the interbank exchange rate on the free market where palmoil proceeds were exchanged rose from 7 Naira/$ in the mid of the 1988 to 9 Naira/$at the end of the same year.

A.2.7.2 Palm Kernel oil prices

Palm Kernels harvesting in Nigeria became more diligent in recent years, with soaring of market prices, and with the increase of industrial demand by the food, the soap and detergents industries. Although it is less desirable for house cooking, it is also used for this purpose.

The table here under shows palm kernel oil prices in connection with the whole kernels:

years	palm kernel Naira/Ton	kernel oil Naira/Ton
1986	450	1600
1987(end)	750	2200
1988(mid)	2000	n.a.
1988(end)	1300	4,500

A.2.7.3 Palmkernel meal prices

With the ban of wheat, Palm kernel meal soared from 70 Naira/Ton in July 1986, to 300 Naira/Ton in 1987, up to 900 Naira/Ton in 1988. The latter is extremely high, considering that poultry dislike feed made from palmkernel meal. One major feed miller declared that poultry feed cannot have more than 5 % of palmkernel meal. Palmkernel meal is also used as fertilizer or exported at world market prices.

A.3 PALM-OIL PROCESSING IN NIGERIA

The whole palm produce, both palm-oil and palm-kernel oil, is locally consumed. The oil palm processing by-product is just the kernel cake, which is sold on the local market as animal feed. Other by-products from pressing of pulp and kernel are used as solid fuel in the steam generating units of the mills.

The following list shows the existing and potential entreprises based on palm oil products in Nigeria. The list reflects those known to NIDB [4].

No.	Name of Company	Location (state)	Product	Nominal capacity T/Y	Remarks
1	Okanata Nigeria Ltd.	*Ogugu Ankpa*	PO	650	
			& PK	500	impl. NIDB
2	Agro-Edibile Industries Ltd.	*Agbara (Ogun)*	Refined PO	8,250	impl. NIDB
3	Risopalm Ltd.	*Ubima (Rivers)*	PO	10,600	comm. oper.
4	Okitipupa Oil Palm Co. Ltd.	*Okitipupa*	PO & PK	30,000	comm. oper.
5	Anambra vegetable oil Co.	*Nnachi (Anambra)*	Refined PO	42,000	comm. oper.
6	Lever Bros. Nig. Ltd.	*Agbara (Ogun)*	Refined PO	14,600	comm. oper.
7	Vegetable oil of Nigeria Ltd.	*Lagos*	Refined PO	35,000	comm. oper.
8	Tempers and Gulders Nig. Ltd.	*Ijebu Ode (Ogun)*	PO	50,000	comm. oper.
9	Ferdinand Ind. Nig. Ltd.		PO	25,000	comm. oper.
10	Ibok Bros. Nig. Ltd.	*Ikot Ekpene(Akwalbom)*	PO	7,500	comm. oper.
11	Tip Top Inds. Nig. Ltd.	*Oyba-Ikeja*	PO	25,000	comm. oper.
12	Npalin Inds. Ltd.	*Port Harcourt (Rivers)*	Refined PO	25,000	comm. oper.
13	Kano State Oil & Allied Prod.Ltd.	*Kano*	Refined PO	20,000	comm. oper.
14	Ilodi (WA) Ltd.	*Onitsha (Anambra)*	Refined PO	5,000	apprais NIDB
15	Ladegbite Nig. Ltd.	*Oshogbo*	Refined PO	25,000	apprais NIDB
16	Senforce Nig. Ltd.	*Bendel*	Refined PO	25,000	apprais NIDB
17	Ugo Blessed Armstrong Trade & Inds. Ltd.				
18	Adamac Inds. Ltd.		PO	2,580	SEAA(NIDB)
19	Macmanuel Nig. Ltd.	*Olutomi (Ogun)*	Refined PO	8,250	P&P pipeline
20	Benso A-C Co. Nig.	*Ifo (Ogun)*	Palm oil	26,000	R&P pipeline
21	Agraline Ltd.	*Ijebu Igbo*	Refined PO	3,000	R&P pipeline
22	Anco Investments Co. Ltd.	*Ede (Oyo)*	PO	9,000	LAA (NIDB)
23	Ofagbe Farms Ltd.	*Ofagbe*	FFB process	24,000	R&P pipeline
24	Adeola Adekanbi Co. Nig.Ltd.	*Ilorin*	Palm Oil	1,700	P&D (NIDB)
25	Elefonsan Inds. Ltd.	*Ijesha*	PO&sunfl.O	1,800	LAA (NIDB)
26	Pamil Inds. Ltd.	*Abak (Akwa Ibom)*	PO	50,000	comm. prod.
27	United Oil Mills Ltd.	*Apapa*	PO	25,000	comm. prod.
28	Oil & Allied Prod. Co. Ltd.	*Ijebu Ode (Ogun)*	Refined PO PO & animal feed		
29	Davog Oil Mills Ltd.	*Akure (Ondo)*	PO & PK cake		comm. prod.
30	Edewor Vegetable Oil Ltd.	*Warri*	PO	200	comm. prod
31	Thomas Oil Inds. Ltd.	*Ode Remo (Ogun)*	PO & PK cake		comm. prod.
32	Food Oils Nig. Ltd.	*Ibadan (ogo)*	PO	100	comm. prod.
33	Origbo vegetable oil Co.Ltd.	*Sapele (Bendel)*	PO & PK cake		comm. prod.
34	Rivers veg. oil Co. Ltd.	*Port Harcourt*	Refined PO		comm. prod.

PO = Palm oil
PK = Palm Kernel
FFB = Fresh Fruit Bunches

[4] Source: Nigerian Institute for Oil Palm

A.3.2 REPORT ON SOME EXISTING PLANTS

A.3.2.1 Okitipupa Oil Palm Co. Ltd.

Okitipupa - Ondo State

This is a State owned Company, mandated to manage State owned oil palm projects and to develop new plantations in Ondo State. At early 1988 the total planted area was 11,174 hectares. These holdings were planted in 1960 and earlier, they are rather old and are due for felling and replanting.

Established in 1974, the mill lies along the Oluwa river.

The fresh fruit bunches (FFB) are transported to the plant by truck and by river boats, within a mean range of about 30 kilometres.
Collection of the FFB is carried out all the year through a peak from March to July.

The plant is operated 300 days/year on 3 shifts of 8 hours each. The nominal capacity is about 20 tons of FFB/hour, that will be increased up to 30. The actual capacity is estimated at 75%, due to difficulties in regards to the spare parts.

The total man-power is 3,000, out of which 80 clerks and 250 workers. There are some transport difficulties during the peak season, especially for fruits of the eastern bank estates, Apoi and Iyansan. The mill also has a palm-wine production and bottling plant that sells to local shops and supermarkets.

Machinery and equipment

Machinery, supplied by the Belgium Company SPEICHEM, is rather old and the whole plant is due for overhauling.
The main problem is the lack of spare parts.

A.3.2.2 Risonpalm Ltd.

Nuclen Estate - Ubima - Rivers State

This estate is entirely owned by Rivers State Government. The Risonpalm comprises two estates, Ubima and Elele. Ubima estate was started in 1978 and completed in 1985 and has a total planted area of 9,513 hectares. The declared yield is 14 tons FFB/hectare.

The Elele estate has a total planted area of 5,500 hectares, out of which about 3,050 of old oil palms scheduled for felling and replanting with improved "Tenera" hybrid.

The Nucleus estate of Ubima is served by a 40 ton of FFB/hour mill (nominal capacity), whilst there is no mill at Elele.

Risonpalm has a total manpower of 4,000, including clerks, workers and farmers. The mill employees 300 units on 2 shifts of 12 hours each, all through the year.

The mill processes its own fresh fruit bunches aas well as the ones purchased by the local small holders within a range of 100 kilometres.
The plant processes the palm fruit only and sells the kernel.

The management declared the following figures:

. Fresh Fruit Bunches cost	=	300 N/ton of FFB[5]
. Processing cost	=	about 3,000 N/ton of oil (estimated)
. Selling price	=	4,200 N/ton for palm oil 2,200 N/ton for kernel

Machinery and equipment

The process technology is rather old. Machinery was supplied by Usine de Wecker of Eindhoven. The installed power is about 500 kW.

The final products are refined palm-oil extracted by pressing and kernel oil.

The plant was completed in 1985 and at present has no serious problems.

A.3.2.3 **Adapalm (Nigeria) Ltd.**

Owerri - Imo State

The nucleus estate owned by Imo State Government with partial sharing of the Belgian Company SOCFINCO is located in Ohaji/Egbema. The Company was established in 1974.

It has 4,310 ha of oil palms and 3 processing mills with a otal capacity of 30 tons of FFB/hour distributed as follows:

1 nill of 20 t/h at Ohaji (this capacity will be increased up to 30 t/h) at Umnogu and 2 mills of 5 t/h each at Mbawsi. The last two mills have been financed by the World Bank.

While the 20 ton/hour mill at Ohaji depends on the nucleus estate for most of its FFB, the other two smaller mills depend on fruit collection from scattered small holders in parts of the state.

The mills process both dura and tenera varieties of fresh fruits, collected in the villages by means of own trucks.

Adapalm has contributed to the local oil palm sector development in a quite impressive manner. Furthermore Adapalm attends to the market policy, exporting the palm kernel.
The company produces only palm oil.

During 1987 it produced 11,000 tons of palm oil and 2,600 tons of palm kernel.

Machinery and equipment

Machinery and equipment of this plant are in very good condition.

At present no problems can be anticipated in regards to spare parts. It is expected that the Belgium partner will supply them.

(5) Source: Risonpalm Management price paid to small holders

A.3.2.4 Nalin Industries (Nigeria) Ltd.

Port Harcourt - Rivers State
Date of survey: April 1989

The industry is owned by a Nigerian private Company with equal foreign sharing. It is specialized in the palm oil refining and in the production of kernel oil. Raw materials are purchased from various states without problems.

The refining plant includes degumming, bleaching, deacidification and deodorizing.
Production started in 1985; in 1987 a modern kernel-oil extraction plant by pressing has been implemented. The plant operates all over the year on 3 daily shifts, employing 300 workers. Its nominal capacity is 150 tons/day for the refining and 150 tons/day for the kernel processing for oil production. The management declared the following figures:

. Raw material costs:

- palm-kernel	2,500-2,700 N/ton
- crude palm-oil	5,500-6,000 N/ton

. Production costs: not available

. Selling prices:

- refined palm kernel-oil	8,500 N/ton
- palm-kernel cake	80 US $/ton exported for animal feed production

Machinery and equipment

Machinery was supplied by DESMET Belgium and at present there are neither operation or maintenance problems, as the plant has been implemented recently.

Comments

The Nalin Industries are well managed and its profits should be very satisfactory as in few years a 5,411 hectares estate of oil palm and a 3,000 hectares of tree rubber have been purchased by tl Company. This demonstrates that palm-oil refining and kernel-oil production are a source of important revenues for the mills. These presently are lost, because most of the mills do not process the kernel, but simply sell it to the refining industries. New improved technologies, based on the oil-extraction by pressing instead of by solvent, will likely contribute to the diffusion of the kernel-oil extraction plants, bearing advantages to the local economy.

A.3.2.5 Anambra vegetable oil products Ltd.
Nachi Udi Anambra state

This factory has been established in 1987 at Enugu and produces margarine and shortening from palm-oil and kernel oil, along with washing and toilet soap. It includes an oil refining plant and is equipped with can filling and bottling section. The end products are the following, from an input of 42,000 tons/year of oil:

refined cooking-oil	22,000 tons
bakery shortening	15,000 tons
margarine	4,000 tons
washing soap	5,000 tons
toilet soap	2,500 tons

Taking into consideration the cost of raw material and processing versus the selling prices, this type of industry seems to be very profitable.

A.4. OIL-PALM RELATED INDUSTRIES IN NIGERIA

A.4.1 Palmoil Sulphonation

Sulphonation is a process used for producing active substances from palm-oil necessary for soap and detergents making. In Nigeria Soap & Detergents consumes 109,000 T/year of active matters, out of which only 42,000 T/year are obtained from processing alkylbenzene. The balance 67,000 T/year are imported. See sector CHEM in the Nigerian Industrial index (annex 1)

A.4.2 Margarine

The Nigerian installed capacity of Margarine processing units is not available. The consumption of margarine is related to the food industry which in Nigeria is very developed to satisfy the population. Beside Food Industry is also consuming palmoil in its other form. See sector FOOD in the Nigerian Industrial index (annex 1)

A.4.3 Poultry & Animal Feed

This industry consumes palmoil and palmkernel by products. The animal feed industry in Nigeria grew a lot in the past years. See sector AGRI in the Nigerian Industrial index (annex 1)

A.5 PALM OIL PRODUCTION/CONSUMPTION GAP FOR YEARS 1984-2000

This table prepared by NIFOR (Nigerian Institute for Oil Palm Research) shows the gap along the years between supply & demand of Palm Oil. Nigeria will increasingly rely on imports[6] unless adequate measures are taken.

	1,000 tons		
Year	A Estimated (potential) supply	B Estimated demand	Deficit (B - A)
1984	750	885	135
1985	770	918	148
1986	791	882	91
1987	812	887	75
1988	834	1024	190
1989	857	1061	204
1990	880	1101	221
1991	904	1141	237
1992	929	1184	255
1993	953	1227	274
1994	979	1273	294
1995	1005	1320	315
1996	1033	1369	336
1997	1060	1419	359
1998	1089	1472	383
1999	1110	1526	416
2000	1149	1583	434

[6] NIFOR assumptions of 2.7 % annual increase for palm oil production & of 3.7 % for domestic demand

A.6 OPPORTUNITY STUDIES

Two opportunities studies may be developped:

- *oil extraction plant*

- *oil sulphonating plant*

A.6.1 OIL EXTRACTION PLANT

A.6.1.1 Opportunity considerations [1]

Eventhough the gap between production and demand will be hardly filled in the future years, the projects promoted by Federal Authorities and International Bodies will increase oilpalm output. These projects are aimed to increase area under cultivation.

Most of the existing plants are technologically obsolete and their capacity saturated . The extracted palmoil is of low grade and palmkernels are generally exported.

New oil processing plant will increase output, improve oil quality, extract palm kernel oil instead of exporting palm kernels.

Major features of suggested plants are the following:

- extract both palm and palm kernel oils.
- preserve intrinsic oil characteristics and eliminate negative effects on oil grade due to preheating and oxygen actions. Avoid oil deterioration during decanting.
- no further refinement of the oil is required
- possibility of blending palm and palm kernel oils during pressing phase
- medium capacity to locate them close to plantations
- easy operation & maintenance

The project fully meets the Government Policy and requires an Investment not exceeding the ceiling imposed by Financing Agencies.

[1] See volume 2 for details on an opportunity study for the Production of Palm oil.

A.6.2 PALMOIL SULPHONATING PLANT [2]

A.6.2.1 Opportunity considerations

Sulphonation of palm oil is a two step process enabling to produce Active Matters to be used in the detergent and soap industry. First step is to produce Methylester from palm oil. The second step is its sulphonation to obtain Active Matters from methylester.

There are three sulphonating units in Nigeria (only second step) with a total nominal capacity of 109,000 T/year of Active Matters.

These units use a raw material linear Alkylbenzene produced in Nigeria by NNPC. Their output is below their nominal capacity because the raw material available is only 30,000 T/y corresponding to 42,000 T of Active Matters. There is a free capacity of 67,000 T/year which cannot be utilized because import of alkylbenzene was banned.

No future expansion of Alkylbenzene plant is foreseen.

Methylesters may be obtained from palm oil.

The opportunity is to satisfy somehow the free capacity of 67,000 tons/year of Active Matters by producing methylester from palm oil.

A convenient module has a nominal capacity of 10,000 T/year of methylester.

A.6.2.2 Description of technology

There are two technologies to obtain methylester from palm oil and generally from oils :

1. **fats splitting technology**
2. **transesterification**: nowadays, preferred, because it consumes less energy and gives a product of higher quality.

The main steps of "transesterification" are:

. degumming through acid treatment to remove organic matters, impurities, etc.
. bleaching and filtering to ensure the required colour to the methylester
. pre-esterification, to reduce excess of Free Fatty Acids if contained in the raw material
. ester interchange of oil as fats, using methanol for methylester production
. methylester distillation, to remove the unpicked triglycerides and heavy impurities as well as traces of low boiling compounds
. methylester hydrogenation at low pressure, to lower the iodine content down to 0,5%.

[2] See volume 2 for details on an opportunity study for the Conversion of Palm oil into Methylester.

The material balance to obtain 1.000 kg of methylester are the following:

material input	kg	
palmoil	1,200	
methanol	135	
chemicals	small q.tes	
material output	**kg**	**equivalent active matters in kg**
methylester ready for sulphonation	1,000	1,150
glycerine for soap, pharmaceuticals and explosives production	110	

B. RUBBER TREES

B.1 OUTLOOK OF RUBBER IN THE WORLD

B.1.1 ENVIRONMENTAL CONDITIONS

Rubber trees grow in the tropical evergreen forest between belt 15 degrees North and 10 degrees South of the Equator. In these areas, rubber trees stand flooded for long periods with temperatures ranging from 74 to 95 degrees F, and rainfalls between 1900 to 2500 mm/year and above, well distributed during the year. Areas with wide temperature fluctuation and/or with prolonged dry season are not ideal for rubber growth. Soils suitable for rubber trees stay in a wide PH range (from 4 to 8). Optimum yield is reported to be obtained in soils with PH in the 5 to 6 bracket.

B.1.2 RUBBER TREE VARIETIES AND RUBBER GRADING

Rubber trees are fast growing, rarely exceeding 25 m height. Average productive age begins 5 to 7 years from plantation and lasts economically up to 25-30 years, after which yield drops. The genus Hevea rubber tree exhibits much more morphological variability, according to sites, than real variety types. Known subspecific and stabilized morphologies may refer to 9 subspecies:(1)

- *H. Brasiliensis*: by far the most spread. It originates almost 95% of world production. Its yield and latex are superior to any other.
- other subspecies: *H. Guianensis* (French Guiana), *H. Benthamiana* (N. Amazon and upper Orinoco Basin), *H. Camporun* (Madeira River), *H. Microphylla* (Rio Negro in Brazil, Colombia and Venezuela), *H. Nitida* (East Colombia), *H. Pauciflora* (Rio Negro, Upper Orinoco, Guiana), *H. Rigidifolia* and *H. Spruceana*.

Rubber used to be traded according to "Conventional Grades". More recently, after 1961 , "TSR grades" (Technically Specified Rubber) have been introduced.

B.1.2.1 Conventional grades

Rubber is graded according to the "International Standard of Quality and Packing for Natural grades",after a visual examination to establish:

- dirt content
- bubbles content
- colour shade and colour uniformity

Conventional grades roughly classify natural rubber in 9 different types for a total of 35 grades.

a) RSS (Rubber Smoked Sheets)

A good part of field latex is converted into RSS. The blended latex is diluted in water at 15% of its dry weight, then let to coagulate by adding formic acid. Prior to coagulation, aluminium vertical partitions are introduced to separate the solution in the tank into slabs. These are compressed in a series of drum rollers to eliminate water until they reach sheets 5 mm thick. The last two rollers are grooved to give sheets of criss-cross surface shape. Sheets are let to dry under sheds, with smoke produced by wood burning, for 4 to 7 days at 60 degrees C. Sheets gain a brown shade. The sheets are piled, for transportation, in bales weighting 113 kg/each. The sides of the bales are left bared, powdered with talcum only.

(1) Schultes R.E. - The Amazon Indian Evolution in Hevea (Rub.Res.Inst.Malaysia)

b) Air dried sheets (ADS)

These have a light amber colour due to air drying instead of smoke drying.

c) Michelin sheets

RSS receive one or two days additional maturing at normal temperature. It is believed that rubber products manufactured with these sheets benefit from this treatment.

d) Pale crepe

The pale yellow colour of natural rubber is due to the presence of B-Carothens. Pale crepe is a premium type of natural rubber in which pigments have been eliminated to a certain extent. Pale crepe is used whenever the colour of end product is important. Pale crepe is obtained from selected latex having low pigment contents or low darkening enzymatic reaction. Latex is diluted in water at 20%, bleached by adding 0,05% of tolyl marcaptan, let to coagulate in slabs, then pressed in heated rollers until sheets reach 1-2 mm. thick. These are let to dry for 2 weeks under 40 degrees C of dry air. For transport, pale crepes are packed in bales weighting 100 kg each. Bales are wrapped with protective polyethylene film or paper sheets.

e) Brown or blanked crepes

Blanked crepes are a mixture of RSS cuttings of wet slabs, coagulated latex, cup lumps, non smoked sheets, etc. They are first soaked in water to eliminate dirt then cleaned by rollers driven at friction speed.

f) Crumbs

Rubber Crumbs are obtained from cup and field latex and from tree lace. Two different techniques are adopted: one combining chemical and mechanical treatments the other based on mechanical treatment only. The aim of these techniques is to eliminate dirt better and in particular in regards to lower grades.

- combined chemical and mechanical process:
The chemical treatment is done by adding Castor Oil to latex solution at 0.5% of the dry weight, or by spraying it on the wet slabs during creeping stage. Castor Oil breaks rubber into small granules.
- mechanical process (Comminution)
Rubber wet slabs pass through a number of machines like dicing machines, rotary cutters, prebreakers extruder and granulators or similar. Rubber granules are pressed in tile shaped cubicles and dried at 100 degrees C.

B.1.2.2 Technically specified rubber (TSR)

This classification was first introduced by Malaysia in substitution to visual examination. In addition to dirt, bubbles and colour shade, other properties may be laboratory tested:

- initial plasticity
- coagulum contents and density for latex
- ash contents
- Nitrogen contents
- volatiles and other chemical contents.

a) SMRL Slightly coloured rubber

Field latex is conserved by adding ammonia or boric acid and sodium metabisulfite at 0,05% to avoid darkening reaction by enzymes. Latex is coagulated by adding Formic acid and matured for 6-12 hours. Coagulum is then broken into granules. Drying lasts about 5 hours and is made in deep head circular driers at 100 degrees C.

b) SMRCV Stabilized Viscosity rubber

Before coagulation with formic acid, a 0,15% of neutral hydroxylamine sulphate is added to ammonia .

c) SMRWF

It is similar to SMRL, but with darker shades. Generally it is a downgrade of SMRL which does not satisfy colour requirements.

d) SMRGP:

It is a general purpose crumb with stabilized viscosity, obtained from a mixture of 60% of latex grade rubber or non-smoked sheets and of 40%, field coagulum.

e) SMR5:

Similar to SMRL but without addition of sodium metabisulfite.

f) SMRLO, SMR20 and SMR50:

Other crumb grades obtained from field coagulum, which are also blended with RSS.

B.1.3 YIELD AND AGRONOMIC CONSIDERATIONS

B.1.3.1 Yield

An average yield of 1000 kg/ha obtained from unselected seedling is considered as satisfactory. Some yields, in selected holdings, may reach as much as 2500 kg/ha. Yields may vary according to:

- environmental conditions
- shading and trees pacing (250 to 400 trees/ha)
- trees of less than 25-30 years of age
- types and frequency of taping
- chemical treatments (pests, diseases, stimulators and plugging retardants).

Major diseases encountered and remedies are the following:

- South American Leaf Blight (Dothidella ulei) which attacks the undersurface, is the most serious. Best remedy is clone selection:i.e. H. Benthamian and H. Nitida clones.
- Black Stripes (Phytophthora Palmivora) which attack taping panel just above the cut . Remedy is weekly fungicide treatment (not copper) and tools disinfection.
- Mouldy Rot (Ceratocystis fimbriata). Remedy is fungicide and reduced tapping.
- Pink disease (Corticium salmonicolor). It causes incrustation over bark surface. Remedy is copper based fungicide.

- White root rot (Fomes lignosus). It is a root disease, mainly spread in S.-E. Asia. Leaves turn yellow and branches die-back, the whole tree follows. Prevention with regular foliar and collar inspection. Remedy is pesticide sprays and collar paint with protectants.
- Red root rot (Ganoderma pseudoferreum). Prevention as above. Remedy is hand care and removal in addition to chemical treatment.
- Brown Bast leads to watery latex increase. Remedy is good cloning and reduced tapping.
- Termites (Coptotermes) and cockchafers (Holotrichia) can be locally of some trouble.

B.1.3.2 Synthetic Rubber (SR)

The outlook of rubber in the world has to consider synthetic rubbers, as well (SR). In the last 50 years, Natural Rubber (NR), suffered a severe set back and its share to total elastomer demand dropped from 100 % to 32 %:

year	Nat. Rubb ('1000 T)	NR % of tot.elastomers
1940	1,130	100 %
1950	1,750	75 %
1960	2,100	52 %
1970	2,990	35 %
1980	3,760	32 %

The use of SR started during the second World War but was boosted in 1955 with the sale of GRS (Government Rubber Stirene) plant to US privates. The GRS took then the brand name of SBR (Styrene-Butadiene Rubber). SBRs , which is by far the most common SR (more than 50 to 55 % of SRs) includes a great variety with different Butadiene styrene ratios and sometimes with different polymerisation. The other SRs are summarized in the following table:

descr of synth. rubber	SR share of market	main characteristics
Styrene-Butadiene	55%	general purpose, comparable to NR
Polisopropylene	3%	chemical formula similar to NR
Polybutadiene	17.5%	excellent dynamics, low hysteresis good resistance to abrasion,low temp resistant
Ethylene Propylene	6%	Ozone, sunlight and heat resistant
Polychloroprene	7.5%	Fire resistant, and good standing at high and low temperatures (-25 to +90 degrees C)
Butyle	7.5%	Low permeability and excellent heat resistant. Widely used in Tubeless tyres and tubes
Neoprene	3.5%	Lube oil, petrol, and grease resistant

B.1.4 TECHNOLOGY AND RUBBER PRODUCTS

B.1.4.1. Technology

Normally, manufacturing of rubber products passes three main steps:

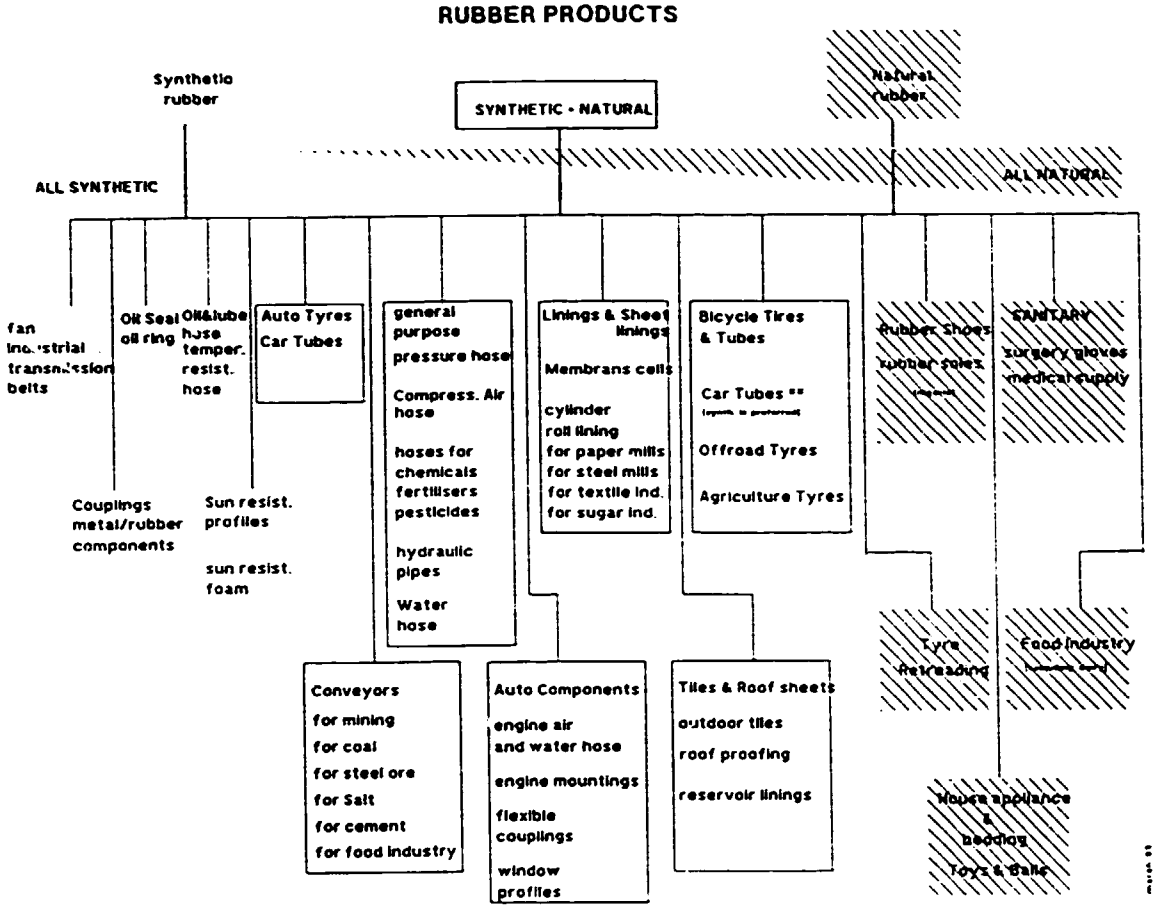
- Semi-finished rubber non vulcanized: obtained by compounding, calendering, extruding and coating; this step is common to all products. Relevant means are similar or equivalent. Machinery is capital intensive.
- Product making unvulcanized; it varies according to products. Even for one product different techniques may be adopted, capital or manpower intensive.
- Vulcanization: common step to all products: Vulcanize means may differ considerably.

B.1.4.2 Rubber Products

A quick panel of rubber products grouped according to the ratio of NR and SR contents, is shown in next page. Rubber products may also be grouped according to the product making (tyres, tubes, hoses, belts,profiles, sheets, latex products) or according to the target type (tyres, automotive, industry, consumer products). Tyres & tubes account for about 70 % of total NR consumption :

Group of product using NR	share of market
Tyre and Tubes	7(
Mechanical components	9
Latex products	7
Footwear	4
Engineer product	3
Adhesives	1
Others	6

RUBBER PRODUCTS



B.1.5 WORLD PRODUCTION AND TRADE

In the following table are shown the annual production of NR and SR for the years 1982-1987:

	total elastomers		natural rubber			synthetic rubber		
Yr	Tot (1,000T)	index	prod. (1,000T)	share %	index	prod. (1,000T)	share %	index
82	11,575	100.00	3,750	32.40	100.00	7,825	67.60	100.00
83	12,305	106.30	4,030	32.75	107.46	8,275	67.25	105.75
84	15,595	114.85	4,250	31.96	113.33	9,045	68.04	115.59
85	13,280	114.73	4,335	32.64	115.60	8,945	67.36	114.31
86	13,680	118.18	4,435	32.41	118.20	9,245	67.59	118.41
87	14,220	122.85	4,775	33.57	127.30	9,445	66.43	120.70

The decline of NR versus SR stopped with a small recovery of the NR. The reasons may be explained by the NR price leveling which encouraged manufacturers to start using more NR in their compounds. The following table shows the price trends during the same years:[2]

year	natural rubber		synthetic rubber	
	price Stg. £.	index %	price Stg. £.	index %
82	517.1	100.00	83	100.00
83	754.7	145.96	844	101.07
84	764.9	147.92	905	108.38
85	642.0	124.15	972	116.40
86	593.2	114.71	995	119.16
87	649.5	125.60	995	119.16

The world planted area is estimated to be 7,5 million ha (1984) with an annual output of 4,775,000 tons.

About 80% of the total is produced in South East Asia: Malaysia (40%), Indonesia (25%) and Thailand (15%).

In Malaysia, the average yield reached in 1984 is 1,500 kg/ha in the larger holdings and 1,000 kg/ha in smaller holdings (lower than 2 ha).

B.2 ASSESSMENT OF RUBBER PLANTATION IN NIGERIA

B.2.1 NIGERIA RUBBER IN FIGURES

In 1985, the area planted with rubber trees in Nigeria was approx 200,000 ha; the production was 60,000 tons and the average yield 280 to 300 kg/ha.

Nigeria remains the largest African producer.

The area location is at Bender, Akwa Ibow, Cross River, Imo, Ogun and Ondo Rivers.

[2] Source: IRSG Int. Study Rubber Group (London) - Prices are referred to RSS1 grade.

B.2.2 EXTENSION OF ESTATES

The average estate size of rubber private holdings in Nigeria is about 1,5 ha/estate. Small size holders are dominant. Public holdings cover 20% of 200,000 ha.

B.2.3 QUALITY OF RUBBER

Nigerian ideal environment conditions for rubber trees growth could have advantaged Nigerian rubber quality.

Insufficient technical care and obsolete processing means cause a large part of Nigerian production to be traded in the lower grades, mainly due to dirt contents and density.

B.2.4 FEDERAL AND STATE POLICIES

B.2.4.1 Rubber Research Institute of Nigeria

This Institute was initially established in 1961 by the Western Nigeria Government.

In 1971 it passed under the control of the Ministry of Agriculture and Natural Resources:

RRIN objectives are the improvement of those species, that could be more suitable to Nigerian climate, improvement of cloning and cultivation techniques.

This institute has two pilot holdings, one (2078 ha)located along Benue-Sapele Road, the other (324 ha) at Akwate.

RRIN activities are not integrated in a broader Federal or State Policy similar to Rubber Research Institute of Malaysia. Lack of funds limits RRIN from taking initiatives.

B.2.4.2 Federal and State policies

As for other crops, Government does not go beyond a general financial discipline. Along with the privatization, loans and financial assistance pass more frequently through commercial banks.

Many Rubber Development Plans were undertaken in the past, but none seems to have increased the planted area, nor the average yield. The planted area is 200,000 ha. against the 300-350,000 ha. planned for 1985/1986. Average trees age exceeds 30 years, new high yield varieties are few.

B.2.5 FUNDING

According to the 12th Annual Report of the Monitoring and Evaluation Unit - (FDA 81987) a great part of funding were bared by the State Agencies: TCU (Tree crops unit) in Bendel and ADC (Agricultural Dev. Corporation) in Imo State and the CREL (Cross Rivers State Estates Ltd.) in Cross Rivers State.

Bendel's TCU made available and sold at cost Latex cups, buckets, dishes, spouts,taping knives and sharpening tools. It also raised new clones in a 10 ha. nursery and sold almost 140,000 young plants.

Although the figures are relatively modest in comparison with large scale rehabilitation, they indicate an inversion in the trend.

Imo's ADC reactivated the processing unit to make delivery easier and encourage small holders.

B.2.6 AGRONOMIC CONSTRAINTS IN NIGERIA

B.2.6.1 Pesticides

Rubber trees are generally little affected by pests or virus diseases or insects. The bared ground underneath does not favour the spreading of diseases. Low exposure of the soil to the sun keeps insects away.

In Nigeria treesmature and natural selection assumes the survival of the fittest.

The use of pesticides is limited and will remain so, unless a large rehabilitation plan is undertaken. in the latter case young trees in nurseries and new cloning may need to be somehow protected.

B.2.6.2 Fertilizers

Considering the height of the trees, the use of engine driven spayer should be recommended, so that the upper leaves may also be reached.

B.2.6.3 Mechanization

Rubber plantation requires mainly hand care and hand tooling. It is fundamental to use tools according to schedules and to give them proper maintenance.

Only engine driven sprayers may be recommended for larger estates. Small holders associations, if any, may also benefit.

B.2.6.4 Irrigation

Rubber trees in Nigeria are located in areas with intensive rainfalls and with low depth water table. No irrigation is needed.

B.2.6.5 Storage and transport

No storage care is required once natural latex is coagulated. If any natural latex has to be processed, attention should be given to distance and to access roads.

Considering the low yield as well, some small holdings, are out of reach or economically inconvenient.

B.2.6.6 Manpower

Manpower requirements expressed in man-day/ha/year vary according to trees age:[3]

work description	immature first 6 years manday/ha/y	mature 7th year on manday/ha/y
Underbrushing,felling,burning,clearing	150.0	
Opening lines and paging	7.5	
Holing	7.5	
Planting and crops covering	15.0	
Fertilizer and fungicide	5.0	5.0
Raw weeding	25.0	
Selective weeding		5.0
General and road maintenance	15.0	10.0
Tapping		125.0
	225.0	145.0

B.2.7 RUBBER PRICE AND REVENUE

B.2.7.1 International prices[4](Stg.£/MT)

year	rss1 (cif)	rss3 (cif)	smr20 (cif)	latex (cif)
1982	517.1	493.7	492.7	N.A.
1983	754.7	730.0	691.2	N.A.
1984	764.9	732.6	742.1	N.A.
1985	642.0	611.5	621.9	N.A.
1986	593.2	570.9	562.5	760.0
1987	649.5	622.3	601.3	757.0
1988(Nov)	600.9	588.4	564.4	1130.0

B.2.7.2 Nigerian Prices and Revenue

In April 1989, merchants collected rubber lu t farmers gate at an average price of 1.5 Naira/kg of lump or coagulum. As foreign exchange ea emillers induced holders to produce.

RSS sheets are sold to manufacturers at a price of about 7 Naira/kg for RSSI which is consistent with prices registered at INRO (International Naturai Rubber Organization) of 0,60 £/kg. Nigerian total revenues from rubber are around 35 millions Stg £.

(3) Source: FAO - Agriculture Development in Nigeria
(4) Source: IRSG Int. Study Rubber Group (London)

B.3 RUBBER PROCESSING IN NIGERIA

B.3.1 RUBBER SHEETS AND CREPES PROCESSING

B.3.1.1 Integrated Plantations Ltd. - Benin City

- Established in 1958.

- Personnel: 24 workers plus seasonals

- Equipment: 12 crepes lines: only two are still working. A new crumb line (10 t/day) has been ordered from Malaysia.

- Production capacity: not reported. Small stocks have been raised in the outer yard. Expected 3,000 t/year of crumbs.

B.3.1.2 Odia & Co. - Ikpoba Hill - Benin City

- Established in 1984.

- Capacity: 15,000 T/year of crumb.

- Personnel: approx 100, seasonals included.

- Covered area: 3,500 sq.m.

B.3.1.3 Grommal Industries Ltd. - Sapele - Bendel State

- Established in 1952 and renewed in 1984.

- Production capacity: 15,000 MT of crumbs

- Personnel: 150, including seasonals

- Covered area: 2,500 sq.m. Free area for future expansion available.

B.3.1.4 Integrated Plantations Ltd. - Usonigre

- Established in 1960.

- Production capacity: 5 T/day or 1,000 T/year.

B.3.2 RUBBER PRODUCTS IN NIGERIA

B.3.2.1 Car tyres

Two main manufacturers (Dunlop and Michelin) produce a total of approx 960,000 car/van tyres and 200,000 industrial vehicle tyres. A third GMO from Onitsha implemented a small line for car tyres.

New expansion of Dunlop is expected to bring the total car/van tyres to 1,360,000 units/year.

The rubber compounds used by above 2 manufacturers are confidential, in particular concerning natural rubber and synthetic rubber ratios (it was reported in Dunlop appraisal study 5,6 kg/tyre of NR against 0,4 kg/tyre of SR, applicable in the new Radial Production).

Considering an average of 6 kg/tyre for all tyres, the consumption of NR for tyres manufacturing in Nigeria is 8 to 9,000 MT/year of NR.

Tyres use also other products locally available such as carbon black and white fillers.

Tyres rely on imports for synthetic rubber, fabric, bread wire and fine chemicals.

Local portions constitute 75% of total weight. By value local portion drops to 34% of total cost.

Besides the new car tyres there are several tyres retreaders. New regulations banning used tyres imports restricted their activities.

B.3.2.2 Tubes

A certain number of rubber manufacturers started to produce tubes. These should normally be produced with SR or with SR rich compounds.

As a matter of fact SR has a higher permeance to air than NR. In Nigeria, due to the import restrictions, it is probable that tubes are manufactured with mainly NR.

Main rubber retreaders are the following:

- Autocraft Nigeria Ltd.	Lagos
- Kano Bandag Rubber Ind. Ltd	Kano
- Olume Rock RTyre Retreading Ltd	Owode-Egba (Ogun State)
- Universal Vulcanizing Co. Ltd.	Ibadan - Oyo State
- Wetico Enterprises Nig. Ltd:	Aba - Imo.

B.3.2.3 Bycicles and motorcycles

Nigeria reached a good self-alliance in this product. With people turning to use cars the demand is expected to shrink. Main manufacturers are (in alphabetic order):

- GMO Rubber Products Ltd.	Onitsha - Anambra State
- Odutola Nigerian Ind. Ltd.	Ibadan - Oyo
- Rodmaster Industries Ltd.	Onitsha - Anambra State
- Senussi Bros Group Ind.	Ikeja - Lagos.

B.3.2.4 Footware and foot soles

Soles in Nigeria are made from rubber sheets, no moulded soles were reported.

Manufacturers are:

- Batts Industry Ltd.	Mbatoli - Iked - Imo State
- Delta Shoe and Plast. Ltd.	Kano
- Eva Rubber and Plast. Prod.Ltd	Onitsha - Anambra

Other sponsors applied for new ventures in this field.

B.3.2.5 Industrial and technical products

One recently implemented project (Rietzcot Nigeria Ltd), close to Lagos, produces moulded automotive components and intends to produce fan belts under an Indian licence agreement.

Sponsors have applied to NIDB for manufacturing rubber hoses , rubber profiles and other automotive components. The approach of these manufacturers and sponsors lack of technical background (laboratory, meteorology and testing labs). None of these products may successfully pass Nigerian car manufacturers' tests nor comply with international specifications for exports.They may survive only as contingency during shortage period.

B.4 RUBBER OPPORTUNITY STUDIES

The opportunities considered are related to the field of technical and industrial rubber products. Four projects are being considered:

- *radiator inlet and outlet hoses*
- *rubber profiles for windows and partitions*
- *rubber hoses (compressed air, welding, pumping stations, butane, agriculture, water and general purpose under 1 inch)*
- *rubber gloves for house and surgery uses*

A plant for rubber regeneration from used tyres was also examined but the results were not economical.

B.4.1 Radiator inlet and outlet hoses

B.4.1.1 Opportunity considerations

Circulating passenger vehicles in Nigeria are estimated to be around 1,000,000 units. Each car has two rubber radiator hoses, one for the inlet, the other for the outlet. Assuming to replace them every 4 or 5 years, the total demand is estimated to be around 400,000 to 500,000 pcs/year. The production mix aims to satisfy the demand of the most spread brands/model namely: Peugeot 504 & 505 and VW Santana, roughly 2/3 of the total demand, that is 300.000 pcs/year.

B.4.1.2 Description of Technology

The suggested production adopts EPDM synthetic rubber. Natural rubber based compounds are more expensive and less performing. Main OE assemblers in Nigeria (VW & Peugeot) have technical specifications hard to fullfil with natural rubber.

Eventhough the market exists, two main reasons suggest to exclude, for the time being the setting up of a plant:

1) synthetic rubber has to be imported

2) car manufacturers hardly will accept locally manufacture products.

B.4.2 Rubber profiles

B.4.2.1 Opportunity considerations

The available statistics are not detailed enough to size market demand and types. Based on CEE 1982-1987 plain rubber profiles export statistics to Nigeria and ACP, and assuming the latter demand ratio remains constant, Nigerian demand is estimated to be around 50,000 to 70,000 kg/year with an average 1987 price of 3.5 US Dollars/kg.

CEE exports to Nigeria and ACP countries in quantity

	1982 kg	1983 kg	1984 kg	1985 kg	1986 kg	1987 kg
Nigeria	108,000	86,000	n.a.	50,000	n.a.	n.a.
ACP (*)	291,000	379,000	411,000	405,000	560,000	530,000

(*) Asian, Caribbean and Pacific countries

CEE exports to Nigeria and ACP countries in value[7]

	1982 (1000 $)	1983 (1000 $)	1984 (1000 $)	1985 (1000 $)	1986 (1000 $)	1987 (1000 $)
Nigeria	365.2	237.8	n.a.	154.1	n.a.	n.a.
ACP	1,066.7	1,171.9	1,318.5	1,305.2	1,642.2	1,504.4

The production mix considers only rubber building profiles for indoor and outdoor use as window and partition gaskets and other plane rubber profiles assimilited to them. Profiles are single extruded and may be of foamed or solid types with no metal or other inserts whatsoever.

This kind of product is made of SR, which has to be imported, therefore no opportunity study will be undertaken.

[7] calculated at the exchange rate of 1$ equivalent to 1.350 Italian Lira

B.4.3 Rubber hoses

B.4.3.1 Opportunity considerations

Available statistics are not detailed to give the proper size of the market demand and the mix of hoses types. Based on CEE 1982-1987 rubber hoses export statistics to Nigeria and ACP, and assuming the export ratio between Nigeria and ACP remains constant, the demand is estimated to be around 350-500 tons/year.

It is suggested to produce rubber hoses below 1 inch for the following applications:

- compressed air
- welding
- agriculture spraying
- house butane pipe
- pumping stations
- water and general purpose hoses

A feasibility study has been carried out by the consultant on behalf of EEC and ICE of Italy for a Nigerian producer, therefore no opportunity study will be undetaken.

B.4.3.2 Description of Technology

The suggested technology is based on the use of compounds rich in natural rubber and the project as proposed is labour intensive.

The production main steps are the following: see flow diagramm in next page.

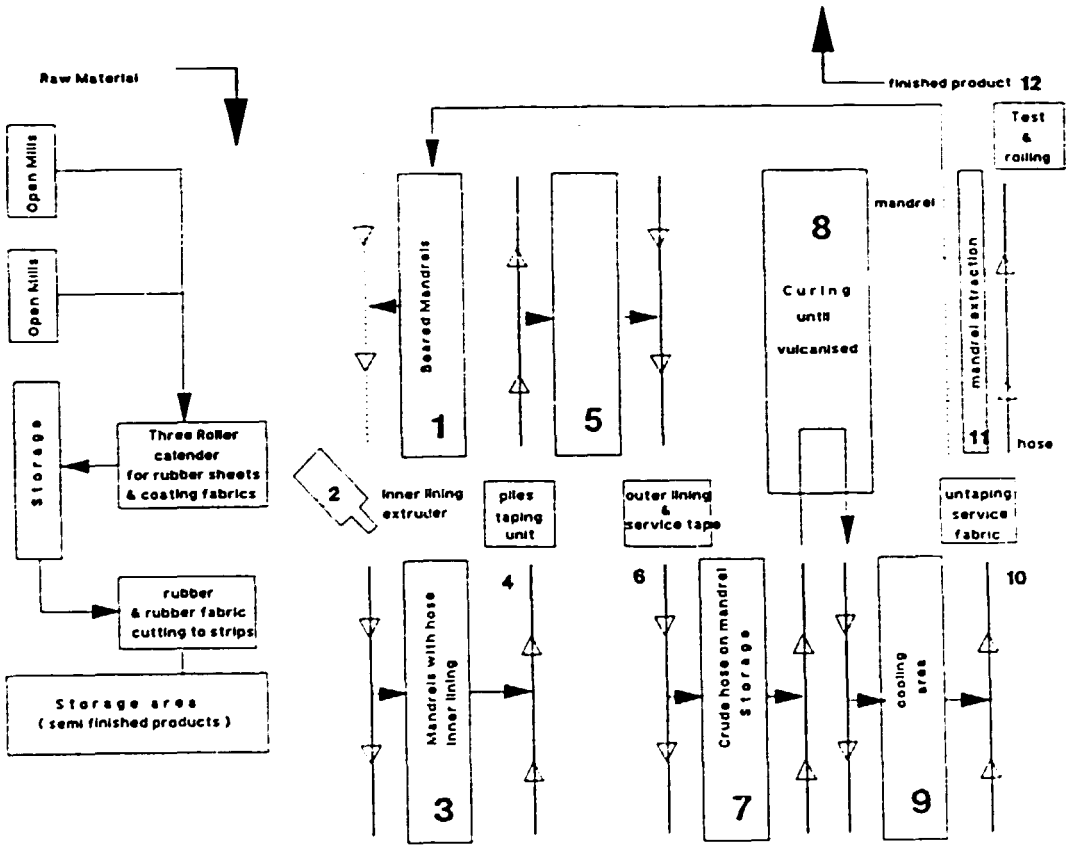
- first layer on mandrel
- insert
- second layer
- wraping
- vulcanizing
- wraping
- mandrel extraction
- labeling, testing & packaging

Alternatives concern the type and length of mandrel, the way rubber layers are applied, the means of winding up the insert, etc ....

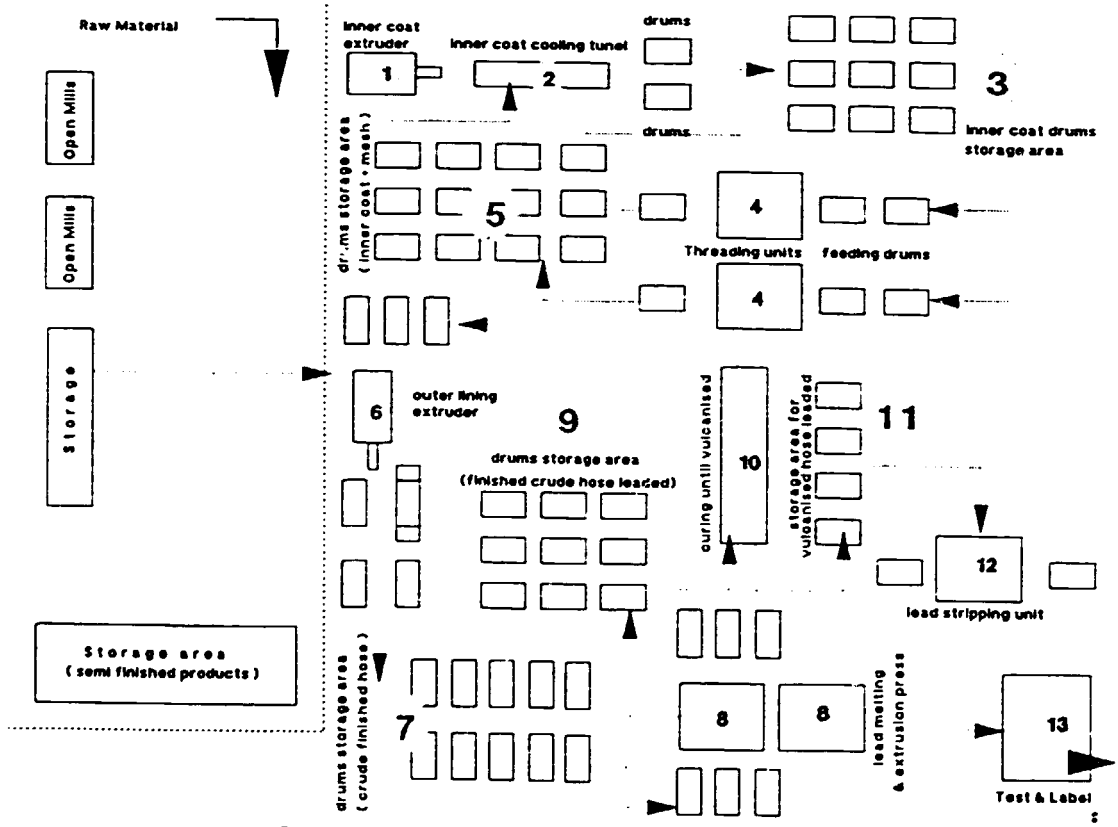
Main equipment and machines may change according to selected technology. Basically they are the following:

- Open mills and calenders or crude rubber compounds are supposed to be available.

- one calender
- one by cutter
- one extruder
- one or two winders
- one wraping machine
- one vulcanizing tunnel
- handling equipment
- set of mandrels
- labeling, marking , testing and packaging



Rubber hose manufacturing flow diagram (on mandrel)



Rubber hose manufacturing flow diagram (lead continuous process)

B.4.4 Rubber latex gloves

B.4.4.1 Opportunity considerations

It is a product made from natural rubber. It requires small investments and its technology is labour intensive. Nigeria does not produce any rubber gloves for home use, surgery, industrial or heavy use. EEC exports to Nigeria in weight between 1982-1987, assuming a unit weight of 0.055 kg/house-glove (respectively 0.030 kg/surgery-glove) leads to estimate the demand as follows:

- 80,000 house-gloves/year
- 400,000 surgery-glove/year

The major producers in the Far East are experiencing a rising trend in labor costs and Nigeria may take the opportunity to supply export markets. This project should be combined with a small field latex production unit.

The production of these products require a specific know-how and sophisticated technology which imply the participation of foreign investor, already known to the market. However, as it is not likely that a foreign investor will be found, it is suggested not to consider this project.

C. COCOA

C.1 OUTLOOK OF COCOA IN THE WORLD

C.1.1 ENVIRONMENTAL CONDITIONS

Cocoa is a strictly tropical crop with limits of cultivation between latitude 20 degrees North and South of the Equator, whereas the bulk of the crop grows between the 10 degrees North and South of the Equator. In these areas trees may stand as long as six months in running water and under temperatures ranging between 20 - 32 degrees.

For an ideal growth rainfalls should be above 1200 mm a year, preferably well distributed along the period. If rainfall drops under 65 mm a month or, in presence of prolonged dry season, irrigation means should be provided. Grown trees survive in dense shade as well as under high sun exposure. However, small trees grow better in shade and should be protected by windbreaks. Soil should be well drained, and well watered possibly with a wet top layer. Optimum pH is around 6.5 .

C.1.2 COCOA VARIETIES AND BEANS GRADING

Main cocoa varieties are the following:

- CRIOLLO: with two sub varieties (i.e the central American and Venezuela criollo)
- AMAZONIAN FORESTERO or AMELONADO:
- TRINITANO: a hybrid of the two above.

The criollo variety is appreciated for its rich flavour. Amelonado variety is by far the most spread being the most vigorous and resistant. Trinitano has been developed to combine the advantages of the other two.

Within each variety a trade grading is given for the batches according to:

- size and shape of the beans which also have to be even. Absence of disease and mouldiness.
- colour and its uniformity
- flavour
- fat content, not less than 55 % .

C.1.3 YIELD AND AGRONOMIC CONSIDERATIONS

Yields may considerably vary according to:

- genotype
- changes in environmental conditions
- shading and trees spacing
- trees age
- pests, diseases and chemical treatment.

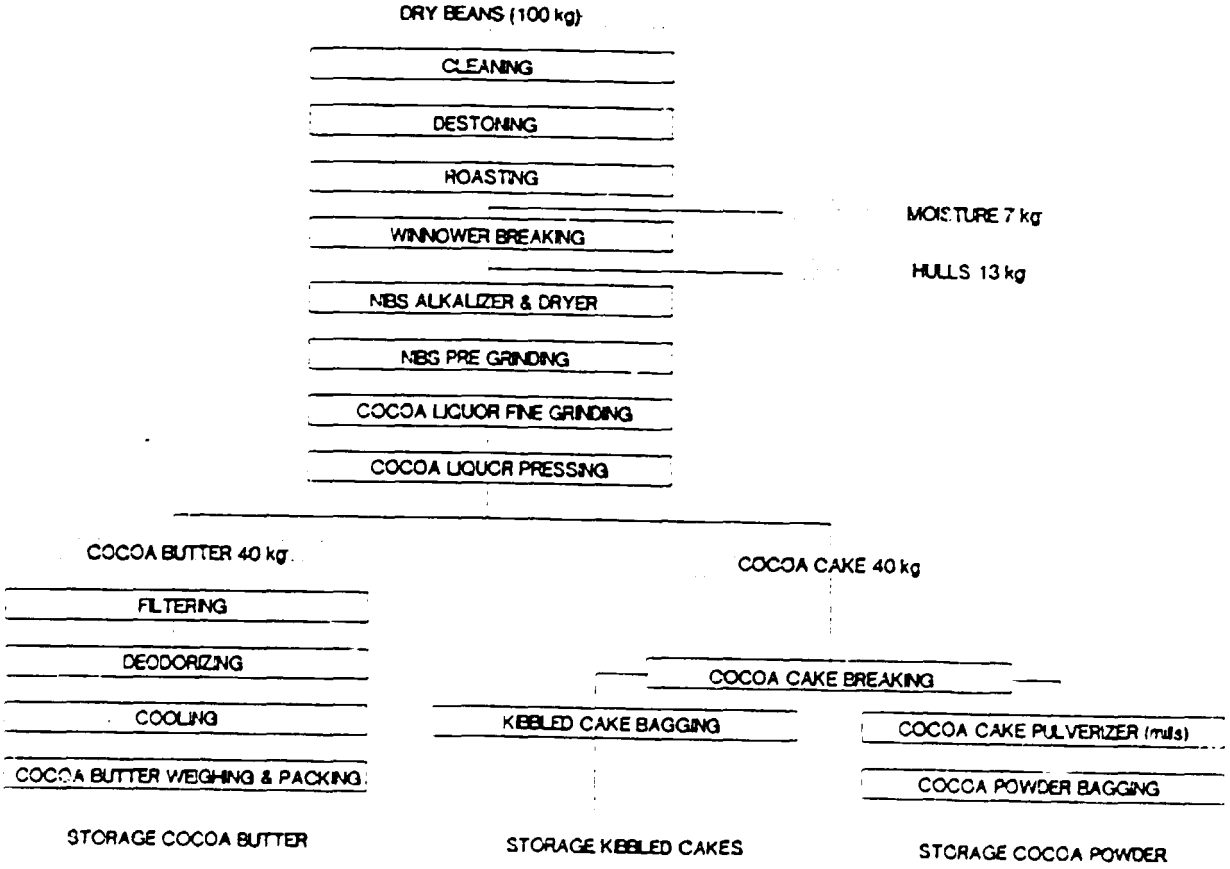
A normal yield in West African Region is considered good if around 600 kg/ha. New varieties developed can reach under accurate control up to 1,000 to 1,500 kg/ha .

The major diseases hitting a cocoa plantation may be summarized as follows:

- diseases that can be controlled by copper based sprays: black pod (*phytophtora palmivora*) is most common being spread by contact, raindrops or wind. Low temperatures, below 20 C degrees help to its diffusion.
- diseases that can only be controlled by appropriated cloning, by hand , like cutting trees or branches or simply by removing the fungus or the broom: witches broom (*marasmius perniciosus*), ceratostomella wilt (*Ceratocystis fimbriata*), Monilia disease (*Monilia r. eri*).
- virus diseases like cherelle wilt and swollen shoot. The latter is quite spread in West Africa mainly in Ghana and Nigeria.
- insect pests : among these Capsids and Cocoa beetles cause the greatest damage. They are controlled by chlorinated hydrocarbons.

C.1.4 COCOA PROCESSING AND MAIN PRODUCTS

After fermentation cocoa beans are spread and let to dry under sunheat for about seven days. While drying only stirring and protection against rain, if any, should be provided. Dry beans are then polished mechanically or by feet. Shells and broken beans should be removed. Dry beans are normally packed in jute sacks. The following flow diagram shows possible cocoa process and utilization. The scraps, mainly cocoa shells, are rich in theobromine, fat and vitamin D and may be used as livestock feed or as manure.



C.1.5 WORLD PRODUCTION AND TRADE

During 1970's up the 80's, the world gross production of cocoa dry beans ranged 1,500.000 MT . World production further increased to reach in the last three years (1986 to 1988) an estimated output of 2,000,000 MT of which 60% from West Africa, 30% from Central and Latin America and the balance from South East Asia.

Major West African producer is Ivory Coast with 30 % of world output, second stands Ghana with 15 %, Cameroon and Nigeria accounts for 7.5 % each.

Almost ninety percent of total world consumption is concentrated in few countries: USA and West Germany import 20 % each, USSR and Holland 15 % each, UK 8 %. A group of other countries (Japan, Italy, France, Belgium, Spain, Switzerland) consume an average of 3 to 4 % each.
World trade is expressed in MT of dry beans. For the purpose of assessing other cocoa products, the following conversion table is used:

- 1 MT of dry beans = 800 kg of cocoa liquor

- 1 MT of dry beans = 376 kg of cocoa butter plus 424 kg of cake

Unit prices expressed in Naira have grown steadily. In regards to the local market, it has been reported that dry bean prices in 1989 rose to 24,000 Naira/MT from an average of 15,000 Naira/MT in 1988. This is inconsistent with the international quotations which average in 1988-1989 1,200 US dollars/MT with an almost constant trend. Even the free exchange rate applicable for exports does not justify the reported prices.

C.2 ASSESSMENT OF COCOA PLANTATIONS IN NIGERIA

C.2.1 NIGERIAN PRODUCTION IN FIGURES

	CROP YEARS		
	10/86	**10/87**	**10/88**
Area planted (ha)	373,000	378,000	383,000
Area harvested(ha)	371,000	363,000	363,000
Average trees per ha	1,000	1,000	1,000
Tree popul. (1000 trees) (incl.non bearing trees)	373,000	378,000	383,000
Cocoa output(MT)	100,000	145,000	130,000
Average yield (MT/ha)	0,27	0,39	0,35

C.2.2 EXTENSION OF ESTATES

The average estate size of cocoa holdings in Nigeria is about 1,5 ha/estate, although estates below 1,5 ha are dominant. The cocoa estates in Nigeria are generally planted interspersed with food crops such as vegetables, corn and yam. The reason of that is to reduce the risks of not surviving seedlings. In new plantations it helps to cash back investments prior to beginning of cocoa production, that is about 4 years after planting.

C.2.3 QUALITY OF COCOA PRODUCT

Traditionally, the Nigerian cocoa dry beans are of good quality and should lead to a price premium in the international market. However, a decline in controls caused a drop in quality during 1986 with complaints from international buyers. In 1987 the quality has been improved and it is expected to be further improved in 1988-1989.
The varieties present in Nigeria are as follows:
- Amelonado 80% of which trees with 25 to 30 years
- Amazon F3 and other varieties of young trees.

In Nigeria the average trend yield is 250-300 kg/ha of dry beans against 600-700 kg/ha from Amelonado variety under ideai farming conditions.

C.2.4 FEDERAL AND STATE POLICIES

The Federal and State policies are going towards a reform with a growing privatization. Private sector is involved in the equity share and in the on-going management of initiatives. Government support is limited mainly to financial discipline , technical assistance through federal agencies or state boards. In the case of cocoa, the former COCOA BOARD has been abolished both at federal and at state level. Instead CDU (Cocoa Development Units) in Ondo, Oyo and Ogun states, and TCU (Tree Crops Units) in Bendel State have been established.These are more organized as consortiums of cocoa producers in each state. At the Federal level it is worth mentioning the Cocoa Research Institute of Nigeria (CRIN). The Federal Government decided, by an official Act, to ban the export of unprocessed beans. Nevertheless, the law will come into force in January 1992, because the existing plants are not able to process the whole production for various reasons (capacity, equipment obsolescence, etc.)

C.2.5 FUNDING

While the Federal Government of Nigeria (FGN) subscribed the great part of funding of cocoa projects in Bendel and Ogun States, Ondo and Oyo States have born a larger share than FGN. The funding figures for 1987 are as follows:

State	FGN	State Gov.	Total Fund
	Naira	Naira	Naira
Bendel	330,000	10,000	340,000
Ogun	367,500	15,500	383,000
Ondo	555,000	1,302,900	1,857,700
Oyo	414,000	2,722,626	3,163,626
TOTAL	1,666,000	4,050,826	5,716,826

The private sector encouraged by cocoa prices ,made more attractive by the Naira open exchange rate (11,000 to 12,000 Naira per MT according to grade), has been more active in new farming and in upgrading old ones. The private sector funding can hardly be assessed. The new seedlings and nurseries utilized by the CDUs (Cocoa Development Units) and by TCU (Technical Cocoa Unit) in the different states support above statement:

State	Seedlings established (units)	Seedlings Utilized (units)	unit cost Naira	Total Cost Naira
Bendel	29 455	267,273	0.10	29,145
Ogun	920,337	781,270	0.10	92,034
Ondo	1,412,500	1,292,631	0.10	141,250
Oyo	644,840	596,388	0.25	161,210
TOTAL	3,269,132	2,937,562		423,639

In 1987, Federal Ministry of Agriculture distributed 7 millions of new seedlings which were placed in 5.000 ha of new areas with a 70% of survival rate. The Ministry of Agriculture also sold chemicals at cost and provided institutional credits, even though direct allocation is far below the target values. Commercial banks accounted for 12% of loans below the expected 15%. Merchant banks loans stand at 3% against the 10% target.

C.2.6 AGRONOMIC CONSIDERATIONS

C.2.6.1 Pesticides

With the increased cocoa prices on the Nigerian market and the drop of Naira, Nigerian farmers have been encouraged to use more insecticides and fungicides. The use of insecticides and fungicides reached in 1987/1988, approx. 2,5 million litres (about 2/3 are fungicides). At present Bordeaux Mixture (Copper sulphate) was reported to be used to control Black Pod. The consumption is roughly 50 kg/ha per year. It has been reported that the Gammalin 20 and Aldrex 40 insecticides were used in a few cases. Hand sprayers are mainly used. These can reach 4-5 meters high, while trees may be 12 to 14 meters tall. The whole upper part of the trees is thus unprotected. To increase the yield, the measures to be undertaken should be the following:

- use of engine driven sprayers.
- increase the consumption of copper sulphate from 50 to 100 kg/ha per year
- increase the consumption of fungicides and pesticides up to respectively 2 kg/ha and 1 kg/ha per year.

2.6.2 Fertilizers

The N-P-K (Potassium - Phosphorous- Nitrogen based) complex fertilizers are reported to be used in few cases and in small quantities. It is however not justified for technical reasons: Cocoa trees, being "mycorrhiza" dependent, provide themselves for their need of phosphorous. On the contrary, high concentration of phosphorous may disturb or damage the tree. From surveys carried out by FAO it appears that the greatest part of the area planted with cocoa is of igneous rocks sediments. This type of soil normally contains potassium and other microelements vital for the trees. The measures to be undertaken as far as fertilizers are concerned may be the following:

- increase urea consumption up to 50 kg/ha per year to be sprayed in ten treatments distributed evenly along the year.
- use of engine driven sprayers.

C.2.6.3 Mechanization

Cocoa trees in Nigeria are placed random, not in regular rows. The access roads between the trees are difficult to reach by large equipment. The farmers use mainly hand tools. Should any mechanization be provided it has to be as follows:

- small overall size to enter between random disposed trees
- low cost so that even small holders may afford it
- multi purpose with additional power take-off for implements
- equipped with optional implements : trailer, sprayer, simple soil working accessories.

C.2.6.4 Irrigation

Although rainfall drops in certain Nigerian States below the recommended levels for an ideal crop, no irrigation is reported. Water for irrigation may be made available from surface (river) or underground sources. Lack of water and the advanced trees age, are the main reasons of low yield in Nigeria.

C.2.6.5 Storage & transport

No particular problems arise from storing cocoa dry beans, only care should be given during drying. Once dried, cocoa beans are put in bags both for internal and export markets.

C.2.6.6 Manpower

Manpower for **new plantations** are estimated to be around 210 man-day/ha per year distributed as follows:

work description	(man-day/ha)
felling, burning & clearing	85
lining and pegging	15
clearing of rows & holding	22
planting & transport of seedlings	38
shading, windbreaking	10
maintenance and earth weeding	40
Total for **new plantation**	210

For **rehabilitation** of existing plantations the need is 60 % higher:

work description	(man-day/ha)
clearing, stumping & top layer removal	150
planting preparation & planting	120
maintenance	70
Total men/day for **rehabilitation**	340

For **ongoing works** the needs per ha are :

work description	(man-day/ha)
weeding, supplying, pruning, thinning,spraying & other hand care	55
harvesting, fermentation & drying	50
Total men/day for normal operation	105

C.2.7 COCOA PRICES & REVENUES

C.2.7.1 International prices

The international Cocoa prices during May 1989 at New York Stock Exchange settlements averaged 1,200 US dollars per MT. Future settlements until May 1990 foresee small fluctuations upward of 1 to 1.5 percent in one year time.

Buffer stocks are going slightly down. However most analysts agree that supply is greater than demand and that prices will remain unstable.

C.2.7.2 Nigerian prices & revenues

The prices in Nigeria expressed in Naira have a different pattern. The new regulations for free exchange of cocoa revenues and the sharp devaluation of Naira against the dollar, attracted private investors. The reported price of dry beans in Nigeria was 25,000 Naira/MT which is inconsistent with the 13,000 Naira/MT equivalent to 1,200 dollars/MT calculated at the free exchange rate reported to be 1 US dollar = 11.2 Naira).

The 1988 revenues of the 130,000 MT are estimated to be 156 Millions US dollars.

C.3 COCOA PROCESSING IN NIGERIA

The crop of cocoa beans remains a little more than one week with the farmers, until it is dried by direct exposure to sun heat. Mostly private traders, duly registered by state governments, purchase directly from farmers. Sometimes they help them with inputs and credits. Prior to export from Nigeria, cocoa is graded twice: first by state authorities, and then by the federal authorities.

There are three existing processing plants with a reported combined capacity of about 80.000 T/year. A concise description of main processing units is made hereafter according to information collected by Baldo & C. experts during the survey carried out in April 1989.

C.3.1 COCOA INDUSTRIES LTD (IKEJA - LAGOS)

This plant was built in 1967. The plant was supplied on turn key basis under supervision of Coutinho Caro , with an initial nominal capacity of 30,000 MT a year of dry Cocoa Beans.
The total number of personnel is 700 workers.

C.3.1.1 Description of plant main equipment and apparent conditions:

- Storage capacity of dry cocoa beans : 1000 MT.
- Sifters equipped with magnetic traps for destoning and impurities clearing.
- Roasters (5 units , 1 MT/h each)
- Mills out of which one is out of duty, a second was under repair
- Bauermeister (West Germany) presses (8 units) out of which 2 are completely out of order, other 2 were under repair, likely for quite a long period, as the manufacturer Bauermeister stopped its activity 8 years ago and spare parts availability may be difficult. The last four presses are working at reduced rate because of some maintenance problems.

The presses cause a loss of 30% in the production of cocoa butter output

- Alkalinisation unit for darkening the powder.
- Deodorizing of cocoa butter, deacidification and pasteurization of cocoa liquor are not foreseen.
- The plant produces also a cocoa based powder mix , soluble in hot water, to prepare energetic drinks. This powder is packed in cans and sold through retailers.

C.3.1.2 **Production Costs :**

These costs have been reported by the management.

- Purchase Costs of Cocoa beans: 25.000 MT
- Transportation costs from production area: 100 Naira/MT
- Industrial processing costs : 1,200 Naira/MT
- Cocoa butter selling price : 53,000 Naira/MT
- Cocoa powder: 11,000 Naira/MT

These costs appear not to be reliable. As a matter of fact, from 1 MT of dry beans at 25,000 Naira we may extract 0.4 MT of cocoa powder at 53,000 Naira/MT and 0,4 MT of cocoa butter at 11,000 Naira/MT. The total average selling revenue becomes 25,600 Naira/MT or a margin of 600 Naira/MT. If the industrial costs of 1,200 Naira/MT are confirmed this plant loses at least 600 Naira per MT processed.

C.3.2 COCOA PRODUCTS INDUSTRY LTD (EDE -OYO STATE)

This plant has been built in 1982 under supervision of Buhler (Switzerland). The major shareholder is the Oyo State. The initial nominal capacity is 26,000 MT a year of dry Cocoa Beans.
The total number of personnel is 180 workers.

C.3.2.1 **Plant main equipment**

- The presses (4 units) out of which 2 supplied by DUYVIS are completely installed. Other 2 supplied by CARLE & MONTANARI have been recently installed and there is a provision to install two additional presses from the same supplier. The total installed nominal capacity will then reach about 26,000 MT/year. The expellers supplied initially have been replaced with the presses to reduce the losses of residual cocoa butter in the cocoa cake from 33 % to 10 - 12%.

- Deodorizing of cocoa butter, deacidification and pasteurization of cocoa liquor are not foreseen.

C.3.2.2 **Production Costs :**

These costs have been reported by the management.

- Purchase cost of cocoa beans: 24,000 Naira/MT
- Transportation costs from production area: 30 Naira/MT
- Industrial processing costs : 1,200 Naira/MT
- Cocoa butter selling price : 53,000 Naira/MT
- Cocoa powder: 11,000 Naira/MT

Concerning the reported costs the same comments made for the previous manufacturer are applicable.

C.3.3 COCOA PRODUCTS COMPANY LTD. (ILE OLUJI- ONDO STATE)

This plant has been built in 1984. Ondo State holds 45% of the shares, NIDB 11 %, Ondo State cocoa producers 15%, and the balance by COUTINHO CARO .The plant was designed by the latter on turn key basis . The initial nominal capacity was 26,000 MT a year of dry Cocoa Beans.

The total number of personnel is 400 direct workers , plus seasonal helpers for handling.

C.3.3.1 Plant description & main equipment:

- Storage capacity 4,000 MT.
- Sifters without magnetic separator supplied by Bauermeister .
- Roasters supplied by PROBAT.
- Mills.
- Presses manufactured by Bauermeister (5 units). As already mentioned this manufacturer has run out of business .The models supplied in this plant are not the latest .

The total installed capacity is claimed to be 20,000 MT/year. While effective is estimated to be 16,000 MT/year. The presses and the sifters are still efficient but problems will arise with spare parts from Bauermeister.

- Deodorizing of cocoa butter, deacidification and pasteurization of cocoa liquor are not foreseen.
- Some technical problems are related with the packaging machines of cocoa butter
- end products are cocoa butter, cocoa powder and kibbled cakes.

C.3.3.2 Production Costs :

These costs have been reported by the management.

- Purchase cost of Cocoa beans:23-24,000 Naira MT
- Transportation costs from production area 30 Naira/MT
- Industrial processing costs: 1,200 Naira/MT
- Cocoa Butter Selling Price : 53-54,000 Naira/MT
- Cocoa Powder: 10-12,000 Naira/MT

Concerning the reported costs the same comments made for the previous manufacturer are applicable.

C.3.4 COCOA PROCESSING PLANT (ESSDE)

This plant has a nominal capacity of 2,000 MT/year and was not surveyed .

C.4 COCOA RELATED INDUSTRY IN NIGERIA

The related industry is concentrated in the production of cocoa based drinks and vegetables:

Name of Enterprise	Location	Products	Output T/Year
- Cadbury Nig. Ltd	Ikeja	Beverages	18,500
- Food Specialities Ltd	Lagos	Beverages & Chocolate	3,000
- Ovomaltine W.A. Ltd	Lagos	Beverages	2,400
- Lipton Nigeria Ltd	Apapa	Beverages	2,500
- Cocoa Industries Ltd	Ikeja	Beverages	1,000
- Abukon Nigeria Ltd	Lagos	Beverages	2,000
- Continental Pharm. Ltd	Oshodi	Cocoa Butter Cosmetics	1,000

The total consumption of cocoa in equivalent dry beans is 3,000 MT/year.

C.5 REHABILITATION OF EXISTING PLANTS

Generally speaking, the existing plants, eventhough employing obsolete technologies do not need to be rehabilitated. Only **Cocoa Industries Ltd** at Ikeja faces problems with the presses which should be replaced(see C.3.1.1). The investment is estimated to be around 2,500,000 US $ for VITALI/SERVCO new presses.

C.6 OPPORTUNITY STUDY

C.6.1 OPPORTUNITY CONSIDERATIONS

The production of cocoa beans in Nigeria estimated in 1988 around 130,000 Tons exceeds the nominal capacity of the existing process plants (90,000 Tons). In order to increase this capacity an opportunity study is suggested for a plant having a nominal capacity of 10,000 tons/year of dry cocoa beans.(1)

To improve the quality of products and meet clients requirements, the considered plant should include equipment for:

- cocoa butter deodorizing
- cocoa liquor deacidification
- cocoa liquor pasteurization

The major producers of cocoa processing are shown in the block diagram in para C.1.4

(1) See Volume 2 for details on an opportunity study for the Cocoa Processing Plant.

D. SOYA BEAN

D.1. SOYA IN THE WORLD

D.1.1 ENVIRONMENTAL CONDITIONS

Soya bean is a sub-tropical plant but cultivation may extend from Tropics up to about 50° North. Favourable environmental conditions are hot and rather damp summers, without excessive heat o: severe winters. Generally speaking, the climate for soya bean is similar to that required for maize cultivation; soya bean can be rotated with maize or other field crops producing beneficial effects on soil fertility. Various soils suit soya bean cultivation. The best are sandy or clay loams and alluvial of good fertility. The soya bean is a short-day plant, flowering more quickly in darkness 10 to 16 hours. The photoperiod is very important because it affects the time from sowing to harvest and the adaptability to latitudes. New introduction has to be tested for adaptation to local conditions; cultivars have now been developed to cover a wide range of latitudes.

D.1.2 SOYA VARIETIES

There is a great number of cultivars, varying in height and plant type, size, colour, time for maturity, oil and protein content of the seed. New cultivars have also been obtained by selection and hybridization. Soya bean is becoming a very important source of vegetable protein. Dry seeds contain an average of 29 to 50% of protein, depending upon varieties; black seed cultivars are the richest in protein. The oil percentage ranges from 15 up to 22% and varies inversely with protein content; for oil extraction purposes, yellow seeds are generally richest in oil.

D.1.3 AGRONOMIC CONSIDERATIONS

The crop can be easily mechanized in all stages until harvest. This led U.S. to an intensive soya bean production since 1942. In United States soya beans are grown in rotation with maize. In China millet and sorghum are rotated with soya beans. In some other areas we find rotation with rice.

Maximum average yield in the world ranges from 1,700 to 2,700 kg/ha of dry beans. In the far East average yields range from 1,000 to 1,350 kg/ha. In other countries yields are much lower.

D.1.3.1 Major diseases and pests

Soya beans are relatively free from serious epidemics and insect pests. The most common diseases encountered are:

- bacterial blight *(Pseudomonas glycinea)*
- bacterial pustule of leases *(Xantomonas phaseoli)*
- pod and stem blight *(Diaporthe phaseolorum)*
- frogeye *(Cercospora daizu)*
- wildfire *(Pseudomonas tabacum)*
- downy mildew *(Peronospora manshurica)*
- soya bean viruses: mosaic and yellow mosaic
- root-knot nematode *(Meloidogyne)* and cyst nematode *(Heterodera)*. Nematodes attack soya bean roots.
- velvet bean caterpillar and blister beetles

Attention is given to soya beans selection disease resistant to bacterial blight and pustule, forgeye, and downy mildew.

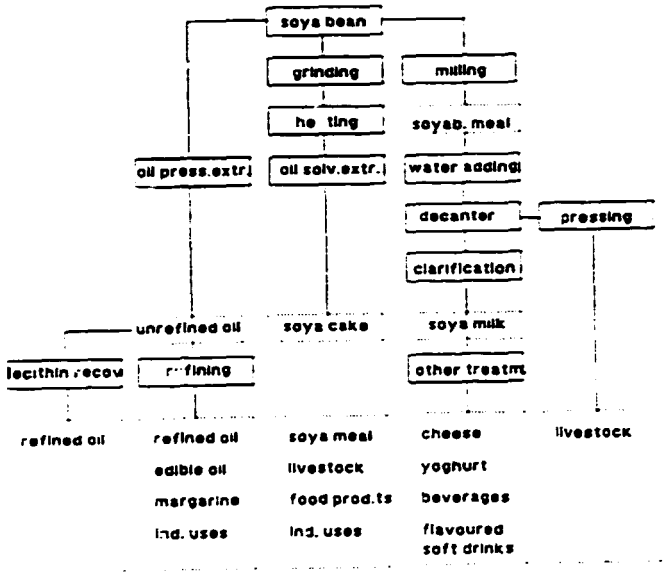
D.1.3.2 Improvements

Methods to improve crop yields are: (At present cultivars are available to cover almost any local condition.)

- introduction of cultivars suitable for environment and latitude requirements
- selection of introduced and local cultivars
- hybridization to combine superior features of the best cultivars

D.1.4 SOYA BEAN PROCESSING AND MAIN PRODUCTS

Soya beans are an important source of vegetable oil and protein. Various products are obtained from soya bean processing:



D.1.4.1 Food and livestock

- soya milk: used plain or to man ufacture curd, cheese., yoghurt
- soya based soft drinks and beverages
- soya sauces and derivative (i.e. Worcester sauce ...)
- edible oil: used plain or to produce margarine and shortening. Fat used in confectionery.
- soya meal: used as animal feed
- soya flour: for bakery and other food products
- lecithine: used as wetting and stabilizing agent in the food industries

D.1.4.2 Industrial non-food products

- oil: to produce paints and varnishes, linoleum, inks, oilclothes, insecticides, disinfectants, soaps, cosmetics etc.

- meal and soya bean protein: to produce acrylic fabrics and fibres, adhesives, waterproofing, fire fighting foams, etc.

- lecithine: it is a by-product (phospholipide) obtained from oil industry. It is used as a wetting and stabilizer for pharmaceuticals, cosmetics, plastics, leathers, etc.

D.1.5 WORLD PRODUCTION AND TRADE

U.S.A. is the major producer of soya bean in the world, with 60% of world production, which in 1970 totaled 47 million tons. Second producer is China with 25%, next comes Brazil with 2.5% and USSR with 1.15%. The world supply is shown in the following table:[1]

production (10^6 Tons)						exports(10^6 Tons)				
82/83	83/84	84/85	85/86	86/87	Country	82/83	83/84	84/85	85/86	86/87
59.61	44.52	50.64	57.11	54.62	**USA**	24.63	20.21	16.28	20.14	20.68
14.75	15.54	18.28	13.40	16.20	**Brazil**	1.31	1.59	3.48	1.20	1.80
4.20	7.00	6.75	7.30	7.70	**Argentina**	1.42	2.97	3.29	2.54	2.65
0.52	0.55	0.95	0.60	0.90	**Paraguay**	0.41	0.43	0.84	0.47	0.76
9.03	9.76	9.69	10.05	11.00	**China**	0.29	0.73	0.26	0.40	0.35
5.46	5.78	6.72	7.31	8.19	**Others**	5.46	5.78	6.72	7.31	8.19
93.57	83.15	93.03	96.23	98.61	**Total**	28.39	26.15	25.24	26.00	27.35

The major world consumers are represented in the next table:

imports in (10^6 Tons)	82/83	83/84	84/85	85/86	86/87
EEC 12	15.71	12.79	12.75	12.96	12.75
Other W. Europe	0.53	0.47	0.51	0.52	0.49
USSR	1.05	0.95	0.85	1.90	2.00
Other E. Europe	0.78	0.84	0.59	0.85	0.79
Japan	4.87	4.73	4.61	4.75	4.85
South Korea	0.69	0.71	0.81	0.98	1.10
Taiwan	1.27	1.36	1.47	1.61	1.96
Indonesia	0.48	0.32	0.31	0.37	0.30
Mexico	1.07	1.44	1.43	1.00	1.10
Brazil	0.08	0.00	0.38	0.28	0.35
Others	2.04	1.56	1.62	1.68	1.69
total imports	28.57	25.18	25.32	27.11	27.11

[1] Source: Commodity Year Book 1987-1988

D.1.5.1 World prices

The average world prices CIF of soya bean imported from Nigeria as reported by the Central Bank of Nigeria are the following:[2]

year	naira/ton
1981	181.4
1982	168.7
1983	215.8
1984	221.4
1985	205.2
1986 (January)	225.1
1986 (April)	161.3
1986 (June)	237.0
1986 (October)	617.0
1986 (December)	684.4
1987 (January)	516.0
1987 (June)	1,183.3
1987 (September)	1,040.6
1989 (May)	6,800.0
1990 (May)	6,700.0

D.2. OUTLOOK OF SOYA BEAN IN NIGERIA

D.2.1 NIGERIA SOYA BEAN OUTPUT

The areas where soya bean is produced are concentrated in Benue, Gongola, Kaduna, Niger and Oyo States. Benue State alone produces 75% of annual production. Nigerian soya bean planted area and output are summarized here-below:[3]

soya bean seed	unit	1987	1988	1989* *forecast
demand				
area planted	ha	110,000	117,000	120,000
area harvested	ha	108,000	115,000	118,000
production	MT	65,000	70,000	75,000
average yield	kg/ha	600	600	630
imports	tons	0	5,000	15,000
total supply	tons	65,000	75,000	90,000
consumption				
domestic crush	tons	10,000	15,000	17,000
food use	tons	45,000	50,000	63,000
livestock	tons	10,000	10,000	10,000
tot consumpt	tons	65,000	75,000	90,000

[2] Source: Central Bank of Nigeria Commodity Book 1987/1988

[3] Source: Unofficial US Dep. of Agr. Foreign Agr. Survey Feb '89

soya bean oil	unit	1987	1988	1989* *forecast
supply				
crush	tons	10,000	15,000	17,000
extraction rate	%	10	7	6
production	tons	1,000	1,000	1,000
total oil supply	tons	1,000	1,000	1,000
oil consumpt				
ind. and dom.	tons	0	0	0
food use	tons	1,000	1,000	1,000
livestock	tons	0	0	0
tot oil	tons	1,000	1,000	1,000

soya bean meal	unit	1987	1988	1989* *forecast
supply				
crush	tons	10,000	15,000	17,000
begin stocks	tons	10,000	3,000	3,000
extraction rate	%	100	93	94
production	tons	9,000	14,000	16,000
imports	tons	5,000	6,000	1,000
tot meal supply	tons	25,000	23,000	20,000
meal consumption				
ind. and dom.	tons	0	0	0
food use	tons	0	0	0
livestock	tons	22,000	20,000	17,000
ending stocks	tons	3,000	3,000	3,000
tot.meal .	tons	22,000	20,000	17,000

D.2.2 SOYA BEAN PRODUCER PRICES

Soya bean prices reported in Nigeria are as follows:[4]

year	naira/ton
1980/1981	150
1981/1982	155
1982/1983	175
1983/1984	230
1984/1985	300
1985/1986	500
1986/1987	1,000

[4] Source: Central Bank of Nigeria - Annual Report 1988

D.2.3 AVERAGE YIELD IN NIGERIA

The average yields per hectare on farms, as opposed to compound production, are low, ranging from 450 to 600 kg/ha. Tests using Malaysian varieties were reported over 1,100 kg/ha, other outstanding yields of 1,500 kg/ha have been reported.

D.2.4 SOYA PROCESSING IN NIGERIA

The major Nigerian enterprises processing soya are the following:

name	product	installed capacity tons/year	remarks
Taraku Veg. Oil Mill (Taraku Benue)	*veg. oil* *animal feed*	30,000	fully implem.
Nestlé Nigeria (Lagos)	*baby food*	N.A.	comm.operat.
Kano State Oil & Allied Ltd(Kano)	*veg. oil*	50,000	comm. operat.
IITA - Univ. of Ibadan (Ibadan)	*Soy-Ogi* *& other*	N.A.	pilot plant

D.3 OPPORTUNITY STUDY

The drybean production forecast in 1989 is 75,000 tons. Considering additionai 15,000 tons imported the total supply amounts to 90,000 tons. The whole quantity will be consumed as meal, oil, and fodder.

A new soy-beans processing plant to obtain soya milk as substitute of powder milk and butter imports seems, at this moment, not viable due to lack of raw material. Another reason suggesting to hold the evaluation of such a project is the complete absence of information about population behaviour towards the introduction of a new food.

A pilot plant was installed in Ibadan by IITA for carrying out tests on soya bean processing, including soya milk. According to an American expert, who spent several years with IITA, Nigerians would hardly accept to consume this product. The use of soya milk instead of animal milk doesn't seem to have encountered the favour of the largest part of populations in Europe and in many other countries with the exception of macrobiotic diets. The few existing plants were contacted by the consultant but no useful data were disclosed.

NIDB has in hand an opportunity study for the production of 3,000 litres/hour of soya milk. The study indicates the viability of such a project.

E. MAIZE

E.1 MAIZE IN THE WORLD

E.1.1 INTRODUCTION

Maize was introduced in Europe after the discovery of America. Maize (or corn) is presently grown all over the world. Production has increased greatly by the introduction of more disease-resistant hybrids with higher yields . Yield depends upon climate and soil conditions, reaching in some cases 13 tons per hectare and even more. Common yields in Europe are within 5 and 7 tons per hectare.

As far as the maize varieties are concerned, there are hundreds of cultivars today with characteristics suitable to various environments. In order to obtain the best results, loamy well drained soils with plenty of water are recommended. Irrigation should be taken into consideration where rainfalls are not sufficient.

Maize grain structure consists of the following parts:

pericarp	external cellulose covering (bran)
germ	rich of oil
endosperm	rich of starch & protein
peduncle	grain terminal part

The composition as a percentage of weight, is as follows:

water	13.3
proteins	10.0
fats	5.0
starch, dextrin, sugar	68.0
cellulose	2.0
minerals	1.7
total	100.0

E.1.2 MAJOR PARASITES AND DISEASES

The maize parasites are of various kind: field or storehouse parasites. On the field the major ones are *"Ustilago maidis"*, *"Sesamia cretica"* and *"Pyrausta nubilalis"*. In the storehouses we find *"Sporisarium maidis"*, *"Sporotrichium maidis"* and *"Penicillum glaucum"*.

The major tropical diseases are *"Puccinia polysora"*, *"Helminthosporium maydis"*, *"Curvularia"* leaf spot, stalk rot caused by *"Fusariun moniliforme"*. A parasitic weed is the *"Striga hermonthica"* (witchweed). Cultivars with various levels of resistance to the diseases have been developed.

E.1.3 MAIZE PROCESSING AND MAIN INDUSTRIES

Excluding human meals , maize processing industries and relevant products are the following:

feed industry	:	blended animal feed
starch industry	:	native starch, modified starch, edible oils, corn syrup, dextrose
flour industry	:	maize flours, edible oil, etc.
distilleries	:	alcohol, whisky, gin

Yellow maize which contains more proteins is preferable in the feed milling industry, while white maize which contains less proteins but more starch is suitable for food products and starch production. It is therefore an important source of basic raw materials for various industries. The main industries involved in the maize derived products are those producing paper, soap, adhesives, fabrics, pharmaceuticals, chemicals, beer, proteins.

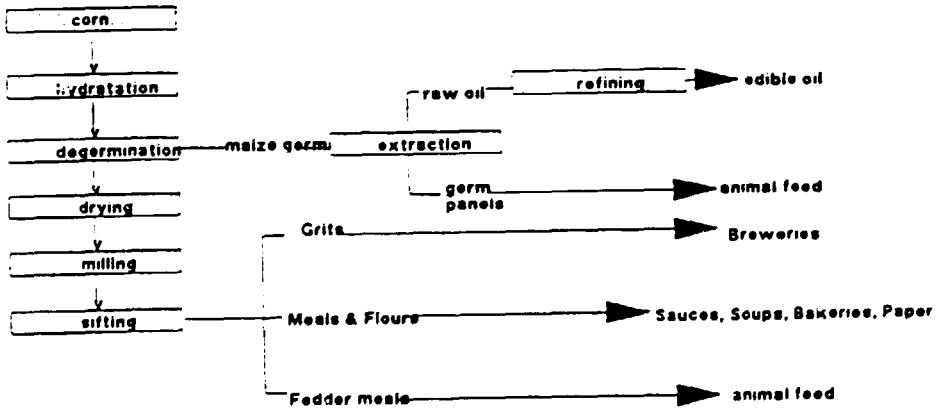
Among all crops considered ,maize is top ranked in starch contents:

	min	max
rice	65	75
maize	50	65
wheat	50	60
millet	53	56
rye	44	47
oats	27	40
lentils	39	40
barley	37	39
peas	38	39
beans	37	38

E.1.4 MAIZE MILLING PROCESSES

E.1.4.1 Dry Milling

Dry milling of maize in Nigeria was traditionally performed by pounding with a pestle in a mortar both made from hard wood. Most maize millers now have access to simple milling machines, usually mills or disc mills driven by diesel engine. The main steps of dry milling process include cleaning of the maize, destoning, dehulling, milling and sieving. The milling stage can be increased depending on the required final products. The products from dry milling process are: Grits,Flour, Meal and By-Products.



E.1.4.2 Whole Milling

The whole milling process is mainly used for the production of feed for livestock and poultry. In this process corn is first milled coarsely with some quantity of water . In a second step, additives such as proteins, vitamins and minerals are mixed during the milling phase. Dry and whole milling corn technology is well established in Nigeria, and there are many flour and feed mills in the country.

4.3 Wet Milling

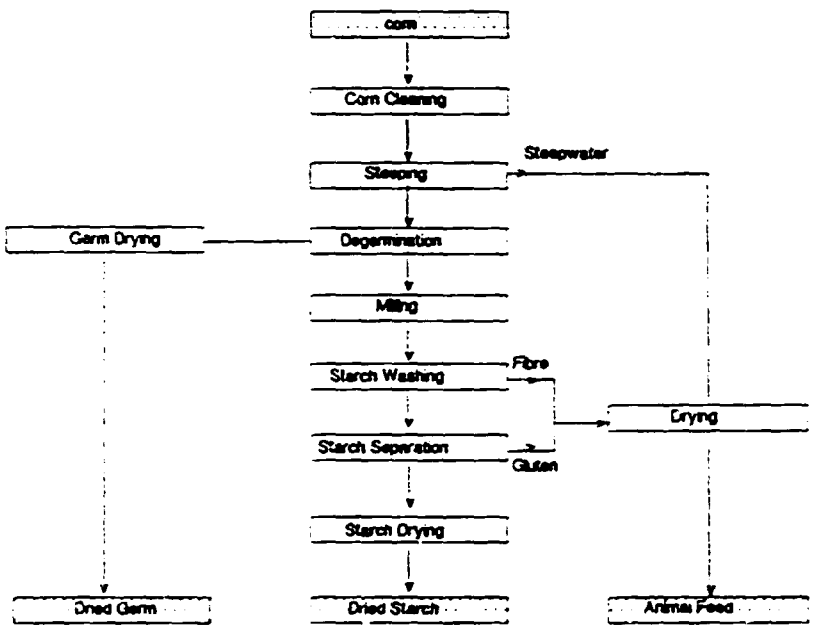
In this process about 65% of starch can be separated from the corn leaving by-products as corn germ, gluten and fibre. The corn germ can be further processed to obtain corn oil, while the gluten is dried and sold to feed-millers.

Presently there is no corn starch plant in the country due to the non availability of corn in good quality and quantity.

The average output from 1,000 kg of good quality corn processed by wet milling is as follows:

Starch	650.0 kg
Gluten	230.0 kg
Germ	70.0 kg

The main wet milling steps are shown in the following diagram:



5.2 MAIZE IN NIGERIA

5.2.1 NIGERIAN PRODUCTION AND CONSUMPTION

Maize is one of the main staple foods in Nigeria, as well as a major input, together with other products, in animal feed preparation. The main part of maize grain contains a high amount of starch and therefore maize constitutes an industrial raw material from which products such as grit, flour, feed, starch, sweeteners, oil and other related products can be obtained. The major maize producing states in Nigeria are Niger, Kaduna, Katsina, Bauchi, Kano, Plateau and Benue. Oyo and Ondo are minor producers. Present maize yield is between 1 and 3 tonnes per hectare varying from forest zone to the Savannah zone. Over 60% of maize in Nigeria is consumed as food . The balance , blended with various by-products ,is used as animal feed and for industrial processing. At present Nigeria's corn production is not sufficient to cover the local needs. Selected seeds should be available in more quantities to improve yields and reduce the corn production deficiency.

The estimated supply and distribution of corn during 1986-88 were as follows:[1]

	Units	1986	1987	1988
Area harvested	'000 Ha	2000	2000	2200
Beginning stocks	'000 MT	100	200	100
Production	'000 MT	2000	1900	2200
Total market year import	'000 MT	0	0	0
Total supply	'000 MT	2100	2100	2300
Total market year exports	'000 MT	0	0	0
Feed domestic consumption	'000 MT	400	250	250
Total dom. consumpt.	'000 MT	1900	2000	2200
Ending stocks	'000 MT	200	100	100
Total distribution	'000 MT	2100	2100	2300

E.2.2 CLIMATE AND YIELD IN NIGERIA

Climate and soil conditions of Nigeria, specially in the middle belt, are favourable for corn growing. The harvesting period is from May to July. The most common varieties are white hybrids. Yields range between 1.2 and 4.5 tons per hectare, the actual average is about 1.6. Corn has a potential yield much greater than either local sorghum or millet. The use of organic manure instead of mineral based fertilizers may contribute to achieve higher yields.

E.2.3 MAIZE PRICES

In April 1988 maize was reported to quote 2,000 Nairas per ton (about 180 US$/ton), while the price of maize for livestock feeding containing by-products reached 1,300 to 1,500 Nairas per ton. On the international market the corresponding price of maize for animal feed was about 100 US$ per ton.

[1] USDA unofficial data

E.2.4 MAIZE TRADE

Before the total import ban imposed by the Federal Government on January 1987, Nigeria used to import corn to satisfy the demand .
The following table shows the figures relevant to production and import of maize in the past years:(2)(3)

Year	Imported corn ('000 tons)	% of total	Local production ('000 tons)	total
1976	10.0	-	n.a.	n.a.
1977	36.8	-	n.a.	n.a.
1978	66.3	-	n.a.	n.a.
1979	111.0	-	n.a.	n.a.
1980	26.0	4.1	612.0	638.0
1981	144.7	16.7	720.0	864.7
1982	347.3	31.4	760.0	1,107.3
1983	49.9	6.7	694.0	743.9
1984	63.0	5.6	1,058.0	1,121.0
1985	723.0	37.8	1,190.0	1,913.0
1986	n.a.	-	1,336.0	n.a.

The ban on imports of maize and wheat caused the demand of local maize to raise dramatically.

E.3 OPPORTUNITY STUDY

E.3.1 Opportunity considerations

There are no statistical data showing whether starch, glucose and High Fructose Syrup (HFS) are imported, so it is impossible to establish what the demand could be. What is only known is that Cadbury company, one of the biggest beverages producers, is completing the installation of a plant designed to produce 6,000 tons per annum of glucose syrup from sorghum. This capacity is sufficient to satisfy the Cadbury's needs; roughly 15 to 20% can be sold to the market. There are about 100 companies operating in the field of beverages (soft drinks) with a production capacity ranging from 25,000 hl to 900,000 hl per annum. About 200 companies are operating in the field of bakery. There is no doubt that an important potential market exists for starch, glucose and HFS. It has also to be taken into consideration that there are some by-products that can be used for fodder production and for a fermentation plant (see PHARMACEUTICALS SUBSECTOR) .

Nigeria is importing more than 90% of its need for sugar, equivalent to about 600,000 tons per annum. Only two sugar companies exist in Nigeria, but their plants output does not exceed 60,000 tons per annum. These plants are located at Bacita and Numan and they process sugar cane. At present, there is no programme for increasing the sugar cane production and for the installation of new sugar mills. Imports of sugar can be reduced if a substitute for sugar will be produced, by processing locally available raw materials. Nigeria produces about 2,000,000 tons of maize and 4,000,000 tons of sorghum.

These two cereals are widely used in the world as raw materials for the production of starch and glucose (now high fructose syrup is the end product more requested in the industrialized countries). Starch, as it is, is used in the food processing or, in a modified form, in the textile industries (printing, finishing, laundering), in the paper making (to improve strength and increase resistance to wrinkling) as a surface coating for paper bags, corrugated and laminated paper and cardboard boxes.

(2) Source: FAO Trade Year Book 1976- 1979
(3) Source: Nigerian Trade Summary - various issues 1980-1986

Other fields of applications are the rubber industry, the adhesives, cosmetics and toilet powders, pharmaceuticals.

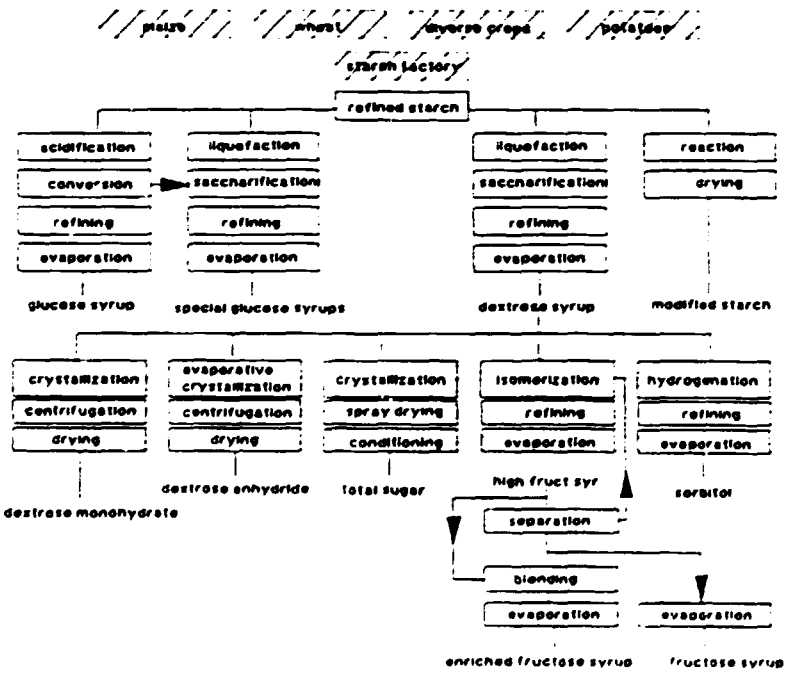
Glucose, which is obtained from starch by hydrating a starch slurry, is a sweetener that can be commercialized as a powder or as a syrup. Glucose syrup is widely used in the beverages, baking, in the pharmaceutical and textile industries, in the tanning of hides, etc.. High fructose syrup (HFS) is obtained from glucose (dextrose) by isomerizing a concentrated dextrose solution. It is a new economical sweetener, suitable for many applications which require liquid sweeteners. The HFS contains 42% of fructose and about 50% of glucose and its sweetness is equivalent to that of sucrose (drybasis). Main uses are:

- Beverages: it can replace up to 100% the inverted liquid sugar
- Bakery: it can replace sucrose in bread, pie filling, jellies up to 100% and in other products up to 70%.
- Jams
- Dairy products
- Ice creams

The installation of a plant for the processing of 200 T/day of corn (or sorghum) would be justified. However, no opportunity study is proposed, since the investment costs for such a plant, highly exceed the ceiling imposed by the financing Agencies. NIDB has in hand an opportunity study which indicates the viability of such a project.

E.3.2 Process Description

The main steps for starch production are shown respectively in the diagrams of dry and wet milling (see paragraphs E.1.4.1 & E.1.4.3). For glucose and or high fructose syrup the main steps are illustrated here below:



F. SORGHUM

F.1 SORGHUM IN THE WORLD

F.1.1 INTRODUCTION

Sorghum (or *Guinea Corn*) is a world-wide spread cereal cultivated in a belt extending from the Tropics up to about 45 degrees of latitude. Arid and semi-arid climates are particularly suitable for this crop. Sorghum grows well on most types of soil, except poor sand and clay. Apart from millet, water requirements are the lowest among all cereals. However sorghum prefers regions with distinct wet and dry seasons. The percentage composition in weight of sorghum grains is as follows (average):

water	10
proteins	8-13
fat	3.3
carbohydrates	70
cellulose	1.5-2.5
ash	1.7

F.1.2 SORGHUM VARIETIES

There are many sorghum varieties having different characteristics and composition . Instead of referring to their species, sorghum varieties are classified according to the final use and consumption:

- sorghum for alimentary purposes: specially consumed in Africa (Dhurra variety)
- sorghum suitable for producing sugar: particularly developed in USA
- sorghum for manufacturing brooms
- fodder sorghum :used for animal feeding.

F.2 SORGHUM IN NIGERIA

F.2.1 ENVIRONMENTAL CONDITIONS OF NIGERIA

Day-time is relatively short in Nigeria and temperatures are relatively high : this environment is suitable to "short-day" crops such as sorghum. Furthermore, sorghum has low water requirements and is resistant to dry spells. For these reasons sorghum is one of the most largely grown grain crops in Nigeria. Together with millet they are the longest established.

F.2.2 MAJOR PARASITES

The major parasites of the sorghum crop are:

- "*Contarinia sorghicola*" (sorghum midge)
- "*Sesami cretica*" (stem-borer)
- "*Striga senegalensis*" (parasitic witch weed).

Good husbandry fights successfully all these parasites. It is a matter of field hygiene, and seed dressing. However, practical measures to prevent these attacks are not so easy to formulate, due to the extent of sorghum cultivation, often mixed with other crops. Losses in storage due to the above mentioned pests are fairly high.

F.2.3 NIGERIAN PRODUCTION, CONSUMPTION AND TRADE

The sorghum harvested area was estimated in 1988 as much as 4,500,000 hectares, giving a production of approximately 3,500,000 tons of crop.

Average yield was 0.780 Ton per hectare, in line with other countries under similar conditions.

Major States cultivating sorghum are Sokoto, Gongola, Bauchi and Niger.

In 1989 import duty on sorghum was increased from 20 per cent to 100 per cent. Currently (April 1989) imported sorghum is delivered, uncleared prior customs, at about 150 to 160 dollars/T.

In Nigeria sorghum is a basic food commodity. Another main use is as poultry feed. In spite the decline in poultry sales, which also shrinked the demand of sorghum as fodder to about 150,000 T/year (a fraction of what it used to be few years ago), Nigeria still imports large quantities.

As the 1988 harvest started, around October, grain prices began to dip. Prices then rose again as breweries concluded that prices were at their low point and began to purchase. On January 1989 sorghum was traded in Lagos at about 1,600 Naira/T. After duty increase buying started energetically and prices are expected to exceed 2,000 Naira/T before the end of 1989.

The following table shows the figures relevant to the production and trade of sorghum for the years 1986-1988.[1]

	Units	1986	1987	1988
Harvested area	'000 ha	4500	4300	4400
Beginning stocks	'000 Ton	350	350	100
Production	'000 Ton	3600	2900	3500
Total market year import	'000 Ton	0	60	50
Total supply	'000 Ton	3950	3310	3650
Total market year exports	'000 Ton	0	50	0
Feed domestic consumption	'000 Ton	100	130	100
Local Consumption		3500	2980	3450
Total dom. consumption	'000 Ton	3600	3160	3550
Ending stocks	'000 Ton	350	100	100
Total distribution	'000 Ton	3950	3310	3650

F.2.4 SORGHUM AS BARLEY ALTERNATIVE

Nigeria's existing economical constraints and import restrictions on cereals, led to the search for alternative sources of malt, suitable for use as brewing material. Sorghum malt was found to be a good substitute to barley malt since 1943 in USA. Later, other countries like India and South Africa made use of it.

A particular sorghum variety, having comparable characteristics as barley, was also developed. In Nigeria, sorghum could diversify the raw material source for malt and reduce somehow supply shortages and/or price fluctuation due to single source dependency.

Nigeria produces roughly 21,000,000 Hl/year of beer. Assuming that all the beer is produced with sorghum malt, it corresponds to 420,000 T/year of sorghum, almost 1/5 of annual sorghum output to malt. (1 Ton of sorghum produces 0.7 Ton of Malt enough to make 50 Hl of beer)

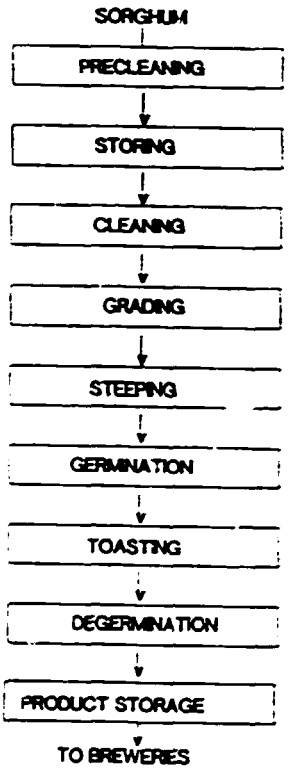
[1] Source: unofficial US Department of Agriculture - Foreign Agriculture Survey

F.2.5 MALTING PROCESS IN BREWING

Beer is normally produced from malt of barley or other cereals. Malting process, which plays a basic role in brewing, consists in turning the starch of cereals into maltose and glucose, both susceptible to fermentation. Malting is due to specific enzymes "*amylasis*", which develop during cereals germination.

F.2.6 SORGHUM MALTING PROCESS

The following diagram shows the main steps of the sorghum malting process:



Grading has the purpose to select grains having homogeneous size, that is very important for an even germination in the following step.

Steeping takes place in tanks, where sorghum grains absorb water up to 50% of their weight. This stage lasts 2-3 days at about 15 C temperature.

Germination lasts one week and is the core stage of the malting process. There are two different kinds of germination as:

- In the "*box malting*" process sorghum grains are placed on a grid-bed in the germination tunnel where they are continuously stirred and ventilated. Temperature ranges from 10 to 25 C.
- In the "*flow malting*" process wet sorghum grains are placed into a rotating drum performing stirring by motion.

Toasting is the next step, carried out at 60-70 C temperature in such a manner that enzymes are not rendered inactive.

Degermination is the final step . It is a mechanical action to separate culms from caryopsises . Sorghum malt is then stored into silos, ready to be sent to the breweries.

Quality and yield of malting process depend upon the sorghum variety. The best results have been reached by the white sorghum. Red and Yellow qualities had less good results.

F.2.7 SORGHUM RELATED INDUSTRY IN NIGERIA

In Nigeria approximately 50 establishments operate in beer and brewery related activities: see Annex 1: Nigerian Industrial Index.[2]

Out of these two are presently using sorghum, namely:

- **Savannah Grains & Food Processing Co Ltd.**
  Zaria - Kaduna State
  Capacity 12,000 tons/year

- **Benman Development Co Ltd**
  Nsukka - Anambra State
  Capacity 10,000 tons/year

Another producer is examining the same opportunity, namely:

- **West African Malting Co Ltd**
  Awkunanaw - Enugu, Anambra State
  Capacity 20,000 tons/year

F.3 OPPORTUNITY STUDY

F.3.1 OPPORTUNITY CONSIDERATIONS

Beer production in Nigeria amounts to about 21,000,000 hl. Barley import being banned, the most valid alternative to proceed with beer production is sorghum malting, even though it is not sufficient to cover the total demand. However, there is no doubt that the demand for sorghum by breweries will convince farmers to increase sorghum cultivated areas, as the soil and climate, are not adequate for barley cultivation.

An opportunity study for a plant malting 35,000 tons of sorghum is suggested.[3]

[2] Source: NIDB - CPS file on brewenes raw material

[3] See Volume 2 for details on an aopportunity study for Sorghum Malting Plant

G. GINGER

G.1 GINGER IN THE WORLD

G.1.1 INTRODUCTION

Ginger is a root-like vegetable original of Asia. It was used as drug, due to its rather sharp taste, since the ancient Greek and Roman period. Ginger is used in the food, beverage and pharmaceutical industries. Main products in which ginger is involved are cakes, biscuits, bread, candies, beer, toilet articles, medical preparations, meat and fish preparation. Ginger requires tropical to subtropical climate, that means abundance both of sunshine and of rainfall. The major producers are India, China, Western Africa, Australia, Fiji Islands, Jamaica, Japan, Bangladesh, Nepal and Malaysia. The average composition of the ginger rhizomes is the following, as percentage in weight:

water	12.0
nitrogenous components	7.5
volatile oil	1.7
fat matter	3.5
non-nitrogenous components	66.0
fibres	4.5
ash	4.8

Yields of ginger plantations range widely, reaching in Jamaica 4-8 tons per hectare and still more in India.

G.1.2 GINGER VARIETIES AND COMMERCIAL FORMS

There are about 30 known varieties of ginger with different characteristics. Generally ginger is traded in the following three basic forms:

G.1.2.1 Fresh ginger

Fresh (or green) ginger is basically considered to be a vegetable since it is usually marketed through grocery outlets. It is used directly in kitchens as flavouring matter in preparation of meat and sauces. From an industrial point of view it is used as raw material for processing in order to obtain preserved and dry ginger, ginger oil and oleoresins.

G.1.2.2 Preserved ginger

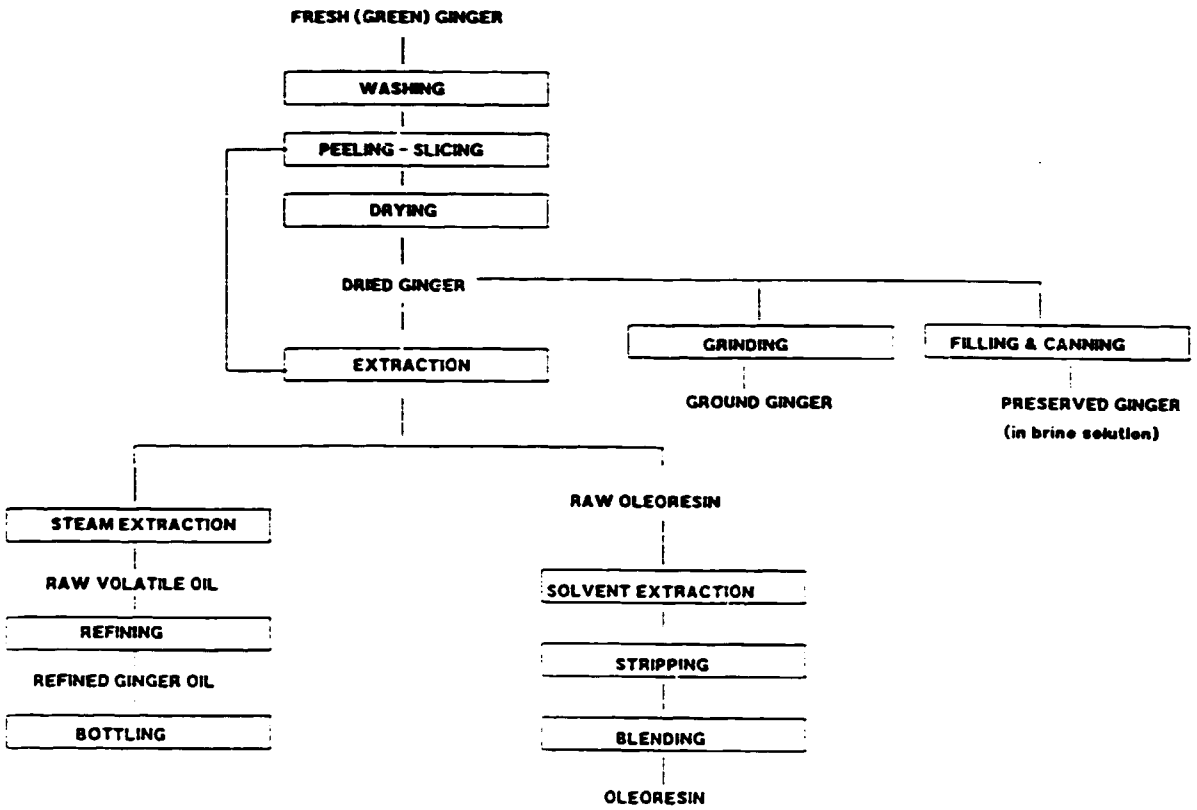
Preserved ginger consists of peeled fresh ginger, stored in brine or impregnated with sugar syrup. It is largely used in the Chinese and Japanese cuisine. Ginger preserved in sugar syrup can be converted into crystallized ginger by further processing. The ginger syrup is mainly used in the industries producing marmalade, jams, sauces, chutneys. The crystallized or candied ginger is used in baking and in the confectionery industries.

G.1.2.3 Dry ginger

Dry ginger, which is regarded as a spice, is the most important from the commercial point of view. It is obtained from the fresh (green) ginger by drying it in the sun or by means of artificial drying in air-oven at 60° C. Fresh ginger weights 4-5 times more than dry ginger. Dried ginger may be powdered into "ground ginger", which is used as ingredient in cookery, in curry preparation, in ginger-based products as cakes, biscuits, beverages and so on. Ginger is also treated for producing the "bleached dry" ginger. The peeled ginger after washing and drying is treated with slaked lime, in order to be more resistant against microbe and insect attack. Other products derived from the dried ginger are the essential oil and the oleoresins.

G.1.3 GINGER PROCESSING

The following diagram shows the main steps of the ginger processing and the relevant products



G.1.3.1 Ginger oil

The ginger essential oil can be obtained by steam distillation both of fresh and of dry ginger. In order to recovery the most part of the volatile oil contained in fresh ginger, distillation of the rhizomes should take place immediately after peeling.

To still dry ginger, rhizomes need to be ground to particles of suitable dimensions.

The distiled oil is then separated by centrifuge from the water phase and stored in suitable containers.

The essential oil yield ranges from 1.5 to 3%.

Because of its characteristics, ginger oil is used as flavouring agent for soft drinks, liquors, bakery products, sauces and so on. It is also used in perfumery as perfume modifier.

G.1.3.2 Ginger oleoresin

Ginger oleoresin is a total extract of ginger.

It contains, in addition to the components of the essential oil, also the non-volatile components, especially the sharp-flavouring principles.

Essential oil contained in ginger oleoresin can reach 30% in weight.

Oleoresin is extracted from dried and ground ginger rhizomes by means of solvents.

Ginger oleoresin is used as spice in processed food industries, where is appreciated for its very high content of the sharp flavouring principles in respect with the dry ginger.

The spent ginger dried meal contains 10-12% of proteins and 40-50% of starch. It can be used as animal feed.

G.1.4 GINGER QUALITY AND STANDARDS

The given quality is mainly evaluated according to physical appearance such as the number of shrivelled and not ripened rhizomes, the amount of earth attached to them, ash and moisture content. There are some standards set by the US-FDA (Food and Drug Administration of the United States), that provide different limits in the composition, according to the following data:

a) Dry ginger:

The washed and dried ginger should have the following contents:

. starch	:	not less than 42%
. cold-water extract	:	not less than 12%
. fibres	:	not less than 8%
. ash	:	not less than 11%
. lime	:	not less than 1%.

b) Jamaica ginger:

it has the same limits of the "dry ginger" with the following exceptions:

. cold-water extract	:	not less than 15%

c) Limed ginger/bleached ginger:

this is whole ginger coated with calcium carbonate. Same characteristics of the "dry ginger" with the following exceptions:

. Calcium carbonate	:	not more than 4%
. ash	:	not more than 10%.

The most appreciated qualities of ginger are the Indian ones, such as "Cochin", "Malabar", and "Calicut". Ginger form Jamaica and Sierra Leone is considered of high quality as to flavour, while Nigerian one is more suitable for the essential oil extraction. For fresh ginger there are not generally accepted quality standards.

G.1.5 GINGER TRADE

G.1.5.1 Fresh ginger

The demand for fresh ginger, which had been raised during the past decade, seems presently to be declining, due to the growing demand for ginger oleoresin.

G.1.5.2 Preserved ginger

As far as the preserved ginger is concerned, the market prospects do not appear encouraging for any potential new supplier on the international market.

Within the last ten years there has been a tendency towards a slight decline in the major market that is the United Kingdom. There has been some growth in import to other markets, but too low to balance. It is estimated that any likely growth in overall demand could be satisfied by the existing producers.

G.1.5.3 Dry ginger

The main producers of dry ginger are India, China, Taiwan, Sierra Leone, Nigeria, Jamaica, Fiji Islands and Australia.

The major importers are USA, United Kingdom, Saudi Arabia, Japan and Federal Republic of Germany.

G.1.5.4 Ground ginger

Ground ginger is generally less acceptable to importers than dried one, as it loses more rapidly its characteristic flavour during storage.

Furthermore, the powdered ginger is more liable to adulteration risk.

The use of ground ginger as industrial flavouring matter has somewhat declined with the growing popularity of ginger oil and oleoresin.

However, the steady increase in the technological capabilities of some of the ginger processing countries, together with emerging new markets, has led to increase the demand of ground ginger.

G.1.5.5 Ginger oil

The United Kingdom is the greatest consumer of ginger oil: The UK consumption is estimated at 1,000 kilograms per year, while the whole world consumption is evaluated about 15,000.

The international market price of ginger oil at December 1982 ranged between 53 and 88 US dollars per kilogram.

G.1.5.6 Ginger oleoresin

As said before, the demand of ginger oleoresin as industrial flavouring material is growing.

G.2. GINGER IN NIGERIA

Official statistical data on the yearly ginger production of Nigeria are not available. Nigeria was one of the major ginger (green) producers up to 1970s, when the demand on the international market declined. Ginger is widely cultivated in Kaduna, Niger and Plateau States.

In 1980 the green ginger produced in these States was estimated at 1,955 tons, according o the projections from 1978 Nigerian Grains Board.

Yield of the ginger plantations in Nigeria ranged around 4 tons of green ginger.

Ginger processing in Nigeria is presently limited to the drying stage of ginger. No company exists for processing ginger to produce essential oil and oleoresin. A project about an integrated plant to produce ginger powder, ginger oil and oleoresin has not yet been carried-out.

G.3 OPPORTUNITY STUDY

G.3.1 OPPORTUNITY CONSIDERATIONS

The raw material would be available for feeding a plant. However, as the finished product, hardly could be sold, since the market seem saturated, no opportunity study will be undertaken.

H CITRUS

H.1 CITRUS IN THE WORLD

H.1.1 INTRODUCTION

The term citrus includes fruits such as orange, tangerin, lemon, grapefruit, lime. Citrus grow in temperate-hot climate, all over the world.

The main citrus world producers are:

- the countries of the Mediterranean basin: i.e. Spain, Italy, Greece, Turkey, Israel, Algeria, Morocco, etc.

- in America: USA, Brazil, Mexico, Argentina

- in Asia: Japan, India.

There are many citrus varieties, depending upon different climate and soil conditions. Hybridization techniques were very important to develop selected cultivars.

Water requirement varies according to the soil type, rainfall should be as abundant as 600 mm evenly distributed through the season. Irrigation has to be provided where rainfalls are not sufficient.

Parasites and diseases are numerous, combated by means of chemicals and tree care.

H.1.2 CITRUS PROCESSING INDUSTRIES

The main products obtained from citrus are juices, essential oils and marmalades. Other products are pectin, flavonoids and dried rind.

Citrus of low quality are suitable to be processed into juices and marmalades.

The most important processes for juice preservation are pasteurization, concentration, concentration plus freezing, lyophilization.

H.2 CITRUS IN NIGERIA

H.2.1 NIGERIAN PRODUCTION

In Nigeria citrus are grown in Benue, Oyo, Ogun and Anambra State. Most of the cultivated areas belong to smallholders. The average size of the plantations is about 1.5 hectares. Many smallholders practice inter-cropping of other crops and citrus. Official statistical data about production, yield, harvested area and trade are not available.

H.2.2 QUALITY OF THE CROP

Citrus, particularly oranges, growing in the tropical and sub-tropical regions, have not a comparable quality with the Mediterranean producers' and Brazil's standards.

As far as oranges are concerned, the most important differences are the following:

1) in tropical and sub-tropical regions, the orange peel remains rather green in the whole fruit and does not turn into the bright colour of the Mediterranean oranges

2) on the contrary of the Mediterranean fruits, peel is too thin and adherent, so it is very difficult to be removed from the fruit

3) taste is more acid in comparison with the European or Brazilian standards.

The above mentioned negative characteristics do not allow tropical and sub-tropical fruits to be easily exported for consumption as "fresh" fruit. They are more suitable to be consumed as "fresh fruit" locally and to be processed into juice.

H.2.3 AVERAGE YIELD

Information and data collected directly on the field by the Consultant, during the survey in Benue State lead to estimate the average yield at about 8 tons of fresh citrus per hectare. As reference, yields per hectare of the Mediterranean countries with intensive cultivations range around 20 tons/ha of fresh fruits for orange, 20 to 30 tons/ha for lemon and 30 tons/ha for grapefruit.

H.2.4 AGRONOMIC CONSIDERATIONS

Chemical fertilizers, pesticides and fungicides are used in few cases. Mechanization and irrigation are not sufficiently developed. In particular it would be advisable to provide plantations with devices and facilities for watering, due to the large quantity of water needed by citrus. Lack and deficiencies of water result into low juice content and poor fruit production.

H.2.5 PRICE LEVELS

In April 1989 the fresh fruit price was ranging from 0.20 to 0.30 Naira per kilogram, ex farms, that corresponds to a revenue from 1,600 to 2,400 Nairas per hectare, in the whole year.

For some years the orange juice price on the international market has been at very low levels, due to the policies followed by the producer countries like Brazil.

H.2.6 CITRUS CONSUMPTION AND INDUSTRIAL PROCESSING

The major part of the products is consumed as fresh fruit in the producing areas. Part of fresh fruits is delivered from the production areas to large towns like Lagos and Kano.

There is no doubt that a large quantity can be processed and can reduce the imports of processed products.

Presently, there are 12 producers of juices and soft drinks. Their total output in the whole accounts to 4,300 tons/year. Many of these use imported concentrated juice, particularly from Brazil.

H.3 OPPORTUNITY STUDY [1]

H.3.1 OPPORTUNITY CONSIDERATIONS

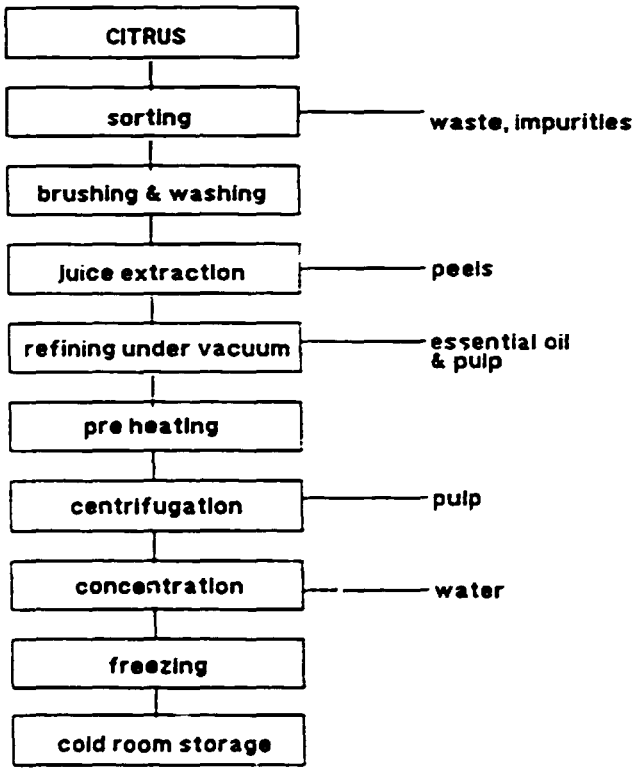
It seems to be advisable to plan a concentrate juice production factory with a daily output of 10 tons of concentrate.

The plant site should be close to the producing area and could be located for example in Macurdi, capital of the Benue State. This choice is based on the good product preservation and on the lower packing and transport costs.

The end product is destinated to become the raw material of soft-drinks and juice factories in substitution of the imported concentrate.

H.3.2 PROCESS DESCRIPTION

The suggested process is illustrated in the following block diagram:



[1] See Volume 2 for details on an opportunity study for the Citrus processing Plant

I TOMATO [1]

I.1 TOMATO IN NIGERIA

Nigeria produces a considerable quantity of tomatoes, which grow mainly in the Borno, Bauchi, Kano, Katsina, Kaduna, Sokoto, Kwara, Niger, Plateau and Gongola States.

"VF-Roma" is the most commonly cultivated specie: it has been found very suitable for most locations in the country, both for rainfed and irrigated cultivation.

Other common cultivated species are "beefsteak" and those, locally developed by the Genetic Resources Unit of the Nigerian Institute of Horticultural Research (NIHORT). The average yield per hectare ranges from 25 tons (rainfed) to 45 tons (irrigated).

Tomatoes can grow all the year round, but the best period is the dry season, between October and April, using irrigation. The peak period of harvesting is between February and May.

I.2. MARKET DEMAND

The tomato is consumed fresh or in processed forms: juices, ketchup or others. One of these is tomato paste which indicates a double concentrate tomato paste (at 28 to 30 Brix) obtained by moisture evaporation.

The demand for paste on the current market is estimated at 60,000 tons/year with an increase of 2% per annum.[2] The product is commercialized in 70 gram cans and in 80 gram pouches. Larger cans are also used for the supply to the hotels and communities.

I.3. MARKET SUPPLY

As far as tomato paste is concerned, until September 1987, the Nigerian demand was covered by domestic production and by imports. later on, imports were banned.

Tomato paste is supplied at present by the following existing plants:

	Tomato paste installed. capacity (tons/year)
- Vegetable & Fruit Processing Co. Ltd. Dadin-Kowa, Borno State	10,000
Gongola Tomato Industries Ltd. Lau, Gongola State	4,000
- Cadbury Nigeria Ltd. Tenti-Baba, Plateau State	4,000

The actual output of these plants is estimated to 14,000 tons per annum. It is reported that, about 8,000 additional tons enter the market through smuggling.

(1) See Volume 2 for details on an opportunity study for the Citrus Processing Plant.
(2) Source : NIDB

I.4 PRICES ON THE NIGERIAN MARKET

The bulk selling price of fresh tomatoes ranges from 180 to 280 Naira per ton, depending upon the season. Selling price for tomato paste is 2 Naira for a 70 gram locally produced can and 3 Naira for the imported one.

I.5. PLANNED TOMATO PROCESSING PLANTS

There are 7 planned tomato processing plants, with a capacity ranging from 3,000 to 5,000 tons/year each. Assuming that all the 7 plants are implemented, the total nominal capacity, would be 45,000 tons per annum including the existing ones. The above capacity corresponds to 75% of the estimated current demand.

I.6. OPPORTUNITY STUDY

I.6.1 OPPORTUNITY CONSIDERATIONS

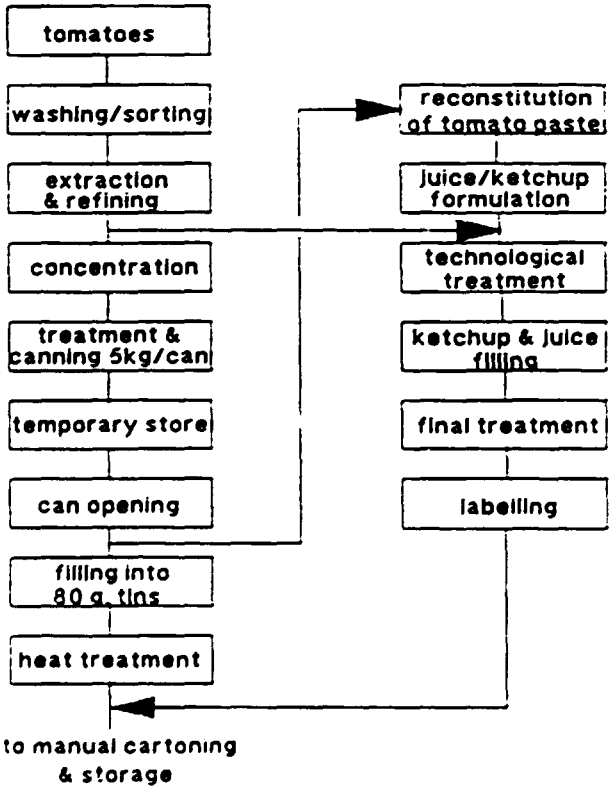
A 5,000 tons/year tomato paste plant is suggested for the following reasons:

- the demand is strong and cannot be satisfied, because imports have been banned
- raw material and packing materials are locally available

The suggested process will allow also the production of ketchup and tomato juice.

I.6.2 PROCESS DESCRIPTION

The main process steps are illustrated in the following flow diagram:



SECTION 3

CHEMICAL SUB-SECTOR ANALYSIS

TABLE OF CONTENT

CHEMICAL INDUSTRIES

The chemical industries subsector currently accounts for about 23 per cent of manufacturing output. However, it is high import dependents mostly mixing and repacking imported items for resale.

It needs to be urgently integrated with two major sources of its raw materials which are petrochemicals and agro-based chemicals.

Nigeria has a great potential in both sources. Nevertheless, the chemical industries are, in general, capital intensive and considering the constraints of the present economic situation, the opportunities of investing in this sector are very few.

In the following chapters the field will be analysed with the aim of finding out projects that can be considered.

Some exceptions will be made, when the envisaged project seems to be beneficial to the Nigerian economy even if its investment costs exceed the imposed limits.

A. CHLOR-ALKALI PLANT [1]

A.1. MAJOR CHEMICALS PRODUCED

Chlor Alkali plant is mainly designed to produce **caustic soda**. However, it also produces other chemicals and elements namely:

- chlorine
- sodium hypochlorite
- hydrogen

Caustic soda (NaOH) world consumption is roughly represented by the following figures:

Industrial sector	share of NaOH cons.
- Organic and inorganic chemicals	43%
- Petroleum	5%
- Food processing	2%
- Pulp and paper	15%
- Soap and detergents	6%
- Alumina	5%
- Textile	3%
- Rayon and cellulose	2%
- Miscellaneous	19%

The first industrial use of **chlorine** was to produce bleaching agents for textiles and paper and for cleaning and disinfecting. Later on, it was regarded merely as a useful chemical agent. Chlorine consumption, as percentage of various product groups for example in USA, Japan and FRG , is the following:

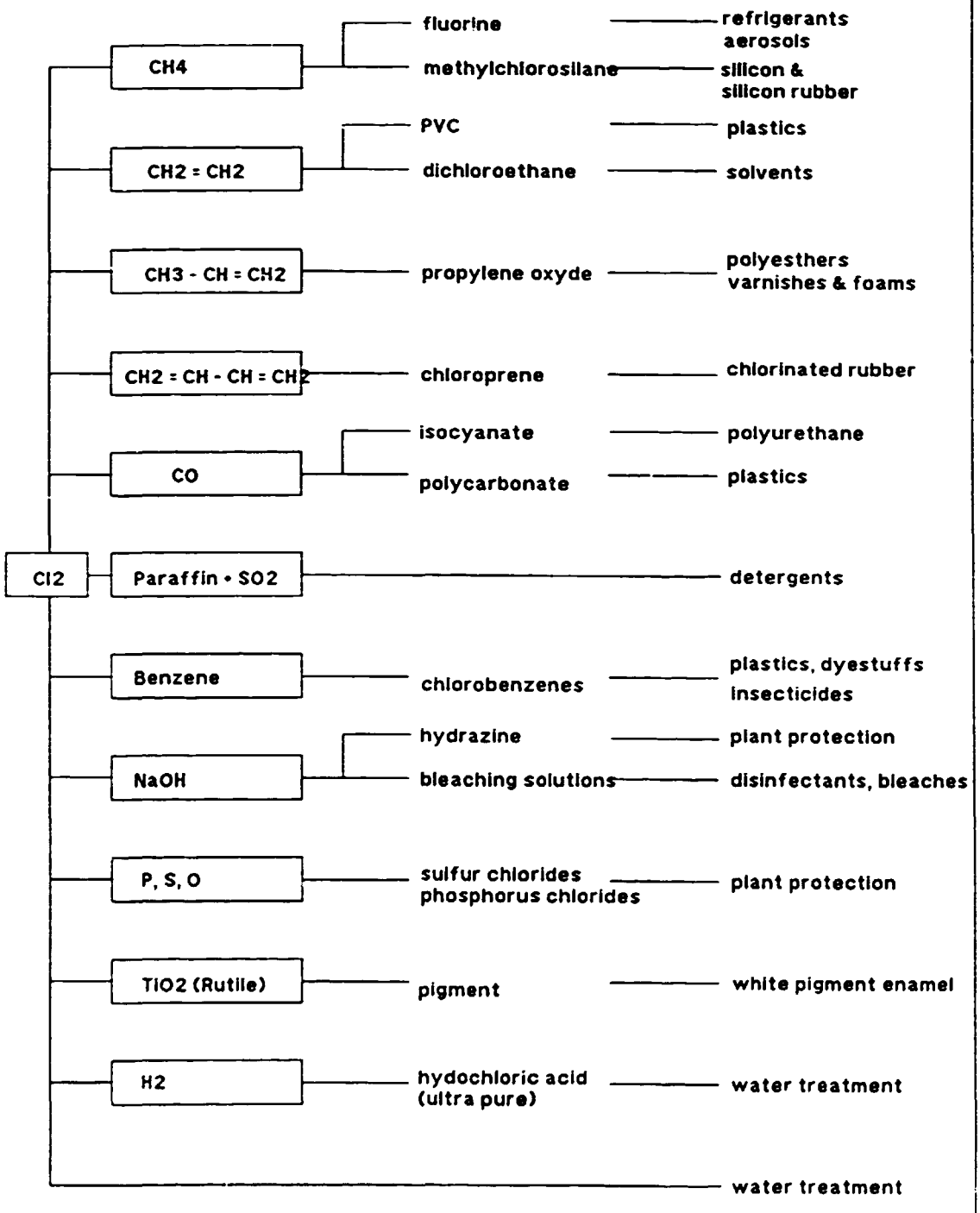
PRODUCT	USA	JAPAN	FRG
Vinylchloride	22	28	23
Solvents	17	16	19
Misc.organic prod.	27	39	47
Water treatment	7	--	
Organic products	12	9	8

In the last years, importance of chlorine declined constantly as raw material for synthetic organic chemistry. The use of elemental chlorine for sterilizing water has declined in some areas, but not in others.

The number of possible reactions of chlorine and, therefore, the number of intermediates and end products is remarkably large.

Some important reactions along with the areas of application of Cl_2 end product are shown in the following table:

[1] See Volume 3 for details on an opportunity study for Chlor-Alkali Plant



Important reactions of chlorine & uses of end products

A.2. DEMAND

Nigeria imports 100% of its needs of caustic soda. In the last years the quantities imported are as follows:[3]

year	tons
1974	23,382
1975	27,918
1976	24,388
1977	22,310
1978	13,374
1979	22,081
1980	12,886
1981	19,336
1982	21,343
1983	15,974
1984	16,556
1985	27,081
1986	n.a.
1987	25,297

The quantities of caustic soda imported are justified by the fact that the major consuming industries stated in paragraph A.1 above, are quite developed in Nigeria: textile, food, paper, soap and detergents, and in particular petroleum industry.

Statistics concerning chlorine imports are not available.

A.3. SUPPLY

There is no chlor-alkali production plant in Nigeria, although some promoters applied for financing. All the demand is satisfied by imports.

A.4. OPPORTUNITY TO STUDIES

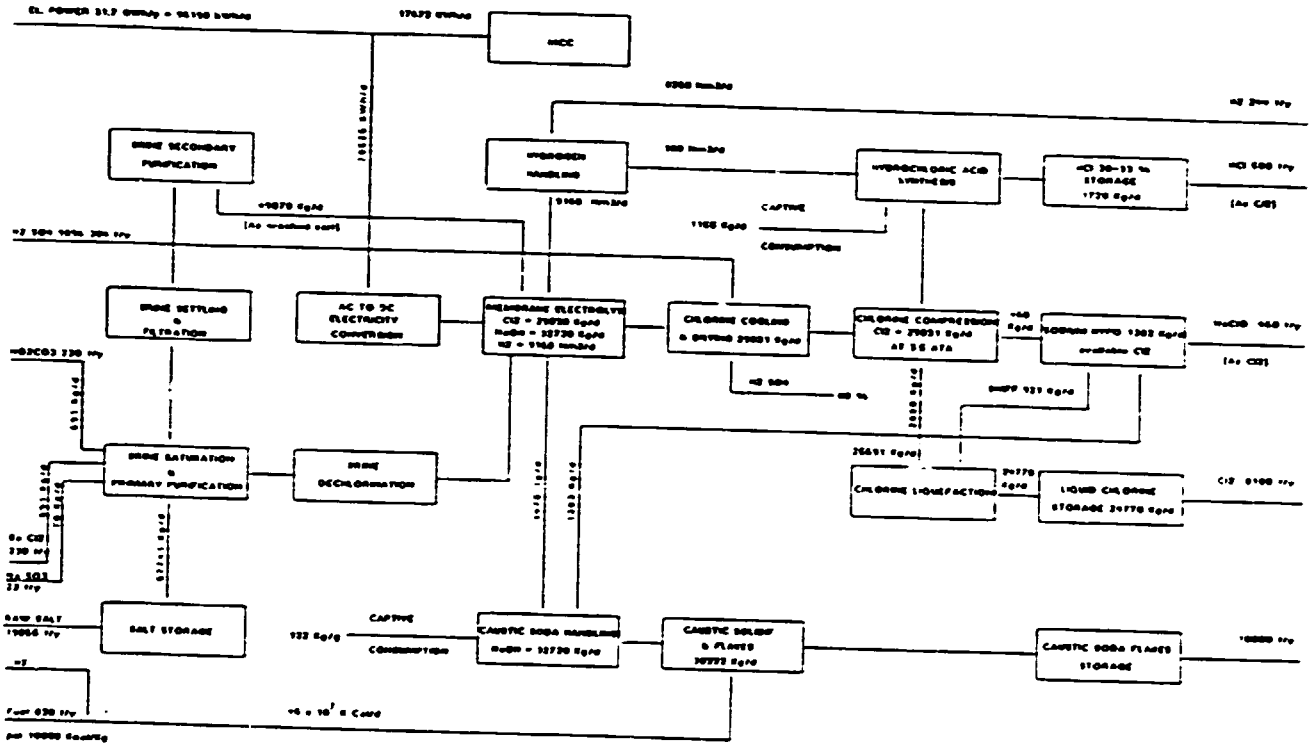
The production of caustic soda was not considered viable, from the technical point of view, because of the difficulty to find where to use the chlorine obtained as by-product. It is the opinion of the consultant that this difficulty may be overcome, by using chlorine for calcium hypochlorite production. Another difficulty was that NaCl a basic raw material, is not available in Nigeria and it has to be imported.

The latter is a minor problem if compared to foreign currency drainage caused by caustic soda imports.

It is suggested to appraise the opportunity of installing a chlor alkali plant to produce 4,000 tons/y of caustic soda which is the minimum economic size of such kind of plants.

[3] Source : FOS Federal Office of Statistics , Lagos

A.5. PROCESS BLOCK DIAGRAM & MATERIAL BALANCE



B CALCIUM HYPOCHLORITE [1]

B.1. INTRODUCTION

Calcium hypochlorite is a chemical obtained from:

- chlorine: (from the suggested 4,000 ton/year caustic soda plant)
- caustic soda: (from the suggested 4,000 ton/year caustic soda plant)
- calcium oxide: (available in Nigeria)
- sodium sulfite: (the only chemical to be imported).

B.2. USES

Sterilizing or Bleaching are the two main applications of Calcium Hypochlorite.Other known chemicals such as chlorine or sodium hypochlorite have the same use, but Calcium Hypochlorite has in comparison the following advantages:

- solid form (granules or briquets), easy to handle, pack, transport and store;
- no danger of pollution, even if stored in large amounts.

In addition, it compared to sodium hypochlorite, it has:

- better chemical stability
- higher "chlorine" content

These advantages have contributed to its success in the industrialized countries. For the same reasons its use is recommended in Nigeria, in the following fields:

- *Water treatment*: disinfection of city waternets and wells, disinfection of water reservoirs, removal and prevention of the algae growth in water tanks.

- *Textile bleaching*: bleaching of cotton yarn and cotton cloth, bleaching and disinfection of children clothing and hospital linen.

- *Industry*: disinfection of facilities at meat processing plants, dairies, canning factories, soft drinks factories and sugar refineries; disinfection of bottles and water used in the production of soft drinks; bleaching and disinfection of raw vegetables and fruits.

- *Public facilities*: disinfecting, deodorizing and bleaching of floors, walls, drains and toilets at hospitals, schools, railway stations and other public buildings.

- *Domestic uses*: disinfecting, deodorizing and bleaching.

The impact of calcium hypochlorite is potentially important taking into consideration

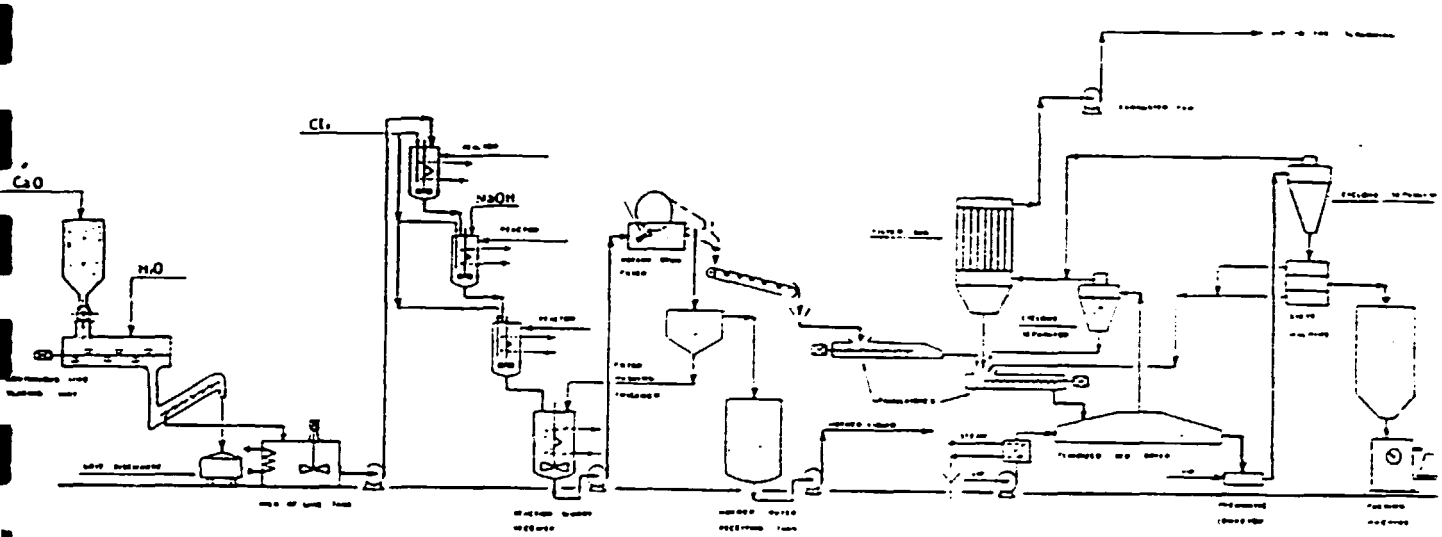
- the water and sanitation problems of a rural population in the country.
- existing users among food and textile industries

B.3. OPPORTUNITY TO STUDY

It is suggested to undertake an opportunity study for the production of calcium hypochlorite.

[1] See Volume 3 for details on an opportunity study for the Production of Calcium Hypochlorite

B.4. PROCESS FLOW DIAGRAM



C LINEAR ALKYLBENZENE (LAB)

C.1. LAB SULPHONATION

Alkylbenzene Sulphonation is the process which produces DAM (Detergent Active Matter) from LAB (Linear AlkylBenzene). Dam is a basic active agent used in the formulation of powdered and liquid detergents for household and industrial purposes.

Kaduna Petrochemical Complex has a nominal annual capacity of 30,000 tonnes of LAB corresponding to 42,000 tons/year of DAM. One ton of DAM requires 718 kg of LAB.

LAB production started in June 1988 . End users reported that both quality and delivery terms are rather unsatisfactory. Federal Authorities banned LAB import.

C.2. SITUATION IN NIGERIA

At present there are three detergent producers from LAB sulphonating with a total annual installed capacity of 109,000 tons/year:

- P.Z INDUSTRY LTD., IKORODU

Commissioned in 1983, its nominal annual capacity, based on three shifts/day is 52,000 tons of DAM.

The plant, designed and supplied by a U.S. firm, is one of the three largest plants in Africa and among world biggest.

It is associated to a 200,000 tons/year "spray tower".

- LEVER BROTHERS NIG. LTD., APAPA

This Company has three sulphonating units and 2 "spray towers",all of them supplied by Ballestra (Italy).

Apapa plant has two sulphonating units ,respectively of 2 and 1 tons/h capacity, and one "spray tower". The corresponding annual capacity based on three shifts is 24,000 tons/year.

Aba plant has one 2 tons/hour sulphonating unit, and one "spray tower", corresponding to an annual three shifts capacity of 16,000 tons/year.

Only Aba plant is operating due to lack of demand and LAB shortage

- NASCO HOUSEHOLD PRODUCTS LTD., JOS

The plant was commissioned in the late 70s. Its nominal annual capacity, based on three shifts/days, is 16,000 tons/year of DAM.

The unit is associated with a "spray tower", whose nominal capacity is 65,000 tons/year of powder detergents.

The plant was reported to operate far below the nominal capacity, because of lack of raw material.

C.3. DETERGENTS DEMAND AND SUPPLY

The table herebelow shows the estimated demand and supply for household detergents.

It is hard to assess detergents demand, as detailed statistical data are not available.

ESTIMATED DEMAND AND SUPPLY FOR HOUSEHOLD DETERGENTS IN NIGERIA (IN '000 TONNE)

Year	Demand for detergents	Supply of detergents	Supply Gap
1989	361.0	303.2	57.8
1990	371.8	318.4	53.5
1991	383.0	334.3	48.7
1992	394.5	351.0	43.5
1993	406.3	368.5	37.8
1994	418.5	387.0	31.5

Source: N.I.D.B. survey (1987) and assumptions

Assumptions on demand and supply estimates

Assumptions on Demand Estimates

1. That 80% of the urban and 40% of the rural population will consume 550 grams of detergents per month which is equivalent to 6.6 kilograms per head per annum.

2. That this is further projected annually by the combined effect of population increase and officially estimated GDP growth rate of 3.0%

Assumptions on Supply Estimates

1. That 80% od total installed capacity of 378,950 tonne (NIDB market investigation, October 1986) would be utilized.

2. That the 80% capacity utilization level is expected to increase at 5.0% per annum to take care of importation and new entrants.

C.4. RECOMMENDATIONS

- The installed LAB sulphonation capacity exceeds the demand.

- LAB production from Kaduna Complex covers one third of sulphonating units capacity.

Investing in a new LAB sulphonating unit will not be considered.
It is suggested to consider the production of SODIUM SULPHATE, a chemical product that is used in the formulation of detergents. Actually, for every tonne of detergent produced, 500 to 700 Kgs of sodium sulphate are used. Considering that the potential output of the existing detergent plants is around 400,000 t/h, the actual demand of Na_2SO_4 is close to 300,000 t/y. An opportunity study will be undertaken.(1)

(1) See Volume 3 for details on an opportunity study for the Production of Sodium Sulphate

D GLUE

D.1. WOOD INDUSTRY IN NIGERIA

The present production of plywood and particle boards in Nigeria is respectively 180,000 cu.m. and 100,000 cu.m.

Major producers are:

- African Timber & Plywood company	Sapele
- Calabar Veneer & Plywood ltd.	Calabar
- Nigerian-Romanian Wood Industries	Ondo
- Serowood ltd.	Calabar
- Yinka Morenike Plywood & Woodworks Ind.	Ise Ekili,Ondo
- Klifco Nigeria ltd.	Port Harcourt
- Piedmont Plywood ltd.	Benin City.

The above producers reported that the demand is increasing year after year and they expect by 1995 to double it:

Manufacturers forecast:

plywood	360,000 cu.m.
particle boards	200,000 cu.m.

These estimates seem too optimistic; a more conservative estimate forecasts the present demand/capacity to increase by 50%:

Consultant previsions:

plywood	250,000 cu.m.
particle boards	150,000 cu.m.

D.2. GLUE DEMAND

For plywood and particle boards a 65% bw solution of UREA-FORMALDEHYDE (U.F) based glue is used.

Average ratio use per cu.m. is the following:

- for 1 cu.m. of plywood:	30 kg of U.F. 65% bw
- for 1 cu.m. of particle boards:	100 kg. of U.F. 65% bw

The present annual need of U.F. 65% bw glue for wood industry is estimated to be about 15,000 tons.

Taking into consideration the conservative forecast,the demand within 1995 is expected to reach about 20,000 tons.

D.3. GLUE SUPPLY

One company is reported to produce U.F. glue in Nigeria. This company imports all basic chemical ingredients.
Clients complain of delivery services and product quality of this company.
The U.F. 65% glue in Nigeria is traded at 6.5 Naira/kg.

D.4. TECHNOLOGY DESCRIPTION

D.4.1 FORMALDEHYDE 36% BW PRODUCTION

Methanol is passed to a steam-heated evaporator, mixed to freshly blown-in air and recycled off-gas from the absorption tower.

The gaseous feed passes through catalyst-filled tubes in a heat-exchanging reactor. A high boiling heat-transfer oil (or molten salts) circulates outside the tubes, removes the heat reaction from the catalyst in the tubes and produces steam.

In the reactor gaseous, the gases are cooled in a heat-exchanger unit and are passed to the bottom of an absorber column in which the formaldehyde concentration 36% bw is obtained by controlling the amount of process water added at the top of the column.

The final product (formaldehyde 36% bw) from the bottom of the absorption column is then sent to the storage.

D.4.2 UREA-FORMALDEHYDE GLUE 65% BW PRODUCTION

Metered formaldehyde 36% and urea are fed to a polycondensation reactor, mixed, warmed up to 85 C before the adding of acetic acid 50%.

After the last addition the polycondensation reaction starts and the temperature raises up to 98 C.

The polycondensation reaction lasts for about one hour and half and it is interrupted by the adding of caustic soda solution 30%.

It follows the cooling down to 65 C and then sent, through a filter, to the storage.

D.4.3 OTHER GLUES

The same equipment used for the Urea-formaldehyde glue 65% may also produce:

- Melamine-Urea-Formaldehyde resins (MUF resins) mainly used for fire retardant and water resistant wood panels.

- Melamine-formaldehyde resins (MF resins) mainly used for paper impregnation.

D.4.4 MATERIAL BALANCE

The production of 1 ton of U.F. 65% bw glue ready for use needs the following ingredients:

- Urea	512 kg
- Formaldehyde (36%	853 kg
- Caustic soda (30%	4.26 kg
- Acetic acid (50%	1.61 kg
- Distiled water	280 kg
- Steam (4 to 7 bars)	450 kg
- Cooling water	15 m3/h

One ton of **formaldehyde** (36%) b.w. requires:

- Methanol	415 kg
- Hydrochloric acid	0.06 kg
- Caustic soda	0.203 kg
- Catalyst	0.07 kg
- Salts for the reactor	0.04 kg
- Electric energy	100 kWh

D.4.5 SOURCE OR RAW MATERIAL

D.4.5.1 Urea

Urea is available in Nigeria. The Petrochemical Complex of Onne started the production in 1988. The nominal output is 600,000 t/y; the major part of it is exported, while the remaining quantity is sold locally as fertilizer.

D.4.5.2 Formaldehyde

Formaldehyde is not produced locally. Formaldehyde production is considered in this opportunity study.

D.4.5.3 Caustic soda

Caustic Soda is not produced locally. NaOH production is suggested in the chlor-alkali opportunity study (see chapter A).

D.4.5.4 Acetic acid

Acetic acid is to be imported.

D.5. OPPORTUNITY STUDY [1]

A plant for the Production 20,000 tons/year of U.F. glue at 65 b.w. is suggested .

The suggested plant has two main sections:

- a **formaldehyde** production section;

- a glue production section.

[1] See Volume 3 for details on an opportunity study for the production of urea-Formaldehyde Glues.

E. FERTILIZERS

E.1 SITUATION IN NIGERIA

Nigeria imported all fertilizers needed, until "THE FEDERAL SUPER-PHOSPHATE FERTILIZER COMPANY LTD.", of Kaduna started its production in 1976. This company was incorporated in 1973 to produce 100,000 tons/y single super-phosphate (SSP) fertilizer. The main raw materials input, sulphur and phosphate rock, were imported. The management reported that production never exceeded 30% of the nominal capacity due to wear and tear and lack of adequate spare parts for maintenance. The plant stopped operating in late 1985. A feasibility study was prepared for the revamping and offers were received but no action was undertaken so far.

In 1988, the NATIONAL FERTILIZER COMPANY OF NIGERIA LTD. (NAFCON), located at Onne, near Port Harcourt, Rivers State, started the commercial production of Urea. The plant is designed for a nominal capacity of 700,000 t/y of Urea. It produces also Ammonia and NPK fertilizers.

The imports of fertilizers in the period 1975 - 1987 are indicated here below[2](figures are in 1000 tons):

year	nitrogen fertilizer	phosphatic fertilizer	potassium fertilizer	(npk) fertilizer	total
1975	82.3	62.6	4.6	1.6	151.0
1976	90.8	99.1	5.8	12.2	207.9
1977	56.9	2207.9	31.0	16.8	2312.6
1978	64.8	918.0	354.6	4.2	1341.6
1979	96.9	30.2	5.3	886.9	1019.3
1980[3]	20.6	18.6	7.5	1.4	48.1
1981	1453.0	348.6	5.1	6.4	1813.1
1982	87.1	361.0	63.6	35.7	547.4
1983	46.9	154.3	0.9	4.8	206.9
1984	87.1	113.9	37.5	266.2	504.7
1985	429.3	196.1	2.3	15.4	643.1
1986	187.5	661.3	6.7	9.8	856.3
1987	779.3	234.6	1.5	13.5	1028.9

In 1988, first year of operation of the NATIONAL FERTILIZER COMPANY OF NIGERIA LTD. (NAFCON) the output was:

	ammonia	urea	npk
tons produced	377,000.0	513,000	144,000.0
days in production	360.0	350.0	225.0

About 40% of this production supplied the local market, while the balance was exported to the USA, Europe and Singapore.

[2] Source: FOS, Nigeria Trade Summary (various issues) Ikoyi, Lagos
[3] Figures from January to June

The ex-works selling prices are:

- UREA	175 US $/ton
- NPK (15+15+15)	250 US $/ton

The installation of a second plant, similar to the first one is in the expansion programmes of NAFCON.

E.2 MARKET DEMAND

In 1987, the arable land was estimated about 30,000,000 ha. In the same year, the total consumption of fertilizers (all types) was about 1,030,000 tons. The average consumption is 30 kg/ha. This value, compared to the averages of other two developing countries like Kenya (46 kg/ha) and Pakistan (73,5 kg/ha) is considered low.

Taking into consideration the Federal Government for efforts to improve agricultural yield, it can be assumed that in the coming years the demand fertilizers increase by 60% corresponding to 50 kg/ha. If this percentage is to be applied to imports registered in 1987 (assumed as a typical year) the need for fertilizer in tons/year becomes as follows:

Nitrogenous fertilizers	779,300 x 1.6 =	1,247,000 tons
Phosphate fertilizers	234,600 x 1.6 =	375,360 tons
NPK fertilizers	13,600 x 1.6 =	21,760 tons
Potassium fertilizers	1,500 x 1.6 =	2,400 tons

E.3 MARKET SUPPLY

The Onne plant, with the foreseen expansion, can easily satisfy the future demand for Nitrogenous and compounds fertilizers.

Phosphatic and potassium fertilizers still have to be imported, as there is no production of potassium fertilizers and the existing plant is out of order. Even if the Kaduna plant is rehabilitated, its capacity (100,000 tons/year) will partially satisfy the demand.

E.4 OPPORTUNITY STUDY

The minimum economic size of a fertilizer plant requires an investment exceeding 20,000,000 US Dollars.[1] Considerting that the raw materials have to be imported it is suggested to abandon the idea of producing SSP from phosphate rocks.
It is proposed, instead, to consider the processing of bones which are available within the country, although their collection could consistute a problem.
Actually, from bones, using sulphuric acid, SSP can be obtained along with other products like bone glue anf fats.[2]

[1] Source: UNIDO - Sectoral Studies Series - Mini Fertilizer Projects
[2] See Volume 3 for details on an opportunity study for the production of Bone Based Chemicals

F. PHARMACEUTICALS

F.1 GENERAL

A field survey was carried out for the purpose of:

- ascertain the present situation
- analyse the health system
- assess the pharmaceutical market
- identify the availability of local raw materials (petro-chemical and/or agro-chemical based)
- identify existing pharmaceutical plants
- collect any other useful information, in order to be able to establish whether local production of active ingredients is possible or not.

The results of the survey are reported here-below.

F.2 HEALTH SITUATION

a) Morbidity pattern[1]

The most common causes of morbidity in Nigeria are preventable infectious diseases.

The most common causes of visit at clinics and at outpatient departments of hospitals are listed here under, along with the frequency percentages:

- infective and parasitic diseases	38.2%
- respiratory diseases	12.7%
- ill defined conditions	9.2%
- skin diseases	8.4%
- digestive system diseases	4.7%

These five causes of diseases account for more than 73% of total causes.

b) Notifiable diseases[2]

The ten leading causes of morbidity from notifiable diseases registered in 1987 are:

Disease	N.of Cases	Rate per 100,000 inhab.
- Malaria	1,067,887	938.2
- Dysentery	227,894	209.8
- Pneumonia	85,752	78.1
- Measles	72,966	67.2
- Gonorrhea	63,127	58.1
- Whooping cough	46,669	42.1
- Schistosmiasis	30,754	28.3
- Ophthalmia neonatal	23,316	21.5
- Tuberculoses	19,512	17.1
- Meningitis	17,079	15.7

(1) Source: The National Health policy - Oct1988

(2) Source: federal Ministery of health - Medical Statistics Division

The general opinion is that the number of cases is much higher because:

- many cases escape diagnoses, the health coverage being rather limited
- some cases are not properly diagnosed
- people living in the far villages do not contact health centres preferring the assistance of traditional doctors.

c) Causes of mortality

The major causes of mortality from notifiable diseases are:

- Malaria
- Meningitis
- Measles
- Yellow fever
- Pneumonia
- Tuberculoses
- Whooping cough
- Tetanus

The World Health Organization (WHO) reports that, indicatively, these diseases are responsible for some 6617 fatalities, at a rate of 6.09 per 100,000 population. The first indication coming out from the preceding points is that anti-malaria and anti-bacterial drugs (antibiotics) are to be considered as first priority in investment opportunities.

F.3. HEALTH SYSTEM

a) Health coverage

Official sources indicate that some 80% of the population can be reached by medical assistance, and that 30 to 35% of the population has a modern medicine health care.

b) Health organization

The health organization is controlled by the Federal Health Department. There are 21 State Health Departments, one for each State plus one Health Department for the Federal Capital Territory. Each State Department is responsible for the organization of the health system, the establishment of health centres and assure them drugs supply . Public health system owns 40% of hospitals , while the remaining 60% is owned by the private sector.

c) Delivery of drugs

The Federal Government has published a list of "Essential Drugs", which includes some 220 products. In public hospitals, doctors are obliged to prescribe essential drugs, for which patients bear 20% of the cost.

F.4. PHARMACEUTICAL MARKET

a) Supply

An 80% of the market supply derives from private companies and the remaining 20% by Government. UNICEF imports occasionally limited amounts of drugs for some special projects, mainly vaccines.

Smuggled drugs enter the market but it is quite difficult to quantify its incidence on the official figures. The market is also fed with imported or locally manufactured fake drugs, which imitate the confections of the most reputed companies but are often of bad quality, substandard or contaminated. In some cases these drugs do not contain the active ingredients. At this stage it is impossible to determine the magnitude of this phenomenon; an investigation of the diffusion of fake drugs is recommended.

There are about 60 registered drug manufacturers. A great number have no manufacturing facilities. They contract their brand products to the few manufacturers with facilities. Other 50 pharmaceutical companies are only engaged in marketing of pharmaceutical drugs.

b) The major active ingredients used in Nigeria are:

active ingredients	tons(1985)	value 1985 N (000)
. acetylsalicilic acid	2,840	10,480
. paracetamol	370	1,910
. chloroquine	220	6,000
. caffeine	170	1,280
. ampicillin	95	3,000
. chloramphenicol	75	340
. oxytetracycline	38	1,940
. tetracycline	21	140
. cloxacillin	5	390
. penicillin G, V & derivatives	5	n.a.

c) Raw materials

All active ingredients are imported. Some inorganic chemicals which can be used for the production of active substances, like ammonia, sulphuric acid, and aluminium sulphate, are locally available. The NNPC petro-chemical plant programmes foresee the production of some organic products in 1995. Such products are just basic organic products which need further transformation before being used as starting materials for the production of pharmaceuticals. An indicative general subdivision of chemicals is reported herebelow along with the order of magnitude of plants output to make their production commercially viable.

BASIC ORGANIC CHEMICALS
50,000 tons/year and up

INTERMEDIATE ORGANIC CHEMICALS
5-10,000 tons/year and up

FINE CHEMICALS
1 ton/year and up

The quantities of intermediate chemicals for the production of pharmaceutical active ingredients are rather small (few hundred tons) .Only in the case of acetylsalicilic acid, the production reaches some thousand tons. This consideration leads to the conclusion that the market is too small to justify an economically viable production of intermediate inorganic chemicals.

F.5. FERMENTATION PRODUCTS

The local availability of agriculture products suggests to examine in detail the production of pharmaceuticals based on their fermentation , especially antibiotics. Particular attention is to be focused on the penicillin G fermentation for the following reasons:

- penicillin G is a drug of strategic importance for itself and for its derivatives
- the quantities required justify an investment
- penicillin G is a starting material for the production of some important semi-synthetic penicillins such as ampicillins, amoxycillin, cloxacillin and for some semi-synthetic cephalosporins such as cephalexin.

The main ingredients for the preparation of the fermentation broth are:

- glucose solution	not available locally
- sugar cane	locally available
- corn steep liquor	not available locally
- coconut oil	locally available
- ammonia	locally available

The low cost of electric energy, which is consumed in large quantity in the fermentation processes, is another reason for which it is suggested to further investigate the fermentation products.

Moreover Nigerian technicians trained in industrial micro-biology at the University of Ibadan are prepared to run such kind of plants.

F.6. PROSPECTIVE OPPORTUNITY STUDIES

After having examined the present situation of the market and the raw materials, the following opportunity studies could be undertaken:

- An industrial fermentation plant for the production of penicillin G.
- A chemical plant for the production of 6-APA by splitting of the side chain of penicillin G (This plant can be installed only if the plant for the production of penicillin is installed).
- A plant for the production of semi-synthetic penicillins especially ampicillin which is largely demanded in Nigeria; the plant could also be used for the production of other semi-synthetic penicillins such as cloxacillin.

In the following paragraph, the description of the projects are provided, although no opportunity studies will be undertaken, since the investment costs are very high.

F.6.1 PENICILLIN PROJECT

The main scope of the suggested project is to produce Potassium Penicillin G by submerged fermentation . Potassium Penicillin G is used for the preparation of 6-aminopenicillanic acid and then of Ampicillin.

The same plant can also produce limited quantities of Sodium Penicillin G, to be used as injectable, and Penicillin G procain salt, both sterile and feed grade.

Penicillin G is an important antibiotic and the first one to be introduced into the market during the 2nd world war. Its importance depends on the following facts:

- it is still a widely used antibiotic as well as its salts and derivatives (sodium and potassium salts, procaine and benzatine, long-acting injectable derivatives).

- it is the starting material for the production of 6-aminopenicillanic acid (6-APA) which is the basic material for the preparation of the semi-synthetic penicillins such as Ampicillin, Amoxycillin Cloxacillin and many others

- it is the starting material for semisynthetic cefalosporins such as Cephalexin through 7-ADCA.

For all these reasons Penicillin G should be considered a strategic product in the field of anti-infective drugs. Self-sufficiency is of vital importance for a Nation also in consideration of the saving of hard currencies.

Since its production is done by fermentation and the nutrients of the fermentation broth are products derived from agriculture which are or will be produced in Nigeria, it is our opinion that local production of Penicillin G should be carefully examined.

F.6.1.1 Market

a) Generalities

The market for Penicillin G and derivatives and for Ampicillin are here discussed together as they are strictly correlated.

According to the Pharmaceutical Manufacturers Association of Nigeria, the value of the pharmaceutical market in 1988 was estimated at 700 millions Naira ex-factory.

The public sector accounts for 20 to 30% of the total market value.

The veterinary market including the feed supplement sector is evaluated around 50 millions Naira at ex-factory prices.

It is very difficult to quantify the illegal market (fake drugs, smuggled drugs etc.) as no information is presently available. According to some opinions the dimension of this parallel market seems to be around 70% of the official. Fake drugs alone account for 20% of the total.

b) The market of penicillins

Like other pharmaceutical products in Nigeria, Penicillins are imported both in the finished form and as a bulk for the local production of the specialties.According to official figures in 1988 the following quantities were imported in Nigeria: (rounded up figures)

Product	Quantity (t)	Value (1000 Naira)
Penicillin G,V and derivatives	6	n.a.
Penicillin G derivatives for zootechnical use (estimate)	8	n.a.
Ampicillin (bulk&finished)	93	11,200

c) Market Projections

To estimate plant capacity preliminary projections have been made both for Penicillin G and derivatives and for Ampicillin.

The market is estimated to be in year 2000 as follows:

Penicillin G & derivatives for human use	12 tons
Penicillin G & derivatives for veterinary and zootechnical use	16 tons
Ampicillin	205 tons

d) Plant capacity

On the basis of the above mentioned projections the capacity of the plant to cope with the local needs calculated in terms of Penicillin G are:

Pharmaceutical Penicillin G (50% procaine)	10 tons
Zootechnical Penicillin G (100% procaine)	10 tons
Ampicillin	270 tons
Total	290 tons

e) Sales prices and total revenues

Present international prices are (1989):

Ampicillin trihydrate	75 $/Kg
Penicillin G sodium salt (crude)	23 $/BU (1)
Penicillin G sodium salt (pharmaceutical grade)	55 $/BU
Penicillin G procain (feed grade)	32 $/BU
Penicillin G procain sterile	55 $/BU

In consideration of the above production mix, at full capacity, the total annual revenues are estimated around US $ 28,000,000.

(1) BU = Billion Units
1 mg = 1650 U Penicillin G Sodium Salt
1 mg = 1000 U Peniciling G procain

F.6.1.2 Materials and inputs

a) Materials

In the fermentation process the main materials are of vegetal and animal origin both locally available; they constitute the source of nitrogen and carbohydrates needed for the growth of the microorganisms. These are

- glucose syrup,
- corn steep liquor,
- an anti-foaming agent of animal origin.

The main other ingredient which should be imported are potassium phenylacetate, part of which is recovered from 6-APA production, plus minor quantities of other salts.

The main ingredient in the process of recovery is the solvent (for instance butyl acetate) which is recovered in major portion.

The fermentation process requires a large quantity of power, steam and electric energy; this is an advantage since in Nigeria the cost of energy is lower than in other countries.

b) Raw materials requirement

The consumption of raw materials for fermentation varies greatly with the different technologies available for the Penicillin production and depends on the fermentation yields.

Average values are:

Glucose solution 60%	8 to 10	kg/BU
Corn steep liquor	1 to 1.5	kg/BU
Potassium phenylacetate	0.8 to 0.9	kg/BU
Anti-foaming agent	0.6 to 0.7	kg/BU

Small quantities of other chemicals are also required.

The main raw material for the recovery is the solvent for extraction which consumption depends on the efficiency of the process; it can be evaluated from 0.3 to 0.5 kg/BU.

c) Utilities requirements

The main utilities needed for the production of penicillin G by fermentation and their approximate quantities are:

Installed power	7000-8000 KW
Process water	40-50 Ton/hr
Steam	7-8 Ton/hr

d) Raw materials and purchasing programme

The main raw materials for the fermentation are of agricultural origin and then their composition is not constant; in particular for the corn steep liquor due to the variability of the quality each batch should be tested in the pilot plant ferments and the nutrient medium adjusted; for this reason a stock of four months is needed. For the glucose syrup a two months stock is sufficient.For the other starting materials, solvents and other chemicals which should be imported, a four months stock is suggested.

F.6.1.3 **Plant description**

The plant is divided in the following sections:

- Pilot plant for fermentation and recovery
- Penicillin fermentation and extraction
- Enzyme production and recovery (for the splitting of the side chain of Penicillin G to obtain 6-APA)
- Injectable penicillins production
- Feed grade penicillin production
- Utilities generation units
- Laboratories
- Solvent recovery
- Waste treatment
- Auxiliary services (workshop, storage, quality control etc.)

A description of the different sections is reported herebelow.

a) Pilot plant for fermentation and recovery

The main scopes of the pilot plant are:

- to investigate the suitability of the various batches of the natural raw materials and adjust the nutrient media
- to check the strain which should be continuously selected.
- to train technical personnel in the technology of fermentation.

The following equipment is required for fermentation:

- No. 6 glass fermentors of two litres capacity (laboratory tests)
- No. 6 glass fermentors of ten litres capacity (laboratory tests)
- No. 3 stainless steel fermentors of 100 litres capacity
- No. 2 stainless steel fermentors of 800-1000 litres capacity

The following main equipment is required for recovery:

- rotatory filter
- liquid -liquid extractor
- evaporator
- crystallizer
- vacuum dryer
- vessels of different volumes
- other minor equipment.

b) Penicillin fermentation and extraction

For the fermentation the following main equipment is needed:

Item	Q.ty	Capacity
Fermentors	6	110 cu.m
Seed fermentors	3	15 cu.m
Culture media vessels	3	15 cu.m
Sterilizers	10	1 to 30 cu.m

For the penicillin recovery the following main equipment is needed:

Item	Q.ty	Capacity
Harvest vessel	2	110 cu.
Vessels	2	30 cu.m
Vacuum filter	2	30 sq.m
Centrifugal extractors	3	
Vessels	15	3 to 15 cu.m
Crystallizers	2	15 cu.m
Rotating vacuum dryer	2	5 cu.m

c) Enzyme production and recovery

The equipment consists in two fermentors of 5 cu.m ,the corresponding seed fermentors, one reactor, one centrifuge, one filter and some minor equipment.

d) Injectable penicillins production

The plant, part of which should be located in a sterile area, consists in four reactors, one sterilization filter, one centrifuge, one drier and other minor equipment.

e) Feed grade penicillin production (procain penicillin G)

The plant consists mainly of two reactors, one centrifuge and one dryer.

f) Utilities generation units

Equipment will be provided for the production of:

- steam (boilers and steam turbine generator)
- cooling water (refrigeration units)
- compressed air (air compressor)
- brine

g) Laboratories

Laboratories for the strain selection and development should be provided; they will be equipped with laminar flow hoods in addition to the usual micro-biological equipment. Furthermore thermo-static rooms with shakers for the growth of the cultures for inoculation of the seed tanks should be provided.

h) Solvent recovery

The solvent recovery section will be provided with three distillation columns, heat exchangers, storage vessels, pumps and other minor equipment.

i) Waste treatment

The waste treatment section consists of tanks, some basins (for floculation, oxidation and sludge thickening) one centrifuge and one sludge incinerator.

j) Auxiliary services

The following auxiliary services will be provided:

- Workshop for maintenance
- Warehouse, one part of which will be air conditioned
- quality control laboratories
- social building in which will be located the canteen and the central locker room.

F.6.1.4 **Process Description**

a) Penicillin fermentation and extraction

The spores of the penicillium for the inoculation of the seed ferments are prepared and checked in the micro-biological laboratories.

The culture medium is prepared in the seed fermentors and steam sterilized; the inoculum is then added in sterile conditions and the growth of the culture is performed under agitation and sterile air introduction until it is ready for the transfer to the production fermentors which requires about 40 hours. In the meantime the production fermentors are filled with the culture medium, heat sterilized to 121 C and cooled to the fermentation temperature. The contents of the seed fermentors is transferred under sterile conditions to the main ferments and the fermentation is carried on under agitation and introduction of sterile air. During the fermentation, several sterile additions are made such as the precursor, anti-foaming agent, sugar or glucose syrup and others. During the fermentation, several parameters should be controlled such as temperature, pressure, air flow, pH value, foam level and others. When the fermentation is ended, the broth is cooled down and filtered to eliminate the mycelium, the mycelium is washed with water and the broth, to which the washings are added, is sent to the solvent extraction. After acidification the broth is fed into a centrifugal continuous counter-current extractor and extracted with a solvent such as butyl acetate, amyl acetate or methylisobutylketone.

Since at acidic pH values the solubility of penicillin in water is very low, the product is transferred to the solvent. The spent broth is sent to a storage tank and successively stripped to recover the solvent contained whereas solvent rich is sent to a second extraction stage where the penicillin is transferred in aqueous solution by extraction with sodium or potassium bicarbonate buffer solution. The spent solvent is sent to the recovery whereas the aqueous penicillin solution is transferred into a crystallizer where it is mixed with butanol to remove water by vacuum azeotropic distillation. The penicillin salt crystallizes and it is separated by centrifugation, washed with butanol and vacuum dried.

b) Enzyme production and recovery

Penicillin acylase enzyme which is needed for the splitting of the side chain of penicillin to obtain 6-APA is produced in small ferments using the usual fermentation techniques. After removal of the mycelium the broth is concentrated and the enzyme is immobilized either with the aid of a carrier or by cross-linking.

c) Injectable penicillins production

The penicillin is dissolved in a reactor and then transferred into a sterile area where it is crystallized, separated by centrifugation and dried.

d) Feed grade penicillin production (procain penicillin G)

Feed grade penicillin G procain is prepared by precipitation in one crystallizer followed by separation by centrifugation and drying.

F.6.1.5 Packaging

Penicillin G is packaged for shipping in 50 kg drums in poliethylene bags.

Sterile Penicillin G procain is shipped in 25 kg aluminium drums under sterile conditions.

F.6.1.6 Layout and civil works

The general lay-out of the plant is shown in the attached drawing. A total surface of about six hectares is required. The following buildings are required:

- pilot plant	500 sqm
- penicillin fermentation unit	1500 sqm
- penicillin recovery unit	2000 sqm
- warehouse	
- workshop	
- offices and quality control laboratories	
- social building.	

F.6.1.7 Investment

The investment costs are estimated at US $ 35,000,000.

F.6.2 AMINOPENICILLANIC ACID (6-APA) PROJECT

In the suggested project only the option of installing the producing plant within the penicillin producing factory is taken into consideration mainly for economic reasons.

6-aminopenicillanic acid referred to as 6-APA, is a product derived from Penicillin G or V which does not show a pharmacological activity by itself but it is an extremely important starting material for the synthesis of most semi synthetic penicillins.

6-APA was discovered in the early sixties by Beecham and was used for the preparation of Ampicillin the most important semi-synthetic penicillin presently on the market. Other semi-synthetic penicillins like Amoxycillin, Cloxacillin etc. followed later on.

F.6.2.1 Market and plant capacity

a) Generalities

The market for 6-APA in Nigeria is dependent on the local production of semisynthetic penicillins an hence it cannot be assessed at present . Its future market is directly related to the quantities of Ampicillin which will be produced taking into consideration a *conservative transformation factor of 0.66 kg of 6-APA for 1 kg af Ampicillin*.

According to official figures in 1988, the quantities of Ampicillin imported both in the finished pharmaceutical forms and as a bulk product were 93 tons. Probably the quantities imported were higher since, some imports escape recording.

In addition to the legal market there is also an illegal one which is composed by :

- fake drugs imported or locally manufactured in the pharmaceutical form; they imitate the confections of the most reputed pharmaceutical Companies. These drugs are very often of bad quality, substandard or contaminated and in many cases they do not contain the active ingredient. This is especially true for Ampicillin which constitute one of the most important and used drugs especially for infectious diseases. In general fake drugs are sold through drugstores and open air markets at a price slightly lower than the original products. Their quantity is difficult to quantify.

- Smuggled drugs whose extent is difficult to quantify but seems to be relevant. The origin of these drugs seems to be from Eastern Asia (Southern Korea, Taiwan, etc.).

b) Market Projections

To calculate the dimension of the 6-APA production plant some projections for Ampicillin have been made. Projections to the year 2000 seems to be realistic because from the approval of the project to the start of the plant a period of six to seven years should be considered.

To forecast the market for Ampicillin for the year 2000 the following elements have been considered to be the most important among others:

- the natural increase of the population, taking into consideration the fact that only a portion of this population will have the possibility to afford drugs

- the increase of the health coverage of the country, which is an essential part of the National Health Programme

- a possible reduction of the illegal market due to the action taken by the government to fight it.

On the basis of the above mentioned factors an increase of consumption on the present one of 6% per year is anticipated.

The Nigerian market for Ampicillin for the year 2000 will be 205 tons per year.

c) Plant capacity

In addition to the expected local consumption, a 30% of export af Ampicillin in particular to the ECOWAS countries seems to be a reasonable and realistic goal which should be considered in the determination of the plant capacity. Thus a local production of 270 tons of Ampicillin per year is considered to be realistic. On this basis the corresponding quantities of 6-APA are 18[illegible] tons for the year 2000 and this will be the projected capacity of the plant.

d) Sales prices and total revenues

The prices in the open market of antibiotics and of 6-APA show a certain fluctuation due to the well known factors affecting their market; so a continuous check is important to have a continuous evaluation of the project.In 1989 international prices for 6-APA are 63-65 $/ kg. In consideration of the projected production the total annual revenues will be at full capacity 11,340,000-11,700,000 $.

F.6.2.2 Materials and inputs

a) Materials

The production of 6-APA requires the following raw materials:

- potassium Penicillin G
- supported enzyme
- solvents
- inorganic alkali and acids

The supported enzyme and Potassium Penicillin G will be locally produced.Solvents are partially recovered and their quantities have only a very limited influence on the total production cost.

b) Raw materials requirement

According to the available know-hows one kg of 6-APA requires the following quantities of starting materials and reagents:

- potassium Penicillin G		1.85 kg
- supported enzyme		1.85 kg
- different solvents	about	0.5 kg

c) Utilities requirements

For the production of 6-APA the following utilities are required:

- electric power
- steam (for recovery of solvents)

d) Raw materials and purchasing programme

Since both potassium Penicillin G and the supported enzyme will be locally produced, a two months stock is considered sufficient. For solvents, acids an alkali which should be imported but which are readily available all over the world, a four months stock is considered sufficient.

e) Location

The production of 6-APA in Nigeria is strictly connected with the production by fermentation of Penicillin G. Whereas in other producing countries in some cases an independent production of 6-APA is economically viable, we think that this project is feasible only in case the local production of Penicillin G takes place. On the other end the need of some services such as solvent recovery for limited amounts of solvents as well as storage, quality control , waste treatment system s etc.seems to be economically heavy for an independent plant. For these reasons we suggest to place the 6-APA production plant in the premises of the penicillin plant in an independent building or in a part of the existing buildings. All the services will be in common with the penicillin production structure thus performing relevant economies in the production costs.

F.6.2.3 Plant description

In order to limit the batch dimension and the risks connected with the high value of the product in case of losses, as in the major producing companies, it seems to be better to double the number of batches increasing the equipment.

Taking into consideration the projected quantities (180 tons/year) considering 240 working days per year, a daily output of 750 kg is needed.

The main equipment needed to reach this capacity is:

Item	No	Capacity
S Steel reactor	2	2000 lts
S Steel reactor	2	3000 lts
S Steel crystallizer	4	8000 lts
Tank	4	15,000 lts
Centrifuge	2	
Drier	4	
Some minor equipment		

For the recovery of the solvents a distillation column and some tanks are required. This equipment can be added to the solvent recovery section of Penicillin G production Unit or the equipment used for penicillin can be slightly over-sized to cope with the needs ot 6-APA production. For waste treatment, tanks and basins proposed for the penicillin production can be used in case with some increase of their capacity.

F.6.2.4 Process description

The principal reaction consists in splitting the Penicillin G side-chain by the action of the supported enzyme penicillin acylase. Penicillin G is suspended in water, brought into solution by addition of alkali and the solution transferred into a reactor containing the supported enzyme; under stirring the reaction is carried on with continuous addition of alkali to control the pH value. When the reaction is over, the enzyme is filtered, a solvent is added, the pH modified by addition of acids and the precipitated 6-APA separated by centrifugation, washed with solvents and dried. From the mother liquors phenylacetic acid is recovered an reused in the Penicillin G fermentation step.

F.6.2.5 Packaging

6-APA is packed for shipping in 50 kg drums.

F.6.2.6 Investment

The investment costs are estimated at US $ 5,000,000.

F.6.3 AMPICILLIN PROJECT

Ampicillin is one of the most important antibiotics presently on the market. Its importance lies on the following facts:

- it is active by oral route
- it has a wide spectrum of activity having a bactericide action on a very large number of microrganisms
- it is readily available all over the world
- the cost of the treatment is relatively limited in comparison with other more recent antibiotics.

The scope of the project is to have a local production of this important antibiotic in order to become self-sufficient in Ampicillin and to save hard currency.

Ampicillin was discovered in the early sixties by Beecham in the effort to find new and more active derivatives of natural penicillins. The first step of this investigation was to split the side chin on Penicillin G obtaining 6-Aminopenicillanic acid.

To this product having the biciclic penicillin nucleus a variety of acidic compounds have been linked to the 6 – aminogroup; the most interesting product was the one having added the phenylglycine side chain obtaining Ampicillin.

Ampicillin is administered or by oral route or by injection after salification of the carboxygroup to solubilize the molecule.

The most common commercial form of Ampicillin is the trihydrate containing three molecules of water whereas the anhydrous which is more expensive has a more limited market. The present project refers to the production of Ampicillin trihydrate.

F.6.3.1 Market and plant capacity

a) Generalities and the market for Ampicillin

An investigation has been made to identify the present market in Nigeria. According to the information collected, besides the legal market there is an illegal one.

According to official figures in 1988 the quantities of ampicillin imported both in the finished pharmaceutical forms and as a bulk product were 93 tons. Probably the quantities imported were higher due to the fact that, as noticed in other cases, some imports escaped recording.

During the investigation the following 25 pharmaceutical specialties based on Ampicillin were identified:

Amblosin, Ampen, Ampiclox (+Cloxacillin), Ampicon, Ampilag, Ampixal, Binotal, Chemiclox (+Cloxacilin), Chempicillin, Cloxampil (+Cloxacillin), Cloxapen, Extrapen, Hospicillin, Karocin, Lifeampil, Mypicin, Penbritin, Pencloxin (+Cloxacillin), Pensyn, Pentarcine, Roscillin, Scamicin, Semicillin, Servicilin, Standacillin.

b) Projections

To calculate the dimension of the Ampicillin production plant some projections have been made. Projections to year 2000 seems to be realistic because from the approval of the project to the start of the plant at least six to seven years should be considered.

To forecast the market for Ampicillin for the year 2000 in Nigeria the following elements and considerations have been considered the most important among the others:

- the natural increase of the population, taking into the consideration the fact that only a portion of this population will have the possibility to afford drugs

- the increase of the health coverage of the country, which is an essential part of the National Health Programme

- a possible reduction of the illegal market due to the action of the Government to fight it.

On the basis of the above mentioned factors an increase of consumption on the present one of 6% per year is anticipated.

The market for Ampicillin for the year 2000 will be 205 tons.

d) Plant capacity

In addition to the expected local consumption, a 30% of export of Ampicillin in particular to the ECOWAS countries seems to be a realistic and reasonable goal which should be considered in the determination of the plant capacity. On these bases a local production of 270 tons of Ampicillin is anticipated.

e) Sales prices and total revenues

The prices in the open market of antibiotics show some fluctuations due to the well known market factors; so a continuous check is recommended to continuously evaluate the project. In 1989 the international market prices for Ampicillin trihydrate were around 75 $/kg. In consideration of the projected production the total annual revenue will be 20,250,000 .$

F.6.3.2 Materials and inputs

The annual production of 270 tons of Ampicillin trihydrate requires the following raw materials:

- 6-aminopenicillanic acid
- D (-) phenylglycine chloride hydrochloride
- organic bases
- dichloromethane
- acetone

With the exclusion of 6-APA which will be locally produced, all the other materials and solvents have to be imported.

a) Raw materials requirements

According to the most reputed know-hows available on the market the production of one kg of Ampicillin trihydrate requires approximatively the following quantities of starting materials, reagents and solvents:

- 6-APA 0.66 kg
- phenylglycine chloride hydrochloride 0.62 kg
- carboxy group protecting agent 0.3 kg
- dichloromethane 3.8 kg
- other reagents and solvents.

Since 6-APA will be locally produced, a two months stock is sufficient. For the reagent and solvents which should be imported a four to six months stock is recommended.

b) Utilities requirement

For the production of Ampicillin the following utilities are required:

- electric power
- steam
- liquid nitrogen

F.6.3.3 Plant description

In order to limit the batch dimension, to give an higher elasticity to the plant and to limit the risks connected with the high values of the products handled, as in the major producing companies, it seems to be better to double the number of batches by doubling the reactors.

Taking into consideration 45 working weeks per year and 10 batches per week, the following equipment is needed to produce 270 tons of Ampicillin trihydrate per year:

Items	No	Capacity
S Steel reactor	2	3000 l
S Steel reactor	4	5000 l
centrifuges	2	
filters	2	
dryers	4	
various tanks		
distillation column		
demineralizer		
refrigeration unit		
waste treatment tanks		
other minor equipment.		

With the same equipment and adding some personnel it is possible to increase the production by about 20%

F.6.3.3 **Process description**

The proposed process consists in the condensation of the acid chloride derived from D(-) phenylglycine with 6-aminopenicillanic acid; before the condensation the carboxy group of 6-APA is protected and the protection removed at the end of the reaction.

6-APA is dissolved in the solvent, an organic base is added together with the reagent used for the protection of the carboxy group. After the reaction is over, an organic base is added, the resulting solution is cooled to a temperature well below 0° C and phenylglycine chloride hydrochloride is added. After completion of the reaction, water is added, the organic layer separated and the aqueous layer treated with a base. The precipitated Ampicillin trihydrate is separated by centrifugation, washed with a solvent and dried.

F.6.3.4 **Packaging**

Ampicillin is packaged for shipping in 50 kg drums.

F.6.3.5 **Lay out and civil works**

For the production building a surface or 500 sq.m is required. In case an independent producing factory is taken into consideration a total surface of 1.5 hectares is required and the following additional buildings should be provided:

- warehouse
- workshop
- offices and quality control laboratories
- an open air structure to locate the distillation towers for solvent recovery
- utilities.

The production unit a reinforced concrete type structure is suggested.

F.6.3.6 **Investment**

The investment costs are estimated at US $ 20,000,000.

G. MEDICINAL PLANTS

During a visit to the Departments of Botany, Pharmacology, Industrial Pharmacy, Organic Chemistry of the University of Ibadan the following information was collected:

a. The cultivation of medicinal plants does not exist, although the climate is such that a number of medicinal plants could grow in large quantity.

b. Medicinal plants exist as wild grove but their assessment is not known.

c. Many efforts are being done to study in detail some medicinal plants; some encouraging results have been obtained in the identification of some active principles which could be used as anti-malarial and as anti-cancer agents.

An opportunity study may be undertaken only after an identification survey is carried out and data made available. At this stage a first screening of known medicinal plants has been carried out to identify those existing in Nigeria.

Plant species (family)	*Part(s) of plant used*	Products of potential industrial value	Therapeutic use or other
Agave sisalana	*juice*	hecogenin	corticosteriod manufacture
Allium sativum	*bulb*	garlic juice, ajoene, essential oil, allicin	hypotensive/anti-bacterial/anti-atherosclerotic, hypoglycaemic
Aloe spp.	*leaf juice*	aloes, aloin, allo-inosides	purgative, anti-dermatitis
Artemisia annua	*whole plant*	artimisinine	antimalarial
Azadirachta indica	*bark, leaves, fruits, gum exudate*	neem oil, nimbidin, nimbinin, nimbidot, mangosine	antituberculer, antifungal, anti-bacterial
Capsicum annum	*fruits*	capsaicin, oleoresin	antirheumatic, counter irritant
Cairca papaya	*fruit latex*	papain	protein digestant
Catharanthus ros.	*leaves roots*	vinblastine,vincri-stine	antineoplastic
Cola nitida	*nuts*	total extract	central stimulant
Costus speciusus and other spp.	*rhizome*	diosgenin	corticosteroid manufacture
Curcuma aromatica other species	*rhizome*	oleoresin and	antiphlogistic/dye-stuff in food ind.
Datura spp.	*leaves*	atropine, hyoscyamine, hyoscine (scopolamine)	anticholinergic, ophtalmic use

Dioscorea spp.	*tubers*	diosgenin	manufacture of corcosteroids
Eucalyptus spp.	*leaves*	essential oil	symptomatic treatment of bronchitis, sinusitis
Gloriosa spp.	*seeds*	colchicine	acute gout suppresant
Hibiscus sabdar.	*flowers*	dried flowers	colouring,flavoring agent, laxative (paedatric)
Holarrhena	*stem, bark*	conessine, total alkaloids	raw mater. for prod of steroid.alkaloid
Momordica charantia and M. foetida	*fruit and leaves seeds, root*	charantin/foetidin-steroid-glycoside	hypoglycaemic agent
Mucuna pruriens syn M. prurita	*beans*	1-dopa	antiparkinson
Passiflora spp.	*leaves*	total extract	sedative
Pausinystalia	*stem, bark*	yohimbine and total extract	anti-rheumatic, US pat.3.047.464(1962) hypotensive
Rauwolfia spp.	*roots*	reserpine, ajmaline, deserpidine, rescinnamine and reserpiline	hypnotic, sedative, hypertensive
Strophanthus spp.	*seeds*	strophantine strophanthidine	cardiac insuffic. coronary conditions
Tamarindus indica	*fruit, pulp*	total extract	laxative
Theobroma cacao	*seed coat*	theophylline and derivatives	analgaesic used in combinatin for co-coronary ailments,
Thevetia nerifolia	*seed*	peruvosides	cardioton. activity
Terminalia spp.	*bark, fruits*	tannins, triterpenes	laxative,cardioton.
Urginea spp.	*bulbs*	scillaren A and proscillaridin A	cardiac stimulant
Voacanga spp.	*seed*	tabersonine	manufacture of Vincamine
Vinca spp.	*leaves*	vincamine	cerebral vaso activator
Zanthoxylum spp.	*root, bark*	total extract, rutin	diuretic
Zingiber officin.	*rhizomes*	essential oil,oleoresin gingerol, shogaol, etc.	carminative, antiflatulent,flavoring

H. PETROCHEMICAL INDUSTRY

The development of the Nigerian petrochemical industry was planned in three phases:

a) Phase 1 (already implemented) deals with the production of Polypropylene, Carbon Black, Linear AlkylBenzene and Solvents).

- Polypropylene is used in injection moulding for household wares, containers, auto-components, bottle-crates and other products.

- Carbon-black is used in the manufacture of tyres, conveyor-belts, footwears, hoses, printing ink, pigments and other products.

- Linear AlkylBenzene is used in the detergent production

- Solvents are used in several fields, among which insecticides, paints, resins etc.

b) Phase 2 (whose implementation is programmed for the second half of the 90s) will be based on natural gas, from which Ethylene will be obtained.
Ethylene will be the basis for the production of Low Density PolyEthylene (LDPE), High Density PolyEthylene (HDPE). These two materials can be used in the manufacture, among other products, of pipes and fittings.
Other intermediate products can be obtained from Ethylene and, by means of different technologies, these intermediates can be processed for the production of PVC (PolyvinylChloride), UPE (Unsaturated PolyEsters), Surfactants, etc.

At this stage, no opportunities will be investigated in this field.

SECTION 4

ENGINEERING INDUSTRY SUBSECTOR

TABLE OF CONTENT

ENGINEERING INDUSTRIES

Nigeria's engineering sub-sector appears to be relatively developed, looking at large number of establishments involved in it. On the whole, it accounts for about 17 per cent of total manufacturing production.

However, the subsector is very weak structurally, consisting mostly of the assembly of imported components. Imports of engineering inputs account for about 80% of the total imports on the average annually. The subsector has, therefore, been hard hit by the shortage of foreign exchange.
The sub-sector's major weakness is the absence of industries producing basic materials, necessary to other industries to develop, such as steel products.

The country's steel industry produces only low carbon structural steel, iron rods and steel wire products such as netting, nails and screws. The production of a large number of steel rolling mills is based on imported billets.

There is far the time being no production of flat sheets in the country thereby precluding the establishment of other industries like press shops for car bodies, tins and cans production, galvanized sheets etc.

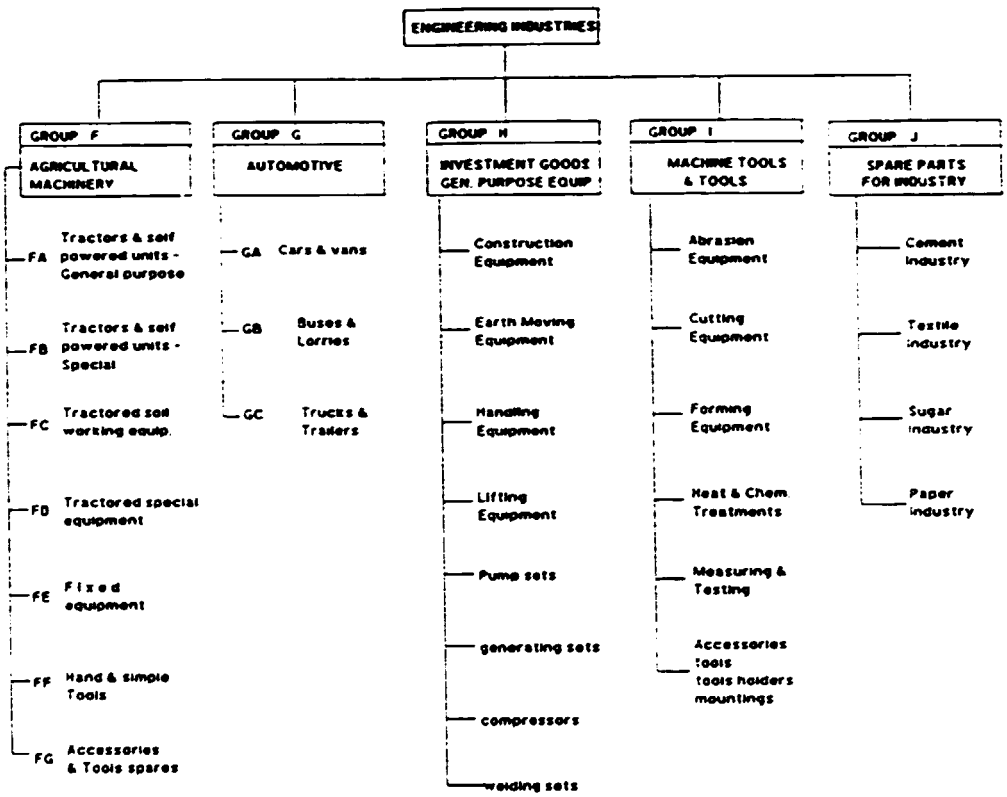
Foundries are numerous, but only few of them are in a position to produce castings such as gears, shafts, or others like spare parts.

A.1 SUBSECTOR DEFINITION

For the purpose of this study the term "Engineering Industries" was extended to the following industrial Groups:

Group F	-Agricultural Machinery
Group G	-Automotive
Group H	-Investment goods and general purpose equipment
Group I	-Machine Tools and Tools
Group J	-Spare parts for industry

The groups main items are illustrated in the following diagram:



The aim was to break down each subsector into primary elements, then to combine all those primary elements shared by different subsectors, in an attempt to define market demand and the opportunities offered by Engineering Industries.

Three break down levels have been identified as:

- 1st level assembly
- 2nd level assembly
- components.

Some assemblies may not correspond to an existing product rather to a dummy assembly for further splitting into components: i.e. fuel system or hydraulic system.

A.2. SCREENING PARAMETERS

A.2.1 PARAMETERS RELATED TO THE MARKET SITUATION

A. Nigerian total demand.
- *negligible*
- *significative.*

B. Local production (considered as installed capacity)
- *negligible*
- *significative*

C. Ratio between local production and Nigerian total demand:

>> 1	Excess of production capacity
> 1	Production capacity higher than demand
= 1	Even
< 1	Demand higher than production
<< 1	Demand much larger than production
negligible	When demand is negligible

A.2.2 PARAMETERS RELATED TO THE PRODUCT/PRODUCTION

A. Investments versus revenues:

-large:	means capital intensive or low return
-medium:	in average
-small:	means high return or small investment

B. Investments versus manpower:

-large	capital intensive or low labour
-medium	in average
-small	labour intensive or small investment

C. Manufactured quantity intended as technical minimum lot:

-large:	means production in large scale
-medium:	in average
-small:	means small scale production

D. Technological Product complexity:

-large:	high know-how and advanced technology
-medium:	in average
-small:	accessible technology

E. Capacity to create induced industries and supplies

-large:	may induce many local industries
-medium:	in average
-small:	do not induce local industries

A.3 PRODUCT SORTING

Based upon above screening parameters, the elements were sorted by elimination:

1st eliminating key:	- Products with "negligible" demand
and/or	- with local production higher than demand
and/or	- with local production much higher than demand.
2nd eliminating key:	- Products identified as capital intensive/low return
or combining together	- large scale/high complexity/low manpower/no induced supply.

B. AGRICULTURAL MACHINERY (GROUP F)

B.1 MAIN PRODUCTS

The Agriculture Machinery main products are shown in the following diagram:

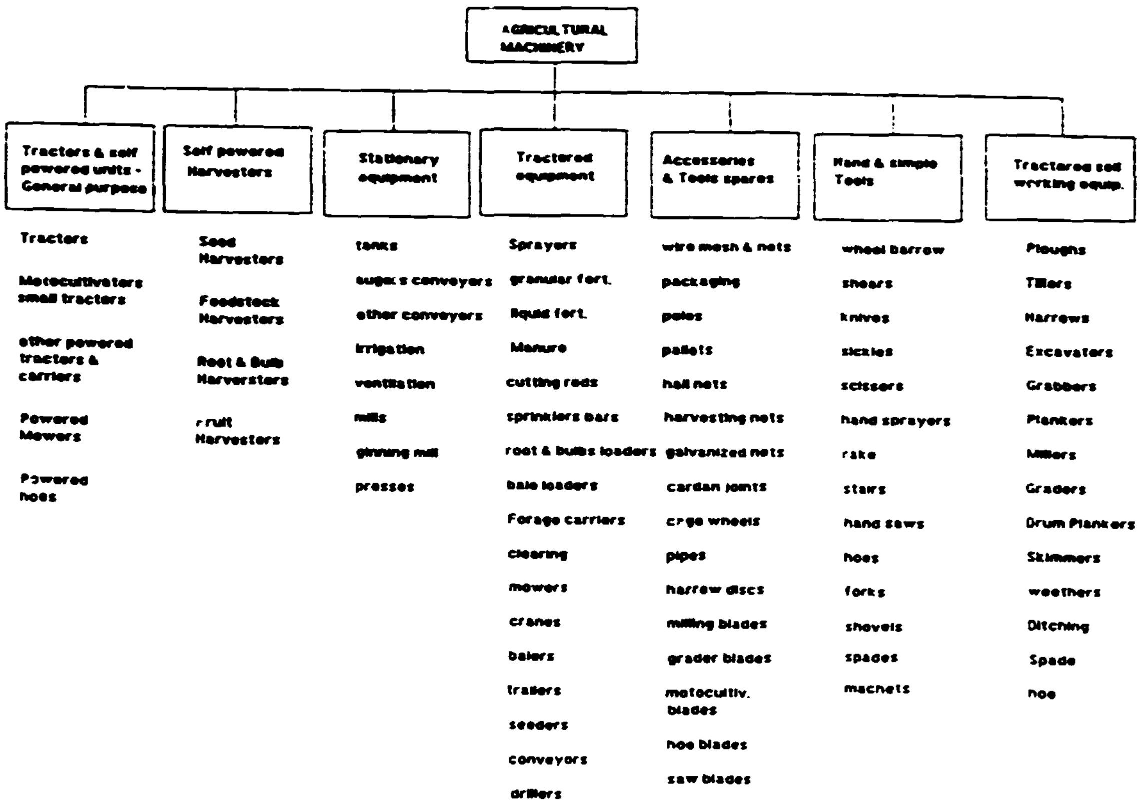


table B.1.a - Agriculture machinery split into 1st level Assembly:

	1st level Assembly	MARKET			PRODUCTION /PRODUCT					REMARKS
		demand	offer	ratio off/dem	invest. vs revenues	invest. manpower	manuf. quantity	techn.lgy complex	induced loc.suppl	
F.1. 1	Petrol engine	signific.	none		large	large	Large	medium	large	
F.1. 2	diesel engine	signific.	none		medium	medium	medium	medium	large	opportunity studies
F.1. 3	transmission	see subassemblies /components								
F.1. 4	suspensions									
F.1. 5										
F.1. 6	break system									
F.1. 7	wheels									
F.1. 8	steering									
F.1. 9	chassis									
F.1.10	body									
F.1.11										
F.1.12	instrumentation									
F.1.13	electric system									
F.1.14	cooling system									
F.1.15	fuel system									
F.1.16	break circuit									
F.1.17										
F.1.18	hydraulic system									
F.1.19	gear boxes									
F.1.20	spraying pumps									
F.1.21	manure pumps									
F.1.22	water pumps									
F.1.23	electric motors									
F.1.24	winches									

table B.1.b - Agriculture Machinery 1st assembly split into 2nd Assembly level:

2ND LEVEL ASSEMBLY	MARKET			PRODUCTION /PRODUCT					REMARKS
	demand	after (loc. manuf.)	ratio off/dom	invest. vs revenues	invest. vs manpower	manuf. quantity	techn. typ complex	induced loc.supply	
F.II. 1 CARBURATOR	negligeable	none	negligeable	large	medium	large	medium	small	
F.II. 2 DISTRIBUTOR	negligeable	none	negligeable	large	medium	large	medium	small	
F.II. 3 SPARKLING-PLUG	negligeable	none	negligeable	medium	medium	large	small	small	
F.II. 4 OIL PUMP	significant	negligeable	->1	medium	medium	medium	medium	small	opportunity study
F.II. 5 WATER PUMP	negligeable	none	negligeable	medium	medium	medium	medium	small	opportunity study
F.II. 6 THERMOSTAT	negligeable	none	negligeable	large					
F.II. 7 INJECTION PUMP	significant	none	negligeable	large					
F.II. 8 INJECTOR	significant	none	negligeable	large					
F.II. 9 ALTERNATOR	significant	none	negligeable	large	medium	large	medium	small	
F.II.10 STARTER MOTOR	significant	none	negligeable	large	medium	large	medium	small	
F.II.11 CLUTCH DISC	significant	negligeable	->1	medium	medium	medium	small	small	opportunity study
F.II.12 CLUTCH SYSTEM	significant	negligeable	->1	medium	medium	medium	small	small	opportunity study
F.II.13 FUEL FILTER	significant	significant	->1						
F.II.14 OIL FILTER	significant	significant	->1						
F.II.15 AIR FILTER	significant	significant	->1						
F.II.16 EXHAUST PIPE	significant	significant	->1						
F.II.17 PETROL ENGINE SUB ASSY									
F.II.18 DIESEL ENGINE SUB ASSY									
F.II.19 GEAR BOX	significant	none	->1	medium	medium	medium	medium		opportunity study
F.II.20 DIFFERENTIAL	significant	none	->1	medium	medium	medium	medium		opportunity study
F.II.21 DRUM BREAKES ASSEMBLY									
F.II.22 WHEEL ASSEMBLY									
F.II.23 STEARING BOX									
F.II.24 STEARING ASSEMBLY									
F.II.25 CHASSIS ASSEMBLY									
F.II.26 BODY METALSHEET ASSY									
F.II.27 BODY LIGHTS ASSEMBLY									
F.II.28 BODY FINISHINGS ASSY									
F.II.29 INSTRUMENTATION PANEL									
F.II.30 CONTROLS									
F.II.31 BATTERY	significant	significant	->1						
F.II.32 ELECTRIC PLANT									
F.II.33 HORN	significant	none	->1	large					
F.II.34 RADIATOR	significant	significant	->1						
F.II.35 COOLING SYSTEM SUB ASS									
F.II.36 FUEL PUMP	significant	none	->1	large					
F.II.37 FUEL SYSTEM SUB ASSY									
F.II.38 BREAKE SYSTEM SUB ASSY									
F.II.39 HYDRAULIC SYSTEM SUB A									
F.II.40 HYDRAULIC PUMPS & MOTO	negligeable								
F.II.41 GEARS	significant	none	->1	medium	medium	medium	medium	medium	opportunity study
F.II.42 SPRAYING PUMPS	significant	none	->1	medium	medium	medium	medium	medium	opportunity study
F.II.43 LIQUID MANURE PUMPS	negligeable								
F.II.44 WATER PUMPS	significant	none	->1	medium	medium	medium	medium	medium	opportunity study
F.II.45 ELECTRIC MOTORS	negligeable								
F.II.46 MACHINES	negligeable								

table B.1.c - Agliculture Machinery 2nd assembly split into 3rd Assembly level and components:

3rd LEVEL ASSEMBLY & COMPONENTS	MARKET			PRODUCTION /PRODUCT					REMARKS
	demand	after (loc. manuf.)	ratio off/dom	invest. vs revenues	invest. vs manpower	manuf. quantity	techn. typ complex	induced loc.supply	
F.III. 1 CRANKASE	significant	none	->1	medium	medium	medium	medium	small	opportunity study
F.III. 2 CRANKSHAFT	significant	none	->1	medium	medium	medium	medium	small	opportunity study
F.III. 3 CAMSHAFT	significant	none	->1	medium	medium	medium	medium	small	opportunity study
F.III. 4 CYLINDER	significant	none	->1	medium	medium	medium	medium	small	opportunity study
F.III. 5 PISTON	significant	none	->1	large	medium	large	medium	small	
F.III. 6 CONNECTING ROD	significant	none	->1	medium	medium	medium	medium	small	opportunity study
F.III. 7 CYLINDER HEAD	significant	none	->1	medium	medium	medium	medium	small	opportunity study
F.III. 8 ROCKER ARM	significant	none	->1	medium	medium	medium	medium	small	opportunity study
F.III. 9 INLET-EXHAUST VALVE	significant	none	->1	large	large	large	medium	small	
F.III.10 FLYWHEEL	significant	none	->1	small	medium	medium	small	small	opportunity study
F.III.11 EXHAUST MANIFOLD	significant	none	->1	medium	medium	medium	small	small	opportunity study
F.III.12 INLET MANIFOLD	significant	none	->1	medium	medium	medium	small	small	opportunity study
F.III.13 PNEUMATIC COMPONENTS	significant	negligeable	->1	medium	small	medium	small	small	opportunity study
F.III.14 REVOLUTIONARY COMPON	significant	negligeable	->1	medium	small	medium	small	small	opportunity study
F.III.15 MOULDED STEEL COMPON	significant	negligeable	->1	medium	large	medium	medium	small	opportunity study
F.III.16 PLASTIC MOULDED COMP	significant	negligeable	->1	medium	large	medium	medium	small	opportunity study
F.III.17 GEARS	significant	negligeable	->1	medium	medium	medium	small	small	opportunity study
F.III.18 BELT	significant	negligeable	->1	medium	medium	large	small	small	opportunity study
F.III.19 PULLEY	significant	negligeable	->1	small	medium	large	small	small	opportunity study
F.III.20 SPRINGS	significant	negligeable	->1	large	medium	large	small	small	
F.III.21 O-RING	significant	none	->1	large	large	large	medium	small	
F.III.22 GASKET	significant	negligeable	->1	medium	medium	large	small	small	opportunity study
F.III.23 BEARINGS	significant	none	->1	large	large	large	medium	small	
F.III.24 BOLTS	significant	negligeable	->1	medium	medium	large	small	small	opportunity study
F.III.25 SCREW-NUTS	significant	negligeable	->1	medium	medium	large	small	small	opportunity study
F.III.26 SHOCK ABSORBERS SPRI	negligeable								
F.III.27 LEAFSPRING	negligeable								
F.III.28 BREAKE DISC	negligeable								
F.III.29 BREAKE DISC PISTONS	negligeable								
F.III.30 BREAKE DRUM	significant	none	->1	medium	small	large	small	small	opportunity study
F.III.31 BREAKE SHOE	significant	none	->1	large	large	large	medium	small	
F.III.32 DRUM BREAKE PISTON	significant	none	->1	large	large	large	medium	small	
F.III.33 RIM	significant	none	->1	large	large	large	medium	small	
F.III.34 TYRES	negligeable								
F.III.35 COUNTERBALANCE WEIGHT	negligeable								
F.III.36 STEERING RODS	significant	none	->1	medium	medium	small	small	small	opportunity study
F.III.37 JOINTS	significant	none	->1	large	large	large	medium	small	
F.III.38 LIGHTS	negligeable								
F.III.39 BACK LIGHTS	negligeable								
F.III.40 SIDE & INNER LIGHTS	negligeable								
F.III.41 RUBBER PROFILES	negligeable								
F.III.42 UPHOLSTERY REINFORCE	significant	significant	*						
F.III.43 UPHOLSTERY FILLING	significant	significant	*						
F.III.44 UPHOLSTERY LINING	significant	significant	*						
F.III.45 INNER PANELS	negligeable								
F.III.46 CABLES & CABLE COMP	negligeable								
F.III.47 ELECTRIC CONTROLS	negligeable								
F.III.48 RUBBER HOSES	significant	negligeable	->1	medium	medium	medium	small	small	opportunity study
F.III.49 PLASTIC HOSES	negligeable								
F.III.50 PIPES	significant	negligeable	->1	large	large	large	medium	small	
F.III.51 RESERVOIRS	negligeable								
F.III.52 FUEL TANK	significant	none	->1	large	large	large	medium	small	

table B.1.d - Agriculture Machinery main products:

group F - AGRICULTURAL MACHINERY		MARKET			PRODUCTION/PRODUCT					REMARKS
		demand	offer	ratio off/dem	inv. vs revenues	inv. vs manpower	manuf. quantity	techn.lgy complex.	induced tec.suppl.	
F.A.	TRACTORS & SELF POWERED UNITS - GENERAL PURPOSE									
F.A. 1	Tractors (above 50 hp)	signific.	signific.	>>1						existing FIAT, STEYR
F.A. 2	Motocultivators (less 50 hp)	signific.	none	<< 1	Medium	Medium	med./small	Medium	Large	opp. study
F.A. 3	other self powered (less 50 hp)	signific.	none	<<1	Medium	Medium	med./small	Medium	Large	opp. study
F.A. 4	Self Powered Mowers	neglige.								
F.A. 5	Self Powered Hoes	neglige.								
F.B.	SELF POWERED HARVESTERS									
F.B. 1	Seed harvesting units (wheat & corn)	neglige.								
F.B. 2	Foodstock harvesters	neglige.								
F.B. 3	Root crops, bulbs harvesters	neglige.								
F.B. 4	Fruits harvesters	neglige.								
F.C.	TRACTORED SOIL WORKING EQUIPMENT									
F.C. 1	Ploughs	signific.	signific.	>1						
F.C. 2	Tillers	neglige.								
F.C. 3	Harrows	signific.	signific.	>1						
F.C. 4	Excavators	neglige.								
F.C. 5	Grubbers	signific.	signific.	>1						
F.C. 6	Planters	neglige.								
F.C. 7	Millers	neglige.								
F.C. 8	Graders	neglige.								
F.C. 9	Drum Planters	neglige.								
F.C. 10	Skimmers	neglige.								
F.C. 11	weeders	signif.	signif.	>1						
F.C. 12	Trenchers	neglige.								
F.C. 13	Ditching and drainage	neglige.								
F.C. 14	Rotary hoe	neglige.								
F.D.	TRACTORED EQUIPMENTS									
F.D. 1	Sprayers	potential	neglige.	<1	Medium	Medium	small	Medium	Large	opp. study
F.D. 2	Equipment for granular fertilizers	neglige.								
F.D. 3	Equipment for liquid fertilizers	neglige.								
F.D. 4	Equipment for manure	neglige.								
F.D. 5	cutting bars	neglige.								
F.D. 6	spraying bars	neglige.								
F.D. 7	roots & bulbs loaders	neglige.								
F.D. 8	bale loaders	neglige.								
F.D. 9	forage carriers	neglige.								
F.D. 10	clearing, leave removers ...	neglige.								
F.D. 11	mowers	neglige.								
F.D. 12	cranes	neglige.								
F.D. 13	forage balers	neglige.								
F.D. 14	trailers	signif.	signif.	>1						
F.D. 15	seeders	neglige.								
F.C. 16	conveyors	neglige.								
F.D. 17	drillers	neglige.								
F.E.	STATIONARY EQUIPMENT									
F.E. 1	tanks	neglige.								
F.E. 2	screw conveyors	neglige.								
F.E. 3	other conveyors	neglige.								
F.E. 4	irrigation nets	neglige.								
F.E. 5	ventilating system	neglige.								
F.E. 7	mills	neglige.								
F.E. 8	ginning mill	neglige.								
F.E. 9	presses	neglige.								
F.F.	HAND & SIMPLE TOOLS									
F.F. 1	wheel barrows	signif.	50 %	<1						opp. study
F.F. 2	shears	signif.	50 %	<1						opp. study
F.F. 3	pruning, grafting, trimming knives & machets	signif.	50 %	<1						opp. study
F.F. 4	sickles	signif.	50 %	<1						opp. study
F.F. 5	scissors	neglige.								
F.F. 6	hand sprayers	signif.	50 %	<1						opp. study
F.F. 7	rake	signif.	50 %	<1						opp. study
F.F. 8	stairs	neglige.								
F.F. 9	hand saws	signif.	50 %	<1						opp. study
F.F. 10	hoes	signif.	50 %	<1						opp. study
F.F. 11	forks	signif.	50 %	<1						opp. study
F.F. 12	shovels	signif.	50 %	<1						opp. study
F.F. 13	spades	signif.	50 %	<1						opp. study
F.G.	ACCESSORIES & SPARES									
F.G. 1	nets	neglige.								
F.G. 2	packaging	neglige.								
F.G. 3	poles	neglige.								
F.G. 4	pallets	neglige.								
F.G. 5	hail nets	neglige.								
F.G. 6	wind breakers	neglige.								
F.G. 7	harvesting nets	neglige.								
F.G. 8	galvanised nets	signif.	signif.	>1						
F.G. 9	cardan joints	neglige.								
F.G. 10	cage wheels	neglige.								
F.G. 11	pipes	neglige.								
F.G. 12	harrow discs	signif.	signif.	>1						
F.G. 13	milling blades	neglige.								
F.G. 14	grader blades	neglige.								
F.G. 15	motocultivator blades	neglige.								
F.G. 16	hoe blades	neglige.								
F.G. 17	saw blades	neglige.								

B.2 SCREENING OF PRODUCTS

Based upon Parag. A.2 & A.3 screening and sorting criteria , there is an interest to evaluate:

Main Products:	1st Level:	2nd Level:	3rd Level:
Motocultivators & small self-powered machinery	Diesel Engines	Oil Pumps,Gear Boxes Clutches & Disks	Components

C. AUTOMOTIVE (GROUP G)

C.1 GROUP G MAIN PRODUCTS

The main products under this chapter are:

- G.A Cars and vans
- G.B Buses and lorries
- G.C Trucks and trailers

table C.1.a - Automotive split into 1st Level

AUTOMOTIVE _ 1ST LEVEL ASSEMBLY		MARKET			PRODUCTION /PRODUCT					REMARKS
		demand	offer (loc. manuf	ratio off/dem	invst. vs revenues	invst. vs manpower	manuf. quantity	techn.lgy complex	induced loc.suppl	
G.I . 1	CARS & VANS	significant	significant	>>1	large	large				
G.I . 2	BUSES & LORRIES	significant	significant	>1	large	large				
G.I . 3	TRUCKS & TRAILERS	significant	significant	>1	large	large				

table C.1.b - Automotive split into 2nd level Assembly

AUTOMOTIVE _ 2ND LEVEL ASSEMBLY		MARKET			PRODUCTION /PRODUCT					REMARKS
		demand	offer (loc. manuf	ratio off/dem	invst. vs revenues	invst. vs manpower	manuf. quantity	techn.lgy complex	induced loc.suppl	
G.II . 1	CARBURETOR	significant	none	negligeable	large	medium	large	medium	small	
G.II . 2	DISTRIBUTOR	significant	none	negligeable	large	medium	large	medium	small	
G.II . 3	SPARKLING-PLUG	significant	none	negligeable	medium	medium	large	small	small	opportunity study
G.II . 4	OIL PUMP	significant	negligeable	<<1	medium	medium	large	medium	small	
G.II . 5	WATER PUMP	significant	negligeable	<<1	medium	medium	large	medium	small	
G.II . 6	THERMOSTAT	significant	none	negligeable	large					
G.II . 7	INJECTION PUMP	significant	none	negligeable	large					
G.II . 8	INJECTOR	significant	none	negligeable	large					
G.II . 9	ALTERNATOR	significant	none	negligeable	large	medium	large	medium	small	
G.II .10	STARTER MOTOR	significant	none	negligeable	large	medium	large	medium	small	
G.II .11	CLUTCH DISK	significant	negligeable	<1	medium	medium	large	small	small	opportunity study
G.II .12	CLUTCH SYSTEM	significant	negligeable	<1	medium	medium	large	small	small	opportunity study
G.II .13	FUEL FILTER	significant	significant	>1						
G.II .14	OIL FILTER	significant	significant	>1						
G.II .15	AIR FILTER	significant	significant	>1						
G.II .16	EXHAUST PIPE	significant	significant	>1						
G.II .17	PETROL ENG. SUBASSY									
G.II .18	DIESEL ENG. SUBASSY									
G.II .19	GEAR BOX	significant	none	<<1	large					
G.II .20	DIFFERENTIAL	significant	none	<<1	large					
G.II .21	ELASTIC JOINT	significant	negligeable	<<1	medium	medium	medium	medium	small	opportunity study
G.II .22	TRANSMISSION SHAFT	significant	none	<<1	large					
G.II .23	SHOCK ABSORBERS	significant	negligeable	<<1	medium	medium	large	medium	medium	opportunity study
G.II .24	SUSPENSION SUB ASSY									
G.II .25	DISK BREAKES ASSY									
G.II .26	DRUM BREAKES ASSY									
G.II .27	WHEEL ASSY									
G.II .28	STEERING BOX	significant	none	<<1	medium	medium	large	medium	medium	
G.II .29	STEERING ASSY									
G.II .30	CHASSIS ASSY									
G.II .31	BODY-MEATLSHEET ASSY									
G.II .32	BODY- GLASS ASSY	significant	significant	>1						
G.II .33	BODY -LIGHTS ASSY									
G.II .34	BODY- PROFILES ASSY									
G.II .35	BODY - BUMPER ASSY	significant	negligeable	<<1	medium	large	medium	small	small	opportunity study
G.II .36	BODY - FINISHINGS ASSY									
G.II .37	INNER LINING									
G.II .38	INNER UPHOLSTERY ASSY									
G.II .39	INNER CARPETS SET	significant	significant	>1						
G.II .40	INNER PANELS SET	significant	significant	>1						
G.II .41	SAFETY BELTS	significant	significant	>1						
G.II .42	CONTROL PANEL	significant	none	<<1	large					
G.II .43	CONTROLS									
G.II .44	WIPERS	significant	none	<<1	large					
G.II .45	BATTERY	significant	significant	>1						
G.II .46	ELECTRIC PLANT									
G.II .47	HORN	significant	none	<<1	large					
G.II .48	ANTENNA	significant	significant	>1						
G.II .49	RADIO	significant	significant	>1						
G.II .50	RADIATOR	significant	significant	>1						
G.II .51	COOLING SYST SUB - ASSY									
G.II .52	FUEL PUMP	significant	none	<<1	large					
G.II .53	FUEL SYSTEM SUB ASSY									
G.II .54	BREAKE PUMP	significant	none	<<1	medium	medium	large	medium	medium	
G.II .55	BREAKE SYST. SUB - ASSY									
G.II .56	SERVO BREAKES	significant	none	<<1	large					
G.II .57	HVAC SUB ASSY	significant	none	<<1	large					
G.II .58	COMPRESSOR	significant	none	<<1	large					
G.II .59	EVAPORARATOR	significant	significant	>1						

table C.1.c - Automotive split into 3rd level Assembly

AUTOMOTIVE _ 3RD LEVEL ASSEMBLY & COMPONENTS		MARKET			PRODUCTION /PRODUCT					REMARKS
		demand	offer (loc. manuf	ratio off/dem	invest. vs revenues	invest. vs manpower	manuf. quantity	techn.lgy complex	induced loc.suppl	
G.III. 1	CRANKCASE	significant	none	<<1	large	large	large	medium	small	
G.III. 2	CRANKSHAFT	significant	none	<<1	large	large	large	medium	small	
G.III. 3	CAMSHAFT	significant	none	<<1	large	large	large	medium	small	
G.III. 4	CYLINDER	significant	none	<<1	medium	medium	large	medium	small	opportunity study
G.III. 5	PISTON	significant	none	<<1	large	medium	large	medium	small	
G.III. 6	CONNECTING ROD	significant	none	<<1	large	large	large	medium	small	
G.III. 7	CYLINDER HEAD	significant	none	<<1	large	large	large	medium	small	
G.III. 8	ROCKER ARM	significant	none	<<1	large	large	large	medium	small	
G.III. 9	INLET-EXHAUST VALVE	significant	none	<<1	large	large	large	medium	small	
G.III.10	FLYWHEEL	significant	none	<<1	small	medium	large	small	small	opportunity study
G.III.11	EXHAUST MANIFOLD	significant	none	<<1	medium	medium	large	small	small	
G.III.12	INLET MANIFOLD	significant	none	<<1	medium	medium	large	small	small	
G.III.13	PRISMATIC COMPONENTS	significant	negligeable	<1	medium	small	large	small	small	opportunity study
G.III.14	REVOLUTIONARY COMPONENTS	significant	negligeable	<1	medium	small	large	small	small	opportunity study
G.III.15	MOULDED STEEL COMPON	significant	negligeable	<1	medium	large	large	medium	small	opportunity study
G.III.16	PLASTIC MOULDED COMPONENTS	significant	negligeable	<1	medium	large	large	medium	small	opportunity study
G.III.17	GEARS	significant	negligeable	<<1	large	medium	large	small	small	
G.III.18	BELT	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
G.III.19	PULLEY	significant	negligeable	<1	small	medium	large	small	small	opportunity study
G.III.20	SPRINGS	significant	negligeable	<<1	large	medium	large	small	small	
G.III.21	O-RING	significant	none	<<1	large	large	large	medium	small	
G.III.22	GASKET	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
G.III.23	BEARINGS	significant	none	<<1	large	large	large	medium	small	
G.III.24	BOLTS	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
G.III.25	SCREW-NUTS	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
G.III.26	SHOCK ABSORBERS SPRINGS	significant	negligeable	<<1	large	medium	large	small	small	
G.III.27	LEAFSPRING	negligeable	none	<<1	large	medium	large	small	small	
G.III.28	BREACE DISK	significant	negligeable	<<1	medium	small	large	small	small	opportunity study
G.III.29	BREACE DISK PISTONS	significant	none	<<1	large	large	large	medium	small	
G.III.30	BREACE DRUM	significant	none	<<1	medium	small	large	small	small	opportunity study
G.III.31	BREACE SHOE	significant	none	<<1	large	large	large	medium	small	
G.III.32	DRUM BREACE PISTON	significant	none	<<1	large	large	large	medium	small	
G.III.33	RIM	significant	none	<<1	large	large	large	medium	small	
G.III.34	TYRES	significant	significant	1						
G.III.35	EQUILIBRATING WEIGHTS	significant	significant	1						
G.III.36	STEERING RODS	significant	none	<<1	medium	medium	large	small	small	opportunity study
G.III.37	JOINTS	significant	none	<<1	large	large	large	medium	small	
G.III.38	LIGHTS	significant	negligeable	<<1	large	large	large	medium	small	
G.III.39	BACK LIGHTS	significant	negligeable	<<1	large	large	large	medium	small	
G.III.40	SIDE & INNER LIGHTS	significant	negligeable	<<1	large	large	large	medium	small	
G.III.41	RUBBER PROFILES	significant	significant	<1	medium	medium	medium	small	small	opportunity study
G.III.42	UPHOLSTERY REINFORCEMENT	significant	significant	1						
G.III.43	UPHOLSTERY FILLING	significant	significant	1						
G.III.44	UPHOLSTERY LINING	significant	significant	1						
G.III.45	INNER PANELS	significant	significant	1						
G.III.46	CABLES & CABLE CONNECTORS	significant	negligeable	<<1	large	large	large	medium	small	
G.III.47	ELECTRIC CONTROLS	significant	negligeable	<<1	large	large	large	medium	small	
G.III.48	RUBBER HOSES	significant	negligeable	<<1	medium	medium	medium	small	small	opportunity study
G.III.49	PLASTIC HOSES	negligeable								
G.III.50	PIPES	significant	negligeable	<<1	large	large	large	medium	small	
G.III.51	RESERVOIRS	significant	negligeable	<<1	large	large	large	medium	small	
G.III.52	FUEL TANK	significant	none	<<1	large	large	large	medium	small	

D. INVESTMENT GOODS & GENERAL PURPOSE EQUIPMENT (GROUP H)

D.1 GROUP H - PRODUCT DEFINITION

This group covers a very large range of products. For the purpose of this study the products hereafter examined have been identified by the following families:

-*Construction Equipment*: all those equipment used only for civil constructions as concrete or trunk mixers, plastering, painting etc...
-*Earth Moving Equipment*:like shovels, dumpers, excavators etc...
-*Lifting Equipment*:like cranes, pulleys, winches, etc...
-*Handling Equipment*:conveyors of all types, forklifts, etc...
-*Pumps* :and pump-sets of all kind
-*Generating sets*
-*Compressors*
-*Welding*

table D.1.a - Investment goods & General Purpose Equipment split into 1st Level

INDUSTRIAL & GEN. PURPOSE MACHINES BREAKDOWN		MARKET			PRODUCTION /PRODUCT					REMARKS
		demand	offer (loc. manuf	ratio off/dem	invest. vs revenues	invest. vs manpower	manuf. quantity	techn.logy complex	induced loc.suppl	
H. . 1	TRUCK MIXERS	negligeable								
H. . 2	CONCRETE MIXERS	significant	negligeable	<<1	small	medium	small	small	medium	opportunity study
H. . 3	DUMPERS	negligeable								
H. . 4	SHOVELS	negligeable								
H. . 5	WINCHES	negligeable								
H. . 6	CRANES	negligeable								
H. . 7	FORKLIFTS	negligeable								
H. . 8	SCREW CONVEYORS	negligeable								
H. . 9	BELT CONVEYORS	negligeable								
H. .10	ROLL CONVOYERS	negligeable								
H. .11	PNEUMATIC CONVEYORS	negligeable								
H. .12	GENSETS	significant	significant	<<1	small	medium	medium	small	medium	opportunity study
H. .13	PUMPSETS	significant	significant	<<1	small	medium	medium	small	medium	opportunity study
H. .14	WELDING MACHINES	significant	negligeable	<<1	small	medium	medium	small	medium	opportunity study
H. .15	COMPRESSORS	significant	negligeable	<<1	small	medium	medium	small	medium	opportunity study
H. .16	EARTHMOVING EQUIPMENT	negligeable								

table D.1.b - Investment goods & General Purpose Equipment split into 3rd Assembly

INDUSTRIAL & GEN. PURPOSE _ 3RD LEVEL ASSEMBLY		MARKET			PRODUCTION /PRODUCT					REMARKS
		demand	offer (loc. manuf	ratio off/dem	invest. vs revenues	invest. vs manpower	manuf. quantity	techn.logy complex	induced loc.suppl	
H.III. 1	CRANKASE	significant	none	<<1	medium	medium	medium	medium	small	opportunity study
H.III. 2	CRANKSHAFT	significant	none	<<1	medium	medium	medium	medium	small	opportunity study
H.III. 3	CAMSHAFT	significant	none	<<1	medium	medium	medium	medium	small	opportunity study
H.III. 4	CYLINDER	significant	none	<<1	medium	medium	medium	medium	small	opportunity study
H.III. 5	PISTON	significant	none	<<1	large	medium	large	medium	small	
H.III. 6	CONNECTING ROD	significant	none	<<1	medium	medium	medium	medium	small	opportunity study
H.III. 7	CYLINDER HEAD	significant	none	<<1	medium	medium	medium	medium	small	opportunity study
H.III. 8	ROCKER ARM	significant	none	<<1	medium	medium	medium	medium	small	opportunity study
H.III. 9	INLET-EXHAUST VALVE	significant	none	<<1	large	large	large	medium	small	
H.III.10	FLYWHEEL	significant	none	<<1	small	medium	medium	small	small	opportunity study
H.III.11	EXHAUST MANIFOLD	significant	none	<<1	medium	medium	medium	small	small	opportunity study
H.III.12	INLET MANIFOLD	significant	none	<<1	medium	medium	medium	small	small	opportunity study
H.III.13	PRISMATIC COMPONENTS	significant	negligeable	<1	medium	small	medium	small	small	opportunity study
H.III.14	REVOLUTIONARY COMPONENTS	significant	negligeable	<1	medium	small	medium	small	small	opportunity study
H.III.15	MOULDED STEEL COMPON	significant	negligeable	<1	medium	large	medium	medium	small	opportunity study
H.III.16	PLASTIC MOULDED COMPONENTS	significant	negligeable	<1	medium	large	medium	medium	small	opportunity study
H.III.17	GEARS	significant	negligeable	<<1	medium	medium	medium	small	small	opportunity study
H.III.18	BELT	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
H.III.19	PULLEY	significant	negligeable	<1	small	medium	large	small	small	opportunity study
H.III.20	SPRINGS	significant	negligeable	<<1	large	medium	large	small	small	
H.III.21	O-RING	significant	none	<<1	large	large	large	medium	small	
H.III.22	GASKET	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
H.III.23	BEARINGS	significant	none	<<1	large	large	large	medium	small	
H.III.24	BOLTS	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
H.III.25	SCREW-NUTS	significant	negligeable	<<1	medium	medium	large	small	small	opportunity study
H.III.26	SHOCK ABSORBERS SPRINGS	negligeable								
H.III.27	LEAFSPRING	negligeable								
H.III.28	BREAKE DISK	negligeable								
H.III.29	BREAKE DISK P. ONS	negligeable								
H.III.30	BREAKE DRUM	negligeable								
H.III.31	BREAKE SHOE	negligeable								
H.III.32	DRUM BREAKE PISTON	negligeable								
H.III.33	RIM	negligeable								
H.III.34	TYRES	negligeable								
H.III.35	EQUILIBRATING WEIGHTS	negligeable								
H.III.36	STEERING RODS	negligeable								
H.III.37	JOINTS	negligeable								
H.III.38	LIGHTS	negligeable								
H.III.39	BACK LIGHTS	negligeable								
H.III.40	SIDE & INNER LIGHTS	negligeable								
H.III.41	RUBBER PROFILES	negligeable								
H.III.42	UPHOLSTERY REINFORCEMENT	negligeable								
H.III.43	UPHOLSTERY FILLING	negligeable								
H.III.44	UPHOLSTERY LINING	negligeable								
H.III.45	INNER PANELS	negligeable								
H.III.46	CABLES & CABLE CONNECTORS	significant	negligeable	<<1	large	large	large	medium	small	
H.III.47	ELECTRIC CONTROLS	significant	negligeable	<<1	large	large	large	medium	small	
H.III.48	RUBBER HOSES	significant	negligeable	<<1	medium	medium	medium	small	small	opportunity study
H.III.49	PLASTIC HOSES	negligeable								
H.III.50	PIPES	significant	negligeable	<<1	large	large	large	medium	small	
H.III.51	RESERVOIRS	negligeable								
H.III.52	FUEL TANK	significant	none	<<1	large	large	large	medium	small	

table D.1.a - Investment goods & General Purpose Equipment split into 2nd Assembly

INDUSTRIAL & GEN. PURPOSE _ 2ND LEVEL ASSEMBLY	MARKET			PRODUCTION /PRODUCT					REMARKS
	demand	offer (loc. manuf	ratio off/dem	invst. vs revenues	invst. vs manpower	manuf. quantity	techn.lgy complex	induced loc.suppl	
M.II . 1 CARBURETOR	negligeable	none	negligeable	large	medium	large	medium	small	
M.II . 2 DISTRIBUTOR	negligeable	none	negligeable	large	medium	large	medium	small	
M.II . 3 SPARKLING-PLUG	negligeable	none	negligeable	medium	medium	large	small	small	
M.II . 4 OIL PUMP	significant	negligeable	<<1	medium	medium	medium	medium	small	opportunity study
M.II . 5 WATER PUMP	negligeable	none	<<1	medium	medium	medium	medium	small	
M.II . 6 THERMOSTAT	negligeable	none	negligeable	large					
M.II . 7 INJECTION PUMP	significant	none	negligeable	large					
M.II . 8 INJECTOR	significant	none	negligeable	large					
M.II . 9 ALTERNATOR	significant	none	negligeable	large	medium	large	medium	small	
M.II .10 STARTER MOTOR	significant	none	negligeable	large	medium	large	medium	small	
M.II .11 CLUTCH DISK	significant	negligeable	<1	medium	medium	medium	small	small	opportunity study
M.II .12 CLUTCH SYSTEM	significant	negligeable	<1	medium	medium	medium	small	small	opportunity study
M.II .13 FUEL FILTER	significant	significant	>1						
M.II .14 OIL FILTER	significant	significant	>1						
M.II .15 AIR FILTER	significant	significant	>1						
M.II .16 EXHAUST PIPE	significant	significant	>1						
M.II .17 PETROL ENG. SUBASST									
M.II .18 DIESEL ENG. SUBASST									
M.II .19 GEAR BOX	significant	none	<<1	medium	medium	medium	medium	medium	opportunity study
M.II .20 DIFFERENTIAL	significant	none	<<1	medium	medium	medium	medium	medium	opportunity study
M.II .21 ELASTIC JOINT	signif'cant	negligeable	<<1	medium	medium	medium	medium	small	opportunity study
M.II .22 TRANSMISSION SHAFT	negligeable								
M.II .23 SHOCK ABSORBERS	negligeable								
M.II .24 SUSPENSION SUB ASSY									
M.II .25 DISK BREAKES ASSY									
M.II .26 DRUM BREAKES ASSY									
M.II .27 WHEEL ASSY									
M.II .28 STEERING BOX	negligeable								
M.II .29 STEERING ASSY									
M.II .30 CHASSIS ASSY									
M.II .31 BODY-METALSHEET ASSY									
M.II .32 BODY- GLASS ASSY									
M.II .33 BODY -LIGHTS ASSY									
M.II .34 BODY- PROFILES ASSY									
M.II .35 BODY - BUMPER ASSY									
M.II .36 BODY - FINISHINGS ASSY									
M.II .37 INNER LINING									
M.II .38 INNER UPHOLSTERY ASSY									
M.II .39 INNER CARPETS SET									
M.II .40 INNER PANELS SET									
M.II .41 SAFETY BELTS									
M.II .42 CONTROL PANEL									
M.II .43 CONTROLS									
M.II .44 WIPERS									
M.II .45 BATTERY	significant	significant	>1						
M.II .46 ELECTRIC PLANT									
M.II .47 HORN									
M.II .48 ANTENNA									
M.II .49 RADIO									
M.II .50 RADIATOR	significant	significant	>1						
M.II .51 COOLING SYST SUB - ASSY									
M.II .52 FUEL PUMP	s'nificant	none	<<1	large					
M.II .53 FUEL SYSTEM SUB ASSY									
M.II .54 BREAKE PUMP	significant	none	<<1	medium	medium	medium	medium	medium	opportunity study
M.II .55 BREAKE SYST. SUB - ASSY									
M.II .56 SERVO BREAKES									
M.II .57 HVAC SUB ASSY									
M.II .58 COMPRESSOR									
M.II .59 EVAPORARATOR									
M.II .60 HYDRAULIC SYST ASSY									
M.II .61 HYDRAULIC PUMPS & MOTORS	negligeable								
M.II .62 GEAR BOXES	significant	none	<<1	medium	medium	medium	medium	medium	opportunity study
M.II .63 SPRAYING PUMPS									
M.II .64 LIQUID MANURE PUMPS									
M.II .65 WATER PUMPS									
M.II .66 ELECTRIC MOTORS	significant	none	<<1	medium	medium	medium	medium	medium	opportunity study
M.II .67 WITCHES	significant	negligeable	<<1	large	large	large	medium	medium	
M.II .68 ALTERNATORS	significant	none	<<1	large	large	large	medium	medium	
M.II .69 DC GENERATORS	negligeable								
M.II .70 COMPRESSORS	negligeable								

Manufacturing opportunities to be investiga · cern the production of:

main products	1s level	2nd level	3rd level
-Concrete Mixers	*diesel engines*	*oil pumps* *clutches*	*components*
-Gen-sets			
-Pump-sets			
-Welding machines			
-Compressors			

E. MACHINE TOOLS & TOOLS (GROUP I)

E.1 GROUP-I PRODUCT DEFINITION

The main products considered in this paragraph are the following:

a. ABRASION EQUIPMENT
- Sharpeners
- Honing and Lapping Machines
- Polishing, rough grinding
- Surfacing machines
- Grinding machines

b. CUTTING EQUIPMENT
- Broaching machines
- Screwing and threading machines
- Milling machines and machining centres
- Gear cutting and finishing machines
- Heavy metal cutting machine tools
- Planing, shaping, cutting-off machines
- Sawing machine
- Turning machines
- Drilling machines
- Other cutting machine tools

c. FORMING EQUIPMENT
- Shearing, Nibbling machines,
- Notching, Poundring machines
- Forging machines
- Machines for bolts, screws production
- Machines nuts and rivets production
- Plate-sheet and strip working machines
- Bar and section working machines
- Wire forming machines
- Tube working machines
- Heavy forming working machines
- Presses
- Other metal working machines

d. HEAT, CHEMICAL & OTHER TREATMENTS
- Hardening & Heating machines and equipments
- Surface treatment machines and equipments
- Physical-chemical process machine tools

e. MEASURING & TESTING EQUIPMENT & INSTRUMENTS
- Testing machines
- Measuring & testing instruments

f. ACCESSORIES, TOOLS, HOLDERS & MOULDS
- Accessories for machine tools
- Work and tools holders
- Moulds and dies

E.2 MACHINE TOOLS SITUATION IN NIGERIA

Only one machine tools manufacturer operates in Nigeria: NMT - Nigerian Machine Tools Ltd., Oshobo. This company was established in joint-venture with Hindustan Machine Tools (India). The production consisted in SKD assembly totally imported from India. Few years after the Indian partner withdrew and stopped the SKD supply.

The management in cooperation with major Nigerian institutions and universities started an own design and production of simple machine tools like wood-working lathes, pedestal grinders, power hacksaw, hand-shears. Since its establishment the company has experienced losses.

Since Government considers the plant strategic, not only it replenishes losses, but it also finances the implementation of the remaining departments:

- by end 1989, a stand-by diesel power plant and 3,000 T/y foundry. Foundry investment costs are estimated 55 million Naira.
- 1991-93 Research & development Centre for a total investment costs of 65 million Naira.
- 1991-92 Tools room for a total investment costs of 37 million Naira.
- 1991-93 Expansion of a training centre for a total investment costs of 65 million Naira.
- 1993-95 Ancillary units for a total investment costs of 92 million Naira

Once completed the complex will consist of the following departments:

- small parts shop
- heavy parts shop
- foundry
- heat treatment department
- sheet metal forming department
- cutting bay
- training centre & RD centre

NMT figures concerning Nigeria 1998 market and their target share the situation, could be the following:

table E.2 - Machine Tools demand and NMT share at full capacity (1998)

	Tot dem.		NMT share		Prod(*)	Un.price	Tot.rev	
Prod&Type	%	Nos	%	Nos	Nos	N	10^6N	
LATHE	100	2846						
C.late	70	1992	30	590	570	115,000	65.550	
MILLING M/c	100	930						
	60	560	40	230	200	152,000	30.400	
DRILL M/c	100	1265						
Bench type	35	540	60	264	250	10,950	2.225	
Pillar t.	44	560	60	336	320	14,500	4.654	
Radial t.	16	165	60	121	120	149,600	17.952	
GRINDING M/c	100	1230						
Pedestal	50	642	50	321	320	12,200	3.835	
Tool&cutter	15	185	50	111	100	59,000	5.900	
SHAPER	100	285	40	114	110	88,000	9.680	
SAWING	100	456						
Power HSaw	50	228	50	114	110	42,000	3.520	
WOODLATHE	100	815						
	60	489	40	196	120	11,500	0.816	

(*) Suggested Production

The opinion of the consultant is that these figures are rather optimistic, in particular for the target share and the suggested production capacity. Other investments in this field will jeopardize the Government and NMT efforts to build up machine tools manufacturing capabilities in Nigeria. Moreover the economic results seem not to be so appealing for private investors.

F. INDUSTRIAL SPARE PARTS (GROUP J)

F.1 INDUSTRIAL SPARE PARTS SITUATION IN NIGERIA

In industrial spare parts the attention was focussed to the following industries:

Cement industry
The cement industry requires wear and tear spare parts characterized by high resistance alloy cast iron.

- Grinding media for raw milling
- Plates for lining
- Crush hammers
- Chains
- Grinding media for clinker milling
- Diaphragms for millings
- Cooler plates
- Others for quarry and mining

In Nigeria operate seven Cement companies for a total installed capacity exceeding 5,000,000 Tons/y. Their total annual demand of cast spare parts is estimated to be 3,800 Tons/y. To the above other 1,800 tons/year of spare parts are needed by quarry and mining equipment. The total demand is estimated about 5,000-6,000 Tons/year. Two foundries namely Delta Steel and Bamfords are equipped to produce these parts. Bamfords declared to be interested only in casting grinding media. Delta Steel produces at the being grinding media and may produce all the other parts. However Delta Steel foundry is foreseen for its own needs and this spare availability will be soon absorbed by internal requests.

- Textile industry
Textile industry consumes a large number of spare parts having small dimensions and an average unit rate from 200 g. to maximum 3 kg:

- Levers
- Screw wheels
- Bearing
- Centre drums/diaphragms
- Crankshafts
- Rotors
- Insulating plates
- Gear wheels
- Bobbin rest body
- Spindles

Textile Mills need to order large quantity of spare parts (2 years) to reach the minimum size accepted by foundries. More than 55 textile mills operate in Nigeria, mainly in four areas: (Lagos: 25, Kano: 15, Kaduna: 15, Aba: 3)

Assuming a unit consumption of 35 to 40 ton/year for each mill the total demand is about 2,000 T/year, out of which it is estimated that almost 70 % (1,400 T/y) consists of cast iron spare parts, 20 to 25 % (500 T/y) of non-ferrous metal and the balance (100 T/y) of special steels.

Sugar Industry
The spare parts fo sugar industry are:

- mill spares: scrapers, trash plates, coupling box, gears
- boiler spares: rails, door frames
- bearing housing, pump cases and impellers

Two Sugar companies operate in Nigeria with a total of 3 sugar mills. Annual estimates of their cast spare parts is around 3,000 t/y of cast iron. The IDU-Industrial development unit of the Commonwealth Fund for Technical Cooperation already submitted a preliminary study concerning a foundry to produce mainly sugar industry spare parts. The capacity of the suggested foundry can also supply cast pieces to other industries such as paper.

G. PRODUCTION OF ASSEMBLY AND COMPONENTS

For each of groups F, G, H the main items were split into first, second and third or components levels to allow to consolidate components needed by the three groups:

G.1 ASSEMBLY & COMPONENTS OF GROUP F "AGRICULTURE MACHINERY"

tab.g.1.a - 1st level assembly installed in the main group F products

AGRICULTURAL MACHINERY		INSTALLED UNITS REFERRED TO MAIN ITEMS OF THE LIST																	
1st level Assembly		TRACT. & SELFPROPELLED GENERAL PURPOSE					HARVESTERS				TRACTORED SOIL WORKING EQUIPMENT				TRACTORED EQUIPMENT			STATIONARY EQUIPMENT
		FA 1	FA 2	FA 3	FA 4	FA 5	FB 1	FB 2	FB 3	FB 4	FC 7	FC 12	FC 13	FC 14	FD 2	FD 6	FD 14	FE 4
F.I. 1	Petrol engine				0.5	0.5				0.5								
F.I. 2	diesel engine	1	1	1	0.5	0.5	1	1	1	0.5								
F.I. 3	transmission	1	1	1	1	1	1	1	1	1								
F.I. 4	suspensions																	
F.I. 5																		
F.I. 6	break system	2	2	2	2	2	2	2	2	2							2	
F.I. 7	wheels	4	2	2	2	3	4	4	4	4							2	
F.I. 8	steering	1					1	1	1	1								
F.I. 9	chassis	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1	
F.I.10	body	1					1											
F.I.11																		
F.I.12	instrumentation	1					1		1									
F.I.13	electric system	1					1		1	1								
F.I.14	cooling system	1					1											
F.I.15	fuel system	1	1	1	1	1	1	1	1	1								
F.I.16	break circuit	1	1	1	1	1	1	1	1	1								
F.I.17																		
F.I.18	hydraulic system	1					1		1									
F.I.19	gear boxes					1	x	1	x	1	1	1	1	1	1			
F.I.20	spraying pumps															1		
F.I.21	manure pumps																	
F.I.22	water pumps																	1
F.I.23	electric motors																	
F.I.24	winches																	

tab.g.1.b - 2nd level assembly installed in the 1st Level assembly

		INSTALLED UNITS REFERRED TO 1ST LEVEL ASSEMBLY																								
F LEVEL	1ST L	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
F.II . 1	CARBURETOR	1																								
F.II . 2	DISTRIBUTOR	1																								
F.II . 3	SPARKLING-PLUG	1																								
F.II . 4	OIL PUMP	1	1																							
F.II . 5	WATER PUMP		x																							
F.II . 6	THERMOSTAT		x																							
F.II . 7	INJECTION PUMP		1																							
F.II . 8	INJECTOR		x																							
F.II . 9	ALTERNATOR	1	1																							
F.II .10	STARTER MOTOR	1	1																							
F.II .11	CLUTCH DISC	1	1																							
F.II .12	CLUTCH SYSTEM	1	1																							FITCHEL-SACKS
F.II .13	FUEL FILTER	1	1																							BOULOS, CHIEME
F.II .14	OIL FILTER	1	1															1								
F.II .15	AIR FILTER	1	1																							
F.II .16	EXAUST PIPE	1	1																							ZEP
F.II .17	PETROL ENG.SUB ASSY	1																								FITCHEL-SACKS
F.II .18	DIESEL ENG.SUB ASSY		1																							
F.II .19	GEAR BOX			1																						
F.II .20	DIFFERENTIAL			1																						
F.II .21	DRUM BREAKES ASSY						1																			
F.II .22	WHEEL ASSEMBLY							1																		
F.II .23	STEARING BOX								1																	
F.II .24	STEARING ASSEMBLY								1																	
F.II .25	CHASSIS ASSEMBLY									1																
F.II .26	BODY METALSHEET ASSY										1															
F.II .27	BODY LIGHTS ASSEMBLY										1															
F.II .28	BODY FINISHINGS ASSY										1															
F.II .29	INSTRUMENTS PANEL												1													
F.II .30	CONTROLS												1													
F.II .31	BATTERY													1												AMB
F.II .32	ELECTRIC PLANT													1												
F.II .33	HORN													1												
F.II .34	RADIATOR														1											
F.II .35	COOLING SYSTEM SUB A														1											
F.II .36	FUEL PUMP															1										
F.II .37	FUEL SYSTEM SUB ASSY															1										
F.II .38	BREAKE SYSTEM SUB AS																1									
F.II .39	HYDRAULIC SYSTEM SUB																	1								
F.II .40	HYDRAULIC PUMPS & MO																	1								
F.II .41	GEARS																		1							
F.II .42	SPRAYING PUMPS																		1							
F.II .43	LIQUID MANURE PUMPS																		1							
F.II .44	WATER PUMPS																		1							
F.II .45	ELECTRIC MOTORS																		1							
F.II .46	WINCHES																		1							

tab.g.1.c - 3rd level assembly installed in the 2nd level assembly

		INSTALLED UNITS REFERRED TO 2ND LEVEL ASSEMBLY																			
COMPONENTS	2ND LE	17	18	21	22	24	25	26	27	28	30	32	35	37	38	39	41	42	44	45	46	REMARKS
F.III. 1	CRANKASE	1	1																			
F.III. 2	CRANKSHAFT	1	1																			
F.III. 3	CAMSHAFT	1	1																			
F.III. 4	CYLINDER	x	x																			
F.III. 5	PISTON	x	x																			
F.III. 6	CONNECTING ROD	x	x																			
F.III. 7	CYLINDER HEAD	1	1																			
F.III. 8	ROCKER ARM	x	x																			
F.III. 9	INLET-EXHAUST VALVE	x	x																			
F.III.10	FLYWHEEL	1	1																			
F.III.11	EXHAUST MANIFOLD	1	1																			BAMFORDS,DELTA
F.III.12	INLET MANIFOLD	1	1																			
F.III.13	PRISMATIC COMPON.TS	x	x	x		x	x				x					x	x	x	x	x	x	BAMFORDS,PAN,SCDA,SEP
F.III.14	REVOLUTION COMPON.TS	x	x	x			x				x					x	x	x	x	x	x	BAMFORDS,PAN,SCDA,SEP
F.III.15	MOULDED STEEL COMPON	x	x		x	x	x	x	x	x	x		x	x			x	x	x	x	x	CHIEME,BROSSET,UGC,MACSHI,SEP,PAN
F.III.16	PLAS.MOULED COMPON.TS	x	x						x		x	x						x		x		HONACO,BROSSET
F.III.17	GEARS	x	x														x					
F.III.18	BELT		2																			
F.III.19	PULLEY	3	3																			
F.III.20	SPRINGS																					
F.III.21	O-RING																					
F.III.22	GASKET																					
F.III.23	BEARINGS																					
F.III.24	BOLTS																					
F.III.25	SCREW-NUTS																					
F.III.26	SHOCK ABSORB.SPRINGS																					
F.III.27	LEAFSPRING																					
F.III.28	BREAKE DISK																					
F.III.29	BREAKE DISK PISTONS																					BAMFORDS,DELTA
F.III.30	BREAKE DRUM			1																		
F.III.31	BREAKE SHOE			1																		BAMFORDS,DELTA
F.III.32	DRUM BREAKE PISTON			1																		
F.III.33	RIM				1																	
F.III.34	TYRES				1																	
F.III.35	EQUILIBRATING WEIGHTS																					MICHELIN
F.III.36	STEERING RODS					x																MAKEBT
F.III.37	JOINTS					x																
F.III.38	LIGHTS																					
F.III.39	BACK LIGHTS								2													
F.III.40	SIDE & INNER LIGHTS								2													
F.III.41	RUBBER PROFILES								x													
F.III.42	UPHOLSTERY REINFORC.T																					
F.III.43	UPHOLSTERY FILLING																					
F.III.44	UPHOLSTERY LINING																					
F.III.45	INNER PANELS																					
F.III.46	CABLES&CABLE CONNECT.																					
F.III.47	ELECTRIC CONTROLS											x										
F.III.48	RUBBER HOSES	x	x	x								x										
F.III.49	PLASTIC HOSES												x		x	x						
F.III.50	PIPES	x	x								x			x								
F.III.51	RESERVOIRS										x			x	x	x						
F.III.52	FUEL TANK												1		1	1						

G.2 ASSEMBLY & COMPONENTS OF GROUPE G "AUTOMOTIVE"

tab.g.2.a - 1st level assembly installed in the main group G products

		INSTALLED UNITS REFERRED TO 1ST LEVEL ASSEMBLY			
I LEVEL	MAIN ITEMS	CARS & VANS	BUSES & LORRIES	TRUCKS & TRAILERS	REMARKS
G.I. 1	PETROL ENGINE	1			Use of Petrol or diesel is indicative
G.I. 2	DIESEL ENGINE		1	1	
G.I. 3	TRANSMISSION	1	1	1	
G.I. 4	SUSPENSIONS	4	6	6	quantities are an average estimate
G.I. 5	DISK BREAKES	2			
G.I. 6	DRUM BREAKES		6	6	quantities are an average estimate
G.I. 7	WHEELS	4	8	8	quantities are an average estimate
G.I. 8	STEERING	1	1	1	
G.I. 9	CHASSIS		1	1	
G.I.10	BODY	1	1	1	
G.I.11	UPHOLSTERY	1	1	1	
G.I.12	INSTRUMENTATION	1	1	1	
G.I.13	ELECTRIC SYSTEM	1	1	1	
G.I.14	COOLING SYSTEM	1	1	1	
G.I.15	FUEL SYSTEM	1	1	1	
G.I.16	BREAKES SYSTEM	1	1	1	
G.I.17	VENTILATION SYSTEM	1	1	1	

tab.g.2.b - 2nd level assembly installed in the 1st Level assembly

		INSTALLED UNITS REFERRED TO 1ST LEVEL ASSEMBLY																
II LEVEL	1ST	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	REMARKS
G.II. 1	CARBURETOR	1																	
G.II. 2	DISTRIBUTOR	1																	
G.II. 3	SPARKLING-PLUG	4																	
G.II. 4	OIL PUMP	1	1																
G.II. 5	WATER PUMP	1	1																
G.II. 6	THERMOSTAT	1	1																
G.II. 7	INJECTION PUMP		1																
G.II. 8	INJECTOR		4																
G.II. 9	ALTERNATOR	1	1																
G.II.10	STARTER MOTOR	1	1																
G.II.11	CLUTCH DISK	1	1																
G.II.12	CLUTCH SYSTEM	1	1																FITCHELSACKS
G.II.13	FUEL FILTER	1	1																BOULOS, CHIEMI
G.II.14	OIL FILTER	1	1																
G.II.15	AIR FILTER	1	1																
G.II.16	EXHAUST PIPE	1	1																SEP
G.II.17	PETROL ENG. SUBASSY	1																	
G.II.18	DIESEL ENG. SUBASSY		1																
G.II.19	GEAR BOX			1															
G.II.20	DIFFERENTIAL			1															
G.II.21	ELASTIC JOINT			2															
G.II.22	TRANSMISSION SHAFT			1															
G.II.23	SHOCK ABSORBERS				4														
G.II.24	SUSPENSION SUB ASSY				1														
G.II.25	DISC BREAKES ASSY					1													
G.II.26	DRUM BREAKES ASSY						1												
G.II.27	WHEEL ASSY							1											
G.II.28	STEERING BOX								1										
G.II.29	STEERING ASSY								1										
G.II.30	CHASSIS ASSY									1									
G.II.31	BODY-METALSHEET ASS										1								
G.II.32	BODY- GLASS ASSY										1								TRIPLEX
G.II.33	BODY -LIGHTS ASSY										1								
G.II.34	BODY- PROFILES ASSY										1								
G.II.35	BODY - BUMPER ASSY										1								BROSSETTE
G.II.36	BODY - FINISHINGS A										1	1							
G.II.37	INNER LINING											1							
G.II.38	INNER UPHOLSTERY AS											1							INFF
G.II.39	INNER CARPETS SET											1							INFF
G.II.40	INNER PANELS SET											1							
G.II.41	SAFETY BELTS											1							
G.II.42	CONTROL PANEL												1						
G.II.43	CONTROLS												1						
G.II.44	WIPERS												1						
G.II.45	BATTERY													1					AMB
G.II.46	ELECTRIC PLANT													1					
G.II.47	HORN													1					
G.II.48	ANTENNA													x					ATECO
G.II.49	RADIO													x					
G.II.50	RADIATOR														1				RHL
G.II.51	COOLING SYST SUB -														1				
G.II.52	[illegible] PUMP															1			
G.II.53	FUEL SYSTEM SUB ASS															1			
G.II.54	BREAKE PUMP																1		
G.II.55	BREAKE SYST. SUB -																1		
G.II.56	SERVO BREAKES																1		
G.II.57	HVAC SUB ASSY																	1	
G.II.58	COMPRESSOR																	1	
G.II.59	EVAPORATATOR																	1	HEV

tab.g.2.c - 3rd level assembly installed in the 2nd level assembly

	INSTALLED UNITS REFERRED TO 2nd LEVEL ASSEMBLY																				
III LEVEL & COMPONENTS/2nd LEVEL		17	18	24	25	26	27	29	30	31	33	34	36	37	38	43	46	51	53	55	REMARKS
G.III. 1	CRANKASE	1	1																		
G.III. 2	CRANKSHAFT	1	1																		
G.III. 3	C.-SHAFT	1	1																		
G.III. 4	CYLINDER	4	4																		
G.III. 5	PISTON	4	4																		
G.III. 6	CONNECTING ROD	4	4																		
G.III. 7	CYLINDER HEAD	1	1																		
G.III. 8	ROCKER ARM	8	8																		
G.III. 9	INLET-EXHAUST VALVE	8	8																		
G.III.10	FLYWHEEL	1	1																		
G.III.11	EXHAUST MANIFOLD	1	1																		BAMFORD,DELTA
G.III.12	INLET MANIFOLD	1	1																		
G.III.13	PRISMATIC COMPONENTS	x	x		x	x		x								x					
G.III.14	REVOLUTIONART COMPONENT	x	x	x	x	x										x					BAMFORD,PAN,SCOA.
G.III.15	MOULDED STEEL COMPON	x	x	x	x		x	x	x	x	x		x	x		x		x	x		BAMFORD,PAN,SCOA.
G.III.16	PLASTIC MOULDED COMPONE	x	x								x	x	x	x	x	x	x				CRIEME,BROSSET,MC
G.III.17	GEARS	x	x								x										HOMACO,BROSSET
G.III.18	BELT	2	2																		
G.III.19	PULLEY	3	3																		
G.III.20	SPRINGS																				
G.III.21	O-RING																				
G.III.22	GASKET																				
G.III.23	BEARINGS																				
G.III.24	BOLTS																				
G.III.25	SCREW-NUTS																				
G.III.26	SHOCK ABSORBERS SPRINGS			1																	
G.III.27	LEAFSPRING			x																	
G.III.28	BREAKE DISK				1																
G.III.29	BREAKE DISK PISTONS				1																BAMFORD,DELTA
G.III.30	BREAKE DRUM					1															
G.III.31	BREAKE SHOE					1															BAMFORD,DELTA
G.III.32	DRUM BREAKE PISTON					1															
G.III.33	RIM						1														
G.III.34	TYRES						1														
G.III.35	EQUILIBRATING WEIGHTS						x														MICHELIN
G.III.36	STEERING RODS							x													RAKERT
G.III.37	JOINTS							x													
G.III.38	LIGHTS																x				
G.III.39	BACK LIGHTS										2										
G.III.40	SIDE & INNER LIGHTS										2										
G.III.41	RUBBER PROFILES										x										
G.III.42	UPHOLSTERY REINFORCEMEN											x									
G.III.43	UPHOLSTERY FILLING														x						
G.III.44	UPHOLSTERY LINING														x						
G.III.45	INNER PANELS														x						
G.III.46	CABLES & CABLE CONNECTO													x			x				
G.III.47	ELECTRIC CONTROLS																x				
G.III.48	RUBBER HOSES	x	x		x	x												x		x	
G.III.49	PLASTIC HOSES												x			x			x		
G.III.50	PIPES	x	x													x			x	x	
G.III.51	RESERVOIRs																	1			
G.III.52	FUEL TANK																		1	1	

G.3 ASSEMBLY & COMPONENTS OF GROUP H "INDUSTRIAL GOODS"

tab.g.3.a - Main group H products

h.1 Truck Mixers	h.2 Concrete mixers	h.3 Dumpers
h.4 Shovels	h.5 Winches	h.6 Cranes
h.7 Fork Lifts	h.8 Screw conveyors	h.9 Belt conveyors
h.10 Roll conveyors	h.11 Pneumatic conveyors	h.12 Generator sets
h.13 Pump sets	h.14 Welding machines	h.15 Compressors
h.16 Earth Moving Equipment		

tab.g.3.b - 2nd level assembly installed in the 1st Level assembly

INDUSTRIAL & GEN. PURPOSE 2nd LEVEL ASSEMBLY / 1st Level	Installed units referred to 1st level assembly																									REMARKS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	
H.II . 1 CARBURETOR	1																												
H.II . 2 DISTRIBUTOR	1																												
H.II . 3 SPARKLING-PLUG	1																												
H.II . 4 OIL PUMP	1	1																											
H.II . 5 WATER PUMP		x																											
H.II . 6 THERMOSTAT		x																											
H.II . 7 INJECTION PUMP		1																											
H.II . 8 INJECTOR		4																											
H.II . 9 ALTERNATOR	1	1																											
H.II .10 STARTER MOTOR		1																											
H.II .11 CLUTCH DISK	1	1																											
H.II .12 CLUTCH SYSTEM	1	1																											
H.II .13 FUEL FILTER	1	1																											
H.II .14 OIL FILTER	1	1																											
H.II .15 AIR FILTER	1	1																											
H.II .16 EXHAUST PIPE	1	1																											
H.II .17 PETROL ENG. SUBASSY	1																												
H.II .18 DIESEL ENG. SUBASSY		1																											
H.II .19 GEAR BOX																													
H.II .20 DIFFERENTIAL																													
H.II .21 ELASTIC JOINT																													
H.II .22 TRANSMISSION SHAFT																													
H.II .23 SHOCK ABSORBERS																													
H.II .24 SUSPENSION SUB ASSY																													
H.II .25 DISK BREAKES ASSY																													
H.II .26 DRUM BREAKES ASSY																													
H.II .27 WHEEL ASSY																													
H.II .28 STEERING BOX																													
H.II .29 STEERING ASSY																													
H.II .30 CHASSIS ASSY									1																				
H.II .31 BODY-METALSHEET ASSY																													
H.II .32 BODY- GLASS ASSY																													
H.II .33 BODY -LIGHTS ASSY																													
H.II .34 BODY- PROFILES ASSY																													
H.II .35 BODY - BUMPER ASSY																													
H.II .36 BODY - FINISHINGS ASSY																													
H.II .37 INNER LINING																													
H.II .38 INNER UPHOLSTERY ASSY																													
H.II .39 INNER CARPETS SET																													
H.II .40 INNER PANELS SET																													
H.II .41 SAFETY BELTS																													
H.II .42 CONTROL PANEL												1																	
H.II .43 CONTROLS		1										1																	
H.II .44 WIPERS																													
H.II .45 BATTERY													1																
H.II .46 ELECTRIC PLANT													1																
H.II .47 HORN																													
H.II .48 ANTENNA																													
H.II .49 RADIO																													
H.II .50 RADIATOR																													
H.II .51 COOLING SYST SUB - ASSY																													
H.II .52 FUEL PUMP															1														
H.II .53 FUEL SYSTEM SUB ASSY															1														
H.II .54 BREAKE PUMP																													
H.II .55 BREAKE SYST. SUB - ASSY																													
H.II .56 SERVO BRAKES																													
H.II .57 HVAC SUB ASSY																													
H.II .58 COMPRESSOR																													
H.II .59 EVAPORATATOR																													
H.II .60 HYDRAULIC SYST ASSY																													
H.II .61 HYDRAULIC PUMPS & MOTORS																													
H.II .62 GEAR BOXES																													
H.II .63 SPRAYING PUMPS																													
H.II .64 LIQUID MANURE PUMPS																													
H.II .65 WATER PUMPS																													
H.II .66 ELECTRIC MOTORS																						1							
H.II .67 WINCHES																							1						
H.II .68 ALTERNATORS																									1				
H.II .69 DC GENERATORS																										1			
H.II .70 COMPRESSORS																											1		

tab.g.3.c - 3rd level assembly installed in the 2nd level assembly

INDUSTRIAL & GEN. PURPOSE 3RD LEVEL ASSEMBLY /2nd level		Installed units referred to 2nd level assembly										REMARKS
		17	18	30	43	46	53	65	66	67	69	
M.III. 1	CRANKASE	1	1									
M.III. 2	CRANKSHAFT	1	1									
M.III. 3	CAMSHAFT	1	1									
M.III. 4	CYLINDER	x	x									
M.III. 5	PISTON	x	x									
M.III. 6	CONNECTING ROD	x	x									
M.III. 7	CYLINDER HEAD	1	1									
M.III. 8	ROCER ARM	x	x									
M.III. 9	INLET-EXHAUST VALVE	x	x									
M.III.10	FLYWHEEL	1	1									
M.III.11	EXHAUST MANIFOLD	1	1									
M.III.12	INLET MANIFOLD	1	1									
M.III.13	PRISMATIC COMPONENTS	x	x	x	x			x	x	x	x	
M.III.14	REVOLUTIONARY COMPONENTS	x	x	x	x			x	x	x	x	
M.III.15	MOULDED STEEL COMPON	x	x	x	x		x	x	x	x	x	
M.III.16	PLASTIC MOULDED COMPONENTS	x	x		x	x			x	x	x	
M.III.17	GEARS	x	x									
M.III.18	BELT											
M.III.19	PULLEY	3	2									
M.III.20	SPRINGS		3									
M.III.21	O-RING											
M.III.22	GASKET											
M.III.23	BEARINGS											
M.III.24	BOLTS											
M.III.25	SCREW-NUTS											
M.III.26	SHOCK ABSORBERS SPRINGS											
M.III.27	LEAFSPRING											
M.III.28	BREAKE DISC											
M.III.29	BREAKE DISC PISTONS											
M.III.30	BREAKE DRUM											
M.III.31	BREAKE SHOE											
M.III.32	DRUM BREAKE PISTON											
M.III.33	RIM											
M.III.34	TYRES											
M.III.35	EQUILIBRATING WEIGHTS											
M.III.36	STEERING RODS											
M.III.37	JOINTS											
M.III.38	LIGHTS											
M.III.39	BACK LIGHTS											
M.III.40	SIDE & INNER LIGHTS											
M.III.41	RUBBER PROFILES											
M.III.42	UPHOLSTERY REINFORCEMENT											
M.III.43	UPHOLSTERY FILLING											
M.III.44	UPHOLSTERY LIFTING											
M.III.45	INNER PANELS											
M.III.46	CABLES & CABLE CONNECTORS					x						
M.III.47	ELECTRIC CONTROLS					x						
M.III.48	RUBBER HOSES	x	x									
M.III.49	PLASTIC HOSES				x		x					
M.III.50	PIPES	x	x		x		x					
M.III.51	RESERVOIRS											
M.III.52	FUEL TANK						1					

G.4 VEHICLES PRODUCTION IN NIGERIA

The installed capacity is significative:[2]

Manufacturer Brand	State	Cars & vans	Buses & lorries	Trucks & trailers	Total
Peugeot	Kaduna	60,000			60,000
Volkswagen	Lagos	45,000			45,000
Mercedes	Enugu		15,000		15,000
Steyr	Bauchi			9,000	9,000
Fiat Iveco	Kano			12,000	12,000
Leyland	Ibadan		26,000		26,000
Scoa Motors	Lagos	15,000			15,000
Federated Mot.Ind.	Lagos				15,000
Total		120,000	41,000	21,000	197,000

For 1989 Manufacturers expect the following production:[3]

Manufacturer	State	Cars & vans	Buses & lorries	Trucks & trailers	Total
Peugeot	Kaduna	8,000			8,000
Volkswagen	Lagos	3,000			3,000
Mercedes	Enugu				0
Steyr	Bauchi			0	0
Fiat Iveco	Kano			0	0
Leyland	Ibadan		0		0
Scoa Motors	Lagos				0
Federated Mot.Ind.	Lagos				0
Total		11,000	0	0	11,000
% of utilization		9.2	0.0	0.0	5.6

The utilization of plants is very low and all manufacturers are running serious crisis. Many of them have shut down the plants or intend to do so.

[2] Source: Federal Office of Statistics - Annual abstract of Statistics 1982 - 1985

[3] Source: from various manufacturers

G.5 VEHICLES DEMAND IN NIGERIA

The motor sales statistics in the years 1978-1983 are as follows:[4]

year	cars & vans		lorries&buses		trucks&trailers		total	
	No	market share %	No	market share %	No	market share %	No	market share %
1978	166,150	57.95	80,369	28.03	40,185	14.00	286,704	100.00
1979	154,198	62.81	60,857	24.79	30,429	12.30	245,484	85.60
1980	188,533	56,82	95,496	28.78	47,748	14.30	331,777	115.70
1981	265,148	55.05	144,329	29.96	72,167	14.90	481,644	168.00
1982	224,705	58.99	103,829	27.25	52,356	13.70	380,890	132.90
1983	134,763	65.10	48,161	23.26	24,081	11.60	207.005	72.20
average		59.45		27.01		13.50		

Sales show a peak in 1981 (481,644 units). The sales since 1983 average 200,000 units/year.

For the purpose of estimating what could be the projection of a "normal" demand, the following table shows imports of bodies, chassis, frames in weight up to 1985 included:[5]

	QUANTITY		VALUE	
Year	Tonnes	%	million N.	%
1977	64,709		261.6	
1978	72,614	100.0	299.3	100.0
1979	91,364	125.8	325.3	108.7
1980*	162,844	224.3	213.9	71.5
1981	130,671	180.0	618.7	206.7
1982	110,875	152.7	482.0	161.0
1983	66,662	91.8	374.7	125.2
1984	97,285	134.0	347.8	116.2
1985	95,665	131.7	277.9	92.8

1980* Figures from January to June

If the weight of years 1978 up to 1983 corresponds to the production of the same years, 1984 and 1985 represent approx 320,000 units. This figure appears excessive, if referred to sales statistics. Import statistics for Chassis & bodies include parts not destinated for local assembly.

In consideration of the economic situation and the sharp devaluation of Naira, a further drop in automotive sales is foreseen.

A conservative estimate of automotive sales may be around 150,000 to 200,000 units/year.

[4] Source: Federal Office of Statistics - Annual abstract of Statistics 1982 - 1985
[5] Source: Federal Office of Statistics - Nigerian Trade Summary

The distribution between main groups may modify towards an increase in commercial and industrial vehicles and a decrease in cars & vans. The share of the main products becomes:

cars and vans	55%
buses and lorries	30%
trucks and trailers	15%

Assuming that the local production satisfies between 30 and 50 % of the total sales , the extreme projection of local production is estimated to be as follows:

	min (150000-30%)	max (200000-50%)	average by Baldo	average by NIDB
cars & vans	25,000	55,000	40,000	39,500
lorries & buses	13,000	30,000	21,500	15,200
trucks & trailers	7,000	9,000	8,000	6,000

NIDB projections considered a plant utilization of 30 % and a different products share:

cars & vans	65%
buses & lorries	25%
trucks & trailers	10%

G.6 O.E. SUPPLIERS IN NIGERIA

All manufacturers visited claimed they have introduced procedures which shall be followed by local manufacturers to make their products accepted as Original Equipment.

Among these manufacturers, only Peugeot (PAN) seemed to proceed ahead, and the local supplies reached in 1989 22 % of the value. Sixty four different suppliers were homologated by 1989 , out of which 35 have materially supplied. The list of PAN suppliers practically covers also potential suppliers to other industries:

Suppliers Name	Items Manufactured	Location	State
ABG electronics	Car radios	Kaduna	Kaduna
Associated Battery Manufactures	Car batteries	Ikeja	Lagos
Augustmoon Plastics	Plastic Tubes	Kaduna	kaduna
A.B.C.Auto Components Ind	Seat foams	Kaduna	Kaduna
Auto Components Ltd.	engine mounting&support,	Otta	Ogun
Brossette Auto&Eng Ind.	A/Choses,fueltank,pedal system, bonnet strut	Kaduna	Kaduna
Bamfords International	Brake disc & brake drum	Jos	Plateau
Beckers Lay Tech	Sound proof materials	Boji	Bendel
Berger Paints	Paints & chemicals	Ikeja	Lagos
Boulos Enterprises Ltd	Stamped parts	Ikeja	Lagos
Buildomat	Spare wheel cradle	Asaba	Bendel
Car Components Ind.	Safety belts	Ikeja	Lagos
Chem. & Allied Prod.Ltd	Paints & chemicals	Lagos	Lagos
Chieme Motors	Front grill & fan blade	Aba	Imo
D V C	Sealers and antigravel spray	Isolo	Lagos
Delta Steel Company	Engine fly wheel	Aladja	Bendel
E. Dums Merchandise	Car radios	Kauna	Kaduna
E.O. Alagor	Car radios	Kaduna	Kaduna
Ferdinand Industry	Oil filter	Uruala	Imo
Fichtel & Sachs Ltd.	Friction disc and clutches	Lagos	Lagos
Gacol	A/C compressors and condensers	Otta	Ogun

PAN Suppliers (follow...1)

Suppliers Name	Items Manufactured	Location	State
General Metal Products	Aliminium profiles	Kaduna	Kaduna
Henkel	Chemicals and glue	Lagos	Lagos
Horizon Syntex Nig.Ltd	Upholstery materials	Lagos	Lagos
Intensive Arts	Stickers	Kaduna	Kaduna
Isoglass	Glasses	Ibadan	Oyo
Jimmy King Nig. Ltd.	Car radios	Kaduna	Kaduna
Leman Ind. (Kaduna) Ltd	Small machined parts, screws, bolts nuts	Kaduna	Kaduna
Makeri Smelting Co.	Balancing weights	Jos	Plateau
Michelin	Tyres and tubes	Port Harcourt	Ri vers
Muhase	Fire ext,traffic tr.	Kaduna	Kaduna
Muktar Foam Ltd.	Slit foams	Kaduna	Kaduna
Multipak Ltd.	Stamping dies	Lagos	Lagos
Nail&Gen.Steel Manuf.Ind.	Stamped/machined parts	Aba	Imo
Nepco	Freon gas	Lagos	Lagos
Nig.Al.Extrusiou Ltd.	Aliminium profiles	Lagos	Lagos
Nig. Engineering Works	A/C evaporator, crossmembers, stamped parts	P.Harcourt	Rivers
Nig.Gas Cylinders Manuf. Co. Ltd.	Stamped parts	Ejioku - Ibadan	Oyo State
Nocaco	Harnesses	Kaduna	Kaduna
Nolman Productions	Stickers	Lagos	Lagos

PAN Suppliers (follow..2)

Suppliers Name	Items Manufactured	Location	State
Norcon Ltd.	Isorel sheet, baft	Kano	Kano
Northern Nig. Fibre	Carpets	Jos	Plateu
Omo Nig. Enterprises	Chemicals	Kaduna	Kaduna
Omot Fire Protect. Eng.	Fire extinguishers, traffic triangles	Lagos	Lagos
Otuechere & Sons	Fire ext,traf.triangles	Lagos	Lagos
Pace Engineering	Filling of batteries	Kaduna	Kaduna
Penters	Chemicals	Ikeja	Lagos
Peugeot Auto Nig.Ltd.	Stamped parts	Kaduna	Kaduna
Polyplast	Upholstery & seat covers	Kano	Kano
Quality Flooring	PVC sheets	Kano	Kano
Quality Radiators	Radiators	P.Harcourt	Rivers
Queensway Aluminium	Aluminium profiles	Kaduna	Kaduna
Safety Products	Windscreen washer reservoir	Kaduna	Kaduna
Scoa Assembly	Horns	Lagos	Lagos
Scoa Iard	Stamped parts	Ikeja	Lagos
Silencer & Exh. Pipes	Exh. pipes, seat frames	Kano	Kano
Specialty Chemicals	Chemicals	Kaduna	Kaduna
Total Nig. Ltd.	Petroleum products	Lagos	Lagos
Tower Galvanized	Hollow pipes	Lagos	Lagos
Triplex Safety Glass	Glasses	Ibadan	Oyo
Ugochukwu Chem.Ind.	Sit foams	Kaduna	Kaduna
Unisteel	Iron components	Kaduna	Kaduna
W/African Batteries	Batteries	Ibadan	Oyo

The real situation is less encouraging than the above list, not because of the production means (machines & equipments), but for other difficulties namely:

-Raw Material availability
-Tools & Moulds availability and capability of making simple ones
-Technical Know how and technology sufficient to pass certification tests
-Lack of infrastructures as: roads, communications, energy etc.

To the above internal difficulties, other may rise on the international scale mainly:

-Lower costs & better quality reached by highly efficient and large scale producers.
-supply is subject to certification and some criteria may be difficult to assess, last but not least is that many of components or assembly are also covered by know how.

The industrial activity, as far as tractors are concerned, is limited to:

- SKD assembly
- painting and finishings

The SKD is made of two large assemblies:

- Complete diesel engine
- Complete transmission group.

No machining line is foreseen and the low utilization of the plant discourages investments

The situation of assemblies and components spare parts should not be mixed with OE supplies. Unless national standards or certification bodies exist, nc authority, except field testing, judges the spare compliance. OE and original spare parts suppliers may also produce and trade good quality assemblies and components spare parts . Seldom the contrary occurs, and non original spare parts manufacturers are allowed to produce low technical , or non vital component: radiators, exhaust pots, etc. The diversification of models and brands characterizing circulating vehicles in Nigeria reduces convenience of making versus buying.

H. OPPORTUNITY STUDY

The break-down into "1st and 2nd level assembly" shown in the previous chapters suggests to investigate more in detail on some products.
Taking into account the current economic situation in Nigeria and the constraints, imposed by the Financing Agencies, fully in agreement with the request of N.I.D.B., the following products will be analysed more in detail:

- Small tractors
- Diesel engines
- Agricultural Hand-tools
- Cement industry spare parts
- Textile industry spare parts
- Vehicles shock absorbers
- Contacts sets
- Domestic pumps

H.1 SMALL TRACTORS[1]

H.1.1 Nigerian economy, up to the 60's, was based on agriculture. Up to that period, the country was not only self sufficient in production of food commodities, but was able to export items such as palm-oil, cocoa, ground nut and cotton.

More than 70% of cultivated land is owned by peasant farmers, who use hand tools in their farming operations. The size of the average holding is between 3 to 5 ha.

H.1.2 In the 70's, Nigeria became an oil producing country; the process of industrialization started and, in general, an appreciable improvement of the social situation was registered.

The demand for consumable goods and food products increased dramatically and the gap between it and the domestic supply was filled by imports.

H.1.3 To correct this negative situation and to enhance agricultural outputs, farmers were provided with incentives such as:

- the establishment of tractor hiring units, to which individual farmers could apply for obtaining services, paying an acceptable fee;
- the establishment of land clearing unit under which developed areas were allocated to farmers and provision for subsidy to the same for the purchase of tractors and other mechanical equipment was made.
- the provision of subsidies for buying fertilizers, seeds and insecticide.

[1] See Volume 4 for details on an opportunity study for the manufacture of Small Tractors

H.1.4 The Federal Government established in 1976 facilities for manufacturing tractors and implements in order to boost the agricultural mechanization and, at the same time, create a basis for the engineering industry.
A joint-venture project with Steyr Daimler Puch of Austria made possible the setting up of a plant in Bauchi for the manufacture of tractors and commercial vehicles.
Another venture was set up with Fiat Trattori/Iveco of Italy: for the assembling of tractors and trucks Kano and National Truck Manufacturers Ltd., Kano was established.

H.1.4.1 Steyr Nigeria ltd., Bauchi

This plant started the activity as imported Semi-Knock-Down (SKD) and Completely Knock-Down (CKD) assembling unit with a program of using parts and components made available by indigenous industry.

The planned annual capacity was 5000 units of 70 HP agricultural tractors, 8000 units of trucks and 4000 units of electric generating sets. The production of tractors reached its peak in 1981 with an output equivalent to only 29% of the nominal capacity.
At present, the plant is assembling only few units and the forecast is to wind up the assembly. The management is studying the diversification of the production, using the existing facilities.

H.1.4.2 National Truck Manufacturers ltd., Kano

This plant started operation with SKD and CKD components. The planned capacity was 3000 tractors having a power ranging from 60 to 190 HP. The plant stopped its operation in 1988 and the company closed down in 1989.

H.1.4.3 The reasons that brought about the failure of these two ventures are not very clear.
According to the management of the plants, the major reasons are strictly related to financial problems, which the two companies were not able to solve such as too long delays in the payments for sales and extreme difficulties in getting the necessary hard currency to import components.

The consultant believes that there are other reasons for the failure.
If the problem is analyzed from the side of the farmers it is possible to enumerate other reasons that can be considered determinant for the stoppage of the plants operation. Among others, the following three seems to be the most important:

a. KIND OF TRACTORS

The types of the machines produced are carbon copies of the machines used in the countries where the agricultural mechanization has reached an advanced stage without any adaptation to the Nigerian environment.

b. PRICE OF TRACTORS

The selling prices, despite the Government's subsidies to the buyers, are too high for the majority of the farmers.

c. MENTALITY OF FARMERS

It is generally true that peasants all over the world cannot be easily convinced to abandon their traditional way of farming. Moreover, Nigeria has large families which provide cheap labour for farming operations. Many farmers also use animal drawn implements, therefore any investment in machines is not favourably considered.

Ways to induce farmers to use mechanical equipment were tried. One of them was to convince the farmers to form cooperatives, in order to pool the resources for buying agricultural machines and share their use.

H.1.5 Government policy is to attain self sufficiency in agricultural production. Farm mechanization is one of the considered measures. Hence it is recommended the assembly of small tractors.

H.1.6 THE MARKET

H.1.6.1 Demand

There is no information and data available for the assessment of the demand of tractors of small and medium power.
The potential of the market is great, but it is hard to anticipate what will be the reaction of the farmers to the product.
On the basis of similar experiences in other countries and taking into consideration previous studies carried out in Nigeria, a demand in the range of 2,000 to 5,000 units per year can be assumed.

H.1.6.2 Supply

At present, there are no facilities in Nigeria manufacturing small/medium tractors and data on imports are not available.

H.2 DIESEL ENGINES [1]

H.2.1 Diesel engines are particularly versatile machines; they can power almost any type of agricultural or industrial equipment: tractors, motocultivators, water pumps, generating sets, concrete mixers, dumpers, air compressors, boats, etc.
In order to facilitate the application of the engine to any machine, the manufacturers always try to develop a very large number of specific optional accessories, such as clutches, reduction gears, flanging bells, fly wheels, hydraulic pump fittings, flexible and centrifugal couplings, etc.

Modern Diesel engines are developed to operate to high performance standards, required by the modern agricultural and industrial machinery, such as:

. high output
. high reliability
. fuel economy
. low vibrations and noise
. great durability, with a life of more than 10,000 hours
. reduced maintenance
. low operating expenses

Their power, for the applications mentioned above, ranges from 5 to 80 HP and above and the number of the cylinders varies from 1 to 6.

H.2.2 Generally, the major Diesel engines manufacturers who own plants, where a large number of engines are produced, have a Research and Development Centre, where the main engine parts are designed.

As far as the manufacturing cycle is concerned, the manufacturers keep inside the whole machining cycle of the most delicate engine parts (crankcase, crankshaft, camshaft, connecting rod, cylinder head, cylinder, crankcase cover, rocker arms).

Other parts, like steel sheet parts (filters, tanks etc.) flywheels, pulleys pins, oil pumps, governors, push rods, intake and exhaust manifolds covers-housings, levers etc. are manufactured by sub-suppliers on the basis of the drawings of the manufacturers.

There are other parts and subassemblies, like injection pumps, fuel injectors, pistons, piston rings, bearings, gaskets, flat and V belts, valves, valve guides and seats, electric starters, alternators, radiators, electric parts, fuel feeding pumps, gas oil and oil filters, that are supplied to the diesel engine manufacturers by companies that are active in the manufacture of one or more of the mentioned items.

This policy makes it possible to reduce dramatically the investments, without affecting the quality of the product and allows a great flexibility in the production.

H.2.3 There are several other Diesel engine manufacturers who are licensees of the major world companies. Main activity of these manufacturers is the assembly of parts and subassemblies, supplied by the licensors; in many cases, the activity is extended to the machining of some parts that can be made available by the licensor in raw form, or bought from third parties. As said before, the investment in machining lines is justified only if the production is high.

H.2.4 Exception made for few cases, licensees have started their activity by installing an assembling unit, designed for a minimum economic size.

[1] See Volume 4 for details on an opportunity study for the Assembling of Diesel Engines

This approach is considered the most appropriate for the current Nigerian situation. It is recommended to analyse the convenience of the assembling of 2 types of diesel engines, which are needed to power the small tractors (para H.2.1).

H.2.5 THE MARKET

H.2.5.1 Demand

At present all Diesel engines are imported already coupled to the machines powered by them. It is hard to establish the type and the quantity of engines imported, because statistical data are not available. For the purpose of this study the demand is assumed to be equivalent to the number of Diesel Engines required by the project of small tractors.

H.2.5.2 Supply

There is no local production or assembly of Diesel engines in the range of 20-30 HP. They are imported mainly from Japan, U.K., FRG, AUSTRIA, ITALY, already coupled to the machines (generators, pumps, dumpers, etc.).

H.3 AGRICULTURAL HANDTOOLS [1]

H.3.1

In Nigeria, more than 70% of agricultural land is cultivated by peasants.

These small holders take care of all farming operations using hand tools.

The process of agricultural mechanization is proceeding at very slow speed and is mainly devoted to medium/big/farms, where the investment on tractors and agricultural machines can be economically justified.

Many State governments introduced the system of tractor hiring, but the results are far from being satisfactory.

Forged hand farm tools, such as spades, shovels, forks, rakes, picks, mattocks, matchets, axes, etc., will still be used for many years to come.

H.3.2 MARKET

H.3.2.1 Demand

The estimated demand [2] for agricultural handtools in Nigeria is as follows:

year	(000 pieces) matchets	(000 pieces) other handtools
1989	7,620	4,572
1990	7,932	4,752
1991	8,256	4,945
1992	8,592	5,150
1993	8,940	5,365
1994	9,312	5,580

The estimates are based on the following assumptions:

1 - The national demand/consumption for 1988 (the base year) is made up of the average import data of 450,000 dozens for 1981-1987 plus the 5 year average output of Crocodile Matchets (Nig.) Ltd. (the only known major producer) of 14,600 dozens and estimated output of 15,000 dozens of the local blacksmiths (10% of Crocodile's output).

2 - That is further projected annually by the average growth rate of 4.8% of agricultural sector.

3 - The demand for other agricultural handtools is estimated to be 60% of that of the matchets.

H.3.2.2 Supply

The demand is satisfied both by local production and imports.
The local producers are the following:

- Industrial & Farm Equipment Co. Ltd., Ketu, Lagos

[1] See Volume 4 for details on an opportunity study for the Production of Agricultural Hand-Tools
[2] N.I.D.B. estimate

- Modern Agro Industrial Techniques Ltd., Lagos

- Plastics and Engineering works Co. Ltd., Kano

- Roadmaster Industries, Ltd., Onitsha

- Maxi Trade Company Ltd., Port Harcourt

- Crocodile Matchets (Nigeria) Ltd. Port Harcourt

- John Holt Agricultural Engineers Ltd., Zaria

The total installed capacity of these plants is estimated to be around 2.5 million units/year[3].

The gap between the demand and the supply is such that the installation of a plant for the production of several types of hand-tools seems economically viable.

[3] N.I.D.B. estimate

H.4 CEMENT INDUSTRY SPARE PARTS [1]

H.4.1 There are seven cement companies in Nigeria; their cement plants have a total annual nominal capacity exceeding 5,000,000 tonnes.

They are:

- Ashaka Cement Company Ltd, Ashaka, Bauchi State.
- Bendel Cement Company Ltd, Upkilla, Bandel State
- Benue Cement Company Ltd, Yandew; Benue State
- Calabar Cement Company Ltd, Calabar, Cross River State
- Nigerian Cement Company Ltd, Nkalagu, Anambra State
- The Cement of Northern Nigeria, Sokoto, Sokoto State
- West African Portland Cement Company, Ogun and Lagos States

Cement plants are large consumers of abrasion and wear resistant parts, that are in alloy cast iron.

The availability of these parts is essential for keeping the plants running; moreover, some of them, like the wear resistant plates, are required to be of a very high quality, for safety of the equipment.

An investigation made contacting some European cement producers, revealed that only few specialized foundries exist in Europe able to satisfy their demand. Actually, the owners or the management try to keep their plants running for more than one year, before stopping them for maintenance. The higher price they pay for high reliable spare parts is largely compensated by the increased productivity.

The number of cement plants in Nigeria suggests the installation of a modern foundry, which could satisfy the cement sector and produce other kind of products of high quality, required by other industries.

It is important to mention that the new foundry would not affect the activity of the foundry shops installed in Nigeria. Only few of them can be considered adequate to fabricate quality products (see Adenowale Engineering Services Ltd, Railway Corporation, Nigeria Ports Authority, Delta Steel Foundry, Ajakouta Steel, Bamfords International). All the others are poorly equipped and in the majority of the cases, they are not equipped at all other than with make-shift facilities.

H.4.2 THE MARKET

H.4.2.1 Demand

Like any industry, cement and mining industries require some basic spare parts to continue in production. Some of the important ones include Grinding Media, Crusher Hammers and liner plates.

[1] See Volume 4 for details on an opportunity study for the installation of a foundry producing Alloy Cast Iron Parts

The annual requirements (tonnes) of the seven cement companies in Nigeria are shown in the following table:

	Grinding Media	Crusher Hammers	Liner Plates	Total
- West Afr. Portland Cem. Co.	1,500	90	215	1,805
- Benue Cement Company	500	30	64	594
- Ashaka Cement Company	600	50	70	720
- Nigerian Cement Company	600	44	105	749
- Calabar Cement Company	250	20	43	313
- Bendel Cement Company	200	17	36	253
- Cement Company of Northern Nigeria	250	20	43	313
	3,900	271	576	4,747

Although no reliable data of the requirements of the mining companies are available, it can be assumed that up to 1/4 of the requirements of the cement companies in Nigeria will also be needed in these mining companies.
The projected demand for cement/mining spare parts will be based on the present requirements of the seven cement companies and the demand of the mining companies assumed to be about 1,187 tonnes.

This gives a ground total of about 5,934 tonne of cement/mining industrial spare parts required in the country per annum. The figure will be held constant as there are no known potential new entrants, into the sub-sectors.

H.4.2.2 Supply

The demand for these spare parts is presently being met by both domestic production and importation. However, due to the low value of the Naira which has made importation very expensive, the volume of imports have dwindled considerably in recent years. Greater attention is now placed on the few local foundries, such as Nigerian Foundries Ltd, Delta Steel Foundry Ltd, Bamfords International, who are known to have the capabilities for producing grinding balls. There is no domestic producers of wear-resistant spare-parts in the country.
There exists only a project for upgrading the existing facilities of the Nigerian Foundries, in order to enable this complex to produce special alloy castings, steel castings and wear-resistant spare parts for cement companies.
The installation of a modern foundry designed to produce alloy cast iron parts is highly recommended.

H.5 TEXTILE INDUSTRY SPARE PARTS [1]

H.5.1 There are more than 56 textile mills in Nigeriam concentrated in 4 zones:

- 25 in Lagos area
- 15 in Kano
- 15 in Kaduna
- 3 in Aba

It is known that this kind of industry consumes a large number of foundry sourced spare parts, whose main characteristics are the small dimensions. Generally, the pieces have a weight ranging from 200 grams to 1.5 Kgs, with the exception of some pieces, whose weight is around 10 Kg. As a consequence, the textile mills are not able to get spare parts in small quantities, (numer and weight), because no foundry or workshops accept small orders.

The only way to overcome this constraint is to place orders for at least of two years operation (increase of inventory), thus allowing the foundry to work on economical lots.

In many countries it is normal practice, when a textile mill of a relevant importance is installed, to provide it with is own small foundry and its maintenance workshop, equipped with simple machine tools. In this case the foundry and the workshop are not direct profit generating centers, but still are of vital importance for assuring the continuous operation of the mill.

More than 50 foundry shops are instailed in Nigeria. Only few of them can be considered adequate to fabricate quality products. These are: The Foundries at Adebowale Engineering Services Ltd; Nigeria Railway Corporation; Nigeria Ports Authority; Nigeria Foundries Ltd; Delta Steel Foundry; Ajakouta Steel; Bamfords International Ltd. Nevertheless, none of these foundries have been designed to produce textile spare parts.

The rest of the foundries are poorly equipped and in the majority of the cases, they are not equipped at all other than with make shift facilities. What is noticed is:

- the non-existence of pattern making shops;
- the non-existence of sand treatment equipment;
- the impossibility of the selection of scrap;
- the non-existence of the minimum testing equipment, such as carbon equivalent and temperature measuring instruments.

To that it can be added:

- inadequate advanced technological man-power and know-how in foundry technology;
- inadequacy of educational and training facilities;
- preference of the management of the plants toward imported parts and components;
- import duty regimes which favour imported finished foundry products over imported raw materials.

The Ministry of Industry, various institutions and several representations of various sectors of the industries, including managers of some foundries, formed an ad hoc committee which analysed in depth the situation of the foundries in Nigeria.

The committe explored all the main and secondary aspects such as the mix of the demand, the availability of raw materials and consumables, the characteristics of the existing foundries, the skill of the manpower, the existing training centers, etc. A comprehensive report was prepared in Dec. 1986.

[1] See Volume 4 for details on an opportunity study for textile Industry Spare Parts

It contains the suggestions expressed by the committee in order to organize the foundry sector in a way that the needs of the country are satisfied. Something has been done in the right direction: at the request of the Ministry of National Planning and of the Nigerian Industrial Development Bank, the Industrial Development Unit (IDU) of the Commonwealth Fund for technical cooperation, visited a certain number of foundries, chosen among those considered potentially adequante to operate satisfactorily, after a proper rehabilitation.

It is hard to say when and how the rehabilitation will take place and if, after that, some foundry will be in a position to satisfy the demand, wholly or partially, of the textile industry.

For that reason, it seems justified to analyse the convenience of installing one (or more) foundry specialilzed in the production of iron and non iron metal castings for the textile industry.

H.5.2 THE MARKET

H.5.2.1 Demand

Estimates provided by N.I.D.B. indicate that the demand of iron castings is exceeding 1000 tons/year and is referred, mainly to the following parts:

. Levers
. Spindlers
. Rotors
. Screw wheel
. Insulating plate
. Bearings
. Centre Fork Bunter
. Centre Fork Crankshaft
. Centre Drum/Diaphragm
. Bobbin Rest Body
. Picks Stick Shop
. Shafts
. Gears
. Supports
. Others

To the iron castings, aluminium and bronze castings shall be added, even though these are required in smaller quantities.

H.5.2.2 Supply

Almost all the demand is satisfied by imported parts. Local supply does not exceed 5% of the demand and it consists in the production of parts that are used to replace broken or consumed parts for the time necessary for the mills to have available imported original spare parts.

On the basis of the estimated demand it would be natural to think of a foundry having a capacity of 1000 tons/y (or more) of iron castings, plus the aluminium and bronze castings. A foundry of such a capacity is relatively small, but if the dimensions and weight of the various parts are considered, it appears evident that only a highly automatized foundry would be able to have the necessary flexibility allowing a smooth production.

According to the experience of the consultant and the philosophy followed by the textile industry, it is advisable to consider a foundry having an annual capacity of:

- 150,000 kg of iron castings

- 20,000 Kg of aluminium castings

- 10,000 Kg of bronze castings

The size of such a foundry is economically viable. The total demand can be satisfied by the installation of other foundries of same capacity.

H.6 SHOCK ABSORBERS [1]

H.6.1

Shock absorbers are parts of the vehicles that play two main important roles: they assure stability to the vehicles and comfort to the passengers.

They are subject to deterioration, especially in those vehicles, like trucks, that are used in severe conditions and run very often on rough roads.

It is known that manufacturers of vehicle design the shock absorbers suitable for the specific vehicle on which they have to be mounted.

Almost all vehicle manufacturers do not fabricate the shock absorbers in their plant, but they buy these components from sub-suppliers, who have installations suitable to fabricate any kind of shock absorbers, for different car make.

H.6.2 THE MARKET

H.6.2.1 Demand

The total estimated primary and replacement demand for shock absorbers in Nigeria is reported in the table herebelow:

Estimated Quantity of Shock Absorbers (in Units) for:			
Year	**Saloon Cars & Private Vehicles**	**Heavy Commercial Vehicles and Trucks**	**Total**
1990	1,363,746	1,102,578	2,466,324
1991	1,616,975	1,316,854	2,933,829
1992	1,920,850	1,573,984	3,494,835
1993	2,285,500	1,882,541	4,168,041
1994	2,723,080	2,252,809	4,975,890

Source : N.I.D.B.

H.6.2.2 Supply

Apart the O.E. imported by Peugeot, Volkswagen, Mercedes and others assemblers, the demand is mainly satisfied by shock absorbers imported from Far Eastern Countries (Korea, Taiwan, Singapore). Even if they are marked as original equipment, the products coming from these countries are imitations and this is known to everybody, but the selling prices are much lower than the O.E., so the users give preference to them.

[1] See Volume for details on an opportunity study on Shock Absorber Producing Plant

H.6.2.3 **Production Plant**

A plant for the fabrication of all parts of shock absorbers is a capital intensive one. It consists mainly of a workshop machining hall with the following equipment:

- Cutting machines	2
- Cnc Lathes and multi mandrill lathes	6
- Grinding machines	8
- Straightening press	2
- Hydraulic press	2
- Lapping machine	1
- Multi mandrill Drilling	2
- Planner	1
- Washing machines	6
- Automatic amd manual welding machines	7

The other sections are:

- pre-assembly
- assembly
- painting
- testing
- packing and store
- maintenance & utilities

The estimated investment is around 20 millions US Dollars. This kind of investment is not suggested for the time being.

H.6.2.4 **Opportunity study**

It is recommended to consider, as a first stage, a plant designed for the assembly of shock absorber for trucks, importing the various parts and components from a licensor.

The investment of this stage should not exceed 2 millions US Dollars for a production of about 50,000 shock absorber/year. An upward integration can be taken into consideration when the production has consolidated its share of the market.

H.7 CONTACTS SETS

H.7.1 The contact set is the part of the ignition distributor mounted in a gasoline engine for providing the necessary voltage to the spark-plugs.

The set, being subjected to movements and electric sparks, deteriorates and it should be replaced as sugggested by the car manufacturer (every 10,000 km for a car). There are several types of contact sets, but, basically, they consist of similar parts, even though they have different shapes: herebelow, there is an example of the main parts of a set.

H.7.2 THE MARKET

H.7.2.1 Demand

Circulating cars, in 1986 were around 660,000 units. From 1986 up to now, the number should not be increased substantially considering that due to the adverse trend of economy, the demand of new cars fell dramatically. The car assembling plants reduced their production below the break-even point (Peugeot did not exceed 25% of its nominal capacity, while Volkswagen reached only the 7%).

The first consequence of this situation is the increase of the life span of a car, which, generally, is considered to be 5 years. The evaluation of the contact sets demand will be based on the following assumptions provided by N.I.D.B.:

a) circulating cars = 700,000

b) set replacement = 3 replacements per car per year = 2,100,000

H.7.2.2 Supply

At present, there are no facilities in Nigeria manufacturing contact sets. The demand is satisfied by imports, mainly from far eastern countries. Their quality is usually low.

H.7.2.3 Opportunity study [1]

It is proposed to evaluate the opportunity of installing a plant, designed to produce 500,000 contact sets per year.

[1] See Volume 4 for details on an opportunity study on Contacts Set Producing Plant

H.8 DOMESTIC PUMPS

Domestic pumps are hydraulic machines widely used in Nigeria for the distribution of water in dwellings, for pumping water from wells and for raising the pressure provided by the main regular flow.

The basic characteristics of pumps which are used for the purpose mentioned above are horizontal centrifugal self priming types and their main features are:

- body and support in cast iron
- impeller, diffusor, ventury and nozzle
- shaft in chrome stainless steel
- mechanical seal
- rotor supported by ball bearings
- single phase electrical motor (0.59 kW and 0.74 kW), IP44 protection

H.8.2 THE MARKET

The pumps under consideration are suitable to be employed for raising water for domestic, agricultural and industrial uses. They are commonly used to pump water from artesian wells.

H.8.2.1 Demand and supply

According to the data supplied by N.I.D.B., the demand of this kind of pumps exceeds 300,000 units per year.

The demand is satisfied by imports. The sources of suppliers are from Italy, Spain and Germany.

H.8.2.2 Opportunity study [1]

It is proposed to evaluate the opportunity of installing a plant designed to produce 50,000 units per year.

[1] See Volume for details on an opportunity study on Domesti Pumps Assembling Plant

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDIES

FINAL REPORT

VOLUME 2 OF 4

AGRO-BASED INDUSTRY

PROJECT SF/NIR/88/001

baldo & Co

CONTENT

VOLUME 2 - AGRO-BASED INDUSTRY

AGRO-BASED INDUSTRIES

Nigeria is primarily an agrarian economy. Agriculture was the main stay of the economy and the major earner of foreign exchange before the oil boom. Despite the large scale neglect of the sub-sector during the oil euphoria, it still accounts for over 30 per cent of the G.D.P. The potential for self sufficiency, export creation and employment expansion in the sub-sector is very considerable. There has been a reawakening to this potential in recent years following the economic recession. The expansion of the sector has featured prominently in the SAP economic reform objectives. It is the new policy of the Federal Government to expand agriculture for self-reliance in food production, supplying raw materials to the agro-allied industrialized sub-sector and generation of adequate surplus to boost non-oil exports.

Incentives are being given to the sector and there are strong indications already that the response is positive. Peasant output is improving, while plantation agriculture is expanding.

The existing linkage between the agricultural and industrial sectors of the economy is extremely weak. Now that agriculture is improving, manufacturing has to respond by processing agricultural produce for the mutual benefit of the two sectors.

Such linkage will reduce the import-dependence of the local manufacturing sector and will minimize the loss of agricultural produce during and after harvest, due to inadequate storage facilities.

In the following chapters some agro-based industries will be explored for investment opportunities. The analysis will include, whenever possible, information on the international situation, mainly in those countries having environmental conditions similar to those of Nigeria.

BASIC ASSUMPTIONS FOR THE FINANCIAL ANALYSIS

The following basic assumptions have been considered for all the projects in the financial analysis carried out by means of the COMFAR.

a) **Economic life**

Fifteen years have been considered the operational life of the plants, even if for some of them a longer life can be easily anticipated; this life span is largely sufficient to appreciate the profitability of a project; the increase of IRR due to longer life is definitely very small;

b) **Rate of discount: 10%**

c) **Depreciation: straightline type;**

rates:	10 %	for machinery and equipment
	5 %	for civil works
	20 %	for site preparation and pre-production expenditures
scraps:	10 %	for machinery and equipment
	50 %	for civil works and site preparation

d) **Foreign loan**

amount:	85% of the value of the imported machinery and equipment (installation costs included) as per "consensus" terms;
repayment:	within 8 years with 2 years of grace;
amortization:	constant principal type; interest 8%

e) **Local loan**

repayment:	within three years, starting from the first year of production;
amortization:	constant principal type; interest 15%

f) **Working capital**

Minimum days of coverage of the costs considered by the COMFAR programme:

	FC	LC
. accounts receivable	30	30
. inventory raw materials	180	60
. inventory utilities	1	1
. inventory energy	1	1
. inventory spare parts	180	180
. work in progress	defined case by case	
. cash in hand	15	15
. finished products	defined case by case	
. accounts payable	1	30

g) **Taxes**

The products are considered as sold ex-works; consequently the profit tax only (40%) has been included in the calculations. Tax holiday and other incentives foreseen to joint venture investments have not been included.

h) **Currency**

All the costs are expressed in Naira or US dollars; in the COMFAR in US dollars only; the exchange rate has been assumed as 7.9 N per 1 US dollar.

i) Utilities

The following prices have been assumed for evaluating the annual expenditures:

gasoline	0.076 $/l
electricity	0.1 $/KWh
cooling water (recycled)	0.0090 $/m3
cooling water (make-up)	0.006 $/m3
fuel oil	0.03 $/Kg
demineralized water	3.5 $/m3
LP steam	8 $/t

j) BEP

The BEP evaluations have been developed according to the formula.

$$\frac{\text{Fixed Costs}}{\text{Revenue - Variable Costs}}$$

The Direct personnel cost has been considered as fixed cost.

k) Salaries

	N/Y
General Manager	50000
Technical manager	40000
or	
Deputy G. M.	45000
Financial manager	40000
Production manager	40000
Chief Engineer	
Chemist	25000
Engineer	
Senior account.	25000
Senior clerk	
Sale Dep. Head	
Purchase Dept. Head	12000
Workshop head	

Foreman or Supervisor	12000
Store Dept. head Mechanical store head Analyst Electrician Mechanic	10000
Security officer	8000
Secretaries	12000
Shift operators Store clerks Purchase dept. Ass. Account clerk Clerk	12000
Drivers	8000
Semiskilled workers Guard	6000
Unskilled workers Unskilled labourers	4000

The above figures have been increased by 40% overheads to consider the actual expenditures for the company.

e) Pre-production Expenses

Expenditures for establishment of company: 1% of the investment

Salaries:	Gen. Man + Tech. Man.+ Fin. Man.	for the whole period of construction
	Adm. manager:	3 months 1st year of construction and 6 months for the 2nd year of construction
	Maint. Man.	8 months of last period of construction
	Training	Chemist Product Man. Foreman Chief eng. Engineers Others — Estimated case by case

m) Erection

10 % of the cost of machinery and equipment in FC

20 % of the cost of machinery and equipment in LC

n) **Civil works**

office buildings:	$ 700 /m2 (per floor)
Industrial buildings:	$ 400 /m2

o) **Freight, taxes and duties**

1 - FC = 10% of the F.O.B. costs

2 - LC = 20% of the F.O.B. costs

p) Other assumptions, diffe-ent from those specified above, are indicated on the paragrpaphs of each study.

q) At this stage no current investments have been considered.

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NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE CONVERSION OF PALM OIL INTO METHYLESTER FOR THE USE OF MANUFACTURERS OF DETERGENTS, SOAP AND SHAMPOO IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for the production of Methylester (ME) from palm oil, to be used as raw material in the production of detergents. Availability of sulphonated products is fundamental for the industry of detergents. The capacity of the existing sulphonating plants in Nigeria is very large, but the present production of detergents and similar products is very low, due to lack of raw materials to be sulphonated.(1)

The only product presently available is linear alkylbenzene (LAB), but in limited quantity (30,000 t/y against a potential demand exceeding 100,000 t/y); importation of such product is not allowed.

Methylester obtained by processing palm-oil could fill the gap.

Nigeria has an urgent necessity of increasing the production of palm oil, since the present local supply of edible oil is inadequate. Investments on new plantations and in the improvement of existing ones are being undertaken and in few years the situation should be satisfactory. The increased production of palm oil will yield a sufficient quantity of the raw material useful for methylester production.

On this basis, a plant producing 10,000 t/y of methylester is proposed and discussed in the following chapters.

The financial analysis of such a project was carried out. Details are given in chapter 9. The salient data in the project are as follows:

- Fixed assets: US $ 8,513,000 (4,700,000 in Foreign currency)
- Working capital (at full production): US $ 2,045,213 (459,729 in Foreign Currency)
- Internal Rate of Return: 22,49%
- Break-Even Point at 5th year of production: 35%
- Pay-Back Period: less than 6.5 years
- Employees: 53

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

(1) For additional background material see Volume 1 p. 67.

1. INTRODUCTION

Natural fats and oils are connected with the production of soap, the oldest and most widely used surfactant before the age of "synthetic detergents".

Improvements in industrial oleochemistry, together with development in surfactant production technology, give natural fats and oils a competitive edge over petrochemical raw materials (see para 2.1.2.).

The conversion of natural fats and oils , or more properly of their main components, the triglycerides, into products to be used in the manufacture of soaps, shampoos and detergent formulations, can be reached through two different ways (see below "Natural oils and fats conversion. Fats splitting process/Interchange process - Flow chart:

- Fats splitting process, followed by the obtained fatty acids distillation, catalytic hydrogenation to obtain fatty alcohol which, with a direct sulphonation can be transformed in constituents of powder and liquid detergent product formulations.
If fatty alcohols are ethoxidated, according to the number of moles of ethylene oxide employed, the obtained products can be used directly or after a further sulphation as constituents of detergent product formulations.

- Ester-interchange process, that is to say, transesterification of triglycerides with methanol to obtain methylester(ME) purified by distillation and low pressure hydrogenation to obtain a final product suitable for sulphonation.
The sulphonation product (MES) is alfa-sulpho methylester to be used as constituent of detergent product formulations. In the proposed plant the conversion of palm oil into products to be used in detergent product formulations will be carried out according to ester-interchange process. The advantages of this process can be summarized as follows:

. Transesterification of fats and oils doesn't require operation under heavy conditions as for fat-splitting.

. Ester-interchange step avoids high yield of undesirable by-products.

. Distillation of ME improves the quality of the product (independently of its final use) and makes the subsequent hydrogenation easier.

. Reduction of the unsaturated degree is more convenient on the ME rather than on raw materials.

. Glycerine separation is an indirect step for an additional refining effect, because of the retention of dark-coloured components in the glycerine layer.

. Glycerine concentration of about 70% is higher than the 18-20% obtained by fat splitting, and this is an important factor in the economics of the process.

. Handling, storage and distillation of methylester require mild-steel made equipment.

. Investment cost for the ester-interchange process is lower than in the fats splitting process.

Commercial washing-powder products, essentially consisting of different types of MES-based formulations, are now entering the market and are expected to share an important percentage of it.

The MES surfactant not only has excellent detergent properties and is 100% biologically degradable, but also has excellent calcium and magnesium sequestering power, which permits the complete or partial replacement of phosphates in detergent formulations.

In conclusion the combining of the production of ME (derived from natural fats and oils) with a sulphonation system indeed permits maximum flexibility for producing a wide range of surfactants.

The scope of the present work will be limited to the study of a ME production plant as the sulphonation of the finished product may be carried out in one of the existing sulphonation Nigerian installations.

The ME produced from raw materials listed below will be ready to be used as raw material for a sulphonation process.

In particular it will have the following characteristics:

. Physical state = clear liquid

. Unsaponifiable matter = less than 1%

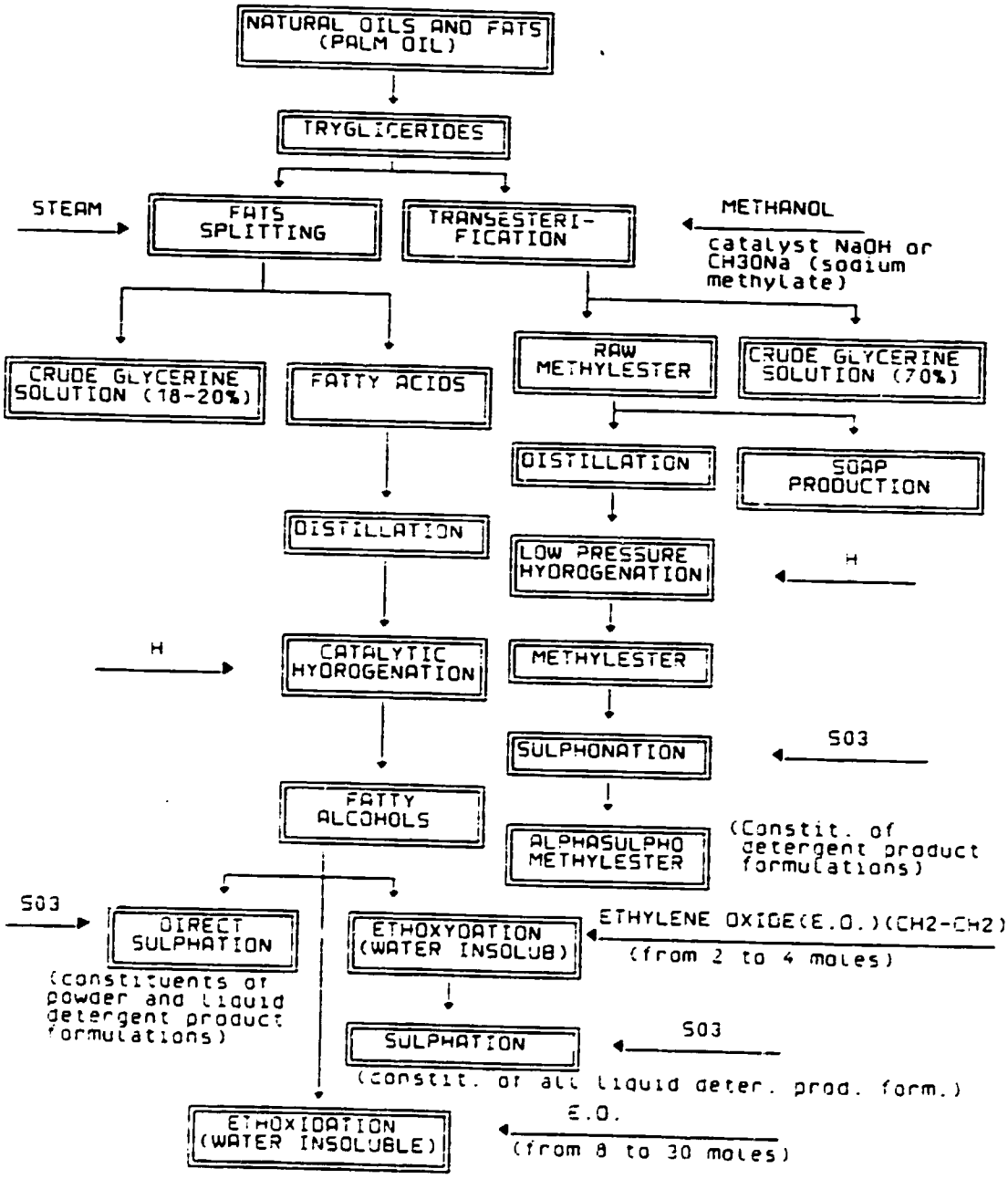
. Iodine number = 0.5 max (to avoid bad colour due to the attack of SO_3 gas on the double bands).

. Specific gravity (at 20 C) = about 0.85.

F L O W C H A R T
NATURAL OILS AND FATS CONVERSION

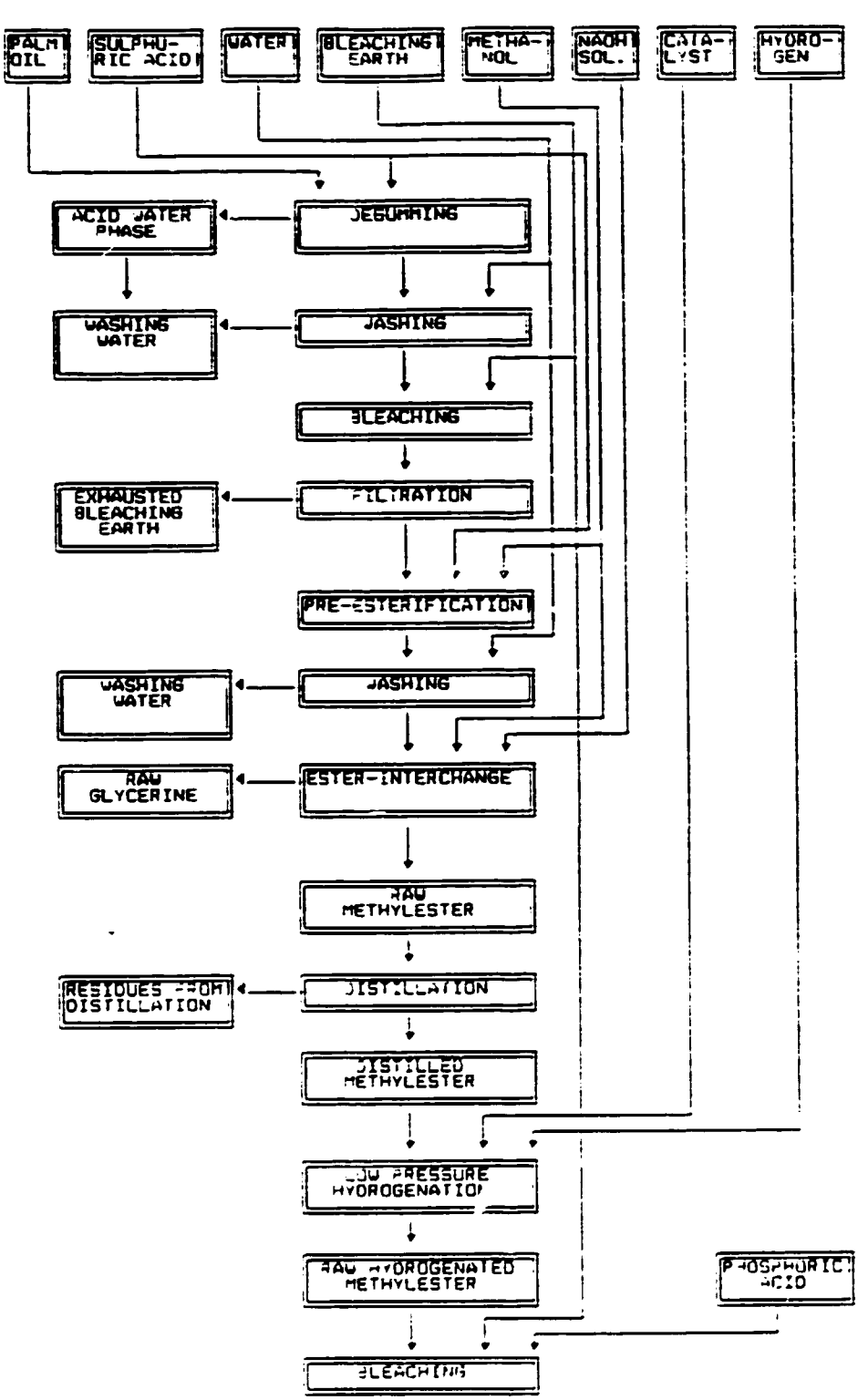
FATS SPLITTING PROCESS

ESTER-INTERCHANGE PROCESS



'nonionic surfactants valuable constituent of powder, liquid and solid detergent product formulations,

FLOW CHART
METHYLESTER PRODUCTION



2. MARKET AND PLANT CAPACITY

2.1 USES

As shown in the flow chart, ME is mainly used as such in the soap industry or sulphonated in the detergents production. Details of such uses are given in the following paragraphs.

2.1.1 Soap Production

In case the ME is to be utilized for soap production, distillation and hydrogenation steps are not necessary.

The production of soap by reacting ME with alkali is nowadays an available technology particularly suitable for the production of high quality toilet soap. The soap from ME is obtained through the reaction of ME with caustic soda and water.

ME saponification has been optimized in order to allow the production of soap at high dry-matter concentration thus reducing the requirement of utilities and equipment in the soap-drying step.

Specific raw materials consumption for the saponification process is the following (for 1 ton of soap noodles produced):

ME	820 kg
CAUSTIC SODA (100%)	120 KG
PROCESS WATER	4 m^3

2.1.2 Production of alpha-sulpho-methylester (MES) (methylester sulphonation)

ME sulphonation can be achieved in the same plant(s) designed for the sulphonation of linear alkylbenzene. However, certain adjustments for the plant operations are required. These adjustments are mainly concerned with temperatures, aging times and other parameters, that must be precisely controlled during neutralization phase.

Neutralization of sulphuric acid is done in order to keep the pH of the end product at max 8.5 to minimize alkaline hydrolysis. The general characteristics enable the use of MES in formulations and to replace linear alkylbenzene sulphonate (LABS) up to 50% or substitute the same completely in phosphate-free formulations.

The use of MES as surfactant will rise significantly in the near future especially in the formulation of detergents to be used in automatic laundry machines. MES is specially advised for low foam detergents and the quality and properties of the products obtained by processing raw materials like palm oil can be considered equivalent or even better than those of other detergents. Specific raw materials consumption for the production of MES and LABS are the following (referred to 1 Ton of 100% of active matter):

RAW MATERIALS	COCO-ME MW = 220	PALM-ME MW = 284	TALLOW-ME MW = 285	LAB MW = 245
Organic raw material	674	727	729	718
Sulphur	122	103	103	101
NaOH (100%)	166	144	144	135

2.1.3 Production of nonionic surfactant from ME

A further interesting possibility in this field is the production of the nonionic Alkylolamide surfactants, by condensing fatty acid ME with Alkylolamines, mainly mono and diethanolamine. These so-called "superamides" produced from fatty acid ME represent valuable constituents of powder, liquid and solid detergent product formulations.

2.1.4 Production of glycerine (as a by-product)

Upon completion of the ester-interchange, the glycerine is separated and a concentrated solution (about 70%) is obtained. This glycerine, whose purity is better than crude glycerine from soap spent-lye, can be further concentrated to produce high-quality crude glycerine and then distilled to obtain pharmaceutical grade or dynamite-grade glycerine.

2.2 DEMAND

2.2.1 Present situation in Nigeria

2.2.1.1 Detergent Producers

At present, there are three detergent producers in Nigeria, whose plants have a total installed capacity of sulphonating 109,000 tons/year of Linear Alkylbenzene (Active Matter).

- P.Z. INDUSTRY LTD. IKORODU

This Company owns one plant, commissioned in 1983, whose sulphonating nominal annual capacity, based on three shifts/day is 53,000 tons of linear Alkylbenzene.

The plant, designed and supplied by a U.S. firm, is one of the three largest plants in Africa and among the biggest plants in the world. It has a spray tower of 200.000 tons/year.

- LEVER BROTHERS NIGERIA LTD, APAPA

This Company has three sulphonating units and 2 spray towers, all of them supplied by Ballestra (Italy).

Two units are located in the Apapa plant; one has 2 tons/h capacity; the second 1 ton/h. The total sulphonating annual capacity based on three shifts is 24,000 tons of LAB. These two units have 1 spray tower.

The third unit is installed in Aba plant; its annual sulphonating capacity, based on three shifts is 16,000 tons of LAB. This unit has 1 spray tower. The only operating plant among the three is the one of Aba, due to shortage of LAB.

- NASCO HOUSEHOLD PRODUCTS LTD, JOS

This Company owns a plant that was commissioned in the late 70's. Its nominal annual sulphonating capacity, based on three shifts/day, is 16,000 tons of Linear Alkylbenzene.

The unit has a spray tower, whose nominal capacity is 65,000 tons/y of powder detergents. The plant was reported to be operating far below the nominal capacity, due to the lack of LAB.

Considering that for 1 tonne of detergent 200 kg of active matter are required and assuming that the efficiency of the plants around 80%, the potential supply of the three sulphonating installing plants is 436,000 tons of detergents per year.

2.2.1.2 Source of Linear Alkylbenzene

Linear Alkylbenzene is produced in the Kaduna Petrochemical Complex since June 1988. The nominal annual output is 30,000 tons, i.e. less than one/third of the sulphonation installed capacity. Import of LAB has been banned by the Federal Government.

2.2.2 Detergents Demand

The N.I.D.B. estimated demand, based on a survey carried out in 1987 and on assumptions, shows the following figures:

YEAR	DEMAND ('000 tonne)
1989	361
1990	371
1991	383
1992	394
1993	406
1994	418

The assumptions on Demand estimates are as follows:

a) 80% of the urban and 40% of the rural population will consume 550 grams of detergents per month which is equivalent to 6.6 kilograms per head per annum.

b) This is further projected annually by the combined effect of population increase and officially estimated GDP growth rate of 3%.

2.2.3 Demand and Supply of ME

The quantity of ME necessary to make the existing sulphonating plants working at full capacity is exceeding 70,000 tonnes per year. ME, like Linear Alkylbenzene, cannot be imported, so the only way of the supply is to produce it, locally.

2.3 PLANT CAPACITY

On the basis of above considerations it is suggested to consider the installation of a plant for the production of methylester having a capacity of 10,000 tons/year (37 tons/day on 3 shifts - 270 days/y) which is the minimum technically and economically justified size.

2.4 SALE PRICES AND TOTAL REVENUES

a) In the world market methylester is traded at US$ 1500 ton ex-works, while Linear Alkylbenzene price ranges from US$ 900 to US$ 1000 ton ex-works. The difference of price between ME and LAB is justified by the fact that ME is highly demanded for phosphate-free formulations, for low foam detergents production and for the production of shampoos and liquid soaps.

To be on the conservative side, a price of 1200 $/t has been assumed.

At full capacity, the revenues could be:

1,200 x 10,000 t = US$ 12,000,000

b) The process makes available, as by-product, 165 Kg of raw glycerine (70% W/W) that is about 110 kg of purified glycerine (98-99% W/W) for every ton of ME produced.

As the price of raw 70% glycerine can be assumed at 400 $/T the revenue from the by-product is:

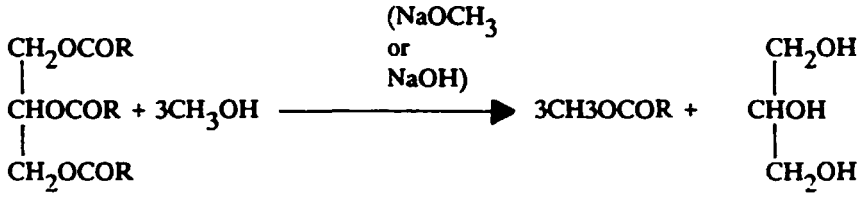
0.165x10.000 x 400 = 660.000 $.

c) The total annual revenue is US $ 12.660.000

3. MATERIALS AND INPUTS

3.1 CHEMISTRY

Manufacture of ME from natural oils and fats in general, and from palm oil in particular, is obtained by a so called "transesterification" or "esterinterchange" reaction. The triglycerides (main constituent of fats and oils) are reacted with methanol to transform them into ME and glycerine, according to the following reaction:



Usually the oil (or fat) is purified before the ester-interchange reaction and the raw ME obtained according to the above chemical reaction, generally undergoes to distillation and hydrogenation.

3.2 MATERIAL AND UTILITIES: REQUIREMENT AND COSTS

The raw materials required for the production of ME are:

- Palm oil
- Methanol
- Phosphoric acid (tech. grade; 75-80% concentr.)
- Sulphuric acid (tech. grade; 98% concentr.)
- Bleaching earths
- Diatomaceous earths
- Hydrogen (10 bars pressure)
- Pre-esterification catalyst (H_2S0_4 98%)
- Ester-interchange catalyst (Na OH)
- Hydrogenation catalyst

Palm oil, sulphuric acid, hydrogen and NaOH are available in Nigeria; all other products must be imported.

Table 3.2 shows the quantity of raw materials and utilities, as well as the relevant unit and total costs, required for the production of 10,000 tons/year of ME.

TABLE 3.2 - Requirement and costs for an annual production

description	unit of measure	required q.ty for 1 ton	1 year	unit costs $ LC	FC	annual costs (000 $) LC	FC	TOTAL
Palm oil	t	1.2	12,000	600		7,200		7,200
Methanol	t	.135	1,350		300		405	405
Phosphoric acid	t	.003	30		730		21.9	21.9
Sulphuric acid	t	.020	200	300		60		60
Bleaching earths	t	.030	300		560		168.	168.
Diatomaceous earth	t	.020	200		370		74.	74.
Hydrogen	Nm3	1.1	11,000	3,6		39,6		39.6
Pre-esterification Catalyst (H_2SO_4)	t	.01	100	300		30		30
Ester-interchange Catalyst (NaOH)	t	.0075	75	370		27.75		27.75
Hydrogenation catalyst	t	.0006	6		4		24.	24.
1 Sub-total: raw materials						**7357.35**	**692.9**	**8050.25**
Saturated steam(13 bars)(2)	t	1	10,000	--				
Electric energy(1)	KWh	100	1,000,000	0.1		100		100
Cooling water (make up)	m3	10	100,000	0.006		0.6		0.6
Fuel	Kg	40	400,000	0.03		12		12
Compressed air (7 bars)	m3	17	170,000	--				
2 Sub-total : utilities						**112.6**		**112.6**
Grand total (1 + 2)						**8,162.85**		

(1) Includes energy consumption for water pumping, lighting, compressed air
(2) Cost included in the fuel

For the financial evaluation, the costs are grouped as follows:

			(in US $ 1,000)
Raw materials	LC	US $	7,357.35
Raw materials	FC	US $	692.90
Energy (fuel)	LC	US $	12.00
Utilities	LC	US $	100.60

		US $	8,162.85

3.3 RAW MATERIALS PURCHASING PROGRAMME AND STORAGE VOLUME

3.3.1 Palm oil

As it is of local supply, a 2 months storage (2000 Tons) seems to be sufficient.

3.3.2 Methanol

It is to be imported and, as it is not a big quantity, the storage for 6 months (approx. 700 tons) seems advisable.

3.3.3 Chemicals

Taking into consideration the relative small quantity for every component it seems advisable to have a storage for 6 months consumption. Sulphuric acid and hydrogen storage for two months operation will be considered.

3.3.4 Total raw materials storage

The following amounts of raw materials will be considered as a minimum storage

Product	days/y	Q.ty	Costs
Palm oil:	60	2000 t	1,200,000 $
Methanol:	180	675 t	202,500 $
Sulphuric acid:	60	35 t	10,500 $
Phosphoric acid:	180	15 t	10,950 $
Sodium hydroxide	180	375 t	13,875 $
Bleaching earth	180	150 t	84,000 $
Diatomaceous earth	180	100 t	37,000 $
Hydrogen	60	1850 m^3	6,660 $
		Total	1,565,485

4. LOCATION

The plant could be located in the surroundings of Lagos taking into consideration the supply of imported raw materials and the proximity of installations for the sulphonation of the product.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

The technology is available in Italy as well as in several other countries.

The selected plant can process palm oil as well as other oils and fats having the following main characteristics:

Raw material	Iodine number	Acid number	Soap number
Palm oil	48-54	6	193-205
Coconut oil	6-12	4	245-265
Cotton seed oil	102-112	6	189-197
Rice bran oil	91-115	10	183-194
Tallow	35-50	10	190-200

A wider range of oils and fats can be processed. The relevant plant performances in terms of plant efficiency and product characteristics can be given only after laboratory and pilot plant tests have been carried out on the specific raw materials.

The process can be divided into the following steps (see the attached "Methylester Production" flow chart):

- Oil degumming (batch process)

- Oil bleaching and filtering (batch process)

- Pre-esterification and ester-interchange (batch process)

- ME distillation (continuous process)

- ME low pressure hydrogenation (batch process)

5.1.1 Oil degumming

Oil degumming is a batchwise operation and is designed to remove the gums from the raw materials. The oil is heated and mixed with diluted sulphuric acid and, after a reaction time of about half an hour, the mixer is stopped and acid water is decanted and separated. Two/three washing operations with water eliminate all traces of sulphuric acid giving a free acid oil.

5.1.2 Oil bleaching and filtering

Oil bleaching and filtering are batchwise operations. The oil, heated to the reaction temperature, is mixed with the required quantity of bleaching earth.

After a proper time, the oil/earth mixture is filtered and the bleached clear oil is separated.

5.1.3 Pre-esterification and ester-interchange

5.1.3.1 Pre-esterification

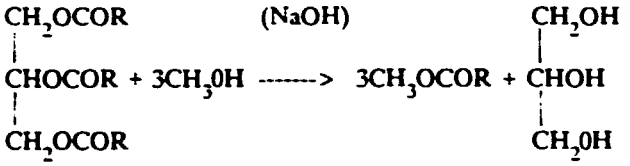
Pre-esterification of the fats is needed only if free fatty acids (F.F.A.) content exceed 2%; this in order to reduce catalyst consumption and soap formation. The acid value is reduced preferably below 0.5 mg KOH/g. In pre-esterification F.F.A. are reacted with methanol to obtain ME according to the following chemical reaction:

$$R\text{-}COOH + CH_3OH \xrightarrow{H_2SO_4} CH_3OCOR + H_2O$$

Pre-esterification is also a batchwise operation. Oil is mixed and heated with methanol (in excess) and the catalyst (usually H_2SO_4). When the esterification reaction is completed, the excess of methanol is stripped and sent to a rectification column. The remaining oil, after cooling, undergoes washing with water to extract the catalyst.

5.1.3.2 **Ester-interchange or transesterification**

The triglycerides (main constituents of oils and fats) are reacted with methanol and transformed into ME and glycerine according to the already seen following reaction:



The reaction is carried out batchwise. In a stirred and heated reactor the oil, methanol and the catalyst are charged. When the reaction is completed, the excess methanol is stripped off and recycled to the process.

The separation of ME and raw glycerine (by decantation) is the final step.

5.1.4 **ME distillation**

ME distillation is required only when ME has to undergo sulphonation or condensation with alkonolamines. For making soaps neither distillation nor hydrogenation are needed. The distillation is performed continuously under a vacuum of 1 Torr at a temperature of about 190 C obtained by means of a diathermic oil.

5.1.5 **ME low pressure hydrogenation**

ME hydrogenation is performed to lower the iodine number down to 0.5. The process is carried out under vacuum. After having removed the moisture, by heating under vacuum the raw ME, the catalyst is added.

The hydrogen feeding at a stated temperature and pressure allows trouble free operation and repeatability of plant performances. The obtained product, before undergoing the filtration, is treated with bleaching earth and phosphoric acid to help the removal and precipitation of the catalyst.

5.2 STORING FACILITIES

5.2.1 Finished product

In case of an autonomous factory, the purified ME (hydrogenated ME), will be collected in tank, having a capacity of 1300 M^3 (30 days of production). ME will be dispatched by tank trucks to the units for the sulphonation. If the ME manufacture installation would be implemented as an expansion of a factory where the sulphonation takes place, the product will be sent by pipes to the sulphonation storage section.

For soap making, raw ME, without undergoing distillation and hydrogenation, will be stored and sent to users in the same way.

5.2.2 Raw materials and liquid chemicals

Raw materials will be stored in tanks as follows:

	unit	volume m^3	material
. Palm oil	2	1000	S.S 304
. Methanol	1	1000	C.S.
. Phosphoric acid (80%)	1	20	S.S 304
. Sulphuric acid (98%)	1	30	C.S.
. Sodium hydroxide	1	35	C.S.

5.2.3 Other chemicals

Solid chemicals in bags (bleaching earth, diatomaceous earth etc.), will be stored in a building having a 600 sq.m. surface.

5.2.4 By-Product

Raw glycerine will be stored in a tank of 150 m^3 capacity (30 days of production) made of stainless steel AISI 304 or equivalent material.

5.3 PACKAGING

The product is sold in bulk. Therefore, no packaging requirement has been taken into consideration, because ME can be transported in tank-trucks.

5.4 LAY-OUT AND CIVIL WORKS

The area required for the installation of the process equipment and all necessary utilities and facilities is about 5,000 sq.m. The process equipment is installed inside a two storey-building, each of about 360 sq.m. This building has a supporting structure of reinforced concrete (steel structure can also be used).

External, internal and partition walls are of brickwork. Paving of ground floor and first floor are of reinforced concrete with hard aggregate as finishing surface. The roof consisting of heat, insulated corrugated asbestos-cement sheets is supported by light steel structure.

Part of the plant, i.e. preesterification, ME production, distillation and hydrogenation, is designed according to the explosion proof codes and therefore it has been located in a room separated from the rest of the plant.

The store-house, 600 sq.m., is one-storey building, whose characteristics are similar to those of the industrial building. A two storey building, for a total of 400 sq.m, will accommodate the offices, the laboratory and the maintenance workshop. This building will be in reinforced concrete structure, with partition and external walls in brickwork.

5.5 INVESTMENT COSTS, DEPRECIATION AND MAINTENANCE

The investment costs for machinery and equipment were obtained from Messrs. Garbato of Milan, Italy.

	LC M$	FC M$	TOTAL M$
- Machinery & Equipment (FOB European port)		3.50	3.50
- Transport, taxes & duties	0.70	0.35	1.05
- Erection	0.80	0.40	1.20
- Insulating & painting	0.05	0.05	0.10
- Civil works	1.29		1.29
- Land and site preparation	0.13		0.13
- Spare parts		0.10	0.10
Total	2.97	4.40	7.37
Contingencies	0.33	0.30	0.63
Grand total	3.30	4.70	8.00

The life of the plant can be considered as fifteen years. Annual maintenance costs have been assumed in the range of 3% of the machinery and equipment costs, that is 120,000 $/y.

In the financial evaluation, the investment costs (contingencies included) are so subdivided:

- Preproduction expenditures	FC	0.0972	million dollars
- Preproduction expenditures	LC	0.1559	million dollars
- Machinery	FC	4.70	million dollars
- Machinery	LC	1.65	million dollars
- Land and site preparation	LC	0.13	million dollars
- Civil works	LC	1.52	million dollars
	TOTAL	8.2531	million dollars

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skill is required for any of the positions listed below, exception made for the technical manager, the production manager and the chemist, for whom a training in similar plant is recommended.

It is recommended that the on-the-job training is carried out by one expert, made available by the technology supplier for a period of 1 year, after start-up. The relevant expenses are estimated US $ 120,000.

7.1 MANAGEMENT

		N/year
- General Manager	1	50,000
- Technical Manager	1	40,000
	---	---
	2	90,000
		overheads 40% 36,000

		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEP.

- Financial Manager	1	40,000
- Accountant	1	25,000
- Purchasing Dept. head	1	12,000
- Storehead	1	12,000
- Sales Dept.	1	12,000
- Clerks	3	36,000
- Guards	6	36,000
- Drivers	2	16,000
	---	---
	16	189,000
		overheads 40% 75,660

		264,600
		(US$ 33,500)

7.3 PRODUCTION DEPT.

- Production Manager	1	40,000
- Shift foremen	6	72,000
- Shift operators	6	48,000
- Semiskilled workers	6	48,000
- Chemist	1	25,000
- Analyst	1	12,000
- Clerks	1	12,000
	---	---
	22	257,000
		overheads 40% 102,800

		359,800
		(US$ 45,500)

7.4 MAINTENANCE DEP.

- Engineer	1	40,000
- Mechanics	4	40,000
- Electricians	4	40,000
- Instruments Spec.	4	40,000
	---	---
	13	160,000
		overheads 40% 64,000

		224,000
		(US$ 28,350)

Summary

Administration	18	49,500 $/y
Production	22	45,500 $/y
Maintenance	13	28,350 $/y
	---	---
	53	123,350 $/y

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start-up the plant is in the range of 24 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 8,513,100 US Dollars. The portion in foreign currency accounts for 4,955,900 US Dollars.

Details of these figures are shown in chapter 5 and in the COMFAR schedules.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,230,000	US$ 3,410,000	US$ 4,640,000
- Foreign Loan (interest 8%)	US$ 800,000	US$ 2,560,000	US$ 3,360,000
- Local Loan (interest 15%)	US$ 150,000	US$ 370,000	US$ 520,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 60%

3rd year 80%

4th and subsequent years 100%

When the plant is in full production, the required working capital amounts to 2,045,213 US Dollars, the foreign portion being US $ 459,729.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US $ 848,621 of which US $ 203,892 in foreign currency.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US $ 4,752,890.

In the fourth year, at full production, the costs amount to US $ 9,406,800, then they start a slight decrease year after year, to reach a constant amount of US $ 8,425,200 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 12,660,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 5,320,600

2nd year 60% : revenue = US$ 7,721,907

3rd year 80% : revenue = US$ 10,254,220

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 22.49%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 35% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 6.5 years, including the construction period.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of the capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

METHYLESTER FROM PALM OIL
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	8513.00	58.682 % foreign
current assets:	0.00	0.000 % foreign
total assets:	8513.00	58.682 % foreign

Source of funds during construction phase

equity & grants:	4640.00	0.000 % foreign
foreign loans :	3360.00	
local loans :	520.00	
total funds :	8520.00	39.437 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	3566.49	8425.20	8425.20
depreciation :	839.60	813.60	76.00
interest :	346.80	134.40	0.00
production costs	4752.89	9373.20	8501.20
thereof foreign	25.43 %	14.90 %	8.62 %
total sales :	5064.30	12660.00	12660.00
gross income :	311.41	3286.80	4158.80
net income :	186.67	1972.08	2495.28
cash balance :	-415.69	2265.63	2571.28
net cashflow :	524.44	2920.08	2571.28

Net Present Value at: 10.00 % = 8580.34
Internal Rate of Return: 22.49 %
Return on equity1: 26.88 %
Return on equity2: 26.17 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	130.000	0.000
Buildings and civil works	1000.000	520.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	900.000	5450.000
Total fixed investment costs	2030.000	5970.000
Pre-production capital expenditures.	143.950	369.050
Net working capital	0.000	0.000
Total initial investment costs	2173.950	6339.050
Of it foreign, in %	38.271	65.682

Total Current Investment in 1000 US $

Year	1992	1993	1994	1995
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000
Working capital	848.621	385.031	406.521	405.041
Total current investment costs	848.621	385.031	406.521	405.041
Of it foreign, %	24.026	13.606	22.618	22.700

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	3220.100	4830.150	6440.200	8050.250	8050.250
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	40.240	60.360	80.480	100.600	100.600
Energy	4.800	7.200	9.400	12.000	12.000
Labour, direct	45.500	45.500	45.500	45.500	45.500
Repair, maintenance	32.000	48.000	64.000	80.000	80.000
Spares	16.000	24.000	32.000	40.000	40.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	3478.640	5015.210	6671.580	8328.351	8328.351
Administrative overheads	87.850	87.850	96.850	96.850	96.850
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	839.600	839.600	826.600	813.600	813.600
Financial costs	346.800	287.200	227.600	168.000	134.400
Total production costs	4752.890	6229.860	7822.630	9406.900	9373.200
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	25.481	19.327	16.836	15.202	14.898
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	123.350	123.350	123.350	123.350	123.350

METHYLESTER FROM PALM OIL --- OCTOBER 1990

---- COMFAR 2.1 - BALDO & CO. S.R.L., MILAN, ITALY -----

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	8050.250	8050.250	8050.250	8050.250	8050.250
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	100.600	100.600	100.600	100.600	100.600
Energy	12.000	12.000	12.000	12.000	12.000
Labour, direct	45.500	45.500	45.500	45.500	45.500
Repair, maintenance	80.000	80.000	80.000	80.000	80.000
Spares	40.000	40.000	40.000	40.000	40.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	8328.351	8328.351	8328.351	8328.351	8328.351
Administrative overheads	96.850	96.850	96.850	96.850	96.850
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	711.000	711.000	711.000	711.000	76.000
Financial costs	100.800	67.200	33.600	0.000	0.000
Total production costs	9237.000	9203.[illegible]	9169.900	9136.200	8501.200
Costs per unit (single product)	0.000	[illegible]	0.000	0.000	0.000
Of it foreign, %	14.114	[illegible]	[illegible]	13.166	9.521
Of it variable,%	0.000	[illegible]	0.000	0.000	0.000
Total labour	123.350	[illegible]	123.350	123.350	123.350

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	8050.250
Other raw materials	0.000
Utilities	100.600
Energy	12.000
Labour, direct	45.500
Repair, maintenance	80.000
Spares	40.000
Factory overheads	0.000
Factory costs	8328.351
Administrative overheads	96.850
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	8425.200
Costs per unit (single product)	0.000
Of it foreign, %	8.699
Of it variable,%	0.000
Total labour	123.350

Net Working Capital in 1000 US $

Year	mdc	coto	1992	1993	1994	1995	1996-2006
Coverage							
Current assets &							
Accounts receivable	30	12.0	297.207	429.255	564.036	702.100	702.100
Inventory and materials	69	5.2	629.182	943.773	1258.364	1572.954	1572.954
Energy	1	360.0	0.013	0.020	0.026	0.033	0.033
Spares	180	2.0	8.000	12.000	16.000	20.000	20.000
Work in progress	1	360.0	9.663	13.931	18.532	23.134	23.134
Finished products	15	24.0	148.604	212.628	282.018	351.050	351.050
Cash in hand	15	24.0	12.556	8.556	9.931	10.931	10.931
Total current assets			1105.225	1616.163	2148.906	2680.203	2680.203
Current liabilities and							
Accounts payable	27	13.1	256.604	382.511	508.734	634.990	634.990
Net working capital			848.621	1233.652	1640.173	2045.213	2045.213
Increase in working capital			848.621	385.031	406.521	405.041	0.000
Net working capital, local			644.729	957.815	1272.390	1585.484	1585.484
Net working capital, foreign			203.892	275.838	367.783	459.729	459.729

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	1230.000	3410.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	800.000	2560.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	150.000	370.000
Loan C, local....	0.000	0.000
Total loan	950.000	2930.000
Current liabilities	0.000	0.000
Bank overcraft	0.000	0.000
Total funds	2180.000	6340.000

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-420.000	-420.000	-420.000	-420.000	-420.000
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-173.333	-173.333	-173.333	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-593.333	-593.333	-593.333	-420.000	-420.000
Current liabilities	256.604	125.906	126.223	126.256	0.000
Bank overdraft	408.689	-408.688	0.000	0.000	0.000
Total funds	71.960	-876.115	-467.110	-293.744	-420.000

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow . .	2180.000	6340.000
Financial resources .	2180.000	6340.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	2173.950	6339.050
Total assets	2130.700	6122.400
Operating costs . . .	0.000	0.000
Cost of finance . . .	43.250	216.650
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	6.050	0.950
Cumulated cash balance	6.050	7.000
Inflow, local	1380.000	3780.000
Outflow, local	1341.950	2175.450
Surplus (deficit) .	38.050	1604.550
Inflow, foreign . . .	800.000	2560.000
Outflow, foreign . . .	832.000	4163.600
Surplus (deficit) .	-32.000	-1603.600
Net cashflow	-2130.700	-6122.400
Cumulated net cashflow	-2130.700	-8253.101

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	5320.604	7721.907	10254.220	12786.260	12660.000	12660.000
Financial resources	256.604	125.906	126.223	126.256	0.000	0.000
Sales, net of tax	5064.000	7596.000	10128.000	12660.000	12660.000	12660.000
Total cash outflow	5736.293	7040.986	9044.255	10845.780	10294.320	10315.200
Total assets	1105.226	510.937	532.744	531.297	0.000	0.000
Operating costs	3566.490	5103.060	6799.429	8425.199	8425.199	8425.199
Cost of finance	346.800	287.200	227.600	168.000	134.400	100.800
Repayment	593.333	593.333	593.333	420.000	420.000	420.000
Corporate tax	124.444	546.456	923.148	1301.280	1314.720	1369.200
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-415.688	680.920	1209.968	1940.480	2365.681	2344.801
Cumulated cash balance	-408.689	272.232	1482.199	3422.680	5788.360	8133.161
Inflow, local	5319.457	7721.833	10253.820	12785.850	12660.000	12660.000
Outflow, local	4429.293	5874.027	7743.982	9432.521	9007.019	9061.499
Surplus (deficit)	890.163	1847.806	2509.833	3353.328	3652.981	3598.501
Inflow, foreign	1.148	0.074	0.407	0.407	0.000	0.000
Outflow, foreign	1306.999	1166.960	1300.273	1413.253	1287.300	1253.700
Surplus (deficit)	-1305.852	-1166.886	-1299.866	-1412.846	-1287.300	-1253.700
Net cashflow	524.445	1561.454	2030.902	2528.480	2920.081	2865.601
Cumulated net cashflow	-7728.656	-6167.202	-4136.300	-1607.819	1312.261	4177.362

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	12660.000	12660.000	12660.000	12660.000	12660.000	12660.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	12660.000	12660.000	12660.000	12660.000	12660.000	12660.000
Total cash outflow	10295.040	10274.880	9934.719	10088.720	10119.120	10119.120
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	8425.199	8425.199	8425.199	8425.199	8425.199	8425.199
Cost of finance	67.200	33.600	0.000	0.000	0.000	0.000
Repayment	420.000	420.000	0.000	0.000	0.000	0.000
Corporate tax	1382.640	1396.080	1509.520	1663.520	1693.920	1693.920
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	2364.961	2385.121	2725.281	2571.281	2540.881	2540.881
Cumulated cash balance	10498.120	12883.240	15608.520	18179.800	20720.690	23261.570
Inflow, local	12660.000	12660.000	12660.000	12660.000	12660.000	12660.000
Outflow, local	9074.938	9088.379	9134.818	9286.818	9386.219	9386.219
Surplus (deficit)	3585.062	3571.621	3525.182	3373.182	3273.781	3273.781
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	1220.100	1186.500	799.900	732.900	732.900	732.900
Surplus (deficit)	-1220.100	-1186.500	-799.900	-732.900	-732.900	-732.900
Net cashflow	2852.161	2838.721	2725.281	2571.281	2540.881	2540.881
Cumulated net cashflow	7030.023	9868.744	12594.030	15265.310	17806.190	20347.070

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	12660.000	12660.000	12660.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	12660.000	12660.000	12660.000
Total cash outflow	10119.120	10119.120	10119.120
Total assets	0.000	0.000	0.000
Operating costs	8425.199	8425.199	8425.199
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1693.920	1693.920	1693.920
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	2540.881	2540.881	2540.881
Cumulated cash balance	25902.450	28443.330	30984.210
Inflow, local	12660.000	12660.000	12660.000
Outflow, local	9386.219	9386.219	9386.219
Surplus (deficit)	3273.781	3273.781	3273.781
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	732.900	732.900	732.900
Surplus (deficit)	-732.900	-732.900	-732.900
Net cashflow	2540.881	2540.881	2540.881
Cumulated net cashflow	22887.950	25428.830	27969.710

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	7685.26	at 10.00 %
Internal Rate of Return (IRRE1) ..	26.88 %	

b) Net Worth versus Net cash return:

Net present value	8582.67	at 10.00 %
Internal Rate of Return (IRRE2) ..	26.17 %	

c) Internal Rate of Return on total investment:

Net present value	8580.34	at 10.00 %
Internal Rate of Return (IRR) ..	22.49 %	

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	5064.000	7596.000	10128.000	12660.000	12660.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	5064.000	7596.000	10128.000	12660.000	12660.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4406.090	5942.660	7595.030	9238.801	9238.800
Operational margin	657.910	1653.340	2532.970	3421.199	3421.200
As % of total sales	12.992	21.766	25.010	27.024	27.024
Cost of finance	346.800	287.200	227.600	168.000	134.400
Gross profit	311.110	1366.140	2305.370	3253.199	3286.800
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	311.110	1366.140	2305.370	3253.199	3286.800
Tax	124.444	546.456	922.148	1301.280	1314.720
Net profit	186.666	819.684	1383.222	1951.920	1972.080
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	186.666	819.684	1383.222	1951.920	1972.080
Accumulated undistributed profit	186.666	1006.350	2389.572	4341.492	6313.571
Gross profit, % of total sales	6.144	17.985	22.762	25.697	25.962
Net profit, % of total sales	3.686	10.791	13.657	15.418	15.577
ROE, Net profit, % of equity	4.023	17.666	29.811	42.067	42.502
ROI, Net profit+interest, % of invest.	5.861	11.468	16.282	20.585	20.455

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	12660.000	12660.000	12660.000	12660.000	12660.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	12660.000	12660.000	12660.000	12660.000	12660.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs incl. depreciation	9136.200	9136.200	9136.201	9136.200	8501.200
Operational margin	3523.800	3523.800	3523.799	3523.800	4158.800
As % of total sales	27.834	27.834	27.834	27.834	32.850
Cost of finance	100.800	67.200	33.600	0.000	0.000
Gross profit	3423.000	3456.600	3490.199	3523.800	4158.800
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3423.000	3456.600	3490.199	3523.800	4158.800
Tax	1369.200	1382.640	1396.080	1409.520	1663.520
Net profit	2053.800	2073.960	2094.120	2114.280	2495.280
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2053.800	2073.960	2094.120	2114.280	2495.280
Accumulated undistributed profit	8367.371	10441.330	12535.450	14649.730	17145.010
Gross profit, % of total sales	27.038	27.303	27.569	27.834	32.850
Net profit, % of total sales	16.223	16.382	16.541	16.700	19.710
ROE, Net profit, % of equity	44.263	44.697	45.132	45.566	53.778
ROI, Net profit+interest, % of invest.	20.922	20.791	20.661	20.530	24.230

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	12660.000	12660.000	12660.000	12660.000	12660.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	12660.000	12660.000	12660.000	12660.000	12660.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	8425.200	8425.200	8425.200	8425.200	8425.200
Operational margin	4234.800	4234.800	4234.800	4234.800	4234.800
As % of total sales	33.450	33.450	33.450	33.450	33.450
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	4234.800	4234.800	4234.800	4234.800	4234.800
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	4234.800	4234.800	4234.800	4234.800	4234.800
Tax	1693.920	1693.920	1693.920	1693.920	1693.920
Net profit	2540.880	2540.880	2540.880	2540.880	2540.880
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2540.880	2540.880	2540.880	2540.880	2540.880
Accumulated undistributed profit	19685.890	22226.770	24767.650	27308.530	29849.410
Gross profit, % of total sales	33.450	33.450	33.450	33.450	33.450
Net profit, % of total sales	20.070	20.070	20.070	20.070	20.070
ROE, Net profit, % of equity	54.760	54.760	54.760	54.760	54.760
ROI, Net profit+interest, % of invest.	24.673	24.673	24.673	24.673	24.673

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	2180.000	8520.000
Fixed assets, net of depreciation	0.000	2173.950
Construction in progress	2173.950	6339.050
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	6.050	7.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	2180.000	8520.000
Equity capital	1230.000	4640.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	950.000	3880.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	0.000	0.000
Total debt	950.000	3880.000
Equity, % of liabilities	56.422	54.460

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Tota assets	8778.626	8722.194	9638.306	11296.480	12848.560
Fixed assets, net of depreciation	7673.400	6833.800	6007.200	5193.600	4380.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1092.669	1607.606	2138.976	2669.272	2669.272
Cash, bank	12.556	8.554	9.931	10.931	10.931
Cash surplus, finance available	0.000	272.231	1482.199	3422.679	5788.360
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	8778.626	8722.194	9638.306	11296.480	12848.560
Equity capital	4640.000	4640.000	4640.000	4640.000	4640.000
Reserves, retained profit	0.000	186.666	1006.350	2389.572	4341.492
Profit	186.666	819.684	1383.222	1951.920	1972.080
Long and medium term debt	3286.667	2693.333	2100.000	1680.000	1260.000
Current liabilities	256.604	382.511	508.734	634.990	634.990
Bank overdraft, finance required.	408.688	0.000	0.000	0.000	0.000
Total debt	3951.959	3075.844	2608.734	2314.990	1894.990
Equity, % of liabilities	52.856	53.198	48.141	41.075	36.113

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	14482.360	16136.320	17810.440	19924.720	22420.000
Fixed assets, net of depreciation	3669.000	2958.000	2247.000	1536.000	1460.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	2669.272	2669.272	2669.272	2669.272	2669.272
Cash, bank	10.931	10.931	10.931	10.931	10.931
Cash surplus, finance available	8133.159	10498.121	12903.240	15708.520	18279.800
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	14482.360	16136.320	17810.440	19924.720	22420.000
Equity capital	4640.000	4640.000	4640.000	4640.000	4640.000
Reserves, retained profit	6313.571	8367.371	10441.330	12535.450	14649.730
Profit	2053.800	2073.960	2094.120	2114.280	2495.230
Long and medium term debt	840.000	420.000	0.000	0.000	0.000
Current liabilities	634.990	634.990	634.990	634.990	634.990
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1474.990	1054.990	634.990	634.990	634.990
Equity, % of liabilities	32.039	33.791	36.052	23.283	20.696

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	24960.880	27501.760	30042.640	32583.520	35124.390
Fixed assets, net of depreciation	1460.000	1460.000	1460.000	1460.000	1460.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	2669.272	2669.272	2669.272	2669.272	2669.272
Cash, bank	10.931	10.931	10.931	10.931	10.931
Cash surplus, finance available	20820.680	23361.560	25902.440	28443.310	30984.190
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	24960.880	27501.760	30042.640	32583.520	35124.390
Equity capital	4640.000	4640.000	4640.000	4640.000	4640.000
Reserves, retained profit	17145.010	19685.890	22226.770	24767.650	27308.530
Profit	2540.880	2540.880	2540.880	2540.880	2540.880
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	634.990	634.990	634.990	634.990	634.990
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	634.990	634.990	634.990	634.990	634.990
Equity, % of liabilities	18.589	16.872	15.445	14.240	13.210

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE REFINING OF GLYCEROL FROM METHYLESTER PRODUCTION IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for the refining of glycerol, made available as a by-product by a methylester production plant, which is the subject of another "Opportunity Study".

Glycerol has many industrial applications: it is used for the production of explosives, synthetic resins and, as an intermediate product, it is used in chemical, pharmaceutical and alimentary industries.

Glycerol can be produced by synthesis, but till now the 75% of the glycerol world-wide produced is obtained as a by-product in the conversion of fats and oils to fatty acids and fatty acids to methylester.(1)

A plant having a capacity of processing 1650 t/y of raw glycerol is proposed and discussed in the following chapters.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 2,467,190 (US$ 1,185,000 in foreign currency)
- Working capital (at full production): US$ 105,793 (US$ 7,206 in foreign currency)
- Internal Rate of Return: 20.32%
- Break-Even Point (at 5th year of production) 45%
- Pay-Back Period: less than 6.5 years (including construction period)
- Employees: 37

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 9,960,000 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

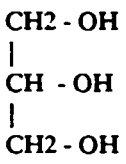
It is also recommended to analyse the possibility of integrating this project with the methylester production plant.

(1) For additional background material see Volume 1 p. 67.

1. INTRODUCTION

Glycerol or 1,2,3-propanetriol, commonly known as glycerine, can be found in all natural fats and oils as fatty esters and it is an important intermediate in the metabolism of living organisms.

Glycerol has the following structural formula:



The first industrial use of glycerol was in 1866 when Nobel produced dynamite, in which the trinitrate of glycerol - nitroglycerin is stabilized by absorption on diatomaceous earth.

Glycerol is now used in a large variety of applications because of its particular combination of chemical and physical properties and because it is physiologically innocuous.

Even though the most important synthesis of glycerol, which used propane as starting material, was developed since 1930, about the 75% of glycerol is still obtained as a by-product in the conversion of fats and oils to fatty acids and fatty acid to methylester.

The main physical properties of glycerol are the following:

Physical state:	sweet-tasting liquid; when pure it is colourless and odourless. At room temperature it is viscous.
Molecular weight:	92.09
Melting point:	18°C
Boiling point	290°C
Flash point:	177 °C
Dynamic viscosity (20 C):	1.410 Pa.s
Density (20 C):	1.260 kg/l

Chemically glycerol, being an alcohol, undergoes all the usual reactions of alcohols.

At room temperature glycerol rapidly absorbs water; when diluted it is attacked by microorganisms.

The main sources of natural glycerol are now fats and oils splitting and transesterification of fats and oils to their methylesters.

The splitting process leads to a 18-20 % solution of glycerol in water (known as sweet water), while by the trasesterification process the crude glycerol is obtained directly at a concentration of 70-75% with obvious advantages for the energy saving in the concentration-distillation step.

2. MARKET AND PLANT CAPACITY

2.1 USES

Glycerol is an extremely useful product with a large variety of applications. Its non-toxicity and lack of colour and odour are of considerable importance. World-wide consumption of glycerol according to major areas of application is listed in the following table.

Application of glycerol (world-wide)

Application	Percentage
Pharmaceuticals, cosmetics	26
Esters	17
Resins	12
Polyols	12
Food	10
Other chemicals	10
Cellulose	5
Nitration	4
Tobacco	4

Glycerol is important in pharmaceutical, cosmetic and food industry because it is non-toxic and possesses good solvent properties for many compounds both organic and inorganic.

It keeps preparations moist and hinders unwanted crystallization. It can be used as a softener, it supplies moisture to the skin and its high viscosity renders solutions syrupy.

The poly-functional reactivity of glycerol is used in the production of alkyd resins and in cross-linked polyesters from mono and dicarboxylic acids and polyols.

Glycerol serves as a lubricator in the textile industry, as well as in equipment and materials that come in contact with food, pharmaceuticals, cosmetics or skin.

Among esters the glycerol trinitrate, nitroglycerine, is produced in a mixture of nitric and sulphuric acids. In addition to its use in form of dynamite, it is also an important therapeutic agent in the treatment of angina pectoris.

2.2 DEMAND

2.2.1 World-wide consumption

Estimated world-wide consumption of glycerol amounts to about 550,000 t/y; almost two-thirds of the total production is in Europe and the United States.

Annual production is as follows:

Western Europe	208,000 t
United States	145,000 t
Japan	45,000 t
Other	152,000 t
Total	550,000 t

The fraction of synthetic glycerol is about 25%. The consumption of glycerol is estimated to increase annually by about 1%.

2.2.2 Present situation in Nigeria

Glycerol is imported in Nigeria, ready to be used in the pharmaceutical, cosmetic and food industry. In 1987 the importation reached 1974 t.

2.3 PLANT CAPACITY

The plant capacity is equivalent to the amount of crude glycerol produced as by product by the ME plant, analysed earlier; therefore, out of 10,000 t/y production of methylester 1650 t/y of crude glycerol (70-75% w/w) are obtained. The purified glycerol (98-99% w/w) produced in this plant will be 1100 t/y (4 t/day on 3 shifts - 270 days/y).

2.4 SALE PRICE AND TOTAL REVENUE

In the World market pure glycerol (99% w/w) is traded (in bulk) at 1600 $/t.

Taking into consideration the transportation charges etc. the price in Nigeria can be assumed at 1700 $/t.

The same price can be assumed for the ex-works selling price of the final product (always in bulk).

The total revenue therefore amounts to 1,870,000 $/y.

Remark - For product packed in 250 kg drums the selling price shall be 1820 $/t.

3. MATERIALS AND INPUTS

3.1 TECHNOLOGY

Crude glycerol recovered from the transesterification process has, as formerly said, the following composition:

CH_3OH	5% max
Soap	15% max
Fats	5% max
Purity	70-75%

To obtain a commercial valid product, purity must be increased up to 98-99%.

To this purpose the crude product undergoes a chemical pretreatment through which a soap splitting is completed by the saponification of any remaining fat compounds.

In two subsequent steps of concentration, t' ication process is completed and the final product obtained.

3.2 MATERIAL AND UTILITIES: AVAILABILITY, REQUIREMENT AND COSTS

All raw materials and utilities are available in Nigeria.

Only activated carbon has to be imported.

The following table shows the quantity of material and utilities, as well as the relevant costs, required for the production of 1 t and 1100 t/y of pharmaceutical grade glycerol.

description	unit of measure	required q.ty for 1 ton	1 year	unit costs $ LC	FC	annual costs $ LC	FC	TOTAL
Raw glycerol	t	1.5	1,650	400		660,000		660,000
Hydrochloric acid(100%)	t	0.022	24	990		23,760		23,760
Caustic soda (100%)	t	0.010	11	495		5,440		5,440
Activated carbon	t	0.004	4.5		1,850		8,330	8,330
1 Sub-total: raw materials						**689,200**	**8,330**	**697,530**
Steam (6/15 bar)	t	1.350	1,485	8		11,880		11,880
Cooling water	m3	60	66,000	0.009		590		590
Electric energy	KWh	80	88,000	0.1		8,800		8,800
Fuel oil	t	0.01	11	30		330		330
2 Sub-total : utilities						**21,600**		**21,600**
Grand total (1 + 2)						**719,130**		

For the financial evaluation, the costs are grouped as follows:

Raw materials	LC	$	689,200
Raw materials	FC	$	8,330
Utilities	LC	$	21,600
TOTAL		$	719,130

3.3 RAW MATERIALS PURCHASING PROGRAMME AND STORAGE VOLUME

Raw glycerine, being produced locally, can be bought every month. Both hydrochloric acid and caustic soda will be stored as a solution at about 30% concentration.

Within the terms of this assignment, it is proposed to set-up a chlor-alkali plant which will make available both hydrochloric acid and caustic soda, therefore a stock equivalent to one month production may be sufficient.

For activated carbon, which will be imported, a stock equivalent to six month consumption is suggested.

On this basis the minimum storage volume and its cost will be as follows:

- raw glycerol 150 t x 400 $/t	= $	60,000
- hydrochloric acid (solution 30% ab)		
as 100% : 2 t x 990 $/t	= $	1,980
- caustic soda (solution 30% ab.)		
as 100% : 1 tx495 $/t	= $	495
- fuel oil 1 t x 30 $/t	= $	30
- activated carbon 2.5 t x 1850 $/t	= $	4,630
TOTAL	$	67,135

4. LOCATION

Due to the close connection of this project with the methylester production plant, its location should be next to or an extension of that plant.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

The proposed process essentially consists of a continuous purification treatment according to the following steps:

- soap-splitting through acidification by hydrochloric acid (HCl), separation and recovery of the floating fatty-acid.

- pH adjustment to neutral value to saponify any remaining fat components (by adding sodium hydroxide or sodium carbonate solution).

- concentration - distillation

The two chemical treatments or "pretreatment steps" are very important in the work-up, and are crucial for trouble - free production and for the quality of the final product.

In the distillation-concentration step, a first flash evaporation (mainly for methanol removal) is followed by a massive evaporation by means of a thin - film evaporator which provides for high heat transfer rate and allows continuous discharging of the residue (salts plus fatty-material).

The thin-film evaporator is a compact unit, characterized by a very high heat exchange efficiency and consequently by a very low residence time of glycerine in the evaporator thus drastically reducing the formation of polyglycerols, that affect the distillation yield and the degradation of glycerine to volatile compounds (such as aldeheyds and ketons) responsible for bad smelling and bad colour of the distilled glycerine.

Both flash and thin-film evaporators work under vacuum.

The distillation pitches are discharged from the bottom of the thin-film evaporator and extracted by a screw conveyor, while the evaporated glycerine is sent to condensation.

The condensating glycerine vapours (after previous activated carbon treatment) give pharmaceutical grade glycerol, while the light portions are passed through a subsequent double stage condensation system to separate the so-called "2nd quality glycerine" from the "weaks".

The 2nd quality glycerine can be re-distilled at the end of the production campaign, while the weaks are sent to waste.

5.2 STORING FACILITIES

5.2.1 Finished product

The purified glycerol will be collected in a tank stainless steel AISI 304, having a capacity of 100 m^3 (30 days production about).

5.2.2 Raw Materials

Liquid raw materials will be stored in tanks as follows:

Description	tank(s)	volume m^3	material
Raw glycerol	1	150	SS AISI 304
Hydrochloric acid (sol. 30%)	1	2	fibre glass
Caustic soda (sol. 30%)	1	1	fibre glass
Fuel oil (utilities included)	1	20	carbon steel

Solid activated carbon (125 bags) will be stored in the storehouse.

5.3 LAY-OUT AND CIVIL WORKS

The area needed for the plant is approx 5200 m^2 and can be divided as follows:

- a building of 240 m^2 surface, 12 m height, for the processing equipment;

- 570 m^2 of buildings for utilities, workshop, warehouse and laboratory;

- a one storey building covering an area of 200 m^2 for the administration offices and facilities;

- 380 m^2 about, of open area, but with the floor made of reinforced concrete with a hard aggregate as finishing surface;

- the remaining space are green areas or roads and courtyards, the last two covered with gravel and rolled.

All the buildings for the processing equipment, utilities, workshop, warehouse and laboratory are covered with corrugated asbestos sheets and supported by steel columns and trusses.

The floors and external walls, when needed, are of brickwork.

The offices building has a reinforced concrete structure and internal and external walls made of brickwork. The roof is insulated by mineral wool lagging covered with corrugated asbestos-cement; the floors are covered with tiles.

The fence consists of wire netting supported by small steel poles, installed all around the complex.

5.4 INVESTMENT COSTS, DEPRECIATION AND MAINTENANCE

The investment costs for machinery and equipment were obtained from Messrs. GIANAZZA, Legnano, Italy.

	LC $	FC $	Total $
Machinery and equipment (FOB European Port)	--	765,000	765,000
Transport, taxes&duties	152,000	76,000	228,000
Erection	152,000	76,000	228,000
Land and site preparation	70,000	--	70,000
Civil works	670,000	--	670,000
Insulating and painting	20,000	--	20,000
Spare parts	--	50,000	50,000
Total	**1,064,000**	**967,000**	**2,031,000**
Contingencies	**86,000**	**100,000**	**186,000**
Grand Total	**1,150,000**	**1,067,000**	**2,217,000**

The life of the plant can be considered as fifteen years. Annual maintenance cost has been assumed in the range of 3% of the machinery and equipment CIF costs, that is US$ 30,000.

In the financial evaluation, the investment costs, contingencies included, are grouped as follows:

Preproduction expenditures	FC	US$	65,000
Preproduction expenditures	LC	US$	107,660
Machinery	FC	US$	1,067,000
Machinery	LC	US$	350,000
Land and site preparation	LC	US$	70,000
Civil works	LC	US$	730,000
Total		US$	2,389,660

6. PLANT ORGANIZATION

In this study, the plant was considered as an autonomous unit, complete with facilities and utilities, operating under the direction of an independent organization. The possibility to integrate this plant with the methylester production plant should be analysed. Saving in investment and operation costs could be obtained.

7. MANPOWER

The technical manager, the production manager, the engineer, the chemist and the foremen should be well trained. Comprehensive training should be provided for technologies specifically involved in the process as well as for the safety procedures.

It is recommended that the job training is carried out by one expert, made available by the technology supplier for one year after the start-up. The relevant cost is estimated at US$ 120,000.

7.1 MANAGEMENT

		N/y
General Manager	1	50,000
Technical Manager	1	40,000
	2	90,000
		overheads 40% 36,000
		126.000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPT.

		N/y
Financial Manager	1	40,000
Senior accountant	1	25,000
Purchasing dept.	1	12,000
Sales dept.	1	12,000
Warehouse keepers	1	10,000
Clerks	2	24,000
Guards	6	36,000
Drivers	2	16,000
	15	175,000
		overheads 40% 70,000
		245,000
		(US$ 31,000)

7.3 PRODUCTION DEPT.

		N/y
Production manager	1	40,000
Shift foremen	3	36,000
Shift operator	3	24,000
Semi-skilled workers	3	24,000
Chemist	1	25,000
Analyst	1	12,000
Clerks	1	12,000
	13	173,000
		overheads 40% 69,000
		242,000
		(US$ 30,600)

7.4 MAINTENANCE DEPT.

		N/y
Engineer	1	40,000
Electricians	2	20,000
Mechanics	2	20,000
Instrument spec.	2	20,000
	7	100,000
		overheads 40% 40,000
		140,000
		(US$ 17,700)

Summary of needed manpower

		$/y
Management	2	16,000
Administrative dept.	15	31,000
Production dept.	13	30,600
Maintenance dept.	7	17,700
	37	95,300

8. IMPLEMENTATION SCHEDULE

Twenty-four months are required for the design, machinery and equipment supply and erection of the plant, up to the commissioning and start-up.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 2,467,190 US Dollars. The portion in foreign currency accounts for 1,185,000 US Dollars.

Details of these figures are shown in chapter 5.4

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 610,000	US$ 651,420	US$ 1,251,420
- Foreign Loan (interest 8%)	US$ 210,000	US$ 697,000	US$ 907,000
- Local Loan (interest 15%)	US$ 52,000	US$ 170,000	US$ 222,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 60%

3rd year 80%

4th and subsequent years 100%

When the plant is in full production, the required working capital amounts to 113,000 US Dollars.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US $ 71,000 of which US $ 22,000 in foreign currency.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US $ 847,548.

In the fourth year, at full production, the costs amount to US $ 1,118,018, then they start a slight decrease year after year, to reach a constant amount of US $ 844,430 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 1,870,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 748,000

2nd year 60% : revenue = US$ 1,112,000

3rd year 80% : revenue = US$ 1,496,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 20.32%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 45% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 6.5 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 9,960,000.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 9,960,000.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of the capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

GLYCEROL
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	2467.19	48.034 % foreign
current assets:	0.00	0.000 % foreign
total assets:	2467.19	48.034 % foreign

Source of funds during construction phase

equity & grants:	1261.42	0.000 % foreign
foreign loans :	907.00	
local loans :	222.00	
total funds :	2390.42	37.943 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	499.45	844.43	844.43
depreciation :	242.24	228.24	71.50
interest :	105.86	36.28	0.00
production costs	847.55	1108.95	915.93
thereof foreign	38.96 %	16.86 %	2.22 %
total sales :	748.00	1870.00	1870.00
gross income :	-99.55	761.05	954.07
net income :	-99.55	456.63	572.44
cash balance :	-115.35	571.49	643.94
net cashflow :	177.88	721.15	643.94

Net Present Value at: 10.00 % = 1906.97
Internal Rate of Return: 20.32 %
Return on equity1: 21.39 %
Return on equity2: 24.07 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	70.000	0.000
Buildings and civil works	490.000	240.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	260.000	1157.000
Total fixed investment costs	820.000	1397.000
Pre-production capital expenditures.	63.540	186.650
Net working capital	0.000	0.000
Total initial investment costs	883.540	1583.650
Of it foreign, in %	24.719	61.041

Total Current Investment in 1000 US $

Year	1992	1993	1994	1995
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000
Working capital	70.666	-0.148	22.296	20.185
Total current investment costs	70.666	-0.148	22.296	20.185
Of it foreign, %	32.191	0.000	6.148	8.474

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	40.000	60.000	80.000	100.000	100.000
Raw material 1	279.010	418.520	558.020	697.530	697.530
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	8.640	12.960	17.280	21.600	21.600
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	30.600	30.600	30.600	30.600	30.600
Repair, maintenance	7.200	10.800	14.400	18.000	18.000
Spares	4.000	6.000	8.000	12.000	12.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	449.450	478.880	628.300	779.730	779.730
Administrative overheads	50.000	50.000	64.700	64.700	64.700
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	242.238	242.238	235.238	228.238	228.238
Financial costs	105.860	85.690	65.520	45.350	36.280
Total production costs	847.548	856.808	993.758	1118.018	1108.948
Costs per unit (single product)	1.926	1.298	1.129	1.016	1.008
Of it foreign, %	38.960	23.903	20.065	17.531	16.856
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	80.600	80.600	95.300	95.300	95.300

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	697.530	697.530	697.530	697.530	697.530
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	21.600	21.600	21.600	21.600	21.600
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	30.600	30.600	30.600	30.600	30.600
Repair, maintenance	18.000	18.000	18.000	18.000	18.000
Spares	12.000	12.000	12.000	12.000	12.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	779.730	779.730	779.730	779.730	779.730
Administrative overheads	64.700	64.700	64.700	64.700	64.700
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	178.200	178.200	178.200	178.200	71.500
Financial costs	27.210	18.140	9.070	0.000	0.000
Total production costs	1049.840	1040.770	1031.700	1022.630	915.930
Costs per unit (single product)	0.954	0.946	0.938	0.930	0.833
Of it foreign, %	14.692	13.948	13.192	12.422	2.229
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	95.300	95.300	95.300	95.300	95.300

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	697.530
Other raw materials	0.000
Utilities	21.600
Energy	0.000
Labour, direct	30.600
Repair, maintenance	18.000
Spares	12.000
Factory overheads	0.000
Factory costs	779.730
Administrative overheads	64.700
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	844.430
Costs per unit (single product)	0.768
Of it foreign, %	2.408
Of it variable,%	0.000
Total labour	95.300

Net Working Capital in 1000 US $

Year	mdc	coto	1992	1993	1994	1995	1996-2006
Coverage							
Current assets &							
Accounts receivable	30	12.0	41.621	44.073	57.750	70.369	70.369
Inventory and materials	32	11.3	25.358	38.040	50.717	63.398	63.398
Energy	0	---	0.000	0.000	0.000	0.000	0.000
Spares	0	---	0.000	0.000	0.000	0.000	0.000
Work in progress	1	360.0	1.248	1.330	1.745	2.166	2.166
Finished products	15	24.0	20.810	22.037	28.875	35.185	35.185
Cash in hand	15	24.0	8.825	4.058	4.904	5.221	5.221
Total current assets			97.863	109.539	143.991	176.339	176.339
Current liabilities and							
Accounts payable	29	12.4	27.197	39.021	51.177	63.340	63.340
Net working capital			70.666	70.518	92.814	112.999	112.999
Increase in working capital			70.666	-0.148	22.296	20.185	0.000
Net working capital, local			47.918	66.393	87.318	105.793	105.793
Net working capital, foreign			22.748	4.125	5.496	7.206	7.206

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	610.000	651.420
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	210.000	697.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	52.000	170.000
Loan C, local....	0.000	0.000
Total loan	262.000	867.000
Current liabilities	0.000	0.000
Bank overdraft	11.540	65.230
Total funds	883.540	1583.650

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-113.375	-113.375	-113.375	-113.375	-113.375
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-74.000	-74.000	-74.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-187.375	-187.375	-187.375	-113.375	-113.375
Current liabilities	27.197	11.824	12.157	12.162	0.000
Bank overdraft	115.351	-192.121	0.000	0.000	0.000
Total funds	-44.827	-367.673	-175.218	-101.213	-113.375

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow . .	872.000	1518.420
Financial resources .	872.000	1518.420
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	883.540	1583.650
Total assets	871.240	1518.420
Operating costs . . .	0.000	0.000
Cost of finance . . .	12.300	65.230
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-11.540	-65.230
Cumulated cash balance	-11.540	-76.770
Inflow, local	662.000	821.420
Outflow, local	665.140	616.970
Surplus (deficit) .	-3.140	204.450
Inflow, foreign . . .	210.000	697.000
Outflow, foreign . . .	218.400	966.680
Surplus (deficit) .	-8.400	-269.680
Net cashflow	-871.240	-1518.420
Cumulated net cashflow	-871.240	-2389.660

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	775.197	1134.147	1508.157	1882.162	1870.000	1870.000
Financial resources	27.197	12.147	12.157	12.162	0.000	0.000
Sales, net of tax	748.000	1122.000	1496.000	1870.000	1870.000	1870.000
Total cash outflow	890.548	920.020	1181.244	1336.295	1298.506	1313.079
Total assets	97.863	11.675	34.453	32.348	0.000	0.000
Operating costs	499.450	528.880	693.000	844.430	844.430	844.430
Cost of finance	105.860	85.690	65.520	45.350	36.280	27.210
Repayment	187.375	187.696	187.375	113.375	113.375	113.375
Corporate tax	0.000	106.077	200.897	300.793	304.421	328.064
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-115.351	214.126	326.912	545.867	571.494	556.921
Cumulated cash balance	-192.121	22.005	348.918	894.785	1466.279	2023.200
Inflow, local	774.843	1134.147	1508.147	1882.147	1870.000	1870.000
Outflow, local	554.181	750.778	997.408	1155.514	1128.521	1152.164
Surplus (deficit)	220.662	383.368	510.738	726.632	741.479	717.836
Inflow, foreign	0.354	0.000	0.010	0.016	0.000	0.000
Outflow, foreign	336.367	169.242	183.836	180.781	169.985	160.915
Surplus (deficit)	-336.013	-169.242	-183.826	-180.765	-169.985	-160.915
Net cashflow	177.884	487.191	579.807	704.592	721.149	697.506
Cumulated net cashflow	-2211.776	-1724.585	-1144.777	-440.185	280.964	978.470

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	1870.000	1870.000	1870.000	1870.000	1870.000	1870.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	1870.000	1870.000	1870.000	1870.000	1870.000	1870.000
Total cash outflow	1307.637	1302.195	1183.378	1226.058	1254.658	1254.658
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	844.430	844.430	844.430	844.430	844.430	844.430
Cost of finance	18.140	9.070	0.000	0.000	0.000	0.000
Repayment	113.375	113.375	0.000	0.000	0.000	0.000
Corporate tax	331.692	335.320	338.948	381.628	410.228	410.228
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	562.363	567.805	686.622	643.942	615.342	615.342
Cumulated cash balance	2585.563	3153.369	3839.991	4483.933	5099.274	5714.616
Inflow, local	1870.000	1870.000	1870.000	1870.000	1870.000	1870.000
Outflow, local	1155.792	1159.420	1163.048	1205.728	1234.328	1234.328
Surplus (deficit)	714.208	710.580	706.952	664.272	635.672	635.672
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	151.845	142.775	20.330	20.330	20.330	20.330
Surplus (deficit)	-151.845	-142.775	-20.330	-20.330	-20.330	-20.330
Net cashflow	693.378	690.250	686.622	643.942	615.342	615.342
Cumulated net cashflow	1672.348	2362.598	3049.220	3693.163	4308.505	4923.847

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	1870.000	1870.000	1870.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	1870.000	1870.000	1870.000
Total cash outflow	1254.658	1254.658	1254.658
Total assets	0.000	0.000	0.000
Operating costs	844.430	844.430	844.430
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	410.228	410.228	410.228
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	615.342	615.342	615.342
Cumulated cash balance	6329.958	6945.300	7560.642
Inflow, local	1870.000	1870.000	1870.000
Outflow, local	1234.328	1234.328	1234.328
Surplus (deficit)	635.672	635.672	635.672
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	20.330	20.330	20.330
Surplus (deficit)	-20.330	-20.330	-20.330
Net cashflow	615.342	615.342	615.342
Cumulated net cashflow	5539.188	6154.530	6769.872

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	1490.98	at	10.00 %
Internal Rate of Return (IRRE1) ..	21.39 %		

b) Net Worth versus Net cash return:

Net present value	1967.70	at	10.00 %
Internal Rate of Return (IRRE2) ..	24.07 %		

c) Internal Rate of Return on total investment:

Net present value	1906.97	at	10.00 %
Internal Rate of Return (IRR) ..	20.32 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	748.000	1122.000	1496.000	1870.000	1870.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	748.000	1122.000	1496.000	1870.000	1870.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	741.688	771.118	928.238	1072.668	1072.668
Operational margin	6.312	350.882	567.762	797.332	797.332
As % of total sales	0.844	31.273	37.952	42.638	42.638
Cost of finance	105.860	85.690	65.520	45.350	36.280
Gross profit	-99.548	265.192	502.242	751.982	761.052
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-99.548	265.192	502.242	751.982	761.052
Tax	0.000	106.077	200.897	300.793	304.421
Net profit	-99.548	159.115	301.345	451.189	456.631
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-99.548	159.115	301.345	451.189	456.631
Accumulated undistributed profit	-99.548	59.567	360.912	812.102	1268.733
Gross profit, % of total sales	-13.309	23.636	33.572	40.213	40.698
Net profit, % of total sales	-13.309	14.181	20.143	24.128	24.419
ROE, Net profit, % of equity	-7.892	12.614	23.889	35.768	36.200
ROI, Net profit+interest, % of invest.	0.257	9.951	14.778	19.840	19.696

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	1870.000	1870.000	1870.000	1870.000	1870.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1870.000	1870.000	1870.000	1870.000	1870.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1022.630	1022.630	1022.630	1022.630	915.930
Operational margin	847.370	847.370	847.370	847.370	954.070
As % of total sales	45.314	45.314	45.314	45.314	51.020
Cost of finance	27.210	18.140	9.070	0.000	0.000
Gross profit	820.160	829.230	838.300	847.370	954.070
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	820.160	829.230	838.300	847.370	954.070
Tax	328.064	331.692	335.320	338.948	381.628
Net profit	492.096	497.538	502.980	508.422	572.442
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	492.096	497.538	502.980	508.422	572.442
Accumulated undistributed profit	1760.829	2258.367	2761.347	3269.769	3842.211
Gross profit, % of total sales	43.859	44.344	44.829	45.314	51.020
Net profit, % of total sales	26.315	26.606	26.897	27.188	30.612
ROE, Net profit, % of equity	39.011	39.443	39.874	40.306	45.381
ROI, Net profit+interest, % of invest.	20.750	20.605	20.460	20.315	22.873

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	1870.000	1870.000	1870.000	1870.000	1870.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1870.000	1870.000	1870.000	1870.000	1870.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	844.430	844.430	844.430	844.430	844.430
Operational margin	1025.570	1025.570	1025.570	1025.570	1025.570
As % of total sales	54.843	54.843	54.843	54.843	54.843
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	1025.570	1025.570	1025.570	1025.570	1025.570
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1025.570	1025.570	1025.570	1025.570	1025.570
Tax	410.228	410.228	410.228	410.228	410.228
Net profit	615.342	615.342	615.342	615.342	615.342
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	615.342	615.342	615.342	615.342	615.342
Accumulated undistributed profit	4457.553	5072.895	5688.236	6303.578	6918.920
Gross profit, % of total sales	54.843	54.843	54.843	54.843	54.843
Net profit, % of total sales	32.906	32.906	32.906	32.906	32.906
ROE, Net profit, % of equity	48.782	48.782	48.782	48.782	48.782
ROI, Net profit+interest, % of invest.	24.588	24.588	24.588	24.588	24.588

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	883.540	2467.190
Fixed assets, net of depreciation	0.000	883.540
Construction in progress	883.540	1583.650
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	883.540	2467.190
Equity capital	610.000	1261.420
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	262.000	1129.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	11.540	76.770
Total debt	273.540	1205.770
Equity, % of liabilities	69.040	51.128

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Total assets	2422.363	2213.806	2240.385	2590.361	2933.617
Fixed assets, net of depreciation	2224.952	1982.714	1747.476	1519.238	1291.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	89.038	105.480	139.087	171.118	171.118
Cash, bank	8.825	4.058	4.904	5.221	5.221
Cash surplus, finance available	0.000	22.005	348.918	894.785	1466.279
Loss carried forward	0.000	99.548	0.000	0.000	0.000
Loss	99.548	0.000	0.000	0.000	0.000
Total liabilities	2422.363	2213.806	2240.385	2590.361	2933.617
Equity capital	1261.420	1261.420	1261.420	1261.420	1261.420
Reserves, retained profit	0.000	0.000	59.567	350.912	812.102
Profit	0.000	159.115	301.345	451.189	456.631
Long and medium term debt	941.625	754.250	566.875	453.500	340.125
Current liabilities	27.197	39.021	51.177	63.340	63.340
Bank overdraft, finance required.	192.121	0.000	0.000	0.000	0.000
Total debt	1160.943	793.271	618.052	516.840	403.465
Equity, % of liabilities	52.074	56.980	56.304	48.697	42.999

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	3312.339	3696.501	4086.107	4594.529	5166.971
Fixed assets, net of depreciation	1112.800	934.600	756.400	578.200	506.700
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	171.118	171.118	171.118	171.118	171.118
Cash, bank	5.221	5.221	5.221	5.221	5.221
Cash surplus, finance available	2023.200	2585.563	3153.368	3839.990	4483.932
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	3312.339	3696.502	4086.107	4594.529	5166.971
Equity capital	1261.420	1261.420	1261.420	1261.420	1261.420
Reserves, retained profit	1268.733	1760.829	2258.367	2761.347	3269.769
Profit	492.096	497.538	502.980	508.422	572.442
Long and medium term debt	226.750	113.375	0.000	0.000	0.000
Current liabilities	63.340	63.340	63.340	63.340	63.340
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	290.090	176.715	63.340	63.340	63.340
Equity, % of liabilities	38.082	34.125	30.871	27.455	24.413

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	5782.313	6397.654	7012.996	7628.338	8243.680
Fixed assets, net of depreciation	506.700	506.700	506.700	506.700	506.700
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	171.118	171.118	171.118	171.118	171.118
Cash, bank	5.221	5.221	5.221	5.221	5.221
Cash surplus, finance available	5099.274	5714.616	6329.958	6945.299	7560.641
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	5782.313	6397.654	7012.996	7628.338	8243.680
Equity capital	1261.420	1261.420	1261.420	1261.420	1261.420
Reserves, retained profit	3842.211	4457.553	5072.895	5688.236	6303.578
Profit	615.342	615.342	615.342	615.342	615.342
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	63.340	63.340	63.340	63.340	63.340
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	63.340	63.340	63.340	63.340	63.340
Equity, % of liabilities	21.815	19.717	17.987	16.536	15.302

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	907.38	907.00	0.38	210.00	697.00	0.35	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	907.38	907.00	0.38	210.00	697.00	0.35	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	2709.23	1185.73	1524.15	218.40	966.68	336.37	169.24
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	1025.30	1131.00	-106.70	210.00	922.00	23.10	-18.95
imported materials . . .	396.95	0.00	396.95	0.00	0.00	127.33	11.00
repayment loans & overd.	907.38	0.00	907.38	0.00	0.00	113.38	113.70
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	379.60	53.08	326.52	8.40	44.68	72.56	63.49
indirect costs							
net foreign exchge flow	-1801.85	-278.08	-1523.77	-8.40	-269.68	-336.01	-169.24
import substit'n effect	25806.00	0.00	25806.00	0.00	0.00	748.00	1122.00
net forgn exchge effect	24004.15	-278.08	24282.23	-8.40	-269.68	411.99	952.76

present values at	10.00 %
foreign exchange flow .	-1225.56
net forgn exchge effect	9960.06

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	0.01	0.02	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.01	0.02	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	183.84	180.78	169.99	160.92	151.85	142.77	20.33
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	1.38	1.73	0.00	0.00	0.00	0.00	0.00
imported materials . . .	14.66	20.33	20.33	20.33	20.33	20.33	20.33
repayment loans & overd.	113.38	113.38	113.38	113.38	113.38	113.38	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	54.42	45.35	36.28	27.21	18.14	9.07	0.00
indirect costs							
net foreign exchge flow	-183.83	-180.77	-169.99	-160.92	-151.85	-142.77	-20.33
import substit'n effect	1496.00	1870.00	1870.00	1870.00	1870.00	1870.00	1870.00
net forgn exchge effect	1312.17	1689.23	1700.02	1709.08	1718.16	1727.22	1849.67

present values at 10.00 %
foreign exchange flow . -1225.56
net forgn exchge effect 9960.06

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total foreign outflow .	20.33	20.33	20.33	20.33	20.33	20.33	-113.91
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-113.96
imported materials . . .	20.33	20.33	20.33	20.33	20.33	20.33	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.06
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net foreign exchge flow	-20.33	-20.33	-20.33	-20.33	-20.33	-20.33	113.91
import substit'n effect	1870.00	1870.00	1870.00	1870.00	1870.00	1870.00	0.00
net forgn exchge effect	1849.67	1849.67	1849.67	1849.67	1849.67	1849.67	113.91

present values at	10.00 %
foreign exchange flow .	-1225.56
net forgn exchge effect	9960.06

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE PRODUCTION OF PALM-OIL IN NIGERIA

PROJECT SF/NIR/88/001

baldo &c.

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing in addition to the existing ones, a plant for the production of palm oil.(1)

The proposed unit has a processing capacity of 36,000 tons of FFB (Fresh Fruit Bunches) per year producing 7,200 t/y of palm oil and 750 t/y of palmkernel oil. This output is based on 300 working days/y, 3 shifts/day, 8 hours/shift.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed Assets: US$ 3,585,400 (US$ 1,700,000 in foreign currency)
- Working capital (at full production): US$ 111,519 (US$ 9,667 in foreign currency)
- International Rate of Return: 27,94%
- Break-Even Point (at 5th year of production): 22%
- Pay-Back Period: little more than 5 years (including construction period)
- Employees: 79

On the basis of the analysis in this study, it is recommended that a feasibility study is undertaken.

1. INTRODUCTION

1.1 BACKGROUND

Oil palm fruit consists of two main parts, the kernel and the pulp surrounding the kernel. From both oil may be extracted. The oil content of the kernel is 40-50% by weight, while it ranges between 40 and 70% for the pulp, depending on the variety.

From a chemical point of view the palmkernel oil is different from the palm oil. In fact the former is mainly a lauric-acid oil while the latter is more rich in palmitic and oleic acid.

Palm and palmkernel oil are utilized in alimentary industries (margarine, vegetal butter) and in manufacturing of soaps, detergents, synthetic rubber, as well as edible oil.

(1) For additional background material see Volume 1 p. 54.

By products are utilized in soap manufacturing, in poultry and animal feed industries.

Presently, in Nigeria a lot of smallholders press their own palm fruits into oil by means of simple machinery. This results in a poor quality of the oil extracted (oxidation, not refined product), hence in rather low prices on the market.

Palmkernel are exported to the countries where oil will be extracted and traded as edible oils.

1.2 YIELDS IN NIGERIA

The climatic conditions of Nigeria are generally favourable to palm trees, that grow in the southern states of Oyo, Ogun, Lagos, Ondo, Bendel, Anambra, Imo, Rivers, Akwa-Ibom, Cross River and Benue.

The average yields for the Nigerian plantations are as follows:

A) For wild grove palm-trees, one hectare of land can produce about 2 tons of fresh fruit bunches (FFB) with 5% of kernel by weight.

The palm-oil extraction rate is 9%, that means 180 kg per hectare.

The kernel-oil extraction rate is about 40%, that means 40 kg per hectare.

B) For Government estates and smallholders plantations, one hectare can produce about 10 tons of FFB with 5% of kernel by weight.

The palm-oil extraction rate ranges between 15 and 20%, that means 1,500-2,000 kg per hectare.

The kernel-oil extraction rate is about 40%, i.e. 200 kg per hectare.

The above mentioned yields are rather low if compared with the ones of Malaysia, where selected cultivars of palm-trees reach a yield of 25 tons of FFB per hectare and more.

The main reasons which explain the low yields of the Nigerian oil-palm plantations are the noxious weeds, intercropping with food crops and some soil nutrients deficiencies.

2. MARKET AND PLANT CAPACITY

2.1 FORECAST DEMAND AND SUPPLY

According to the studies carried out by NIFOR (Nigerian Institute for Oil Palm Research) the estimated gap between supply and demand of palm oil will rise from about 200,000 tons in the year 1990 up to more than 400,000 tons per year in early 2000.

However, if the ongoing project (based on a feasibility study prepared by FAO in 1987) financed by the World Bank, to expand and improve palm plantations as well as producing capacity is successfully implemented, the projected supply gap will be reduced.

2.2 PLANT CAPACITY

The proposed plant has a capacity of 5 tons/hour of fresh fruit bunches (FFB), that is the lowest economic size for this type of plant, considering the investment and the production costs.

This plant should be operated 300 days per year over 3 daily shifts of 8 hours each.

On the basis of the above mentioned figures the yearly processing capacity will be 36,000 tons of FFB.

The palmkernel-oil extraction line has a processing capacity three times greater than the 250 kg/h of hulled kernel coming from the input of 5,000 kg/h of FFB, thus its capacity is not saturated. On the other hand the size of the kernel-oil extraction line is the minimum available on the market. This means that the plant could also process kernels coming from other oil-mills located nearby.

The yearly production of the plant is expected to be the following:

- palm-oil (refined)	7,200 tons/year
- palmkernel-oil (refined)	750 tons/year
- kernel-cake (by-product)	1,050 tons/year

The above figures relevant to the palmkernel-oil and kernel-cake have been calculated without considering any supply of kernel from external oil mills. The kernel-cake as by-product will be sold to the soap manufacturing industries.

2.3 SALES PRICES AND REVENUE

The Central Bank of Nigeria Annual Report and Statement of Accounts 1989, and a MArket Survey carried out by NIDB in August 1990 indicate the following selling prices.

- palm oil (refined)	8,100	Naira/ton
- kernel-oil (refined)	9,000	Naira/ton
- kernel cake	700	Naira/ton

These prices seem to be too high if compared with those related to the international market. Financial bullettins indicate the following:

- palm-oil (refined)	400	US Dollars/t
- kernel-oil (refined)	530	US Dollars/t

To be conservative, the revenue will be calculated on the following selling prices:

- palm-oil	500	US Dollars/t
- kernel-oil	600	US Dollars/t
- kernel-cake	80	US Dollars/t

- palm-oil (refined)	500	$/t x 7,200	T/y =	US$	3,600,000
- palmkernel-oil (refined)	600	$/t x 750	T/y =	US$	450,000
- kernel-cake:	80	$/t x 1,050	T/y =	US$	84,000
GRAND TOTAL				US$	4,134,000

3. MATERIALS AND INPUTS

3.1 MATERIALS BALANCE AND YIELDS

The production yields have been calculated considering the following average figures:

A) 100 kg of palm fruit pulp (separated from kernel) added with 50 kg of water and 0.5 kg of hydrochloric acid during the kneading stage give:

42.5 kg of palm-oil
41.8 kg of water
66.2 kg of wet solid panel

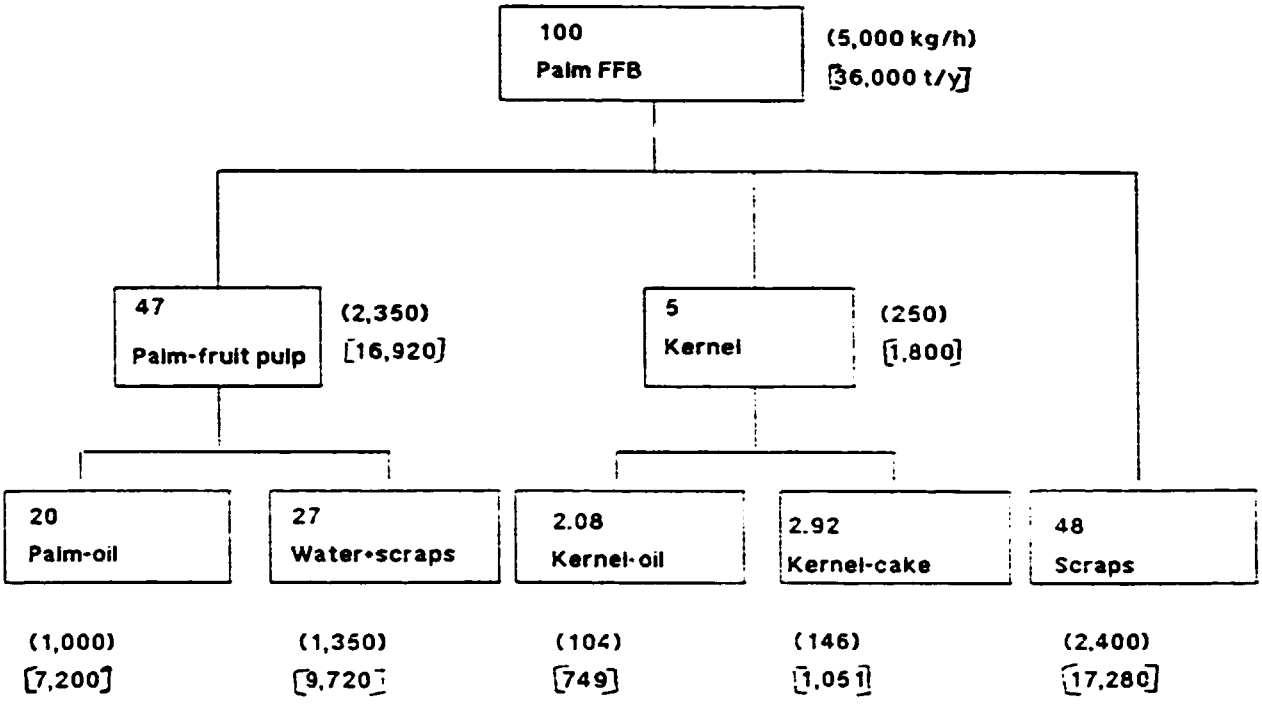
B) 100 kg of kernel added with 100 kg of water and 0.5 kg of hydrochloric acid during the kneading stage give:

41.6 kg of palmkernel-oil
60.9 kg of water
98.0 kg of wet solid panel

FBB are the raw material from which palm-oil and kernel-oil can be obtained. As said before, a project, sponsored by the World Bank is being implemented to expand plantations and increase the productivity. It can be anticipated that raw material will be available in sufficient quantity to make the plant operate without problems. Actually, the quantity needed for an annual production amounts to 36,000 tonnes, which is a negligible portion of the total production. The cost of the FFB is US$ 40/tonne.

Other materials are entering the process hydrochloric acid and water. Hydrochloric acid is commonly traded in Nigeria by importers at US$ 230/t.

These figures have been considered in drawing the following materials balance scheme, where the figures between round brackets refer to the hourly production of the envisaged plant in kilograms, whilst figures between square brackets refer to the annual production in tons.



3.2 SPECIFIC CONSUMPTIONS

The specific consumption per hour of raw material and utilities have been estimated as follows:

- FFB = 5 · -s/hour

A) For the palm oil extraction line:

- electric energy	90 kWh
- water	2 cu.m/hour
- hydrochloric acid	12.5 kg/hour
- fuel oil	70 kg/hour

B) For the palmkernel-oil extraction line:

- electric energy	95 kWh
- water	0.2 cu.m/hour
- hydrochloric acid	12.5 kg/hour
- fuel oil	1.0 kg/hour

3.3 MATERIALS AND UTILITIES: REQUIREMENTS AND COSTS

On the basis of the above mentioned data and considering 7,200 working hours per year (on the basis of 300 days x 24 hours/day), the materials and utilities required by the plant operating at 100% capacity, including consumption for the offices, are listed in the following table along with unit and annual costs.

Materials/utilities	unit cost	yearly consumption		annual cost $
Raw materials:				
. FFB	40 $/t	36,000	tons	1,440,000
. hydrochloric acid	230 $/t	92	tons	21,200
Containers:				
. 50 litres capacity	2.50 $/each	97,000		242,500
. 100 litres capacity	3.80 $/each	40,000		152,000
Utilities:				
. electric energy	0.10 $/kWh	810,000	kWh	81,000
. water	0.01 $/m3	30,000	m3	300
. fuel oil	30 $/t	533	tons	16,000
Total				1,953,000

As far as the packaging materials are concerned, plastic or metal containers have been considered, with capacity of 50 and 100 litres. It has been assumed that the whole kernel-oil and fifty per cent of the palm-oil produced will be packed into 50 litres containers, while the remaining fifty per cent of palm-oil will be packed into 100 litres containers.

4. LOCATION

The plant should be located in the area of oil-palm plantations, in a place that will be suitable considering the existing plants, the transport problems and the raw material availability. Water sources also have to be considered, either by river or by artesian well, when selecting the site for the plant.

Electric power will be supplied by the public main or by an autonomous gen-set of suitable size. Lastly the required manpower shall be possibly recruited in the neighbouring villages in order to allow the people to live with their own families.

5. PROJECT ENGINEERING

5.1 THE PROPOSED TECHNOLOGY FEATURES

The proposed technology is very simple and at the same time is the most up-dated and suitable to attain high yields in production and good oil quality. It prevents the damages usually encountered in the traditional processing of palm fruits as performed by the smallholders, namely:

- lowering of the oil characteristics and decay of the minor valuable components, due to oxidation phenomena which occur during the pre-heating phase carried out in oxygen atmosphere;

- partial loss of kernel-oil, which is the most valuable component, due to mixing of the palm-oil with the kernel oil during the pressing phase;

- a further oil quality loss during the decantation phase performed under oxidizing atmosphere, which results in a higher acidity grade.

The proposed plant will have such features that oil extracted, both from the fruit pulp and from the kernel, will not need any further refining stage. The oil quality is expected to be at the highest levels with regard to clearness, cleanness and low acidity grade.

5.2 PROCESS DESCRIPTION

The fresh fruit bunches are placed into suitable containers, which are introduced into a tunnel where they are sterilized by means of superheated steam.

This operation, which lasts about one hour, has the aim to kill parasites and to render inactive the endogenous enzymes such as lipase which breaks up fats causing oil to become acid. Furthermore this operation has the purpose to render fragile the fruit stalk in order to make easier its separation from the bunch.

The fruits are mechanically separated from the bunch (trashing) and kernel of each fruit is separated from the pulp. Trashes are sold to the soap manufacturing industries, that utilize the residual oil content.

a) The fruit pulp is homogenized in a kneading unit (digestor) under preset conditions of temperature, dilution, acidity and duration. These conditions are automatically adjusted during the working cycle. This operation lasts about 30 minutes at a temperature of 40 centigrades. During the digestion phase the cell walls break up releasing their oil content.

   From the kneading unit the mass is sent to the decanter where it is centrifugated and separated into a solid and a liquid (oil + water) phase. The oily phase passing through a vertical centrifuge is separated into a first palm-oil fraction. The aqueous phase also enters the centrifuge separating the dispersed oil fraction.

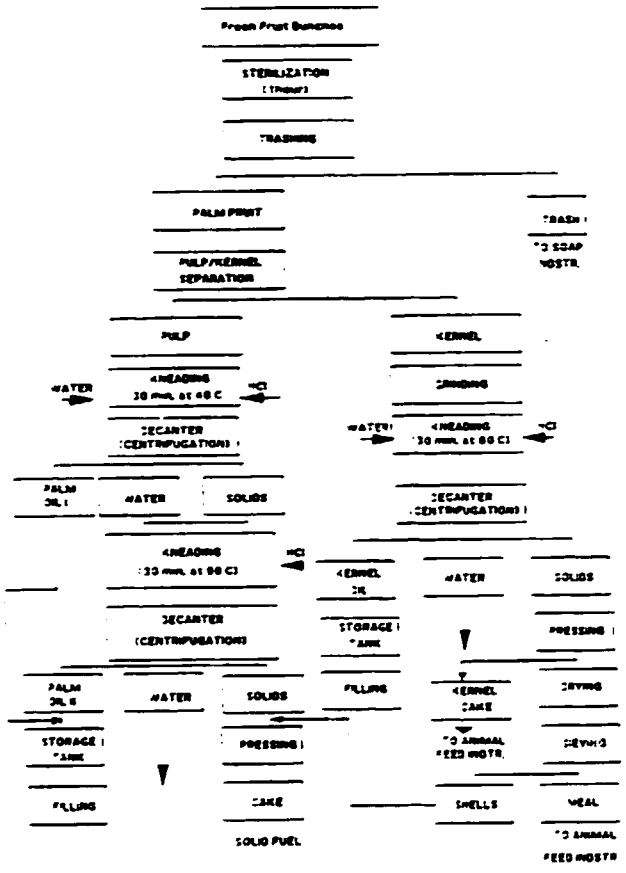
   At the same time the solid phase passes through a second kneading unit under preset conditions, which enables a second amount of oil to be extracted. This operation lasts about 30 minutes, at a temperature of 90 centigrades. The exhausted solid phase is pressed so as to remove the residual water and then dried in order to be utilized as solid fuel for heating water which will be added to the matter in the kneading stage.

b) As far as kernel processing is concerned, after separation from the fruit pulp, kernels are collected and ground in a hammer mill. Then a kneading phase takes place under preset conditions of temperature, dilution with water, pH and duration. This stage lasts 30 minutes at 80 centigrades. It is important to remark that kernels are processed without removing shells in order to achieve the highest yields in oil extraction.

Then the mass is fed to a decanter where the oily and aqueous phases are separated from the solid one. The oily phase by means of centrifugation produces a first quality of kernel-oil.

The aqueous phase also is centrifugated in the same vertical centrifuge, while the solid phase is pressed, dried and sieved to separate meal and shells. Such meal can be utilized as animal feed, shells can be used as solid fuel.

5.3 PROCESS FLOW-CHART (PALM-OIL & PALMKERNEL-OIL)



5.4 PACKAGING

It has been foreseen that the final products will be sold to the industries only (manufacturing margarine, detergents, etc.) in 50-100 litres containers and not to the small consumers. Furthermore it has been assumed that 50% of palm-oil produced will be packed in 50 litres containers and the remaining 50% into 100 litres containers. Palmkernel-oil will be packed in containers with capacity of 50 litres each. These containers will be plastic or metal drums, depending upon the availability on the local market. Considering a specific gravity of 0.9 for both, the volumes of palm-oil and palmkernel-oil produced are respectively 8,000,000 and 833,000 litres per year.

Two separate filling lines, manually operated, have been foreseen, one for palm-oil, the other for kernel-oil. Taking into account the above mentioned data the required containers will be as shown in the following table:

	50 l containers		100 l containers	
Product	Drums Nos	Filling rate drums/hour	Drums Nos	Filling rate drums/hour
Palm oil	80,000	12	40,000	6
Kernel-oil	16,700	3	-	-

The low filling rates of the table indicate that non-automatic filling lines will be sufficient to meet the production requirements. The filling rates have been calculated on the basis of 300 working days and 24 hours per day.

5.5 MAIN EQUIPMENT LIST

The production plant consists of two main lines, namely the palm-oil extraction line and the palmkernel-oil extraction line. For both the main plant machinery and equipment are listed here below.

A) Palm-oil extraction line:

. 2 metallic containers, capacity 2.5 tons each

. 1 sterilization tunnel

. 1 vertical screw conveyor

. 1 kernel separating machine

. 1 kneading unit

. 1 5-stage kneading unit

. 1 decanter

. 2 feeding pumps

. 2 vertical centrifuges

. 1 metal frame

. 1 horizontal screw conveyor

. 1 belt conveyor

. 5 stainless steel tanks, 30 cu.mt capacity each

. 2 transfer pumps

. 1 electric control panel

B) Palmkernel-oil extraction line:

. 3 vertical screw conveyors

. 1 hammer hill

. 1 3-stage grinding machine

. 1 horizontal screw conveyor

. 1 2-stage kneading unit

. 1 hydraulic lifting unit

. pressing machiine

. 1 horizontal centrifuge

. stainless steel tank, 20 cu. motors capacity, equipped with a transfer pump

. 1 electric control panel.

5.5.1 Laboratory

Equipment for the oil acidity test is required, whereas other analyses could be performed, when necessary, by the NIFOR's laboratories.

5.5.2 Maintenance workshop

A workshop is foreseen for the current mechanical and electrical maintenance. It will be equipped with the basic portable machines and hand tools (drilling and grinding machines, etc.).

5.5.3 Transport equipment

For internal handling of raw material containers and various purposes an electric fork-lift has been foreseen and a second one, diesel engine powered, for transportation in the open air.

5.6 UTILITIES

The plant needs steam for sterilization of the palm FFB and heating during the process. Water is necessary for the boiler to produce steam and for general purposes (drinkable water, toilets, showers, etc.). Some quantity of compressed air is needed for the maintenance workshop and for general purposes.

An emergency diesel generating set will be installed.

The utilities equipment is as follows:

- n. 1 steam generator, capacity 1,000 kg/hour of steam at 4 bar, complete with feed water softener;
- n. 1 compressed air station, capacity 15 cubic meters/hour at 7 bar;
- n. 1 gen-set 300 kVA, diesel engine powered, air cooled.

5.7 CIVIL WORKS AND BUILDINGS

The cost of the civil works, including the site preparation and development, will depend upon the conditions of the selected place (soil, water, deforestation, site grading, etc.). The process equipment, the utilities and facilities will be installed within a shed, while the administrative offices will be placed in a separate building.

The shed will have a steel structure with internal partitions and external walls made of sandwich-type panels. The office building will be made of masonry with reinforced concrete structure. The shed floor will be of concrete slabs, while the surrounding area will simply be rolled. A fence, made of a steel wire net supported by small steel poles, will enclose the entire factory area.

5.7.1 Required area

The covered area of the plant has been estimated as follows:

working shed	1,000	square meters
storehouse	450	square meters
workshop + lab	250	square meters
utilities	150	square meters
offices	150	square meters
shelter	600	square meters
TOTAL	2,600	square meters

The sheltered area has been foreseen for storage of empty containers placed on pallets, plastic film wrapped. Taking into account the additional area for open yard, roads, trucks loading/unloading and other needs, the total required area can be estimated at 10,000 square meters.

5.8 INVESTMENT COSTS

The estimated investment costs are shown in the following table. The machinery and equipment were quoted by PIERALISI, Ancona, Italy.

Description	Local currency $	Foreign currency $	Total $
Machinery & equipment (FOB European port)	-	1,300,000	1,300,000
Transport, taxes and duties	260,000	130,000	390,000
Erection	260,000	130,000	390,000
Land and site preparation	90,000	-	90,000
Civil works and buildings	950,000	-	950,000
Spare parts	-	30,000	30,000
TOTAL	**1,560,000**	**1,590,000**	**3,150,000**
Contingencies	**140,000**	**110,000**	**250,000**
GRAND TOTAL	**1,700,000**	**1,700,000**	**3,400,000**

The industrial life of the plant has been considered 15 years.

The maintenance costs are estimated at US$ 40,000.

In the financial evaluation the investment costs, contingencies included, are subdivided as follows:

Preproduction expenditures	FC	US$	0
Preproduction expenditures	LC	US$	80,000
Machinery	FC	US$	1,700,000
Machinery	LC	US$	600,000
Land and site preparation	LC	US$	100,000
Civil works and building	LC	US$	1,000,000

TOTAL		US$	3,480,000

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

In general, there is no need for special training, exception made for the production manager, who can attend training courses in the similar existing plants in Nigeria. For the other personnel it is recommended that the job training is carried out by one expert, made available by the technology supplier for one year after the start-up. The relevant cost is estimated at US$ 120,000.

7.1 MANAGEMENT

		Salary (Naira/year)
General Manager	1	50,000
Technical Manager	1	40,000
	2	90,000
		Overhead 40% 36,000
		126,000

7.2 ADMINISTRATION DEPT.

Financial manager	1	40,000
Accountants	2	24,000
Purchasing head	1	12,000
Store head	1	12,000
Sales dept. head	1	12,000
Clerks	3	36,000
Guards	6	36,000
Drivers	4	32,000
	19	204,000
		Overhead 40% 82,000
		284,000

7.3 PRODUCTION DEPT.

Production manager	1	40,000
Shift foremen (One each shift)	3	36,000
Analyst	2	20,000
Semiskilled workers (4 each shift)	12	72,000
Unskilled workers (11 each shift)	33	132,000
	51	300,000
	Overhead 40%	120,000
		420,000

7.4 MAINTENANCE DEPT.

Mechanics	4	40,000
Electricians	3	30,000
	7	70,000
	Overhead 40%	28,000
		98,000

7.5 SUMMARY

		ANNUAL Naira/y	COST $/y
Management & administr.	21	412,000	52,000
Production	51	420,000	53,000
Maintenance	7	98,000	12,000
GRAND TOTAL	79	930,000	117,000

8. IMPLEMENTATION SCHEDULE

Starting from the contract award, the time needed to design, build and start-up the plant is in the range of 18 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 3,585,400 US Dollars. The portion in foreign currency accounts for 1,700,000 US Dollars.

Details of these figures are shown in chapter 5.8.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,455,000	US$ 590,000	US$ 2,045,000
- Foreign Loan (interest 8%)	US$ 595,000	US$ 805,000	US$ 1,445,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 60%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 111,520 US Dollars.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US $ 90,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 60% of its nominal capacity, the production costs amount to US $ 1,864,480.

In the third year, at full production, the costs amount to US $ 2,502,700, then they start a slight decrease year after year, to reach a constant amount of US $ 2,110,000 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 4,134,000. As said before, the production programme foresees that full production is reached gradually:

1st year 60% : revenue = US$ 2,480,000

2nd year 80% : revenue = US$ 3,307,200

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 27.94%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 22%

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 6 years, including the construction period.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

PALM OIL
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1,000 US$

Total initial investment during construction phase

fixed assets:	3585.40	50.354 % foreign
current assets:	0.00	0.000 % foreign
total assets:	3585.40	50.354 % foreign

Source of funds during construction phase

equity & grants:	2045.00	0.000 % foreign
foreign loans :	1445.00	
local loans :	0.00	
total funds :	3490.00	41.404 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1432.88	2110.00	2110.00
depreciation :	316.00	296.00	50.00
interest :	115.60	57.80	0.00
production costs	1864.48	2463.80	2160.00
thereof foreign	22.24 %	9.85 %	0.69 %
total sales :	2480.40	4134.00	4134.00
gross income :	615.92	1670.20	1974.00
net income :	369.55	1002.12	1184.40
cash balance :	415.62	1117.49	1234.40
net cashflow :	711.85	1355.92	1234.40

Net Present Value at: 10.00 % = 5228.88
Internal Rate of Return: 27.94 %
Return on equity1: 31.69 %
Return on equity2: 34.56 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1,000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	100.000	0.000
Buildings and civil works	1000.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	900.000	1400.000
Total fixed investment costs	2000.000	1400.000
Pre-production capital expenditures.	63.800	121.600
Net working capital	0.000	0.000
Total initial investment costs	2063.800	1521.600
Of it foreign, in %	35.071	71.083

Total Current Investment in 1,000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	89.306	2.430	19.784
Total current investment costs	89.306	2.430	19.784
Of it foreign, %	25.904	0.000	9.772

Total Production Costs in 1,000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	864.000	1152.000	1440.000	1440.000	1440.000
Other raw materials	249.500	332.500	415.700	415.700	415.700
Utilities	9.780	13.040	16.300	16.300	16.300
Energy	48.600	64.800	81.000	81.000	81.000
Labour, direct	53.000	53.000	53.000	53.000	53.000
Repair, maintenance	15.000	20.000	25.000	25.000	25.000
Spares	9.000	12.000	15.000	15.000	15.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	1368.880	1647.340	2046.000	2046.000	2046.000
Administrative overheads	64.000	64.000	64.000	64.000	64.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	316.000	316.000	306.000	296.000	296.000
Financial costs	115.600	101.150	86.700	72.250	57.800
Total production costs	1864.480	2128.490	2502.700	2478.250	2463.800
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	22.237	13.303	10.856	10.380	9.855
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	117.000	117.000	117.000	117.000	117.000

Total Production Costs in 1,000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	1440.000	1440.000	1440.000	1440.000	1440.000
Other raw materials	415.700	415.700	415.700	415.700	415.700
Utilities	16.300	16.300	16.300	16.300	16.300
Energy	81.000	81.000	81.000	81.000	81.000
Labour, direct	53.000	53.000	53.000	53.000	53.000
Repair, maintenance	25.000	25.000	25.000	25.000	25.000
Spares	15.000	15.000	15.000	15.000	15.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	2046.000	2046.000	2046.000	2046.000	2046.000
Administrative overheads	64.000	64.000	64.000	64.000	64.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	280.000	280.000	280.000	280.000	50.000
Financial costs	43.350	28.900	14.450	0.000	0.000
Total production costs	2433.350	2418.900	2404.450	2390.000	2160.000
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	9.384	8.843	8.295	7.741	8.694
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	117.000	117.000	117.000	117.000	117.000

Total Production Costs in 1,000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	1440.000
Other raw materials	415.700
Utilities	16.300
Energy	81.000
Labour, direct	53.000
Repair, maintenance	25.000
Spares	15.000
Factory overheads	0.000
Factory costs	2046.000
Administrative overheads	64.000
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	2110.000
Costs per unit (single product)	0.000
Of it foreign, %	0.711
Of it variable,%	0.000
Total labour	117.000

Net Working Capital in 1,000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	119.407	142.612	175.833	175.833
Inventory and materials	8	42.5	26.407	35.195	44.000	44.000
Energy	1	360.0	0.135	0.180	0.225	0.225
Spares	180	2.0	4.500	6.000	7.500	7.500
Work in progress	1	360.0	3.802	4.576	5.683	5.683
Finished products	7	51.4	27.862	33.276	41.028	41.028
Cash in hand	15	24.0	10.875	6 208	6.542	6.542
Total current assets			192.987	228.047	280.811	280.811
Current liabilities and						
Accounts payable	30	* .1	103.682	136.312	169.292	169.292
Net working capital			89.306	91.735	111.519	111.519
Increase in working capital			89.306	2.430	19.784	0.000
Net working capital, local			66.172	84.002	101.853	101.853
Net working capital, foreign			23.133	7.733	9.667	9.667

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1,000 US$

Year	1990	1991
Equity, ordinary ..	1455.000	590.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	595.000	850.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	0.000
Total loan	595.000	850.000
Current liabilities	0.000	0.000
Bank overdraft	13.800	81.600
Total funds	2063.800	1521.600

Source of Finance, production in 1,000 US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-180.625	-180.625	-180.625	-180.625
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-180.625	-180.625	-180.625	-180.625
Current liabilities	103.682	32.630	32.980	0.000
Bank overdraft	-95.400	0.000	0.000	0.000
Total funds	-172.343	-147.995	-147.645	-180.625

Cashflow Tables, construction in 1,000 US$

Year	1990	1991
Total cash inflow . .	2050.000	1440.000
Financial resources .	2050.000	1440.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	2063.800	1521.600
Total assets	2040.000	1440.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	23.800	81.600
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-13.800	-81.600
Cumulated cash balance	-13.800	-95.400
Inflow, local	1455.000	590.000
Outflow, local	1340.000	440.000
Surplus (deficit) .	115.000	150.000
Inflow, foreign . . .	595.000	850.000
Outflow, foreign . . .	723.800	1081.600
Surplus (deficit) .	-128.800	-231.600
Net cashflow	-2040.000	-1440.000
Cumulated net cashflow	-2040.000	-3480.000

Cashflow tables, production in 1,000 US$

Year	2004	2005	2006
Total cash inflow	4134.000	4134.000	4134.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	4134.000	4134.000	4134.000
Total cash outflow	2919.600	2919.600	2919.600
Total assets	0.000	0.000	0.000
Operating costs	2110.000	2110.000	2110.000
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	809.600	809.600	809.600
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	1214.400	1214.400	1214.400
Cumulated cash balance	14060.390	15274.790	16489.190
Inflow, local	4134.000	4134.000	4134.000
Outflow, local	2904.600	2904.600	2904.600
Surplus (deficit)	1229.400	1229.400	1229.400
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	15.000	15.000	15.000
Surplus (deficit)	-15.000	-15.000	-15.000
Net cashflow	1214.400	1214.400	1214.400
Cumulated net cashflow	12640.990	13855.390	15069.790

Cashflow tables, production in 1,000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	2584.082	3340.155	4166.980	4134.000	4134.000	4134.000
Financial resources	103.682	32.955	32.980	0.000	0.000	0.000
Sales, net of tax	2480.400	3307.200	4134.000	4134.000	4134.000	4134.000
Total cash outflow	2168.460	2499.984	3082.609	3025.175	3016.505	3014.235
Total assets	192.987	35.060	52.764	0.000	0.000	0.000
Operating costs	1432.880	1711.340	2110.000	2110.000	2110.000	2110.000
Cost of finance	115.600	101.150	86.700	72.250	57.800	43.350
Repayment	180.625	180.950	180.625	180.625	180.625	180.625
Corporate tax	246.368	471.484	652.520	662.300	668.080	680.260
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	415.621	840.171	1084.371	1108.825	1117.495	1119.765
Cumulated cash balance	320.221	1160.393	2244.764	3353.589	4471.083	5590.849
Inflow, local	2583.723	3340.155	4166.972	4134.000	4134.000	4134.000
Outflow, local	1719.743	2221.609	2798.343	2757.300	2763.080	2775.260
Surplus (deficit)	863.980	1118.546	1368.629	1376.700	1370.920	1358.740
Inflow, foreign	0.358	0.000	0.008	0.000	0.000	0.000
Outflow, foreign	448.717	278.375	284.267	267.875	253.425	238.975
Surplus (deficit)	-448.358	-278.375	-284.258	-267.875	-253.425	-238.975
Net cashflow	711.846	1121.946	1351.696	1361.700	1355.920	1343.740
Cumulated net cashflow	-2768.154	-1646.207	-294.511	1067.188	2423.108	3766.848

Cashflow tables, production in 1,000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	4134.000	4134.000	4134.000	4134.000	4134.000	4134.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	4134.000	4134.000	4134.000	4134.000	4134.000	4134.000
Total cash outflow	3005.565	2996.895	2807.600	2899.600	2919.600	2919.600
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	2110.000	2110.000	2110.000	2110.000	2110.000	2110.000
Cost of finance	28.900	14.450	0.000	0.000	0.000	0.000
Repayment	180.625	180.625	0.000	0.000	0.000	0.000
Corporate tax	686.040	691.820	697.600	789.600	809.600	809.600
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1128.435	1137.105	1326.400	1234.400	1214.400	1214.400
Cumulated cash balance	6719.284	7856.389	9182.789	10417.190	11631.590	12845.990
Inflow, local	4134.000	4134.000	4134.000	4134.000	4134.000	4134.000
Outflow, local	2781.040	2786.820	2792.600	2884.600	2904.600	2904.600
Surplus (deficit)	1352.960	1347.180	1341.400	1249.400	1229.400	1229.400
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	224.525	210.075	15.000	15.000	15.000	15.000
Surplus (deficit)	-224.525	-210.075	-15.000	-15.000	-15.000	-15.000
Net cashflow	1337.960	1332.180	1326.400	1234.400	1214.400	1214.400
Cumulated net cashflow	5104.809	6436.988	7763.388	8997.788	10212.190	11426.590

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	4572.29	at	10.00 %
Internal Rate of Return (IRRE1) ..	31.69 %		

b) Net Worth versus Net cash return:

Net present value	5360.50	at	10.00 %
Internal Rate of Return (IRRE2) ..	34.56 %		

c) Internal Rate of Return on total investment:

Net present value	5228.88	at	10.00 %
Internal Rate of Return (IRR) ..	27.94 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1,000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	2480.400	3307.200	4134.000	4134.000	4134.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	2480.400	3307.200	4134.000	4134.000	4134.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1748.880	2027.340	2416.000	2406.000	2406.000
Operational margin	731.520	1279.860	1718.000	1728.000	1728.000
As % of total sales	29.492	38.699	41.558	41.800	41.800
Cost of finance	115.600	101.150	86.700	72.250	57.800
Gross profit	615.920	1178.710	1631.300	1655.750	1670.200
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	615.920	1178.710	1631.300	1655.750	1670.200
Tax	246.368	471.484	652.520	662.300	668.080
Net profit	369.552	707.226	978.780	993.450	1002.120
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	369.552	707.226	978.780	993.450	1002.120
Accumulated undistributed profit	369.552	1076.778	2055.558	3049.008	4051.128
Gross profit, % of total sales	24.831	35.641	39.461	40.052	40.402
Net profit, % of total sales	14.899	21.384	23.676	24.031	24.241
ROE, Net profit, % of equity	18.071	34.583	47.862	48.579	49.003
ROI, Net profit+interest, % of invest.	13.592	22.633	29.667	29.673	29.512

Net Income Statement in 1,000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	4134.000	4134.000	4134.000	4134.000	4134.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4134.000	4134.000	4134.000	4134.000	4134.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2390.000	2390.000	2390.000	2390.000	2160.000
Operational margin	1744.000	1744.000	1744.000	1744.000	1974.000
As % of total sales	42.187	42.187	42.187	42.187	47.750
Cost of finance	43.350	28.900	14.450	0.000	0.000
Gross profit	1700.650	1715.100	1729.550	1744.000	1974.000
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1700.650	1715.100	1729.550	1744.000	1974.000
Tax	680.260	686.040	691.820	697.600	789.600
Net profit	1020.390	1029.060	1037.730	1046.400	1184.400
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1020.390	1029.060	1037.730	1046.400	1184.400
Accumulated undistributed profit	5071.518	6100.578	7138.308	8184.708	9369.107
Gross profit, % of total sales	41.138	41.488	41.837	42.187	47.750
Net profit, % of total sales	24.683	24.893	25.102	25.312	28.650
ROE, Net profit, % of equity	49.897	50.321	50.745	51.169	57.917
ROI, Net profit+interest, % of invest.	29.618	29.457	29.296	29.135	32.978

Net Income Statement in 1,000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	4134.000	4134.000	4134.000	4134.000	4134.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4134.000	4134.000	4134.000	4134.000	4134.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2110.000	2110.000	2110.000	2110.000	2110.000
Operational margin	2024.000	2024.000	2024.000	2024.000	2024.000
As % of total sales	48.960	48.960	48.960	48.960	48.960
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	2024.000	2024.000	2024.000	2024.000	2024.000
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2024.000	2024.000	2024.000	2024.000	2024.000
Tax	809.600	809.600	809.600	809.600	809.600
Net profit	1214.400	1214.400	1214.400	1214.400	1214.400
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1214.400	1214.400	1214.400	1214.400	1214.400
Accumulated undistributed profit	10583.510	11797.910	13012.310	14226.710	15441.110
Gross profit, % of total sales	48.960	48.960	48.960	48.960	48.960
Net profit, % of total sales	29.376	29.376	29.376	29.376	29.376
ROE, Net profit, % of equity	59.384	59.384	59.384	59.384	59.384
ROI, Net profit+interest, % of invest.	33.813	33.813	33.813	33.813	33.813

Projected Balance Sheets, construction in 1,000 US$

Year	1990	1991
Total assets	2063.800	3585.400
Fixed assets, net of depreciation	0.000	2063.800
Construction in progress	2063.800	1521.600
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	2063.800	3585.400
Equity capital	1455.000	2045.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	595.000	1445.000
Current liabilities	0.000	0.000
Bank overdraft, finance required	13.800	95.400
Total debt	608.800	1540.400
Equity, % of liabilities	70.501	57.037

Projected Balance Sheets, Production in 1,000 US$

Year	1992	1993	1994	1995	1996
Total assets	3782.609	4341.839	5172.974	5985.799	6807.294
Fixed assets, net of depreciation	3269.400	2953.400	2647.400	2351.400	2055.400
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	182.112	221.839	274.269	274.269	274.269
Cash, bank	10.875	6.208	6.542	6.542	6.542
Cash surplus, finance available	320.221	1160.393	2244.763	3353.588	4471.083
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	3782.609	4341.839	5172.974	5985.799	6807.294
Equity capital	2045.000	2045.000	2045.000	2045.000	2045.000
Reserves, retained profit	0.000	369.552	1076.778	2055.558	3049.008
Profit	369.552	707.226	978.780	993.450	1002.120
Long and medium term debt	1264.375	1083.750	903.125	722.500	541.875
Current liabilities	103.682	136.312	169.292	169.292	169.292
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1368.057	1220.062	1072.417	891.792	711.167
Equity, % of liabilities	54.063	47.100	39.532	34.164	30.041

Projected Balance Sheets, Production in 1,000 US$

Year	1997	1998	1999	2000	2001
Total assets	7647.059	8495.495	9352.600	10399.000	11583.400
Fixed assets, net of depreciation	1775.400	1495.400	1215.400	935.400	885.400
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	274.269	274.269	274.269	274.269	274.269
Cash, bank	6.542	6.542	6.542	6.542	6.542
Cash surplus, finance available	5590.848	6719.284	7856.389	9182.789	10417.190
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	7647.059	8495.495	9352.600	10399.000	11583.400
Equity capital	2045.000	2045.000	2045.000	2045.000	2045.000
Reserves, retained profit	4051.128	5071.518	6100.578	7138.308	8184.708
Profit	1020.390	1029.060	1037.730	1046.400	1184.400
Long and medium term debt	361.250	180.625	0.000	0.000	0.000
Current liabilities	169.292	169.292	169.292	169.292	169.292
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	530.542	349.917	169.292	169.292	169.292
Equity, % of liabilities	26.742	24.072	21.866	19.665	17.655

Projected Balance Sheets, Production in 1,000 US$

Year	2002	2003	2004	2005	2006
Total assets	12797.800	14012.200	15226.600	16441.000	17655.400
Fixed assets, net of depreciation	885.400	885.400	885.400	885.400	885.400
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	274.269	274.269	274.269	274.269	274.269
Cash, bank	6.542	6.542	6.542	6.542	6.542
Cash surplus, finance available	11631.590	12845.990	14060.390	15274.790	16489.190
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	12797.800	14012.200	15226.600	16441.000	17655.400
Equity capital	2045.000	2045.000	2045.000	2045.000	2045.000
Reserves, retained profit	9369.107	10583.510	11797.910	13012.310	14226.710
Profit	1214.400	1214.400	1214.400	1214.400	1214.400
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	169.292	169.292	169.292	169.292	169.292
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	169.292	169.292	169.292	169.292	169.292
Equity, % of liabilities	15.979	14.594	13.430	12.438	11.583

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATIONS

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR A COCOA PROCESSING PLANT IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for processing cocoa. The envisaged plant has a nominal processing capacity of 10,000 tons of cocoa beans per year, with an output of 4,130 tons of cocoa powder and 3,860 tons of cocoa butter.(1)

The plant will be operated 300 days per year, over 3 shifts - 8 hours each. The financial analysis of such as a project was carried out. Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed Assets: US$ 11,548,470 (US$ 6,680,790 in foreign currency)
- Working capital (at full production) US$ 2,233,799
- Internal Rate of Return : 22.55%
- Break-Even Point (at 5th year of production): 27%
- Pay-Back Period: less than 6 years (including construction period)
- Employees: 56

The evaluation of the foreign exchange effect was also carried out.

It shows a net inflow of US$ 96,724,590 (as present value at 10%).

On the basis of the analysis in this study and in consideration that the Federal Government recently decided that as from January 1991 the export of cocoa beans is banned, it is recommended that a feasibility study is undertaken.

1. INTRODUCTION

Cocoa is a tropical tree, present in Nigeria, with two main varieties, namely "Amelonado" and "Amazon F3". Almost 90% of the land cultivated with cocoa in Nigeria is located in the dry forest area, i.e. in Ogun, Oyo, Ondo and Bendel States; a small percentage is located in Mid-Western and in Eastern Nigeria.

The average yield in Nigeria is 250-300 kg of dry beans per hectare, against 600-700 kg/ha from Amelonado variety reached under ideal farming conditions.

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(1) For additional background material see Volume I p. 88.

In 1988 the production of cocoa beans was around 130,000 tons. The major part of the production was exported as cocoa beans, in spite of the fact that three cocoa processing plants, with a combined capacity of 80,000 t/y are installed in Nigeria. They are:

- Cocoa Industries Ltd. (Ikeja - Lagos) established in 1967 with a nominal capacity of processing 30,000 t/y of beans,
- Cocoa Products Industry Ltd. (Ede - Oyo State) established in 1982 with a nominal capacity of processing 26,000 t/y of beans,
- Ile-Oluji Cocoa Products Co. Ltd (Ile Oluji - Ondo State) established in 1984 with a nominal capacity of processing 20,000 t/y of beans.

Two reasons justify the preference of cocoa beans producers for export:

a) they are paid in foreign currency

b) the existing plants are not able to exploit their capacity, because of lack of spare parts, inadequate maintenance and lack of working capital. It is therefore recommended to consider the installation of a new plant to increase the processing capacity in the country, also in view of the fact that as from January 1992, as decided by the Government, the export of cocoa beans is banned.

2. MARKET AND PLANT CAPACITY

2.1 MARKET DEMAND AND SUPPLY

Cocoa beans are quoted on the international market. In April 1990 the price was US$ 950/t and the forecast for the end of the year is US$ 1000/t. Most of the world production is consumed in the countries which produce chocolate, cocoa powder and cocoa butter: U.S.A. and West Germany import 20% each, U.S.S.R. and Holland 15%, United Kingdom 8%, Japan and Europe about 20%.

As far as Nigeria is concerned, the production of cocoa beans has been dropping constantly and dramatically from 1981 until early 1986. The negative trend changed during 1986-1987. The beans export followed the same course, reaching a minimum in 1985-1986.

Official data are not available, with regard to the domestic demand of cocoa products. The extracted raw cocoa butter is almost entirely exported. A small part of cocoa powder is transformed into soluble products by adding sugar and powder milk and sold as such on the domestic market; the balance is exported.

2.2 PLANT CAPACITY

The proposed plant will produce cocoa butter and cocoa powder. Taking into account a yearly input of 10,000 tons of cocoa beans, the expected output will be 4,130 tons of cocoa powder and 3,860 tons of cocoa butter.

This production is based on 300 working days at 24 hours per day, including 4 hours each day for cleaning and maintenance.

2.3 SALE PRICES AND REVENUES

The sale prices considered in the present study are the following:

- cocoa butter	=	3,300	$/ton
- cocoa powder	=	700	$/ton

Therefore, the expected annual revenue at full plant capacity would be:

- cocoa butter:	3,860 tons x 3,300 $/t	=	US$ 12,738,000
- cocoa powder:	4,130 tons x 790 $/t	=	US$ 3,262,700

TOTAL			US$ 16,000,700

The above mentioned sale prices have been assumed according to the international quotation as of September 1990.

3. MATERIALS AND INPUTS

3.1 AVAILABILITY AND COST

The raw material needed by the plant are cocoa beans. Raw material will be available in large quantities, especially after January 1991, when the export of cocoa beans will be banned. The cost considered is US $ 1,000/t. Auxiliary materials needed are the packaging materials for the final products (paper bags and cartons). They are available in Nigeria and their cost is estimated 2.5% of the total revenue.

Other inputs are electric energy, fuel, water.

3.2 RAW MATERIALS AND UTILITIES

The following table shows the yearly raw materials and utilities consumption, the unit and total cost, all in local currency.

Description	unit	annual consumption	Unit cost $	Total cost $
Cocoa beans	t	10,000	1000	1,000,000
Packaging				400,000
1 Sub-total: raw materials				**10,400,000**
Electric energy	KWh	2,800,000	0.10	280,000
Fuel oil	t	400	30	12,000
Water	m3	50,000	0.006	300
2 Sub-total : utilities				**292,300**
Grand total (1 + 2)				**10,692,300**

4. LOCATION

The plant should be located either in the Ondo or in Oyo State, where the largest plantations of cocoa are located. The most suitable place is near the town of Akure (Ondo State), which produces about 60% of the whole cocoa beans of Nigeria.

The continuous increase of plantations will assure the supply of raw material to the new plant. Other important advantages coming from the suggested location are the municipality services and facilities as water, electricity, roads and transportation means.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

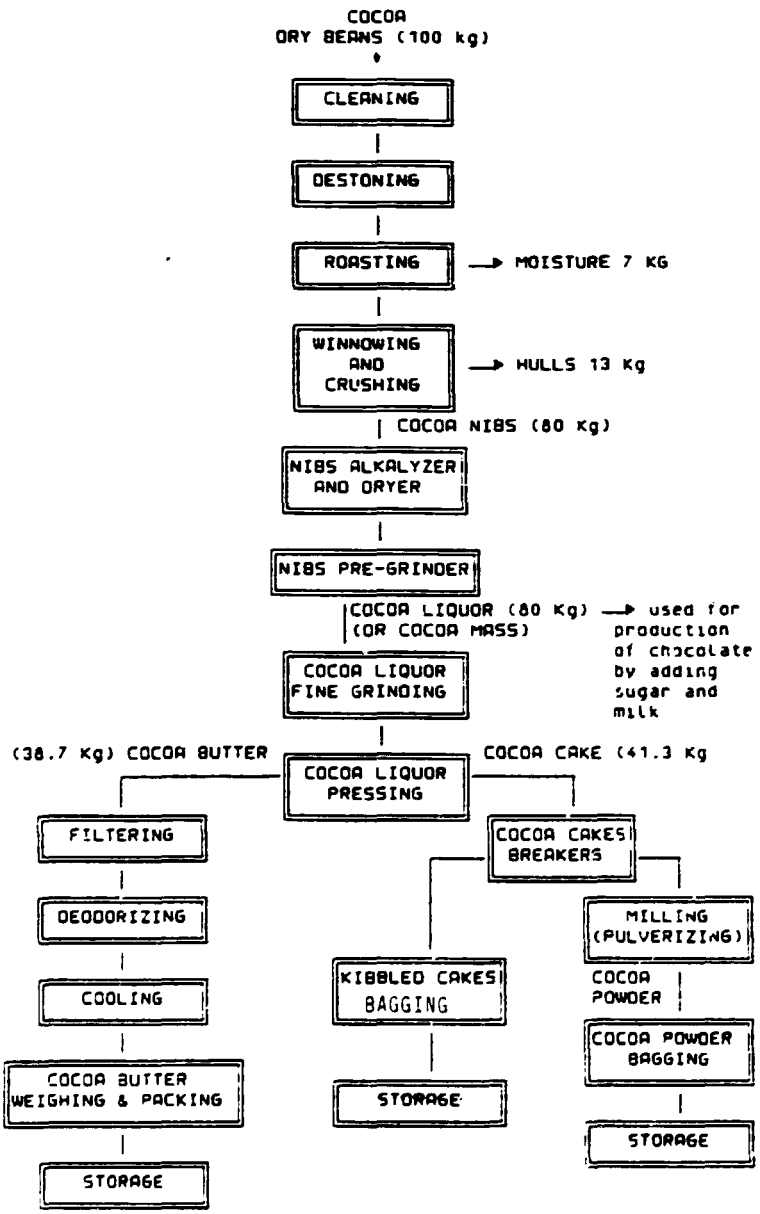
Cocoa beans are placed for 3 to 10 days into special tanks where natural fermentation takes place, reaching a temperature of about 45 C in the mass. This has the aim of developing the aroma of the beans and of facilitating the hull separation. Then cocoa beans are dried in the sun, cleaned and destoned before roasting at 120-140 centigrades.

The next stages of winnowing and breaking give the cocoa nibs; the "cocoa liquor", also called "cocoa mass", is obtained by grinding the nibs.

Cocoa liquor (mass) by means of mechanical pressure produces the cocoa butter and the cake. Cocoa butter is filtered, deodorized, cooled and packed. The cake may be either ground to give kibbled cake or milled to be turned into cocoa powder. Cocoa nibs are mixed with a small percentage of potassium carbonate (alkalyzer) in order to obtain a darkner colour for the cocoa powder.

Cocoa liquor is used to produce chocolate by adding sugar, milk and other ingredients. Cocoa hulls (scraps) are used as livestock food or as manure. They are also utilized as source of theobromine, fat and vitamine D. The following flow-diagram shows the main steps and products of the cocoa process.

COCOA PROCESSING FLOW-DIAGRAM



5.2 LAY-OUT AND CIVIL WORKS

The area required for the whole plant, including open yard, roads, truck loading/unloading area, is about 10,000 square meters. Out of these the covered area is 4,000 square meters split as follows:

Working shed	2,000 square meters
Storehouse	800 square meters
Cool room (18 C)	500 square meters
Workshop	300 square meters
Utilities	200 square meters
Offices	200 square meters
TOTAL	4,000 square meters

Administrative offices and lab building will be of reinforced concrete with external and internal walls of brickwork. Working shed as storehouse will have a steel structure with roof and cladding made of corrugated asbestos sheets.

A fencing wire net will surround the whole factory. The cool room air-conditioned at 18 centigrades will be utilized to store the blocks of cocoa liquor and cocoa butter.

5.3 MAIN EQUIPMENT LIST

The main machinery and equipment of the cocoa beans processing plant is the following:

A) Cocoa beans and nibs treatment

1 cocoa beans cleaning and destoning machine

1 pre-treatment machine

1 winnowing and crushing unit

1 hull conveying system

1 pneumatic feeding system

1 roasting unit

1 cooler

1 pneumatic discharging system

1 automatic control system

B) Cocoa liquor treating unit

3 cocoa liquor pre-grinders

1 cocoa liquor tanks

3 cocoa liquor refiners

4 cocoa liquor tanks

1 cocoa liquor blocking off unit

1 control system

C) Cocoa butter unit

2 cocoa butter presses

2 butter weighing system

2 filter-press

2 cocoa butter tanks

1 cocoa butter blocking off

D) Cocoa kibbled cake unit

1 cocoa cake crushers

dosing and sacking unit (paper sacks)

5.3.1 Utilities

The plant needs the following utility equipment:

- 2 (1+1 stand-by) steam boilers, 300 kg/h capacity at 6 bar, complete with feed water softner

- 1 air compressor, 25 m^3/h at 7 bar

- 1 gen-set 500 kVA, diesel engine powered.

5.3.2 **Laboratory**

A minimum equipment for carrying out tests and analyses on the raw materials and products is provided for the determination of the bacteriological charge and of the pH value.

5.3.3 **Maintenance workshop**

A workshop is provided for the curreat mechanical and electrical maintenance operation.

5.3.4 **Transport equipment**

An electric fork-lift is provided for the internal handling. A Diesel-engine fork-lift is provided for the external handling.

5.4 INVESTMENT COSTS

The estimated investment costs are shown in the following table.

The machinery and equipment have been quoted by G.W. BARTH, Germany.

Description	Foreign Currency $	Local Currency $	Total $
Machinery and equipment	5,100,000	---	5,100,000
Transport, taxes and duties	510,000	1,020,000	1,530,000
Erection	510,000	1,020,000	1,530,000
Land and site preparation	---	100,000	100,000
Civil works and buildings	---	2,000,000	2,000,000
Spare parts	150,000	---	150,000
TOTAL	5,760,000	4,040,000	9,800,000
Contingencies	576,000	404,000	980,000
GRAND TOTAL	6,336,000	4,444,000	10,780,000

The industrial life of the plant has been considered 15 years. In the financial evaluation the investment cost, including contingencies, are so subdivided:

Preproduction expenditures	FC	US$	0
Preproduction expenditures	LC	US$	200,000
Machinery	FC	US$	6,336,000
Machinery	LC	US$	2,244,000
Land & Site preparation	LC	US$	110,000
Civil works and buildings	LC	US$	2,090,000
TOTAL		US$	10,980,000

The annual expenditures for maintenance are estimated US$ 150,000.

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

The personnel required and the relevant salaries are shown herebelow.

The production personnel does not need special training abroad. It is recommended that on the job training is carried out by one expert, made available by the technology supplier, for one year after the start-up. The relevant cost is estimated US$ 120,000.

7.1 MANAGEMENT

		Salary (Naira/year)
General manager	1	50,000
Technical manager	1	40,000
	2	90,000
	Overhead 40%	36,000
		126,000

7.2 ADMINISTRATIVE DEPT.

		Salary (Naira/year)
Financial manager	1	40,000
Accountants	2	24,000
Purchasing head	1	12,000
Store head	1	12,000
Sales dept. head	1	12,000
Clerks	3	36,000
Guards	6	36,000
Drivers	4	32,000
	19	204,000
	Overhead 40%	81,600
		285,600

7.3 PRODUCTION DEPT.

		Salary (Naira/year)
Production manager	1	40,000
Shift foremen (1 each shift)	3	36,000
Lab chief	1	25,000
Lab staff	2	20,000
Semiskilled workers (6 each shift)	18	108,000
	25	229,000
	Overhead 40%	91,600
		320,600

7.4 MAINTENANCE DEPT.

		Salary (Naira/year)
Mechanics	6	60,000
Electricians	4	40,000
	10	100,000
	Overhead 40%	40,000
		140,000

7.5 SUMMARY

		Salary (Naira/year)	$/y
Management & Administr.	21	411,600	52,000
Production	25	320,600	40,600
Maintenance	10	140,000	17,700
GRAND TOTAL	56	872,000	110,300

8. IMPLEMENTATION SCHEDULE

From the signing of the contract 24 months are required for the construction and commissioning of the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 11,548,470 US Dollars. The portion in foreign currency accounts for 6,700,000 US Dollars.

Details of these figures are shown in chapter 5.4

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 2,000,000	US$ 2,000,000	US$ 4,000,000
- Foreign Loan (interest 8%)	US$ 1,615,000	US$ 3,770,000	US$ 5,385,000
- Local Loan (interest 15%)	US$ 695,000	US$ 900,000	US$ 1,595,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 60%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 2,233,799 US Dollars.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plan· This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US $ 1,358,000, of which US $ 40,444 in F.C.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 60% of its nominal capacity, the production costs amount to US $ 8,464,625.

In the third year, at full production, the costs amount to US $ 12,413,420, then they start a slight decrease year after year, to arrive to be constant to US $ 11,056,800 from the 11th to 15th year.

9.1.5 Sales revenue .

When the plant is in full production, the revenue is US $ 16,000,700. As said before, the production programme foresees that full production is reached gradually:

1st year 60% : revenue = US$ 9,600,420

2nd year 80% : revenue = US$ 12,800,560

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 22.55%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 27% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 6 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly exported quantities and value have been assumed equal to the production programme.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 96,724,590.

Hence, the amount of foreign exchange earned by implementing this project is such that after having repaid the foreign loan and related interests, there is a surplus which in term of present value amounts to US$ 96,724,590.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

COCOA PROCESSING PLANT
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: '000 US$

Total initial investment during construction phase

fixed assets:	11548.47	57.848 % foreign
current assets:	0.00	0.000 % foreign
total assets:	11548.47	57.848 % foreign

Source of funds during construction phase

equity & grants:	4000.00	0.000 % foreign
foreign loans :	5385.00	
local loans :	1595.00	
total funds :	10980.00	49.044 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	6725.30	10952.30	10952.30
depreciation :	1069.27	1047.27	104.50
interest :	670.05	215.40	0.00
production costs	8464.63	12214.98	11056.80
thereof foreign	14.46 %	7.56 %	0.68 %
total sales :	9600.42	16000.70	16000.70
gross income :	1135.79	3785.72	4943.90
net income :	681.48	2271.43	2966.34
cash balance :	-812.11	2645.58	3070.84
net cashflow :	1062.73	3534.11	3070.84

Net Present Value at: 10.00 % = 10882.85
Internal Rate of Return: 22.53 %
Return on equity1: 36.00 %
Return on equity2: 30.28 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	110.000	0.000
Buildings and civil works	1500.000	590.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	2600.000	5980.000
Total fixed investment costs	4210.000	6570.000
Pre-production capital expenditures.	216.725	551.750
Net working capital	0.000	0.000
Total initial investment costs	4426.725	7121.750
Of it foreign, in %	46.639	64.816

Total Current Investment in 1000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	1358.071	431.939	443.789
Total current investment costs	1358.071	431.939	443.789
Of it foreign, %	2.978	0.000	2.122

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	6000.000	8000.000	10000.000	10000.000	10000.000
Other raw materials	240.000	320.000	400.000	400.000	400.000
Utilities	175.000	233.000	292.000	292.000	292.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	40.600	40.600	40.600	40.600	40.600
Repair, maintenance	40.000	60.000	75.000	75.000	75.000
Spares	40.000	60.000	75.000	75.000	75.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	6655.600	8713.600	10882.600	10882.600	10882.600
Administrative overheads	69.700	69.700	69.700	69.700	69.700
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1069.275	1069.275	1058.275	1047.275	1047.275
Financial costs	670.050	536.450	402.850	269.250	215.400
Total production costs	8464.625	10389.020	12413.420	12268.820	12214.970
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	14.465	10.305	8.311	7.970	7.564
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	110.300	110.300	110.300	110.300	110.300

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001- 6
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	10000.000	10000.000	10000.000	10000.000	10000.000
Other raw materials	400.000	400.000	400.000	400.000	400.000
Utilities	292.000	292.000	292.000	292.000	292.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	40.600	40.600	40.600	40.600	40.600
Repair, maintenance	75.000	75.000	75.000	75.000	75.000
Spares	75.000	75.000	75.000	75.000	75.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	10882.600	10882.600	10882.600	10882.600	10882.600
Administrative overheads	69.700	69.700	69.700	69.700	69.700
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	962.500	962.500	962.500	962.499	104.500
Financial costs	161.550	107.700	53.850	0.000	0.000
Total production costs	12076.350	12022.500	11968.650	11914.800	11056.800
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	7.205	6.790	6.370	5.947	0.573
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	110.300	110.300	110.300	110.300	110.300

Net Working Capital in 1000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	560.442	731.942	912.692	912.692
Inventory and materials	57	6.3	1013.958	1351.931	1689.944	1689.944
Energy	0	---	0.000	0.000	0.000	0.000
Spares	180	2.0	20.000	30.000	37.500	37.500
Work in progress	1	360.0	18.488	24.204	30.229	30.229
Finished products	15	24.2	273.999	363.637	453.429	453.429
Cash in hand	15	24.0	12.929	9.596	10.846	10.846
Total current assets			1899.816	2511.310	3134.641	3134.641
Current liabilities and						
Accounts payable	30	12.1	541.744	721.300	900.842	900.842
Net working capital			1358.071	1790.010	2233.799	2233.799
Increase in working capital			1358.071	431.939	443.789	0.000
Net working capital, local			1317.627	1752.343	2186.715	2186.715
Net working capital, foreign			40.444	37.667	47.083	47.083

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	2000.000	2000.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1615.000	3770.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	695.000	900.000
Loan C, local....	0.000	0.000
Total loan	2310.000	4670.000
Current liabilities	0.000	0.000
Bank overdraft	116.725	451.750
Total funds	4426.725	7121.750

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-673.125	-673.125	-673.125	-673.125
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	-531.667	-531.667	-531.667	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-1204.792	-1204.792	-1204.792	-673.125
Current liabilities	541.744	179.556	179.542	0.000
Bank overdraft	812.110	-863.625	-516.960	0.000
Total funds	149.063	-1888.861	-1542.210	-673.125

Cashflow Tables, construction in 1000 US$

Year	1990	1991
Total cash inflow	4310.000	6670.000
Financial resources	4310.000	6670.000
Sales, net of tax	0.000	0.000
Total cash outflow	4426.725	7121.750
Total assets	4310.000	6670.000
Operating costs	0.000	0.000
Cost of finance	116.725	451.750
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	-116.725	-451.750
Cumulated cash balance	-116.725	-568.475
Inflow, local	2695.000	2900.000
Outflow, local	2362.125	2505.750
Surplus (deficit)	332.875	394.250
Inflow, foreign	1615.000	3770.000
Outflow, foreign	2064.600	4616.000
Surplus (deficit)	-449.600	-846.000
Net cashflow	-4310.000	-6670.000
Cumulated net cashflow	-4310.000	-10980.000

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	10142.160	12953.990	16180.240	16000.700	16000.700	16000.700
Financial resources	541.744	179.833	179.542	0.000	0.000	0.000
Sales, net of tax	9600.420	12774.160	16000.700	16000.700	16000.700	16000.700
Total cash outflow	10954.280	12090.370	14618.180	13387.420	13355.120	13356.710
Total assets	1899.816	611.494	623.330	0.000	0.000	0.000
Operating costs	6725.300	8783.300	10952.300	10952.300	10952.300	10952.300
Cost of finance	670.050	536.450	402.850	269.250	215.400	161.550
Repayment	1204.792	1205.069	1204.792	673.125	673.125	673.125
Corporate tax	454.318	954.054	1434.910	1492.750	1514.290	1569.740
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-812.112	863.626	1562.061	2613.275	2645.585	2643.985
Cumulated cash balance	-1380.587	-516.961	1045.099	3658.375	6303.959	8947.945
Inflow, local	541.300	179.833	179.500	0.000	0.000	0.000
Outflow, local	9649.462	10983.070	13537.500	12370.050	12391.590	12447.040
Surplus (deficit)	-9108.162	-10803.240	-13358.000	-12370.050	-12391.590	-12447.040
Inflow, foreign	9600.864	12774.160	16000.740	16000.700	16000.700	16000.700
Outflow, foreign	1304.814	1107.297	1080.683	1017.375	963.525	909.675
Surplus (deficit)	8296.051	11666.860	14920.060	14983.330	15037.170	15091.030
Net cashflow	1062.731	2604.868	3169.702	3555.650	3534.111	3478.661
Cumulated net cashflow	-9917.270	-7312.402	-4142.699	-587.049	2947.062	6425.723

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	16000.700	16000.700	16000.700	16000.700	16000.700	16000.700
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	16000.700	16000.700	16000.700	16000.700	16000.700	16000.700
Total cash outflow	13324.410	13292.090	12586.660	12929.860	12929.860	12929.860
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	10952.300	10952.300	10952.300	10952.300	10952.300	10952.300
Cost of finance	107.700	53.850	0.000	0.000	0.000	0.000
Repayment	673.125	673.125	0.000	0.000	0.000	0.000
Corporate tax	1591.280	1612.820	1634.361	1977.560	1977.560	1977.560
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	2676.295	2708.605	3414.040	3070.840	3070.840	3070.840
Cumulated cash balance	11624.240	14332.850	17746.890	20817.730	23888.570	26959.410
Inflow, local	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, local	12468.580	12490.120	12511.660	12854.860	12854.860	12854.860
Surplus (deficit)	-12468.580	-12490.120	-12511.660	-12854.860	-12854.860	-12854.860
Inflow, foreign	16000.700	16000.700	16000.700	16000.700	16000.700	16000.700
Outflow, foreign	855.825	801.975	75.000	75.000	75.000	75.000
Surplus (deficit)	15144.880	15198.730	15925.700	15925.700	15925.700	15925.700
Net cashflow	3457.120	3435.581	3414.040	3070.840	3070.840	3070.840
Cumulated net cashflow	9882.843	13318.420	16732.460	19803.300	22874.140	25944.980

Cashflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	16000.700	16000.700	16000.700
Financial resources	0.000	0.000	0.000
Sales, net of tax	16000.700	16000.700	16000.700
Total cash outflow	12929.860	12929.860	12929.860
Total assets	0.000	0.000	0.000
Operating costs	10952.300	10952.300	10952.300
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1977.560	1977.560	1977.560
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	3070.840	3070.840	3070.840
Cumulated cash balance	30030.250	33101.090	36171.930
Inflow, local	0.000	0.000	0.000
Outflow, local	12854.860	12854.860	12854.860
Surplus (deficit)	-12854.860	-12854.860	-12854.860
Inflow, foreign	16000.700	16000.700	16000.700
Outflow, foreign	75.000	75.000	75.000
Surplus (deficit)	15925.700	15925.700	15925.700
Net cashflow	3070.840	3070.840	3070.840
Cumulated net cashflow	29015.820	32086.660	35157.500

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	11236.67	at	10.00 %
Internal Rate of Return (IRRE1) ..	36.00 %		

b) Net Worth versus Net cash return:

Net present value	11295.01	at	10.00 %
Internal Rate of Return (IRRE2) ..	30.28 %		

c) Internal Rate of Return on total investment:

Net present value	10882.85	at	10.00 %
Internal Rate of Return (IRR) ..	22.53 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	9600.420	12774.160	16000.700	16000.700	16000.700
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	9600.420	12774.160	16000.700	16000.700	16000.700
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	7794.575	9852.576	12010.580	11999.580	11999.580
Operational margin	1805.845	2921.584	3990.124	4001.124	4001.124
As % of total sales	18.810	22.871	24.937	25.006	25.006
Cost of finance	670.050	536.450	402.850	269.250	215.400
Gross profit	1135.795	2385.135	3587.274	3731.875	3785.725
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1135.795	2385.135	3587.274	3731.875	3785.725
Tax	454.318	954.054	1434.910	1492.750	1514.290
Net profit	681.477	1431.081	2152.365	2239.125	2271.435
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	681.477	1431.081	2152.365	2239.125	2271.435
Accumulated undistributed profit	681.477	2112.558	4264.922	6504.047	8775.482
Gross profit, % of total sales	11.831	18.672	22.419	23.323	23.660
Net profit, % of total sales	7.098	11.203	13.452	13.994	14.196
ROE, Net profit, % of equity	17.037	35.777	53.809	55.978	56.786
ROI, Net profit+interest, % of invest.	10.954	15.407	19.337	18.983	18.820

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	16000.700	16000.700	16000.700	16000.700	16000.700
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	16000.700	16000.700	16000.700	16000.700	16000.700
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	11914.800	11914.800	11914.800	11914.800	11056.800
Operational margin	4085.899	4085.900	4085.899	4085.901	4943.900
As % of total sales	25.536	25.536	25.536	25.536	30.898
Cost of finance	161.550	107.700	53.850	0.000	0.000
Gross profit	3924.350	3978.200	4032.050	4085.901	4943.900
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3924.350	3978.200	4032.050	4085.901	4943.900
Tax	1569.740	1591.280	1612.820	1634.361	1977.560
Net profit	2354.610	2386.920	2419.230	2451.541	2966.340
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2354.610	2386.920	2419.230	2451.541	2966.340
Accumulated undistributed profit	11130.090	13517.010	15936.240	18387.780	21354.120
Gross profit, % of total sales	24.526	24.863	25.199	25.536	30.898
Net profit, % of total sales	14.716	14.918	15.120	15.321	18.539
ROE, Net profit, % of equity	58.865	59.673	60.481	61.289	74.159
ROI, Net profit+interest, % of invest.	19.042	18.879	18.716	18.553	22.449

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	16000.700	16000.700	16000.700	16000.700	16000.700
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	16000.700	16000.700	16000.700	16000.700	16000.700
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	11056.800	11056.800	11056.800	11056.800	11056.800
Operational margin	4943.900	4943.900	4943.900	4943.900	4943.900
As % of total sales	30.898	30.898	30.898	30.898	30.898
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	4943.900	4943.900	4943.900	4943.900	4943.900
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	4943.900	4943.900	4943.900	4943.900	4943.900
Tax	1977.560	1977.560	1977.560	1977.560	1977.560
Net profit	2966.340	2966.340	2966.340	2966.340	2966.340
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2966.340	2966.340	2966.340	2966.340	2966.340
Accumulated undistributed profit	24320.460	27286.800	30253.140	33219.480	36185.820
Gross profit, % of total sales	30.898	30.898	30.898	30.898	30.898
Net profit, % of total sales	18.539	18.539	18.539	18.539	18.539
ROE, Net profit, % of equity	74.159	74.159	74.159	74.159	74.159
ROI, Net profit+interest, % of invest.	22.449	22.449	22.449	22.449	22.449

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	4426.725	11548.470
Fixed assets, net of depreciation	0.000	4426.725
Construction in progress	4426.725	7121.750
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	4426.725	11548.470
Equity capital	2000.000	4000.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	2310.000	6980.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	116.725	568.475
Total debt	2426.725	7548.475
Equity, % of liabilities	45.180	34.637

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	12379.010	11921.230	12531.390	14097.390	15695.700
Fixed assets, net of depreciation	10479.200	9409.924	8351.648	7304.374	6257.099
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1886.886	2501.714	3123.795	3123.795	3123.795
Cash, bank	12.929	9.596	10.846	10.846	10.846
Cash surplus, finance available	0.000	0.000	1045.100	3658.375	6303.959
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	12379.010	11921.230	12531.390	14097.390	15695.700
Equity capital	4000.000	4000.000	4000.000	4000.000	4000.000
Reserves, retained profit	0.000	681.477	2112.558	4264.922	6504.047
Profit	681.477	1431.081	2152.365	2239.125	2271.435
Long and medium term debt	5775.208	4570.417	3365.625	2692.500	2019.375
Current liabilities	541.744	721.300	900.842	900.842	900.842
Bank overdraft, finance required.	1380.585	516.960	0.000	0.000	0.000
Total debt	7697.538	5808.676	4266.467	3593.342	2920.217
Equity, % of liabilities	32.313	33.554	31.920	28.374	25.485

Projected Balance Sheets, Production in 1000 US$

Year	1997	1998	1999	2000	2001
Total assets	17377.180	19090.980	20837.080	23298.630	26254.960
Fixed assets, net of depreciation	5294.599	4332.099	3369.599	2407.100	2302.600
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	3123.795	3123.795	3123.795	3123.795	3123.795
Cash, bank	10.846	10.846	10.846	10.846	10.846
Cash surplus, finance available	8947.944	11624.240	14332.840	17746.880	20817.720
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	17377.180	19090.980	20837.080	23298.630	26254.960
Equity capital	4000.000	4000.000	4000.000	4000.000	4000.000
Reserves, retained profit	8775.482	11130.090	13517.010	15936.240	18387.780
Profit	2354.610	2386.920	2419.230	2451.541	2966.340
Long and medium term debt	1346.250	673.125	0.000	0.000	0.000
Current liabilities	900.842	900.842	900.842	900.842	900.842
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	2247.092	1573.967	900.842	900.842	900.842
Equity, % of liabilities	23.019	20.952	19.197	17.176	15.235

Projected Balance Sheets, Production in 1000 US$

Year	2002	2003	2004	2005	2006
Total assets	29221.300	32187.640	35153.980	38120.320	41086.660
Fixed assets, net of depreciation	2198.100	2093.600	1989.100	1884.600	1780.100
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	3123.795	3123.795	3123.795	3123.795	3123.795
Cash, bank	10.846	10.846	10.846	10.846	10.846
Cash surplus, finance available	23885.560	26959.400	30030.240	33101.080	36171.920
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	29221.300	32187.640	35153.980	38120.320	41086.660
Equity capital	4000.000	4000.000	4000.000	4000.000	4000.000
Reserves, retained profit	21354.120	24320.460	27286.800	30253.140	33219.480
Profit	2966.340	2966.340	2966.340	2966.340	2966.340
Long and medium term debt	-0.000	-0.000	-0.000	-0.000	-0.000
Current liabilities	900.842	900.842	900.842	900.842	900.842
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	900.842	900.842	900.842	900.842	900.842
Equity, % of liabilities	13.689	12.427	11.379	10.493	9.736

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	235769.20	5385.00	230384.20	1615.00	3770.00	9600.86	12774.16
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	5385.49	5385.00	0.49	1615.00	3770.00	0.44	0.00
exports	230383.70	0.00	230383.70	0.00	0.00	9600.42	12774.16
indirect effects							
total foreign outflow .	14221.49	6680.60	7540.89	2064.60	4616.00	1304.81	1107.30
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	5357.80	6336.00	-978.20	2000.00	4336.00	40.89	-3.06
imported materials . . .	1195.00	0.00	1195.00	0.00	0.00	160.00	60.00
repayment loans & overd.	5385.49	0.00	5385.49	0.00	0.00	673.13	673.40
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	2283.20	344.60	1938.60	64.60	280.00	430.80	376.95
indirect costs							
net foreign exchge flow	221547.70	-1295.60	222843.30	-449.60	-846.00	8296.05	11666.86
import substit'n effect	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net forgn exchge effect	221547.70	-1295.60	222843.30	-449.60	-846.00	8296.05	11666.86

present values at 10.00 %	
foreign exchange flow .	96724.59
net forgn exchge effect	96724.59

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	16000.74	16000.70	16000.70	16000.70	16000.70	16000.70	16000.70
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.04	0.00	0.00	0.00	0.00	0.00	0.00
exports	16000.70	16000.70	16000.70	16000.70	16000.70	16000.70	16000.70
indirect effects							
total foreign outflow .	1080.68	1017.38	963.53	909.67	855.83	801.97	75.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	9.46	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	75.00	75.00	75.00	75.00	75.00	75.00	75.00
repayment loans & overd.	673.13	673.13	673.13	673.13	673.13	673.13	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	323.10	269.25	215.40	161.55	107.70	53.85	0.00
indirect costs							
net foreign exchge flow	14920.06	14983.33	15037.17	15091.03	15144.88	15198.73	15925.70
import substit'n effect	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net forgn exchge effect	14920.06	14983.33	15037.17	15091.03	15144.88	15198.73	15925.70

present values at	10.00 %
foreign exchange flow .	96724.59
net forgn exchge effect	96724.59

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	16000.70	16000.70	16000.70	16000.70	16000.70	16000.70	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	16000.70	16000.70	16000.70	16000.70	16000.70	16000.70	0.00
indirect effects							
total foreign outflow .	75.00	75.00	75.00	75.00	75.00	75.00	-1025.28
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-1025.49
imported materials . . .	75.00	75.00	75.00	75.00	75.00	75.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.21
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	15925.70	15925.70	15925.70	15925.70	15925.70	15925.70	1025.28
import substit'n effect	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net forgn exchge effect	15925.70	15925.70	15925.70	15925.70	15925.70	15925.70	1025.28

present values at	10.00 %
foreign exchange flow .	96724.59
net forgn exchge effect	96724.59

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR A TOMATO PROCESSING PLANT IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for tomato processing to produce tomate paste, tomato ketchup and tomato juice.

The tomato paste demand on the current Nigerian market is strong since import ban of September 1987 and is only partially covered by the local production.

The existing gap leads to conclude that there is room for several new plants sized to produce 3,000 to 5,000 tons/year of tomato paste.

Other important considerations favourable to the implementation of the project are the local availability both of raw material and of packing materials (cans).[1]

The suggested plant capacity is 5,000 tons/year of tomato paste in order to optimize investment costs and production needs. With the foreseen additional equipment the plant will be able to produce also 500 tons of ketchup and 500 tons of tomato juice, to meet the local market requirements. The plant will be operated 260 days per year over 3 daily shifts of 8 hours each.

The financial analysis of such a project was carried out. Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed Assets: US $ 5,555,000.
- Working capital: (at full production) US $ 2,578,435.
- Internal Rate of Return: 36,10%.
- Break-Even Point (at 5th year of production): 15%.
- Pay-Back period: less than 4 years including the construction period.
- Employees: 130.

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 85,870,930 (as a present value at 10%).

On the basis of the analysis in this study, it is recommended that a feasibility study is undertaken.

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[1] For additional background material, see Volume I p. 122.

1. INTRODUCTION

Nigeria produces a considerable quantity of tomato, which mainly grows in the Borno, Bauchi, Kano, Katsina, Kaduna, Sokoto, Kwara, Niger, Plateau and Gongola States.

"VF-Roma" is the most commonly cultivated specie: it has been found very suitable for most locations in the country, both for rainfed and irrigated cultivation.

Other common cultivated species are "beefsteak" and others species which were locally developed by the Genetic Resources Unit of the Nigerian Institute of Horticultural Research (NIHORT). The average yield per hectare ranges from 25 tons (rainfed) to 45 tons (irrigated).

Tomato can be grown all the year round, but the best period is the dry season, between October and April, using irrigation. The peak period of harvesting is between February and May.

Tomato is consumed either as fresh fruit or in processed forms as tomato paste, juice and ketchup.

The tomato paste is the concentrate, usually at 28-30 Brix degrees, obtained by evaporation of the moisture content.

Tomato juice is a soft beverage based on tomato paste diluted with water and added with flavours.

Ketchup is a traditional red sauce, formulated on a basis of tomato paste with spices and flavours added giving a peculiar sharp taste, commonly used in preparation of food.

2. MARKET AND PLANT CAPACITY

2.1 MARKET DEMAND AND SUPPLY

The tomato paste demand on the Nigerian market is estimated at 60,000 tons/year with an increase of 2% per year, according to the NIDB's information bulletin on Nigerian tomato industry (April 1989).

The product is generally commercialized in 70 gram cans. Larger cans are also used for the supply needs of hotels and institutions.

As far as tomato paste is concerned, until September 1987 (data of importation ban) the Nigerian demand was covered by domestic production and importation.

Presently the estimated supply of tomato paste is 22,000 tons/year, out of which only 14,000 from local producers, the balance of 8,000 tons/year may be through smuggling.

Official data are not available with regard to the tomato juice and ketchup consumption on the local market.

According to NIDB' estimate, the demand is around 6,000 tons/year of juice and 6,000 tons/year of ketchup. The demand of these two products is covered only by 50% by local production.

Tomato juice is generally packed in 200-250 ml size cans, while ketchup is packed in 340 gram bottles.

2.2 PLANT CAPACITY

The proposed plant will produce 5,000 tons/year of tomato paste as double concentrate at 28-30 Brix plus 500 tons of ketchup and 500 tons of tomato juice. The plant is designed for operating 260 days/year, 3 shifts/day.

All the products will be sold on the local market, packed in standard containers that are manufactured by the Nigerian industries.

Tomato paste will be packed both in 10 kg cans for hotels and institutions and in 70 gram cans, that is the most popular size for the domestic consumption. Ketchup will be sold in 340 gram glass bottles, while tomato juice in 200 milliliters (0.2 liters) cans.

The production programme at full capacity foresees the following quantities and sizes:

Product	Package size	Quantity t/y	Units/y
Tomato paste	10 kg can 70 g can	1,000 4,000	100,000 57,143,000
Ketchup	340 g bottle	500	1,471,000
Tomato juice	200 ml can	500	2,500,000

2.3 SALES PRICES AND REVENUE

According to the NIDB's information bulletin on Nigerian tomato industry the retail price for tomato paste in 1989 was 2.00 Naira for a 70 gram tin locally produced and 3.00 Naira for the imported one. The ketchup retail price was 7 Naira, while the tomato juice was 4.5 Naira.

In order to estimate the sales revenue at full production the following unit prices (ex-factory) have been assumed:

Tomato paste	10	kg can:	13.00	$ each
	70	gram can:	0.20	$ each
Ketchup	340	gram bottle:	0.40	$ each
Tomato juice	200	ml can:	0.22	$ each

The total revenue for the envisaged production amounts to 13,866,000 US dollars. Revenue from each product are detailed in the following table.

Product	Package size	Quantity t/y	Units sold/y	Unit price $/piece	Sales $/y
Tomato paste	10 kg can 70 gram can	1,000 4,000	100,000 57,143,000	13.00 0.20	1,300,000 11,428,000
Ketchup	340 g bottle	500	1,471,000	0.40	588,000
Tomato juice	200 ml can	500	2,500,000	0.22	550,000
Total sale revenue per year					**13,866,000**

3. MATERIALS AND INPUTS

The raw materials required to produce the tomato paste are fresh tomatoes and salt. The formulation both of tomato juice and ketchup includes also sugar, vinegar and spices and varies according to the market taste.

Auxiliary materials to be considered are the packing materials such as cans, bottles and cartons.

Other inputs are energy, fuel, water.

All the raw materials, packing materials and utilities are locally available.

In the following tables requirements and costs are shown:

Raw materials

Item	t/y	Unit cost $/ton	Total cost $/y
Fresh tomatoes	34,000	30	1,020,000
Salt	150	350	52,500
Sugar	25	1,600	15,000
Vinegar	25	850	21,250
Spices	30	2,500	75,000
Total			**1,183,750**

Utilities

Item	Yearly consumption	Unit cost	Total cost $/y
Electricity	1,100,000 kWh	0.10 $/kWh	110,000
Fuel oil	2,400 tons	30 $/ton	72,000
Water	100,000 m^3	0.006 $/$m^3$	360
Total			**182,360**

Packing materials

Item	Unit/year	Unit cost $/	Total cost $/year
70 gram cans (tomato paste)	57,143,000	0.10	5,714,000
10 kg cans (tomato paste)	265,000	1.40	371,000
200 ml cans (tomato juice)	2,500,000	0.15	375,000
340 gram bottles (ketchup)	1,471,000	0.18	265,000
cartons	753,000	0.40	301,000
Total			**7,026,000**

4. LOCATION

The location of the plant should, of course, be chosen in an area where tomatoes are cultivated, in order to reduce the transportation time, which would be advantageous both from the economic point of view and considering that prolonged transportation time could result in waste fruits.

Therefore the States indicated in the introduction are the most suitable for a tomatoes processing plant, which should be located in a baricentric place in respect of the surrounding plantations that will supply the fresh fruits.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

In order to have a clear scheme of the whole process please refer to the "Process flow-diagram" shown in fig. A.

Harvested fresh tomatoes are transported by truck to the factory where they are unloaded.

Firstly they are mechanically washed and inspected by sight on a suitable sorting conveyor, to allow the sound fruits to be selected and enter the next steps of the processing line. Then tomatoes are chopped and pre-heated up to 80 C in a tube next continuous cooker and are fed to the pulping and refining group for the extraction of juice.

Then tomato juice passes through a continuous concentrator, where most of water content is evaporated to reach the design concentration of 28-30 Brix.

The next step is the concentrate treatment which consists in pasteurization at 98 C before canning.

The proposed plant is designed for processing 34,000 tons/year of fresh tomatoes and will produce 5,000 tons of double concentrate (tomato paste), 500 tons of tomato juice and 500 tons of ketchup.

Considering a percentage of 5-6% of bad tomatoes out of 34,000 input tons of fresh fruits, this means about 1,900 tons of waste and 32,100 tons of sound fruits to be processed.

The processing capacity of the envisaged plant is about 200 tons of fresh tomatoes each 24 hours (8.30 tons per hour) in order to produce tomato concentrate at 28-30 Brix degrees during the harvesting season.

The concentration ratio 6:1 gives an output of 5,350 tons of tomato double concentrate per year. This is in fact the amount of concentrate needed to produce the required quantities of the final products, i.e. tomato paste, ketchup and tomato juice.

The concentrate will be partially packed into cans 70 gram capacity for direct sale on the market and partially into 10 kg cans to be stored and then retrieved in a second time, after the harvesting season, in order to be processed again during the remaining days of the year.

It was assumed that 1,000 tons of concentrate will be directly sold on the market packed in cans of 10 kg capacity, to hotels and institutions.

Other 350 tons of concentrate will be utilized to produce 500 tons of ketchup and 500 tons of tomato juice.

The remaining 4,000 tons of tomato double concentrate will be packed in small size (70 gram) tins, that is the most popular size.

The flow chart of the tomato concentrate with the material balance is shown in fig. B.

The plant will be operated continuously 3 shifts per day over 160-165 days/year, during the tomato harvesting season, to produce the whole quantity (5,350 tons) of concentrate.

As far as ketchup and tomato juice production is concerned, the formulation line is the same, with a maximum flow rate of 2,000 litres/hour. Considering an operation coefficient of 90%, the actual flow rate becomes 1,800 litres/hour, that means about 556 hours needed for producing the required 1,00 tons (500 tons of ketchup plus 500 of juice). In conclusion the plant will operate about 260 days per year over 3 shifts/day, considering also the tomato concentrate canning.

FIG. A - PROCESS FLOW DIAGRAM

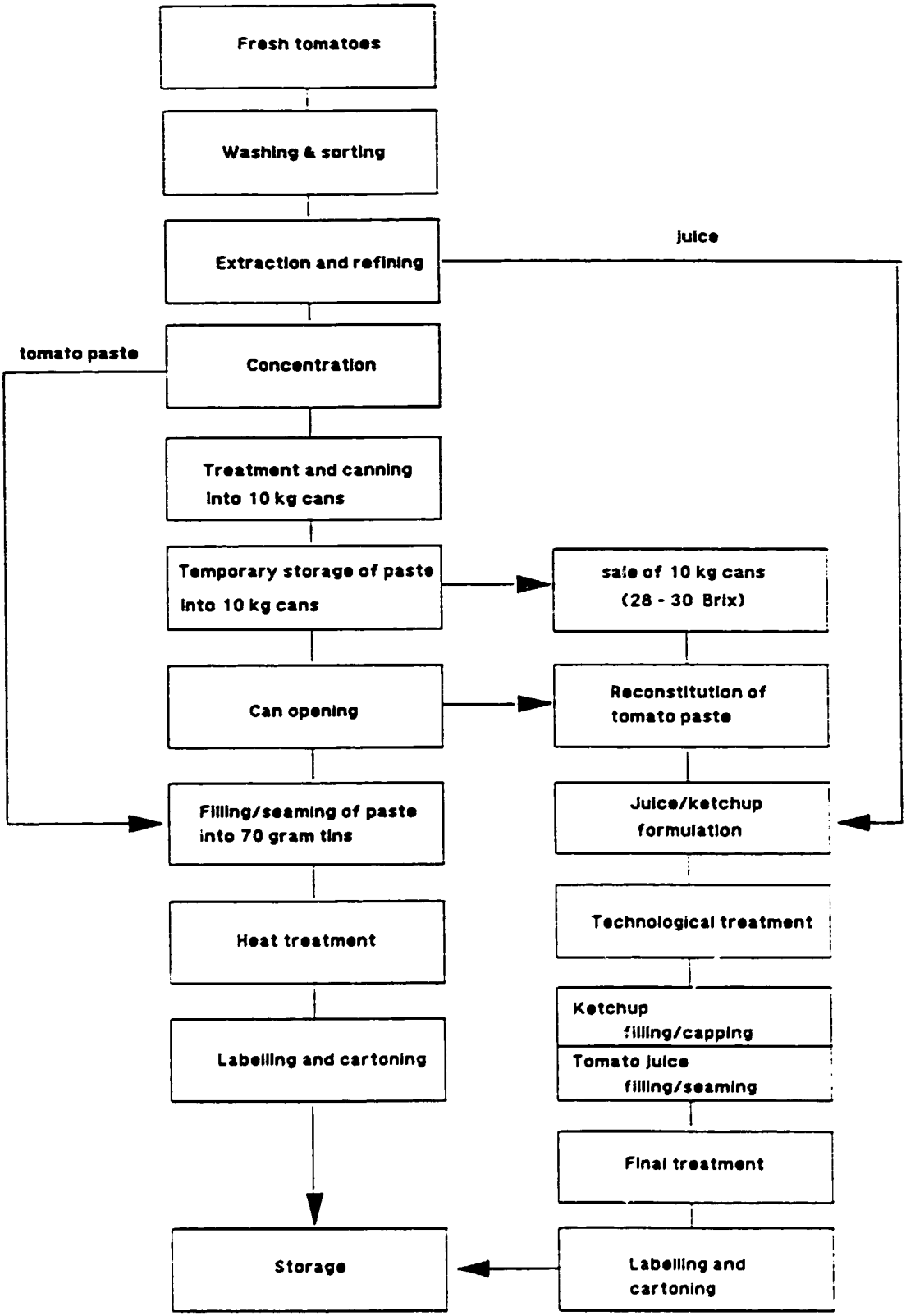
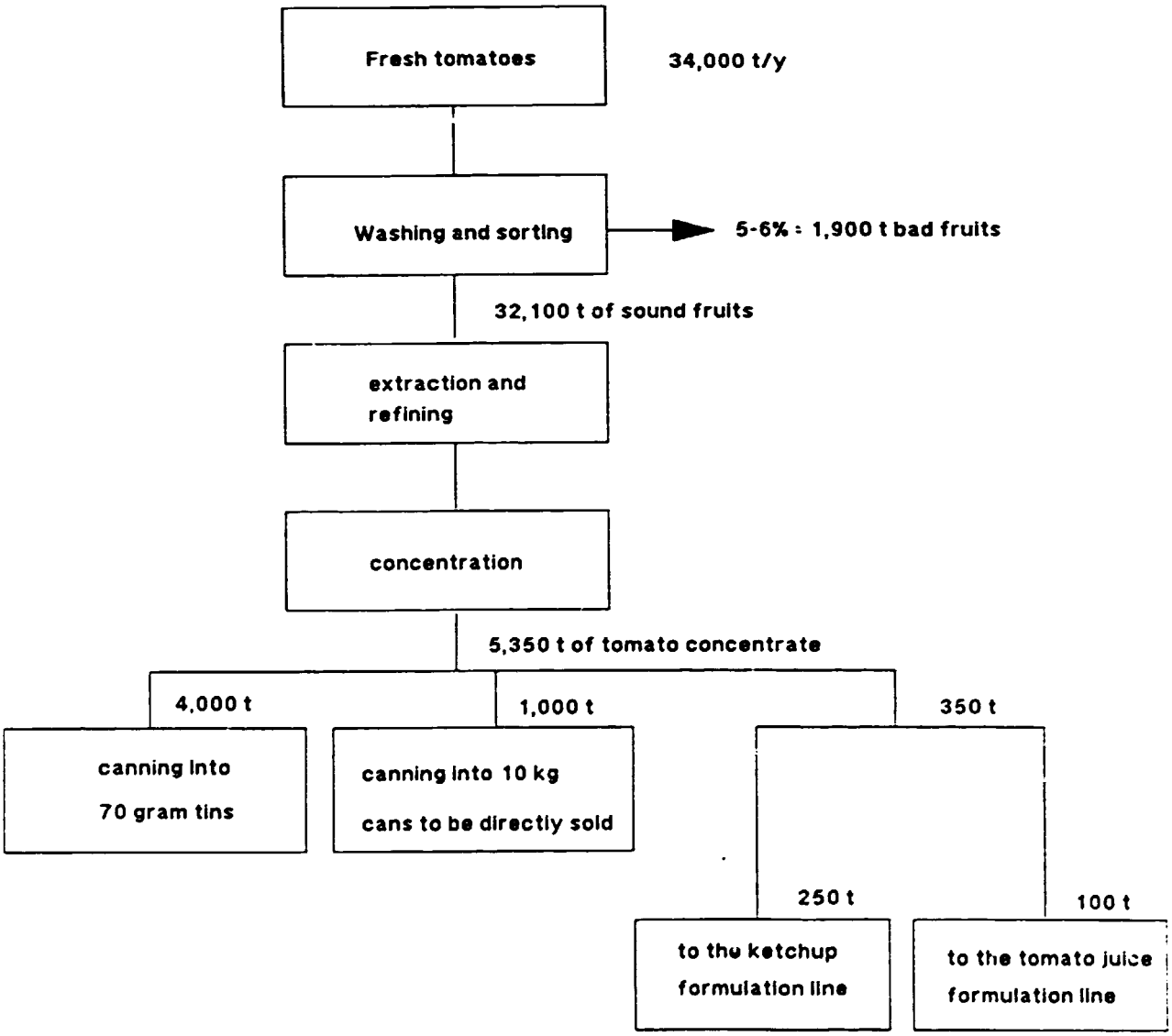


FIG. B - TOMATO CONCENTRATE DESTINATIONS



5.2 LAY-OUT AND CIVIL WORKS

The area required for the installation of the process equipment with utilities and facilities, including open yard, roads, trucks loading/unloading area, is about 7,000 square meters. Out of these the covered area is 2,400 square meters split as follows:

working shed	1,000	square meters
storehouse	450	square meters
workshop	250	square meters
utilities	150	square meters
offices	150	square meters
shelter	400	square meters
Total	2,400	square meters

Administrative offices, laboratory maintenance workshop are grouped in a one-storey building, having a supporting structure of reinforced concrete, external and internal walls of brickwork, roof made of concrete slabs.

The floors of the offices, laboratory and services are covered with tiles, while the workshop has concrete floor.

The working shed and storehouse will have a structure of steel structure or of reinforced concrete and the floor paved with concrete slabs.

For roofing and cladding corrugated asbestos sheets will be used. The fencing will consist of a wire net supported by small steel poles.

5.3 MAIN EQUIPMENT LIST

The main machinery and equipment of the tomato processing plant is listed here below, considering the various production departments.

A. WASHING, INSPECTION AND EXTRACTION LINE

A.1) 1 unit with rotating roller conveyor for tomatoes washing and sorting

A.2) 1 tomato chopping machine

A.3) 1 tube nest continuous cooker, for tomato preheating with thermal cycle up to 80 C (heating by steam)

A.4) 1 sanitary volumetric pump (screw type), AISI 316 stainless steel made

A.5) 1 tank, AISI 304 made, 5,000 litres capacity

A.6) 1 pulping and refining group for the extraction of tomato juice

A.7) 1 sanitary volumetric pump (screw type), AISI 316 S.S. made

A.8) 1 120 litres bin, AISI 304 S.S. made

A.9) 1 tomato juice squeezing and refining unit, equipped with a system to regulate the squeezing intensity

A.10) 1 belt conveyor suitable to transport wastes

A.11) 1 tank 2,000 litres capacity, AISI 304 S.S. made

A.12) 1 complete set of accessories, connections, valves, piping, fittings, joints, stainless steel made.

B. CONCENTRATION LINE

B.1) 1 double effect continuous concentrator, equipped with a thermic circulation pre-concentrator, pan finisher and electronic refractometer

B.2) 1 mixing tank, 1,000 litres capacity, AISI 304 S.S. made

B.3) 1 mixing tank, 1,000 litres capacity, AISI 304 S.S. made

B.4) 1 sanitary volumetric pump (screw type)

B.5) 1 complete set of accessories, connections, valves, piping, fittings, joints, stainless steel made.

C. CONCENTRATE TREATMENT AND PACKAGING LINE IN 10 KG CANS

C.1) 1 tube nest pasteurizer, suitable to treat tomato concentrate, ketchup, sauces and similar products at a temperature of about 98 C. Heating obtained by steam injection with overheated water recycling.

C.2) 1 rotating table, diameter 1 metre, on which cans or bottles are accumulated for feeding or discharging the packing lines

C.3) 1 belt conveyor for cans or bottles transport

C.4) 1 sterilizer, tunnel type, for cans of different size, equipped with a set of steam spraying nozzles

C.5) 1 dosing unit, volumetric type, suitable to fill 5-10 kg cans

C.6) 1 seaming machine, automatic type, complete with lid store and feeder, suitable to seam cans with size ranging from 2 to 10 kg

C.7) 1 continuous tunnel conveyor for the pasteurization and cooling of food containers like tin cans, jars, bottles, cartons, pouches or plastic bags. The unit is equipped with feeding and discharging conveyors. It is also foreseen a drying group by means of forced ventilation at the tunnel outlet

C.8) 1 electric control board

C.9) 1 complete set of accessories, connections, valves, piping, fitting, joints stainless steel made.

D. PACKAGING LINE FOR 70 GRAM CANS TINS (TOMATO PASTE) AND 200 GRAM CANS (JUICE)

D.1) 1 rotating table, diameter 1 meter, on which cans or bottles are accumulated for feeding or discharging the packing lines

D.2) 1 empty cans elevator to feed cans to the dosing unit

D.3) 1 empty can sterilizer, steam jet type

D.4) 1 empty can distributor

D.5) 1 automatic volumetric unit for filling 70 gram cans

D.6) 1 automatic seaming machine; output 180 filled cans minute

D.7) 1 belt conveyor for cans or bottle transport, complete with feeding conveyor

D.8) 1 continuous tunnel convevor for the pasteurization and cooling of food containers like cans, jars, bottles, cartons, pouches or plastic bags. Equipped with discharging conveyor

D.9) 1 belt conveyor, suitable for cans or bottles. Equipped with drying group by means of forced ventilation at the tunnel outlet

D.10) 1 belt conveyor, suitable for cans or bottles

D.11) 1 case packer suitable to pack 70 gram cans in 2 or 4 layers (25 cans per layer). Complete with twister, can elevator, 5 lanes distributor, packer unit, discharge roller conveyor, 2 manual banding grips

D.12) 1 belt conveyor suitable for cans or bottles

D.13) 1 belt conveyor suitable for cans or bottles

D.14) 1 automatic filling/seaming machine with 3 rotating stages to fill liquid products, pre-seaming and seaming of cans

D.15) 1 electric control board

D.16) 1 complete set of accessories, connections, valves, piping, fittings, joints, stainless steel made.

E. FORMULATION LINE FOR KETCHUP AND JUICE (2,000 litres/hour max flow rate)

E.1) 1 can opener, semi-automatic type, for opening 10 kg cans. Manual loading, automatic can washing

E.2) 1 thermoinsulated tank, 2,000 litres capacity, AISI 304 S.S. made, provided with plates for products heating or cooling by means of steam or water circulation. Equipped with motorized stirrer.

E.3) 1 sanitary volumetric pump (screw type), AISI 316 S.S. made

E.4) 1 automatic dosing group for the preparation of tomato juice and other alimentary liquids, consisting of a 2,000 litres mixing tank equipped with magnetic sensors for presetting the weighing cycle.

E.5) 1 electro-pneumatic valve with filter and by-pass to feed tanks

E.6) 1 microelement preparation group, suitable to prepare a solution of microelements for juices formulation and/or acidity correction

E.7) 1 mixing tank, 1,000 litres capacity, AISI 304 S.S. made, provided with motorized stirrer

E.8 + e.9) 1 screw conveyor with hopper for feeding sugar to the dosing group

E.10) 1 centrifugal pump, AISI 316 S.S. made

E.11) 1 sanitary volumetric pump (screw type), AISI 316 S.S. made

E.12) 1 mixing tank, 2,000 litres capacity, AISI 304 S.S. made, provided with motorized stirrer

E.13) 1 sanitary volumetric pump (screw type), AISI 316 S.S.

E.14) 1 pre-heater; heat exchanger for the thermal treatment of pre-heating or cooling of juices to be primarily deaerated. Complete with steam pressure reducing group.

E.15) deareating unit for the elimination of air incorporated in liquid or thick alimentary products, by nebulization under vacuum

E.16) dispersor-homogenizer; this unit works by means of a combined action of high pressure, lamination and abrasion to realize an efficient homogenization of juices and ketchup

E.17) 1 pasteurizer for the treatment of juices, complete with steam pressure reducing group

E.18) 1 electric control board

E.19) 1 complete set of accessories, connections, valves, piping, fitting, joints, stainless steel made.

F. KETCHUP PACKING LINE (2,000 bottles/hour of 340 grams)

F.1) 1 rotating table, diameter 1 meter, suitable to accumulate cans or bottles for feeding or discharging the packing lines

F.2) 1 belt conveyor, suitable for cans or bottles transport

F.3) 1 tunnel type pre-heater for bottles of ketchup provided with steam jets

F.4) 1 automatic filling machine, working under vacuum, to fill bottles of size ranging from 0.2 to 1 litre. Complete with vacuum group

F.5) 1 capping unit, automatic type, suitable to close bottles with twist-off caps. Equipped with lid distributor and steam jets

F.6) 1 belt conveyor suitable for cans or bottles transport

F.7) 1 tunnel-pasteurizer/cooler; this is the same equipment already included in line "d".

F.8) 1 labelling machine, linear type, for the application of one body label; capacity 3,000 pcs/hour

F.9) 1 rotating table, diameter 1 meter, suitable to accumulate cans or bottles for feeding or discharging the packing lines

F.10) 1 electric control board

F.11) 1 complete set of accessories, connections, valves, piping, fittings, joints, stainless steel made.

5.3.1 Utilities

The plant needs the following equipment for the process:

- No. 2 (1+1 stand-by) steam boilers 6,000 kg/h capacity at 6 bar, complete with feed water softner.

- No. 1 air compressor, capacity 25 cubic meters/hour at 7 bar

- No. 1 gen-set 400 kVA, diesel engine operated, air cooled

5.3.2 Laboratory

A minimum equipment for carrying out tests and analyses on the product is required.

5.3.3. Maintenance workshop

A shop is foreseen for the current mechanical and electrical maintenance, equipped with the main portable machines and hand tools (drilling and grinding machines, etc.)

5.3.4 Transport equipment

For internal handling of raw material containers and various purposes an electric fork-lift has been foreseen and a second one, diesel engine powered, for external utilization.

5.3.5 **Investment costs**

The estimated investment costs are shown in the following table (in US dollars). The machinery and equipment have been quoted by Bertuzzi, Milano, Italy.

Description	LC	FC	Total
Machinery and equipment	--	2,500,000	2,500,000
Transport, taxes and duties	500,000	250,000	750,000
Erection	500,000	250,000	750,000
Land and site preparation	100,000	--	100,000
Civil works and buildings	600,000	--	600,000
Spare parts	--	70,000	70,000
Total	**1,700,000**	**3,070,000**	**4,770,000**
Contingencies	**170,000**	**307,000**	**477,000**
GRAND TOTAL	**1,870,000**	**3,377,000**	**5,247,000**

The industrial life of the plant has been considered 15 years. The annual expenditures for maintenance are estimated at US $ 75,000.

In the financial evaluation the investment costs (contingencies included), are subdivided as follows:

Preproduction expenditures	FC	US$	0
Preproduction expenditures	LC	US$	88,000
Machinery	FC	US$	3,377,000
Machinery	LC	US$	1,100,000
Land and site preparation	LC	US$	110,000
Civil works and buildings	LC	US$	660,000
TOTAL		US$	5,335,000

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skill is required for any position listed here below, exception made for the technical manager and technical assistants. It is however recommended that on the job training is carried out by one expert, made available by the tecnnology supplier, for one year after the start-up. The relevant cost is estimated US$ 120,000.

The personnel required and the relevant salaries are shown herebelow.

The number of personnel reflects the needs of three shifts.

7.1 MANAGEMENT

		Salary (N/Y)
- General manager	1	50,000
- Technical manager	1	40,000
Total	2	90,000
	Overhead 40%	36,000
		126,000

7.2 ADMINISTRATIVE DEPT.

		Salary (N/Y)
- Financial manager	1	40,000
- Accountants	2	24,000
- Purchasing head	1	12,000
- Store head	1	12,000
- Sales dept. head	1	12,000
- Clerks	3	36,000
- Guards	6	36,000
- Drivers	4	32,000
Total	19	204,000
	Overhead 40%	41,600
		285,600

7.3 PRODUCTION DEPT.

		Salary (N/Y)
- Production manager	1	40,000
- Shift foreman (1 per shift)	3	36,000
- Analysts	2	20,000
- Semiskilled workers (12 per shift)	36	216,000
- Unskilled workers (20 per shift)	60	240,000
Total	102	552,000
	Overhead 40%	220,000
		772,800

7.4 MAINTENANCE DEPT.

		Salary (N/Y)
- Mechanics	4	40,000
- Electricians	3	30,000
Total	7	70,000
	Overhead 40%	28,000
		98,000

7.5 SALARY

		annual cost	
		Naira	US$
Management and Administration	21	111,600	52,100
Production	102	772,800	97,800
Maintenance	7	98,000	12,400
Grand Total (rounded)	**130**	**1,282,000**	**162,000**

8. IMPLEMENTATION SCHEDULE

From the signing of the contract 18 months are required for the construction and commissioning of the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 5,555,000 US Dollars. The portion in foreign currency accounts for 3,600,000 US Dollars.

Details of these figures are shown in chapter 5.3.5

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,540,000	US$ 920,000	US$ 2,460,000
- Foreign Loan (interest 8%)	US$ 1,300,000	US$ 1,600,000	US$ 2,900,000
- Local Loan (interest 15%)	US$ 0	US$ 0	US$ 0

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 60%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 2,590,700 US Dollars.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 1,587,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 60% of its nominal capacity, the production costs amount to US $ 6,115,010.

In the third year, at full production, the costs amount to US $ 9,312,700 then they start a slight decrease year after year, to reach a constant amount of US$ 8,629,400 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US$ 13,867,000. As said before, the production programme foresees that full production is reached gradually:

1st year 60% : revenue = US$ 8,320,000

2nd year 80% : revenue = US$ 11,093,600

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 36.1%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 15% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 4 years, including the construction period.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of capacity utilization.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 85,870,930.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amount to US$ 85,870,930.

ANNEXE 1

COMFAR SCHEDULES

TOMATO
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1,000 US$

Total initial investment during construction phase

fixed assets:	5555.00	64.752 % foreign
current assets:	0.00	0.000 % foreign
total assets:	5555.00	64.752 % foreign

Source of funds during construction phase

equity & grants:	2460.00	0.000 % foreign
foreign loans :	2900.00	
local loans :	0.00	
total funds :	5360.00	54.104 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	5352.71	8629.41	8629.41
depreciation :	520.30	498.30	33.00
interest :	232.00	116.00	0.00
production costs	6115.01	9243.71	8662.41
thereof foreign:	11.62 %	5.29 %	0.40 %
total sales :	8320.20	13867.00	13867.00
gross income :	2205.19	4623.29	5204.59
net income :	1323.11	2773.97	3122.75
cash balance :	-105.73	2909.78	3155.76
net cashflow :	488.77	3388.28	3155.76

Net Present Value at: 10.00 % = 14984.54
Internal Rate of Return: 36.10 %
Return on equity1: 60.62 %
Return on equity2: 49.16 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1,000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	110.000	0.000
Buildings and civil works	660.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	2000.000	2477.000
Total fixed investment costs	2770.000	2477.000
Pre-production capital expenditures	115.000	193.000
Net working capital	0.000	0.000
Total initial investment costs	2885.000	2670.000
Of it foreign, in %	53.795	76.592

Total Current Investment in 1,000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	1586.641	493.686	510.329
Total current investment costs	1586.641	493.686	510.329
Of it foreign, %	1.896	0.000	0.876

Total Production Costs in 1,000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	710.250	947.000	1183.750	1183.750	1183.750
Other raw materials	4215.600	5620.800	7026.000	7026.000	7026.000
Utilities	43.560	58.000	72.360	72.360	72.360
Energy	66.000	88.000	110.000	110.000	110.000
Labour, direct	97.800	97.800	97.800	97.800	97.800
Repair, maintenance	24.000	32.000	40.000	40.000	40.000
Spares	21.000	28.000	35.000	35.000	35.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	5298.210	6871.600	8564.910	8564.910	8564.910
Administrative overheads	64.500	64.500	64.500	64.500	64.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	520.300	520.300	509.300	498.300	498.300
Financial costs	232.000	203.000	174.000	145.000	116.000
Total production costs	6115.010	7659.399	9312.710	9272.710	9243.710
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	11.622	7.425	5.870	5.583	5.287
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	162.300	162.300	162.300	162.300	162.300

Total Production Costs in 1,000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	1183.750	1183.750	1183.750	1183.750	1183.750
Other raw materials	7026.000	7026.000	7026.000	7026.000	7026.000
Utilities	72.360	72.360	72.360	72.360	72.360
Energy	110.000	110.000	110.000	110.000	110.000
Labour, direct	97.800	97.800	97.800	97.800	97.800
Repair, maintenance	40.000	40.000	40.000	40.000	40.000
Spares	35.000	35.000	35.000	35.000	35.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	8564.910	8564.910	8564.910	8564.910	8564.910
Administrative overheads	64.500	64.500	64.500	64.500	64.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	480.700	480.700	480.700	480.700	33.000
Financial costs	87.000	58.000	29.000	0.000	0.000
Total production costs	9197.110	9168.110	9139.110	9110.110	8662.410
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	4.998	4.698	4.395	4.091	0.404
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	162.300	162.300	162.300	162.300	162.300

Total Production Costs in 1,000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	1183.750
Other raw materials	7026.000
Utilities	72.360
Energy	110.000
Labour, direct	97.800
Repair, maintenance	40.000
Spares	35.000
Factory overheads	0.000
Factory costs	8564.910
Administrative overheads	64.500
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	8629.410
Costs per unit (single product)	0.000
Of it foreign, %	0.406
Of it variable,%	0.000
Total labour	162.300

Net Working Capital in 1,000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	446.892	578.008	719.118	719.118
Inventory and materials	13	27.4	181.411	241.878	302.341	302.341
Energy	1	360.0	0.183	0.244	0.306	0.306
Spares	180	2.0	10.500	14.000	17.500	17.500
Work in progress	90	4.0	1289.694	1710.978	2132.575	2132.575
Finished products	5	72.0	74.482	96.335	119.853	119.853
Cash in hand	15	24.0	13.637	9.262	9.888	9.888
Total current assets			2016.800	2650.705	3301.580	3301.580
Current liabilities and						
Accounts payable	30	12.1	430.159	570.378	710.923	710.923
Net working capital			1586.641	2080.328	2590.657	2590.657
Increase in working capital			1586.641	493.686	510.329	0.000
Net working capital, local			1556.558	2062.439	2568.295	2568.295
Net working capital, foreign			30.083	17.889	22.361	22.361

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1,000 US$

Year	1990	1991
Equity, ordinary ..	1540.000	920.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1300.000	1600.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	0.000
Total loan	1300.000	1600.000
Current liabilities	0.000	0.000
Bank overdraft	45.000	150.000
Total funds	2885.000	2670.000

Source of Finance, production in 1,000 US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-362.500	-362.500	-362.500	-362.500
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-362.500	-362.500	-362.500	-362.500
Current liabilities	430.159	140.219	140.545	0.000
Bank overdraft	105.728	-300.728	0.000	0.000
Total funds	173.387	-523.009	-221.955	-362.500

Cashflow Tables, construction in 1,000 US$

Year	1990	1991
Total cash inflow . .	2840.000	2520.000
Financial resources .	2840.000	2520.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	2885.000	2670.000
Total assets	2833.000	2502.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	52.000	168.000
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-45.000	-150.000
Cumulated cash balance	-45.000	-195.000
Inflow, local	1540.000	920.000
Outflow, local	1333.000	625.000
Surplus (deficit) .	207.000	295.000
Inflow, foreign . . .	1300.000	1600.000
Outflow, foreign . . .	1552.000	2045.000
Surplus (deficit) .	-252.000	-445.000
Net cashflow	-2833.000	-2502.000
Cumulated net cashflow	-2833.000	-5335.000

Cashflow tables, production in 1,000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	8750.359	11234.130	14007.550	13867.000	13867.000	13867.000
Financial resources	430.159	140.533	140.545	0.000	0.000	0.000
Sales, net of tax	8320.200	11093.600	13867.000	13867.000	13867.000	13867.000
Total cash outflow	8856.086	9509.499	11638.500	10974.630	10957.230	10946.870
Total assets	2016.800	633.905	650.874	0.000	0.000	0.000
Operating costs	5362.710	6936.100	8629.409	8629.409	8629.409	8629.409
Cost of finance	232.000	203.000	174.000	145.000	116.000	87.000
Repayment	362.500	362.814	362.500	362.500	362.500	362.500
Corporate tax	882.076	1373.680	1821.716	1837.716	1849.316	1867.956
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-105.727	1724.633	2369.046	2892.375	2969.775	2920.136
Cumulated cash balance	-300.727	1423.906	3792.952	6685.327	9595.103	12515.240
Inflow, local	8749.968	11234.130	14007.530	13867.000	13867.000	13867.000
Outflow, local	8090.111	8928.193	11062.510	10432.130	10443.730	10462.370
Surplus (deficit)	659.856	2305.938	2945.019	3434.875	3423.275	3404.636
Inflow, foreign	0.392	0.000	0.019	0.000	0.000	0.000
Outflow, foreign	765.975	581.306	575.992	542.500	513.500	484.500
Surplus (deficit)	-765.583	-581.306	-575.972	-542.500	-513.500	-484.500
Net cashflow	488.773	2290.134	2905.547	3399.875	3388.275	3369.635
Cumulated net cashflow	-4846.227	-2556.094	349.453	3749.329	7137.604	10507.240

Cashflow tables, production in 1,000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	13867.000	13867.000	13867.000	13867.000	13867.000	13867.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	13867.000	13867.000	13867.000	13867.000	13867.000	13867.000
Total cash outflow	10929.470	10912.070	10532.170	10711.250	10724.450	10724.450
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	8629.409	8629.409	8629.409	8629.409	8629.409	8629.409
Cost of finance	58.000	29.000	0.000	0.000	0.000	0.000
Repayment	362.500	362.500	0.000	0.000	0.000	0.000
Corporate tax	1879.556	1891.156	1902.756	2081.836	2095.036	2095.036
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	2937.535	2954.936	3334.836	3155.756	3142.556	3142.556
Cumulated cash balance	15452.770	18407.710	21742.540	24898.300	28040.860	31183.410
Inflow, local	13867.000	13867.000	13867.000	13867.000	13867.000	13867.000
Outflow, local	10473.970	10485.570	10497.170	10676.250	10689.450	10689.450
Surplus (deficit)	3393.035	3381.436	3369.836	3190.756	3177.556	3177.556
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	455.500	426.500	35.000	35.000	35.000	35.000
Surplus (deficit)	-455.500	-426.500	-35.000	-35.000	-35.000	-35.000
Net cashflow	3356.036	3346.436	3334.835	3155.756	3142.556	3142.556
Cumulated net cashflow	17865.280	17211.710	20546.550	23702.300	26844.860	29987.410

Cashflow tables, production in 1,000 US$

Year	2004	2005	2006
Total cash inflow	13867.000	13867.000	13867.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	13867.000	13867.000	13867.000
Total cash outflow	10724.450	10724.450	10724.450
Total assets	0.000	0.000	0.000
Operating costs	8629.409	8629.409	8629.409
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	2095.036	2095.036	2095.036
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	3142.556	3142.556	3142.556
Cumulated cash balance	34325.960	37468.520	40611.070
Inflow, local	13867.000	13867.000	13867.000
Outflow, local	10689.450	10689.450	10689.450
Surplus (deficit)	3177.556	3177.556	3177.556
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	35.000	35.000	35.000
Surplus (deficit)	-35.000	-35.000	-35.000
Net cashflow	3142.556	3142.556	3142.556
Cumulated net cashflow	33129.970	36272.520	39415.080

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	15735.42	at	10.00 %
Internal Rate of Return (IRRE1) ..	60.62 %		

b) Net Worth versus Net cash return:

Net present value	15255.01	at	10.00 %
Internal Rate of Return (IRRE2) ..	49.16 %		

c) Internal Rate of Return on total investment:

Net present value	14984.54	at	10.00 %
Internal Rate of Return (IRR) ..	36.10 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1,000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	8320.200	11093.600	13867.000	13867.000	13867.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	8320.200	11093.600	13867.000	13867.000	13867.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	5883.010	7456.399	9138.710	9127.710	9127.710
Operational margin	2437.190	3637.200	4728.291	4739.291	4739.291
As % of total sales	29.292	32.786	34.097	34.177	34.177
Cost of finance	232.000	203.000	174.000	145.000	116.000
Gross profit	2205.190	3434.200	4554.291	4594.291	4623.291
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2205.190	3434.200	4554.291	4594.291	4623.291
Tax	882.076	1373.680	1821.716	1837.716	1849.316
Net profit	1323.114	2060.520	2732.575	2756.575	2773.975
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1323.114	2060.520	2732.575	2756.575	2773.975
Accumulated undistributed profit	1323.114	3383.634	6116.209	8872.783	11646.760
Gross profit, % of total sales	26.504	30.957	32.843	33.131	33.340
Net profit, % of total sales	15.902	18.574	19.706	19.879	20.004
ROE, Net profit, % of equity	53.785	83.761	111.080	112.056	112.763
ROI, Net profit+interest, % of invest.	22.467	30.525	36.673	36.610	36.464

Net Income Statement in 1,000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	13867.000	13867.000	13867.000	13867.000	13867.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	13867.000	13867.000	13867.000	13867.000	13867.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	9110.110	9110.110	9110.110	9110.110	8662.410
Operational margin	4756.891	4756.891	4756.891	4756.891	5204.591
As % of total sales	34.304	34.304	34.304	34.304	37.532
Cost of finance	87.000	58.000	29.000	0.000	0.000
Gross profit	4669.891	4698.891	4727.891	4756.891	5204.591
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	4669.891	4698.891	4727.891	4756.891	5204.591
Tax	1867.956	1879.556	1891.156	1902.756	2081.836
Net profit	2801.934	2819.334	2836.734	2854.134	3122.755
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2801.934	2819.334	2836.734	2854.134	3122.755
Accumulated undistributed profit	14448.690	17268.030	20104.760	22958.900	26081.650
Gross profit, % of total sales	33.676	33.885	34.095	34.304	37.532
Net profit, % of total sales	20.206	20.331	20.457	20.582	22.519
ROE, Net profit, % of equity	113.900	114.607	115.314	116.022	126.961
ROI, Net profit+interest, % of invest.	36.450	36.304	36.158	36.011	39.401

Net Income Statement in 1,000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	13867.000	13867.000	13867.000	13867.000	13867.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	13867.000	13867.000	13867.000	13867.000	13867.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	8629.410	8629.410	8629.410	8629.410	8629.410
Operational margin	5237.591	5237.591	5237.591	5237.591	5237.591
As % of total sales	37.770	37.770	37.770	37.770	37.770
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	5237.591	5237.591	5237.591	5237.591	5237.591
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	5237.591	5237.591	5237.591	5237.591	5237.591
Tax	2095.036	2095.036	2095.036	2095.036	2095.036
Net profit	3142.555	3142.555	3142.555	3142.555	3142.555
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	3142.555	3142.555	3142.555	3142.555	3142.555
Accumulated undistributed profit	29224.210	32366.760	35509.310	38651.870	41794.420
Gross profit, % of total sales	37.770	37.770	37.770	37.770	37.770
Net profit, % of total sales	22.662	22.662	22.662	22.662	22.662
ROE, Net profit, % of equity	127.746	127.746	127.746	127.746	127.746
ROI, Net profit+interest, % of invest.	39.650	39.650	39.650	39.650	39.650

Projected Balance Sheets, construction in 1,000 US$

Year	1990	1991
Total assets	2885.000	5555.000
Fixed assets, net of depreciation	0.000	2885.000
Construction in progress	2885.000	2670.000
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	2885.000	5555.000
Equity capital	1540.000	2460.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	1300.000	2900.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	45.000	195.000
Total debt	1345.000	3095.000
Equity, % of liabilities	53.380	44.284

Projected Balance Sheets, Production in 1,000 US$

Year	1992	1993	1994	1995	1996
Total assets	7051.501	8589.012	11099.630	13493.710	15905.180
Fixed assets, net of depreciation	5034.700	4514.400	4005.100	3506.800	3008.500
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	2003.163	2641.443	3291.692	3291.692	3291.692
Cash, bank	13.637	9.262	9.888	9.888	9.888
Cash surplus, finance available	0.000	1423.906	3792.952	6685.326	9595.101
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	7051.501	8589.012	11099.630	13493.710	15905.180
Equity capital	2460.000	2460.000	2460.000	2460.000	2460.000
Reserves, retained profit	0.000	1323.114	3383.634	6116.209	8872.783
Profit	1323.114	2060.520	2732.575	2756.575	2773.975
Long and medium term debt	2537.500	2175.000	1812.500	1450.000	1087.500
Current liabilities	430.159	570.378	710.923	710.923	710.923
Bank overdraft, finance required.	300.728	0.000	0.000	0.000	0.000
Total debt	3268.387	2745.378	2523.423	2160.923	1798.423
Equity, % of liabilities	34.886	28.641	22.163	18.231	15.467

Projected Balance Sheets, Production in 1,000 US$

Year	1997	1998	1999	2000	2001
Total assets	18344.620	20801.450	23275.690	26129.820	29252.570
Fixed assets, net of depreciation	2527.800	2047.100	1566.400	1085.700	1052.700
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	3291.692	3291.692	3291.692	3291.692	3291.692
Cash, bank	9.888	9.888	9.888	9.888	9.888
Cash surplus, finance available	12515.240	15452.770	18407.710	21742.540	24898.290
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	18344.620	20801.450	23275.690	26129.820	29252.570
Equity capital	2460.000	2460.000	2460.000	2460.000	2460.000
Reserves, retained profit	11646.760	14448.690	17268.030	20104.760	22958.900
Profit	2801.934	2819.334	2836.734	2854.134	3122.755
Long and medium term debt	725.000	362.500	0.000	0.000	0.000
Current liabilities	710.923	710.923	710.923	710.923	710.923
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1435.923	1073.423	710.923	710.923	710.923
Equity, % of liabilities	13.410	11.826	10.569	9.415	8.410

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Projected Balance Sheets, Production in 1,000 US$

Year	2002	2003	2004	2005	2006
Total assets	32395.130	35537.680	38680.230	41822.790	44965.340
Fixed assets, net of depreciation	1052.700	1052.700	1052.700	1052.700	1052.700
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	3291.692	3291.692	3291.692	3291.692	3291.692
Cash, bank	9.888	9.888	9.888	9.888	9.888
Cash surplus, finance available	28040.850	31183.400	34325.950	37468.510	40611.060
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	32395.130	35537.680	38680.230	41822.790	44965.340
Equity capital	2460.000	2460.000	2460.000	2460.000	2460.000
Reserves, retained profit	26081.650	29224.210	32366.760	35509.310	38651.870
Profit	3142.555	3142.555	3142.555	3142.555	3142.555
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	710.923	710.923	710.923	710.923	710.923
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	710.923	710.923	710.923	710.923	710.923
Equity, % of liabilities	7.594	6.922	6.360	5.882	5.471

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	2900.41	2900.00	0.41	1300.00	1600.00	0.39	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	2900.41	2900.00	0.41	1300.00	1600.00	0.39	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	7607.71	3597.00	4010.71	1552.00	2045.00	765.97	581.31
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	2819.30	3377.00	-557.70	1500.00	1877.00	30.48	-12.51
imported materials . . .	624.00	0.00	624.00	0.00	0.00	141.00	28.00
repayment loans & overd.	2900.41	0.00	2900.41	0.00	0.00	362.50	362.81
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1264.00	220.00	1044.00	52.00	168.00	232.00	203.00
indirect costs							
net foreign exchge flow	-4707.30	-697.00	-4010.30	-252.00	-445.00	-765.58	-581.31
import substit'n effect	199684.00	0.00	199684.00	0.00	0.00	8320.00	11093.00
net forgn exchge effect	194976.70	-697.00	195673.70	-252.00	-445.00	7554.42	10511.69

present values at	10.00 %
foreign exchange flow .	-3345.60
net forgn exchge effect	85870.93

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	0.02	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.02	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	575.99	542.50	513.50	484.50	455.50	426.50	35.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	4.49	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	35.00	35.00	35.00	35.00	35.00	35.00	35.00
repayment loans & overd.	362.50	362.50	362.50	362.50	362.50	362.50	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	174.00	145.00	116.00	87.00	58.00	29.00	0.00
indirect costs							
net foreign exchge flow	-575.97	-542.50	-513.50	-484.50	-455.50	-426.50	-35.00
import substit'n effect	13867.00	13867.00	13867.00	13867.00	13867.00	13867.00	13867.00
net forgn exchge effect	13291.03	13324.50	13353.50	13382.50	13411.50	13440.50	13832.00

present values at	10.00 %
foreign exchange flow .	-3345.60
net forgn exchge effect	85870.93

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	35.00	35.00	35.00	35.00	35.00	35.00	-580.06
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-580.16
imported materials . . .	35.00	35.00	35.00	35.00	35.00	35.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.10
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-35.00	-35.00	-35.00	-35.00	-35.00	-35.00	580.06
import substit'n effect	13867.00	13867.00	13867.00	13867.00	13867.00	13867.00	0.00
net forgn exchge effect	13832.00	13832.00	13832.00	13832.00	13832.00	13832.00	580.06

present values at	10.00 %
foreign exchange flow .	-3345.60
net forgn exchge effect	85870.93

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR A SORGHUM MALTING PLANT IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a sorghum malting plant for the breweries existing in Nigeria, as alternative to barley malt.[1]

The envisaged plant has a nominal capacity of 25,000 tons of malt per year, with an input of about 35,000 tons of surghum. It will be operated 300 days a year, 3 shifts per day, 8 hours per shift.

The financial analysis of such a project was carried out. Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed Assets: US$ 11,248,500 (US$ 6,817,000 in foreign currency)
- Working capital (at full production): US$ 647,183
- Internal Rate of Return: 20.87%
- Break-Even Point: 33%
- Pay-Back Period: little more than 6 years (including construction period)
- Employees: 70

On the basis of the analysis in this study, it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

The present study takes into consideration sorghum (Guinea Corn) as alternative raw material to barley for production of beer. Barley is considered as the traditional raw material for malting in the brewing industry. Before the ban, large quantities of barley were imported by Nigeria to cover the needs of the local producers.

In recent years Nigeria's economic constraints and import restrictions on cereals, barley included, led to the search for an alternative source for malt, suitable to be used as brewing material. Sorghum malt was found to be a good substitute to barley malt since 1943 in U.S.A. and later introduced also in other countries like India and South Africa. The environmental conditions of Nigeria, day-time relatively short and temperatures relatively high, are very suitable to sorghum growing, whilst on the other hand they aren't good for barley cultivation.

[1] For additional background material, see Volume I p. 110..

For these reasons and because of low water requirements and resistance to dry spells, sorghum is one of the largely grown cereals in Nigeria. Major States cultivating sorghum are Sokoto, Gongola, Bauchi and Niger. Average yield is estimated at 0.78 ton per hectare, in line with other countries under similar conditions as Nigeria. Presently, in Nigeria about 50 establishments operate in beer and brewery related activities. Out of these two are using sorghum malt (Savannah Grains & Food Processing Co. Ltd. in Kaduna State and Benman Development Co. Ltd in Anambra State) with good results, even if in conjunction with barley malt.

2. MARKET AND PLANT CAPACITY

2.1 MARKET DEMAND AND SUPPLY

Nigeria's production capacity of beer is roughly estimated in 21,000,000 hectolitres a year. The market demand is increasing, so the raw material demand should have positive trend. On the other hand the ban on imported barley, which is the traditional raw material used for producing beer, causes difficulties to the brewing factories.

The sorghum planted area in Nigeria is estimated at 4,500,000 hectares, producing at 3,500,000 tons of crop. Assuming that 1 ton of sorghum produces 0.7 ton of malt which is needed to produce about 50 hectolitres of beer, the quantity of sorghum required to produce 21,000,000 hectolitres of beer (the whole Nigerian production) will be 420,000 tons, that means about 12% of the annual sorghum production.

Presently, the sorghum produced in Nigeria is not sufficient to cover the total demand, which includes only in small part the brewing industries (mainly it is utilized for alimentary purposes, for producing sugar and for animal feeding).

However, the area planted with sorghum is rapidly expanding. It is expeceted that the gap is covered soon.

2.2 PLANT CAPACITY

The proposed plant will produce 25,000 tons of sorghum malt per year, with an input of 35,000 tons of sorghum and will be operated 300 days a year on a basis of 3 shifts per day, 8 hours each shift.

2.3 SALE PRICE AND REVENUE

For the financial evaluation of the project revenue the selling price of sorghum malt has been estimated at 380 $/ton.

Hence, the annual revenue for the envisaged production, at full capacity, would be US$ 9,500,000 $.

3. MATERIALS AND INPUTS AND AVAILABILITY

The raw material needed by the plant is sorghum. Other inputs are water, electric energy, fuel oil. All of these requirements are listed here below with the relevant costs.

Raw materials	Tons/year	Unit cost $/t	Annual cost $
Sorghum	35,000	130	4,550,000

Utilities	Yearly Consumption	Unit cost	Annual Cost $/
Electricity	5,630,000 kWh	0.10 $/kWh	563,000
Fuel oil	3,500 tons	30 $/t	105,000
Water	350,000 m^3	0.006 $/m^3$	2,000
TOTAL	----	----	670,000

The final product, sorghum malt, is usually stored in silos and directly sent in bulk to breweries, so no packaging material is needed.

Both raw materials and other inputs are locally available.

4. LOCATION

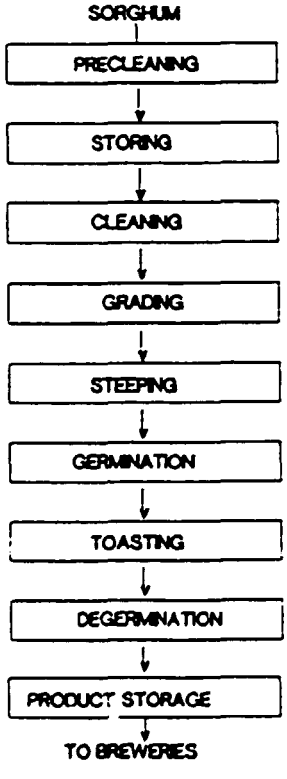
The sorghum malting plant should be located near to the final utilizers, that means in an area close to one are more breweries, possibly within a range of about 100 kilometers. Other requirements to be considered for the site selection are the infrastructural facilities like power and water supply and good communication services (roads, expressways, railway).

5. PROCESS ENGINEERING

5.1 PROCESS DESCRIPTION

Beer is normally produced from malt of barley or other cereals. Malting process, which plays a basic role in brewing, consists in turning the starch of cereals into maltose and glucose, both susceptible of fermentation. Malting is due to specific enzymes "amylasis", which develop during cereals germination.

The following diagram shows the main steps of the sorghum malting process:



Grading has the purpose to select grains having homogeneous size, that is very important for an even germination at the following step.

Steeping takes place in tanks, where sorghum grains absorb water up to 50% of their weight. This stage lasts 2-3 days at about 15 C temperature.

Germination lasts one week and is the core stage of the malting process. Two different germinations exist:

- in the "box malting" process sorghum grains are placed on a grid-bed in the germination tunnel where they are continuously stirred and ventilated. The temperature ranges from 10 to 25 C.

- in the "flow malting" process wet sorghum grains are placed into a rotating drum performing stirring by motion.

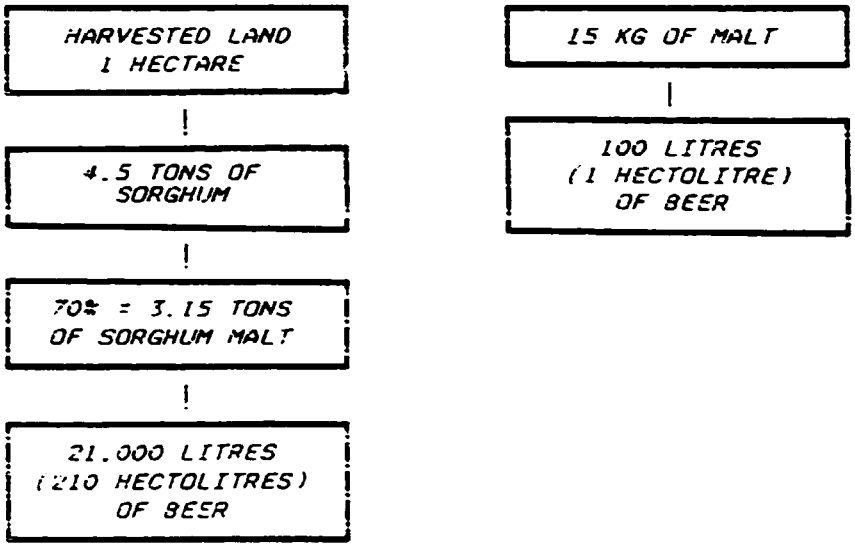
Toasting is the next step, carried out at 60-70 C temperature in such a manner that enzymes are not rendered inactive.

Degermination is the final step. It is a mechanical action to separate culms from caryopsises. Sorghum malt is then stored into silos, ready to be sent to the breweries.

Quality and yield of malting process depend upon the sorghum variety. The best results have been reached with the white sorghum which is the most common "type" in Nigeria. Red and Yellow qualities had less good results.

5.2 PRODUCTION YIELDS

The average yield of harvested land ranges about 4,500 kg of sorghum each hectare. Sorghum yields 70% as malt and 15 kg of sorghum malt are needed to produce 100 litres of beer. The following block-diagrams show clearly the average yields.



5.3 MAIN EQUIPMENT LIST

The main machinery and equipment of the sorghum malting plant is listed here below:

5 silos 1,500 tons capacity

2 pre-cleaning machines

2 gravimetric type separators

5 tanks 150 tons capacity

5 sorghum steeping tanks

50 units of germinating boxes

3 kilns

3 malt degerminating units

7 silos 150 tons capacity.

Belt and screw conveyors, elevators

Electrical plant

5.3.1 Utilities

The utilities equipment includes:

- 2 (1 + 1 stand-by) steam boilers 6,000 kg/h capacity at 6 bar + complete with feed water softener.

- 1 air compressor, capacity 100 m^3/h at 7 bar

- 1 gen set 400 kV.A, diesel engine air cooled.

5.3.2 Laboratory

The necessary equipment for carrying out tests and analyses on raw material and final product to be provided.

5.3.3 Maintenance workshop

A shop is needed for the current mechanical and electrical maintenance, equipped with few small machine tools, welding machines, working benches and hand tools.

5.3.4 Transport equipment

For internal handling, an electric fork-lift has been included and a second one, diesel engine powered, for external utilization.

5.4 LAY-OUT AND CIVIL WORKS

The area required for the installation of the plant, including open yard, truck loading/unloading areas, is about 20,000 square meters. The covered area is 3,900 square meters split as follows:

Working shed	3,000 sq. meters
Workshop	400 sq. meters
Utilities	200 sq. meters
Offices	300 sq. meters
TOTAL	3,900 sq. meters

The working shed, workshop and utilities buildings will be in steel structure, with roofing made of galvanized steel sheets. Cladding and internal partition walls will be made in cement blocks or clay bricks. The floor of the industrial area will be of reinforced concrete slabs, the floor of the offices of ceramic tiles. A fencing net supported by small steel poles will surround the whole factory area.

5.5 INVESTMENT COSTS

The estimated investment costs are shown in the following table.

The machinery and equipment have been quoted by PIERALISI, Ancona, Italy.

Technical offer have been received by Dr. Huppmann, Germany and HENESA, Switzerland.

Description	Local Currency $	Foreign Currency $	Total $
Machinery and equipment	4,800,000	---	4,800,000
Transport, taxes and duties	480,000	960,000	1,440,000
Erection	480,000	960,000	1,440,000
Land and site preparation	---	100,000	100,000
Civil works and buildings	---	1,700,000	1,700,000
Spare parts	130,000	---	130,000
Total	**5,890,000**	**3,720,000**	**9,610,000**
Contingencies 10%	**589,000**	**372,000**	**961,000**
Grand total	**6,479,000**	**4,092,000**	**10,571,000**

The industrial life of the plant has been considered 15 years. In the financial evaluation the investment cost, including contingencies, are so subdivided:

Preproduction expenditures	FC	US$	0
Preproduction expenditures	LC	US$	150,000
Machinery	FC	US$	6,479,000
Machinery	LC	US$	2,112,000
Land & Site preparation	LC	US$	110,000
Civil works and buildings	LC	US$	1,870,000
TOTAL		US$	10,721,000

The annual expenditures for maintenance are estimated 130,000 US $.

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skill is required for any of the positions listed here below. It is however recommended that on the job training is carried out by one expert, made available by the technology supplier, for one year after the start-up. The relevant cost is estimated US$ 120,000. The number of personnel reflects the needs for three shifts.

7.1 MANAGEMENT

		Salary (Naira/year)
General manager	1	50,000
Technical manager	1	40,000
	2	90,000
	Overhead 40%	36,000
		126,000

7.2 ADMINISTRATIVE DEPT.

		Salary (Naira/year)
Financial manager	1	40,000
Accountants	2	24,000
Purchasing head	1	12,000
Store head	1	12,000
Sales dept. head	1	12,000
Clerks	3	36,000
Guards	6	36,000
Drivers	4	32,000
	19	204,000
	Overhead 40%	81,600
		285,600

7.3 PRODUCTION DEPT.

		Salary (Naira/year)
Production manager	1	40,000
Shift foremen (1 each shift)	3	36,000
Analyst	2	20,000
Unskilled workers (8 each shift)	24	96,000
Semiskilled workers (4 each shift)	12	72,000
	42	264,000
	Overhead 40%	105,600
		396,600

7.4 MAINTENANCE DEPT.

		Salary (Naira/year)
Mechanics	4	40,000
Electricians	3	30,000
	7	70,000
	Overhead 40%	28,000
		98,000

7.5 SUMMARY

		Salary (Naira/year)	$/y
Management & Administr.	21	411,600	52,100
Production	42	369,600	46,800
Maintenance	7	98,000	12,400
GRAND TOTAL (rounded)	70	879,000	111,000

8. IMPLEMENTATION SCHEDULE

From the signing of the contract 18 months are required for the construction and commissioning of the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 11,248,500 US Dollars. The portion in foreign currency accounts for 6,817,000 US Dollars.

Details of these figures are shown in chapter 5.4

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,830,000	US$ 1,891,000	US$ 3,721,000
- Foreign Loan (interest 8%)	US$ 1,500,000	US$ 44,000,000	US$ 5,500,000
- Local Loan (interest 15%)	US$ 500,000	US$ 1,000,000	US$ 1,500,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 60%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 647,000 US Dollars.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US $ 410,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 60% of its nominal capacity, the production costs amount to US $ 5,157,400.

In the third year, at full production, the costs amount to US $ 6,897,400 then they start a slight decrease year after year, to arrive to be constant to US $ 5,461,300 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 9,500,000. As said before, the production programme foresees that full production is reached gradually:

1st year 60% : revenue = US$ 5,700,000

2nd year 80% : revenue = US$ 7,600,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 20.87% of production.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 33%

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 6.5 years, including the construction period.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

SORGHUM MALTING PLANT
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US$

Total initial investment during construction phase

fixed assets:	11248.50	60.621 % foreign
current assets:	0.00	0.000 % foreign
total assets:	11248.50	60.621 % foreign

Source of funds during construction phase

equity & grants:	3721.00	0.000 % foreign
foreign loans :	5500.00	
local loans :	1500.00	
total funds :	10721.00	51.301 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	3450.30	5461.30	5461.30
depreciation :	1042.10	1020.10	93.50
interest :	665.00	220.00	0.00
production costs	5157.40	6701.40	5554.80
thereof foreign	24.20 %	13.92 %	1.17 %
total sales :	5700.00	9500.00	9500.00
gross income :	542.60	2798.60	3945.20
net income :	325.56	1679.16	2367.12
cash balance :	-229.12	2011.76	2460.62
net cashflow :	1623.38	2919.26	2460.62

Net Present Value at: 10.00 % = 8178.60
Internal Rate of Return: 20.87 %
Return on equity1: 29.72 %
Return on equity2: 28.67 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	110.000	0.000
Buildings and civil works	1000.000	870.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	2600.000	5991.000
Total fixed investment costs	3710.000	6861.000
Pre-production capital expenditures.	217.500	460.000
Net working capital	0.000	0.000
Total initial investment costs	3927.500	7321.000
Of it foreign, in %	52.451	65.005

Total Current Investment in 1000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	409.281	110.550	127.353
Total current investment costs	409.281	110.550	127.353
Of it foreign, %	5.022	0.000	1.538

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	60.000	80.000	100.000	100.000	100.000
Raw material 1	2730.000	3640.000	4550.000	4550.000	4550.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	337.000	450.000	563.000	563.000	563.000
Energy	72.000	85.000	107.000	107.000	107.000
Labour, direct	46.800	46.800	46.800	46.800	46.800
Repair, maintenance	40.000	50.000	65.000	65.000	65.000
Spares	40.000	50.000	65.000	65.000	65.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	3385.800	4321.800	5396.800	5396.800	5396.800
Administrative overheads	64.500	64.500	64.500	64.500	64.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1042.100	1042.100	1031.100	1020.100	1020.100
Financial costs	665.000	535.000	405.000	275.000	220.000
Total production costs	5157.400	5963.400	6897.400	6756.400	6701.400
Costs per unit (single product)	0.344	0.298	0.276	0.270	0.268
Of it foreign, %	24.196	18.159	15.120	14.622	13.921
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	111.300	111.300	111.300	111.300	111.300

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	4550.000	4550.000	4550.000	4550.000	4550.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	563.000	563.000	563.000	563.000	563.000
Energy	107.000	107.000	107.000	107.000	107.000
Labour, direct	46.800	46.800	46.800	46.800	46.800
Repair, maintenance	65.000	65.000	65.000	65.000	65.000
Spares	65.000	65.000	65.000	65.000	65.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	5396.800	5396.800	5396.800	5396.800	5396.800
Administrative overheads	64.500	64.500	64.500	64.500	64.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	952.600	952.600	952.600	952.601	93.500
Financial costs	165.000	110.000	55.000	0.000	0.000
Total production costs	6578.900	6523.900	6468.900	6413.901	5554.800
Costs per unit (single product)	0.263	0.261	0.259	0.257	0.222
Of it foreign, %	13.344	12.614	11.871	11.115	1.170
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	111.300	111.300	111.300	111.300	111.300

Total Production Costs in 1000 US$

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	4550.000
Other raw materials	0.000
Utilities	563.000
Energy	107.000
Labour, direct	46.800
Repair, maintenance	65.000
Spares	65.000
Factory overheads	0.000
Factory costs	5396.800
Administrative overheads	64.500
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	5461.300
Costs per unit (single product)	0.218
Of it foreign, %	1.190
Of it variable,%	0.000
Total labour	111.300

Net Working Capital in 1000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	287.525	365.525	455.108	455.108
Inventory and materials	28	12.7	241.542	322.083	402.625	402.625
Energy	1	360.0	0.200	0.236	0.297	0.297
Spares	1	360.0	0.111	0.139	0.181	0.181
Work in progress	10	36.4	90.050	118.800	148.256	148.256
Finished products	5	72.8	46.143	60.365	75.129	75.129
Cash in hand	15	24.0	12.971	8.804	10.054	10.054
Total current assets			678.542	875.953	1091.681	1091.681
Current liabilities and						
Accounts payable	30	12.2	269.261	356.122	444.497	444.497
Net working capital			409.281	519.831	647.183	647.183
Increase in working capital			409.281	110.550	127.353	0.000
Net working capital, local			388.725	513.303	638.697	638.697
Net working capital, foreign			20.556	6.528	8.486	8.486

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	1830.000	1891.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1500.000	4000.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	500.000	1000.000
Loan C, local....	0.000	0.000
Total loan	2000.000	5000.000
Current liabilities	0.000	0.000
Bank overdraft	97.500	430.000
Total funds	3927.500	7321.000

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-687.500	-687.500	-687.500	-687.500
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	-500.000	-500.000	-500.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-1187.500	-1187.500	-1187.500	-687.500
Current liabilities	269.261	86.861	88.375	0.000
Bank overdraft	229.121	-726.010	-30.611	0.000
Total funds	-689.118	-1826.649	-1129.736	-687.500

Cashflow Tables, construction in 1000 US$

Year	1990	1991
Total cash inflow	3830.000	6891.000
Financial resources	3830.000	6891.000
Sales, net of tax	0.000	0.000
Total cash outflow	3927.500	7321.000
Total assets	3830.000	6891.000
Operating costs	0.000	0.000
Cost of finance	97.500	430.000
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	-97.500	-430.000
Cumulated cash balance	-97.500	-527.500
Inflow, local	2330.000	2891.000
Outflow, local	1867.500	2562.000
Surplus (deficit)	462.500	329.000
Inflow, foreign	1500.000	4000.000
Outflow, foreign	2060.000	4759.000
Surplus (deficit)	-560.000	-759.000
Net cashflow	-3830.000	-6891.000
Cumulated net cashflow	-3830.000	-10721.000

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	5969.261	7687.167	9588.375	9500.000	9500.000	9500.000
Financial resources	269.261	87.167	88.375	0.000	0.000	0.000
Sales, net of tax	5700.000	7600.000	9500.000	9500.000	9500.000	9500.000
Total cash outflow	6198.382	6961.157	8310.567	7521.240	7488.240	7482.240
Total assets	678.542	197.411	215.728	0.000	0.000	0.000
Operating costs	3450.300	4386.300	5461.300	5461.300	5461.300	5461.300
Cost of finance	665.000	535.000	405.000	275.000	220.000	165.000
Repayment	1187.500	1187.806	1187.500	687.500	687.500	687.500
Corporate tax	217.040	654.640	1041.040	1097.440	1119.440	1168.440
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-229.121	726.010	1277.808	1978.760	2011.760	2017.760
Cumulated cash balance	-756.621	-30.611	1247.197	3225.957	5237.717	7255.478
Inflow, local	5968.817	7687.167	9588.333	9500.000	9500.000	9500.000
Outflow, local	4889.882	5852.684	7226.067	6493.740	6515.740	6564.740
Surplus (deficit)	1078.935	1834.482	2362.266	3006.260	2984.260	2935.260
Inflow, foreign	0.444	0.000	0.042	0.000	0.000	0.000
Outflow, foreign	1308.500	1108.472	1084.500	1027.500	972.500	917.500
Surplus (deficit)	-1308.056	-1108.472	-1084.458	-1027.500	-972.500	-917.500
Net cashflow	1623.379	2448.510	2870.308	2941.260	2919.260	2870.260
Cumulated net cashflow	-9097.621	-6649.111	-3778.804	-837.543	2081.717	4951.977

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	9500.000	9500.000	9500.000	9500.000	9500.000	9500.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	9500.000	9500.000	9500.000	9500.000	9500.000	9500.000
Total cash outflow	7449.240	7416.240	6695.739	7039.380	7076.780	7076.780
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	5461.300	5461.300	5461.300	5461.300	5461.300	5461.300
Cost of finance	110.000	55.000	0.000	0.000	0.000	0.000
Repayment	687.500	687.500	0.000	0.000	0.000	0.000
Corporate tax	1190.440	1212.440	1234.440	1578.080	1615.480	1615.480
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	2050.760	2083.760	2804.261	2460.620	2423.220	2423.220
Cumulated cash balance	9306.238	11390.000	14194.260	16654.880	19078.100	21501.320
Inflow, local	9500.000	9500.000	9500.000	9500.000	9500.000	9500.000
Outflow, local	6586.740	6608.740	6630.739	6974.380	7011.780	7011.780
Surplus (deficit)	2913.260	2891.260	2869.261	2525.620	2488.220	2488.220
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	862.500	807.500	65.000	65.000	65.000	65.000
Surplus (deficit)	-862.500	-807.500	-65.000	-65.000	-65.000	-65.000
Net cashflow	2848.260	2826.260	2804.260	2460.620	2423.220	2423.220
Cumulated net cashflow	7800.237	10626.500	13430.760	15891.380	18314.600	20737.820

Cashflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	9500.000	9500.000	9500.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	9500.000	9500.000	9500.000
Total cash outflow	7076.780	7076.780	7076.780
Total assets	0.000	0.000	0.000
Operating costs	5461.300	5461.300	5461.300
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1615.480	1615.480	1615.480
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	2423.220	2423.220	2423.220
Cumulated cash balance	23924.540	26347.760	28770.980
Inflow, local	9500.000	9500.000	9500.000
Outflow, local	7011.780	7011.780	7011.780
Surplus (deficit)	2488.220	2488.220	2488.220
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	65.000	65.000	65.000
Surplus (deficit)	-65.000	-65.000	-65.000
Net cashflow	2423.220	2423.220	2423.220
Cumulated net cashflow	23161.040	25584.260	28007.480

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	7761.14 at	10.00 %
Internal Rate of Return (IRRE1) ..	29.72 %	

b) Net Worth versus Net cash return:

Net present value	8576.93 at	10.00 %
Internal Rate of Return (IRRE2) ..	28.67 %	

c) Internal Rate of Return on total investment:

Net present value	8178.60 at	10.00 %
Internal Rate of Return (IRR) ..	20.87 %	

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	5700.000	7600.000	9500.000	9500.000	9500.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	5700.000	7600.000	9500.000	9500.000	9500.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4492.400	5428.400	6492.400	6481.400	6481.400
Operational margin	1207.600	2171.600	3007.600	3018.600	3018.600
As % of total sales	21.186	28.574	31.659	31.775	31.775
Cost of finance	665.000	535.000	405.000	275.000	220.000
Gross profit	542.600	1636.600	2602.600	2743.600	2798.600
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	542.600	1636.600	2602.600	2743.600	2798.600
Tax	217.040	654.640	1041.040	1097.440	1119.440
Net profit	325.560	981.960	1561.560	1646.160	1679.160
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	325.560	981.960	1561.560	1646.160	1679.160
Accumulated undistributed profit	325.560	1307.520	2869.080	4515.240	6194.400
Gross profit, % of total sales	9.519	21.534	27.396	28.880	29.459
Net profit, % of total sales	5.712	12.921	16.437	17.328	17.675
ROE, Net profit, % of equity	8.749	26.390	41.966	44.240	45.127
ROI, Net profit+interest, % of invest.	8.900	13.495	17.299	16.399	16.706

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	9500.000	9500.000	9500.000	9500.000	9500.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	9500.000	9500.000	9500.000	9500.000	9500.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	6413.900	6413.900	6413.900	6413.901	5554.800
Operational margin	3086.100	3086.100	3086.100	3086.099	3945.200
As % of total sales	32.485	32.485	32.485	32.485	41.528
Cost of finance	165.000	110.000	55.000	0.000	0.000
Gross profit	2921.100	2976.100	3031.100	3086.099	3945.200
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2921.100	2976.100	3031.100	3086.099	3945.200
Tax	1168.440	1190.440	1212.440	1234.440	1578.080
Net profit	1752.660	1785.660	1818.660	1851.659	2367.120
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1752.660	1785.660	1818.660	1851.659	2367.120
Accumulated undistributed profit	7947.061	9732.721	11551.380	13403.040	15770.160
Gross profit, % of total sales	30.748	31.327	31.906	32.485	41.528
Net profit, % of total sales	18.449	18.796	19.144	19.491	24.917
ROE, Net profit, % of equity	47.102	47.989	48.876	49.762	63.615
ROI, Net profit+interest, % of invest.	16.869	16.675	16.482	16.288	20.822

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	9500.000	9500.000	9500.000	9500.000	9500.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	9500.000	9500.000	9500.000	9500.000	9500.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	5461.300	5461.300	5461.300	5461.300	5461.300
Operational margin	4038.700	4038.700	4038.700	4038.700	4038.700
As % of total sales	42.513	42.513	42.513	42.513	42.513
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	4038.700	4038.700	4038.700	4038.700	4038.700
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	4038.700	4038.700	4038.700	4038.700	4038.700
Tax	1615.480	1615.480	1615.480	1615.480	1615.480
Net profit	2423.220	2423.220	2423.220	2423.220	2423.220
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2423.220	2423.220	2423.220	2423.220	2423.220
Accumulated undistributed profit	18193.380	20616.600	23039.820	25463.040	27886.260
Gross profit, % of total sales	42.513	42.513	42.513	42.513	42.513
Net profit, % of total sales	25.508	25.508	25.508	25.508	25.508
RCE, Net profit, % of equity	65.123	65.123	65.123	65.123	65.123
ROI, Net profit+interest, % of invest.	21.316	21.316	21.316	21.316	21.316

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	3927.500	11248.500
Fixed assets, net of depreciation	0.000	3927.500
Construction in progress	3927.500	7321.000
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	3927.500	11248.500
Equity capital	1830.000	3721.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	2000.000	7000.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	97.500	527.500
Total debt	2097.500	7527.500
Equity, % of liabilities	46.595	33.080

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	10884.940	10040.250	10472.080	11430.740	12422.400
Fixed assets, net of depreciation	10206.400	9164.301	8133.201	7113.101	6093.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	665.571	867.149	1081.626	1081.626	1081.626
Cash, bank	12.971	8.804	10.054	10.054	10.054
Cash surplus, finance available	0.000	0.000	1247.196	3225.957	5237.716
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	10884.940	10040.250	10472.080	11430.740	12422.400
Equity capital	3721.000	3721.000	3721.000	3721.000	3721.000
Reserves, retained profit	0.000	325.560	1307.520	2869.080	4515.240
Profit	325.560	981.960	1561.560	1646.160	1679.160
Long and medium term debt	5812.500	4625.000	3437.500	2750.000	2062.500
Current liabilities	269.261	356.122	444.497	444.497	444.497
Bank overdraft, finance required.	756.621	30.611	0.000	0.000	0.000
Total debt	6838.382	5011.733	3881.997	3194.497	2506.997
Equity, % of liabilities	34.185	37.061	35.533	32.553	29.954

Projected Balance Sheets, Production in 1000 US$

Year	1997	1998	1999	2000	2001
Total assets	13487.560	14585.720	15716.880	17568.540	19935.660
Fixed assets, net of depreciation	5140.400	4187.800	3235.200	2282.599	2189.099
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1081.626	1081.626	1081.626	1081.626	1081.626
Cash, bank	10.054	10.054	10.054	10.054	10.054
Cash surplus, finance available	7255.477	9306.236	11390.000	14194.260	16654.880
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	13487.560	14585.720	15716.880	17568.540	19935.660
Equity capital	3721.000	3721.000	3721.000	3721.000	3721.000
Reserves, retained profit	6194.400	7947.061	9732.721	11551.380	13403.040
Profit	1752.660	1785.660	1818.660	1851.659	2367.120
Long and medium term debt	1375.000	687.500	0.000	0.000	0.000
Current liabilities	444.497	444.497	444.497	444.497	444.497
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1819.497	1131.997	444.497	444.497	444.497
Equity, % of liabilities	27.588	25.511	23.675	21.180	18.665

Projected Balance Sheets, Production in 1000 US$

Year	2002	2003	2004	2005	2006
Total assets	22358.880	24782.100	27205.320	29628.540	32051.760
Fixed assets, net of depreciation	2189.099	2189.099	2189.099	2189.099	2189.099
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1081.626	1081.626	1081.626	1081.626	1081.626
Cash, bank	10.054	10.054	10.054	10.054	10.054
Cash surplus, finance available	19078.100	21501.320	23924.540	26347.760	28770.980
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	22358.880	24782.100	27205.320	29628.540	32051.760
Equity capital	3721.000	3721.000	3721.000	3721.000	3721.000
Reserves, retained profit	15770.160	18193.380	20616.600	23039.820	25463.040
Profit	2423.220	2423.220	2423.220	2423.220	2423.220
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	444.497	444.497	444.497	444.497	444.497
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	444.497	444.497	444.497	444.497	444.497
Equity, % of liabilities	16.642	15.015	13.677	12.559	11.609

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR A CITRUS PROCESSING PLANT IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a citrus processing plant to produce concentrate juice and essential oil. The proposed plant has a nominal capacity of 1,900 tons/year of orange concentrate juice and 75 t/y of essential oil over a period of 180 working days (harvesting season).[1] The plant will be operated 3 shifts/day, 8 hours/shift.

The plant is suitable to process also lemmons, limes and grapefruits. The orange concentrate juice will be sold to the soft drinks producers, while the essential oil can be sold to cosmetics producers, to the food industry and they can also be exported.

The financial analysis of such as a project was carried out. Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed Assets: US$ 5,385,000 (US$ 3,175,000 in foreign currency)
- Working capital (at full production) US$ 82,300
- Internal Rate of Return : 18.29%
- Break-Even Point (at 5th year of production): 36%
- Pay-Back Period: 7 years (including construction period)
- Employees: 89

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 18,260,030 (as a present value at 10%).

On the basis of the analysis in this study, it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

The oranges, which are cultivated in Benue, Oyo, Ogun and Anambra States, are mainly "Washington Navel" and "Valencia Late", whose period of harvesting starts in November and lasts in April/May. The oranges growing in Nigeria, as far as quality is concerned, are not so good as the Mediterranean or Brazilian ones. These negative characteristics do not allow their exports as fresh fruits, therefore they are consumed locally as fresh fruits and turned into juice.

(1) For additional background material, see Volume I p. 119.

2. MARKET AND PLANT CAPACITY

2.1 MARKET DEMAND AND SUPPLY

The demand for orange juice cannot be determined, since statistical data are not available. The only information available is that in Nigeria there are 12 soft drinks producers of juices and soft drinks. Their total output is estimated in the range of 4,500 to 5,000 t/y. Many of these import concentrate juices from Brazil, others from California.

According to what stated by some producers, the demand for citrus juices is increasing and the import of the concentrate juices, as raw material, is increasing accordingly.

The local production of orange concentrate juice can easily find its share. The essential oil, whose quantity is of certain importance, can be sold to the Nigerian market and also exported.

2.2 PLANT CAPACITY

The proposed plant will produce orange concentrate juice and essential oil. The plant is suitable to process other types of fruits like lime, lemmon and others.

The processing capacity will be 8 t/hour of oranges to produce about 3.2 t/h of fresh juice at 10 Brix and 0.48 t/h of concentrate juice at 65 Brix. Considering 180 working days a year and 3 shifts per day, on a basis of 22 hours of actual production each day, the yearly output will be 1,900 tons of concentrate juice (orange) at 65 Brix and about 75 tons of essential oil.

2.3 SALE PRICES AND REVENUE

The exworks selling prices considered for the revenues calculation are the following:

orange concentrate juice = 1,600 US $/ton

orange essential oil = 3,500 US $/ton.

These values are equivalent to the present international prices.

The annual revenue therefore is:

orange concentrate juice	=	1,900 tons x 1,600 $/t =	US$ 3,040,000
essential oil	=	75 tons x 3,500 $/t =	US$ 262,500
		Total	US$ 3,219,000

3. MATERIALS AND INPUTS

Oranges are the the raw material from which concentrate juice and essential oil will be obtained.

As said before, oranges are grown in 4 states and they are traded at 27 US$/t.

Other inputs are the metal containers having a capacity of 5 kg each and a unit cost of US$ 0.6.

Utilities needed are electric energy, fuel oil and water.

The table herebelow shows the annual requirement and the relevant costs of both raw materials and inputs.

Description	unit	Quantity	Unit cost $	Total cost $
1 Raw material				
Oranges	t	33.265 (1)	27	898,128
Container	nos	395,000	0.6	237,000
1 Sub-total: raw materials				**1,135,128**
2 Utilities				
Electric Energy	KWh	2,000,000	0.1	200,000
Fuel oil	t	1000	30	30,000
Cooling water	m^3	180,000	0.006	1,100
2 Sub-total : utilities				**231,100**
Grand total (1 + 2)				**1,366,228**

4. LOCATION

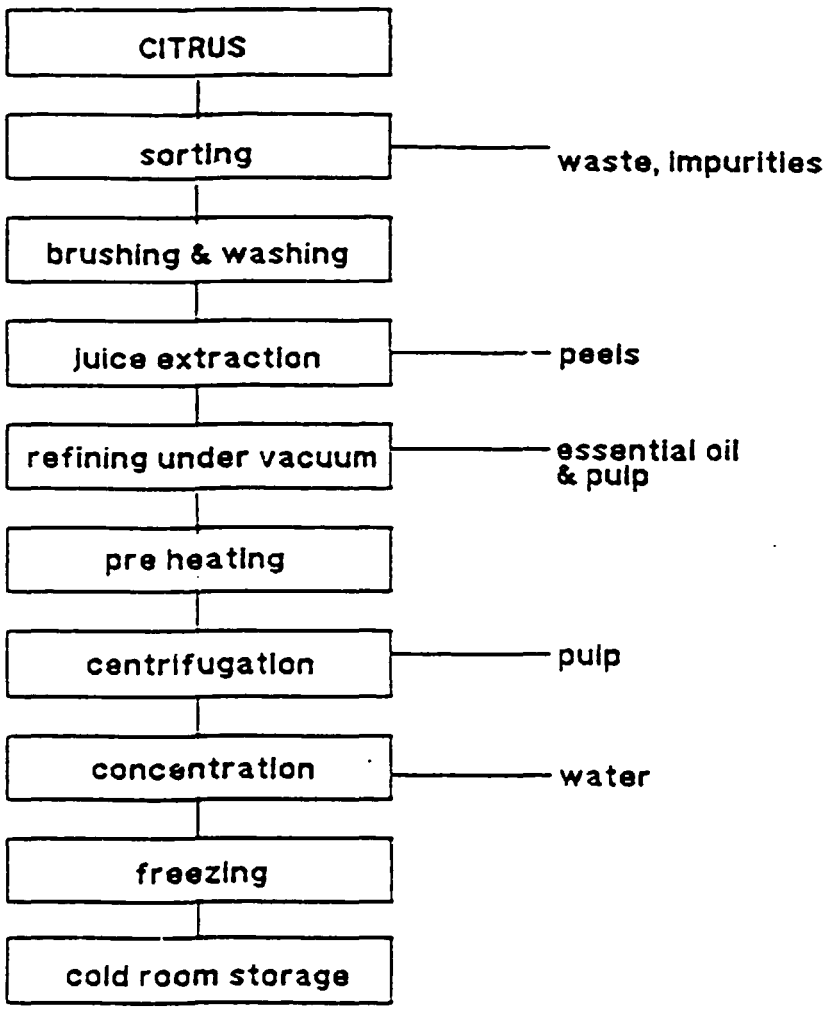
The plant should be located near Macurdi, Benue State, owing to the raw material availability and the existing infrastructures (road network, power distribution grid etc.).

(1) 5% of scrap has been considered.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

The process main steps are illustrated in the following block diagram:



Citrus fresh fruits after sorting are mechanically brushed and washed to allow the mould particles to be removed. Then they enter the extraction unit, which consists of two parts, the first one suitable to extract the essential oils contained in the peel of fruits, the second part suitable to extract the juice. More in detail, the essential oil, obtained by rasping the outer surface of the whole fruit, is gathered by means of water sprays and the emulsion flows into a two stage finisher, where the solid particles in suspension are separated by centrifugation.

The clarified emulsion is then fed to the centrifuge separator to recover the essential oil. After the oil extraction, the fruit automatically enter the second part of the extraction machine that is the juice extraction section. Here each fruit is cut into two halves and squeezed. The juice is collected and sent to the centrifuge clarifiers.

The clarified juice is then concentrated by evaporating part of the moisture content. The next steps are the pasteurization of concentrate and the final packaging into containers.

5.2 PRODUCTION YIELD

Yield of finished product (concentrate juice) depends upon the type and quality of fruit. The following average yields are considered:

Fruit	Input Quantity	Juice	Concentrate Juice	Essential Oil
Orange	8,000 kg	3,200 litres at 10 Brix	480 kg at 65 Brix	19.2 kg
Lime [2]	2,400 kg	800 litres at 7 Brix	128 kg at 45 Brix	8 kg

5.3 MAIN EQUIPMENT LIST

The main machinery and equipment of the citrus processing plant is the following:

1) Feeding and sorting conveyor belt

2) Brushing and washing machine

3) Feeding belt

4) Extraction plant, suitable for extraction both of essential oil and of juice from the fresh fruits

5) Conveyor belt for peels and scraps

6) Screw-conveyor for discharging of scraps

7) Under vacuum one-stage refiner

8) Vacuum pump

9) Pre-heater

10) Centrifuges

[2] Indicated for comparison only

11) Double effect concentration unit

12) Pumps of various capacity

13) Tanks of various capacity

14) Filling/packing machine

15) Freezing tunnel

16) Cold room

5.3.1 Utilities

- 2 (1+1 stand-by) steam boilers, capacity 3,000 kg/h at 6 bar, complete with water softener

- 1 air compressor 40 m^3/h at 7 bar

- 1 gen-set 300 kVA

- Refrigerating unit

5.3.2 Laboratory

The equipment for the determination of the bacteriological charge and of pH value is provided.

5.3.3 Maintenance workshop

A workshop is foreseen for the current mechanical and electrical maintenance operation. It will be provided with the basic equipment and tools.

5.3.4 Transport equipment

For internal handling an electrical fork-lift has been foreseen and a second one, diesel engine powered, for the external services.

In addition, a refrigerated truck is foreseen for transportation of the concentrates to the customers.

5.4 LAY-OUT AND CIVIL WORKS

The area required for the whole plant, including open yard, roads, truck loading/unloading area, is about 8,000 square meters. Out of these the covered area is 2,200 sq. meters split as follows:

Working shed	1,000 sq. meters
Storehouse	200 sq. meters
Cold room	400 sq. meters
Workshop	200 sq. meters
Utilities room	200 sq. meters
Offices	200 sq. meters
TOTAL	2,200 sq. meters

Administrative offices will be of reinforced concrete with external and internal walls of brickwork. Working shed and workshop will have a steel structure with roof and cladding made of corrugated asbestos sheets. A fencing wire net will sorround the whole factory. The cold room where the temperature will be minus 20 centigrades will be heat insulated by using proper sandwich panels.

5.5 INVESTMENT COSTS

The estimated investment costs are shown in the following table. The machinery and equipment have been quoted by Bertuzzi, Milano, Italy.

Description	Local Currency $	Foreign Currency $	Total $
Machinery and equipment			
F.O.B. European Port	---	2,200,000	2,200,000
Transport, taxes and duties	440,000	220,000	660,000
Erection	440,000	220,000	660,000
Land and site preparation	100,000	---	100,000
Civil works and buildings	950,000	---	950,000
Spare parts	---	70,000	70,000
Total	1,930,000	2,710,000	4,640,000
Contingencies 10%	193,000	271,000	464,000
Grand Total	2,123,000	2,981,000	5,104,000

The industrial life of the plant has been considered 15 years. The annual expenditures for maintenance are estimated at US $ 50,000.

In the financial evaluation the investment cost, including contingencies, are so subdivided:

Preproduction expenditures	FC	US$	0
Preproduction expenditures	LC	US$	85,000
Machinery	FC	US$	2,981,000
Machinery	LC	US$	968,000
Land & Site preparation	LC	US$	110,000
Civil works and buildings	LC	US$	1,045,000
TOTAL		US$	5,189,000

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skill is required for any of the positions listed herebelow. It is however recommended that on the job training is carried out by one expert, made available by the technology supplier, for one year (two campaigns) after the start up. The relevant cost is estimated US$ 120,000.

The number of personnel reflects the needs of three shifts.

7.1 MANAGEMENT

		Salary (Naira/year)[3]
General manager	1	50,000
Technical manager	1	40,000
	2	90,000
	Overhead 40%	36,000
		126,000

[3] The actual cost is lower, if it is considered that the plant is operated 180 days/y instead of 250 days. The difference is negligible.

7.2 ADMINISTRATIVE DEPT.

		Salary (Naira/year)
Financial manager	1	40,000
Accountants	2	24,000
Purchasing head	1	12,000
Store head	1	12,000
Sales dept. head	1	12,000
Clercks	3	36,000
Guards	6	36,000
Drivers	4	32,000
	19	204,000
	Overhead 40%	81,600
		285,600

7.3 PRODUCTION DEPT.

		Salary (Naira/year)
Production manager	1	40,000
Shift foremen (1 each shift)	3	36,000
Lab chief	1	25,000
Lab staff	2	20,000
Unskilled workers (12 each shift)	36	144,000
Semiskilled workers (5 each shift)	15	90,000
	58	355,000
	Overhead 40%	142,000
		497,000

7.4 MAINTENANCE DEPT.

		Salary (Naira/year)
Mechanics	6	60,000
Electricians	4	40,000
	10	100,000
	Overhead 40%	40,000
		140,000

7.5 SUMMARY

		Salary (Naira/year)	$/y
Management & Administr.	21	411,600	52,100
Production	58	497,000	62,900
Maintenance	10	140,000	17,700
GRAND TOTAL	89	1,048,600	132,700

8. IMPLEMENTATION SCHEDULE

From the signing of the contract 18 months are required for the construction and commissioning of the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 5,385,000 US Dollars. The portion in foreign currency accounts for 3,175,000 US Dollars.

Details of these figures are shown in chapter 5.4

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,845,000	US$ 644,000	US$ 2,489,000
- Foreign Loan (interest 8%)	US$ 1,100,000	US$ 1,600,000	US$ 2,700,000
- Local Loan (interest 15%)	US$ 0	US$ 0	US$ 0

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 60%

3rd year and subsequent years 100%

When the plant is in full production, the required working capital amounts to 80,000 US Dollars.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US $ 1,804,570.

In the third year, at full production, the costs amount to US $ 2,186,058, then they start a slight decrease year after year, to reach a constant amount of US $ 1,548,908 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 3,302,500. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 1,981,500

2nd year 60% : revenue = US$ 2,642,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 18.48%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 36% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [4] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is seven years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

[4] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of capacity utilization.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 18,260,030.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amount to US$ 18,260,030.

ANNEXE 1

COMFAR SCHEDULES

CITRUS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1,000 US$

Total initial investment during construction phase

fixed assets:	5385.00	58.997 % foreign
current assets:	0.00	0.000 % foreign
total assets:	5385.00	58.997 % foreign

Source of funds during construction phase

equity & grants:	2489.00	0.000 % foreign
foreign loans :	2700.00	
local loans :	0.00	
total funds :	5189.00	52.033 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1102.42	1548.91	1548.91
depreciation :	486.15	464.15	52.25
interest :	216.00	108.00	0.00
production costs	1804.57	2121.06	1601.16
thereof foreign	36.30 %	20.80 %	2.19 %
total sales :	1981.50	3302.50	3302.50
gross income :	176.93	1181.44	1701.34
net income :	106.16	708.87	1020.81
cash balance :	184.35	835.52	1073.05
net cashflow :	737.85	1281.02	1073.05

Net Present Value at: 10.00 % = 3074.75
Internal Rate of Return: 18.29 %
Return on equity1: 19.93 %
Return on equity2: 23.29 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1,000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	110.000	0.000
Buildings and civil works	1065.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	1730.000	2219.000
Total fixed investment costs	2885.000	2219.000
Pre-production capital expenditures.	104.000	177.000
Net working capital	0.000	0.000
Total initial investment costs	2989.000	2396.000
Of it foreign, in %	44.965	76.503

Total Current Investment in 1,000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	70.462	-1.915	13.753
Total current investment costs	70.462	-1.915	13.753
Of it foreign, %	41.027	0.000	32.095

Total Production Costs in 1,000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	538.870	718.500	898.128	898.128	898.128
Other raw materials	142.200	189.600	237.000	237.000	237.000
Utilities	18.650	24.860	31.080	31.080	31.080
Energy	120.000	160.000	200.000	200.000	200.000
Labour, direct	62.900	62.900	62.900	62.900	62.900
Repair, maintenance	9.000	12.000	15.000	15.000	15.000
Spares	21.000	28.000	35.000	35.000	35.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	1032.620	1195.860	1479.108	1479.108	1479.108
Administrative overheads	69.800	69.800	69.800	69.800	69.800
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	486.150	486.150	475.150	464.150	464.150
Financial costs	216.000	189.000	162.000	135.000	108.000
Total production costs	1804.570	1940.810	2186.058	2148.058	2121.058
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	36.302	26.540	22.648	21.792	20.796
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	132.700	132.700	132.700	132.700	132.700

Total Production Costs in 1,000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	898.128	898.128	898.128	898.128	898.128
Other raw materials	237.000	237.000	237.000	237.000	237.000
Utilities	31.080	31.080	31.080	31.080	31.080
Energy	200.000	200.000	200.000	200.000	200.000
Labour, direct	62.900	62.900	62.900	62.900	62.900
Repair, maintenance	15.000	15.000	15.000	15.000	15.000
Spares	35.000	35.000	35.000	35.000	35.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	1479.108	1479.108	1479.108	1479.108	1479.108
Administrative overheads	69.800	69.800	69.800	69.800	69.800
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	447.150	447.150	447.150	447.150	52.250
Financial costs	81.000	54.000	27.000	0.000	0.000
Total production costs	2077.058	2050.058	2023.058	1996.058	1601.158
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	19.937	18.882	17.800	16.688	2.186
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	132.700	132.700	132.700	132.700	132.700

Total Production Costs in 1,000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	898.128
Other raw materials	237.000
Utilities	31.080
Energy	200.000
Labour, direct	62.900
Repair, maintenance	15.000
Spares	35.000
Factory overheads	0.000
Factory costs	1479.108
Administrative overheads	69.800
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	1548.908
Costs per unit (single product)	0.000
Of it foreign, %	2.260
Of it variable,%	0.000
Total labour	132.700

Net Working Capital in 1,000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	91.868	105.472	129.076	129.076
Inventory and materials	6	62.5	11.193	14.923	18.654	18.654
Energy	1	360.0	0.333	0.444	0.556	0.556
Spares	180	2.0	10.500	14.000	17.500	17.500
Work in progress	2	180.0	5.737	6.644	8.217	8.217
Finished products	5	73.6	13.745	17.267	21.124	21.124
Cash in hand	15	24.0	11.779	7.196	7.612	7.612
Total current assets			145.155	165.946	202.739	202.739
Current liabilities and						
Accounts payable	29	12.3	74.693	97.399	120.440	120.440
Net working capital			70.462	68.547	82.300	82.300
Increase in working capital			70.462	-1.915	13.753	0.000
Net working capital, local			41.553	50.891	60.230	60.230
Net working capital, foreign			28.908	17.656	22.069	22.069

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1,000 US$

Year	1990	1991
Equity, ordinary ..	1845.000	644.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1100.000	1600.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	0.000
Total loan	1100.000	1600.000
Current liabilities	0.000	0.000
Bank overdraft	44.000	152.000
Total funds	2989.000	2396.000

Source of finance, production in 1,000 US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-337.500	-337.500	-337.500	-337.500
Loan B, foreign...	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-337.500	-337.500	-337.500	-337.500
Current liabilities	74.693	22.706	23.040	0.000
Bank overdraft	-184.346	-11.654	0.000	0.000
Total funds	-447.153	-326.448	-314.460	-337.500

Cashflow Tables, construction in 1,000 US$

Year	1990	1991
Total cash inflow . .	2945.000	2244.000
Financial resources .	2945.000	2244.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	2989.000	2396.000
Total assets	2945.000	2244.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	44.000	152.000
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-44.000	-152.000
Cumulated cash balance	-44.000	-196.000
Inflow, local	1845.000	644.000
Outflow, local	1645.000	563.000
Surplus (deficit) .	200.000	81.000
Inflow, foreign . . .	1100.000	1600.000
Outflow, foreign . . .	1344.000	1833.000
Surplus (deficit) .	-244.000	-233.000
Net cashflow	-2945.000	-2244.000
Cumulated net cashflow	-2945.000	-5189.000

Cashflow tables, production in 1,000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	2056.193	2665.020	3325.540	3302.500	3302.500	3302.500
Financial resources	74.693	23.020	23.040	0.000	0.000	0.000
Sales, net of tax	1981.500	2642.000	3302.500	3302.500	3302.500	3302.500
Total cash outflow	1871.847	2093.741	2531.777	2483.185	2466.985	2457.585
Total assets	145.155	20.791	36.793	0.000	0.000	0.000
Operating costs	1102.420	1265.660	1548.908	1548.908	1548.908	1548.908
Cost of finance	216.000	189.000	162.000	135.000	108.000	81.000
Repayment	337.500	337.814	337.500	337.500	337.500	337.500
Corporate tax	70.772	280.476	446.577	461.777	472.577	490.177
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	184.346	571.279	793.763	819.315	835.515	844.915
Cumulated cash balance	-11.654	559.625	1353.388	2172.703	3008.218	3853.133
Inflow, local	2055.802	2665.020	3325.521	3302.500	3302.500	3302.500
Outflow, local	1148.047	1550.494	1992.844	1975.685	1986.485	2004.085
Surplus (deficit)	907.755	1114.526	1332.676	1326.815	1316.015	1298.415
Inflow, foreign	0.392	0.000	0.019	0.000	0.000	0.000
Outflow, foreign	723.800	543.247	538.933	507.500	480.500	453.500
Surplus (deficit)	-723.408	-543.247	-538.914	-507.500	-480.500	-453.500
Net cashflow	737.846	1097.779	1293.262	1291.815	1281.015	1263.415
Cumulated net cashflow	-4451.153	-3353.375	-2060.112	-768.297	512.718	1776.133

Cashflow tables, production in 1,000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	3302.500	3302.500	3302.500	3302.500	3302.500	3302.500
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	3302.500	3302.500	3302.500	3302.500	3302.500	3302.500
Total cash outflow	2441.385	2425.185	2071.485	2229.445	2250.345	2250.345
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	1548.908	1548.908	1548.908	1548.908	1548.908	1548.908
Cost of finance	54.000	27.000	0.000	0.000	0.000	0.000
Repayment	337.500	337.500	0.000	0.000	0.000	0.000
Corporate tax	500.977	511.777	522.577	680.537	701.437	701.437
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	861.115	877.315	1231.015	1073.055	1052.155	1052.155
Cumulated cash balance	4714.248	5591.563	6822.578	7895.633	8947.788	9999.943
Inflow, local	3302.500	3302.500	3302.500	3302.500	3302.500	3302.500
Outflow, local	2014.885	2025.685	2036.485	2194.445	2215.345	2215.345
Surplus (deficit)	1287.615	1276.815	1266.015	1108.055	1087.155	1087.155
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	426.500	399.500	35.000	35.000	35.000	35.000
Surplus (deficit)	-426.500	-399.500	-35.000	-35.000	-35.000	-35.000
Net cashflow	1252.615	1241.815	1231.015	1073.055	1052.155	1052.155
Cumulated net cashflow	3028.748	4270.563	5501.578	6574.633	7626.788	8678.943

Cashflow tables, production in 1,000 US$

Year	2004	2005	2006
Total cash inflow	3302.500	3302.500	3302.500
Financial resources	0.000	0.000	0.000
Sales, net of tax	3302.500	3302.500	3302.500
Total cash outflow	2250.345	2250.345	2250.345
Total assets	0.000	0.000	0.000
Operating costs	1548.908	1548.908	1548.908
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	701.437	701.437	701.437
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	1052.155	1052.155	1052.155
Cumulated cash balance	11052.100	12104.250	13156.410
Inflow, local	3302.500	3302.500	3302.500
Outflow, local	2215.345	2215.345	2215.345
Surplus (deficit)	1087.155	1087.155	1087.155
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	35.000	35.000	35.000
Surplus (deficit)	-35.000	-35.000	-35.000
Net cashflow	1052.155	1052.155	1052.155
Cumulated net cashflow	9731.099	10783.250	11835.410

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	2372.50	at	10.00 %
Internal Rate of Return (IRRE1) ..	19.93 %		

b) Net Worth versus Net cash return:

Net present value	3358.29	at	10.00 %
Internal Rate of Return (IRRE2) ..	23.29 %		

c) Internal Rate of Return on total investment:

Net present value	3074.75	at	10.00 %
Internal Rate of Return (IRR) ..	18.29 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1,000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	1981.500	2642.000	3302.500	3302.500	3302.500
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1981.500	2642.000	3302.500	3302.500	3302.500
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1588.570	1751.810	2024.058	2013.058	2013.058
Operational margin	392.930	890.190	1278.442	1289.442	1289.442
As % of total sales	19.830	33.694	38.711	39.044	39.044
Cost of finance	216.000	189.000	162.000	135.000	108.000
Gross profit	176.930	701.190	1116.442	1154.442	1181.442
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	176.930	701.190	1116.442	1154.442	1181.442
Tax	70.772	280.476	446.577	461.777	472.577
Net profit	106.158	420.714	669.865	692.665	708.865
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	106.158	420.714	669.865	692.665	708.865
Accumulated undistributed profit	106.158	526.872	1196.737	1889.402	2598.267
Gross profit, % of total sales	8.929	26.540	33.806	34.957	35.774
Net profit, % of total sales	5.357	15.924	20.284	20.974	21.464
ROE, Net profit, % of equity	4.265	16.903	26.913	27.829	28.480
ROI, Net profit+interest, % of invest.	6.125	11.597	15.781	15.701	15.496

Net Income Statement in 1,000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	3302.500	3302.500	3302.500	3302.500	3302.500
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	3302.500	3302.500	3302.500	3302.500	3302.500
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1996.058	1996.058	1996.058	1996.058	1601.158
Operational margin	1306.442	1306.442	1306.442	1306.442	1701.342
As % of total sales	39.559	39.559	39.559	39.559	51.517
Cost of finance	81.000	54.000	27.000	0.000	0.000
Gross profit	1225.442	1252.442	1279.442	1306.442	1701.342
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1225.442	1252.442	1279.442	1306.442	1701.342
Tax	490.177	500.977	511.777	522.577	680.537
Net profit	735.265	751.465	767.665	783.865	1020.805
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	735.265	751.465	767.665	783.865	1020.805
Accumulated undistributed profit	3333.532	4084.998	4852.663	5636.528	6657.333
Gross profit, % of total sales	37.106	37.924	38.742	39.559	51.517
Net profit, % of total sales	22.264	22.754	23.245	23.736	30.910
ROE, Net profit, % of equity	29.541	30.191	30.842	31.493	41.013
ROI, Net profit+interest, % of invest.	15.485	15.280	15.075	14.870	19.365

Net Income Statement in 1,000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	3302.500	3302.500	3302.500	3302.500	3302.500
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	3302.500	3302.500	3302.500	3302.500	3302.500
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1548.908	1548.908	1548.908	1548.908	1548.908
Operational margin	1753.592	1753.592	1753.592	1753.592	1753.592
As % of total sales	53.099	53.099	53.099	53.099	53.099
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	1753.592	1753.592	1753.592	1753.592	1753.592
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1753.592	1753.592	1753.592	1753.592	1753.592
Tax	701.437	701.437	701.437	701.437	701.437
Net profit	1052.155	1052.155	1052.155	1052.155	1052.155
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1052.155	1052.155	1052.155	1052.155	1052.155
Accumulated undistributed profit	7709.488	8761.644	9813.799	10865.950	11918.110
Gross profit, % of total sales	53.099	53.099	53.099	53.099	53.099
Net profit, % of total sales	31.859	31.859	31.859	31.859	31.859
ROE, Net profit, % of equity	42.272	42.272	42.272	42.272	42.272
ROI, Net profit+interest, % of invest.	19.960	19.960	19.960	19.960	19.960

Projected Balance Sheets, construction in 1,000 US$

Year	1990	1991
Total assets	2989.000	5385.000
Fixed assets, net of depreciation	0.000	2989.000
Construction in progress	2989.000	2396.000
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	2989.000	5385.000
Equity capital	1845.000	2489.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	1100.000	2700.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	44.000	196.000
Total debt	1144.000	2896.000
Equity, % of liabilities	61.726	46.221

Projected Balance Sheets, Production in 1,000 US$

Year	1992	1993	1994	1995	1996
Total assets	5044.005	5138.271	5493.677	5848.842	6220.207
Fixed assets, net of depreciation	4898.850	4412.700	3937.550	3473.400	3009.250
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	133.376	158.751	195.127	195.127	195.127
Cash, bank	11.779	7.196	7.612	7.612	7.612
Cash surplus, finance available	0.000	559.625	1353.388	2172.702	3008.218
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	5044.005	5138.271	5493.677	5848.842	6220.207
Equity capital	2489.000	2489.000	2489.000	2489.000	2489.000
Reserves, retained profit	0.000	106.158	526.872	1196.737	1889.402
Profit	106.158	420.714	669.865	692.665	708.865
Long and medium term debt	2362.500	2025.000	1687.500	1350.000	1012.500
Current liabilities	74.693	97.399	120.440	120.440	120.440
Bank overdraft, finance required.	11.654	0.000	0.000	0.000	0.000
Total debt	2448.847	2122.399	1807.940	1470.440	1132.940
Equity, % of liabilities	49.346	48.440	45.307	42.555	40.015

Projected Balance Sheets, Production in 1,000 US$

Year	1997	1998	1999	2000	2001
Total assets	6617.972	7031.937	7462.103	8245.968	9266.772
Fixed assets, net of depreciation	2562.101	2114.951	1667.801	1220.651	1168.401
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	195.127	195.127	195.127	195.127	195.127
Cash, bank	7.612	7.612	7.612	7.612	7.612
Cash surplus, finance available	3853.133	4714.247	5591.563	6822.578	7895.633
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	6617.972	7031.937	7462.102	8245.968	9256.772
Equity capital	2489.000	2489.000	2489.000	2489.000	2489.000
Reserves, retained profit	2598.267	3333.532	4084.998	4852.663	5636.528
Profit	735.265	751.465	767.665	783.865	1020.805
Long and medium term debt	675.000	337.500	0.000	0.000	0.000
Current liabilities	120.440	120.440	120.440	120.440	120.440
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	795.440	457.940	120.440	120.440	120.440
Equity, % of liabilities	37.610	35.396	33.355	30.194	26.859

Projected Balance Sheets, Production in 1,000 US$

Year	2002	2003	2004	2005	2006
Total assets	10318.930	11371.080	12423.240	13475.390	14527.550
Fixed assets, net of depreciation	1168.401	1168.401	1168.401	1168.401	1168.401
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	195.127	195.127	195.127	195.127	195.127
Cash, bank	7.612	7.612	7.612	7.612	7.612
Cash surplus, finance available	8947.788	9999.943	11052.100	12104.250	13156.410
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	10318.930	11371.080	12423.240	13475.390	14527.550
Equity capital	2489.000	2489.000	2489.000	2489.000	2489.000
Reserves, retained profit	6657.333	7709.488	8761.644	9813.799	10865.950
Profit	1052.155	1052.155	1052.155	1052.155	1052.155
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	120.440	120.440	120.440	120.440	120.440
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	120.440	120.440	120.440	120.440	120.440
Equity, % of liabilities	24.121	21.889	20.035	18.471	17.133

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	2700.41	2700.00	0.41	1100.00	1600.00	0.39	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	2700.41	2700.00	0.41	1100.00	1600.00	0.39	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	6979.31	3177.00	3802.31	1344.00	1833.00	723.80	543.25
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	2486.90	2981.00	-494.10	1300.00	1681.00	29.30	-11.57
imported materials . . .	624.00	0.00	624.00	0.00	0.00	141.00	28.00
repayment loans & overd.	2700.41	0.00	2700.41	0.00	0.00	337.50	337.81
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1168.00	196.00	972.00	44.00	152.00	216.00	189.00
indirect costs							
net foreign exchge flow	-4278.90	-477.00	-3801.90	-244.00	-233.00	-723.41	-543.25
import substit'n effect	47556.00	0.00	47556.00	0.00	0.00	1981.50	2642.00
net forgn exchge effect	43277.10	-477.00	43754.10	-244.00	-233.00	1258.09	2098.75

present values at	10.00 %
foreign exchange flow .	-2987.51
net forgn exchge effect	18260.03

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	0.02	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.02	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	538.93	507.50	480.50	453.50	426.50	399.50	35.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	4.43	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	35.00	35.00	35.00	35.00	35.00	35.00	35.00
repayment loans & overd.	337.50	337.50	337.50	337.50	337.50	337.50	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	162.00	135.00	108.00	81.00	54.00	27.00	0.00
indirect costs							
net foreign exchge flow	-538.91	-507.50	-480.50	-453.50	-426.50	-399.50	-35.00
import substit'n effect	3302.50	3302.50	3302.50	3302.50	3302.50	3302.50	3302.50
net forgn exchge effect	2763.59	2795.00	2822.00	2849.00	2876.00	2903.00	3267.50

present values at	10.00 %
foreign exchange flow .	-2987.51
net forgn exchge effect	18260.03

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	35.00	35.00	35.00	35.00	35.00	35.00	-516.17
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-516.27
imported materials . . .	35.00	35.00	35.00	35.00	35.00	35.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.10
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-35.00	-35.00	-35.00	-35.00	-35.00	-35.00	516.17
import substit'n effect	3302.50	3302.50	3302.50	3302.50	3302.50	3302.50	0.00
net forgn exchge effect	3267.50	3267.50	3267.50	3267.50	3267.50	3267.50	516.17

present values at	10.00 %
foreign exchange flow .	-2987.51
net forgn exchge effect	18260.03

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	2700.41	2700.00	0.41	1100.00	1600.00	0.39	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	2700.41	2700.00	0.41	1100.00	1600.00	0.39	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	6977.31	3177.00	3802.31	1344.00	1833.00	723.80	543.25
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	2686.90	2981.00	-494.10	1300.00	1681.00	29.30	-11.57
imported materials . . .	626.00	0.00	626.00	0.00	0.00	141.00	28.00
repayment loans & overd.	2700.41	0.00	2700.41	0.00	0.00	337.50	337.81
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1168.00	196.00	972.00	44.00	152.00	216.00	189.00
indirect costs							
net foreign exchge flow	-4278.90	-477.00	-3801.90	-244.00	-233.00	-723.41	-543.25
import substit'n effect	47556.00	0.00	47556.00	0.00	0.00	1981.50	2642.00
net forgn exchge effect	43277.10	-477.00	43754.10	-244.00	-233.00	1258.09	2098.75

present values at	10.00 %
foreign exchange flow .	-2987.51
net forgn exchge effect	18260.03

Foreign Exchange Effect in 1,000 US$

Economic Analysis excluding indirect effects

100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	0.02	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.02	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	538.93	507.50	480.50	453.50	426.50	399.50	35.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	4.43	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	35.00	35.00	35.00	35.00	35.00	35.00	35.00
repayment loans & overd.	337.50	337.50	337.50	337.50	337.50	337.50	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	162.00	135.00	108.00	81.00	54.00	27.00	0.00
indirect costs							
net foreign exchge flow	-538.91	-507.50	-480.50	-453.50	-426.50	-399.50	-35.00
import substit'n effect	3302.50	3302.50	3302.50	3302.50	3302.50	3302.50	3302.50
net forgn exchge effect	2763.59	2795.00	2822.00	2849.00	2876.00	2903.00	3267.50

present values at	10.00 %
foreign exchange flow .	-2987.51
net forgn exchge effect	18260.03

Foreign Exchange Effect in 1,000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	35.00	35.00	35.00	35.00	35.00	35.00	-516.17
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-516.27
imported materials . . .	35.00	35.00	35.00	35.00	35.00	35.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.10
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-35.00	-35.00	-35.00	-35.00	-35.00	-35.00	516.17
import substit'n effect	3302.50	3302.50	3302.50	3302.50	3302.50	3302.50	0.00
net forgn exchge effect	3267.50	3267.50	3267.50	3267.50	3267.50	3267.50	516.17

present values at	10.00 %
foreign exchange flow .	-2987.51
net forgn exchge effect	18260.03

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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDIES

FINAL REPORT

VOLUME 3 OF 4

CHEMICAL INDUSTRY

PROJECT SF/NIR/88/001

baldo & C.

CONTENT

VOLUME 3 - CHEMICAL INDUSTRY

CHEMICAL INDUSTRIES

The chemical industries subsector currently accounts for about 23 per cent of manufacturing output. However, it is high import dependents mostly mixing and repacking imported items for resale.

It needs to be urgently integrated with two major sources of its raw materials which are petrochemicals and agro-based chemicals.

Nigeria has a great potential in both sources. Nevertheless. the chemical industries are, in general, capital intensive and considering the constraints of the present economic situation, the opportunities of investing in this sector are very few.

In the following chapters the field will be analysed with the aim of finding out projects that can be considered.

Some exceptions will be made, when the envisaged project seems to be beneficial to the Nigerian economy even if its investment costs exceed the imposed limits.

BASIC ASSUMPTIONS FOR THE FINANCIAL ANALYSIS

The following basic assumptions have been considered for all the projects in the financial analysis carried out by means of the COMFAR.

a) **Economic life**

Fifteen years have been considered the operational life of the plants, even if for some of them a longer life can be easily anticipated; this life span is largely sufficient to appreciate the profitability of a project; the increase of IRR due to longer life is definitely very small;

b) **Rate of discount: 10%**

c) **Depreciation: straightline type;**

rates:	10 %	for machinery and equipment
	5 %	for civil works
	20 %	for site preparation and pre-production expenditures
scraps:	10 %	for machinery and equipment
	50 %	for civil works and site preparation

d) **Foreign loan**

amount:	85% of the value of the imported machinery and equipment (installation costs included) as per "consensus" terms;
repayment:	within 8 years with 2 years of grace:
amortization:	constant principal type; interest 8%

e) **Local loan**

repayment:	within three years, starting from the first year of production;
amortization:	constant principal type; interest 15%

f) **Working capital**

Minimum days of coverage of the costs considered by the COMFAR programme:

	FC	LC
. accounts receivable	30	30
. inventory raw materials	180	60
. inventory utilities	1	1
. inventory energy	1	1
. inventory spare parts	180	180
. work in progress	defined case by case	
. cash in hand	15	15
. finished products	defined case by case	
. accounts payable	1	30

g) **Taxes**

The products are considered as sold ex-works; consequently the profit tax only (40%) has been included in the calculations. Tax holiday and other incentives foreseen to joint venture investments have not been included.

h) **Currency**

All the costs are expressed in Naira or US dollars; in the COMFAR in US dollars only; the exchange rate has been assumed as 7.9 N per 1 US dollar.

i) **Utilities**

The following prices have been assumed for evaluating the annual expenditures:

gasoline	0.076 $/l
electricity	0.1 $/KWh
cooling water (recycled)	0.0090 $/m3
cooling water (make-up)	0.006 $/m3
fuel oil	0.03 $/Kg
demineralized water	3.5 $/m3
LP steam	8 $/t

j) **BEP**

The BEP evaluations have been developed according to the formula.

$$\frac{\text{Fixed Costs}}{\text{Revenue - Variable Costs}}$$

The Direct personnel cost has been considered as fixed cost.

k) **Salaries**

	N/Y
General Manager	50000
Technical manager or Deputy G. M.	40000 45000
Financial manager	40000
Production manager Chief Engineer	40000
Chemist Engineer	25000
Senior account.	25000
Senior clerk Sale Dep. Head Purchase Dept. Head Workshop head	12000

Foreman or Supervisor	12000
Store Dept. head Mechanical store head Analyst Electrician Mechanic	10000
Security officer	8000
Secretaries	12000
Shift operators Store clerks Purchase dept. Ass. Account clerk Clerk	12000
Drivers	8000
Semiskilled workers Guard	6000
Unskilled workers Unskilled labourers	4000

The above figures have been increased by 40% overheads to consider the actual expenditures for the company.

e) **Pre-production Expenses**

Expenditures for establishment of company: 1% of the investment

Salaries:	Gen. Man + Tech. Man. + Fin. Man.	for the whole period of construction
	Adm. manager:	3 months 1st year of construction and 6 months for the 2nd year of construction
	Maint. Man.	8 months of last period of construction
	Training	Chemist Product Man. Foreman Chief eng. Engineers Others — Estimated case by case

m) **Erection**

10 % of the cost of machinery and equipment in FC

20 % of the cost of machinery and equipment in LC

n) **Civil works**

office buildings:	$ 700 /m2 (per floor)
Industrial buildings:	$ 400 /m2

o) **Freight, taxes and duties**

1 - FC = 10% of the F.O.B. costs

2 - LC = 20% of the F.O.B. costs

p) Other assumptions, different from those specified above, are indicated on the paragrpaphs of each study.

q) At this stage no current investments have been considered.

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OPPORTUNITY STUDY FOR THE PRODUCTION OF CHLOR-ALKALI IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

The present study analyzes the opportunity of constructing a chlor-alkali plant to be located in the neighbourhood of a port. The plant would use imported salt as main raw material and would produce the following outputs, working 250 days/y, 3 shifts/day, 8 hours/shift:[1]

- caustic soda 100% (as solution 32% w/w): 3550 t/y
- liquid chlorine 2570 t/y
- hydrochloric acid (solution 33% w/w): 1500 t/y (495 t/y as HCl 100%)
- sodium hypochlorite (150 g/l available Cl):2640 (330 t/y available Cl)

Chlorine is presently imported. It may be used for water potabilization, either as chlorine or calcium hypochlorite, to produce sodium hypochlorite and hydrochloric acid. The next opportunity study examines the production of Calcium Hypochlorite using the Chlorine produced by the plant under study.

Sodium hypochlorite can be used as bleaching or sterilizing agent in a number of applications (bleaching of cotton yarn, disinfection of the facilities of food processing plants, disinfection and deodorizing of public facilities, hospitals, schools, etc.)

Hydrochloric acid has many industrial applications (metal, textile and food industry, mainly).

Caustic soda is a basic chemical needed in a variety of applications and its importance is so great that its consumption is taken as an index of the industrial activity of a country.

The financial analysis of such a project was carried out. Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 12,974,200
- Working capital (at full production): US$ 416,089 (US$ 356,418 in foreign currency)
- Internal Rate of Return: 11.26%
- Break-Even Point (at 5th year of production): 62%
- Pay-back Period: less than 9 years (including construction period)
- Employees: 145

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[1] For additional background material, see Volume I p. 125.

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 12,363,190 (as present value at 10%).

On the basis of the analysis in this study, it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

Sodium Chloride is the main raw material for the production of some basic derivatives for the chemical industry. The products that will be considered in this opportunity study are: chlorine, sodium hydroxide, hydrogen, hydrochloric acid and, to a great extent as a by-product, sodium hypochlorite.

The main characteristics of the products are:

- Chlorine (Cl_2)

Atomic weight	=	35.453
Physical state	=	greenish yellow gas
Boiling point	=	- 34.05 C
Melting point	=	- 101 C
Critical temperature	=	144 C at 76.1 atm
Density of the gas	=	3.214 g/l at 0 C and 1 atm

- Sodium hydroxide (Na OH)

Molecular weight	=	40.01
Physical state	=	white deliquescent solid
Melting point	=	318.4 C
Density at 20 C	=	2.130 g/ml

- Hydrochloric acid (Hcl)

Molecular weight	=	36.5
Physical state	=	colourless gas

- Sodium hypochlorite (NaClO)

Molecular weight	=	91.5
Physical state	=	liquid
Specific gravity	=	1.200 kg/l (at available chlorine content of 150 gpl).

2. MARKET AND PLANT CAPACITY

2.1 USES

The various uses of the product generated by a chlor-alkali plant in the major industrial countries are given below. Some of this applications will be relevant to Nigeria.

2.1.1 Caustic soda

The utilization of caustic soda or sodium hydroxide (NaOH) has become increasingly diversified, especially in the field of chemical production. The consumption of caustic soda in soap, textiles and petroleum refining, although still substantial, is decreasing. In highly industrialized countries, the mid-century decades have witenessed aggressive activity in finding new uses for caustic soda, in order to minimize the chlorine-caustic soda demand imbalance.

On the other hand, in developing countries, chlorine is not as widely used as in developed countries.

In the world the relative share in the consumption of caustic soda (in 1988) by industrial subsectors was as follows:

Industrial subsectors	Share of NaOH cons.
- Organic and inorganic chemicals	43%
- Petroleum	5%
- Food processing	2%
- Pulp and paper	15%
- Soap and detergents	6%
- Alumina	5%
- Textile	3%
- Rayon and cellulose	2%
- Miscellaneous	19%

The most common sodium hydroxide derivatives are the following

.1) Chemicals

- Sodium phosphate tribasic - sodium chlorite

Oxidizing agent for improvement of potable water; bleach for textiles, paper, edible oils, straw products, oxidizing agent for vat dyes.

- Sodium chloroacetate

herbicides, dyes, vitamins

- Sodium cyanide

Case hardening and heat treating agent for steel, extraction agent for gold and silver production from ores, ore flotation, dyes, pharmaceuticals, plastics, rubber treatment, etc.

- Sodium formiate

Pharmaceuticals, mordants, leather tanning agent, wallpaper printing

- Sodium propionate

Pesticides

- Sodium stannate

Tin, metal-electrolytic process, blueprint-papers, dye mordant, ceramics and glass, tin electroplating, textile, fireproofing, stabilizer for hydrogen peroxide.

- Sodium formaldehyde sulfoxylate

Bleaching agent for molasses and soap

- Vinyl chloride (from ethylene dichloride)

- Sodium salt, oil-soluble petroleum sulfonate

Lubricating oil additives

.2) Refining of kraft (sulfate) process pulp

Rayon, viscose rayon

.3) Petroleum refining

.4) Wood pulp

Sulfate process

.5) Manufacture of detergents

Sodium salt, linear alkilate sulfonate, sodium lauryl sulfate)

.6) Manufacture of soaps

Sodium salt, stearic acid, sodium stearate

(soaps, greases, pharmaceuticals, waterproofing plastic stabilizers)

Sodium salt, oleic acid, sodium oleate (ore flotation, emulsifiers, soaps)

.7) Textile processing

.8) Vegetable oils refining

.9) Metal processing

Ore flotation, aluminium ore bauxite

.10) Water and acid waste stream treatment

.11) Wood pulp (soda process)

.12) Paint remover

.13) Disinfectants

.14) Rubber latex stabilizer

.15) Stabilizations of sodium hypochlorite

2.1.2 Chlorine

Chlorine, which was originally used almost entirely for bleaching, is no longer of great importance in this field because it is too destructive for wool, silk and other products of animal origin while in recent years hydrogen peroxide has become economically available for this and other purposes.

Now chlorine is used mainly in the synthesis of chemicals, mostly in the organic chemical field.

In many countries a remarkable use of chlorine is in the field of water sanitation.

Chlorine is also used in metallurgy, which includes several important methods not only for beneficiating ores and fluxings, but also for the actual extraction of copper, lead, zinc, nickel, gold, platinum, metallic elements of the rare earth group, titanium, tungsten, vanadium and others.

Another important field of utilization is the extraction of bromine.

The relative chlorine consumption of various product groups in percent in USA, Japan and FRG, is as follows:

PRODUCT	USA	JAPAN	FRG
Vinylchloride	22	28	23
Solvents	17	16	19
Misc. organic prod.	7	39	47
Water treatment	7	--	--
Organic products	12	9	8

In the recent years, the importance of chlorine as raw material has been increasing for synthetic organic chemistry.

The number of possible reactions of chlorine and, therefore, the number of intermediates and end products is remarkably large.

Some important reactions along with the areas of application of the end product are shown in table 2.1.

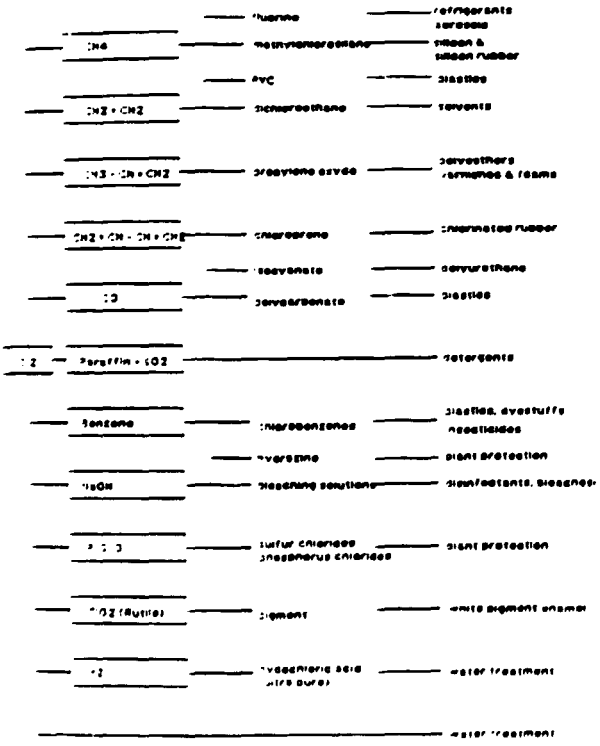


Table 2.1 Important reactions of chlorine & uses of end products

2.1.3 Sodium hypochlorite

The main use of sodium hypochlorite is as a bleaching or sterilizing agent.

The possible applications are:

- water treatment: disinfection of city water, well water, water tanks; prevention of algae growth in water systems for both potable and industrial uses;

- bleaching of cotton yarn and cotton cloth; disinfection and bleaching of children clothing and linen for hospitals;

- disinfection of the facilities of food processing plants: meat and fish canning, dairies, sugar refineries, soft drink factories, vegetables and fruit cannings;

- disinfection and deodorizing of public facilities, that is floors, walls, drains and toilets in hospitals,schools, railway stations and other public buildings;

- domestic disinfection and bleaching

2.1.4 Aqueous hydrochloric acid

The largest single use for hydrochloric acid is for pickling of steel as it readily dissolves all of the various oxides present in the mill scale formed in the rolling process.

Hydrochloric acid can replace sulphuric acid in the production of chlorine dioxide (ClO_2) from sodium chlorate.

Chlorine dioxide is an important pulp bleaching agent.

Acidulation of phosphoric rock instead of sulphuric acid is another possible use for hydrochloric acid.

2.1.5 Hydrogen gas

Hydrogen gas is used mainly in the manufacture of ammonia. At present the only possible use is the production of hydrochloric acid; the balance must be used as a fuel.

2.2 FORECAST DEMAND AND PLANT CAPACITY

2.2.1 Demand

Nigeria imports all of its needs of caustic soda. The following table shows the quantities imported during 1974-1987 period: (1)

YEAR	TONS
1974	23,382
1975	27,918
1976	24,388
1977	22,310
1978	13,374
1979	22,081
1980	12,886
1981	19,336
1982	21,343
1983	15,974
1984	16,556
1985	27,081
1986	n.a.
1987	25,297

The imported caustic soda is used mainly by: textile, food, paper, soap and detergents, and in particular petroleum industry.

Statistical data concerning hydrochloric acid and sodium hypochlorite, obtained as by products together with caustic soda production, are not available.

Because of the difficulty of disposing of the chlorine obtained as a by-product, the production of caustic soda was not considered commercial viable. It is the opinion of the consultant that this difficulty may be overcome by using chlorine for calcium hypochlorite production. As a first step it is suggested to evaluate the opportunity of installing a chlor-alkaly plant of the minimum economical size, that is about 3500 t/y of caustic soda 100%, 2570 t/y of liquid chlorine together with 1500 t/y of hydrochloric acid 33% w/w and 2640 t/y of sodium hypochlorite (150 gpl of available chlorine). These outputs are based on 250 working days/y, 3 shifts/day, 8 hours/shifts.

With such a capacity the free chlorine could be used to produce about 2200 t/y of calcium hypochlorite which is the minimum economic size for such a plant.

(1) Source: Federal Office of Statistics, Lagos

If the chlorine requirement should increase, a reduction in the production of hydrochloric acid and sodium hypochlorite can supply a max additional amount of 700 t/y of chlorine.

This proposal is the subject of another opportunity study within this subsector.

2.3 SALES PRICES AND REVENUE

On the assumption of selling all caustic soda (32% w/w solution) on the domestic market, the price in bulk of this product has been assumed equal to the present selling price FOB European port (365 $/t 100% basis) plus the freight from Europe to Nigerian port estimated at 130 $/t: having suggested to locate the factory near the sea, the ex-works selling price is assumed at 495 $/t.

As far as liquid chlorine is concerned, the selling price has been fixed also on the basis of the present cost FOB European port, that is 206 $/t of product packed in cylinders of 1 ton content.

The freight from Europe to Nigerian port, excluding charges for the hire of cylinders and their return, when empty, to European supplier is estimated of 150 $/t that is to say a total selling price CIF Nigeria of 365 $/t.

Using the same procedure the price of hydrochloric acid (33% w/w solution) in bulk had been fixed at 200 $/t FOB European port that, with a cost freight of 130 $/t from Europe to Nigerian port, gives a total selling price of 330 $/t.

For the Sodium hypochlorite (150 gpl of available chlorine) the price in bulk FOB European port is in the range of 175 $/t that, with a cost freight of 130 $/t, gives a total selling price CIF Nigeria of 305 $/t.

Based on these selling prices the total annual revenue ex-works, is estimated as follows:

- caustic soda (32%solution) equivalent to 3550 100% t/y x 495 $/t	=	US $	1.757,250
- liquid chlorine 2570 t/y x 365 $/t	=	US$	38,050
- hydrochloric acid (33% w/w) 1500 t/y x 330 $/t	=	US$	495,000
- sodium hypochlorite 2640 t/y x 305 $/t	=	US$	805,200
TOTAL REVENUES		US$	3,995,500

3. MATERIAL AND INPUTS

3.1 CHEMISTRY

Chlorine is produced almost entirely by electrolytic methods from electrolysis of brines: chlorine is produced at the anode and hydrogen, together with sodium hydroxide, at the cathode.

$$NaCl \text{ -----> } NA^{+} + Cl$$
$$Na + H_2O \text{ -----> } NaOH + 1/2\ H_2$$

It follows that only salt and electricity are required as main inputs

The salt used as feedstock (raw salt) should correspond to the following specification:

NaCl	99.0 % w/w
Ca^{++}	0.12 % w/w
Mg^{++}	0.06 % w/w
SO_4^{-}	0.24 % w/w
Insoluble in water	0.06 % w/w max

3.2 RAW MATERIALS AND UTILITIES REQUIREMENTS AND COSTS

Main inputs, for the plant are raw salt (Nall) and electric energy. Salt has to be imported at US$ 73/t. Electric energy will be produced by the plant itself. A connection to the NEPA grid is suggested for emergency.

The list and costs of raw materials and utilities to be supplied annually to the plant at full capacity (3550 t/y of caustic soda 100% as solution 32% w/w) 2570 t/y of liquid chlorine; 1500 t/y of Hydrochloric acid as solution 33% w/w; 2640 of sodium hypochlorite 150 gpl) and obtained by products are as follows:

Raw materials

Raw salt (99%NaCl) 6039 t/y x 73 $/t	=	US$ 440,850
Chemicals	=	US$ 44,085
		US$ 484,935

Utilities

Electric energy for process 8,800,000 kWh/y x 0.03 $/kWh	=	US$	264,000
Electric energy for services 700,000 kWh/y x 0.03 $/kWh	=	US$	21,000
Demineralized water 6400 t/y x 3.5 $/t	=	US$	22,400
		US$	307,400

For the financial evaluation the costs are grouped as follows:

- raw material 1 (salt)	=	FC	US$ 440,850
- other raw materials	=	FC	US$ 44,085
- utilities	=	LC	US$ 307,400
TOTAL			US$ 792,335

REMARKS:

Chemicals (technical grade) are, generally utilized for brine treatment.

The most important are:

- Sodium sulphite
- Sodium carbonate
- Barium chloride
- Activated carbon, chelating resins, flocculant, precoating material etc.
- Sulphuric acid 98% for chlorine drying and compression.

Beside the above mentioned chemicals caustic soda and hydrochloric acid (captive consumption) are used for the start-up, demineralized water production, etc.

3.3 RAW MATERIAL PURCHASING PROGRAMME AND STORAGE VOLUMES

On the assumption of the importation of the salt and chemicals, a stock of these equivalent to 6 months consumption, at full production, is a necessity.

The costs are as follows:

- Raw salt 3000 t equivalent to	$ 219,000
- Sulphuric acid	
- Sodium carbonate	
- Sodium sulphite	$ 22,000
- Barium chloride	
- Other chemicals	
TOTAL	$ 241,000

4. LOCATION

Due to the high consumption of salt, the ideal place would be in the neighbourhood of a port.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

Up-to-date chlorine-caustic soda processes are based on membrane electrolysers (diaphragm process), while in the past mercury cathode cells were used.

In the diaphragm process brine is fed continuously into all the cells and flows from the anode compartment through a diaphragm to the cathode.

The main steps of the process, including the production of hydrochloric acid, can be summarized as follows:

- brine preparation and its electrolysis
- chlorine cooling and drying
- chlorine compression and liquefaction
- caustic soda collection
- neutralization of wasted gases with production of sodium hypochlorite;
- hydrochloric acid synthesis

The process requires continuous operation of the plant.

The design allows the plant to be operated within a production range from 40% to 100% of the rated capacity.

5.1.1 Brine preparation and its electrolysis

Raw salt is collected in an open storage area from which, through a feed mill and a belt conveyor is fed to the brine preparation tank with process water. The resulting brine is collected in a water purifier with flocculants; then is sent to a settler where it is separated from impurities.

The NaCl solution prepared in this way (that is with a concentration of approximately 300 g/l) is fed to the electrolysers.

The brine feed rate is held at a value proportional to the rated capacity of the electrolyser so as to ensure that the brine leaving the electrolyser will contain approx. 200 g/l NaCl.

The depleted brine leaving the electrolysers, saturated with chlorine, is first sent to the chlorate decomposer where concentrated hydrochloric acid is added to the brine for decomposing the excess gas of chlorates in order to maintain them at an acceptable value for the membranes of the cell, then it is dechlorinated by vacuum dechlorination.

The chlorine gas is recovered in the main chlorine header.

The dechlorinated brine is then passed through a column packed with activated carbon for neutralization of the last traces of dissolved chlorine which may adversely affect the subsequent purification process.

After neutralizing the excess acidity, the dechlorinated brine is submitted to the re-saturation step.

The saturated brine, at approx. 300 g/l NaCl, flows to the reactor, mechanically agitated, where it is mixed with chemicals to precipitate the impurities.

The impurities which are usually present in a raw brine are mainly magnesium, calcium, sulphate and , though in small quantity, iron.

Caustic soda is used for precipitating magnesium as magnesium hydroxide, barium chloride lets sulphites precipitate as barium sulphites and sodium carbonate for the calcium precipitation as calcium carbonate.

The brine from the reactor flows by gravity to a settler and is then pumped through a filter of the precoat type and sent to a receiver.

After controlling the brine temperature, the filtered brine undergoes the purification process for reducing the Ca and Mg hardness to a few tenths of ppm, as required by the membrane cells process.

High purification levels are reached by ion exchange treatment in columns packed with chelating resins having high selectivity towards the metal ion impurities of the brine.

Three columns are installed, two in operation and one in regeneration.

The operating sequence at the three columns is automatically controlled by a programme/controller.

Following this step of purification, the brine flows to the cells.

5.1.2 Chlorine cooling and drying

Chlorine leaving the electrolysers saturated with water vapour flows to a titanium shell and tubes cooler, where the gas is cooled so that most of its water vapour is condensed.

Afterwards the chlorine flows to a second shell and tube titanium cooler with chilled water as cooling medium.

The chlorine is sub-cooled so that most of its water vapour is condensed in order to minimize sulphuric acid consumption for chlorine drying.

Chlorine saturated condensed water is sent to brine before dechlorination. Sub-cooled chlorine is passed through a special mist eliminator, which removes salt mist and entrained particles, and then flows to the first drying tower where it is dried by direct washing with sulphuric acid.

A centrifugal pump- re-circulates the acid through the tower while a fraction of acid overflows continuously to the dilute acid pump tank.

Dilute acid is stripped with air to remove dissolved chlorine and is then pumped to a storage tank and then to the plant battery limits.

The concentration of overflowing diluted sulphuric acid is kept at approximately 80% which is a tolerable limit for the piping material and the cooler provided for the system.

A similar acid circulation takes place in the second and third drying tower: from this tower acid overflows to the first drying tower at a concentration of about 93%, while fresh acid, at 96-98% concentration, is fed continuously into the system from the concentrated acid head tank.

Coolers are provided to remove the absorption and dilution heat from the sulphuric acid solution. The cooling medium for these sulphuric acid coolers is chilled water.

5.1.3 Chlorine compression

Dry chlorine gas is compressed by a sulphuric acid liquid ring-compressor at approx. 3.5 ATA and delivered to chlorine liquefaction, or if needed, to the HCl synthesis unit and chlorine neutralization (sodium hypochlorite, see para 5.1.7).

5.1.4 Chlorine liquefaction

The compressed chlorine gas is condensed by a freon system.

Condensed chlorine flows by gravity to liquid chlorine storage tanks.

The composition of non-condensed gases (known as sniff gas) is controlled in order to keep the hydrogen content within safe limits. This sniff gas will be delivered to the chlorine neutralization unit/gas.

5.1.5 Caustic soda

The caustic soda from the electrolysers (a 33% NsOH water solution) is collected in a stainless steel receiver located at the end of the electrolysis room and is delivered to utilization units.

5.1.6 Neutralization of wasted gases: hypochlorite production

The absorption system consists essentially of one reaction tower, two circulation tanks and of a set of centrifugal pumps for recirculating the absorption solution through the reaction tower. Vent and sniff chlorine gases from the various plant sections are fed to the bottom of the reaction tower, while diluted caustic enters at the top of the tower and is recirculated through it until the limit strength has been obtained.

This sector of the plant gives rise to a production of sodium hypochlorite solution.

The normal quantity of chlorine to be neutralized is about the 3-4% of the total chlorine production.

The capacity or the absorption system is calculated to neutralize up to about the 10% of the total chlorine production. Unabsorbed gases such as nitrogen, oxygen and hydrogen are vented by an exhaust fan from the reaction tower to the atmosphere.

5.1.7 Hydrochloric acid synthesis unit

The hydrochloric acid synthesis unit consists of 3 principal parts: the burner, the synthesis chamber-heat exchanger assembly, the receptor.

a) The burner consists of two silica tubes mounted inside a graphilor housing. These tubes are fixed in the housing, in order to assure their easy replacement. The burner has two inlets, one for chlorine, and the other for hydrogen.

b) The synthesis chamber-heat exchanger assembly consists of a combustion chamber provided with two sight tubes which permit the automatic control of the flame and the lighting of the furnace.

The unit synthesis-absorption type also includes a distribution element with an inlet for the absorber

The heat exchanger (at the lower part) consists of a column of absorbing blocks. The heat exchanger includes a column of cooler blocks.

c) The receptor is a graphilor element for the separation of the acid product from the vent gases.

At the bottom of this element there is a graphilor safety disk and below this an explosion guard.

The hydrogen coming from electrolysis room, after cooling is delivered to the furnace burner by blowers.

The chlorine is directly fed to the furnace burner by the chlorine blowing system. The chlorine pressure is automatically controlled by a pressure control valve.

In both the hydrogen and chlorine lines automatic block valves interlocked with the furnace photoelectric cell are installed. In case of flame failure, the two valves are automatically closed.

The hydrochloric acid gas is absorbed by water and the obtained hydrochloric acid solution flows down into an intermediate tank from where is pumped to the storage tank.

5.1.8 Expected quality of the products

The following data are based on plant operating under normal conditions at the rated production capacities for the different sections.

.1) Caustic soda

Solution at electrolyzer outlet

Analysis:		
NaOH	32-35%	w/w
NaCl	30	ppm
$NaClO_3$	20	ppm

.2) Chlorine (cell gas on dry basis)

Analysis:		
Cl_2	97-98%	v/v
H_2	0.1	v/v
O_2	2.0	v/v
inerts & air	balance	

.3) Hydrogen (cell gas on dry basis)

Analysis:		
H_2	99.9%	v/v

.4) Sodium hypochlorite

Analysis:

available chlorine	150	g/l

.5) Liquid chlorine

moisture	20	ppm

.6) Hydrochloric acid

Analysis:

HCl	31-33%	w/w

5.2 STORAGE FACILITIES

The caustic soda obtained as a solution at 32% by weight will be stored in 4 tanks of 100 m^3 capacity (about 16 days of production).

As far as liquid chlorine is concerned, the plant is provided with 3 tanks for storing about 200 tons chlorine each one (about 2.5 months production).

Sodium hypochlorite, solution (150 g/l of available chlorine), is stored in 2 tanks of 50 m^3 (15 days of production).

Hydrochloric acid solution 33% by weight will be stored in a 500 m^3 tank (total capacity 190 t of HCl 100% that is about 4.2 months of production).

5.3 PACKAGING

All the products are assumed to be sold in bulk. Therefore no packaging cost has been included.

5.4 LAY-OUT AND CIVIL WORKS

The whole complex including the production plants, the utility and the general facility plant and the offices covers an area of about 14,000 sq.m.

The administrative offices, laboratories, the workshops, the storehouse, the electrical substation, the emergency diesel power station, the electrolysis plant and its auxiliaries are all inside buildings. All the remaining sections of the plant are installed outdoors.

The administrative building is of two-storeys, covering an area of 200 sq.m; its structure is of reinforced concrete while the walls, internal and external, are of brickwork; the roof is insulated with mineral wool lagging covered with corrugated asbestos-cement sheets.

The other buildings covering a total area of 1330 sq.m, are of the same construction design, but single-storey.

The roads and all the open space among the various plant sections are asphalted. The routing of pipes an cables are completely above-ground on steel racks. The sewerage consists of two sewer systems: one for rain water collection an one for the waste water to be treated.

5.5 INVESTMENT COST, DEPRECIATION AND MAINTENANCE

The investment costs for the plant, utilities included, are shown herebelow.

The machinery and equipment have been quoted by Oronzio De Nora, Milan, Italy.

Description	LC M$	FC M$	total M$
a) machinery & equipment (FOB European port)		6.400	6.400
b) transportation	0.300	0.600	0.900
c) land + site preparation	0.130	--	0.130
d) civil works & steel structures	1.300	--	1.300
e) erection	1.300	0.600	1.900
f) insulation & painting	0.050	0.050	0.100
g) spare parts	--	0.240	0.240
Total	**3.080**	**7.890**	**10.970**
Contingencies	**0.220**	**0.810**	**1.030**
Grand total	**3.300**	**8.700**	**12.000**

The life cycle of the plant can be considered fifteen years.

The annual maintenance cost, has been assumed US$ 240.000.

In the financial evaluation the above mentioned total investment cost (contingencies included) has been subdivided as follows:

Description		milliion $
preproduction expenditures	FC	0.162
preproduction expenditures	LC	0.312
machinery	FC	8.70
machinery	LC	1.70
land + site preparation	LC	0.13
civil works	LC	1.47
Total		**12.474**

6. PLANT ORGANIZATION

The plant has been considered as an autonomous unit, complete with utilities and facilities.

7. MANPOWER

No particular skills are required for any of the positions listed below except for the technical manager, the production manager, the chief engineer and the chemist, who must have thorough training in the technology involved in the process with particular regard to analysis of raw materials and finished product, hazard control, maintenance of the cells and electric equipment. The requirements for all the other positions are not different from those required in any other chemical factory. It is recommended that on the job training is carried out by one expert, made available by the technology supplier, for one year after the start-up. The relevant cost is estimated US$ 120.000.

7.1 MANAGEMENT

		N/y
General manager	1	50.000
Technical manager	1	40.000
Total	2	90.000
	Overheads 40%	36.000
		126.000
		(16.000 US$)

7.2 ADMINISTRATIVE DEPT.

		N/y
Financial manager	1	40,000
Senior accountant	1	29,000
Accountant clerks	2	24,000
Purchasing dept. head	1	12,000
Purchasing dept. ass.	2	16,000
Store head	1	12,000
Store clerks	2	16,000
Sales dept. head	1	12,000
Drivers	5	40,000
Security officer	1	12,000
Guards	9	54,000
Secretaries	4	32,000
Total	30	290,000
	Overheads 40%	116,000
		406,000
		(51,400 US$)

7.3 PRODUCTION DEPARTMENT

		N/y
Production manager	1	40,000
Shift foremen	8	96,000
Shift operators	28	224,000
Semiskilled workers	28	168,000
Chemist	1	25,000
Analyst	4	48,000
Clerks	2	24,000
Unskilled workers	8	40,000
Total	80	665,000
	Overheads 40%	226,000
		931,000
		(117,800 US$)

7.4 MAINTENANCE DEPT.

		N/y
Chief engineer	1	40,000
Engineers	4	60,000
Workshop head	1	12,000
Mech. store head	1	10,000
Foremen	3	36,000
Welders	2	16,000
Electricians	4	40,000
Mechanics	6	60,000
Semiskilled	3	24,000
Clerks	2	16,000
Labourers	6	24,000
Total	33	338,000
	Overheads 40%	135,200
		473,200
		(60,000 US$)

Summary

		$/y
Administrative	32	67,400
Production	80	117,800
Maintenance	33	60,000
Total Manpower	145	245,200

8 IMPLEMENTATION SCHEDULE

Approximately 20 months are needed for the design, construction and commissioning of the plant from the moment the project is approved.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 12,974,200 US Dollars. The portion in foreign currency accounts for 9,260,000 US Dollars.

Details of these figures are shown in chapter 5.5

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,138,000	US$ 4,161,200	US$ 5,299,200
- Foreign Loan (interest 8%)	US$ 1,750,000	US$ 4,625,000	US$ 6,375,000
- Local Loan (interest 15%)	US$ 300,000	US$ 500,000	US$ 800,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 60%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 416,089 US Dollars, the foreign portion being US$ 356,418.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US $ 194,107 of which US$ 162,567 in foreign currency.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 60% of its nominal capacity, the production costs amount to US $ 2,657,274.

In the third year, at full production, the costs amount to US $ 3,008,375 then they start a slight decrease year after year, to reach a constant amount of US $ 1,277,535 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 3,995,500. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 1,598,200

2nd year 60% : revenue = US$ 2,397,300

3rd year 80% : revenue = US$ 3,196,400

4th and subsequent years: revenue = US$ 3,995,000.

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 11.26%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 62% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [2] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 9 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 12,263,190.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 12,263,190.

[2] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

CHLOR-ALKALI PLANT
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	12974.20	71.349 % foreign
current assets:	0.00	0.000 % foreign
total assets:	12974.20	71.349 % foreign

Source of funds during construction phase

equity & grants:	5299.20	0.000 % foreign
foreign loans :	6375.00	
local loans :	800.00	
total funds :	12474.20	51.105 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	730.73	1277.54	1277.54
depreciation :	1334.34	1308.34	243.50
interest :	630.00	255.00	0.00
production costs	2695.07	2840.88	1521.04
thereof foreign	68.18 %	63.41 %	37.14 %
total sales :	1598.20	3995.50	3995.50
gross income :	-1096.87	1154.62	2474.46
net income :	-1096.87	692.77	1484.68
cash balance :	-1023.44	1204.24	1728.18
net cashflow :	670.10	2256.11	1728.18

Net Present Value at: 10.00 % = 974.02
Internal Rate of Return: 11.26 %
Return on equity1: 8.38 %
Return on equity2: 12.83 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, cevelopment	130.000	0.000
Buildings and civil works	980.000	490.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	1910.000	8490.000
Total fixed investment costs	3020.000	8980.000
Pre-production capital expenditures.	260.500	713.700
Net working capital	0.000	0.000
Total initial investment costs	3280.500	9693.700
Of it foreign, in %	55.175	76.823

Total Current Investment in 1000 US $

Year	1992	1993	1994	1995
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures	0.000	0.000	0.000	0.000
Working capital	197.362	56.942	84.842	76.942
Total current investment costs	197.362	56.942	84.842	76.942
Of it foreign, %	82.370	90.062	84.019	92.645

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	176.340	264.510	352.680	440.850	440.850
Other raw materials	17.634	26.451	35.268	44.085	44.085
Utilities	122.960	184.440	245.920	307.400	307.400
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	117.800	117.800	117.800	117.800	117.800
Repair, maintenance	64.000	96.000	128.000	160.000	160.000
Spares	32.000	48.000	64.000	80.000	80.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	650.734	737.201	943.668	1150.135	1150.135
Administrative overheads	80.000	80.000	127.400	127.400	127.400
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1334.340	1334.340	1321.340	1308.340	1308.340
Financial costs	630.000	526.250	422.500	318.750	255.000
Total production costs	2695.074	2677.791	2814.908	2904.625	2840.875
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	68.175	65.973	64.508	64.211	63.408
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	197.800	197.800	245.200	245.200	245.200

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	440.850	440.850	440.850	440.850	440.850
Other raw materials	44.085	44.085	44.085	44.085	44.085
Utilities	307.400	307.400	307.400	307.400	307.400
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	117.800	117.800	117.800	117.800	117.800
Repair, maintenance	160.000	160.000	160.000	160.000	160.000
Spares	80.000	80.000	80.000	80.000	80.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	1150.135	1150.135	1150.135	1150.135	1150.135
Administrative overheads	127.400	127.400	127.400	127.400	127.400
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1113.500	1113.500	1113.500	1113.500	243.500
Financial costs	191.250	127.500	63.750	0.000	0.000
Total production costs	2582.285	2518.535	2454.785	2391.035	1521.035
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	62.975	62.037	61.052	60.013	57.741
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	245.200	245.200	245.200	245.200	245.200

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	440.850
Other raw materials	44.085
Utilities	307.400
Energy	0.000
Labour, direct	117.800
Repair, maintenance	160.000
Spares	80.000
Factory overheads	0.000
Factory costs	1150.135
Administrative overheads	127.400
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	1277.535
Costs per unit (single product)	0.000
Of it foreign, %	44.221
Of it variable,%	0.000
Total labour	245.200

Net Working Capital in 1000 [illegible] $

Year	mdc	coto	1992	1993	1994	1995	1996-2006
Coverage							
Current assets &							
Accounts receivable	30	12.0	60.895	68.100	89.256	106.461	106.461
Inventory and materials	111	3.3	97.329	145.993	194.657	243.321	243.321
Energy	0	---	0.000	0.000	0.000	0.000	0.000
Spares	180	2.0	16.000	24.000	32.000	40.000	40.000
Work in progress	1	360.0	1.808	2.048	2.621	3.195	3.195
Finished products	15	24.0	30.447	34.050	44.628	53.231	53.231
Cash in hand	15	24.0	17.242	14.242	18.217	20.217	20.217
Total current assets			223.720	288.432	381.379	466.425	466.425
Current liabilities and							
Accounts payable	16	22.8	26.358	34.128	42.232	50.336	50.336
Net working capital			197.362	254.304	339.147	416.089	416.089
Increase in working capital			197.362	56.942	84.842	76.942	0.000
Net working capital, local			34.795	40.454	54.012	59.671	59.671
Net working capital, foreign			162.567	213.851	285.134	356.418	356.418

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	1138.000	4161.200
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1750.000	4625.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	300.000	500.000
Loan C, local....	0.000	0.000
Total loan	2050.000	5125.000
Current liabilities	0.000	0.000
Bank overdraft	92.500	407.500
Total funds	3280.500	9693.700

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-796.875	-796.875	-796.875	-796.875	-796.875	-796.875
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-266.667	-266.667	-266.667	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000	0.000
Total loan	-1063.542	-1063.542	-1063.542	-796.875	-796.875	-796.875
Current liabilities	26.358	7.771	8.104	8.104	0.000	0.000
Bank overdraft	1023.436	66.636	-401.850	-1089.048	-99.175	0.000
Total funds	-13.747	-989.135	-1457.287	-1877.819	-896.050	-796.875

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow . .	3188.000	9286.200
Financial resources .	3188.000	9286.200
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	3280.500	9693.700
Total assets	3188.000	9286.200
Operating costs . . .	0.000	0.000
Cost of finance . . .	92.500	407.500
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-92.500	-407.500
Cumulated cash balance	-92.500	-500.000
Inflow, local	1438.000	4661.200
Outflow, local	1470.500	2246.700
Surplus (deficit) .	-32.500	2414.500
Inflow, foreign . . .	1750.000	4625.000
Outflow, foreign . . .	1810.000	7447.000
Surplus (deficit) .	-60.000	-2822.000
Net cashflow	-3188.000	-9286.200
Cumulated net cashflow	-3188.000	-12474.200

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	1624.557	2405.090	3204.503	4003.604	3995.500	3995.500
Financial resources	26.358	7.790	8.104	8.104	0.000	0.000
Sales, net of tax	1598.200	2397.300	3196.400	3995.500	3995.500	3995.500
Total cash outflow	2647.995	2471.725	2802.653	2914.556	2791.260	2830.946
Total assets	223.720	64.713	92.946	85.046	0.000	0.000
Operating costs	730.734	817.201	1071.068	1277.535	1277.535	1277.535
Cost of finance	630.000	526.250	422.500	318.750	255.000	191.250
Repayment	1063.542	1063.561	1063.542	796.875	796.875	796.875
Corporate tax	0.000	0.000	152.597	436.350	461.850	565.286
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-1023.438	-66.635	401.851	1089.048	1204.240	1164.554
Cumulated cash balance	-1523.433	-1590.073	-1188.222	-99.175	1105.065	2269.619
Inflow, local	1623.596	2405.090	3204.190	4003.290	3995.500	3995.500
Outflow, local	831.618	838.355	1099.732	1162.398	1174.450	1277.886
Surplus (deficit)	791.978	1566.734	2104.458	2840.891	2821.050	2717.614
Inflow, foreign	0.961	0.000	0.314	0.314	0.000	0.000
Outflow, foreign	1816.377	1633.370	1702.920	1752.157	1616.810	1553.060
Surplus (deficit)	-1815.416	-1633.370	-1702.607	-1751.844	-1616.810	-1553.060
Net cashflow	670.104	1523.156	1887.893	2204.673	2256.115	2152.679
Cumulated net cashflow	-11804.100	-10280.940	-8393.048	-6188.375	-3932.260	-1779.581

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	3995.500	3995.500	3995.500	3995.500	3995.500	3995.500
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	3995.500	3995.500	3995.500	3995.500	3995.500	3995.500
Total cash outflow	2792.696	2754.446	1919.321	2267.321	2364.721	2364.721
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	1277.535	1277.535	1277.535	1277.535	1277.535	1277.535
Cost of finance	127.500	63.750	0.000	0.000	0.000	0.000
Repayment	796.875	796.875	0.000	0.000	0.000	0.000
Corporate tax	590.786	616.286	641.786	989.786	1087.186	1087.186
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1202.804	1241.054	2076.179	1728.179	1630.779	1630.779
Cumulated cash balance	3472.423	4713.477	6789.656	8517.835	10148.610	11779.390
Inflow, local	3995.500	3995.500	3995.500	3995.500	3995.500	3995.500
Outflow, local	1323.386	1328.886	1354.386	1702.386	1799.786	1799.786
Surplus (deficit)	2672.114	2666.614	2641.114	2293.114	2195.714	2195.714
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	1469.310	1425.560	564.935	564.935	564.935	564.935
Surplus (deficit)	-1469.310	-1425.560	-564.935	-564.935	-564.935	-564.935
Net cashflow	2127.179	2101.679	2076.179	1728.179	1630.779	1630.779
Cumulated net cashflow	347.598	2449.277	4525.456	6253.635	7884.414	9515.192

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	3995.500	3995.500	3995.500
Financial resources	0.000	0.000	0.000
Sales, net of tax	3995.500	3995.500	3995.500
Total cash outflow	2364.721	2364.721	2364.721
Total assets	0.000	0.000	0.000
Operating costs	1277.535	1277.535	1277.535
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1087.186	1087.186	1087.186
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	1630.779	1630.779	1630.779
Cumulated cash balance	13410.170	15040.950	16671.730
Inflow, local	3995.500	3995.500	3995.500
Outflow, local	1799.786	1799.786	1799.786
Surplus (deficit)	2195.714	2195.714	2195.714
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	564.935	564.935	564.935
Surplus (deficit)	-564.935	-564.935	-564.935
Net cashflow	1630.779	1630.779	1630.779
Cumulated net cashflow	11145.970	12776.750	14407.530

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-785.52	at	10.00 %
Internal Rate of Return (IRRE1) ..	8.38 %		

b) Net Worth versus Net cash return:

Net present value	1484.32	at	10.00 %
Internal Rate of Return (IRRE2) ..	12.83 %		

c) Internal Rate of Return on total investment:

Net present value	974.02	at	10.00 %
Internal Rate of Return (IRR) ..	11.26 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	1598.200	2397.300	3196.400	3995.500	3995.500
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1598.200	2397.300	3196.400	3995.500	3995.50[illegible]
As % of total sales	100.000	100.000	100.000	100.000	100.[illegible]
Non-variable costs, incl. depreciation	2065.074	2151.541	2392.408	2585.875	2585.[illegible]
Operational margin	-466.874	245.759	803.992	1409.625	1409.625
As % of total sales	-29.213	10.251	25.153	35.280	35.280
Cost of finance	630.000	526.250	422.500	318.750	255.000
Gross profit	-1096.874	-280.491	381.492	1090.875	1154.625
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-1096.874	-280.491	381.492	1090.875	1154.625
Tax	0.000	0.000	152.597	436.350	461.850
Net profit	-1096.874	-280.491	228.895	654.525	692.775
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-1096.874	-280.491	228.895	654.525	692.775
Accumulated undistributed profit	-1096.874	-1377.365	-1148.470	-493.945	198.829
Gross profit, % of total sales	-68.632	-11.700	11.935	27.303	28.898
Net profit, % of total sales	-68.632	-11.700	7.161	16.382	17.339
ROE, Net profit, % of equity	-20.699	-5.293	4 319	12.351	13.073
ROI, Net profit+interest, % of invest.	-3.684	1.931	5.084	7.550	7.353

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	3995.500	3995.500	3995.500	3995.500	3995.500
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	3995.500	3995.500	3995.500	3995.500	3995.500
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2391.035	2391.035	2391.035	2391.035	1521.035
Operational margin	1604.465	1604.465	1604.465	1604.465	2474.465
As % of total sales	40.157	40.157	40.157	40.157	61.931
Cost of finance	191.250	127.500	63.750	0.000	0.000
Gross profit	1413.215	1476.965	1540.715	1604.465	2474.465
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1413.215	1476.965	1540.715	1604.465	2474.465
Tax	565.286	590.786	616.286	641.786	989.786
Net profit	847.929	886.179	924.429	962.679	1484.679
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	847.929	886.179	924.429	962.679	1484.679
Accumulated undistributed profit	1046.758	1932.937	2857.366	3820.045	5304.724
Gross profit, % of total sales	35.370	36.966	38.561	40.157	61.931
Net profit, % of total sales	21.222	22.179	23.137	24.094	37.159
ROE, Net profit, % of equity	16.001	16.723	17.445	18.166	28.017
ROI, Net profit+interest, % of invest.	3.062	7.864	7.666	7.468	11.518

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	3995.500	3995.500	3995.500	3995.500	3995.500
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	3995.500	3995.500	3995.500	3995.500	3995.500
As % of total sales	100.000	100.000	100.000	100.000	100.0
Non-variable costs, incl. depreciation	1277.535	1277.535	1277.535	1277.535	1277.53.
Operational margin	2717.965	2717.965	2717.965	2717.965	2717.965
As % of total sales	68.026	68.026	68.026	68.026	68.026
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	2717.965	2717.965	2717.965	2717.965	2717.965
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2717.965	2717.965	2717.965	2717.965	2717.965
Tax	1087.186	1087.186	1087.186	1087.186	1087.186
Net profit	1630.779	1630.779	1630.779	1630.779	1630.779
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1630.779	1630.779	1630.779	1630.779	1630.779
Accumulated undistributed profit	6935.503	8566.282	10197.060	11827.840	13458.620
Gross profit, % of total sales	68.026	68.026	68.026	68.026	68.026
Net profit, % of total sales	40.815	40.815	40.815	40.815	40.815
ROE, Net profit, % of equity	30.774	30.774	30.774	30.774	30.774
ROI, Net profit+interest, % of invest.	12.651	12.651	12.651	12.651	12.651

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	3280.500	12974.200
Fixed assets, net of depreciation	0.000	3280.500
Construction in progress	3280.500	9693.700
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	3280.500	12974.200
Equity capital	1138.000	5299.200
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	2050.000	7175.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	92.500	500.000
Total debt	2142.500	7675.000
Equity, % of liabilities	34.690	40.844

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Total assets	12960.450	11971.320	10742.920	9290.736	8432.936
Fixed assets, net of depreciation	11639.860	10305.520	8984.181	7675.841	6367.501
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	206.478	274.191	363.162	446.208	446.208
Cash, bank	17.242	14.242	18.217	20.217	20.217
Cash surplus, finance available	0.000	0.000	0.000	0.000	1105.064
Loss carried forward	0.000	1096.874	1377.365	1148.470	493.945
Loss	1096.874	280.491	0.000	0.000	0.000
Total liabilities	12960.450	11971.320	10742.920	9290.736	8432.936
Equity capital	5299.200	5299.200	5299.200	5299.200	5299.200
Reserves, retained profit	0.000	0.000	0.000	0.000	0.000
Profit	0.000	0.000	228.895	654.525	692.775
Long and medium term debt	6111.458	5047.917	3984.375	3187.500	2390.625
Current liabilities	26.358	34.128	42.232	50.336	50.336
Bank overdraft, finance required.	1523.438	1590.072	1188.222	99.176	0.000
Total debt	7661.254	6672.117	5214.829	3337.012	2440.961
Equity, % of liabilities	40.887	44.266	49.327	57.037	62.839

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	7990.044	8079.348	8206.902	9169.581	10654.260
Fixed assets, net of depreciation	5254.001	4140.501	3027.001	1913.501	1670.001
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	446.208	446.208	446.208	446.208	446.208
Cash, bank	20.217	20.217	20.217	20.217	20.217
Cash surplus, finance available	2269.618	3472.422	4713.477	6789.655	8517.834
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	7990.044	8079.348	8206.902	9169.581	10654.260
Equity capital	5299.200	5299.200	5299.200	5299.200	5299.200
Reserves, retained profit	198.829	1046.758	1932.937	2857.366	3820.045
Profit	847.929	886.179	924.429	962.679	1484.679
Long and medium term debt	1593.750	796.875	0.000	0.000	0.000
Current liabilities	50.336	50.336	50.336	50.336	50.336
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1644.086	847.211	50.336	50.336	50.336
Equity, % of liabilities	66.323	65.589	64.570	57.791	49.738

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	12285.040	13915.820	15546.600	17177.380	18808.160
Fixed assets, net of depreciation	1670.001	1670.001	1670.001	1670.001	1670.001
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	446.208	446.208	446.208	446.208	446.208
Cash, bank	20.217	20.217	20.217	20.217	20.217
Cash surplus, finance available	10148.610	11779.390	13410.170	15040.950	16671.730
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	12285.040	13915.820	15546.600	17177.380	18808.160
Equity capital	5299.200	5299.200	5299.200	5299.200	5299.200
Reserves, retained profit	5304.724	6935.503	8566.282	10197.060	11827.840
Profit	1630.779	1630.779	1630.779	1630.779	1630.779
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	50.336	50.336	50.336	50.336	50.336
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	50.336	50.336	50.336	50.336	50.336
Equity, % of liabilities	43.135	38.080	34.086	30.850	28.175

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	6375.59	6375.00	1.59	1750.00	4625.00	0.96	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	6376.59	6375.00	1.59	1750.00	4625.00	0.96	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	24974.69	9257.00	15717.69	1810.00	7447.00	1816.38	1633.37
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	7992.00	8862.00	-870.00	1740.00	7122.00	163.53	51.26
imported materials . . .	7916.10	0.00	7916.10	0.00	0.00	345.97	338.96
repayment loans & overd.	6376.59	0.00	6376.59	0.00	0.00	796.88	796.89
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	2690.00	395.00	2295.00	70.00	325.00	510.00	446.25
indirect costs							
net foreign exchge flow	-18598.10	-2882.00	-15716.10	-60.00	-2822.00	-1815.42	-1633.37
import substit'n effect	55137.90	0.00	55137.90	0.00	0.00	1598.20	2397.30
net forgn exchge effect	36539.80	-2882.00	39421.80	-60.00	-2822.00	-217.22	763.93

present values at	10.00 %
foreign exchange flow .	-11536.37
net forgn exchge effect	12363.19

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	0.31	0.31	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.31	0.31	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	1702.92	1752.16	1616.81	1553.06	1489.31	1425.56	564.93
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	71.60	71.60	0.00	0.00	0.00	0.00	0.00
imported materials . . .	451.95	564.93	564.93	564.93	564.93	564.93	564.93
repayment loans & overd.	796.88	796.88	796.88	796.88	796.88	796.88	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	382.50	318.75	255.00	191.25	127.50	63.75	0.00
indirect costs							
net foreign exchge flow	-1702.61	-1751.84	-1616.81	-1553.06	-1489.31	-1425.56	-564.93
import substit'n effect	3196.40	3995.50	3995.50	3995.50	3995.50	3995.50	3995.50
net forgn exchge effect	1493.79	2243.66	2378.69	2442.44	2506.19	2569.94	3430.56

present values at	10.00 %
foreign exchange flow .	-11536.37
net forgn exchge effect	12363.19

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	564.93	564.93	564.93	564.93	564.93	564.93	-1226.42
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-1227.99
imported materials . . .	564.93	564.93	564.93	564.93	564.93	564.93	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	1.57
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-564.93	-564.93	-564.93	-564.93	-564.93	-564.93	1226.42
import substit'n effect	3995.50	3995.50	3995.50	3995.50	3995.50	3995.50	0.00
net forgn exchge effect	3430.56	3430.56	3430.56	3430.56	3430.56	3430.56	1226.42

present values at	10.00 %
foreign exchange flow .	-11536.37
net forgn exchge effect	12353.19

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPME[illegible]NK

OPPORTUNITY STUDY FOR THE PRODUCTION OF CALCIUM HYPOCHLORITE IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This opportunity study analyses the possibility of producing Calcium Hypochlorite in Nigeria once the chlorine is available fro: the proposed chlor-alkali plant that has been described in another opportunity study.

Calcium Hypochlorite can be used as a sterilizing or bleaching agent and may replace both chlo and sodium hypochlorite. C.H. is as effective as chlorine gas, but has the advantage of being in powdered form and may be easily stored in hot climates. Dosage (in terms of active chlorine) is identical to that of chlorine gas.(1)

It may therefore be used as a substitute of chlorine for a number of extremely important applications (also as far as its social impact is concerned) such as:

- water treatment: disinfection of city and well water, water tanks, etc.
- disinfection of public facilities, hospitals, schools, etc.
- disinfection of food processing plants (meat, dairies, canning, soft drinks, sugar refineries, etc.)
- industrial applications: bleaching of cotton yarn and cotton cloth, etc.

It is produced by using three main raw materials: chlorine gas, lime and caustic soda.

All three would be of local origin.

The plant will be located near the chlor-alkali plant (where chlorine and caustic soda can be available). Its nominal capacity is 2300 t/y of HSH (High Strength Hypochlorite) based on 250 working days, 3 shifts/day, 8 hours/shift.

The financial analysis of such a project was carried out. Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed Assets: US$ 8,309,800
- Working capital (at full production): US$ 171,713
- Internal rate of Return: 17.07%
- Break-Even Point (at 5th year of production): 43%
- Pay-Back Period: less than 8.5 years (including construction period)
- Employees: 93

(1) For additional background material, see Volume I p. 129.

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 25.111.740 (as present value at 10%).

On the basis of the analysis in this study, it is recommeded that a feasibility study be undertaken.

1. INTRODUCTION

Calcium hypochlorite is a solid, bleaching agent with the formula $Ca(OCl)_2$.

The strength (or the oxidizing power) of hypochlorite solution is usually measured in terms of "available chlorine".

"Available chlorine" may be expressed as a percentage which is grams of available chlorine per 100 ml solution.

Standard bleaching powders are mixtures containing mainly calcium hypochlorite Ca $(OCl)_2$, calcium chloride $CaCl_2$ and sodium chloride $NaCl_2$ with varying amounts of water. This study will deal with the production of "High strength hypochlorite" (HSH) which allows to obtain a solid hypochlorite with 70% or more, of available chlorine.

The technical product is in the form of briquets and/or free flowing granules.

Due to the low content of hygroscopic calcium chloride impurity, the product shows good chemical stability with very low decomposition rate.
A typical analysis of the HSH is as follows:

$Ca(OCl)_2$	min	70%	w/w
NaCl		15-17%	w/w
$Ca(OH)_2$		3-4%	w/w
$CaCl_2$		1-2%	w/w
$CaCO_3$		2-4%	w/w
$Ca(ClO_3)_2$		1-2%	w/w
Others		1-2%	w/w
Water	max	5%	w/w

The mother liquor which remains after filtration of HSH is an important by-product that can be used directly as a bleaching solution.

A typical analysis of such a mother liquor is as follows:

$Ca(OCl)_2$	0-11%	w/w
NaCl	19-20%	w/w
Water	balance	

2. MARKET AND PLANT CAPACITY

2.1 USES

Calcium hypochlorite is used as a sterilizing or bleaching agent. In these fields it has the same uses as other well known products such as chlorine or sodium hypochlorite; but, compared with each of these, it has the following advantages:

- solid form (granules or briquets), easy to handle, pack, transport and store;
- no danger of pollution, even if stored in large quantities:

In addition it has these other benefits when compared with sodium hypochlorite only:

- chemical stability
- higher "available chlorine" content

All these characteristics have brought up the success of this new product in the industrialized countries and its use in Nigeria will be in the following main applications:

a) Water treatment: disinfection of city and well waters, disinfection of water tanks, removal and prevention of the growth of algae in tanks.

b) Bleaching: bleaching of cotton yarn and cotton cloth, bleaching and disinfection of children's clothing and hospital linen.

c) Industry: disinfection of facilities at meat processing plants, dairies, canning factories, soft drink factories and sugar refineries; disinfection of bottles and water used in the production of soft drinks; disinfection of raw vegetables and fruits.

d) Public facilities: disinfecting, deodorizing and bleaching of floors, walls, drains and toilets at hospitals, schools, railway stations and other public buildings.

e) Domestic uses: disinfecting, deodorizing and bleaching.

This product would therefore have a very effective social impact, taking into consideration the water and sanitation problems of a rural population (the product can be easily transported and stored).

2.2 MARKET AND PLANT CAPACITY

2.2.1 Demand and supply

At present, there is no production of calcium hypochlorite in Nigeria. The demand is satisfied by imports. The actual market cannot be assessed, because there are no data available. It is anyway confirmed by N.I.D.B. that this product is imported by textile industry and Municipalities.

2.2.2 Plant capacity

Taking into consideration the minimum economical size for this kind of plant, a production of 2300 t/y of HSH technical grade (that is 1600 t/y of pure calcium hypochlorite) will be analyzed.
This output is based on 250 working days/y, 3 shifts/day, 8 hours/shift. It also produces, as a by-product, 10,000 t of calcium hypochlorite solution with a 11% "available chlorine" that can be sold as such for disinfecting and bleaching purposes.

2.3 SALES PRICE AND TOTAL REVENUE

As far as calcium hypochlorite solution is concerned, its sale price can be fixed on the basis of the "available chlorine" content, that is on the basis of the quantity of chlorine of equivalent effect.
As stated above, this available chlorine content is about 11%; so the price of the calcium hypochlorite solution should be the 11% of the price of chlorine, which is traded at 365 $/t. Taking this value as base price for chlorine, the price of the calcium hypochlorite solution can be evaluated at 365 x 0.11 = 40 $/t. For the HSH, on the other hand, the value is higher than the equivalent amount of chlorine, due to its easier distribution, storage and utilization. On the international market it is quoted at about 2000 $/t and this can be assumed as the selling price in Nigeria.
Consequently the total annual revenues at full capacity (2300 t/y of HSH technical grade and 10,000 m^3 of calcium hypochlorite solution) result as follows:

- HSH		
2300 t/y x 2000 $/t =	4,600,000	$/y
- calcium hypochlorite solution		
10,000 t/y x 40 $/t =	400,000	$/y
Total	5,000,000	$/y

3. MATERIAL AND INPUTS

3.1 CHEMISTRY

The chemistry of the plant, i.e. the production of HSH can be represented by the following main reaction:

$$2\,Ca(OH)_2 + 2\,Cl_2 = CaCl_2 + Ca(OCl)_2 + 2H_2O$$

As a consequence the main required raw materials are calcium oxide and chlorine; caustic soda and sodium sulfite are also needed.

Caustic soda will be available in the Country, if the plant considered in an opportunity study within this subsector is implemented.

Calcium oxide, largely available in the country, should have the following specifications:

CaO	min	85	%
MgO	max	1	%
SiO_2	max	1	%
$CaSO_4$	max	0.5	%
$CaCO_3$ (unbacked)	max	6.5	%
$CaCO_3$ (overbacked)	max	4.5	%
$Fe_2O_3 + Al_2O_3$	max	0.5	%
Ni, Co, Mn	max	traces	%

3.2 MATERIAL AND UTILITIES REQUIREMENTS AND COSTS

The complete list of inputs and utilities (amounts and costs) to be supplied annually to the plant at full capacity (2300 t/y) is:

raw materials			US $
chlorine (100% basis)	2645 t x 365 US$/t	=	965,425
calcium oxide[3]	1380 t x 40 US$/t	=	55,200
caustic soda 100%	1495 t x 495 US$/t	=	740,025
sodium sulfite	11.5 t x 500 US$/t	=	5,750
			1,766,400

In the event that the Chlor-Alkali project is not implemented it is still possible to install the plant for the production of HSH. In such a case, Chlorine has to be imported along with Sodium Sulfite.

(2) For milk lime preparation

(3) Expressed as cost of the Limestone raw material

utilities			US $/y
electric energy	1,978,000 kWh x 0.1 US$/kWh	=	197,800
steam (10 ate)[4]	7,475 t x 8 $/t	=	59,800
cooling water (T range = 10 C)[5]	322,000 m^3 x 0,0075 m^3	=	2,415
			260,015

In the financial evaluation these costs and packaging costs are allocated as follows:

raw mat. 1	LC	1,705,450	(chlorine caustic soda)
raw mat. 1	FC	5,750	(sodium sulfite)
other raw mat.	LC	125,200	(calcium oxide & packaging)
utilities	LC	260,015	

3.3 RAW MATERIALS PURCHASING AND STORAGE VOLUMES

On the assumption of installing the plant next to the proposed caustic soda plant, no stock of chlorine and caustic soda has been considered necessary, since these two products have been presumed to be piped directly from the production plant to the user.

For sodium sulfite, being imported raw material, a stock equivalent to six months consumption at full capacity is advisable while for calcium oxide one month is enough.

As a result the following amounts of chemical must be considered as a minimum stock:

- sodium sulfite	6 t	equivalent to	$ 3,000
- calcium oxide	115 t	equivalent to	$ 4,600
		Total	$ 7,600

4. LOCATION

Due to the connection of this production with the chlor-alkali plant, the location should be next to the chlor-alkali plant.

[4] Expressed as cost of fuel

[5] Expressed as cost of electric energy for pumping

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

The proposed process essentially consists of a three-stage reaction, followed by filtration, drying and drum filling of the main product, as shown in the attached process flowsheet.

Raw materials to be fed into the reactors are: chlorine gas, milk of lime and caustic soda solution.

While chlorine and caustic soda, as produced in the adjacent chloralkali plant, can be considered suitable processable chemicals, the commercially available slaked lime might show a wide range of impurity content which could affect the quality and uniformity of the final product. It is preferable to provide the on-site slaking of commercial quick lime: a well designed slake improves the quality of the milk of lime by separating inerts and grits and by producing milk of uniform strength.

Three reactors are operated batchwise. A dosed amount of milk of lime is fed to the reactor and, under pH and temperature control, chlorine is added until the fed milk of lime is partially chlorinated. Caustic soda is then added to the reaction system and the reaction is completed under pH and temperature control.

All the reactors are provided with titanium coolers to remove reaction heat.

The final product of the reaction is a slurry that flows to a receiver provided with agitator and refrigerating coil.

Pressure inside the reactors is nearly atmospheric (slightly negative). The amount of chlorine contaminated gas to be vented to the chlorine neutralization unit depends on the concentration of the feed chlorine: the higher the concentration, the less waste gas is eliminated.

From the receiver, the slurry is pumped to a rotary filter where most of the mother liquor is separated from the wet cake. The mother liquor, collected in a storage tank, is a bleach solution with about 11% $Ca(OCl)_2$ content, free of calcium chloride impurity.

The cake enters the dryer properly mixed with the recycles in a granulate. In the drying chamber the product enters into contact with hot air and flows concurrently down through the drying chamber. Hot air is obtained by indirect heating with steam.

The dry product from the fluidized bed is pneumatically conveyed to an aid-back silo which feeds a sieve machine separating the HSH of proper granulometry from powders and large granules that are recycled tc the granulator.

HSH is collected in a storage silo and packaged in 25 kg bags provided with internal plastic bags.

Spent air leaves the drying chamber and passes to a cyclone separation system. Spent air form the cyclone is vented to the atmosphere after being de-powdered in a bag filter and scrubbed in a packed tower in counter-current with alkaline water.

In normal storage conditions the product will lose 3 to 5% of its available chlorine content in a year.

5.2 PACKAGING

The HSH will be packed in 25 kg plastic bags estimated 0.7 $ per piece: for the whole production the cost of packaging will amount to US$ 70,000 per year.

5.3 LAYOUT AND CIVIL WORKS

The area covered by the general lay-out, is approx 3900 m^2, and can be divided as follows:

- a multistorey building of 480 m^2 surface, 15 m height, for the processing plant, utilities, workshop, warehouse and laboratory;

- a two-storey building covering an area of 200 m^2 for the administration offices and other services;

- the remaining space consists of roads and courtyards, covered with gravel and rolled.

The buildings for the processing equipment, utilities, workshop, warehouses and laboratory are covered with corrugated asbestos sheets and supported by steel columns and trusses.

The floors are of concrete with a hard aggregate as finishing surface. Partitions and external walls, where needed, are of brickwork. The offices building has a reinforced concrete structure and internal and external walls made of brickwork. The roof is insulated by mineral wool lagging covered with corrugated asbestos-cement; the floors are covered with tiles.

The fence consists of wire netting supported by small steel poles and is installed all around the complex.

5.4 INVESTMENT COSTS, DEPRECIATION AND MAINTENANCE

Description	LC M$	FC M$	Total M$
Machinery and equipment for process and utilities FOB European port	--	4.000	4.000
Transportation	0.200	0.400	0.600
Erection	0.800	0.400	1.200
Insulations and paintings	0.075	0.050	0.125
Site preparation	0.070	--	0.070
Civil works	0.766	--	0.766
Spare parts	--	0.200	0.200
Total	**1.911**	**5.050**	**6.961**
Contingencies	**0.189**	**0.450**	**0.639**
GRAND TOTAL	**2.100**	**5.500**	**7.600**

The machinery and equipment have been quoted by Garbato, Milan, Italy.

The industrial life of the plant can be considered as 15 years.

The annual maintenance cost has been assumed equivalent to 4% of the machinery and equipment cost, that is 160,000 $.

In the financial evaluation the investment costs (contingencies included) have been subdivided as follows:

preproduction expenditures	FC	0.140 million dollars
preproduction expenditures	LC	0.232 million dollars
machinery	FC	5.500 million dollars
machinery	LC	1.089 million dollars
civil works	LC	0.941 million dollars
land + site preparation	LC	0.070 million dollars
	TOTAL	7.972 million dollars

6. PLANT ORGANIZATION

The plant is considered as an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skills are required for any of the positions listed below except for the technical manager, the production manager, the workshop engineer and the chemist, who must have thorough training in the technology involved in the process (with particular regard to analysis of raw materials and finished product, corrosion problems, performance optimization).

The requirements for all the other positions are not different from those required in any other chemical factory. It is recommended that on the job training is carried out by one expert made available by the technology supplier, for one year after the start-up.

The relevant cost is estimated US$ 120,000.

The number of personnel reflects the needs of three shifts.

7.1 MANAGEMENT

		N/Y
- General manager	1	50,000
- Technical manager	1	40,000
Total	2	90,000
	Overheads 40%	36,000
		126,000
		(16,000 US$)

7.2 ADMINISTRATIVE DEPT.

		N/Y
- Financial manager	1	40,000
- Accountants	2	24,000
- Purchasing dept.	1	12,000
- Warehouse keepers	2	24,000
- Sales dept.	1	12,000
- Clerks & secretary	6	72,000
- Guards	8	48,000
- Drivers	3	24,000
Total	24	256,000
	Overheads 40%	102,400
Total		358,400
		(45,400 US$)

7.3 PRODUCTION DEPT.

		N/Y
- Production manager	1	40,000
- Shift foreman	8	96,000
- Shift operators	20	160,000
- Semiskilled shift workers	20	120,000
- Chemist	1	25,000
- Analysts	3	36,000
- Clerk	1	12,000
Total	54	489.000
	Overheads 40%	195,600
		684,600
		(86,700 US$)

7.4 MAINTENANCE DEPT.

		N/Y
- Chief engineer	1	40,000
- Foremen	2	24,000
- Electricians	2	20,000
- Mechanical fitters	4	40,000
- Semiskilled workers	2	16,000
- Unskilled workers	2	12,000
Total	13	152,000
	Overheads 40%	60,800
		212,800
		(27,000 US$)

Summary:

Administration	26	61,400 $/y
Production	54	86,700 $/y
Maintenance	13	27,000 $/y
Total manpower	93	175,100 $/y

8. IMPLEMENTATION SCHEDULE

From the moment the financing of the project is finalized, 20 months will be needed in order to design, build and commissioning the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 8,309,800 US Dollars. The portion in foreign currency accounts for 5,900,000 US Dollars.

Details of these figures are shown in chapter 5.4

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 628,000	US$ 2,749,000	US$ 3,377,000
- Foreign Loan (interest 8%)	US$ 1,100,000	US$ 2,895,000	US$ 3,995,000
- Local Loan (interest 15%)	US$ 300,000	US$ 300,000	US$ 600,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 **Working capital**

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 60%

3rd year 80%

4th and subsequent years 100%

When the plant is in full production, the required working capital amounts to 171,713 US Dollars, the foreign portion being US$ 36,252.

It is worth mentioning that raw materials shall be purchased just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US $ 97,000 of which US $ 35,000 in foreign currency.

9.1.4 **Total production costs**

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US $ 2,436,810.

In the fourth year, at full production, the costs amount to US $ 3,479,160, then they start a slight decrease year after year, to reach a constant amount of US $ 2,431,500 from the 11th to 15th year. The unit production cost results to be:

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 5,000,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 2,000,000

2nd year 60% : revenue = US$ 3,000,000

3rd year 80% : revenue = US$ 4,000,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 17.07%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 43% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [5] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 8.5 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

[5] Direct labour is considered as fixed cost, due to the necessity to have well trained people for the operation of the plant regardless of capacity utilization.

The yearly imported quantity and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 25,111,740.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US $ 25,111,740.

ANNEXE 1

COMFAR SCHEDULES

CALCIUM HYPOCHLORITE
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	8309.80	70.854 % foreign
current assets:	0.00	0.000 % foreign
total assets:	8309.80	70.854 % foreign

Source of funds during construction phase

equity & grants:	3377.00	0.000 % foreign
foreign loans :	3995.00	
local loans :	600.00	
total funds :	7972.00	50.113 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1165.30	2431.50	2431.50
depreciation :	861.91	847.91	155.95
interest :	409.60	159.80	0.00
production costs	2436.81	3439.21	2587.45
thereof foreign	44.76 %	24.61 %	2.28 %
total sales :	2000.00	5000.00	5000.00
gross income :	-436.81	1560.79	2412.55
net income :	-436.81	936.47	1447.53
cash balance :	-371.36	1285.01	1603.48
net cashflow :	737.61	1944.18	1603.48

Net Present Value at: 10.00 % = 3786.26
Internal Rate of Return: 17.07 %
Return on equity1: 17.79 %
Return on equity2: 21.76 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	70.000	0.000
Buildings and civil works	626.000	315.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	1200.000	5389.000
Total fixed investment costs	1896.000	5704.000
Pre-production capital expenditures.	198.5[illegible]	511.300
Net working capital	0.0[illegible]	0.000
Total initial investment costs	2094.[illegible]	6215.300
Of it foreign, in %	54.619	76.325

Total Current Investment in 1000 US $

Year	1992	1993	1994	1995
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	[illegible]	0.000
Working capital	97.086	9.817	[illegible]	30.746
Total current investment costs	97.086	9.817	.64	30.746
Of it foreign, %	35.536	0.000	21.245	23.582

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	682.200	1023.300	1364.400	1705.450	1705.450
Other raw materials	52.400	78.550	104.300	130.950	130.950
Utilities	100.000	150.000	190.000	260.000	260.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	86.700	86.700	86.700	86.700	86.700
Repair, maintenance	42.680	64.020	85.360	106.700	106.700
Spares	21.320	32.000	42.640	53.300	53.300
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	1105.300	1434.570	1873.900	2343.100	2343.100
Administrative overheads	60.000	60.000	88.400	88.400	88.400
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	861.910	861.910	854.910	847.910	847.910
Financial costs	409.600	339.650	269.700	199.750	159.800
Total production costs	2436.810	2696.130	3086.910	3479.160	3439.210
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	44.763	34.963	29.625	25.476	24.611
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	146.700	146.700	175.100	175.100	175.100

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	1705.450	1705.450	1705.450	1705.450	1705.450
Other raw materials	130.950	130.950	130.950	130.950	130.950
Utilities	260.000	260.000	260.000	260.000	260.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	86.700	86.700	86.700	86.700	86.700
Repair, maintenance	106.700	106.700	106.700	106.700	106.700
Spares	53.300	53.300	53.300	53.300	53.300
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	2343.100	2343.100	2343.100	2343.100	2343.100
Administrative overheads	88.400	88.400	88.400	88.400	88.400
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	705.950	705.950	705.950	705.950	155.950
Financial costs	119.850	79.900	39.950	0.000	0.000
Total production costs	3257.300	3217.350	3177.400	3137.450	2587.450
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	[illegible]	[illegible]	[illegible]	[illegible]	3.282
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	1705.450
Other raw materials	130.950
Utilities	260.000
Energy	0.000
Labour, direct	86.700
Repair, maintenance	106.700
Spares	53.300
Factory overheads	0.000
Factory costs	2343.100
Administrative overheads	88.400
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	2431.500
Costs per unit (single product)	0.000
Of it foreign, %	2.429
Of it variable,%	0.000
Total labour	175.100

Net Working Capital in 1000 US $

Year	mdc	coto	1992	1993	1994	1995	1996-2006
Current assets &							
Accounts receivable	30	12.0	97.108	124.548	163.525	202.625	202.625
Inventory and materials	10	34.4	4.453	6.675	8.878	11.156	11.156
Energy	0	---	0.000	0.000	0.000	0.000	0.000
Spares	180	2.0	10.660	16.000	21.320	26.650	26.650
Work in progress	1	360.0	3.070	3.985	5.205	6.509	6.509
Finished products	15	24.0	48.554	62.274	81.762	101.312	101.312
Cash in hand	15	24.0	13.779	10.113	12.629	13.962	13.962
Total current assets			177.625	223.594	293.320	362.214	362.214
Current liabilities and							
Accounts payable	29	12.3	80.539	116.692	152.353	190.502	190.502
Net working capital			97.086	106.903	140.967	171.713	171.713
Increase in working capital			97.086	9.817	34.064	30.746	0.000
Net working capital, local			62.585	85.138	111.965	135.461	135.461
Net working capital, foreign			34.501	21.765	29.002	36.252	36.252

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	628.000	2749.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1100.000	2895.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	300.000	300.000
Loan C, local....	0.000	0.000
Total loan	1400.000	3195.000
Current liabilities	0.000	0.000
Bank overdraft	66.500	271.300
Total funds	2094.500	6215.300

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-499.375	-499.375	-499.375	-499.375	-499.375
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-200.000	-200.000	-200.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-699.375	-699.375	-699.375	-499.375	-499.375
Current liabilities	80.539	36.153	35.661	38.149	0.000
Bank overdraft	371.361	-335.041	-374.120	0.000	0.000
Total funds	-247.475	-998.263	-1037.834	-461.226	-499.375

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow	2028.000	5944.00
Financial resources	2028.000	5944.000
Sales, net of tax	0.000	0.000
Total cash outflow	2094.500	6215.300
Total assets	2028.000	5944.000
Operating costs	0.000	0.000
Cost of finance	66.500	271.300
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	-66.500	-271.300
Cumulated cash balance	-66.500	-337.800
Inflow, local	928.000	3049.000
Outflow, local	950.500	1471.500
Surplus (deficit)	-22.500	1577.500
Inflow, foreign	1100.000	2895.000
Outflow, foreign	1144.000	4743.800
Surplus (deficit)	-44.000	-1848.800
Net cashflow	-2028.000	-5944.000
Cumulated net cashflow	-2028.000	-7972.000

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	2080.539	3036.453	4035.661	5038.148	5000.000	5000.000
Financial resources	80.539	36.453	35.661	38.149	0.000	0.000
Sales, net of tax	2000.000	3000.000	4000.000	5000.000	5000.000	5000.000
Total cash outflow	2451.900	2701.413	3366.336	3807.856	3714.991	3747.805
Total assets	177.625	45.970	69.725	68.894	0.000	0.000
Operating costs	1165.300	1494.570	1962.300	2431.500	2431.500	2431.500
Cost of finance	409.600	339.650	269.700	199.750	159.800	119.850
Repayment	699.375	699.675	699.375	499.375	499.375	499.375
Corporate tax	0.000	121.548	365.236	608.336	624.316	697.080
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-371.361	335.041	669.325	1230.292	1285.009	1252.195
Cumulated cash balance	-709.161	-374.120	295.205	1525.498	2810.506	4062.701
Inflow, local	2080.140	3036.453	4035 628	5038.116	5000.000	5000.000
Outflow, local	1454.405	1899.674	2572.751	3042.398	2996.766	3069.530
Surplus (deficit)	625.735	1136.779	1462.877	1995.718	2003.234	1930.470
Inflow, foreign	0.399	0.000	0.033	0.033	0.000	0.000
Outflow, foreign	997.495	801.739	793.585	765.458	718.225	678.275
Surplus (deficit)	-997.096	-801.739	-793.552	-765.425	-718.225	-678.275
Net cashflow	737.614	1374.066	1638.400	1929.418	1944.184	1871.420
Cumulated net cashflow	-7234 386	-5860.320	-4221.920	-2292.502	-348.319	1523.101

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	5000.000	5000.000	5000.000	5000.000	5000.000	5000.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	5000.000	5000.000	5000.000	5000.000	5000.000	5000.000
Total cash outflow	3723.835	3699.865	3176.521	3396.521	3458.900	3458.900
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	2431.500	2431.500	2431.500	2431.500	2431.500	2431.500
Cost of finance	79.900	39.950	0.000	0.000	0.000	0.000
Repayment	499.375	499.375	0.000	0.000	0.000	0.000
Corporate tax	713.060	729.040	745.020	965.020	1027.400	1027.400
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1276.165	1300.135	1823.479	1603.479	1541.100	1541.100
Cumulated cash balance	5338.865	6639.000	8462.479	10065.960	11607.060	13148.160
Inflow, local	5000.000	5000.000	5000.000	5000.000	5000.000	5000.000
Outflow, local	3085.510	3101.490	3117.470	3337.470	3399.850	3399.850
Surplus (deficit)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	[illegible]	[illegible]	59.050	59.050	59.050	59.050
Surplus (deficit)	-638.325	-598.375	59.050	-59.050	-59.050	-59.050
Net cashflow	1855.440	1839.460	1823.480	1603.480	1541.100	1541.100
Cumulated net cashflow	3378.541	9218.000	7041.479	8644.959	10186.060	11727.160

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	5000.000	5000.000	5000.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	5000.000	5000.000	5000.000
Total cash outflow	3458.900	3458.900	3458.900
Total assets	0.000	0.000	0.000
Operating costs	2431.500	2431.500	2431.500
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1027.400	1027.400	1027.400
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	1541.100	1541.100	1541.100
Cumulated cash balance	14689.260	16230.360	17771.460
Inflow, local	5000.000	5000.000	5000.000
Outflow, local	3399.850	3399.850	3399.850
Surplus (deficit)	1600.150	1600.150	1600.150
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	59.050	59.050	59.050
Surplus (deficit)	-59.050	-59.050	-59.050
Net cashflow	1541.100	1541.100	1541.100
Cumulated net cashflow	13268.260	14809.360	16350.460

Cashflow Discounting:

a) Equity paid versus Net income flow:
Net present value ..... 2603.39 at 10.00 %
Internal Rate of Return (IRRE1) .. 17.79 %

b) Net Worth versus Net cash return:
Net present value ..... 4108.86 at 10.00 %
Internal Rate of Return (IRRE2) .. 21.76 %

c) Internal Rate of Return on total investment:
Net present value ..... 3786.26 at 10.00 %
Internal Rate of Return (IRR) .. 17.07 %

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	2000.000	3000.000	4000.000	5000.000	5000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	2000.000	3000.000	4000.000	5000.000	5000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2027.210	2356.480	2817.210	3279.410	3279.410
Operational margin	-27.210	643.520	1182.790	1720.590	1720.590
As % of total sales	-1.361	21.451	29.570	34.412	34.412
Cost of finance	409.600	339.650	269.700	199.750	159.800
Gross profit	-436.810	303.870	913.090	1520.840	1560.790
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-436.810	303.870	913.090	1520.840	1560.790
Tax	0.000	121.548	365.236	608.336	624.316
Net profit	-436.810	182.322	547.854	912.504	936.474
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-436.810	182.322	547.854	912.504	936.474
Accumulated undistributed profit	-436.810	-254.488	293.366	1205.870	2142.344
Gross profit, % of total sales	-21.841	10.129	22.827	30.417	31.216
Net profit, % of total sales	-21.841	6.077	13.696	18.250	18.729
ROE, Net profit, % of equity	-12.935	5.399	16.223	27.021	27.731
ROI, Net profit+interest, % of invest.	-0.337	6.461	10.077	13.658	13.462

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	5000.000	5000.000	5000.000	5000.000	5000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	5000.000	5000.000	5000.000	5000.000	5000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	3137.449	3137.450	3137.450	3137.450	2587.450
Operational margin	1862.551	1862.550	1862.550	1862.550	2412.550
As % of total sales	37.251	37.251	37.251	37.251	48.251
Cost of finance	119.850	79.900	39.950	0.000	0.000
Gross profit	1742.700	1782.650	1822.600	1862.550	2412.550
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1742.700	1782.650	1822.600	1862.550	2412.550
Tax	697.080	713.060	729.040	745.020	965.020
Net profit	1045.620	1069.590	1093.560	1117.530	1447.530
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1045.620	1069.590	1093.560	1117.530	1447.530
Accumulated undistributed profit	3187.965	4257.555	5351.115	6468.646	7916.176
Gross profit, % of total sales	34.854	35.653	36.452	37.251	48.251
Net profit, % of total sales	20.912	21.392	21.871	22.351	28.951
ROE, Net profit, % of equity	30.963	31.673	32.383	33.092	42.864
ROI, Net profit+interest, % of invest.	14.311	14.115	13.919	13.723	17.775

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	5000.000	5000.000	5000.000	5000.000	5000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	5000.000	5000.000	5000.000	5000.000	5000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2431.500	2431.500	2431.500	2431.500	2431.500
Operational margin	2568.500	2568.500	2568.500	2568.500	2568.500
As % of total sales	51.370	51.370	51.370	51.370	51.370
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	2568.500	2568.500	2568.500	2568.500	2568.500
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2568.500	2568.500	2568.500	2568.500	2568.500
Tax	1027.400	1027.400	1027.400	1027.400	1027.400
Net profit	1541.100	1541.100	1541.100	1541.100	1541.100
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1541.100	1541.100	1541.100	1541.100	1541.100
Accumulated undistributed profit	9457.276	10998.380	12539.480	14080.580	15621.680
Gross profit, % of total sales	51.370	51.370	51.370	51.370	51.370
Net profit, % of total sales	30.822	30.822	30.822	30.822	30.822
ROE, Net profit, % of equity	45.635	45.635	45.635	45.635	45.635
ROI, Net profit+interest, % of invest.	18.924	18.924	18.924	18.924	18.924

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	2094.500	8309.800
Fixed assets, net of depreciation	0.000	2094.500
Construction in progress	2094.500	6215.300
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	2094.500	8309.800
Equity capital	628.000	3377.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	1400.000	4595.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	66.500	337.800
Total debt	1466.500	4932.800
Equity, % of liabilities	29.983	40.639

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Total assets	8062.325	7246.384	6574.082	6770.872	7207.971
Fixed assets, net of depreciation	7447.890	6585.979	5731.069	4883.159	4035.249
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	163.846	213.481	280.691	348.252	348.252
Cash, bank	13.779	10.113	12.629	13.962	13.962
Cash surplus, finance available	0.000	0.000	295.205	1525.499	2810.508
Loss carried forward	0.000	436.810	254.488	0.000	0.000
Loss	436.810	0.000	0.000	0.000	0.000
Total liabilities	8062.325	7246.384	6574.082	6770.872	7207.971
Equity capital	3377.000	3377.000	3377.000	3377.000	3377.000
Reserves, retained profit	0.000	0.000	0.000	293.366	1205.870
Profit	0.000	182.322	547.854	912.504	936.476
Long and medium term debt	3895.625	3196.250	2496.875	1997.500	1498.125
Current liabilities	80.539	116.692	152.353	190.502	190.502
Bank overdraft, finance required.	709.161	374.120	0.000	0.000	0.000
Total debt	4685.325	3687.062	2649.228	2188.001	1688.626
Equity, % of liabilities	41.886	46.603	51.368	49.875	46.851

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	7754.216	8324.432	8918.617	10036.150	11483.680
Fixed assets, net of depreciation	3329.299	2623.349	1917.399	1211.449	1055.499
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	348.252	348.252	348.252	348.252	348.252
Cash, bank	13.962	13.962	13.962	13.962	13.962
Cash surplus, finance available	4062.703	5338.868	6639.004	8462.484	10065.960
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	7754.216	8324.432	8918.617	10036.150	11483.680
Equity capital	3377.000	3377.000	3377.000	3377.000	3377.000
Reserves, retained profit	2142.344	3187.965	4257.555	5351.115	6468.646
Profit	1045.620	1069.590	1093.560	1117.530	1447.530
Long and medium term debt	998.750	499.375	0.000	0.000	0.000
Current liabilities	190.502	190.502	190.502	190.502	190.502
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1189.251	689.877	190.502	190.502	190.502
Equity, % of liabilities	43.550	40.567	37.865	33.648	29.407

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	13024.780	14565.880	16106.980	17648.080	19189.180
Fixed assets, net of depreciation	1055.499	1055.499	1055.499	1055.499	1055.499
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	348.252	348.252	348.252	348.252	348.252
Cash, bank	13.962	13.962	13.962	13.962	13.962
Cash surplus, finance available	11607.060	13148.170	14689.270	16230.370	17771.470
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	13024.780	14565.880	16106.980	17648.080	19189.180
Equity capital	3377.000	3377.000	3377.000	3377.000	3377.000
Reserves, retained profit	7916.176	9457.276	10998.380	12539.480	14080.580
Profit	1541.100	1541.100	1541.100	1541.100	1541.100
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	190.502	190.502	190.502	190.502	190.502
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	190.502	190.502	190.502	190.502	190.502
Equity, % of liabilities	25.928	23.184	20.966	19.135	17.598

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US $
Economic Analysis including indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	3995.46	3995.00	0.46	1100.00	2895.00	0.40	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	3995.46	3995.00	0.46	1100.00	2895.00	0.40	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total foreign outflow .	11706.37	5887.80	5818.57	1144.00	4743.80	997.49	801.74
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	5090.00	5640.00	-550.00	1100.00	4540.00	34.90	-13.04
imported materials . . .	934.91	0.00	934.91	0.00	0.00	143.62	35.45
repayment loans & overd.	3995.46	0.00	3995.46	0.00	0.00	499.38	499.68
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1686.00	247.80	1438.20	44.00	203.80	319.60	279.65
indirect costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net foreign exchge flow	-7710.91	-1892.80	-5818.11	-44.00	-1848.80	-997.10	-801.74
import substit'n effect	70000.00	0.00	70000.00	0.00	0.00	2000.00	3000.00
net forgn exchge effect	62289.09	-1892.80	64181.89	-44.00	-1848.80	1002.90	2198.26

present values at	10.00 %
foreign exchange flow .	-5479.37
net forgn exchge effect	25111.74

CALCIUM HYPOCHLORITE

Foreign Exchange Effect in 1000 US $
Economic Analysis including indirect effects
100 units foreign CU = 100.00 units local CU

	production 1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	0.03	0.03	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.03	0.03	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total foreign outflow .	793.58	765.46	718.22	678.27	638.33	598.38	59.05
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	7.27	7.28	0.00	0.00	0.00	0.00	0.00
imported materials . . .	47.24	59.05	59.05	59.05	59.05	59.05	59.05
repayment loans & overd.	499.38	499.38	499.38	499.38	499.38	499.38	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	239.70	199.75	159.80	119.85	79.90	39.95	0.00
indirect costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net foreign exchge flow	-793.55	-765.43	-718.22	-678.27	-638.33	-598.38	-59.05
import substit'n effect	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00
net forgn exchge effect	4206.45	4234.57	4281.77	4321.73	4361.67	4401.63	4940.95

present values at	10.00 %
foreign exchange flow .	-5479.37
net forgn exchge effect	25111.74

Foreign Exchange Effect in 1000 US $
Economic Analysis including indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total foreign outflow .	59.05	59.05	59.05	59.05	59.05	59.05	-586.25
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-586.42
imported materials . . .	59.05	59.05	59.05	59.05	59.05	59.05	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.16
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net foreign exchge flow	-59.05	-59.05	-59.05	-59.05	-59.05	-59.05	586.25
import substit'n effect	5000.00	5000.00	5000.00	5000.00	5000.00	5000.00	0.00
net forgn exchge effect	4940.95	4940.95	4940.95	4940.95	4940.95	4940.95	586.25

present values at	10.00 %
foreign exchange flow .	-5479.37
net forgn exchge effect	25111.74

CALCIUM HYPOCHLORITE

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE PRODUCTION OF CALCIUM CARBIDE IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for the production of Calcium Carbide in Nigeria.

The envisaged plant has a nominal capacity of 7,000 tons/year based on 330 working days, 3 shift/day, 8 hours/shift.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 9,614,520 (US$ 6,537,000 in foreign currency)
- Working capital (at full production): US$ 473,014 (US$ 267,100 in foreign currency)
- Internal Rate of Return: 18.54%
- Break-Even Point (at 5th year of production) 42%
- Pay-Back Period: less than 7 years (including construction period)
- Employees: 90

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 25,895,290 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

Calcium carbide, CaC_2, when pure, is a transparent and colourless solid, with a specific gravity of 2,22 at 18 C. Pure CaC_2 is a rarity, and the general properties of calcium carbide have been determined by extrapolation from values obtained on high purity commercial carbide. Commercial CaC_2 varies in colour from steel-gray to reddish brown, depending on the impurities and the method of production.

The characteristics of technical CaC_2 are as follows:

purity =	80%
balance =	CaO plus 2 to 5% of other impurities
developable acetylene =	300 l from 1 kg of CaC_2
PH3 content in acetylene =	0.05 - 0.07% (max 0.09%)
size =	from 15 to 80 mm[2]
Bulk density =	2.2

2. MARKET AND PLANT CAPACITY

2.1 USES

The outstanding property of CaC_2 is the reaction with water to produce acetylene according to the following equation:

$$CaC_2 + 2H_20 \text{ ----> } C_2H_2 + Ca(0H)_2$$

In the past, commercial CaC_2 was the main source of acetylene used as a raw material in the synthesis of many organic chemicals, resins and plastics. CaC_2 is still the main source of acetylene for oxyacetylene welding and cutting of metals. CaC_2 is also the main raw material for the production of calcium cyanamide by the fixation of atmospheric nitrogen, used as a fertilizer and as a basis for a series of chemicals according to the following equation:

$$CaC_2 + N_2 \text{ ----> } CaCN_2 + C + 70.7 \text{ Kcal.}$$

Smaller amounts of CaC_2 are used as a dehydrating agent and as a reducing and desulfurizing agent in metallurgical processes. Another very important use of calcium carbide is as a source of acetylene to burn in a lamp for lighting purposes where electricity or petroleum is not available. The acetylene flame is very luminous; so in the past calcium carbide was the only source of light in the mines and is still used on fishing boats. The lamp is very simple, and quite efficient.[3]

[1] Sizes ranging from 2 to 4 mm are sometimes used for acetylene production.

[2] 300 gr of CaC_2 can provide illumination equivalent to 12 Watts for eight hours; that is 1100 h/y of light using 40 kg of calcium carbide.

Even without precise comparative calculations, it can be stated that calcium carbide can be considered, now and for many years to come, as a very economical way of producing lighting in many rural areas where electricity could not be brought without a tremendous economic effort.

2.2 DEMAND, SUPPLY AND PLANT CAPACITY

2.2.1 Demand

The demand of calcium carbide (CaC_2) cannot be assessed because statistical data are not available.
The only known figure is the quantity of CaC_2 imported in 1987: it is equivalent to 5840 tonnes.
It is the general opinion that this quantity is for below the actual demand, which cannot be satisfied because there is no local production and import is quite difficult, because of lack of foreign currency.

2.2.2 Supply

A said above, import is the only source of supply of CaC_2.

2.2.3 Plant capacity

In consideration of the lack of information on the actual demand, it is suggested the installation of a plant of 7,000 t/y, which is the minimum economical size.
This capacity is based on 330 working days /y, 3 shifts/day, 8 hours/shift.

2.3 SALES PRICES AND TOTAL REVENUE

The present average price of the product on the European market is about 700 $/t. The selling price on the retail market is not known, but considering the usual charges for clearing, unloading, bank commissions and transportation, a selling price of at least 800 $/t, ex-works, can be assumed. On this basis the total annual revenues at full capacity result:

7000 t/y x $ 800/t = US $ 5.600.000

3. MATERIAL AND INPUTS

3.1 CHEMISTRY

The preparation of CaC_2 takes place according to the following equation

$$CaO + 3C \longrightarrow CaC_2 + CO - 111{,}3 \text{ Kcal}$$

The main raw materials are limestone and coal. Limestone is abundant in the country and can be found in adequate quality without difficulty at a price of 25 $/t. The required quality, referring to calcined limestone, should be as follows:

MgO content, less than 2%

CaO content, more than 95%

Many types of coal can be used : metallurgical coke, anthracite and charcoal. Metallurgical coke is imported into the country but it is assumed that it will be available in the future when the integrated iron and steel project will be implemented. Its cost has been estimated in the range of 100 $/t.

The process also requires a large quantity of electricity, which must be insured from the NEPA grid. At the moment the distribution network is weak and black out are occasional. A stand-by generator will be installed to keep running those parts of the plant that could be damaged in case of power failure.

3.2 MATERIALS AND UTILITIES REQUIREMENT AND COSTS

The raw materials and utilities annually required by the plant at full capacity (7,000 t/y) are as follows:

Raw materials	LC $/y	FC $/y
Limestone 14,000 t x 25 $/t	350,000	--
Metallurgical coke 4200 t x 100 $/t	--	420,000
Electrodes 210,000 Kg x 0,4 $/Kg	--	84,000
Total	**350,000**	**504,000**

Utilities	
Electricity 24,5 x 10^6 KWh x 0,03 $/kWh	735,000
Fuel oil 980 t x 30/t	29,400
Total	**764,400**

For the financial evaluations the annual costs are grouped as follows:

raw materials	LC	350,000
raw materials	FC	504,000
fuel oil	LC	29,400
electric energy	LC	735,000
Total		1,618,400

3.3 RAW MATERIAL AND PURCHASING PROGRAMME

For Coke and the electrodes filling materials, which will be imported, a stock equivalent to four months consumption at full capacity is suggested.

An amount equivalent to one month consumption is estimated enough for the other raw materials of local source.

As a result the following stocks must be considered as minimum:

- limestone	
1200 t equivalent to	$ 30,000
- coke	
1400 t equivalent to	$ 140,000
- fuel oil	
100 t equivalent to	$ 3,000
- electrodes	
70 t equivalent to	$ 28,000
Total	$ 201,000

4. LOCATION

The selection of the site will take into consideration areas where limestone, electricity and transport facilities are available and where the relative humidity is low.

5. PROJECT ENGINEERING

5.1 PROCESS AND MAIN EQUIPMENT DESCRIPTION

Firstly, limestone must be calcined to obtain calcium oxide as required by the process reaction. For this purpose the plant is provided with a kiln using oil as fuel; its capacity is ranging from 25 to 30 t/day.

The calcined limestone and the coke are then transferred to the furnace area by belt conveyors and discharged into weighing hopp rs and from there to the furnace. The charge is carried out once every 3-4 hours, while the kiln is operating continuously. The furnace, where the carbide is produced, consists of a basin where the raw materials, loaded in the prefixed ratio, are melted by means of electric energy; the electricity is fed by three electrodes immersed in the melting mass: a voltage difference of 75-125 Volts among the electrodes causes the flowing of direct current through the

melting mass increasing its temperature to about 2000 C; the electrode heads are refrigerated by cooling water.

Every hour, the liquid carbide is discharged from the furnace into ingot moulds, where it is left to solidify and cool for 24 hours. Afterwards, the solidified carbide is crushed and reduced to commercial size: 18-80 mm. While the furnace is operated continuously, the crushing can be accomplished during one shift only. The crushing equipment is complete with a cyclone type removal system. After the crushing, the product is poured into steel drums; this operation is performed under inert atmosphere to avoid the risk of ignition or explosion of the product. Carbon Dioxide produced during limestone calcination can be used for this purpose.

5.2 PACKAGING

The product is normally distributed in drums, 150-200 Kg each. The drums are made of carbon steel with gasket clamp-bolted cover. For special uses, as well as for export, it is also possible to fill and ship tanks of larger size, i.e. 2000-3000 Kg each.

The cost of the drums are estimated at about 35 $/piece, and considering a partial recovery of the drums the annual expenditure can be assumed as 600,000 $/y. In the financial evaluation this amount is indicated as "other raw material".

5.3 LAY-OUT AND CIVIL WORKS

The total area covered by the process plant, including the electric substation and the stocks of raw materials and finished products, is of 1400 sq. mt. The whole area is covered by a simple shelter, except for the electric auxiliary equipment which is located in a separate building (but transformers can be installed outdoors).

Administrative offices, laboratory, warehouse and workshop are located in a two-storey building of 200 sq. mt.

The shelter has a steel structure; the roof is insulated with mineral wool lagging covered with corrugated asbestos cement; the floor is of reinforced concrete with a hard aggregate as finishing surface; reinforced concrete walls of limited height are employed to contain the raw material stocks; the electric substation building has a reinforced concrete structure.

5.4 INVESTMENT COSTS

The investment costs relating to machinery and equipment for the process plant as well as for utilities and general facilities are reported in the table below. Quotation on machineries and equipment has been received by CARBITALIA, Milano, Italy.

Description	LC M$	FC M$	TOTAL M$
Machines and equipment FOB European Port		4.540	4.540
Transport, taxes and duties	0.900	0.454	1.354
Erection	0.900	0.454	1.354
Land and site preparation	0.060		0.060
Civil works and building	0.620		0.620
Spare parts		0.090	
Total	**2.480**	**5.538**	**8.018**
Contingencies 10%	**0.248**	**0.553**	**0.801**
Grand total	**2.728**	**6.092**	**8.820**

The life cycle of the plant can be estimated 15 years.

The annual cost for plant maintenance is equivalent to US$ 100,000.

In the financial evaluation the investment costs (contingencies included) are so subdivided:

Preproduction expenditures	FC	M$ 0.140
Preproduction expenditures	LC	M$ 0.240
Machinery	FC	M$ 6.092
Machinery	LC	M$ 1.980
Land + Site preparation	LC	M$ 0.066
Civil works	LC	M$ 0.682
Total		**M$ 9.200**

6. PLANT ORGANIZATION

The plant has been considered as an autonomous unit complete with its own utilities and facilities operating under an independent organization.

7. MANPOWER

No particular skills are required for any of the positions listed below except for the technical manager, the production manager, the workshop engineer and the chemist, who must have thorough training in the technology involved in the process (with particular regard to analysis of raw materials and finished product, hazard control, maintenance of the furnace, electric equipment performance). The requirements for all the other positions are not different from those required in any other chemical factory.

It is however recommended that on the job training is carried out by one expert, made available by the technology supplier, for one year after the plant start-up. The relevant cost is estimated US$ 120,000. The number of personnel reflects the needs of three shifts.

7.1 MANAGEMENT

		N/year
General Manager	1	50,000
Technical manager	1	40,000
	---	---
	2	90,000
	Overheads 40%	36,000

		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPARTMENT

		N/year
Finance manager	1	40,000
Senior accountant	1	25,000
Accountants	2	24,000
Purchasing dep.head	1	12,000
Warehouse keepers	2	20,000
Sales dep.head	1	12,000
Clerks and secretaries	5	72,000
Guards	8	48,000
Drivers	3	24,000
Others	3	12,000
	---	---
	27	289,000
	Overheads 40%	115,600

		404,600
		(US$ 51,200)

7.3 PRODUCTION DEPARTMENT

		N/year
Production manager	1	40,000
Shift foremen	8	96,000
Shift operators	32	256,000
Chemist	1	25,000
Clerks	2	24,000
	44	441,000
	Overheads 40%	176,400
		617,400
		(US$ 78,150)

7.4 MAINTENANCE DEPARTMENT

Chief Engineer	1	40,000
Supervisors	2	24,000
Electricians	4	40,000
Mechanics	4	40,000
Semi-skilled workers	4	24,000
Unskilled workers	2	8,000
	17	176,000
	Overheads 40%	70,400
		246,400
		(US$ 31,200)

Summary of needed manpower:

Administration	29	US$ 67,200
Production dept.	44	US$ 78,150
Maintenance dept.	17	US$ 31,200
	90	US$ 176,550

8. IMPLEMENTATION SCHEDULING

24 months are needed for the design, construction and commissioning of the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 9,614,520 US Dollars. The portion in foreign currency accounts for 6,537,000 US Dollars.

Details of these figures are shown in chapter 5.4.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,000,000	US$ 2,198,000	US$ 3,198,000
- Foreign Loan (interest 8%)	US$ 1,020,000	US$ 4,158,000	US$ 5,178,000
- Local Loan (interest 15%)	US$ 424,000	US$ 400,000	US$ 824,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 473,014 US Dollars, being the foreign portion US$ 267,100.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 225,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US$ 2,775,504.

In the third year, at full production, the costs amount to US $ 3,853,984, then they start a slight decrease year after year, to reach a constant amount of US $ 2,495,300 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 5,600.000. As said before. the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 2,240,000

2nd year 80% : revenue = US$ 4,480,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 18.54%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 42% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [4] + administrative), depreciation and financial costs.

[4] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

9.2.3 Pay-back Period

The pay-back period is less than 7 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 25,895,290.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 25,895,290.

ANNEXE 1

COMFAR SCHEDULES

CALCIUM CARBIDE
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	9614.52	67.826 % foreign
current assets:	0.00	0.000 % foreign
total assets:	9614.52	67.826 % foreign

Source of funds during construction phase

equity & grants:	3198.40	0.013 % foreign
foreign loans :	5178.00	
local loans :	824.00	
total funds :	9200.40	56.285 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1224.26	2495.30	2495.30
depreciation :	1013.40	1000.20	232.10
interest :	537.84	207.12	0.00
production costs	2775.50	3702.62	2727.40
thereof foreign	52.20 %	39.19 %	20.13 %
total sales :	2240.00	5600.00	5600.00
gross income :	-535.50	1897.38	2872.60
net income :	-535.50	1138.43	1723.56
cash balance :	-668.97	1491.38	1955.66
net cashflow :	790.78	2345.75	1955.66

Net Present Value at: 10.00 % = 5309.97
Internal Rate of Return: 18.54 %
Return on equity1: 22.95 %
Return on equity2: 25.04 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	66.000	0.000
Buildings and civil works	540.000	142.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	1700.000	6372.000
Total fixed investment costs	2306.000	6514.000
Pre-production capital expenditures	210.600	583.920
Net working capital	0.000	0.000
Total initial investment costs	2516.600	7097.920
Of it foreign, in %	49.305	74.393

Total Current Investment in 1000 US $

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	224.958	158.259	89.796
Total current investment costs	224.958	158.259	89.796
Of it foreign, %	56.977	54.029	59.490

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	40.000	80.000	100.000	100.000	100.000
Raw material 1	341.600	683.200	854.000	854.000	854.000
Other raw materials	240.000	480.000	600.000	600.000	600.000
Utilities	294.000	588.000	735.000	735.000	735.000
Energy	11.760	23.520	29.400	29.400	29.400
Labour, direct	78.500	78.500	78.500	78.500	78.500
Repair, maintenance	22.000	44.000	55.000	55.000	55.000
Spares	18.000	36.000	45.000	45.000	45.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	1125.860	1933.220	2396.900	2396.900	2396.900
Administrative overheads	98.400	98.400	98.400	98.400	98.400
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1013.404	1013.404	1006.804	1000.204	1000.204
Financial costs	537.840	444.860	351.880	258.900	207.120
Total production costs	2775.504	3489.884	3853.984	3754.404	3702.624
Costs per unit (single product)	0.991	0.623	0.551	0.536	0.529
Of it foreign, %	52.202	42.886	40.340	40.031	39.192
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	176.900	176.900	176.900	176.900	176.900

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	854.000	854.000	854.000	854.000	854.000
Other raw materials	600.000	600.000	600.000	600.000	600.000
Utilities	735.000	735.000	735.000	735.000	735.000
Energy	29.400	29.400	29.400	29.400	29.400
Labour, direct	78.500	78.500	78.500	78.500	78.500
Repair, maintenance	55.000	55.000	55.000	55.000	55.000
Spares	45.000	45.000	45.000	45.000	45.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	2396.900	2396.900	2396.900	2396.900	2396.900
Administrative overheads	98.400	98.400	98.400	98.400	98.400
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	841.300	841.300	841.300	841.300	232.100
Financial costs	155.340	103.560	51.780	0.000	0.000
Total production costs	3491.940	3440.160	3388.380	3336.600	2727.400
Costs per unit (single product)	0.499	0.491	0.484	0.477	0.390
Of it foreign, %	37.616	36.677	35.738	34.798	33.129
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	176.900	176.900	176.900	176.900	176.900

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	854.000
Other raw materials	600.000
Utilities	735.000
Energy	29.400
Labour, direct	78.500
Repair, maintenance	55.000
Spares	45.000
Factory overheads	0.000
Factory costs	2396.900
Administrative overheads	98.400
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	2495.300
Costs per unit (single product)	0.356
Of it foreign, %	22.001
Of it variable,%	0.000
Total labour	176.900

Net Working Capital in 1000 US $

Year			1992	1993	1994	1995-2006
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	102.022	169.302	207.942	207.942
Inventory and materials	41	8.8	99.683	199.367	249.208	249.208
Energy	1	360.0	0.033	0.065	0.082	0.082
Spares	180	2.0	9.000	18.000	22.500	22.500
Work in progress	5	72.0	15.637	26.850	33.290	33.290
Finished products	15	24.0	51.011	84.651	103.971	103.971
Cash in hand	15	24.0	14.038	10.704	11.538	11.538
Total current assets			291.423	508.939	628.530	628.530
Current liabilities and						
Accounts payable	23	15.5	66.465	125.722	155.517	155.517
Net working capital			224.958	383.217	473.014	473.014
Increase in working capital			224.958	158.259	89.796	0.000
Net working capital, local			96.785	169.537	205.914	205.914
Net working capital, foreign			128.173	213.680	267.100	267.100

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	1000.000	2198.400
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1020.000	4158.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	424.000	400.000
Loan C, local....	0.000	0.000
Total loan	1444.000	4558.000
Current liabilities	0.000	0.000
Bank overdraft	72.600	341.519
Total funds	2516.600	7097.919

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-647.250	-647.250	-647.250	-647.250
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	-274.667	-274.667	-274.667	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-921.917	-921.917	-921.917	-647.250
Current liabilities	66.465	59.257	29.795	0.000
Bank overdraft	668.975	-527.297	-555.796	0.000
Total funds	-186.477	-1389.957	-1447.918	-647.250

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow . .	2444.000	6756.400
Financial resources .	2444.000	6756.400
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	2516.600	7097.920
Total assets	2444.000	6756.400
Operating costs . . .	0.000	0.000
Cost of finance . . .	72.600	341.520
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-72.600	-341.520
Cumulated cash balance	-72.600	-414.120
Inflow, local	1424.000	2598.000
Outflow, local	1275.800	1817.600
Surplus (deficit) .	148.200	780.400
Inflow, foreign . . .	1020.000	4158.400
Outflow, foreign . . .	1240.800	5280.320
Surplus (deficit) .	-220.800	-1121.920
Net cashflow	-2444.000	-6756.400
Cumulated net cashflow	-2444.000	-9200.400

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	2306.465	4539.257	5629.795	5600.000	5600.000	5600.000
Financial resources	66.465	59.257	29.795	0.000	0.000	0.000
Sales, net of tax	2240.000	4480.000	5600.000	5600.000	5600.000	5600.000
Total cash outflow	2975.439	4011.959	4587.094	4139.688	4108.620	4141.114
Total assets	291.423	217.516	119.591	0.000	0.000	0.000
Operating costs	1224.260	2031.620	2495.300	2495.300	2495.300	2495.300
Cost of finance	537.840	444.860	351.880	258.900	207.120	155.340
Repayment	921.917	921.917	921.917	647.250	647.250	647.250
Corporate tax	0.000	396.046	698.406	738.238	758.950	843.224
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-668.974	527.298	1042.701	1460.312	1491.380	1458.886
Cumulated cash balance	-1083.094	-555.797	486.904	1947.216	3438.596	4897.482
Inflow, local	2305.522	4538.980	5629.490	5600.000	5600.000	5600.000
Outflow, local	1445.233	2477.266	3026.439	2684.538	2705.250	2789.524
Surplus (deficit)	860.289	2061.714	2603.051	2915.462	2894.750	2810.476
Inflow, foreign	0.943	0.277	0.305	0.000	0.000	0.000
Outflow, foreign	1530.207	1534.693	1560.655	1455.150	1403.370	1351.590
Surplus (deficit)	-1529.263	-1534.417	-1560.350	-1455.150	-1403.370	-1351.590
Net cashflow	790.782	1894.074	2316.498	2366.462	2345.750	2261.476
Cumulated net cashflow	-8409.618	-6515.544	-4199.046	-1832.584	513.165	2774.641

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	5600.000	5600.000	5600.000	5600.000	5600.000	5600.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	5600.000	5600.000	5600.000	5600.000	5600.000	5600.000
Total cash outflow	4110.046	4078.978	3400.660	3644.340	3737.180	3737.180
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	2495.300	2495.300	2495.300	2495.300	2495.300	2495.300
Cost of finance	103.560	51.780	0.000	0.000	0.000	0.000
Repayment	647.250	647.250	0.000	0.000	0.000	0.000
Corporate tax	863.936	884.648	905.360	1149.040	1241.880	1241.880
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1489.954	1521.022	2199.340	1955.660	1862.820	1862.820
Cumulated cash balance	6387.437	7908.458	10107.800	12063.460	13926.280	15789.100
Inflow, local	5600.000	5600.000	5600.000	5600.000	5600.000	5600.000
Outflow, local	2310.226	2330.940	2351.660	2085.340	2138.720	2138.720
Surplus (deficit)	3289.774	3269.052	3248.340	3514.660	3461.280	3461.280
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	1299.810	1248.030	549.000	549.000	549.000	549.000
Surplus (deficit)	-1299.810	-1248.030	-549.000	-549.000	-549.000	-549.000
Net cashflow	2240.764	2220.052	2199.340	1955.660	1862.820	1862.820
Cumulated net cashflow	5015.405	7235.458	9434.798	11390.460	13253.280	15116.100

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	5600.000	5600.000	5600.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	5600.000	5600.000	5600.000
Total cash outflow	3737.180	3737.180	3737.180
Total assets	0.000	0.000	0.000
Operating costs	2495.300	2495.300	2495.300
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1241.880	1241.880	1241.880
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	1862.820	1862.820	1862.820
Cumulated cash balance	17651.920	19514.740	21377.560
Inflow, local	5600.000	5600.000	5600.000
Outflow, local	3188.180	3188.180	3188.180
Surplus (deficit)	2411.820	2411.820	2411.820
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	549.000	549.000	549.000
Surplus (deficit)	-549.000	-549.000	-549.000
Net cashflow	1862.820	1862.820	1862.820
Cumulated net cashflow	16978.920	18841.740	20704.560

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	4470.03 at	10.00 %
Internal Rate of Return (IRRE1) ..	22.95 %	

b) Net Worth versus Net cash return:

Net present value	5690.81 at	10.00 %
Internal Rate of Return (IRRE2) ..	25.04 %	

c) Internal Rate of Return on total investment:

Net present value	5309.97 at	10.00 %
Internal Rate of Return (IRR) ..	18.54 %	

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	2240.000	4480.000	5600.000	5600.000	5600.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	2240.000	4480.000	5600.000	5600.000	5600.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2237.664	3045.024	3502.104	3495.504	3495.504
Operational margin	2.336	1434.976	2097.896	2104.496	2104.496
As % of total sales	0.104	32.031	37.462	37.580	37.580
Cost of finance	537.840	444.860	351.880	258.900	207.120
Gross profit	-535.504	990.116	1746.016	1845.596	1897.376
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-535.504	990.116	1746.016	1845.596	1897.376
Tax	0.000	396.046	698.406	738.238	758.950
Net profit	-535.504	594.070	1047.610	1107.358	1138.426
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-535.504	594.070	1047.610	1107.358	1138.426
Accumulated undistributed profit	-535.504	58.566	1106.175	2213.533	3351.958
Gross profit, % of total sales	-23.906	22.101	31.179	32.957	33.882
Net profit, % of total sales	-23.906	13.260	18.707	19.774	20.329
ROE, Net profit, % of equity	-16.743	18.574	32.754	34.622	35.594
ROI, Net profit+interest, % of invest.	0.025	10.841	14.467	14.124	13.910

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	5600.000	5600.000	5600.000	5600.000	5600.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	5600.000	5600.000	5600.000	5600.000	5600.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	3336.600	3336.600	3336.600	3336.600	2727.400
Operational margin	2263.400	2263.400	2263.400	2263.400	2872.600
As % of total sales	40.418	40.418	40.418	40.418	51.296
Cost of finance	155.340	103.560	51.780	0.000	0.000
Gross profit	2108.060	2159.840	2211.620	2263.400	2872.600
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2108.060	2159.840	2211.620	2263.400	2872.600
Tax	843.224	863.936	884.648	905.360	1149.040
Net profit	1264.836	1295.904	1326.972	1358.040	1723.560
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1264.836	1295.904	1326.972	1358.040	1723.560
Accumulated undistributed profit	4616.794	5912.698	7239.670	8597.711	10321.270
Gross profit, % of total sales	37.644	38.569	39.493	40.418	51.296
Net profit, % of total sales	22.586	23.141	23.696	24.251	30.778
ROE, Net profit, % of equity	39.546	40.517	41.489	42.460	53.888
ROI, Net profit+interest, % of invest.	14.681	14.467	14.253	14.039	17.817

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	5600.000	5600.000	5600.000	5600.000	5600.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	5600.000	5600.000	5600.000	5600.000	5600.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2495.300	2495.300	2495.300	2495.300	2495.300
Operational margin	3104.700	3104.700	3104.700	3104.700	3104.700
As % of total sales	55.441	55.441	55.441	55.441	55.441
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	3104.700	3104.700	3104.700	3104.700	3104.700
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3104.700	3104.700	3104.700	3104.700	3104.700
Tax	1241.880	1241.880	1241.880	1241.880	1241.880
Net profit	1862.820	1862.820	1862.820	1862.820	1862.820
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1862.820	1862.820	1862.820	1862.820	1862.820
Accumulated undistributed profit	12184.090	14046.910	15909.730	17772.550	19635.370
Gross profit, % of total sales	55.441	55.441	55.441	55.441	55.441
Net profit, % of total sales	33.265	33.265	33.265	33.265	33.265
ROE, Net profit, % of equity	58.242	58.242	58.242	58.242	58.242
ROI, Net profit+interest, % of invest.	19.257	19.257	19.257	19.257	19.257

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	2516.600	9614.520
Fixed assets, net of depreciation	0.000	2516.600
Construction in progress	2516.600	7097.920
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	2516.600	9614.520
Equity capital	1000.000	3198.400
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	1444.000	6002.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	72.600	414.119
Total debt	1516.600	6416.119
Equity, % of liabilities	39.736	33.266

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Total assets	9428.042	8632.154	7696.342	8156.449	8647.625
Fixed assets, net of depreciation	8601.115	7587.711	6580.907	5580.703	4580.499
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	277.385	498.235	616.993	616.993	616.993
Cash, bank	14.038	10.704	11.538	11.538	11.538
Cash surplus, finance available	0.000	0.000	486.905	1947.216	3438.596
Loss carried forward	0.000	535.504	0.000	0.000	0.000
Loss	535.504	0.000	0.000	0.000	0.000
Total liabilities	9428.042	8632.154	7696.342	8156.449	8647.625
Equity capital	3198.400	3198.400	3198.400	3198.400	3198.400
Reserves, retained profit	0.000	0.000	58.566	1106.175	2213.533
Profit	0.000	594.070	1047.610	1107.358	1138.426
Long and medium term debt	5080.083	4158.167	3236.250	2589.000	1941.750
Current liabilities	66.465	125.722	155.517	155.517	155.517
Bank overdraft, finance required.	1083.094	555.797	0.000	0.000	0.000
Total debt	6229.642	4839.685	3391.767	2744.517	2097.267
Equity, % of liabilities	33.924	37.052	41.557	39.213	36.986

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	9265.211	9913.865	10593.590	11951.630	13675.190
Fixed assets, net of depreciation	3739.198	2897.898	2056.598	1215.298	983.198
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	616.993	616.993	616.993	616.993	616.993
Cash, bank	11.538	11.538	11.538	11.538	11.538
Cash surplus, finance available	4897.482	6387.437	7908.457	10107.800	12063.460
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	9265.211	9913.865	10593.590	11951.630	13675.190
Equity capital	3198.400	3198.400	3198.400	3198.400	3198.400
Reserves, retained profit	3351.958	4616.794	5912.698	7239.670	8597.711
Profit	1264.836	1295.904	1326.972	1358.040	1723.560
Long and medium term debt	1294.500	647.250	0.000	0.000	0.000
Current liabilities	155.517	155.517	155.517	155.517	155.517
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1450.017	802.767	155.517	155.517	155.517
Equity, % of liabilities	34.521	32.262	30.192	26.761	23.388

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	15538.010	17400.830	19263.650	21126.470	22989.290
Fixed assets, net of depreciation	983.198	983.198	983.198	983.198	983.198
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	616.993	616.993	616.993	616.993	616.993
Cash, bank	11.538	11.538	11.538	11.538	11.538
Cash surplus, finance available	13926.280	15789.100	17651.920	19514.740	21377.560
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	15538.010	17400.830	19263.650	21126.470	22989.290
Equity capital	3198.400	3198.400	3198.400	3198.400	3198.400
Reserves, retained profit	10321.270	12184.090	14046.910	15909.730	17772.550
Profit	1862.820	1862.820	1862.820	1862.820	1862.820
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	155.517	155.517	155.517	155.517	155.517
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	155.517	155.517	155.517	155.517	155.517
Equity, % of liabilities	20.584	18.381	16.603	15.139	13.913

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	5179.92	5178.40	1.52	1020.00	4158.40	0.96	0.28
equity capital	0.40	0.40	0.00	0.00	0.40	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	5179.52	5178.00	1.52	1020.00	4158.00	0.96	0.28
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	20871.32	6521.12	14350.21	1240.80	5280.32	1530.21	1534.69
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	5623.20	6232.40	-609.20	1200.00	5032.40	129.12	85.78
imported materials . . .	7915.80	0.00	7915.80	0.00	0.00	339.60	439.20
repayment loans & overd.	5179.52	0.00	5179.52	0.00	0.00	647.25	647.25
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	2152.80	288.72	1864.08	40.80	247.92	414.24	362.46
indirect costs							
net foreign exchge flow	-15691.40	-1342.72	-14348.68	-220.80	-1121.92	-1529.26	-1534.42
import substit'n effect	79520.00	0.00	79520.00	0.00	0.00	2240.00	4480.00
net forgn exchge effect	63828.60	-1342.72	65171.32	-220.80	-1121.92	710.74	2945.58

present values at	10.00 %
foreign exchange flow .	-9208.23
net forgn exchge effect	25895.29

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	0.30	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.30	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	1560.66	1455.15	1403.37	1351.59	1299.81	1248.03	549.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	53.72	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . .	549.00	549.00	549.00	549.00	549.00	549.00	549.00
repayment loans & overd.	647.25	647.25	647.25	647.25	647.25	647.25	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	310.68	258.90	207.12	155.34	103.56	51.78	0.00
indirect costs							
net foreign exchge flow	-1560.35	-1455.15	-1403.37	-1351.59	-1299.81	-1248.03	-549.00
import substit'n effect	5600.00	5600.00	5600.00	5600.00	5600.00	5600.00	5600.00
net forgn exchge effect	4039.65	4144.85	4196.63	4248.41	4300.19	4351.97	5051.00

present values at	10.00 %
foreign exchange flow .	-9208.23
net forgn exchge effect	25895.29

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	549.00	549.00	549.00	549.00	549.00	549.00	-876.30
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-877.83
imported materials . . .	549.00	549.00	549.00	549.00	549.00	549.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	1.52
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-549.00	-549.00	-549.00	-549.00	-549.00	-549.00	876.30
import substit'n effect	5600.00	5600.00	5600.00	5600.00	5600.00	5600.00	0.00
net forgn exchge effect	5051.00	5051.00	5051.00	5051.00	5051.00	5051.00	876.30

present values at	10.00 %
foreign exchange flow .	-9208.23
net forgn exchge effect	25895.29

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE PRODUCTION OF SULPHURIC ACID IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyzes the opportunity of installing a plant for the production of H_2SO_4. Sulphuric acid has a lot of uses: until recent years the consumption of sulphuric acid was taken as a good measure of the degree of industrialization of a country and also served as an index of general business condition. Presently the main consumption of sulphuric acid is in the preparation of phosphate fertilizers and ammonium sulphate. Other uses are in the production of inorganic pigments, textile fibers, petroleum products, detergents, pulp and paper and other chemicals.

Presently in Nigeria the demand is satisfied by import, since the local production is totally absorbed by other associated productions.

The plant as proposed in the study, has a nominal capacity of 6600 t/y of sulphuric acid 98%, which is the minimum economic size for this kind of plant.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 3,915,350 (US$ 2,270,000 in foreign currency)
- Working capital (at full production): US$ 291,745 (US$ 269,000 in foreign currency)
- Internal Rate of Return: 18.31%
- Break-Even Point (at 5th year of production) 41.5%
- Pay-Back Period: less than 5 years (including construction period)
- Employees: 54

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 7,557,340 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

Sulphuric acid (H_2SO_4) has been an important item of commerce for many years. In the eighteenth and nineteenth century it was essentially produced by chamber process, in which oxides of nitrogen (as nitrosyl compounds) were used as catalysts for the oxidation of sulphur dioxide.

The product obtained by this process is of rather low concentration (typically 60 Baumé or about 77-78 % wt of H_2SO_4) not high enough for many commercial uses. During the first part of the twentieth century, the chamber process was gradually replaced by the contact process, and today the former is considered obsolete.

Primary impetus for the development of the contact process came from the need for high strength acid and oleum to make synthetic dyes, organic chemicals and to provide concentrated mixtures of sulphuric and nitric acids for explosive production. In the contact process the sulphur dioxide (SO_2) obtained mainly by sulphur burning (or other sources) is converted into SO_3 by contact of the gas with successive beds of vanadium oxide catalyst which, mainly for small plants, are often arranged in sections of a single tower.

In the above described process or "SINGLE-ABSORPTION PROCESS" the recovery of sulphur as sulphuric acid is ab 98%: the remainder is lost to the atmosphere as SO_2. Because of the world-wide pressure to reduce SO_2 emissions, the "DOUBLE-ABSORPTION PROCESS" was developed and adopted mainly for the large size plants.

By this means, the overall conversions can be increased from about 98% up to 99.5% thereby reducing emission of unconverted SO_2 to atmosphere. Because of the small capacity plant, chosen in order to reduce the investment cost, study shall be based on a single-contact sulphuric acid plant from SO_2 produced by sulphur burning.

- sulphuric acid

physical state :	colourless, viscous liquid
molecular weight :	98.07
specific gravity (H_2SO_4 100% at 20 C):	ab. 1.84
boiling point (760 mm Hg):	270 C

Sulphuric acid is by far the largest volume chemical commodity produced and is sold or used commercially in a number of different concentration including 77 - 78% (... Be'), 93 wt% (66 Be'), 96 wt%, 98, 99 wt%, 100%.

Sulphuric acid has several desirable properties that lead to its use in a wide variety of applications. Typically it is less costly than any other acid: it can be readily handled in steel or common alloy tanks at high commercial concentrations; and it is available and readily handled at concentration more than 100 wt% (oieum). Sulphuric acid is a strong acid; it reacts readily with any organic compounds to produce useful products. Concentrated sulphuric acid is a good dehydrating agent and under some circumstances may be used as an oxidizing agent.

The characteristics of the product are as follows:

Sulphuric acid

- Physical state :	colourless, liquid free from suspended and/or insoluble matters
- Specific gravity (20 C) :	ca 1.84
- Purity :	98 $\pm$ 0.5 wt% H_2SO_4
- Iron :	0.02 max
- Arsenic :	0.01 max
- Sulphuric dioxide :	0.01 max

Since the use of demineralized water (as process water) is foreseen, H_2SO_4 obtained shall be of the battery grade (iron content not more than 0.005%)

2. MARKET AND PLANT CAPACITY

2.1 USES

The current heavy usage of sulphuric acid by the phosphate fertilizer industry, has resulted in larger consumption of this product. Of total world-wide sulphuric acid production, over two-thirds now go into phosphate fertilizers, while other uses are growing slowly or declining.

Formerly, sulphuric acid was used to produce normal superphosphate, which is a material containing both mono- and dicalcium phosphates and unseparated calcium sulphate. Now, mainly in developed countries, the trend is toward higher purity fertilizers containing very little calcium sulphate because of savings in freight and handling costs.

In this kind of phosphate fertilizers, the primary role of sulphuric acid is to convert phosphate rocks to phosphoric acid and solid calcium sulphates which is removed by filtration.

Other uses of sulphuric acid are in the production of inorganic pigments, textile fibers, petroleum products, alcohols, pulp and paper, detergents, other chemicals and as a bleaching agent for ores, a pickling agent for iron and steel and a component of lead storage batteries.

2.2 DEMAND/SUPPLY

2.2.1 World-wide production

World-wide production of sulphuric acid (100% H_2SO_4) was in 1980 as follows:

	(10^6 Metric Tons)
North America	46.8
Central and South America	3.8
Western Europe	27.8
Eastern Europe	32.6
Africa	8.7
Asia	19.6
Australia and New Zealand	2.9
TOTAL	142.2

Future growth is expected to be relatively slow in Western Europe and higher than average in the Middle East and Africa (particularly north Africa, which has extensive phosphate rock deposits).

2.2.2 Present situation in Nigeria

The demand of H_2SO_4 is satisfied mainly by import. In the area of Lagos, there exists a H_2SO_4 plant of 30,000 MT/y capacity, associated to an aluminium sulphate production; part of the H_2SO_4 there produced (less than 30%) is made available to the market, which cannot be quantified, because statistical data are not available.

Kaduna fertilizer manufacturing plant, which produced sulphuric acid for normal superphosphate production, is now out of order and needs revamping. Other small scale production of sulphuric acid, which undoubtedly exist, does not reach the market because H_2SO_4 is entirely consumed by the producers.

2.3 PLANT CAPACITY

This study will analyze the minimum economical size for H_2SO_4 production that is a plant having a capacity of 6600 MT/y (20 MT/day on 3 shifts - 330 days/y) of 98 wt% sulphuric acid.

2.4 SALES PRICES AND TOTAL REVENUE

H_2SO_4 98 wt% is quoted FOB European port present 165 $/t. The current selling price[1] in Nigeria for the sulphuric acid is4,500 Naira/tonne, equivalent to about 500 US Dollars. This price can be justified only by the fact that the few producers have no competition.

To be realistic, the selling price of 300 US Dollars/tonne will be considered, while computing the revenue.

So at full capacity, the revenue could be:

$$6{,}600 \text{ t/y} \times 300 \text{ \$/t} = 1{,}980{,}000 \text{ \$/y}$$

3. MATERIALS AND INPUTS

3.1 CHEMISTRY

The basic chemistry is as follows:

Oxidation of Sulphur to Sulphur Dioxide

The oxidation can be considered as proceeding according to the following reaction, which takes place by burning sulphur in air:

$$S + O_2 = SO_2$$

A great deal of heat is liberated by this reaction, and as a result the burning of sulphur in air is self sustaining once combustion has started. To reach this condition, the furnace or reaction chamber must be initially preheated to a temperature in excess of 500 C, using fuel oil.

[1] N.I.D.B. Market Survey, 1990, + Central Bank of Nigeria Annual Report and Statement of Accounts, 1989

Oxidation of Sulphur Dioxide to Sulphur Trioxide

The oxidation of SO_2 to SO_3 proceeds according to the reaction:

$$SO_2 + 1/2\,O_2 = SO_3$$

over a suitable catalyst (generally vanadium pentoxide)

The reaction is highly exothermic. With SO_2 temperatures below 400 C the rate of the reaction over a vanadium pentoxide catalyst is low. With increase in SO_3, temperature the reaction rate increases, but the equilibrium constant decreases, and this reduces the conversion percentage of SO_2 to SO_3. Therefore, control of the temperature at an optimum value is necessary to obtain sulphuric acid on the most economical basis.

It has been found that an inlet SO_2 temperature of about 430 C gives the optimum converter performance. The reaction equilibrium is also influenced by the ratio of the concentration of SO_2, to the concentration of O_2.

Absorption of Sulphur Trioxide

Sulphur trioxide is absorbed in water according to the following reaction:

$$SO_3 + H_2O = H_2SO_4$$

Again the reaction is exothermic. SO_3 is absorbed by circulating 98% acid over the absorption tower as the rate of absorption of SO_3, in acid is greater then water alone. The rate of absorption in acid is found to be at a maximum when the acid is in the 98-99% strength region.

3.2 MATERIAL AND UTILITIES: AVAILABILITY, REQUIREMENT AND COSTS

The raw material necessary for the production of H2SO4 is sulphur, which is not available in Nigeria, It has to be imported at a cost of US$ 170. Other inputs are the utilities, which are available locally. The following table shows the quantity of material and inputs, as well as the relevant costs required for the production of 1 MT and 6600 MT/y of H_2SO_4 98 wt%.

Description	Unit of measure	Required quantity for 1 T	Required quantity for 1 year	Unit cost ($) LC	Unit cost ($) FC	Annual cost ($) LC	Annual cost ($) FC	Annual cost ($) TOTAL
Sulphur	T	0.335	2211	--	170	--	375,900	375,900
Cooling water	T	70	462,000	0,009	--	4,160	--	4,160
Demiwater	T	1.25	8,250	3,5	--	28,870	--	28,870
Electric energy	Kwh	74	488,400	0,10	--	48,840	--	48,840
TOTAL						81,870	375,900	457,770

For the financial evaluation, the costs are grouped as follows:

Raw material (sulphur)	FC	$ 375,900
Utilities	LC	$ 81,870
	TOTAL	$ 457,770

3.3 RAW MATERIALS PURCHASING PROGRAMME

Sulphur is the only raw material required for the production of H_2SO_4. It is not available in Nigeria, therefore it has to be imported. Considering that the annual consumption is not high, a minimum of 6 months stock is suggested.

The relevant cost will be about $ 200,000.

4. LOCATION

The choice of location will be mainly influenced by the uses. From the technical point of view, the transport does not constitute a problem; generally, while for large quantities, tank-trucks are used, for small quantities plastic jerry cans are suggested.

In order to reduce the transport costs, the plant should be located close to the users. The plant is provided with equipment which will minimize the pollution; nevertheless, when selecting the site, it is suggested to consider the installation of the plant not very close to an urban area.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION AND MAIN EQUIPMENT

5.1.1 Process sections

The sulphuric acid production takes place in four stages:

a) Sulphur melting

b) Combustion of molten sulphur in dried air to form sulphur dioxide;

c) Oxidation of sulphur dioxide to sulphur trioxide in a catalytic converter;

d) Absorption of the obtained sulphur trioxide in 98% sulphuric acid.

5.1.2 Process description

Solid sulphur is charged by a mechanical shovel into a hopper equipped with a vibrating extractor located at the hopper bottom, which feeds sulphur into the melting pit.

In order to eliminate free acidity, usually present in sulphur and mainly composed by H_2S, lime powder is added into the melting pit.

Melting pit is provided with an agitator to increase melting efficiency.

Sulphur melting heat is supplied by steam at 6 bar condensing in coils submerged in the molten mass.

Molten sulphur is pumped by a vertical pump to the filter to eliminate impurities in the form of ash and lime surplus. Said pressure filter is provided with special metallic filtering clothes and with a steam jacket for temperature maintenance.

The filtered sulphur comes back by gravity into a separate department of the melting pit and is pumped by a pump to the storage tank.

From the sulphur storage tank the molten sulphur is fed by the reciprocating pump to the sulphur burner located on the furnace or in the combustion chamber.

The combustion chamber is provided also with a fuel oil burner, complete with a small tank, for furnace pre-heating during start-up.

The process air is compressed by the blower. After compression, the air is dried in the drying tower. Drying is effected by sulphuric acid at production title. Entrained mists, if any, are essentially arrested on the demister.

Process air from tower outlet is sent to the furnace for SO_2 production.

Sulphurous gases, before being sent to conversion, are cooled in a fire-tube waste heat boiler up to the optimum converter inlet temperature.

Sulphurous/sulphuric gases pass through 4 beds of vanadium pentoxide catalyst and after each conversion layer, a pre-established quantity of dried air is added.

Said additions are foreseen both to control the gas temperature at the inlet of each catalytic layer to the required value and to increase oxygen partial pressure as the conversion SO_2 to SO_3 proceeds.

The sulphuric gases coming out from the converter are sent to the economizer in order to recover most of their sensible heat. After cooling the reaction products pass into the tower for the absorption of SO_3, in concentrated sulphuric acid, to give the final product.

The gas coming out from tower is filtered in a high efficiency mist eliminator to avoid any problem of mists and plume from the stack.

The concentration of the produced sulphuric acid is controlled by the addition of demineralized water.

The heat evolved in the absorption of SO_3 in H_2O is removed in special plate-type or coil-type heat exchangers.

The vertical pump provides the acid re-circulation to towers.

A level regulator located on controls the production to be sent to the storage tank after being cooled.

The heat exchangers are fed with cooling water recirculating in the cooling tower system.

Most of heat obtained from the sulphur combustion and subsequent oxidation of SO_2 to SO_3 is recovered in the form of steam.

The water for the production of said steam must be demineralized and then dearated. The pumps feed the economizer and the boiler.

The steam produced at medium pressure in the boiler is partly used at 6 bar for sulphur melting and partly at 3 bar for molten sulphur temperature maintenance and boiler feed water dearating.

5.1.3 Main equipment

Sulphur melting system

- Melting tank
- Liquid sulphur transferring and filtering system
- Liquid sulphur storage tank
- Metering pump for burner feeding

Sulphur combustion

- Air blower
- Air drying tower
- Burner
- Waste heat boiler

Conversion

- Multistage contact converter, filled with vanadium-pentoxide
- Interstage gas coolers
- Economizer

Absorption stage

- Packed tower for gas absorption
- Gas stack
- Recirculation tank and pump
- Acid coolers
- Acid storage tank
- Loading arms

Start-up auxiliaries

- Gasoil storage tank
- Auxiliary burner for gasoil combustion
- Heat exchanger (flue gas from gasoil combustion/dry air)
- Auxiliary stack

Utilities

- Cooling tower system
- Water treating plant for producing process water and boiler make-up water
- Steam condensate recovery system
- Boiler feed water dearator and pumping system
- Compressed air system
- Electric transformer

5.2 STORING FACILITIES

5.2.1 Finished product

The sulphuric acid 98% will be collected in a carbon steel tank having a capacity of 250 m^3 (about 22 days production at full capacity).

5.2.2 Raw material

Sulphur, the only important raw material, will be stored in a building of 800 m^2 (storage capacity 6 months of production).

5.3 PACKAGING

Since the production has been supposed to be sold in bulk, no expenditure for packaging material has been evaluated.

5.4 LAY-OUT AND CIVIL WORKS

The area required for the installation of the process equipment, with all necessary utilities and facilities is 20,000 sq.mt.

Process and utilities equipment and machinery are designed for outdoor installation.

Foundations shall be in reinforced concrete, protected with acid resistant lining.

The sulphur will be stored in a building having a support structure of reinforced concrete and the floor paved with concrete slabs. For the roofing, asbestos sheets will be used.

Administrative offices, laboratory, maintenance workshop, social services and other facilities are grouped in one storey-building, covering an area of 500 sq.m, about. This building has a supporting structure of reinforced concrete; external and internal walls are of brickwork, while the roof is in light concrete.

The floors of the offices, laboratory and social services are covered with tiles, while workshop has a concrete floor.

5.5 INVESTMENT COSTS, DEPRECIATION AND MAINTENANCE

The machinery and equipment have been quoted by GARBATO, Milan, Italy. The investment costs are as follows:

	LC $	F.. $	TOTAL $
- Machinery & Equipment (FOB European Port)	----	1,500,000	1,500,000
- Transport, taxes + duties	300,000	150,000	450,000
- Erection	300,000	150,000	450,000
- Land and site preparation	100,000	---	100,000
- Civil works	500,000	---	500,000
- Insulation and painting	50,000	---	50,000
- Spare parts	---	100,000	100,000
Total	**1,250,000**	**1,900,000**	**3,150,000**
Contingencies	**125,000**	**190,000**	**315,000**
Grand total	**1,375,000**	**2,090,000**	**3,465,000**

The life of the plant can be considered as fifteen years. Annual maintenance cost has been assumed in the range of 6% of the machinery and equipment costs, that is US$ 90,000.

In the financial evaluation, the investment cost (contingencies included) are so subdivided:

Preproduction expenditures	FC	US$ 75,000
Preproduction expenditures	LC	US$ 150,000
Machinery	FC	US$ 2,090,000
Machinery	LC	US$ 715,000
Land and site preparation	LC	US$ 110,000
Civil works	LC	US$ 550,000
TOTAL		US$ 3,690,000

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skill is required for any of the positions listed below, exception made for the process engineer, chemist and foremen, who must have through training in the technology.

For the remaining personnel it is recommended that on the job training is carried out by an expert, made available by the technology supplier, for one year after the start-up. The relevant cost is estimated US$ 120,000. The number of personnel reflects the needs of three shifts.

7.1 MANAGEMENT AND ADMINISTRATIVE DEPARTMENT

		N/Y
General manager	1	50,000
Technical manager	1	40,000
Senior accountant	1	25,000
Purchasing dept.head	1	12,000
Sales dept. head	1	12,000
Clerks and secretaries	3	36,000
Drivers	3	24,000
Security	4	24,000
	---	---
	15	223,000
	Overheads 40%	89,200

		312,200
		(US$ 39,500)

7.2 PRODUCTION DEPARTMENT

		N/Y
Production manager	1	40,000
Process engineer	1	40,000
Chemist	1	25,000
Warehouse keeper	1	10,000
Shift foreman	4	48,000
Shift operators	12	120,000
Semi skilled workers	6	36,000
	26	319,000
	Overheads 40%	127,600
		446,600
		(US$ 56,500)

7.3 MAINTENANCE DEPARTMENT

		N/Y
Chief engineer	1	40,000
Mechanics	4	40,000
Electricians	4	40,000
Instrument specialists	4	40,000
	13	160,000
	Overheads 40%	64,000
		224,000
		(US$ 28,300)

Manpower summary

Administration	15	39,500 $/y
Production Dep.	26	56,500 $/y
Maintenance Dep.	13	28,300 $/y
TOTAL	54	124,300 $/y

8. IMPLEMENTATION SCHEDULE

From the signing of the contract, 18 months are required for the construction and the commissioning of the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to US $ 3,915,350. The portion in foreign currency accounts for US $ 2,270,000.

Details of these figures are shown in chapter 5.5.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 500,000	US$ 500,000	US$ 1,000,000
- Foreign Loan (interest 8%)	US$ 510,000	US$ 1,267,000	US$ 1,777,000
- Local Loan (interest 15%)	US$ 300,000	US$ 613,000	US$ 913,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 **Working capital**

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 291,745 US Dollars, the foreign portion being US$ 269,000.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 127,335.

9.1.4 **Total production costs**

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US$ 1,162,880.

In the third year, at full production, the costs amount to US $ 1,233,410, then they start a slight decrease year after year, to reach a constant amount of US $ 672,000 from the 11th to 15th year.

9.1.5 **Sales revenue**

When the plant is in full production, the revenue is US $ 1,980,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 792,000

2nd year 80% : revenue = US$ 1,584,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 18.31%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 41.5% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [2] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 7 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 7,557,340.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 7,557,340.

[2] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

SULPHURIC ACID
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	3915.35	58.153 % foreign
current assets:	0.00	0.000 % foreign
total assets:	3915.35	58.153 % foreign

Source of funds during construction phase

equity & grants:	1000.00	0.000 % foreign
foreign loans :	1777.00	
local loans :	913.00	
total funds :	3690.00	48.157 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	463.70	672.07	672.07
depreciation :	420.07	398.07	27.50
interest :	279.11	71.08	0.00
production costs	1162.88	1141.22	699.57
thereof foreign	58.38 %	65.14 %	60.88 %
total sales :	792.00	1980.00	1980.00
gross income :	-370.88	838.78	1280.43
net income :	-370.88	503.27	768.26
cash balance :	-623.70	679.21	795.76
net cashflow :	181.87	972.42	795.76

Net Present Value at: 10.00 % = 2214.56
Internal Rate of Return: 18.31 %
Return on equity1: 26.07 %
Return on equity2: 24.11 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	110.000	0.000
Buildings and civil works	350.000	200.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	800.000	2005.000
Total fixed investment costs	1260.000	2205.000
Pre-production capital expenditures.	92.900	357.455
Net working capital	0.000	0.000
Total initial investment costs	1352.900	2562.455
Of it foreign, in %	45.857	64.644

Total Current Investment in 1000 US $

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	146.435	90.183	55.129
Total current investment costs	146.435	90.183	55.129
Of it foreign, %	86.956	96.770	97.348

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	40.000	80.000	100.000	100.000	100.000
Raw material 1	150.400	300.700	375.900	375.900	375.900
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	33.000	65.500	81.870	81.870	81.870
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	56.500	56.500	56.500	56.500	56.500
Repair, maintenance	16.000	32.000	40.000	40.000	40.000
Spares	20.000	40.000	50.000	50.000	50.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	395.900	494.700	604.270	604.270	604.270
Administrative overheads	67.800	67.800	67.800	67.800	67.800
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	420.071	420.071	409.071	398.071	398.071
Financial costs	279.110	215.690	152.270	88.850	71.080
Total production costs	1162.881	1198.261	1233.411	1158.991	1141.221
Costs per unit (single product)	0.440	0.227	0.187	0.176	0.173
Of it foreign, %	58.384	59.375	63.150	65.671	65.137
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	124.300	124.300	124.300	124.300	124.300

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	375.900	375.900	375.900	375.900	375.900
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	81.870	81.870	81.870	81.870	81.870
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	56.500	56.500	56.500	56.500	56.500
Repair, maintenance	40.000	40.000	40.000	40.000	40.000
Spares	50.000	50.000	50.000	50.000	50.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	604.270	604.270	604.270	604.270	604.270
Administrative overheads	67.800	67.800	67.800	67.800	67.800
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	308.000	308.000	308.000	308.000	27.500
Financial costs	53.310	35.540	17.770	0.000	0.000
Total production costs	1033.380	1015.610	997.840	980.070	699.570
Costs per unit (single product)	0.157	0.154	0.151	0.148	0.106
Of it foreign, %	66.598	66.014	65.408	64.781	60.380
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	124.300	124.300	124.300	124.300	124.300

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	375.900
Other raw materials	0.000
Utilities	81.870
Energy	0.000
Labour, direct	56.500
Repair, maintenance	40.000
Spares	50.000
Factory overheads	0.000
Factory costs	604.270
Administrative overheads	67.800
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	672.070
Costs per unit (single product)	0.102
Of it foreign, %	63.371
Of it variable,%	0.000
Total labour	124.300

Net Working Capital in 1000 US $

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	38.642	46.875	56.006	56.006
Inventory and materials	148	2.4	75.292	150.532	188.177	188.177
Energy	0	---	0.000	0.000	0.000	0.000
Spares	180	2.0	10.000	20.000	25.000	25.000
Work in progress	1	360.0	1.100	1.374	1.679	1.679
Finished products	15	24.0	19.321	23.438	28.003	28.003
Cash in hand	15	24.0	11.679	8.179	8.929	8.929
Total current assets			156.033	250.398	307.794	307.794
Current liabilities and						
Accounts payable	10	37.7	9.598	13.780	16.047	16.047
Net working capital			146.435	236.618	291.747	291.747
Increase in working capital			146.435	90.183	55.129	0.000
Net working capital, local			19.101	22.014	23.476	23.476
Net working capital, foreign			127.333	214.604	268.271	268.271

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	500.000	500.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	510.000	1267.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	300.000	613.000
Loan C, local....	0.000	0.000
Total loan	810.000	1880.000
Current liabilities	0.000	0.000
Bank overdraft	42.900	182.455
Total funds	1352.900	2562.455

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-222.125	-222.125	-222.125	-222.125	-222.125
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-304.333	-304.333	-304.333	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-526.458	-526.458	-526.458	-222.125	-222.125
Current liabilities	9.598	4.181	2.267	0.000	0.000
Bank overdraft	623.703	-34.873	-275.437	-538.748	0.000
Total funds	106.843	-557.150	-799.628	-760.873	-222.125

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow . .	1310.000	2380.000
Financial resources .	1310.000	2380.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	1352.900	2562.455
Total assets	1310.000	2380.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	42.900	182.455
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-42.900	-182.455
Cumulated cash balance	-42.900	-225.355
Inflow, local	800.000	1113.000
Outflow, local	732.500	905.975
Surplus (deficit) .	67.500	207.025
Inflow, foreign . . .	510.000	1267.000
Outflow, foreign . . .	620.400	1656.480
Surplus (deficit) .	-110.400	-389.480
Net cashflow	-1310.000	-2380.000
Cumulated net cashflow	-1310.000	-3690.000

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	801.598	1588.182	1982.268	1980.000	1980.000	1980.000
Financial resources	9.598	4.181	2.267	0.000	0.000	0.000
Sales, net of tax	792.000	1584.000	1980.000	1980.000	1980.000	1980.000
Total cash outflow	1425.301	1553.309	1706.830	1311.449	1300.787	1326.153
Total assets	156.033	94.365	57.396	0.000	0.000	0.000
Operating costs	463.700	562.500	672.070	672.070	672.070	672.070
Cost of finance	279.110	215.690	152.270	88.850	71.080	53.310
Repayment	526.458	526.458	526.458	222.125	222.125	222.125
Corporate tax	0.000	154.296	298.636	328.404	335.512	378.648
Dividends paid	0.000	0.000	0.000	0.000	0.000	0 000
Surplus (deficit)	-623.703	34.873	275.438	668.551	679.213	653.847
Cumulated cash balance	-849.058	-814.185	-538.748	129.804	809.017	1462.864
Inflow, local	800.792	1588.042	1982.031	1980.000	1980.000	1980.000
Outflow, local	642.476	778.683	898.282	574.574	581.682	624.818
Surplus (deficit)	158.315	809.359	1083.749	1405.426	1398.318	1355.182
Inflow, foreign	0.807	0.140	0.237	0.000	0.000	0.000
Outflow, foreign	782.825	774.626	808.548	736.875	719.105	701.335
Surplus (deficit)	-782.018	-774.486	-808.312	-736.875	-719.105	-701.335
Net cashflow	181.865	777.021	954.166	979.526	972.418	929.282
Cumulated net cashflow	-3508.135	-2731.113	-1776.948	-797.421	174.997	1104.279

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	1980.000	1980.000	1980.000	1980.000	1980.000	1980.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	1980.000	1980.000	1980.000	1980.000	1980.000	1980.000
Total cash outflow	1315.491	1304.829	1072.042	1184.242	1195.242	1195.242
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	672.070	672.070	672.070	672.070	672.070	672.070
Cost of finance	35.540	17..70	0.000	0.000	0.000	0.000
Repayment	222.125	222.125	0.000	0.000	0.000	0.000
Corporate tax	385.756	392.864	399.972	512.172	523.172	523.172
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	664.509	675.171	907.958	795.758	784.758	784.758
Cumulated cash balance	2127.373	2802.544	3710.502	4506.260	5291.018	6075.775
Inflow, local	1980.000	1980.000	1980.000	1980.000	1980.000	1980.000
Outflow, local	631.926	639.034	646.142	758.342	769.342	769.342
Surplus (deficit)	1348.074	1340.966	1333.358	1221.658	1210.658	1210.658
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	683.565	665.795	425.900	425.900	425.900	425.900
Surplus (deficit)	-683.565	-665.795	-425.900	-425.900	-425.900	-425.900
Net cashflow	922.174	915.066	907.958	795.758	784.758	784.758
Cumulated net cashflow	2026.453	2941.519	3849.477	4645.235	5429.993	6214.750

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	1980.000	1980.000	1980.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	1980.000	1980.000	1980.000
Total cash outflow	1195.242	1195.242	1195.242
Total assets	0.000	0.000	0.000
Operating costs	672.070	672.070	672.070
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	523.172	523.172	523.172
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	784.758	784.758	784.758
Cumulated cash balance	6860.533	7645.291	8430.049
Inflow, local	1980.000	1980.000	1980.000
Outflow, local	769.342	769.342	769.342
Surplus (deficit)	1210.658	1210.658	1210.658
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	425.900	425.900	425.900
Surplus (deficit)	-425.900	-425.900	-425.900
Net cashflow	784.758	784.758	784.758
Cumulated net cashflow	6999.508	7784.266	8569.024

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	2163.30	at	10.00 %
Internal Rate of Return (IRRE1) ..	26.07 %		

b) Net Worth versus Net cash return:

Net present value	2326.84	at	10.00 %
Internal Rate of Return (IRRE2) ..	24.11 %		

c) Internal Rate of Return on total investment:

Net present value	2214.56	at	10.00 %
Internal Rate of Return (IRR) ..	18.31 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	792.000	1584.000	1980.000	1980.000	1980.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	792.000	1584.000	1980.000	1980.000	1980.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	883.771	982.571	1081.141	1070.141	1070.141
Operational margin	-91.771	601.429	898.859	909.859	909.859
As % of total sales	-11.587	37.969	45.397	45.952	45.952
Cost of finance	279.110	215.690	152.270	88.850	71.080
Gross profit	-370.881	385.739	746.589	821.009	838.779
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-370.881	385.739	746.589	821.009	838.779
Tax	0.000	154.296	298.636	328.404	335.512
Net profit	-370.881	231.443	447.953	492.605	503.267
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-370.881	231.443	447.953	492.605	503.267
Accumulated undistributed profit	-370.881	-139.438	308.516	801.121	1304.389
Gross profit, % of total sales	-46.828	24.352	37.707	41.465	42.363
Net profit, % of total sales	-46.828	14.611	22.624	24.879	25.418
ROE, Net profit, % of equity	-37.088	23.144	44.795	49.261	50.327
ROI, Net profit+interest, % of invest.	-2.392	11.387	15.074	14.603	14.425

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	1980.000	1980.000	1980.000	1980.000	1980.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1980.000	1980.000	1980.000	1980.000	1980.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	980.070	980.070	980.070	980.070	699.570
Operational margin	999.930	999.930	999.930	999.930	1280.430
As % of total sales	50.502	50.502	50.502	50.502	64.668
Cost of finance	53.310	35.540	17.770	0.000	0.000
Gross profit	946.620	964.390	982.160	999.930	1280.430
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	946.620	964.390	982.160	999.930	1280.430
Tax	378.648	385.756	392.864	399.972	512.172
Net profit	567.972	578.634	589.296	599.958	768.258
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	567.972	578.634	589.296	599.958	768.258
Accumulated undistributed profit	1872.361	2450.995	3040.291	3640.250	4408.508
Gross profit, % of total sales	47.809	48.707	49.604	50.502	64.668
Net profit, % of total sales	28.685	29.224	29.762	30.301	38.301
ROE, Net profit, % of equity	56.797	57.863	58.930	59.996	76.826
ROI, Net profit+interest, % of invest.	15.603	15.425	15.246	15.068	19.295

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	1980.000	1980.000	1980.000	1980.000	1980.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1980.000	1980.000	1980.000	1980.000	1980.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	672.070	672.070	672.070	672.070	672.070
Operational margin	1307.930	1307.930	1307.930	1307.930	1307.930
As % of total sales	66.057	66.057	66.057	66.057	66.057
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	1307.930	1307.930	1307.930	1307.930	1307.930
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1307.930	1307.930	1307.930	1307.930	1307.930
Tax	523.172	523.172	523.172	523.172	523.172
Net profit	784.758	784.758	784.758	784.758	784.758
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	784.758	784.758	784.758	784.758	784.758
Accumulated undistributed profit	5193.266	5978.024	6762.783	7547.541	8332.299
Gross profit, % of total sales	66.057	66.057	66.057	66.057	66.057
Net profit, % of total sales	39.634	39.634	39.634	39.634	39.634
ROE, Net profit, % of equity	78.476	78.476	78.476	78.476	78.476
ROI, Net profit+interest, % of invest.	19.709	19.709	19.709	19.709	19.709

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	1352.900	3915.355
Fixed assets, net of depreciation	0.000	1352.900
Construction in progress	1352.900	2562.455
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	1352.900	3915.355
Equity capital	500.000	1000.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	810.000	2690.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	42.900	225.355
Total debt	852.900	2915.355
Equity, % of liabilities	36.958	25.540

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Total assets	4022.198	3696.492	3113.373	2705.668	2986.811
Fixed assets, net of depreciation	3495.284	3075.213	2666.142	2268.071	1870.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	144.354	242.219	298.865	298.865	298.865
Cash, bank	11.679	8.179	8.929	8.929	8.929
Cash surplus, finance available	0.000	0.000	0.000	129.804	809.017
Loss carried forward	0.000	370.881	139.438	0.000	0.000
Loss	370.881	0.000	0.000	0.000	0.000
Total liabilities	4022.198	3696.492	3113.373	2705.668	2986.811
Equity capital	1000.000	1000.000	1000.000	1000.000	1000.000
Reserves, retained profit	0.000	0.000	0.000	308.516	801.121
Profit	0.000	231.443	447.953	492.605	503.267
Long and medium term debt	2163.542	1637.083	1110.625	888.500	666.375
Current liabilities	9.598	13.780	16.047	16.047	16.047
Bank overdraft, finance required.	849.058	814.185	538.748	0.000	0.000
Total debt	3022.198	2465.048	1665.420	904.547	682.422
Equity, % of liabilities	24.862	27.053	32.120	36.959	33.481

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	3332.658	3689.167	4056.338	4656.297	5424.555
Fixed assets, net of depreciation	1562.000	1254.000	946.000	638.000	610.500
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	298.865	298.865	298.865	298.865	298.865
Cash, bank	8.929	8.929	8.929	8.929	8.929
Cash surplus, finance available	1462.864	2127.373	2802.545	3710.503	4506.262
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	3332.658	3689.167	4056.338	4656.297	5424.555
Equity capital	1000.000	1000.000	1000.000	1000.000	1000.000
Reserves, retained profit	1304.389	1872.361	2450.995	3040.291	3640.250
Profit	567.972	578.634	589.296	599.958	768.258
Long and medium term debt	444.250	222.125	-0.000	-0.000	-0.000
Current liabilities	16.047	16.047	16.047	16.047	16.047
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	460.297	238.172	16.047	16.047	16.047
Equity, % of liabilities	30.006	27.106	24.653	21.476	18.435

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	6209.313	6994.072	7778.830	8563.588	9348.346
Fixed assets, net of depreciation	610.500	610.500	610.500	610.500	610.500
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	298.865	298.865	298.865	298.865	298.865
Cash, bank	8.929	8.929	8.929	8.929	8.929
Cash surplus, finance available	5291.020	6075.778	6860.537	7645.294	8430.052
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	6209.313	6994.072	7778.830	8563.588	9348.346
Equity capital	1000.000	1000.000	1000.000	1000.000	1000.000
Reserves, retained profit	4408.508	5193.266	5978.024	6762.783	7547.541
Profit	784.758	784.758	784.758	784.758	784.758
Long and medium term debt	-0.000	-0.000	-0.000	-0.000	-0.000
Current liabilities	16.047	16.047	16.047	16.047	16.047
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	16.047	16.047	16.047	16.047	16.047
Equity, % of liabilities	16.105	14.298	12.855	11.677	10.697

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	1778.18	1777.00	1.18	510.00	1267.00	0.81	0.14
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	1778.18	1777.00	1.18	510.00	1267.00	0.81	0.14
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	10653.58	2276.88	8376.70	620.40	1656.48	782.82	774.63
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	1956.00	2165.00	-209.00	600.00	1565.00	128.14	87.47
imported materials . . .	6167.80	0.00	6167.80	0.00	0.00	290.40	340.70
repayment loans & overd.	1778.18	0.00	1778.18	0.00	0.00	222.13	222.13
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	751.60	111.88	639.72	20.40	91.48	142.16	124.39
indirect costs							
net foreign exchge flow	-8875.40	-499.88	-8375.52	-110.40	-389.48	-782.02	-774.49
import substit'n effect	28116.00	0.00	28116.00	0.00	0.00	792.00	1584.00
net forgn exchge effect	19240.60	-499.88	19740.48	-110.40	-389.48	9.98	809.51

present values at	10.00 %
foreign exchange flow .	-4854.27
net forgn exchge effect	7557.34

SULPHURIC ACID

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	0.24	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.24	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	808.55	736.88	719.11	701.34	683.57	665.80	425.90
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	53.90	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	425.90	425.90	425.90	425.90	425.90	425.90	425.90
repayment loans & overd.	222.13	222.13	222.13	222.13	222.13	222.13	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	106.62	88.85	71.08	53.31	35.54	17.77	0.00
indirect costs							
net foreign exchge flow	-808.31	-736.88	-719.11	-701.34	-683.57	-665.80	-425.90
import substit'n effect	1980.00	1980.00	1980.00	1980.00	1980.00	1980.00	1980.00
net forgn exchge effect	1171.69	1243.13	1260.90	1278.67	1296.44	1314.20	1554.10

present values at	10.00 %
foreign exchange flow .	-4854.27
net forgn exchge effect	7557.34

SULPHURIC ACID

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	425.90	425.90	425.90	425.90	425.90	425.90	-477.27
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-478.45
imported materials . . .	425.90	425.90	425.90	425.90	425.90	425.90	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	1.18
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-425.90	-425.90	-425.90	-425.90	-425.90	-425.90	477.27
import substit'n effect	1980.00	1980.00	1980.00	1980.00	1980.00	1980.00	0.00
net forgn exchge effect	1554.10	1554.10	1554.10	1554.10	1554.10	1554.10	477.27

present values at	10.00 %
foreign exchange flow .	-4854.27
net forgn exchge effect	7557.34

SULPHURIC ACID

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE PRODUCTION OF UREA-FORMALDEHYDE GLUES IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of building up a plant for the production of UF (urea-formaldheyde) glues in Nigeria.[1]

The envisaged plant has a nominal capacity of 20,000 tons/y of UF 65% b/w glue, based on 300 days/y, 3 shifts/day.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 10,648,250 (US$ 6,400,000 in foreign currency)
- Working capital (at full production): US$ 1,693,850 (US$ 1,395,000 in foreign currency)
- Internal Rate of Return: 25.97%
- Break-Even Point (at 5th year of production) 22%
- Pay-Back Period: less than 5.5 years (including construction period)
- Employees: 53

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 43,766,780 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

1.1 GENERAL

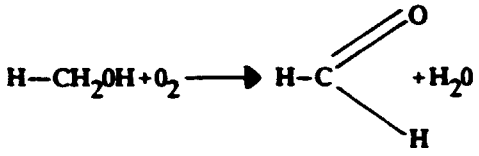
Urea-formaldehyde (UF) glues belong to the family of synthetic thermo-hardening resins. The synthesis of UF glues takes place through two main steps:

- synthesis of formaldehyde
- reaction of formaldehyde with urea.

[1] For additional background material, see Volume I p. 134.

1.1.1 Synthesis of formaldehyde

Formaldehyde is synthesized by oxidation of methanol according to the following reaction:

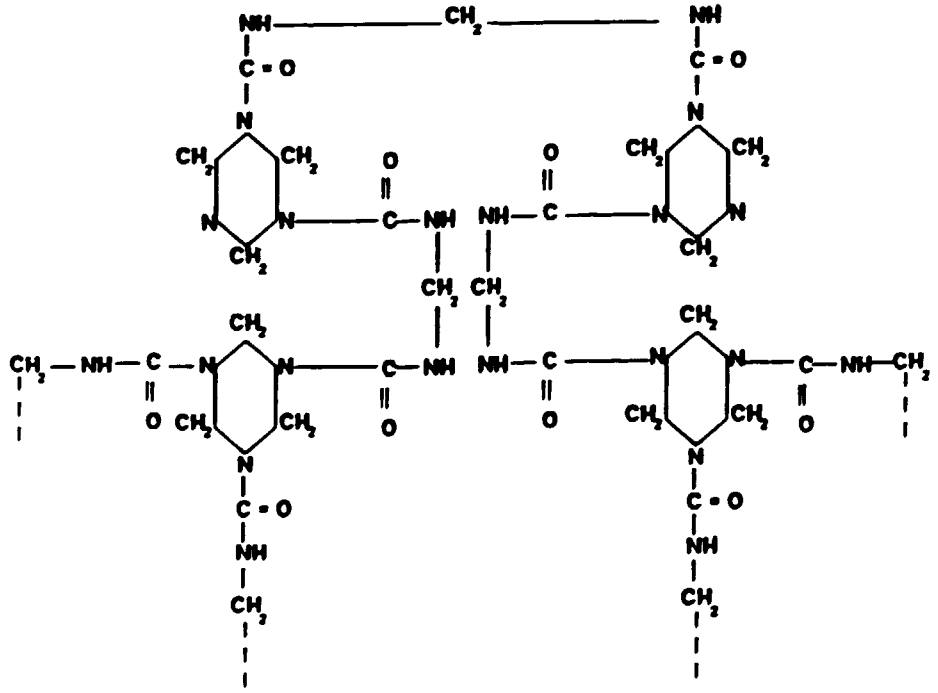


The reaction is carried out in the presence of suitable catalyst.

1.1.2 Reaction of formaldehyde with Urea

The chemical combinations of Formaldehyde with Urea are such that various products can be obtained, with a different structure and molecular complexity. It is possible to form simple addition compound, like mitilol urea:

or condensation products with higher molecular weight, like :



The latter is the final and the most complex stage of the combination. The reaction, under the influence of various factors, like heat and catalyst, can form soluble products (glues) or insoluble products (resins).

In order to obtain glues, the reaction shall be stopped at a controlled stage for obtaining a product partially polymerized, which can easily be handled by the customer. The final polymerization stage is reached during the utilization phase, by adding hardeners.

The structure of the UF glues depends essentially from the following factors:

- pH of the medium of the reagents
- molecular ratio between Urea and Formaldehyde
- temperature of the reaction.

2. MARKET AND PLANT CAPACITY

2.1 USE

Urea-Formaldehyde glues are world-wide used in the Wood Industry for the production of wood panels like plywood, particle boards, medium density boards and blackboards. These glues are traded either as water solutions, with a concentration of 65 to 70% as dry product, or in powder state.

The second way offers some advantages as far as the transport and storage is concerned. The disadvantages are the higher costs and the necessity to bring them into solution by the customer before using them.

2.2 WOOD INDUSTRY IN NIGERIA

The present annual production of plywood and particle boards in Nigeria is estimated to be 180,000 cu.m. and 100,000 cu.m. respectively. Major producers are:

African Timber & Plywood Co.	Sapele
Calabar Veneer & Plywood Ltd	Calabar
Nigerian-Romanian Wood Industries	Ondo
Serowood Ltd	Calabar
Yinca Morenike Plywood & Woodworks Ind.	Ise Ekili, Ondo
Klifko Nigeria Ltd	Port Harcourt
Piedmont Plywood Ltd	Benin City

According to the producers the demand is increasing year after year and their forecast for 1995 is the following:

Plywood	360,000 cu. m.
Particle boards	200,0000 cu. m.

This estimate seems too optimistic; a more conservative evaluation suggests to consider the production, by year 1995, as follows:

Plywood	250,000 cu.m.
Particle boards	150,000 cu.m.

2.3 DEMAND

2.3.1 Present demand

Specific consumption of UF glue at 65% bw solution is as follows (average ratio):

for 1 cu.m. of plywood	30 Kg
for 1 cu.m.of particle boards	100 Kg

The present demand results to be:

Plywood 180,000 cu.m x 30 Kg	5,400,000
Particle boards 100,000 cu.m x 100 Kg	10,000,000
	Total Kg 15,400,000

2.3.2 Forecast demand

Taking into account the specific consumption indicated above and the production forecast for year 1995 (the conservative one), the demand will be as follows:

Plywood	250,000 cu.m x 30 Kg	=	Kg 7,500,000
Particle boards	150,000 cu.m x 100 Kg	=	Kg 15,000,000
	Total		22,500,000

2.4 SUPPLY

Almost all the demand is satisfied by imported dry glue. Only a small quantity (about 1000 tonnes of water solution 65% w/w) is produced in Nigeria by the Organic Chemical Industries, a Company based at Ifo, close to Lagos. All ingredients are imported.

According to the users, the quality of glues sold by this company is not acceptable and very often long delays are registered in the delivery.

2.5 PLANT CAPACITY

From the economic point of view, the minimum capacity of a plant to produce UF 65% bw glue is ranging between 20,000 to 25,000 tons. Taking into account the forecast demand, a plant for the production of 20,000 tonnes/year of UF 65% bw glue has been considered. The plant is designed for operating 300 day/year, 3 shifts/day.

2.6 SALE PRICES AND REVENUE

2.6.1 International prices

The average selling prices in international market are as follows:

. UF dry glue	0.800 US Dollars/Kg
. UF 65% bw glue	0.450 US Dollars/Kg

2.6.2 Prices in Nigeria

At present, UF glues in Nigeria are traded at following prices:

. UF dry glue	6.5 N/Kg (imported)	= US$ 0.823
. UF 65% bw glue	4.5 N/Kg (Organic Chemical Industries)	= US$ 0.57

2.6.3 Revenue

The foreseen plant will produce 20,000 tonnes of UF 65% bw per year. The selling price, ex-works, packaging included, could be around 0.53 $/Kg. The total annual revenue would be US$ 10,568,000.

3. MATERIALS AND INPUTS

The production of UF glue requires various raw materials, some available locally, others to be imported. Among the latter, we have:

- methanol, whose cost is US$/t 300
- acetic acid, whose cost is US$/t 385
- catalist, whose cost is US$/t 3,000.

Details are provided herebelow. Caustic soda and hydrochloric acid are products that can be made available locally if the chlor-alkali plant, object of another study in this sub-sector will be implemented.

3.1 SPECIFIC CONSUMPTION

3.1.1 UF 65% glue

The specific consumption of raw materials and utilities for the production of 1000 Kg of UF 65% glue are as follows:

Urea	512 Kg
Formaldehyde (36%)	853 Kg
Caustic Soda (30%)	4.26 Kg
Acetic Acid (50%)	1.61 Kg
Demineralized water	280 Kg
Steam (4 to 7 bars)	450 Kg
Cooling water(make up and purging)	1.5 m^3
Electric energy	15 KWh

3.1.2 Formaldehyde

The envisaged plant is designed also for the production of Formaldehyde. The specific consumption of raw materials and utilities required for the production of 1000 Kg of formaldehyde 36% are as follows:

Methanol	415 Kg
Hydrochloric acid (30%)	0.06 Kg
Caustic soda (30%)	0.203 Kg
Catalyst	0.07 Kg
Electric Energy	100 Kwh

3.2 REQUIREMENT AND COSTS

Table 3.2 shows the quantity and the costs of materials and inputs referred to the production of 20,000 tonnes/year of U.F. 65% glue.

Table 3.2 - Requirement and costs of material and inputs for 20,000 tonnes of U.F. 65% glue

Description	Unit of measure	Quantity 1 year	Unit cost $ L.C.	Unit cost $ F.C.	Annual costs $ L.C.	Annual costs $ F.C.
Methanol	t	7080		300		2,124,000
Urea	t	10240	175		1,792,000	
Caustic Soda (30%)	t	90	150		13,500	
Acetic Acid (50%)	t	32,2		385		12,397
Hydrochloric Acid (30%)	t	1	330		330	
Catalyst	t	1,2		3000		3,600
1 Sub-total: raw materials					**1,805,830**	**2,139,997**
Electric Energy(1)	KWh	3000000	0.1		300,000	
Steam	t	9000	8		(3)72,000	
Demineralized water	m^3	5600	3.5		19,500	
Cooling water	m^3	30000	0.0060		180	
2 Sub-total : utilities					**391,680**	
GRAND TOTAL (1+2)					**4,337,507**	

For the financial evaluation the costs are grouped as follows:

. raw materials	LC	=	1,805,830 $/y
. raw materials	FC	=	2,139,997 $/y
. utilities	LC	=	391,680 $/y

3.3 RAW MATERIALS PURCHASING PROGRAMME

It is suggested the purchasing of 6 months of the required quantity of methanol (about 4000 t). One month of stock of urea is considered sufficient. Due to the small quantity of the other raw materials, their purchasing could be planned on one year basis. As a result of the above assumptions the following stocks are considered:

(1) Includes energy consumption for water pumping, lighting etc.
(3) Cost of fuel to produce steam

- methanol 4000 t equivalent to 170 operat. days	US$	1,200,000
- urea 1000 t equivalent to 30 operating days	US$	175,000
- hydrochloric acid 30% 1 t equivalent to 300 days	US$	100
- caustic soda 30% 90 t equivalent to 300 days	US$	13,500
- acetic acid 50% 32.2 t equivalent to 300 days	US$	12,400
- catalyst 1.2 t equivalent to 300 days	US$	3,600
Total		1,404,600

4. LOCATION

The choice of the location will be mainly influenced by the stability of the final product. Therefore it is suggested a location near to the utilization areas. Considering the location of the existing wood industries it is suggested to install the plant at Warri, where water, electric power and port facilities are available.

5. PROJECT ENGINEERING

5.1 PROCESS AND MAIN EQUIPMENT DESCRIPTION

5.1.1 Formaldehyde

The process consists in the conversion of methanol to formaldehyde using metal oxide as a catalyst.

Methanol, coming from the storage tanks, is passed to a steam-heated evaporator.

Freshly blown-in air and recycled off-gas from the absorption tower are mixed, heated and fed to the evaporator. A mixture of methanol and air at a temperature of 150 C and a pressure of 260 mm/Hg is obtained.

This gaseous mixture passes through catalyst filled tubes in a heat-exchanging reactor.

The oxidation reaction is highly exothermic: the heat of reaction is removed from the reactor outside the tubes by circulation of molten salts or other fluids.

The process employs excess air and the temperature is controlled to a value of ab. 320 C.

A secondary circuit controls the reaction temperature by circulation of water and simultaneous generation steam: after leaving the reactor, the hot gases are cooled down to 120 C in a heat-exchange unit and the heat recovered produces steam at 18 ate. Then the gases pass to the bottom of an absorber column.

The formaldehyde concentration is regulated by controlling the amount of process water added to the top of the column. The heat developed during the absorption of the formaldehyde is removed using plate heat-exchangers.

The formaldehyde is sent to the storage tanks. The gas coming out from the absorber column, at a temperature of ca. 38-45 C, passes through a condenser; the condensed water is utilized for dissolving urea in the next step, while the residual gas is partially sent to the oxidation plant.

The obtained formaldehyde water solution has the following characteristics:

CH_20 content	36% ± 1
pH	3.3
Density	1.108
Ch_30H content	0.4 to 0.8%
Formic acid	0.003%
Iron	1 ppm max

5.1.1.1 List of main equipment

The main equipment of this section consists of:

. Methanol tanks

. Evaporator

. Blower

. Reactor

. Steam boiler

. Heat exchanger

. Formaldehyde column

. Formaldehyde cooler

. Plate Heat Exchanger

5.1.2 U.F. 65% bw glue

The raw materials (urea and formaldehyde) are sent into a reactor of 30 m^3 capacity and heated to ab 85 C in about 30'. At this temperature, acetic acid 50% is added and the polycondensation reaction takes place. The heating is obtained by circulation of steam at 6-7 bar in a coil welded outside the reactor and controlled by a pressure regulator.

The reaction lasts for 90 minutes at atmospheric pressure and reaches the maximum temperature of 98 C. This value is automatically controlled by making circulate cool water in a tube coil placed inside the reactor.

The polycondensation is controlled by checking the viscosity. When the viscosity has reached desired value, the reaction is interrupted by additioning caustic soda 30%.

Some water is eliminated by vacuum distillation to a temperature of 65 C and some urea is added, if necessary.

The solution is then cooled, filtered and discharged. The obtained U.F./65% bw glue has the following average characteristics:

Appearance	white liquid
Dry content (2 hours at 120 C)	65% ± 1
pH	8-9
Viscosity (at 20 C in m Pas)	400-600
Free formaldehyde	0.1%-0.3%
Density	1,3 ca.

5.1.2.1 List of main equipment

. Urea deposit (in bulk)

. Condenser

. Reactor

. Filter

5.2 PACKAGING

The product is normally distributed in plastic drums of 150-200 Kg capacity. These containers are available in Nigeria at 20 US Dollars/each. It is normal practice that customers return the drum to the plant, thus reducing the cost and avoiding large stock of containers. An initial stock of 10,000 pieces is included in the fixed investment.

5.3 LAY-OUT AND CIVIL WORKS

The area required for the installation of the process equipment with all the necessary utilities and facilities is about 20,000 sqm. The whole process plant is installed outdoor, except for the reactor and related equipment for which a building of 400 sq. m. is required. The control room of the whole plant, which requires 150 sq. m is located in the same building. For the storing of urea and other chemicals (methanol will be stored in S.S. tanks) as well as for the empty and filled drums, a building of about 2000 sq. m. is envisaged.

Administrative offices, laboratory, maintenance workshop, social services and other facilities are grouped in a one-storey building, covering an area of 700 sq.m. This building has a supporting structure of reinforced concrete; external and internal walls are of brickwork, while the roof is made of concrete slabs. The floors of the offices, laboratory and social services are covered with tiles, while the workshop has a concrete floor. The building where the reactor and the related equipment are installed and where the control room is located, has a support structure of reinforced concrete. For roofing and cladding, corrugated asbestos sheets will be used.

The warehouse has a support structure of reinforced concrete and the floor is paved with concrete slabs. For roofing and cladding, corrugated asbestos sheets will be used. The fence consists of a wire netting supported by small steel poles.

5.4 INVESTMENT COSTS, DEPRECIATION AND MAINTENANCE

The quotation of the equipment was obtained from SADEPAN, Mantova, Italy. The investment costs are as follows:

Description	LC M$	FC M$	TOTAL M$
Machines and equipment			
FOB European Port		4.6	4.6
Transport, taxes and duties	0.9	0.45	1.35
Erection	0.9	0.45	1.35
Land and site preparation	0.2		0.2
Civil works and building	1.6		1.6
Spare parts		0.1	0.1
Total	**3.6**	**5.6**	**9.2**
Contingencies 10%	**0.4**	**0.4**	**0.8**
Grand total	**4.0**	**6.0**	**10.0**

The life span of the plant is estimated 15 years. Annual maintenance expenditure is estimated US$ 130,000.

Preproduction expenditures	FC	US$ 120,000
Preproduction expenditures	LC	US$ 100,000
Machinery	FC	US$ 6,000,000
Machinery	LC	US$ 2,000,000
Land + Site preparation	LC	US$ 200,000
Civil works	LC	US$ 1,800,000
Total		**US$ 10,220,000**

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skill is required for any of the positions listed below, exception made for the technical manager, the production manager and the chemist. It is recommended that on the job training is carried out by one expert, made available by the technology supplier, for one year after the start-up. The relevent cost is estimated US$ 120,000.

The number of personnel reflects the needs of three shifts.

7.1 MANAGEMENT AND ADMINISTRATIVE DEPARTMENT

		N /year
General Manager	1	50,000
Technical Manager	1	30,000
Financial Manager	1	40,000
Accountant	1	12,000
Purchasing Dept. Head	1	12,000
Sales Dept. Head	1	12,000
Warehouse keepers	2	24,000
Clerks and secretaries	3	36,000
Drivers	3	24,000
Guards	4	24,000
	18	274,000
		Overheads 40% 109,600
		383,600
		(US$ 48,500)

7.2 PRODUCTION DEPARTMENT

		N /year
Production Manager	1	40,000
Chemist	1	25,000
Foremen	8	96,000
Shift operators	6	72,000
Unskilled workers	6	24,000
	22	257,000
		Overheads 40% 102,800
		359,800
		(US$ 45,500)

7.3 MAINTENANCE DEPARTMENT

		N /year
Chief Engineering	1	40,000
Mechanics	4	40,000
Electricians	4	40,000
Instrument Specialists	4	40,000
	13	160,000
		Overheads 40% 64,000
		224,000
		(US$ 28,300)

Summary

Production	22	US$ 45,500
Administrative	18	US$ 48,500
Maintenance	13	US$ 28,300
	53	US$ 122,300

8. IMPLEMENTATION SCHEDULE

From the signing of the contract about 24 months are required for the construction and the commissioning of the plant.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 10,648,250 US Dollars. The portion in foreign currency accounts for 6,400,000 US Dollars.

Details of these figures are shown in chapter 5.5.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 2,000,000	US$ 2,000,000	US$ 4,000,000
- Foreign Loan (interest 8%)	US$ 1,275,000	US$ 3,825,000	US$ 5,100,000
- Local Loan (interest 15%)	US$ 255,000	US$ 865,000	US$ 1,120,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 60%

3rd year 80%

4th and subsequent years 100%

When the plant is in full production, the required working capital amounts to 1,693,850 US Dollars, the foreign portion being US$ 1,395,230.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 700,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US$ 3,663,790.

In the fourth year, at full production, the costs amount to US $ 5,864,130, then they start a slight decrease year after year, to reach a constant amount of US $ 4,589,480 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 10,560,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 4,224,000

2nd year 60% : revenue = US$ 6,336,000

3rd year 80% : revenue = US$ 8,448,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 25.97%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 22% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [3] + administrative), depreciation and financial costs.

[3] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

9.2.3 Pay-back Period

The pay-back period is less than 5.5 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 43,766,780.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 43,766,780.

ANNEXE 1

COMFAR SCHEDULES

UREA-FORMALDEHYDE GLUE
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	10648.25	60.348 % foreign
current assets:	0.00	0.000 % foreign
total assets:	10648.25	60.348 % foreign

Source of funds during construction phase

equity & grants:	4000.00	0.000 % foreign
foreign loans :	5100.00	
local loans :	1120.00	
total funds :	10220.00	49.902 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	2028.14	4589.48	4589.48
depreciation :	1059.65	1019.65	290.00
interest :	576.00	204.00	0.00
production costs	3663.79	5813.13	4879.48
thereof foreign	57.02 %	52.97 %	44.88 %
total sales :	4224.00	10560.00	10560.00
gross income :	560.21	4746.87	5680.52
net income :	336.13	2848.12	3408.31
cash balance :	-324.19	3230.27	3698.31
net cashflow :	1262.64	4071.77	3698.31

Net Present Value at: 10.00 % = 13794.16
Internal Rate of Return: 25.97 %
Return on equity1: 36.97 %
Return on equity2: 34.75 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	200.000	0.000
Buildings and civil works	1200.000	600.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	2100.000	5900.000
Total fixed investment costs	3500.000	6500.000
Pre-production capital expenditures	100.125	548.125
Net working capital	0.000	0.000
Total initial investment costs	3600.125	7048.125
Of it foreign, in %	43.082	69.167

Total Current Investment in 1000 US $

Year	1992	1993	1994	1995
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000
Working capital	709.131	314.043	335.304	335.364
Total current investment costs	709.131	314.043	335.304	335.364
Of it foreign, %	81.709	82.063	83.222	83.207

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	40.000	60.000	80.000	100.000	100.000
Raw material 1	856.040	1284.060	1712.080	2140.100	2140.100
Other raw materials	722.300	1083.500	1444.600	1805.800	1805.800
Utilities	156.000	235.000	313.000	391.780	391.780
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	45.000	45.000	45.000	45.000	45.000
Repair, maintenance	32.000	48.000	64.000	80.000	80.000
Spares	20.000	30.000	40.000	50.000	50.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	1951.340	2725.560	3618.680	4512.680	4512.680
Administrative overheads	76.800	76.800	76.800	76.800	76.800
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1059.650	1059.650	1039.650	1019.650	1019.650
Financial costs	576.000	469.000	362.000	255.000	204.000
Total production costs	3663.790	4331.010	5097.130	5864.130	5813.130
Costs per unit (single product)	0.458	0.361	0.319	0.293	0.291
Of it foreign, %	57.024	54.404	53.820	53.380	52.971
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	121.800	121.800	121.800	121.800	121.800

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	2140.100	2140.100	2140.100	2140.100	2140.100
Other raw materials	1805.800	1805.800	1805.800	1805.800	1805.800
Utilities	391.780	391.780	391.780	391.780	391.780
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	45.000	45.000	45.000	45.000	45.000
Repair, maintenance	80.000	80.000	80.000	80.000	80.000
Spares	50.000	50.000	50.000	50.000	50.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	4512.680	4512.680	4512.680	4512.680	4512.680
Administrative overheads	76.800	76.800	76.800	76.800	76.800
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	890.000	890.000	890.000	890.000	290.000
Financial costs	153.000	102.000	51.000	0.000	0.000
Total production costs	5632.480	5581.480	5530.480	5479.480	4879.480
Costs per unit (single product)	0.282	0.279	0.277	0.274	0.244
Of it foreign, %	52.252	51.816	51.372	50.919	46.284
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	121.800	121.800	121.800	121.800	121.800

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	2140.100
Other raw materials	1805.800
Utilities	391.780
Energy	0.000
Labour, direct	45.000
Repair, maintenance	80.000
Spares	50.000
Factory overheads	0 000
Factory costs	4512.680
Administrative overheads	76.800
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	4589.480
Costs per unit (single product)	0.229
Of it foreign, %	47.720
Of it variable,%	0.000
Total labour	121.800

Net Working Capital in 1000 US $

Year	mdc	coto	1992	1993	1994	1995	1996-2006
Current assets &							
Accounts receivable	30	12.0	169.012	233.530	307.957	382.457	382.457
Inventory and materials	101	3.6	488.645	732.974	977.293	1221.622	1221.622
Energy	0	---	0.000	0.000	0.000	0.000	0.000
Spares	180	2.0	10.000	15.000	20.000	25.000	25.000
Work in progress	5	72.0	27.102	37.855	50.259	62.676	62.676
Finished products	15	24.0	84.506	116.765	153.978	191.228	191.228
Cash in hand	15	24.0	12.242	8.325	9.408	10.492	10.492
Total current assets			791.506	1144.449	1518.896	1893.475	1893.475
Current liabilities and							
Accounts payable	16	22.6	82.375	121.275	160.417	199.632	199.632
Net working capital			709.131	1023.174	1358.479	1693.843	1693.843
Increase in working capital			709.131	314.043	335.304	335.364	0.000
Net working capital, local			129.706	186.036	242.294	298.612	298.612
Net working capital, foreign			579.425	837.138	1116.184	1395.230	1395.230

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	2000.000	2000.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1275.000	3825.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	255.000	865.000
Loan C, local....	0.000	0.000
Total loan	1530.000	4690.000
Current liabilities	0.000	0.000
Bank overdraft	70.125	358.125
Total funds	3600.125	7048.125

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-637.500	-637.500	-637.500	-637.500	-637.500
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-373.333	-373.333	-373.333	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-1010.833	-1010.833	-1010.833	-637.500	-637.500
Current liabilities	82.375	38.900	39.142	39.215	0.000
Bank overdraft	324.188	-752.439	0.000	0.000	0.000
Total funds	-604.270	-1724.372	-971.692	-598.285	-637.500

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow . .	3530.000	6690.000
Financial resources .	3530.000	6690.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	3600.125	7048.125
Total assets	3530.000	6690.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	70.125	358.125
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-70.125	-358.125
Cumulated cash balance	-70.125	-428.250
Inflow, local	2255.000	2865.000
Outflow, local	2049.125	2173.125
Surplus (deficit) .	205.875	691.875
Inflow, foreign . . .	1275.000	3825.000
Outflow, foreign . . .	1551.000	4875.000
Surplus (deficit) .	-276.000	-1050.000
Net cashflow	-3530.000	6690.000
Cumulated net cashflow	-3530.000	-10220.000

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	4306.375	6374.899	8487.141	10599.210	10560.000	10560.000
Financial resources	82.375	38.900	39.142	39.215	0.000	0.000
Sales, net of tax	4224.000	6335.999	8447.999	10560.000	10560.000	10560.000
Total cash outflow	4630.563	5437.133	6783.107	7734.907	7329.728	7350.987
Total assets	791.506	352.943	374.446	374.579	0.000	0.000
Operating costs	2028.140	2802.360	3695.479	4589.480	4589.480	4589.480
Cost of finance	576.000	469.000	362.000	255.000	204.000	153.000
Repayment	1010.833	1010.833	1010.833	637.500	637.500	637.500
Corporate tax	224.084	801.996	1340.348	1878.348	1898.748	1971.007
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-324.189	937.766	1704.034	2864.307	3230.271	3209.012
Cumulated cash balance	-752.439	185.327	1889.361	4753.668	7983.939	11192.950
Inflow, local	4303.608	6374.016	8485.924	10598.000	10560.000	10560.000
Outflow, local	2006.831	2869.977	3807.264	4372.044	4298.127	4370.387
Surplus (deficit)	2296.777	3504.039	4678.660	6225.953	6261.872	6189.612
Inflow, foreign	2.767	0.883	1.217	1.217	0.000	0.000
Outflow, foreign	2623.732	2567.156	2975.843	3362.863	3031.600	2980.600
Surplus (deficit)	-2620.965	-2566.273	-2974.626	-3361.646	-3031.600	-2980.600
Net cashflow	1262.645	2417.600	3076.867	3756.807	4071.771	3999.512
Cumulated net cashflow	-8957.355	-6539.756	-3462.888	293.919	4365.690	8365.202

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	10560.000	10560.000	10560.000	10560.000	10560.000	10560.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	10560.000	10560.000	10560.000	10560.000	10560.000	10560.000
Total cash outflow	7320.388	7289.788	6621.688	6861.688	6977.688	6977.688
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	4589.480	4589.480	4589.480	4589.480	4589.480	4589.480
Cost of finance	102.000	51.000	0.000	0.000	0.000	0.000
Repayment	637.500	637.500	0.000	0.000	0.000	0.000
Corporate tax	1991.407	2011.807	2032.208	2272.208	2388.208	2388.208
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	3239.611	3270.211	3938.312	3698.312	3582.312	3582.312
Cumulated cash balance	14432.560	17702.770	21641.090	25339.400	28921.710	32504.020
Inflow, local	10560.000	10560.000	10560.000	10560.000	10560.000	10560.000
Outflow, local	4390.787	4411.188	4431.587	4671.587	4787.587	4787.587
Surplus (deficit)	6169.212	6148.812	6128.412	5888.412	5772.412	5772.412
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	2929.600	2878.600	2190.100	2190.100	2190.100	2190.100
Surplus (deficit)	-2929.600	-2878.600	-2190.100	-2190.100	-2190.100	-2190.100
Net cashflow	3979.112	3958.711	3938.312	3698.312	3582.312	3582.312
Cumulated net cashflow	12344.310	16303.030	20241.340	23939.650	27521.960	31104.270

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	10560.000	10560.000	10560.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	10560.000	10560.000	10560.000
Total cash outflow	6977.688	6977.688	6977.688
Total assets	0.000	0.000	0.000
Operating costs	4589.480	4589.480	4589.480
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	2388.208	2388.208	2388.208
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	3582.312	3582.312	3582.312
Cumulated cash balance	36086.340	39668.650	43250.960
Inflow, local	10560.000	10560.000	10560.000
Outflow, local	4787.587	4787.587	4787.587
Surplus (deficit)	5772.412	5772.412	5772.412
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	2190.100	2190.100	2190.100
Surplus (deficit)	-2190.100	-2190.100	-2190.100
Net cashflow	3582.312	3582.312	3582.312
Cumulated net cashflow	34686.590	38268.900	41851.210

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	13413.74	at	10.00 %
Internal Rate of Return (IRRE1) ..	36.97 %		

b) Net Worth versus Net cash return:

Net present value	14155.08	at	10.00 %
Internal Rate of Return (IRRE2) ..	34.75 %		

c) Internal Rate of Return on total investment:

Net present value	13794.16	at	10.00 %
Internal Rate of Return (IRR) ..	25.97 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	4224.000	6335.999	8447.999	10560.000	10560.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4224.000	6335.999	8447.999	10560.000	10560.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	3087.790	3862.010	4735.130	5609.130	5609.130
Operational margin	1136.209	2473.989	3712.869	4950.869	4950.869
As % of total sales	26.899	39.047	43.950	46.883	46.883
Cost of finance	576.000	469.000	362.000	255.000	204.000
Gross profit	560.209	2004.989	3350.869	4695.869	4746.869
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	560.209	2004.989	3350.869	4695.869	4746.869
Tax	224.084	801.996	1340.348	1878.348	1898.748
Net profit	336.126	1202.994	2010.521	2817.521	2848.122
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	336.126	1202.994	2010.521	2817.521	2848.122
Accumulated undistributed profit	336.126	1539.119	3549.641	6367.162	9215.283
Gross profit, % of total sales	13.263	31.644	39.665	44.468	44.951
Net profit, % of total sales	7.958	18.987	23.799	26.681	26.971
ROE, Net profit, % of equity	8.403	30.075	50.263	70.438	71.203
ROI, Net profit+interest, % of invest.	8.346	14.871	20.491	25.790	25.618

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	10560.000	10560.000	10560.000	10560.000	10560.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	10560.000	10560.000	10560.000	10560.000	10560.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	5479.480	5479.480	5479.480	5479.480	4879.480
Operational margin	5080.519	5080.519	5080.519	5080.519	5680.519
As % of total sales	48.111	48.111	48.111	48.111	53.793
Cost of finance	153.000	102.000	51.000	0.000	0.000
Gross profit	4927.519	4978.519	5029.519	5080.519	5680.519
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	4927.519	4978.519	5029.519	5080.519	5680.519
Tax	1971.007	1991.407	2011.807	2032.208	2272.208
Net profit	2956.511	2987.111	3017.711	3048.311	3408.311
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2956.511	2987.111	3017.711	3048.311	3408.311
Accumulated undistributed profit	12171.790	15158.910	18176.620	21224.930	24633.240
Gross profit, % of total sales	46.662	47.145	47.628	48.111	53.793
Net profit, % of total sales	27.997	28.287	28.577	28.867	32.276
ROE, Net profit, % of equity	73.913	74.678	75.443	76.208	85.208
ROI, Net profit+interest, % of invest.	26.100	25.929	25.758	25.586	28.608

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	10560.000	10560.000	10560.000	10560.000	10560.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	10560.000	10560.000	10560.000	10560.000	10560.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4589.480	4589.480	4589.480	4589.480	4589.480
Operational margin	5970.519	5970.519	5970.519	5970.519	5970.519
As % of total sales	56.539	56.539	56.539	56.539	56.539
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	5970.519	5970.519	5970.519	5970.519	5970.519
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	5970.519	5970.519	5970.519	5970.519	5970.519
Tax	2388.208	2388.208	2388.208	2388.208	2388.208
Net profit	3582.311	3582.311	3582.311	3582.311	3582.311
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	3582.311	3582.311	3582.311	3582.311	3582.311
Accumulated undistributed profit	28215.550	31797.860	35380.170	38962.480	42544.800
Gross profit, % of total sales	56.539	56.539	56.539	56.539	56.539
Net profit, % of total sales	33.923	33.923	33.923	33.923	33.923
ROE, Net profit, % of equity	89.558	89.558	89.558	89.558	89.558
ROI, Net profit+interest, % of invest.	30.068	30.068	30.068	30.068	30.068

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	3600.125	10648.250
Fixed assets, net of depreciation	0.000	3600.125
Construction in progress	3600.125	7048.125
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	3600.125	10648.250
Equity capital	2000.000	4000.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	1530.000	6220.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	70.125	428.250
Total debt	1600.125	6648.250
Equity, % of liabilities	55.554	37.565

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Total assets	10380.110	9858.729	10897.560	13116.790	15327.420
Fixed assets, net of depreciation	9588.600	8528.949	7489.299	6469.649	5450.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	779.264	1136.125	1509.487	1882.983	1882.983
Cash, bank	12.242	8.325	9.408	10.492	10.492
Cash surplus, finance available	0.000	185.329	1889.363	4753.671	7983.941
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	10380.110	9858.729	10897.560	13116.790	15327.420
Equity capital	4000.000	4000.000	4000.000	4000.000	4000.000
Reserves, retained profit	0.000	336.126	1539.119	3549.641	6367.162
Profit	336.126	1202.994	2010.521	2817.521	2848.122
Long and medium term debt	5209.167	4198.333	3187.500	2550.000	1912.500
Current liabilities	82.375	121.275	160.417	199.632	199.632
Bank overdraft, finance required.	752.438	0.000	0.000	0.000	0.000
Total debt	6043.980	4319.609	3347.917	2749.632	2112.132
Equity, % of liabilities	38.535	40.573	36.705	30.495	26.097

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	17646.430	19996.040	22376.250	25424.560	28832.870
Fixed assets, net of depreciation	4560.000	3670.000	2780.000	1890.000	1600.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1882.983	1882.983	1882.983	1882.983	1882.983
Cash, bank	10.492	10.492	10.492	10.492	10.492
Cash surplus, finance available	11192.950	14432.560	17702.780	21641.090	25339.400
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	17646.430	19996.040	22376.250	25424.560	28832.870
Equity capital	4000.000	4000.000	4000.000	4000.000	4000.000
Reserves, retained profit	9215.283	12171.790	15158.910	18176.620	21224.930
Profit	2956.511	2987.111	3017.711	3048.311	3408.311
Long and medium term debt	1275.000	637.500	-0.000	-0.000	-0.000
Current liabilities	199.632	199.632	199.632	199.632	199.632
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1474.632	837.132	199.632	199.632	199.632
Equity, % of liabilities	22.667	20.004	17.876	15.733	13.873

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	32415.180	35997.490	39579.800	43162.120	46744.430
Fixed assets, net of depreciation	1600.000	1600.000	1600.000	1600.000	1600.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1882.983	1882.983	1882.983	1882.983	1882.983
Cash, bank	10.492	10.492	10.492	10.492	10.492
Cash surplus, finance available	28921.710	32504.020	36086.330	39668.640	43250.960
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	32415.180	35997.490	39579.800	43162.120	46744.430
Equity capital	4000.000	4000.000	4000.000	4000.000	4000.000
Reserves, retained profit	24633.240	28215.550	31797.860	35380.170	38962.480
Profit	3582.311	3582.311	3582.311	3582.311	3582.311
Long and medium term debt	-0.000	-0.000	-0.000	-0.000	-0.000
Current liabilities	199.632	199.632	199.632	199.632	199.632
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	199.632	199.632	199.632	199.632	199.632
Equity, % of liabilities	12.340	11.112	10.106	9.267	8.557

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	construction 1990	construction 1991	construction 1992	production 1993
total foreign inflow . .	5106.08	5100.00	6.08	1275.00	3825.00	2.77	0.88
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	5106.08	5100.00	6.08	1275.00	3825.00	2.77	0.88
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	43111.46	6426.00	36685.46	1551.00	4875.00	2623.73	2567.16
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	5520.00	6120.00	-600.00	1500.00	4620.00	582.19	258.60
imported materials . . .	30343.38	0.00	30343.38	0.00	0.00	996.04	1314.06
repayment loans & overd.	5106.08	0.00	5106.08	0.00	0.00	637.50	637.50
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	2142.00	306.00	1836.00	51.00	255.00	408.00	357.00
indirect costs							
net foreign exchge flow	-38005.38	-1326.00	-36679.38	-276.00	-1050.00	-2620.97	-2566.27
import substit'n effect	145728.00	0.00	145728.00	0.00	0.00	4224.00	6336.00
net forgn exchge effect	107722.60	-1326.00	109048.60	-276.00	-1050.00	1603.03	3769.73

present values at	10.00 %
foreign exchange flow .	-19399.12
net forgn exchge effect	43766.78

UREA-FORMALDEHYDE GLUE

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	1.22	1.22	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	1.22	1.22	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	2975.84	3362.86	3031.60	2980.60	2929.60	2878.60	2190.10
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	280.26	280.26	0.00	0.00	0.00	0.00	0.00
imported materials . . .	1752.08	2190.10	2190.10	2190.10	2190.10	2190.10	2190.10
repayment loans & overd.	637.50	637.50	637.50	637.50	637.50	637.50	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	306.00	255.00	204.00	153.00	102.00	51.00	0.00
indirect costs							
net foreign exchge flow	-2974.63	-3361.65	-3031.60	-2980.60	-2929.60	-2878.60	-2190.10
import substit'n effect	8448.00	10560.00	10560.00	10560.00	10560.00	10560.00	10560.00
net forgn exchge effect	5473.37	7198.35	7528.40	7579.40	7630.40	7681.40	8369.90

present values at	10.00 %
foreign exchange flow .	-19399.12
net forgn exchge effect	43766.78

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	2190.10	2190.10	2190.10	2190.10	2190.10	2190.10	-1995.23
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-2001.31
imported materials . . .	2190.10	2190.10	2190.10	2190.10	2190.10	2190.10	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	6.08
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-2190.10	-2190.10	-2190.10	-2190.10	-2190.10	-2190.10	1995.23
import substit'n effect	10560.00	10560.00	10560.00	10560.00	10560.00	10560.00	0.00
net forgn exchge effect	8369.90	8369.90	8369.90	8369.90	8369.90	8369.90	1995.23

present values at	10.00 %
foreign exchange flow .	-19399.12
net forgn exchge effect	43766.78

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY S' UDY FOR THE PRODUCTION OF BONE BASED CHEMICALS IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

Livestock is an important resource of Nigeria but one of its main by-products, animal bones, is only marginally exploited. The aim of this study is to verify the viability of processing bones made available by the butcheries in order to obtain the following products:

2,000	tons per year of fat
4,000	tons per year of glue
24,000	tons per year of normal super phosphate

Fat can be used by the Nigerian soap industry which imports a large quantity of raw materials.

Bone glue has the potential to be exported to Europe (Italy alone presently imports at least 2,500 t/y of bone glue from Comecon Countries and China). NSP or normal super phosphate is an excellent fertilizer and its production can considerably increase the input of nutrients for agriculture with a consequent increase of yield and diminution of imports.

The proposed technology poses no major difficulties in getting the plant on stream. However, it will be necessary to study and implement an efficient system for the collection of bones.(1)

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 5,761,900 (US$ 3,140,000 in foreign currency)
- Working capital (at full production): US$ 659,000 (US$ 340,000 in foreign currency)
- Internal Rate of Return: 30.60%
- Break-Even Point (at 5th year of production) 23%
- Pay-Back Period: less than 6 years (including construction period)
- Employees: 150

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 63,384,470 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

(1) For additional background material, see Volume I p. 137.

1. INTRODUCTION

The main products usually obtained by processing animal bones are:

- fat
- gelatines
- glues
- phosphatic fertilizers
- animal feed
- bone black (active carbons)

Only some of them are still in current production in industrialized countries, as the others have largely been substituted by other products, such as phosphorites used as raw material for the preparation of phosphatic fertilizer, synthetic adhesives as binders with a larger spectrum of applications and vegetable charcoal as a raw material for the production of active carbon.

The present study deals with bone processing for the production of:

- fat
- glue
- perphosphate fertilizer (called normal superphosphate NSP or also single superphosphate SSP)

2. MARKET AND PLANT CAPACITY

2.1 USES

Fat, especially if it is of good quality, is mainly used as ingredient in the production of special lubricants, soap and candles.

The commercial characteristics of fat should be within the following limits:

Moisture	0.6-4%
Free fatty acids (as oleic acid)	18-49%
Ash	0.1-3%
Soap index	181-194
Iodine index	48-56
Title (solidification point)	36-42 C

Animal glues are used in woodwork, paper manufacture, emery paper manufacture, even though synthetic glues are widely used in these fields.

Among the technical characteristics of animal glues, the most important are its appearance (which, in the best quality products, is transparent and colourless), moisture (no more than 20%) and ashes (less than 4% and in fine qualities, less than 1%).

Bone glue having these technical characteristics can well compete with skin and hide glues (which are considered the best for the most sophisticated applications) and with other, less expensive glues as those synthetic or derived from maize or potatoes: for example, against a total consumption of animal glues of 6000 t/y in Italy, a 35% is still covered by bone glues, the major part of which is imported from East European countries and China.

Phosphate is the final substance obtainable from the bones, after the fat and collagen have been extracted. It contains one of the three fundamental elements (phosphorous, potassium and nitrogen) needed extensively by the soil to enhance agricultural yield and for this purpose, it could be used as it is, only finely ground, but its action would be slow, due to the low solubility of the tricalcium-phosphate of the bones.

On the contrary, if the bones are treated with sulphuric acid, the resulting phosphate product is soluble and therefore of immediate use for the plants. This latter product is the normal method of utilization of natural calcium phosphate (either of mineral or organic origin) commercially known as NSP (Normal Super Phosphate) not to be confused with TSP (Triple Superphosphate) which is obtained from natural phosphate treated with phosphoric acid instead of sulphuric acid.

Nigeria presently imports phosphate based fertilizers (the only SSP existing plant in Kaduna is out of order) and therefore any amount available locally from the bones processing unit would be beneficial.

The most important feature of this product is the soluble phosphorous content which must be in the range of 14 to 20 as P_2O_5 soluble in water.

2.2 DEMAND

The demand of fat and glue cannot be quantified, since the data shown in the Federal Office of Statistics (1987) indicate, for both products, only the amounts spent in Naira for the imports. On the other hand, the quantity of both products coming out from the proposed plant are modest and can easily find their share in the market. The demand of NSP, on the contrary, is estimated between 25,000 and 400,000 t/y.

2.3 SUPPLY

The supply of the three products is satisfied by import.

2.4 PLANT CAPACITY

The envisaged plant is designed to process 20,000 t/y of raw bones, working 330 days, 3 shift/day, 8 hours/shift.

The composition of the bones varies considerably, depending on the age and type of animal as well as on parts of the skeleton and the state of conservation. In any case, the following composition gives an average analysis of bones (green bones) processed in large plants:

moisture	12%
organic substances	28% (with 3-4% of nitrogen)
tricalcium phosphate	44%
fat	10%
calcium carbonate, silica, etc.	5%

Processing 20,000 tons/y of bones and taking into account the following yields;

- 1750-1800 kg of NSP per 1000 kg of bones, after fat and glue has been removed
- 100 kg of fat per 1000 kg of bones
- 200 kg of glue per 1000 kg of bones (not all the ossein is removed by the process)

the following finished products can be obtained:

	t/y
NSP (14-20% P_2O_5)	24,000
Fat	2,000
Glue	4,000

2.5 SALE PRICES AND TOTAL REVENUE

The NSP selling price has been estimated at 200 $/y and the fat price at 700$/t.

The glue is traded in Europe at 1800 $/t; a selling price ex-works of 900 $/t will be considered. Upon these assumptions, the total annual revenues are as follows:

24,000	t/y	x 200 $/t	=	4,800,000 $/y
2,000	t/y	x 700 $/t	=	1,400,000 $/y
4,000	t/y	x 900 $/t	=	3,600,000 $/y
		Total		9,800,000 $/y

3. MATERIALS AND INPUTS

3.1 MATERIALS AND UTILITIES: AVAILABILITY, REQUIREMENTS AND COSTS

The main raw materials needed are bones and sulphuric acid.

Bones are available (eventhough they have to be collected from the butcheries) and their cost is estimated at US$ 160/t.

Sulphuric acid is available in small quantity. Anyhow, a sulphuric acid plant is the object of an opportunity study in this sub-sector. If the project will be implemented, this product will be locally available at the desired concentration (65% bw) at US $ 170.

In table 3.2 requirements and costs of raw materials and utilities are reported, subdivided among the three types of end products; the notes explain the criteria adopted.

Table 3.2 MATERIAL AND UTILITIES : REQUIREMENTS AND COSTS

Description	Unit	Consumption for [2]1T	Consumption for 1 Year	Unit cost $	Annual cost $ LC	Annual cost $ FC	Annual cost $ Total
a) Fat extraction:							
bones	t	n.a.	20,000	36.5	730,000	--	730,000
gasoline	t	0.0035	70	110	7,700	--	7,700
steam	t	1.3	26,000	8	208,000	--	208,000
cooling water[3]	m^3	3.25	65,000	0.009	580	--	580
electric energy	kWh	19	380,000	0.1	38,000	--	38,000
Total		--	--	--	**984,280**	--	**984,280**
b) Glue extraction:							
bones without fat	t	n.a.	18,000	100	1,800,000	--	1,800,000
steam	t	0.674	12,130	8	97,040	--	97,040
cooling water[2]	m^3	1.685	30,330	0.009	27,300	--	27,300
electric energy	kWh	8.088	145,580	0.1	14,558	--	14,558
Total		--	--	--	**1,938,898**	--	**1,938,898**
c) NSP production:							
residual from bones	t	n.a.	13,500	49.5	670,000	--	670,000
electric energy [4]	kWh	39,5	533.250	0.1	53,325	--	53,325
sulphuric acid 52-53Bé	t	0.9	12,150	170	2,065,500	--	2,065,500
Total					**2,788,825**	--	**2,788,825**
Grand Total		--	--	--	**5,712,003**	--	**5,712,003**

Remark: The cost of green bones is estimated 160 US $/ton. The annual expenditures will amount to 3,200,000 US $. The costs charged to the three end products take into consideration the actual incidence of the raw material on a given finished product.

For the financial evaluation the costs of table 3.2 are grouped as follows:

Raw material 1 (bones)	LC	US$ 3,200,000
Other raw material (sulphuric acid)	LC	US$ 2,065,000
Energy (fuel and gasoline)	LC	US$ 312,740
Utilities	LC	US$ 133,760
TOTAL		US$ 5,711,500

Packaging (see para 5.2)

[2] Referring to 1 ton of processed bones
[3] Make-up water only
[4] Includes the grinding of bones

3.2 PURCHASING PROGRAMME AND STORAGE VOLUME OF RAW MATERIALS

Bones will be purchased daily or every two or three days. An average quantity of 100-200 t will be enough. For fuel oil, gasoline and sulphuric acid, a stock equivalent to one month consumption at full capacity is reasonable for each of them. On this basis the following storage volumes are required:

- Fuel oil	280 t	equivalent to	US$ 8,400
- Gasoline	6.4 t	equivalent to	US$ 704
- Sulphuric acid	1,100 t	equivalent to	US$ 187,000
	Total		US$ 196,104

4. LOCATION

The plant shall be located in an urban area close to bones suppliers, in order to reduce to a minimum the transport costs.

5. PROJECT ENGINEERING

5.1 DESCRIPTION OF PROCESS AND MAIN EQUIPMENT

Bone processing is carried out through the following steps:

- bone collection and crushing
- fat extraction through solvent process
- collagen extraction through boiling down process
- perphosphate production through acid treatment.

a) **Bone collection and crushing**

The bones should be processed preferably shortly after their collection since the quality of the extracted substances is affected by a possible deterioration of the bones; for this reason the pile of collected bones should not be too high and every two or three days (depending on the atmospheric conditions) should be sprayed with a solution of acid (300 g of carbolic acid in 1000 l of water); the amount of solution should always be equal to 5-10% of the bone weight. In

addition, the sheltering of the bones under a roof is recommended.

The crushing of bones, which is the first step of the process should be limited to the quantity daily processed in the successive phases.

b) **Fat extraction**

The crushed bones are loaded into extractors, each consisting of a cylindrical tank fitted with a drilled false bottom, to support the bones and a steam pipe coil at the bottom; after bone loading the tank is closed and filled with gasoline up to the false bottom; the gasoline is then evaporated by using steam; the contact of the gasoline vapours with the bones dissolves the fat which is gathered at the bottom.

After the evaporation (about 2 hours) the gasoline is condensed in a water cooled exchanger and collected in a storage tank; the fat is then discharged from the bottom of the extractor in a distiller where the recovery of the solvent is completed. This operation is repeated, with the same bone load, three times. After the third extraction the bones are washed and dried by direct injection of steam, then unloaded. The residual moisture is around 4-6%.

The equipment is now ready for a new load.

c) **Glue extraction**

The defatted bones are now loaded into a steam jacketed autoclave together with a certain amount of softened water; then the temperature of the mass is brought to a temperature not exceeding 90 C and maintained for 3 hours.

The resulting mass is then discharged and sent through a coarse filter to the concentration; this boiling operation is carried out twice for each batch. After the concentration (up to 40%), carried out in a multiple effect evaporator, the liquid is clarified and discoloured with SO_2; it is then left to solidify in blocks, successively cut into slices and left to dry completely, in a well ventilated room.

A similar operation could be carried out in a separate tank and at a strictly controlled temperature, on selected bones (the shin bones) to recover the neatsfoot oil. Pure neatsfoot oil fetches a very high price but the production process is rather lengthy and requires delicate handling. The main requirements are:

- raw material must be fresh and free from blood and dirt
- no bones other than those of the feet are used and over-cooking must be avoided.

The production of neatsfoot oil, therefore, is economically viable only where a large number of animals (the average yield is approximately 1/2 litre of oil from one head) is slaughtered.
Consequently, the possibility of installing the necessary equipment should be considered only when all the other production lines are well in operation and the supply of bones is well organized.

d) **NSP production**

The defatted and degelatinized bones are now ready to be transformed in NSP. At first, the bones are ground in ball mills, as the reaction speed between calcium triphosphate and sulphuric acid depends on the fineness of the milling.
As the process is of the batch type, the ground material is conveyed from the ball mills to a storage hopper, from which it is fed through another conveyor to the manually operated weigh hopper (a scale-mounted hopper). The operator controls the flow by starting and stopping the conveyor.
The acid measure is of the volumetric type: the operator merely fills the tank to a proper level for a mixer batch, usually by observing a visual gauge.
The two measured components may now be mixed: this mixing must be accomplished in a very short time because the mix sets in a few minutes and if a thorough mixing is not obtained within this period, portions of the product will be underacidulated, while others will be overacidulated.
As a mixer, the vertical pan shaft mixer has been selected; this pan mixer is made of cast iron and consists of two main parts: the pan and plow assemblies (special steels are used for the plows); in operation both the pan and the plow assemblies turn, the pan at approx. 4 RPM and the plows at

approx. 40. The discharge is controlled by a counterbalanced level that raises the discharge plug and at the same time lower a scraper to help to push the mix to the centre; total time for the cycle of filling, mixing and emptying 1 ton of slurry usually ranges from 1 to 1,2 minutes.

From the mixer the slurry is discharged into a den (usually a mixer with two or more dens is used) where the curing hold for 18-24 h is situated. During this period the temperature reaches 130 C. Keeping in mind that unlike phosphorite rocks, the bones do not contain fluorine, the gas evolved during this phase and during the emptying of the den result neither harmful nor pollutant as in the other case.

The den is made up of simple brickwork with an exhausting vent, a loading opening on the top and a side door for the product discharge. The capacity of these dens is 50 t approx. (they must not be filled completely as provision for the expansion of the slurry during curing).

When the setting up period has expired, the side door is opened and the perphosphate is pulled out with a dragline scraper onto a conveyor system that carries it to the ageing pile in a storehouse. The perphosphate is ready to be packaged in bags and shipped after approximately three months of storing. Due to this curing period and to the seasonal nature of fertilizer sales, a large storage capacity is required.

The installation will therefore include the following main machinery and equipment:

1) Bone crushing

- 1 bone washer, rotating drum type
- 1 crusher, complete with an electromagnet for the iron scrap removal - total installed power 75 kW.
- 1 silos, 10 m^3 capacity

2) Fat extraction

- 4 carbon steel extractors, each with a capacity of 8000 l, fitted with false bottom and internal pipe coil, mechanical bone discharger and complete with water tube condenser, distiller and gasoline separator.
- 1 heated, carbon steel tank for fat storage (4000 l capacity).

3) Glue extraction

- 4 carbon steel, steam jacketed, autoclaves, each fitted with an agitator and mechanical extractor and sized for a filling capacity of 7600 kg (gross volume 12,000 l)
- 1 glue container
- 1 coarse filter
- 1 three effects evaporative unit designed for concentrating 15-20% gelatine solution to a 20-40% solution - inlet capacity 6 t/h
- 1 clarifier, carbon steel construction, 4000 l capacity, complete with reagent dosing unit
- 1 series of plastic trays with water cooled bottom

4) NSP production

- 2 carbon steel steam jacketed autoclaves, as described above
- 1 ball mill; total installed power : 70 kW
- 1 carbon steel hopper; capacity 5000 Kg
- 2 carbon steel weigh hoppers; capacity 500 kg each
- 1 carbon steel tank for sulphuric acid measure; capacity 500 l
- 1 carbon steel tank for sulphuric acid storage cap. 500 m^3
- 1 cast iron pan mixer (1 standby); capacity per charge: 1t; installed power: 25 kW
- 1 series of apparatus for 4 dens of 50 ton capacity each
- 1 dragline scraper.

5) auxiliary equipment

- 1 boiler sized for producing 10 t/h of steam at 6 bar, burning fuel oil
- 1 Na-cation exchanger, salt regenerated, sized for the production of 100 m^3 of net softened water
- 1 cooling water system with cooling towers
- 1 electric substation complete with transformer, motor control centre and distribution network for a total installed power of 1000 kW and a stand-by diesel generator set
- 1 effluent water treatment system
- 1 series of conveyors for the bone transfer form one process stage to another
- 1 mobile grab bucket for crusher loading.

5.2 PACKAGING

The fat is dispatched in carbon steel drums (160 Kg) directly filled from the heated storage tank. The cost of each empty drum is 13 $ but, as it is possible to foresee their use for four times, the price can be reduced to 3.25 $. The glue slabs are manually discharged in cardboard boxes (10 kg each), wrapped in a moisture resistant envelope; cost of each pack: 1.5 $.

The NSP is sold in 50 kg paperbag, cost of each bag: 0.4 $.

The total expenditure amounts to 832,625 $/y.

In the financial evaluation this total amount has been indicated as "other raw material".

5.3 LAYOUT AND CIVIL WORKS

The area of the factory is approx. 10.000 m^2 divided as follows:

- 1700 m^2 about, for the processing plant, workshop, warehouse, packaging and the storage of bones and sulphuric acid
- 1500 m^2 for the storage of NSP
- 200 m^2 for a two-storey building for the administration offices, and social facilities
- the remaining space as roads and courtyards.

The area of the processing plants is sheltered with a roof; the roof is covered by corrugated asbestos sheets and supported by steel columns and trusses. The floors, including the area for the depot of bones, are of concrete with a hard aggregate as finishing surface.

The same type of construction is used for the storage of the NSP, but with a closure of corrugated asbestos on three side walls.

The four dens are of cylindrical shape, 4.5 m diameter, 4 m height. The walls are of heavy brickwork, the roof of reinforced concrete, the floors of concrete or stones, the doors, very heavy, of wood.

The building has a supporting structure of reinforced concrete; external and internal walls of brickwork; the roof is covered with asbestos cement insulated with mineral wool lagging; the floors are covered with tiles.

Roads and courtyard are covered with gravel and rolled. A fence, consisting of a wire-netting supported by small steel poles, encloses the entire factory.

5.4 INVESTMENT COSTS: DEPRECIATION AND MAINTENANCE

The quotation of machinery and equipment was obtained by Garbato, Milan, Italy.

Description	LC M$	FC M$	Total M$
Machinery and equipment			
FOB European port	--	2.100	2.100
Transport, tax and duties	0.420	0.210	0.630
Erection	0.420	0.210	0.630
Site preparation	0.130	--	0.130
Civil work	1.320	--	1.320
Spare parts	--	0.200	0.200
Total	**2.290**	**2.720**	**5.010**
Contingencies	**0.220**	**0.270**	**0.490**
Grand total	**2.510**	**2.990**	**5.500**

The life cycle of this plant may be estimated as 15 years.

Annual maintenance cost is estimated at 140,000 US Dollars.

In the financial evaluation the investment costs (contingencies included) are grouped as follows:

preproduction expenses	FC	0	million $
Preproduction expenses	LC	0.080	million $
Machinery	FC	2.990	million $
Machinery	LC	0.940	million $
Site development	LC	0.130	million $
Civil works	LC	1.440	million $

Total		5.580	million $

6. PLANT ORGANIZATION

The plant has been considered as an autonomous unit, complete with utilities and general facilities, operating under the direction of an independent organization.

7. MANPOWER

Although the processes involved in this plant are quite simple in principle, experience plays an important role in the achievement of the proposed yield with the quality required; this experience is made up of many small details to be learned. For this reason an on-the-job training and technical assistance provided by two experts, for a period of at least 6 months, is recommended. The relevant cost is estimated at US$ 120,000.

7.1 MANAGEMENT AND ADMINISTRATIVE DEPARTMENT

		N/year
- General manager	1	50,000
- Technical manager	1	40,000
- Financial manager	1	40,000
- Senior accountant	1	25,000
- Purchasing dep. head	1	12,000
- Sale dept. head	1	12,000
- Storage dept. head	1	10,000
- Senior clerks	4	48,000
- Secretaries and clerks	9	90,000
- Drivers	3	24,000
- Guards	12	72,000
	35	423,000
	Overheads 40%	169,200
		592,200
		(US$ 75,00

7.2 PRODUCTION

		N/year
- Production manager	1	40,000
- Foremen	12	144,000
- Operators	36	288,000
- Chemist	1	25,000
- Analysts	3	36,000
- Clerks	2	24,000
- Unskilled workers	30	120,000
	85	677,000
	Overheads 40%	270,800
		947,800
		(US$ 120,800)

7.3 MAINTENANCE DEPT.

		N/year
- Engineer	1	40,000
- Supervisors	3	36,000
- Mechanics	6	60,000
- Electricians	4	40,000
- Assistants	6	60,000
- Unskilled workers	10	40,000
	30	276,000
	Overheads 40%	110,400
		386,400
		(US$ 49,000)

Summar of needed manpower:

Administration	35	75,000 $/y
Production Dep.	85	120,000 $/y
Maint. Dep.	30	49,000 $/y
TOTAL	150	244,000 $/y

8. IMPLEMENTATION SCHEDULE

Twenty four months will be necessary for the design, equipment supply and erection of the plant, up to the commissioning and start up.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to US $ 5,761,910. The portion in foreign currency accounts for US $ 3,140,000.

Details of these figures are shown in chapter 5.4.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,215,000	US$ 1,393,500	US$ 2,608,500
- Foreign Loan (interest 8%)	US$ 600,000	US$ 1,941,500	US$ 2,541,500
- Local Loan (interest 15%)	---	US$ 430,000	US$ 430,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 658,865 U'S Dollars.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 297,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US$ 3,481,200.

In the third year, at full production, the costs amount to US $ 6,820,370. then they start a slight decrease year after year, to reach a constant amount of US $ 6,116,000 fr · .1th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 9,800,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 3,920,800

2nd year 80% : revenue = US$ 7,840,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 30.60%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 23% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [4] + administrative), depreciation and financial costs.

[4] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

9.2.3 Pay-back Period

The pay-back period is less than 6 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 65,384,470.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 65,384,470.

ANNEXE 1

COMFAR SCHEDULES

BONE BASED CHEMICALS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US $

Total initial investment during construction phase

fixed assets:	5761.91	54.490 % foreign
current assets:	0.00	0.000 % foreign
total assets:	5761.91	54.490 % foreign

Source of funds during construction phase

equity & grants:	2608.50	0.000 % foreign
foreign loans :	2541.50	
local loans :	430.00	
total funds :	5580.00	45.547 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	2670.00	6116.00	6116.00
depreciation :	543.38	517.38	166.00
interest :	267.82	101.66	0.00
production costs	3481.20	6735.04	6282.00
thereof foreign	19.89 %	7.88 %	1.59 %
total sales :	3920.00	9800.00	9800.00
gross income :	438.80	3064.96	3518.00
net income :	263.28	1838.97	2110.80
cash balance :	48.60	2038.67	2276.80
net cashflow :	777.44	2458.02	2276.80

Net Present Value at: 10.00 % = 9705.56
Internal Rate of Return: 30.60 %
Return on equity1: 40.92 %
Return on equity2: 40.17 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	130.000	0.000
Buildings and civil works	965.000	475.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	700.000	3230.000
Total fixed investment costs	1795.000	3705.000
Pre-production capital expenditures.	44.000	217.910
Net working capital	0.000	0.000
Total initial investment costs	1839.000	3922.910
Of it foreign, in %	33.931	64.127

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Total Current Investment in 1000 US $

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	297.039	233.314	128.512
Total current investment costs	297.039	233.314	128.512
Of it foreign, %	16.309	2.476	10.548

Total Production Costs in 1000 US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	1280.000	2560.000	3200.000	3200.000	3200.000
Other raw materials	826.000	1652.000	2065.500	2065.500	2065.500
Utilities	54.000	107.000	133.760	133.760	133.760
Energy	125.000	250.000	312.740	312.740	312.740
Labour, direct	120.000	120.000	120.000	120.000	120.000
Repair, maintenance	25.000	50.000	60.000	60.000	60.000
Spares	40.000	80.000	100.000	100.000	100.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	2590.000	4819.000	5992.000	5992.000	5992.000
Administrative overheads	80.000	104.000	124.000	124.000	124.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	543.382	543.382	530.382	517.382	517.382
Financial costs	267.820	220.905	173.990	127.075	101.660
Total production costs	3481.202	5687.287	6820.372	6760.457	6735.042
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	19.885	10.318	8.525	8.224	7.878
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	200.000	224.000	244.000	244.000	244.000

Total Production Costs in 1000 US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	3200.000	3200.000	3200.000	3200.000	3200.000
Other raw materials	2065.500	2065.500	2065.500	2065.500	2065.500
Utilities	133.760	133.760	133.760	133.760	133.760
Energy	312.740	312.740	312.740	312.740	312.740
Labour, direct	120.000	120.000	120.000	120.000	120.000
Repair, maintenance	60.000	60.000	60.000	60.000	60.000
Spares	100.000	100.000	100.000	100.000	100.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	5992.000	5992.000	5992.000	5992.000	5992.000
Administrative overheads	124.000	124.000	124.000	124.000	124.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	465.000	465.000	465.000	465.000	166.000
Financial costs	76.245	50.830	25.415	0.000	0.000
Total production costs	6657.245	6631.830	6606.415	6581.000	6282.000
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	7.139	6.783	6.424	6.063	1.592
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	244.000	244.000	244.000	244.000	244.000

Total Production Costs in 1000 US $

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	3200.000
Other raw materials	2065.500
Utilities	133.760
Energy	312.740
Labour, direct	120.000
Repair, maintenance	60.000
Spares	100.000
Factory overheads	0.000
Factory costs	5992.000
Administrative overheads	124.000
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	6116.000
Costs per unit (single product) .	0.000
Of it foreign, %	1.635
Of it variable,%	0.000
Total labour	244.000

Net Working Capital in 1000 US $

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	222.500	410.250	509.667	509.667
Inventory and materials	16	23.0	93.872	187.742	234.719	234.719
Energy	1	360.0	0.347	0.694	0.869	0.869
Spares	180	2.0	20.000	40.000	50.000	50.000
Work in progress	5	72.0	35.972	66.931	83.222	83.222
Finished products	15	24.0	111.250	205.125	254.833	254.833
Cash in hand	15	24.0	16.042	14.750	16.833	16.833
Total current assets			499.983	925.492	1150.143	1150.143
Current liabilities and						
Accounts payable	29	12.2	202.944	395.139	491.278	491.278
Net working capital			297.039	530.353	658.865	658.865
Increase in working capital			297.039	233.314	128.513	0.000
Net working capital, local			248.594	476.131	591.087	591.087
Net working capital, foreign			48.444	54.222	67.778	67.778

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US $

Year	1990	1991
Equity, ordinary ..	1215.000	1393.500
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	600.000	1941.500
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	430.000
Loan C, local....	0.000	0.000
Total loan	600.000	2371.500
Current liabilities	0.000	0.000
Bank overdraft	24.000	157.910
Total funds	1839.000	3922.910

Source of Finance, production in 1000 US $

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-317.688	-317.688	-317.688	-317.688
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	-143.333	-143.333	-143.333	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-461.021	-461.021	-461.021	-317.688
Current liabilities	202.944	192.194	96.139	0.000
Bank overdraft	-48.601	-133.310	0.000	0.000
Total funds	-306.677	-402.136	-364.882	-317.688

Cashflow Tables, construction in 1000 US $

Year	1990	1991
Total cash inflow	1815.000	3765.000
Financial resources	1815.000	3765.000
Sales, net of tax	0.000	0.000
Total cash outflow	1839.000	3922.910
Total assets	1815.000	3765.000
Operating costs	0.000	0.000
Cost of finance	24.000	157.910
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	-24.000	-157.910
Cumulated cash balance	-24.000	-181.910
Inflow, local	1215.000	1823.500
Outflow, local	1215.000	1407.250
Surplus (deficit)	0.000	416.250
Inflow, foreign	600.000	1941.500
Outflow, foreign	624.000	2515.660
Surplus (deficit)	-24.000	-574.160
Net cashflow	-1815.000	-3765.000
Cumulated net cashflow	-1815.000	-5580.000

Cashflow tables, production in 1000 US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	4122.944	8032.417	9896.139	9800.000	9800.000	9800.000
Financial resources	202.944	192.417	96.139	0.000	0.000	0.000
Sales, net of tax	3920.000	7840.000	9800.000	9800.000	9800.000	9800.000
Total cash outflow	4074.344	6891.741	8167.514	7776.580	7761.331	7767.035
Total assets	499.983	425.508	224.651	0.000	0.000	0.000
Operating costs	2670.000	4923.000	6116.000	6116.000	6116.000	6116.000
Cost of finance	267.820	220.905	173.990	127.075	101.660	76.245
Repayment	461.021	461.243	461.021	317.688	317.688	317.688
Corporate tax	175.519	861.085	1191.851	1215.817	1225.983	1257.102
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	48.601	1140.675	1728.625	2023.420	2038.669	2032.965
Cumulated cash balance	-133.309	1007.366	2735.991	4759.411	6798.080	8831.045
Inflow, local	4122.500	8032.417	9896.083	9800.000	9800.000	9800.000
Outflow, local	3344.447	6310.371	7583.725	7231.817	7241.983	7273.102
Surplus (deficit)	778.053	1722.045	2312.358	2568.183	2558.017	2526.898
Inflow, foreign	0.444	0.000	0.056	0.000	0.000	0.000
Outflow, foreign	729.896	581.370	583.789	544.763	519.348	493.932
Surplus (deficit)	-729.452	-581.370	-583.733	-544.763	-519.348	-493.932
Net cashflow	777.442	1822.601	2363.636	2468.183	2458.017	2426.898
Cumulated net cashflow	-4802.558	-2979.957	-616.321	1851.862	4309.879	6736.777

Cashflow tables, production in 1000 US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	9800.000	9800.000	9800.000	9800.000	9800.000	9800.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	9800.000	9800.000	9800.000	9800.000	9800.000	9800.000
Total cash outflow	7751.786	7736.537	7403.600	7523.200	7589.600	7589.600
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	6116.000	6116.000	6116.000	6116.000	6116.000	6116.000
Cost of finance	50.830	25.415	0.000	0.000	0.000	0.000
Repayment	317.688	317.688	0.000	0.000	0.000	0.000
Corporate tax	1267.268	1277.434	1287.600	1407.200	1473.600	1473.600
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	2048.214	2063.463	2396.400	2276.800	2210.400	2210.400
Cumulated cash balance	10879.260	12942.720	15339.120	17615.920	19826.320	22036.720
Inflow, local	9800.000	9800.000	9800.000	9800.000	9800.000	9800.000
Outflow, local	7283.268	7293.434	7303.600	7423.200	7489.600	7489.600
Surplus (deficit)	2516.732	2506.566	2496.400	2376.800	2310.400	2310.400
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	468.518	443.103	100.000	100.000	100.000	100.000
Surplus (deficit)	-468.518	-443.103	-100.000	-100.000	-100.000	-100.000
Net cashflow	2416.732	2406.566	2396.400	2276.800	2210.400	2210.400
Cumulated net cashflow	9153.509	11560.070	13956.470	16233.270	18443.670	20654.070

Cashflow tables, production in 1000 US $

Year	2004	2005	2006
Total cash inflow	9800.000	9800.000	9800.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	9800.000	9800.000	9800.000
Total cash outflow	7589.600	7589.600	7589.600
Total assets	0.000	0.000	0.000
Operating costs	6116.000	6116.000	6116.000
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1473.600	1473.600	1473.600
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	2210.400	2210.400	2210.400
Cumulated cash balance	24247.120	26457.520	28667.920
Inflow, local	9800.000	9800.000	9800.000
Outflow, local	7489.600	7489.600	7489.600
Surplus (deficit)	2310.400	2310.400	2310.400
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	100.000	100.000	100.000
Surplus (deficit)	-100.000	-100.000	-100.000
Net cashflow	2210.400	2210.400	2210.400
Cumulated net cashflow	22864.470	25074.880	27285.280

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	9186.06	at	10.00 %
Internal Rate of Return (IRRE1) ..	40.92 %		

b) Net Worth versus Net cash return:

Net present value	9880.61	at	10.00 %
Internal Rate of Return (IRRE2) ..	40.17 %		

c) Internal Rate of Return on total investment:

Net present value	9705.56	at	10.00 %
Internal Rate of Return (IRR) ..	30.60 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US $

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	3920.000	7840.000	9800.000	9800.000	9800.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	3920.000	7840.000	9800.000	9800.000	9800.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	3213.382	5466.382	6646.382	6633.382	6633.382
Operational margin	706.618	2373.618	3153.618	3166.618	3166.618
As % of total sales	18.026	30.276	32.180	32.312	32.312
Cost of finance	267.820	220.905	173.990	127.075	101.660
Gross profit	438.798	2152.713	2979.628	3039.543	3064.958
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	438.798	2152.713	2979.628	3039.543	3064.958
Tax	175.519	861.085	1191.851	1215.817	1225.983
Net profit	263.279	1291.628	1787.777	1823.726	1838.975
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	263.279	1291.628	1787.777	1823.726	1838.975
Accumulated undistributed profit	263.279	1554.906	3342.683	5166.409	7005.384
Gross profit, % of total sales	11.194	27.458	30.404	31.016	31.275
Net profit, % of total sales	6.716	16.475	18.243	18.609	18.765
RCE, Net profit, % of equity	10.093	49.516	68.537	69.915	70.499
ROI, Net profit+interest, % of invest.	9.037	24.754	31.444	31.269	31.106

Net Income Statement in 1000 US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	9800.000	9800.000	9800.000	9800.000	9800.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	9800.000	9800.000	9800.000	9800.000	9800.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	6581.000	6581.000	6581.000	6581.000	6282.000
Operational margin	3219.000	3219.000	3219.000	3219.000	3518.000
As % of total sales	32.847	32.847	32.847	32.847	35.898
Cost of finance	76.245	50.830	25.415	0.000	0.000
Gross profit	3142.755	3168.170	3193.585	3219.000	3518.000
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3142.755	3168.170	3193.585	3219.000	3518.000
Tax	1257.102	1267.268	1277.434	1287.600	1407.200
Net profit	1885.653	1900.902	1916.151	1931.400	2110.800
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1885.653	1900.902	1916.151	1931.400	2110.800
Accumulated undistributed profit	8891.037	10791.940	12708.090	14639.490	16750.290
Gross profit, % of total sales	32.069	32.328	32.588	32.847	35.898
Net profit, % of total sales	19.241	19.397	19.553	19.708	21.539
ROE, Net profit, % of equity	72.289	72.873	73.458	74.043	80.920
ROI, Net profit+interest, % of invest.	31.446	31.283	31.121	30.958	33.333

Net Income Statement in 1000 US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	9800.000	9800.000	9800.000	9800.000	9800.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	9800.000	9800.000	9800.000	9800.000	9800.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	6116.000	6116.000	6116.000	6116.000	6116.000
Operational margin	3684.000	3684.000	3684.000	3684.000	3684.000
As % of total sales	37.592	37.592	37.592	37.592	37.592
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	3684.000	3684.000	3684.000	3684.000	3684.000
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3684.000	3684.000	3684.000	3684.000	3684.000
Tax	1473.600	1473.600	1473.600	1473.600	1473.600
Net profit	2210.400	2210.400	2210.400	2210.400	2210.400
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2210.400	2210.400	2210.400	2210.400	2210.400
Accumulated undistributed profit	18960.690	21171.090	23381.490	25591.890	27802.290
Gross profit, % of total sales	37.592	37.592	37.592	37.592	37.592
Net profit, % of total sales	22.555	22.555	22.555	22.555	22.555
ROE, Net profit, % of equity	84.738	84.738	84.738	84.738	84.738
ROI, Net profit+interest, % of invest.	35.430	35.430	35.430	35.430	35.430

Projected Balance Sheets, construction in 1000 US $

Year	1990	1991
Total assets	1839.000	5761.910
Fixed assets, net of depreciation	0.000	1839.000
Construction in progress	1839.000	3922.910
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	1839.000	5761.910
Equity capital	1215.000	2608.500
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	600.000	2971.500
Current liabilities	0.000	0.000
Bank overdraft, finance required.	24.000	181.910
Total debt	624.000	3153.410
Equity, % of liabilities	66.069	45.271

Projected Balance Sheets, Production in 1000 US $

Year	1992	1993	1994	1995	1996
Total assets	5718.512	6608.003	8030.898	9536.937	11058.220
Fixed assets, net of depreciation	5218.528	4675.146	4144.765	3627.383	3110.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	483.942	910.742	1133.310	1133.310	1133.310
Cash, bank	16.042	14.750	16.833	16.833	16.833
Cash surplus, finance available	0.000	1007.365	2735.991	4759.411	6798.080
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	5718.512	6608.003	8030.898	9536.937	11058.220
Equity capital	2608.500	2608.500	2608.500	2608.500	2608.500
Reserves, retained profit	0.000	263.279	1554.906	3342.683	5166.409
Profit	263.279	1291.628	1787.777	1823.726	1838.975
Long and medium term debt	2510.479	2049.458	1588.438	1270.750	953.063
Current liabilities	202.944	395.139	491.278	491.278	491.278
Bank overdraft, finance required.	133.310	0.000	0.000	0.000	0.000
Total debt	2846.733	2444.597	2079.715	1762.028	1444.340
Equity, % of liabilities	45.615	39.475	32.481	27.352	23.589

Projected Balance Sheets, Production in 1000 US $

Year	1997	1998	1999	2000	2001
Total assets	12626.190	14209.400	15807.870	17739.270	19850.070
Fixed assets, net of depreciation	2645.000	2180.000	1715.000	1250.000	1084.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1133.310	1133.310	1133.310	1133.310	1133.310
Cash, bank	16.833	16.833	16.833	16.833	16.833
Cash surplus, finance available	8831.046	10879.260	12942.720	15339.120	17615.930
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	12626.190	14209.400	15807.870	17739.270	19850.070
Equity capital	2608.500	2608.500	2608.500	2608.500	2608.500
Reserves, retained profit	7005.384	8891.037	10791.940	12708.090	14639.490
Profit	1885.653	1900.902	1916.151	1931.400	2110.800
Long and medium term debt	635.375	317.688	0.000	0.000	0.000
Current liabilities	491.278	491.278	491.278	491.278	491.278
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1126.653	808.965	491.278	491.278	491.278
Equity, % of liabilities	20.659	18.358	16.501	14.705	13.141

Projected Balance Sheets, Production in 1000 US $

Year	2002	2003	2004	2005	2006
Total assets	22060.470	24270.870	26481.270	28691.670	30902.070
Fixed assets, net of depreciation	1084.000	1084.000	1084.000	1084.000	1084.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1133.310	1133.310	1133.310	1133.310	1133.310
Cash, bank	16.833	16.833	16.833	16.833	16.833
Cash surplus, finance available	19826.320	22036.730	24247.130	26457.530	28667.930
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	22060.470	24270.870	26481.270	28691.670	30902.070
Equity capital	2608.500	2608.500	2608.500	2608.500	2608.500
Reserves, retained profit	16750.290	18960.690	21171.090	23381.490	25591.890
Profit	2210.400	2210.400	2210.400	2210.400	2210.400
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	491.278	491.278	491.278	491.278	491.278
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	491.278	491.278	491.278	491.278	491.278
Equity, % of liabilities	11.824	10.747	9.850	9.091	8.441

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	2542.00	2541.50	0.50	600.00	1941.50	0.44	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	2542.00	2541.50	0.50	600.00	1941.50	0.44	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	7837.60	3139.66	4697.94	624.00	2515.66	729.90	581.37
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	2691.00	2990.00	-299.00	600.00	2390.00	48.89	5.56
imported materials . . .	1540.00	0.00	1540.00	0.00	0.00	160.00	80.00
repayment loans & overd.	2542.00	0.00	2542.00	0.00	0.00	317.69	317.91
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1064.60	149.66	914.94	24.00	125.66	203.32	177.90
indirect costs							
net foreign exchge flow	-5295.60	-598.16	-4697.44	-24.00	-574.16	-729.45	-581.37
import substit'n effect	148960.00	0.00	148960.00	0.00	0.00	3920.00	17643.00
net forgn exchge effect	143664.40	-598.16	144262.60	-24.00	-574.16	3190.55	17058.63

present values at	10.00 %
foreign exchange flow .	-3409.57
net forgn exchge effect	65384.47

BONE-BASED CHEMICALS

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	0.06	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.06	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	583.79	544.76	519.35	493.93	468.52	443.10	100.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	13.61	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	100.00	100.00	100.00	100.00	100.00	100.00	100.00
repayment loans & overd.	317.69	317.69	317.69	317.69	317.69	317.69	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	152.49	127.07	101.66	76.25	50.83	25.42	0.00
indirect costs							
net foreign exchge flow	-583.73	-544.76	-519.35	-493.93	-468.52	-443.10	-100.00
import substit'n effect	9800.00	9800.00	9800.00	9800.00	9800.00	9800.00	9800.00
net forgn exchge effect	9216.27	9255.24	9280.65	9306.07	9331.48	9356.90	9700.00

present values at	10.00 %
foreign exchange flow .	-3409.57
net forgn exchge effect	65384.47

Foreign Exchange Effect in 1000 US $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	100.00	100.00	100.00	100.00	100.00	100.00	-366.78
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-367.06
imported materials . . .	100.00	100.00	100.00	100.00	100.00	100.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.28
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-100.00	-100.00	-100.00	-100.00	-100.00	-100.00	366.78
import substit'n effect	9800.00	9800.00	9800.00	9800.00	9800.00	9800.00	0.00
net forgn exchge effect	9700.00	9700.00	9700.00	9700.00	9700.00	9700.00	366.78

present values at	10.00 %
foreign exchange flow .	-3409.57
net forgn exchge effect	65384.47

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE PRODUCTION OF SODIUM SULPHATE IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for the production of sodium sulphate (Na_2SO_4) in Nigeria.

The envisaged plant has a nominal capacity of 8000 t/y Na_2SO_4 as main product and 11,440 t/y of hydrocloridric Acid (31-33% solution) as a by-product.(1)

The capacity of the plant is the minimum economical size available on the market.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 14,828,750 (US$ 10,232,000 in foreign currency)
- Working capital (at full production): US$ 772,460 (US$ 340,000 in foreign currency)
- Internal Rate of Return: 14.49%
- Break-Even Point (at 5th year of production) 48%
- Pay-Back Period: less than 8 years (including construction period)
- Employees: 75

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 28,060,650 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

The sulphates of sodium are commonly sold in four commercial forms:

- anhydrous sodium sulphate, Na_2SO_4
- technical grade sodium sulphate (known as salt cake)
- sodium sulphate decahydrate, $Na_2SO_4 \cdot 10H_2O$ (known as Glauber's salt)
- and sodium hydrogen sulphate, $NaHSO_4$ (known as niter cake).

(1) For additional background material, see Volume I p.133.

All grades of sodium sulphate are significant items of commerce but Glauber's salt sales have declined since 1960. Sodium sulphate has been important throughout the hystory of the chemical industry but more as a by-product or intermediate than a leading product. Its abundance, both naturally and as a by-product of many chemical process, has kept its price low.

In the seventeenth century, Johann Glauber produced salt cake as a by-product from the reaction of salt and sulphuric acid to form hydrochloric acid (HCl) and, for a number of years, HCl was mainly produced according to this method.

Later the demand for HCl from salt cake decreased because HCl became easily available from electrolitic chlorine acid hydrogen.

The resulting decrease in salt cake production was accompanied by increasing demand from the developing sulphate paper process. The chemical inertness and low price of sodium sulphate have also led to its use as a filler in the production of household detergents.

Even though sodium sulphate is today manufactured as a by-product of several processes; an important process remains the manufacture of salt cake, or crude sodium sulphate, through the decomposition of sodium chloride with sulphuric acid:

$$2\,NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl\,(g)$$

Crude sodium sulphate undergoes then a purification to attain the "detergent grade" sodium sulphate.

From the production of 1000 kg of sodium sulphate are theoretically obtained, as a by-product, about 500 kg of hydrochloric acid gas. Physical and chemical properties of pure anhydrous sodium sulphate (Na_2SO_4) are the following:

- Molecular weight:	142.04
- Melting point:	882
- Specific gravity	2.664
- Refractive index	1.464, 1.474, 1.485
- Crystalline form	rhombic or hexagonal

The reactivity of Na_2SO_4, varies widely with temperature. In the solid state and close to ambient temperatures, Na_2SO_4 is relatively inert but at higher temperatures and particularly in the molten state is very reactive.

This study will deal with the manufacture of "detergent grade" sodium sulphate, starting from salt and sulphuric acid as raw materials.

Sodium sulphate "detergent grade" will have the following characteristics:

- Na_2SO_4	:	99 wt% min
- insoluble	:	0,02 wt% max
- Fe	:	50 ppm max
- bulk density	:	1,2 - 1,4 kg/l

The hydrochloric acid by-product will be of the following quality:

- Hydrochloric acid commercial grade	:	31-33% solution
- H_2SO_4	:	0,5% wt max
- Fe	:	50 ppm

2. MARKET AND PLANT CAPACITY

2.1 USES

Sodium sulphate is used industrially because of its inertness at low temperatures and its reactivity at high temperatures. The principal uses for Na_2SO_4 are:

- Paper	:	67%
- Detergents	:	26%
- Glass and others	:	7%

Consumption in the paper industry is declining and uses for detergents are increasing. In the kraft or sulphate paper process, a mixture of sodium sulphide and sodium hydroxide is used to digest wood chips.

The sulphide and hydroxide are generated starting with salt cake as raw material. The high temperature properties of Na_2SO_4 are also an advantage in glass making where it helps speed up the melting process, it reduces the tendency for alkaline gas bubbles and it ceases to form.

The low temperature, inert properties of Na_2SO_4 makes it desirable as a principal component of household laundry detergents. Such detergents contain as much as 75% wt Na_2SO_4 as a diluent and builder for the concentrated detergents.

Sodim sulphate is the least expensive inert material available and also improves the detergency of surfactants. Anhydrous Na_2SO_4 is the preferred form because of its higher purity and whitness.

In the dye industry Na_2SO_4 is used to dilute or standardize the dyes.

Sodium sulphate is also used in cattle feed, in cellulose-sponge manufacture, as a cement and plaster hardener, and as an aid in metallurgical refining.

2.2 DEMAND

2.2.1 International market

Trend of sodium sulphate production and consumption in the United States appear to be leading the rest of the world. The greatest U.S. production occured from 1965 through 1974 when annnual production reached ca 1.3×10^6 metric tons.

Worldwide production reached its peak in 1975 and 1976 at 4.4×10^6 metric tons per year. In the subsequent years a reduction in demand was registered. This decline can be attributed to the rapid escalation of fluid fuel prices since 1973 and increasingly strict regulations governing air and water pollution. The kraft paper industry, representing approximately two thirds of the total consumption is the main contributor to the consumption decline.

It is unlikely that the present rate of decline will continue for long time because of the slow but continuing expansion of detergent and paper production.

2.2.2 Present situation in Nigeria

The detergents producers are the major consumers of Na_2SO_4. Actually, for every tonne of detergent produced, 500 to 700 kg of sodium sulphate are used.

Considering that the potential output of the existing detergent plants exceeds 400,000 t/year, the actual demand of Na_2SO_4 is ranging between 200,000-300,000 t/year. The demand can be satisfied only by imports. Other industries consume sodium sulphate, but there are no data available indicating their needs.

2.3 PLANT CAPACITY

This study will analyse the minimum economical size for *detergent grade* (that is anhydrous) *sodium sulphate* production , i.e. a plant having a capacity of 8000 t/y (24 t/day of 3 shifts - 333 day/t). Together with sodium sulphate will be produced, as a by-product, about 11.440 t/y of hydrochloric acid of commercial grade 31-33% wt solution.

The capacity of the plant is determined by the size of the reaction furnace, which is standardized for a production of 24 t/day.

2.4 SALE PRICE AND TOTAL REVENUE

2.4.1 In the world market anhydrous sodium sulphate, in 50 kg paperbags, is traded at US $ 250/ton. Taking into consideration the transportation charges etc., the price in Nigeria can be assumed US $ 350/ton. At full capacity, the revenue will be:

$$350 \times 8000 \text{ ton} = 2{,}800{,}000 \text{ \$/ton}$$

2.4.2 The process makes also available about 11,400 ton/y of hydrochloric acid as a commercial grade 31-33 wt% solution. The price for this product (in tanks), in Europe is around 200 $/ton. In Nigeria the selling price will be 330 $/ton ex-works, taking into consideration the transportation charges fron Europe to Nigeria.

The revenue, for this product, will be:

330 x 11,400 ton = 3,762,000 $/t

When the plant is in full production the total revenue will be 2,800,000 + 3,762,000 = US$ 6,562,000.

2.4.3 Production programme

It is foreseen that the plant operates at full capacity in the third year after the start-up.

In the first year the output will be 40% of nominal capacity, while the 80% will be reached in the second year.

3. MATERIALS AND INPUTS

3.1 CHEMISTRY

Technical sodium sulphate production is based on the reaction of sodium chloride with sulphuric acid, according to the following reaction:

$$2NaCl + H_2SO_4 \text{ -------> } Na_2SO_4 + 2HCl$$

which occurs in a muffle-type furnace operating continuously.

When a high-purity product is required, as for the detergents production, technical sodium sulphate is refined to primarily eliminate the unreacted products and iron.

Together with the sodium sulphate a commercial grade 31-33 wt% solution of hydrochloric acid (about 1430 kg per ton of the main product) is obtained.

3.2 MATERIAL AND UTILITIES: AVAILABILITY, REQUIREMENT AND COSTS

Salt is the main raw material which has to be imported. The relevant cost is US$ 73/t. All other materials and utilities are locally available. The following table shows the quantity of material and input, as well as the relevant costs, required for the production of 8000 tons/y of anhydrous sodium sulphate.

Description	unit of measure	required q.ty for 1 ton	1 year	unit costs $ LC	FC	annual costs $ LC	FC	TOTAL
Raw materials								
Raw salt (as NaCl 100%)	t	0.835	6,680	--	73	--	487,640	487,640
Sulphuric acid 98% (as 100%)	t	0,720	5.760	300	--	1,728,000	--	1,728,000
Chemicals								
Sodium carbonate 100%	t	0.025	200	--	300	--	60,000	60,000
Packing (paper bags)	no	20	160,000	0,3	--	48,000	--	48,000
1 Sub-total: raw materials	--	--	--	--	--	**1,776,000**	--	**2,323,640**
Utilities								
Cooling water	m^3	50	400,000	0.009	--	3,600	--	3,600
Demiwater	m^3	1.51	12,000	3.5	--	42,000	--	42,000
Fuel gas	nm^3	130	1,040,000	0,025	--	26,000	--	26,000
Electric Energy	Kwh	100	800,000	0,1	--	80,000	--	80,000
2 Sub-total : utilities	--	--	--	--	--	**151,600**	--	**151,600**
Grand total (1 + 2)						**2,480,240**		

For the financial evaluation, the costs are grouped as follows:

Raw materials	LC	US$	1,776,000
Raw materials	FC	US$	547,640
Electric Energy	LC	US$	80,000
Other utilities	LC	US$	71,600

TOTAL		US$	2,480,240

3.3 RAW MATERIALS PURCHASING PROGRAMME AND STORAGE VOLUME

3.3.1 Raw salt (NaCl 100%)

It is to be imported and the storage for 6 months (3500 tons) is advisible.

3.3.2 Sulphuric acid 98%

This product is the object of an opportunity study in this subsector. It is likewise that a plant will be set-up, thus making H_2SO_4 locally available. As a consequence H_2SO_4 will be considered of local supply and only 50 days storage (about 900 tons) seems to be sufficient.

3.3.3 Sodium carbonate 100%

This is a chemical product that has to be imported. Because it is needed in a small quantity it seems advisable to have a stock for one year consumption (200 tons).

3.3.4 Total raw materials stock

The following amount of raw materials will be considered as a minimum stock.

Product	Working days	Quantity	Costs	
Raw salt	175	3500 tons	US$	255,500
Sulphuric acid	52	900 tons	US$	270,000
Sodium carbonate	330	220 tons	US$	60,000

		Total	US$	585,500

4. LOCATION

The plant should be installed in an industrial area close to Lagos, where the plants of main users are located. Moreover, in the same area, the Company importing the salt has its headquarters and deposits.

5. PROJECT ENGINEERING

5.1 BACKGROUND

As already said the process consists in reacting sodium chloride with sulphuric acid according to the following reaction:

$$2NaCl + H_2SO_4 \text{ -----> } NA_2SO_4 + 2HCl$$

The reaction is highly endothermic and heat of reaction must be supplied.

To attain an high reaction yield, the salt is to be fed in grains not larger than 3 mm and containing max. 0,5% moisture.

The raw sodium sulphate leaving the furnace has this average composition:

- Na_2SO_4	:	96 - 96,5 %
- NaCl	:	1 - 1,5 %
- H_2SO_4	:	2 - 2,2 %

This raw sodium sulphate cannot be traded as it is. It should be procesed further and according to one of the following routes:

1) Conditioning of raw sodium sulphate to achieve technical grade product.

2) Refining of raw sodium sulphate to achieve detergent grade product.

The hydrochloric acid leaves the furnace in form of gas and it is condensed in two steps.

In the first step 3% approx. of HCl is condensated together with most of H_2SO_4 present in the gas, hence attaining a mixture of acid condensate. This is normaily used for steel pickling purpose.

In the second step the remaining HCl is absorbed in water to give a commercial grade of hydrochloric acid.

As technical grade sodium sulphate is not foreseen, the project will consider only the detergent grade production.

5.2 DESCRIPTION OF THE PROCESS

The process can be divided into the following steps:

- Salt conditioning
- Raw sodium sulphate and hydrochloric acid production
- Raw sodium sulphate purification.

5.2.1 Salt conditioning

The salt is continuously dried in a fluid bed dryer by means of air heated in a fuel gas generator. Dry salt is then continuously ground to obtain particles having the size suitable to the furnace.

5.2.2 Raw sodium sulphate and hydrochloric acid production

The conditioned salt stored in a hopper having the capacity of eight hours, is loaded into containers, equipped with quantity control device.

By means of a hoist and monorail the containers are lifted and emptied into the feed-box of the furnace which is fed continuously.

The reaction heat is supplied by an indirect heating system by burning fuel gas and circulating the combustion gas in the top of the furnace. Heat is transferred from fuel gas to the reaction chamber through a silicone carbide voult.

The hot gases leaving the furnace are cooled in a waste heat boiler that produces low pressure steam, and after sent to the atmosphere.

The sodium sulphate is discharged into Cooling Drums, where it is indirectly cooled by water, and transferred to the technical sodium sulphate purification, by pneumatic transport.

HCl gas produced by reaction together with stripped H_2SO_4 are cooled down in Heat Exchangers and washed in a tower, where the sulphuric acid and a part of hydrochloric acid are condensed.

HCl gas still present is absorbed in water, collected into a tank and pumped to the storage.

5.2.3 **Raw sodium sulphate purification**

In order tc attain the "detergent grade" sodium sulphate, the sulphate leaving the furnace must be treated to remove the unreacted sulphuric acid and the impurities still present in it.

The raw sulphate is dissolved batchwise into a reactor where, under a pH control, a soda solution is added.

The sulphuric acid reacts with the alkaline solution, the impurities (mainly iron) precipitate and are removed by filtration.

The clear solution, stored in a tank, is then acidified with sulphuric acid under pH control.

After this, the solution is fed continuously to a vacuum Evaporator Crystallizer, where most of the water is evaporated.

The heat required is supplied by steam in a Heat Exchanger through which the solution is continuously circulated.

To reduce the steam consumption two thermal compressors are provided.

The slurry collected from the Crystallizer is centrifuged and the obtained cystals are dried in a Flash Dryer heated by hot hair.

Finally, the pneumatic transport, the purified sodium sulphate is sent to silos and mechanically bagged.

5.2.4 **List of main Equipment**

5.2.4.1 Salt Conditioning Section

1	NaCl MILL
1	NaCl FEED HOPPER
1	DRY NaCl HOPPER
1	VIBRATORY EXTRACTOR
1	NaCl DRYING UNIT PACKAGE
1	RAW NaCl EXTRACTOR BELT
1	RAW NaCl BUCKET ELEVATOR
1	DRY NaCl BUCKET ELEVATOR

5.2.4.2 Na_2SO_4 + HCl Production Section

1	HORIZONTAL CYLINDRICAL COOLER
1	HORIZONTAL CYLINDRICAL COOLER
1	CIRCULATION TANK
1	HCl TANK
1	WATER TANK
1	RECYCLE TANK
1	GAS COOLER
1	GAS COOLER
1	ACID CONDENSATE COOLER
1	WASTE HEATR BOILER
1	EXHAUST GAS STACK
1	COMBUSTION AIR FAN
1+1	EXHAUST GAS FAN
1	TAIL GAS FAN
1	AIR BLOWER FOR PNEUM. TRANSPORT
1+1	BOILER WATER FEED PUMP
1+1	H_2SO_4 FEED PUMP
1+1	MIXED ACIDS CIRCULAT. PUMP
1	RECYCLE PUMP
1+1	HCl STORAGE PUMP
1+1	ABSORPTION SOLUT. PUMP
1	HORIZONTAL FURNACE MULTI-TYPE
1	WASHING TOWER
1	MILLED NaCl HOPPER
1	NaCl FURNACE HOPPER
1	RAW Na_2SO_4 HOPPER
1	ABSORPTION UNIT PACKAGE
1	NaCl SCALE

1	MILLED NaCl BUCKET ELEVATOR
1	NaCl TO WEIGHING SCREW-CONVEYOR
1	MONORAIL LIFTING SYSTEM
1	NaCl SCREW FEEDER
1	RAW SULPHATE SCREW CONVEYOR
1	RAW SULPHATE SCREW CONVEYOR
1	RAW Na_2SO_4 BELT CONVEYOR

5.2.4.3 Sodium Sulphate Purification

1	RAW Na_2SO_4 SOLUT. TANK
1	PRE-COAT TANK
1	Na_2SO_4 SOLUT. INTERMEDIATE TANK
1	CONDENSATE TANK
1	PRODUCT TANK
1	BAROMETRIC TANK
1	NaOH SOLUTION TANK
2	EVAPORATOR
1	WATER CONDENSER
1	RAW Na_2SO_4 SOLUTION FILTER
1	FILTER CYCLONE
1	FILTER CYCLONE
1	VACUUM PUMP
1	AIR BLOWER FOR PNEUMATIC TRANSPORT
2	THERMOCOMPRESSOR
1	DISSOLUTION MIXER
1	Na_2SO_4 SOLUTION MIXER
1	FILTER AID MIXER
1	FILTERED Na_2SO_4 MIXER
1	CRYSTAL SUSPENSION MIXER
1	CRYSTALLIZER

1+1	Na_2SO_4 SOLUTION FILTERING PUMP
1	FILTER AID FEED PUMP
1	H_2SO_4 FEED PUMP
1+1	CRYSTALLIZER FEED PUMP
2	CRYSTALLIZER CIRCULATION PUMP
1	NaOH FEED PUMP
1	CONDENSATE DISCHARGE PUMP
2	CONDENSATE CHRAGE PUMP
1	DISCHARGE SOLUTION PUMP
1+1	CENTRIFUGE FEED PUMP
1	WATER TO COOLING TOWER
1	Na_2SO_4 DISSOL. REACTOR
1	HYDROCYCLONE
1	CENTRIFUGE
1	VIBRATORY SCREEN
1	DISCHARGE TANK
1	RAW Na_2SO_4 HOPPER
1	Na_2SO_4 DETERGENT GRADE STORAGE
1	AIR SATURATOR
1	Na_2SO_4 FLASH DRYING UNIT PACKAGE
1	BAGGING MACHINE
1	RAW Na_2SO_4 TO DISSOLUTION
1	CRUDE CRYSTALL TO DRYING UNIT
1	DRY CRYSTALL TO STORAGE
1	SILO SCREW-EXTRACTOR

5.3 STORING FACILITIES

5.3.1 Finished product

The "detergent grade" sodium sulphate, contained in 50 Kg paperbags, piled in pallets of 1 ton, will take place in a building having 1000 sqm surface (storage capacity of about 40 days production).

5.3.2 Raw materials

5.3.2.1 Sulphuric acid (commercial grade 98%)

Two carbon steel tanks with a capacity of 250 m^3 each will store the H_2SO_4 (about 50 days production at full capacity).

5.3.2.2 Raw salt

3500 tons of salt (needed for 6 months operation) will be stored in a building having a total covered area of 2500 sqm.

5.3.2.3 Sodium carbonate

The 200 tons of sodium carbonate needed for 1 year will be stored together with sodium sulphate.

5.3.3 By-products

5.3.3.1 Hydrochloric acid (solution 31-33%)

It must be stored in rubber-lined carbon steel.

Two tanks with 500 m^3 capacity each one (1 month production) will be provided.

5.4 LAY-OUT AND CIVIL WORKS

The area required for the installation of the plant with all necessary utilities and facilities is 15000 sqm.

Process and utilities equipment and machinery have to be located indoor.

The total area required by the plant is 40 m x 16 m except the solid storage area for NaCl and Na_2SO_4 final product.

The total area is so divided:

- Salt conditioning : 15 m x 16 m, free height 10 m
- Raw sodium sulphate production : 15 m x 16 m, free height 15 m
- Raw sodium sulphate purification : 20 m x 8 m, free height 15 m

Foundations shall be in reinforced concrete, lined with acid resistant cement.

The salt will be stored in a building, of 2500 sqm surface having a support structure of reinforced concrete and floor paved with concrete slabs. For the roofing, asbestos sheets will be used.

The finished sodium sulphate in 50 kg paperbags and in pallets will be stored in a building having 1000 sqm surface. The characteristics of this building are identical to the one foreseen for the salt storage. Administrative offices, laboratory, maintenance workshop, social services and other facilities will be grouped in one storey-building covering an area of 500 sqm about.

This building will have a supporting structure of reinforced concrete, external and internal walls of brickwork, while the roof is made of concrete slabs. The floor of the offices, laboratory and social services will be covered with tiles, while workshop will have a concrete floor.

5.5 INVESTMENT COSTS, DEPRECIATION AND MAINTENANCE

The quotation of machinery and equipment was obtained from Garbato, Milan, Italy.

	LC (M$)	FC (M$)	Total (M$)
Machinery and equipment (FOB European Port)	--	7	7
Transport, taxes&duties	1.4	0.7	2.1
Land and site preparation	0.1	--	0.1
Erection	1.4	0,7	2.1
Building and civil works	1.0	--	1.0
Spare parts	--	0.2	0.2
Total	**3.9**	**8.6**	**12,5**
Contingencies	**0.4**	**0.9**	**1.3**
Grand Total	**4.3**	**9.5**	**13.8**

The life of the plant can be considered as fifteen years. Annual maintenance cost has been assumed in the range of 3% of the machinery and equipment costs, that is US$ 210,000.

For the financial evaluation, the investment costs, contingencies included, are grouped as follows:

Preproduction expenditures	FC	0.14	million dollars
Preproduction expenditures	LC	0.232	million dollars
Machinery	FC	9.5	million dollars
Machinery	LC	2.8	million dollars
Land and site preparation	LC	0.1	million dollars
Civil works	LC	1.4	million dollars

Total		14.172	million dollars

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

The process is rather complex so the technical manager, the engineers, the chemist and the foremen should be well trained in a similar plant.

It is also recommended that one expert is made available by the technology supplier for the technical assistance and for on the job training for a period of one year after the start-up of the plant. The relevant cost is estimated US$ 120,000. The number of personnel reflects the need of three shifts.

7.1 MANAGEMENT

		N/y
General Manager	1	50,000
Technical Manager	1	40,000
	---	---------
	2	90,000
		overheads 40% 36,000

		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPT.

		N/y
Senior accountant	1	25,000
Purchasing dept. Head	1	12,000
Sales dept.	1	12,000
Warehouse keepers	1	10,000
Clerks	3	36,000
Drivers	3	24,000
Security	6	36,000
	16	165,000
		overheads 40% 66,000
		231,000
		(US$ 30,000)

7.3 PRODUCTION DEPT.

		N/y
Production manager	1	40,000
Shift foremen	6	72,000
Shift operator	20	160,000
Semi-skilled workers	12	72,000
Chemist	1	25,000
Analyst	3	15,000
Clerk	1	12,000
	44	396,000
		overheads 40% 158,400
		554,400
		(US$ 70,000)

7.4 MAINTENANCE DEPT.

		N/y
Engineer	1	40,000
Electricians	4	40,000
Mechanics	6	60,000
Instrument spec.	2	20,000
	13	160,000
		overheads 40% 64,000
		241,000
		(US$ 29,700)

Summary

		$/y
Management	2	16,000
Administraton dept.	16	30,000
Production dept.	44	70,000
Maintenance dept.	13	29,000
Total	75	145,000

8. IMPLEMENTATION SCHEDULING

Twenty-four months are required for the design, machinery and equipment supply and erection of the plant, up to the commissioning and start-up.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 14,828,750 US Dollars. The portion in foreign currency accounts for 10,232,000 US Dollars.

Details of these figures are shown in chapter 5.5.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 2,000,000	US$ 2,765,000	US$ 4,765,000
- Foreign Loan (interest 8%)	US$ 2,550,000	US$ 5,525,000	US$ 8,075,000
- Local Loan (interest 15%)	US$ 400,000	US$ 1,490,000	US$ 1,890,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 80%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 772,466 US Dollars, the foreign portion being US$ 399,583.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 336,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US$ 3,692,375.

In the third year, at full production, the costs amount to US $ 4,824,475, then they start a slight decrease year after year, to reach a constant amount of US $ 2,832,600 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 6,562,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 2,624,800

2nd year 80% : revenue = US$ 5,249,600

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 14.49%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 48% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 8 years, including the construction period.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 28,842,500.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 28,842,500.

ANNEXE 1

COMFAR SCHEDULES

SODIUM SULPHATE
NOVEMBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US$

Total initial investment during construction phase

fixed assets:	14828.75	68.967 % foreign
current assets:	0.00	0.000 % foreign
total assets:	14828.75	68.967 % foreign

Source of funds during construction phase

equity & grants:	4765.00	0.000 % foreign
foreign loans :	8075.00	
local loans :	1890.00	
total funds :	14730.00	54.820 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1340.00	2832.60	2832.60
depreciation :	1422.88	1402.88	172.88
interest :	929.50	323.00	0.00
production costs	3692.38	4558.48	3005.48
thereof foreign	55.48 %	43.78 %	24.05 %
total sales :	2624.80	6562.00	6562.00
gross income :	-1067.58	2003.52	3556.52
net income :	-1067.58	1202.11	2133.92
cash balance :	-1620.16	1595.62	2306.79
net cashflow :	948.71	2927.99	2306.79

Net Present Value at: 10.00 % = 4175.98
Internal Rate of Return: 14.49 %
Return on equity1: 16.28 %
Return on equity2: 17.06 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	100.000	0.000
Buildings and civil works	1000.000	400.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	3800.000	8500.000
Total fixed investment costs	4900.000	8900.000
Pre-production capital expenditures	182.000	846.750
Net working capital	0.000	0.000
Total initial investment costs	5082.000	9746.750
Of it foreign, in %	61.039	73.101

Total Current Investment in 1000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	336.086	284.778	151.602
Total current investment costs	336.086	284.778	151.602
Of it foreign, %	52.913	49.805	52.715

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	930.000	1860.000	2326.000	2326.000	2326.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	61.000	121.000	151.600	151.600	151.600
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	70.000	70.000	70.000	70.000	70.000
Repair, maintenance	44.000	88.000	110.000	110.000	110.000
Spares	40.000	80.000	100.000	100.000	100.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	1265.000	2219.000	2757.600	2757.600	2757.600
Administrative overheads	75.000	75.000	75.000	75.000	75.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1422.875	1422.875	1412.875	1402.875	1402.875
Financial costs	929.500	754.250	579.000	403.750	323.000
Total production costs	3692.375	4471.125	4824.475	4639.225	4558.475
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	55.485	47.146	44.714	44.759	43.780
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	145.000	145.000	145.000	145.000	145.000

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	2326.000	2326.000	2326.000	2326.000	2326.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	151.600	151.600	151.600	151.600	151.600
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	70.000	70.000	70.000	70.000	70.000
Repair, maintenance	110.000	110.000	110.000	110.000	110.000
Spares	100.000	100.000	100.000	100.000	100.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	2757.600	2757.600	2757.600	2757.600	2757.600
Administrative overheads	75.000	75.000	75.000	75.000	75.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1402.875	1402.875	1402.875	1402.875	172.875
Financial costs	242.250	161.500	80.750	0.000	0.000
Total production costs	4477.725	4396.975	4316.225	4235.475	3005.475
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	42.766	41.715	40.625	39.493	24.046
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	145.000	145.000	145.000	145.000	145.000

Total Production Costs in 1000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	2326.000
Other raw materials	0.000
Utilities	151.600
Energy	0.000
Labour, direct	70.000
Repair, maintenance	110.000
Spares	100.000
Factory overheads	0.000
Factory costs	2757.600
Administrative overheads	75.000
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	2832.600
Costs per unit (single product)	0.000
Of it foreign, %	22.947
Of it variable,%	0.000
Total labour	145.000

Net Working Capital in 1000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	111.667	191.167	236.050	236.050
Inventory and materials	83	4.3	228.593	457.003	571.421	571.421
Energy	0	---	0.000	0.000	0.000	0.000
Spares	180	2.0	20.000	40.000	50.000	50.000
Work in progress	5	72.0	17.569	30.819	38.300	38.300
Finished products	5	72.0	18.611	31.361	39.342	39.342
Cash in hand	15	24.0	14.542	13.042	14.792	14.792
Total current assets			410.892	763.892	949.904	949.904
Current liabilities and						
Accounts payable	23	15.6	74.806	143.028	177.439	177.439
Net working capital			336.086	620.864	772.466	772.466
Increase in working capital			336.086	284.778	151.602	0.000
Net working capital, local			158.253	301.197	372.882	372.882
Net working capital, foreign			177.833	319.667	399.583	399.583

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	2000.000	2765.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	2550.000	5525.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	400.000	1490.000
Loan C, local....	0.000	0.000
Total loan	2950.000	7015.000
Current liabilities	0.000	0.000
Bank overdraft	132.000	-33.250
Total funds	5082.000	9746.750

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-1009.375	-1009.375	-1009.375	-1009.375	-1009.375
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-630.000	-630.000	-630.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-1639.375	-1639.375	-1639.375	-1009.375	-1009.375
Current liabilities	74.806	68.222	34.411	0.000	0.000
Bank overdraft	1620.161	34.193	-664.412	-1088.692	0.000
Total funds	55.592	-1536.959	-2269.376	-2098.067	-1009.375

Cashflow Tables, construction in 1000 US$

Year	1990	1991
Total cash inflow . .	4950.000	9780.000
Financial resources .	4950.000	9780.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	5082.000	9746.750
Total assets	4950.000	9150.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	132.000	596.750
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-132.000	33.250
Cumulated cash balance	-132.000	-98.750
Inflow, local	2400.000	4255.000
Outflow, local	1980.000	2621.750
Surplus (deficit) .	420.000	1633.250
Inflow, foreign . . .	2550.000	5525.000
Outflow, foreign . . .	3102.000	7125.000
Surplus (deficit) .	-552.000	-1600.000
Net cashflow	-4950.000	-9150.000
Cumulated net cashflow	-4950.000	-14100.000

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	2699.605	5317.822	6596.411	6562.000	6562.000	6562.000
Financial resources	74.806	68.222	34.411	0.000	0.000	0.000
Sales, net of tax	2624.800	5249.600	6562.000	6562.000	6562.000	6562.000
Total cash outflow	4319.767	5352.015	5931.997	5014.834	4966.385	4917.935
Total assets	410.892	353.000	186.013	0.000	0.000	0.000
Operating costs	1340.000	2294.000	2832.600	2832.600	2832.600	2832.600
Cost of finance	929.500	754.250	579.000	403.750	323.000	242.250
Repayment	1639.375	1639.375	1639.375	1009.375	1009.375	1009.375
Corporate tax	0.000	311.390	695.010	769.110	801.410	833.710
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-1620.161	-34.193	664.414	1547.166	1595.615	1644.065
Cumulated cash balance	-1718.911	-1753.104	-1088.690	458.476	2054.091	3698.156
Inflow, local	2698.550	5317.433	6596.050	6562.000	6562.000	6562.000
Outflow, local	2105.503	3115.168	3707.844	2951.709	2984.010	3016.310
Surplus (deficit)	593.047	2202.265	2888.205	3610.291	3577.990	3545.690
Inflow, foreign	1.056	0.389	0.361	0.000	0.000	0.000
Outflow, foreign	2214.264	2236.847	2224.153	2063.125	1982.375	1901.625
Surplus (deficit)	-2213.208	-2236.458	-2223.792	-2063.125	-1982.375	-1901.625
Net cashflow	948.714	2359.432	2882.789	2960.291	2927.990	2895.690
Cumulated net cashflow	-13151.290	-10791.850	-7909.065	-4948.775	-2020.784	874.906

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	6562.000	6562.000	6562.000	6562.000	6562.000	6562.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	6562.000	6562.000	6562.000	6562.000	6562.000	6562.000
Total cash outflow	4869.484	4821.035	3763.209	4255.209	4324.359	4324.359
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	2832.600	2832.600	2832.600	2832.600	2832.600	2832.600
Cost of finance	161.500	80.750	0.000	0.000	0.000	0.000
Repayment	1009.375	1009.375	0.000	0.000	0.000	0.000
Corporate tax	866.010	898.310	930.610	1422.610	1491.760	1491.760
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1692.516	1740.965	2798.791	2306.791	2237.641	2237.641
Cumulated cash balance	5390.672	7131.637	9930.428	12237.220	14474.860	16712.500
Inflow, local	6562.000	6562.000	6562.000	6562.000	6562.000	6562.000
Outflow, local	3048.610	3080.910	3113.209	3605.209	3674.360	3674.360
Surplus (deficit)	3513.390	3481.090	3448.791	2956.791	2887.640	2887.640
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	1820.875	1740.125	650.000	650.000	650.000	650.000
Surplus (deficit)	-1820.875	-1740.125	-650.000	-650.000	-650.000	-650.000
Net cashflow	2863.390	2831.090	2798.791	2306.791	2237.640	2237.640
Cumulated net cashflow	3738.296	6569.387	9368 178	11674.970	13912.610	16150.250

Cashflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	6562.000	6562.000	6562.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	6562.000	6562.000	6562.000
Total cash outflow	4324.359	4324.359	4324.359
Total assets	0.000	0.000	0.000
Operating costs	2832.600	2832.600	2832.600
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1491.760	1491.760	1491.760
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	2237.641	2237.641	2237.641
Cumulated cash balance	18950.140	21187.780	23425.420
Inflow, local	6562.000	6562.000	6562.000
Outflow, local	3674.360	3674.360	3674.360
Surplus (deficit)	2887.640	2887.640	2887.640
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	650.000	650.000	650.000
Surplus (deficit)	-650.000	-650.000	-650.000
Net cashflow	2237.640	2237.640	2237.640
Cumulated net cashflow	18387.890	20625.530	22863.170

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	3140.28	at	10.00 %
Internal Rate of Return (IRRE1) ..	16.28 %		

b) Net Worth versus Net cash return:

Net present value	4213.59	at	10.00 %
Internal Rate of Return (IRRE2) ..	17.06 %		

c) Internal Rate of Return on total investment:

Net present value	4175.98	at	10.00 %
Internal Rate of Return (IRR) ..	14.49 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	2624.800	5249.600	6562.000	6562.000	6562.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	2624.800	5249.600	6562.000	6562.000	6562.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2762.875	3716.875	4245.475	4235.475	4235.475
Operational margin	-138.075	1532.725	2316.525	2326.525	2326.525
As % of total sales	-5.260	29.197	35.302	35.455	35.455
Cost of finance	929.500	754.250	579.000	403.750	323.000
Gross profit	-1067.575	778.475	1737.525	1922.775	2003.525
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-1067.575	778.475	1737.525	1922.775	2003.525
Tax	0.000	311.390	695.010	769.110	801.410
Net profit	-1067.575	467.085	1042.515	1153.665	1202.115
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-1067.575	467.085	1042.515	1153.665	1202.115
Accumulated undistributed profit	-1067.575	-600.490	442.024	1595.689	2797.804
Gross profit, % of total sales	-40.673	14.829	26.479	29.302	30.532
Net profit, % of total sales	-40.673	8.898	15.887	17.581	18.319
ROE, Net profit, % of equity	-22.405	9.802	21.879	24.211	25.228
ROI, Net profit+interest, % of invest.	-0.956	8.297	10.903	10.472	10.255

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	6562.000	6562.000	6562.000	6562.000	6562.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	6562.000	6562.000	6562.000	6562.000	6562.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4235.475	4235.475	4235.475	4235.475	3005.475
Operational margin	2326.525	2326.525	2326.525	2326.525	3556.525
As % of total sales	35.455	35.455	35.455	35.455	54.199
Cost of finance	242.250	161.500	80.750	0.000	0.000
Gross profit	2084.275	2165.025	2245.775	2326.525	3556.525
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2084.275	2165.025	2245.775	2326.525	3556.525
Tax	833.710	866.010	898.310	930.610	1422.610
Net profit	1250.565	1299.015	1347.465	1395.915	2133.915
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1250.565	1299.015	1347.465	1395.915	2133.915
Accumulated undistributed profit	4048.369	5347.384	6694.849	8090.764	10224.680
Gross profit, % of total sales	31.763	32.993	34.224	35.455	54.199
Net profit, % of total sales	19.058	19.796	20.534	21.273	32.519
RCE, Net profit, % of equity	26.245	27.262	28.278	29.295	44.783
ROI, Net profit+interest, % of invest.	10.037	9.820	9.603	9.386	14.348

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	6562.000	6562.000	6562.000	6562.000	6562.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	6562.000	6562.000	6562.000	6562.000	6562.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2832.600	2832.600	2832.600	2832.600	2832.600
Operational margin	3729.400	3729.400	3729.400	3729.400	3729.400
As % of total sales	56.833	56.833	56.833	56.833	56.833
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	3729.400	3729.400	3729.400	3729.400	3729.400
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3729.400	3729.400	3729.400	3729.400	3729.400
Tax	1491.760	1491.760	1491.760	1491.760	1491.760
Net profit	2237.640	2237.640	2237.640	2237.640	2237.640
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2237.640	2237.640	2237.640	2237.640	2237.640
Accumulated undistributed profit	12462.320	14699.960	16937.600	19175.240	21412.880
Gross profit, % of total sales	56.833	56.833	56.833	56.833	56.833
Net profit, % of total sales	34.100	34.100	34.100	34.100	34.100
ROE, Net profit, % of equity	46.960	46.960	46.960	46.960	46.960
ROI, Net profit+interest, % of invest.	15.046	15.046	15.046	15.046	15.046

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	5082.000	14828.750
Fixed assets, net of depreciation	0.000	5082.000
Construction in progress	5082.000	9746.750
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	5082.000	14828.750
Equity capital	2000.000	4765.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	2950.000	9965.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	132.000	98.750
Total debt	3082.000	10063.750
Equity, % of liabilities	39.355	32.134

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	14884.340	13814.470	12120.520	10575.630	10768.370
Fixed assets, net of depreciation	13405.880	11983.000	10570.130	9167.250	7764.375
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	396.350	750.850	935.113	935.113	935.113
Cash, bank	14.542	13.042	14.792	14.792	14.792
Cash surplus, finance available	0.000	0.000	0.000	458.473	2054.088
Loss carried forward	0.000	1067.575	600.490	0.000	0.000
Loss	1067.575	0.000	0.000	0.000	0.000
Total liabilities	14884.340	13814.470	12120.520	10575.630	10768.370
Equity capital	4765.000	4765.000	4765.000	4765.000	4765.000
Reserves, retained profit	0.000	0.000	0.000	442.024	1595.689
Profit	0.000	467.085	1042.515	1153.665	1202.115
Long and medium term debt	8325.625	6686.250	5046.875	4037.500	3028.125
Current liabilities	74.806	143.028	177.439	177.439	177.439
Bank overdraft, finance required.	1718.911	1753.104	1088.692	0.000	0.000
Total debt	10119.340	8582.383	6313.006	4214.939	3205.564
Equity, % of liabilities	32.014	34.493	39.313	45.056	44.250

Projected Balance Sheets, Production in 1000 US$

Year	1997	1998	1999	2000	2001
Total assets	11009.560	11299.200	11637.290	13033.200	15167.120
Fixed assets, net of depreciation	6361.500	4958.625	3555.750	2152.875	1980.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	935.113	935.113	935.113	935.113	935.113
Cash, bank	14.792	14.792	14.792	14.792	14.792
Cash surplus, finance available	3698.153	5390.668	7131.634	9930.424	12237.210
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	11009.560	11299.200	11637.290	13033.200	15167.120
Equity capital	4765.000	4765.000	4765.000	4765.000	4765.000
Reserves, retained profit	2797.804	4048.369	5347.384	6694.849	8090.764
Profit	1250.565	1299.015	1347.465	1395.915	2133.915
Long and medium term debt	2018.750	1009.375	0.000	0.000	0.000
Current liabilities	177.439	177.439	177.439	177.439	177.439
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	2196.189	1186.814	177.439	177.439	177.439
Equity, % of liabilities	43.281	42.171	40.946	36.560	31.417

Projected Balance Sheets, Production in 1000 US$

Year	2002	2003	2004	2005	2006
Total assets	17404.760	19642.400	21880.040	24117.680	26355.320
Fixed assets, net of depreciation	1980.000	1980.000	1980.000	1980.000	1980.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	935.113	935.113	935.113	935.113	935.113
Cash, bank	14.792	14.792	14.792	14.792	14.792
Cash surplus, finance available	14474.860	16712.500	18950.130	21187.780	23425.420
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	17404.760	19642.400	21880.040	24117.680	26355.320
Equity capital	4765.000	4765.000	4765.000	4765.000	4765.000
Reserves, retained profit	10224.680	12462.320	14699.960	16937.600	19175.240
Profit	2237.640	2237.640	2237.640	2237.640	2237.640
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	177.439	177.439	177.439	177.439	177.439
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	177.439	177.439	177.439	177.439	177.439
Equity, % of liabilities	27.378	24.259	21.778	19.757	18.080

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	8076.81	8075.00	1.81	2550.00	5525.00	1.06	0.39
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	8076.81	8075.00	1.81	2550.00	5525.00	1.06	0.39
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	29610.80	10227.00	19383.80	3102.00	7125.00	2214.26	2236.85
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	8750.00	9700.00	-950.00	3000.00	6700.00	178.89	142.22
imported materials . . .	9350.00	0.00	9350.00	0.00	0.00	380.00	520.00
repayment loans & overd.	8076.81	0.00	8076.81	0.00	0.00	1009.38	1009.38
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	3434.00	527.00	2907.00	102.00	425.00	646.00	565.25
indirect costs							
net foreign exchge flow	-21534.00	-2152.00	-19382.00	-552.00	-1600.00	-2213.21	-2236.46
import substitn effect	93180.40	0.00	93180.40	0.00	0.00	2624.80	5249.60
net forgn exchge effect	71646.40	-2152.00	73798.40	-552.00	-1600.00	411.59	3013.14

present values at	10.00 %
foreign exchange flow .	-13073.15
net forgn exchge effect	28060.65

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	0.36	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.36	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	2224.15	2063.13	1982.38	1901.63	1820.88	1740.13	650.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	80.28	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	650.00	650.00	650.00	650.00	650.00	650.00	650.00
repayment loans & overd.	1009.38	1009.38	1009.38	1009.38	1009.38	1009.38	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	484.50	403.75	323.00	242.25	161.50	80.75	0.00
indirect costs							
net foreign exchge flow	-2223.79	-2063.13	-1982.38	-1901.63	-1820.88	-1740.13	-650.00
import substit'n effect	6562.00	6562.00	6562.00	6562.00	6562.00	6562.00	6562.00
net forgn exchge effect	4338.21	4498.88	4579.63	4660.38	4741.13	4821.88	5912.00

present values at	10.00 %
foreign exchange flow .	-13073.15
net forgn exchge effect	28060.65

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	650.00	650.00	650.00	650.00	650.00	650.00	-1349.58
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-1351.39
imported materials . . .	650.00	650.00	650.00	650.00	650.00	650.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	1.81
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00		0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-650.00	-650.00	-650.00	-650.00	-650.00	-650.00	1349.58
import substit'n effect	6562.00	6562.00	6562.00	6562.00	6562.00	6562.00	0.00
net forgn exchge effect	5912.00	5912.00	5912.00	5912.00	5912.00	5912.00	1349.58

present values at 10.00 %	
foreign exchange flow .	-13073.15
net forgn exchge effect	28060.65

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U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDIES

FINAL REPORT

VOLUME 4 OF 4

ENGINEERING INDUSTRY

PROJECT SF/NIR/88/001

baldo & C.
CONSULTING ENGINEERS

CONTENT

VOLUME 4 - ENGINEERING INDUSTRY

ENGINEERING INDUSTRIES

Nigeria's engineering sub-sector appears to be relatively developed, looking at large number of establishments involved in it. On the whole, it accounts for about 17 per cent of total manufacturing production.

However, the subsector is very weak structurally, consisting mostly of the assembly of imported components. Imports of engineering inputs account for about 80% of the total imports on the average annually. The subsector has, therefore, been hard hit by the shortage of foreign exchange.
The sub-sector's major weakness is the absence of industries producing basic materials, necessary to other industries to develop, such as steel products.

The country's steel industry produces only low carbon structural steel, iron rods and steel wire products such as netting, nails and screws. The production of a large number of steel rolling mills is based on imported billets.

There is far the time being no production of flat sheets in the country thereby precluding the establishment of other industries like press shops for car bodies, tins and cans production, galvanized sheets etc.

Foundries are numerous, but only few of them are in a position to produce castings such as gears, shafts, or others like spare parts.

BASIC ASSUMPTIONS FOR THE FINANCIAL ANALYSIS

The following basic assumptions have been considered for all the projects in the financial analysis carried out by means of the COMFAR.

a) **Economic life**

Fifteen years have been considered the operational life of the plants, even if for some of them a longer life can be easily anticipated; this life span is largely sufficient to appreciate the profitability of a project; the increase of IRR due to longer life is definitely very small;

b) **Rate of discount: 10%**

c) **Depreciation: straightline type;**

rates:	10 %	for machinery and equipment
	5 %	for civil works
	20 %	for site preparation and pre-production expenditures
scraps:	10 %	for machinery and equipment
	50 %	for civil works and site preparation

d) **Foreign loan**

amount:	85% of the value of the imported machinery and equipment (installation costs included) as per "consensus" terms;
repayment:	within 8 years with 2 years of grace;
amortization:	constant principal type; interest 8%

e) **Local loan**

repayment:	within three years, starting from the first year of production;
amortization:	constant principal type; interest 15%

f) Working capital

Minimum days of coverage of the costs considered by the COMFAR programme:

	FC	LC
. accounts receivable	30	30
. inventory raw materials	180	60
. inventory utilities	1	1
. inventory energy	1	1
. inventory spare parts	180	180
. work in progress	defined case by case	
. cash in hand	15	15
. finished products	defined case by case	
. accounts payable	1	30

g) Taxes

The products are considered as sold ex-works; consequently the profit tax only (40%) has been included in the calculations. Tax holiday and other incentives foreseen to joint venture investments have not been included.

h) Currency

All the costs are expressed in Naira or US dollars; in the COMFAR in US dollars only; the exchange rate has been assumed as 7.9 N per 1 US dollar.

i) Utilities

The following prices have been assumed for evaluating the annual expenditures:

gasoline	0.076 $/l
electricity	0.1 $/KWh
cooling water (recycled)	0.0090 $/m3
cooling water (make-up)	0.006 $/m3
fuel oil	0.03 $/Kg
demineralized water	3.5 $/m3
LP steam	8 $/t

j) BEP

The BEP evaluations have been developed according to the formula.

$$\frac{\text{Fixed Costs}}{\text{Revenue - Variable Costs}}$$

The Direct personnel cost has been considered as fixed cost.

k) Salaries

	N/Y
General Manager	50000
Technical manager or Deputy G. M.	40000 45000
Financial manager	40000
Production manager Chief Engineer	40000
Chemist Engineer	25000
Senior account.	25000
Senior clerk Sale Dep. Head Purchase Dept. Head Workshop head	12000

Foreman or Supervisor	12000
Store Dept. head Mechanical store head Analyst Electrician Mechanic	10000
Security officer	8000
Secretaries	12000
Shift operators Store clerks Purchase dept. Ass. Account clerk Clerk	12000
Drivers	8000
Semiskilled workers Guard	6000
Unskilled workers Unskilled labourers	4000

The above figures have been increased by 40% overheads to consider the actual expenditures for the company.

e) Pre-production Expenses

Expenditures for establishment of company: 1% of the investment

Salaries:	Gen. Man + Tech. Man.+ Fin. Man.	for the whole period of construction
	Adm. manager:	3 months 1st year of construction and 6 months for the 2nd year of construction
	Maint. Man.	8 months of last period of construction
	Training	Chemist Product Man. Foreman Chief eng. Engineers Others — Estimated case by case

m) Erection

10 % of the cost of machinery and equipment in FC

20 % of the cost of machinery and equipment in LC

n) **Civil works**

office buildings:	$ 700 /m2 (per floor)
Industrial buildings:	$ 400 /m2

o) **Freight, taxes and duties**

1 - FC = 10% of the F.O.B. costs

2 - LC = 20% of the F.O.B. costs

p) Other assumptions, different from those specified above, are indicated on the paragrpaphs of each study.

q) At this stage no current investments have been considered.

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NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE MANUFACTURE OF SMALL TRACTORS IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0 SUMMARY AND CONCLUSIONS

This study analyses the opportunity of setting up a plant for the assembling of small tractors in Nigeria. The envisaged plant has a nominal capacity of 2,000 units per year, based on 250 days/y, 8 hours 1 shift/day.(1)

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 8,091,360 (US$ 4,000,000 in foreign currency)
- Working capital (at full production): US$ 3,876,868 (US$ 3,309,000 in foreign currency)
- Internal Rate of Return: 16.97%
- Break-Even Point (at 5th year of production) 29%
- Pay-Back Period: less than 7 years (including construction period)
- Employees: 127

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 34,959,820 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

1.1 Nigerian economy, up to the 60's, was based on agriculture. Up to that period, the country was not only self sufficient in production of food commodities, but was able to export items such as palm-oil, cocoa, ground nut and cotton.

More than 70% of cultivated land is owned by peasant farmers, who use hand tools in their farming operations. The size of the average holding is between 3 to 5 ha.

1.2 In the 70's, Nigeria became an oil producing country; the process of industrialization started and, in general, an appreciable improvement of the social situation was registered.

The demand for consumable goods and food products increased dramatically and the gap between it and the domestic supply was filled by imports.

(1) For additional background material, see Volume I p. 186.

1.3 To correct this negative situation and to enhance agricultural outputs, farmers were provided with incentives such as:

- the establishment of tractor hiring units, to which individual farmers could apply for obtaining services, paying an acceptable fee;

- the establishment of land clearing unit under which developed areas were allocated to farmers and provision for subsidy to the same for the purchase of tractors and other mechanical equipment was made.

- the provision of subsidies for buying fertilizers, seeds and insecticide.

1.4 The Federal Government established in 1976 facilities for manufacturing tractors and implements in order to boost the agricultural mechanization and, at the same time, create a basis for the engineering industry.

A joint-venture project with Steyr Daimler Puch of Austria made possible the setting up of a plant in Bauchi for the manufacture of tractors and commercial vehicles.

Another venture was set up with Fiat Trattori/Iveco of Italy: for the assembling of tractors and trucks Kano and National Truck Manufacturers Ltd., Kano was established.

1.4.1 <u>Steyr Nigeria ltd., Bauchi</u>

This plant started the activity as imported SKD (Semi-knock-Down) and CKD (Completely Knock-Down) assembling unit with a program of using parts and components made available by indigenous industry.

The planned annual capacity was 5000 units of 70 HP agricultural tractors, 8000 units of trucks and 4000 units of electric generating sets. The production of tractors reached its peak in 1981 with an output equivalent to only 29% of the nominal capacity.

At present, the plant is assembling only few units and the forecast is to wind up the assembly. The management is studying the diversification of the production, using the existing facilities.

1.4.2 National Truck Manufacturers ltd., Kano

This plant started operation with SKD and CKD components. The planned capacity was 3000 tractors having a power ranging from 60 to 190 HP. The plant stopped its operation in 1988 and the company closed down in 1989.

1.4.3 The reasons that brought about the failure of these two ventures are not very clear.

According to the management of the plants, the major reasons are strictly related to financial problems, which the two companies were not able to solve such as too long delays in the payments for sales and extreme difficulties in getting the necessary hard currency to import components.

The consultant believes that there are other reasons for the failure.

If the problem is analyzed from the side of the farmers it is possible to enumerate other reasons that can be considered determinant for the stoppage of the plants operation. Among others, the following three seems to be the most important:

a. KIND OF TRACTORS

The types of the machines produced are carbon copies of the machines used in the countries where the agricultural mechanization has reached an advanced stage without any adaptation to the Nigerian environment.

b. PRICE OF TRACTORS

The selling prices, despite the Government's subsidies to the buyers, are too high for the majority of the farmers.

c. MENTALITY OF FARMERS

It is generally true that peasants all over the world cannot be easily convinced to abandon their traditional way of farming. Moreover, Nigeria has large families which provide cheap labour for farming operations. Many farmers also use animal drawn implements, therefore any investment in machines is not favourably considered.

Ways to induce farmers to use mechanical equipment were tried. One of them was to co nvince the farmers to form cooperatives, in order to pool the resources for buying agricultural machines and share their use.

1.5 Government policy is to attain self sufficiency in agricultural production. Farm mechanization is one of the cousidered measures. Hence this proposal recommended the assembly of tractors based on the following conditions:

- high percentage of indigenous manufacturing contribution
- strong construction
- simple design
- easy maintenance
- reasonable price

This study will analyze the installation of a plant for the manufacture of tractors powered by diesel engines of 20 and 30 HP.

2. MARKET AND PLANT CAPACITY

2.1 THE DEMAND

There is no information and data available for the assessment of the demand of tractors of small and medium power.

The potential of the market is great, but it is hard to anticipate what will be the reaction of the farmers to the product.

On the basi of similar experiences in other countries and taking into consideration previous studies carried out in Nigeria, a demand in the range of 2,000 to 5,000 units per year can be assumed.

2.2 THE SUPPLY

At present, as already mentioned in the introduction, there are no facilities in Nigeria manufacturing small/medium tractors and data on imports are not available.

2.3 PLANT CAPACITY

The plant is designed for an output of 2000 units per year:

1000 units 2 WD powered with 20 HP diesel engine; 1000 units 4 WD powered with 30 HP diesel engine;

These quantities can be changed in accordance with the response of the market.

The production is based on 250 days/year, 1 shift/day.

2.4 THE TRACTORS

The proposed tractors have been specially studied, designed and are manufactured to meet the needs of developing countries farmers.

They are perfectly in line with the requisites already mentioned in chapter 1. The main features are the following:

Technical specifications

. steel frame

. rear wheel drive or four wheel drive

. front wheel steering

. differential gear - differencial lock

. pivoting front axle

. drumbrakes dm. 180 mm on front wheels with parking brake rear wheels

. disk brakes on rear wheels (optional)

. rear P.T.O.

. front P.T.O.

. front tires 4.00 - 12

. rear tires 6.50 - 16

. wheel base 1450 mm.

. front tracks 1150 mm.

. rear tracks 1200 mm.

. total lenght with cutting bar 3450 mm.

. total height 1500 mm.

. total weight (without implements) kg. 780

. 3 point linkage cat. 1st

. rear hook for trailers

Engine

. two cylinders four strokes air cooled diesel engine

. rated horse power 20HP at 3000 R.P.M.

or

. 3 cylinders four strokes, air cooled diesel engine

. rated horse power: 30 HP at 3000 R.P.M.

Clutch

. single disk $7^{1/2}$ inches dry clutch, mechanically operated

Gear box

. six forwards and three reverse speeds with sliding gears

. four satellite differential sets with locking device

. final reduction set

Steering

. rack and pinion steering box

Brakes

. drum service brakes on the front wheels,, mechanically operated

. drum parking brake on the gear box, mechanically operated

Hydraulic system

. open center hydraulic system with engine operated gear pump

. pump capacity 8.2 c.c.

. maximum operating pressure 180 bars

. manually operated valve with 3 ways distributor

Lifting and trailing device

Front lifting device (specific for cutting bar and for harvester binder) hydraulically operated.

. rear standard 3 point linkage, category 1, hydraulically operated

. lifting capacity (at the end balls) 900 lbs

. rear standard hook for trailers

Electric and lifting system

. 12 volts with engine operated A.C., 480 watt generator

. 45 Am battery

. engine starting device

. head lamps

. rear road signals

2.5 SALES PRICES AND REVENUE

The following selling prices will be considered:

- 20 HP 2 WD tractor	US $	6,500
- 30 HP 4 WD tractor	US $	8,000

It is expected that the plant will reach its nominal output in the third year of operation, passing through two steps:

1st year	30%
2nd year	60%

The revenues will be as follows:

1st year	(1,950,000 + 2,400,000)	US$ 4,350,000
2nd year	(3,900,000 + 4,800,000)	US$ 8,700,000
3rd year	(6,500,000 + 8,000,000)	US$ 14,500,000

3. MATERIAL AND INPUTS

3.1 MATERIALS

Herebelow the materials required for the manufacturing of tractors are reported mainly as sub-assemblies and parts. The details of the sub-assemblies and parts can be seen in the annexe 2.

The split of the costs in local and foreign currencies has to be considered indicative only.

A detailed market survey in Nigeria will establish the actual portion of parts, components and sub-assemblies that can be manufactured and supplied by local industries.

As far as the engines are concerned, it is worth mentioning that an opportunity study has been prepared to establish the convenience of setting up a diesel engine assembling unit.

The materials and components at present available in Nigeria are:

- wheels
- electrical systems
- steel profiles for the chassis construction

All other components and subassemblies have to be imported.

3.1.1 Sub-assemblies and parts

Table 3.1.1.a - Tractor 20 HP 2 WD

Description	Q.ty		Unit cost	total cost (US $)	
			(US $)	L.C.	F.C.
Diesel engine	1,000	units	2,500		[1]2,500,000
Clutch	1,000	units	80		80,000
Steering system	1,000	series	80		80,000
Wheels	1,000	series	400	400,000	
Gears	1,000	series	200		200,000
Cast iron boxes	1,000	series	160		160,000
Electrical system	1,000	series	200	200,000	
Chassis and linkages	350	tons	1,250	437,500	
Bearings	1,000	series	120		120,000
Miscellaneous	1,000	series	400	200,000	200,000
Total				**1,237,500**	**3,340,000**
Grand total				**4,577,500**	

[1] An opportunity study for an assembling plant of diesel engines has been carried out. If this plant will be implemented, this amount will be considered in LC.

Table 3.1.1.b - Tractor 30 HP 4 WD

Description	Q.ty	Unit cost	total cost (US $)	
		(US $)	L.C.	F.C.
Diesel engine	1,000 units	3,500		(1)3,500,000
Clutch	1,000 units	80		80,000
Steering system	1,000 series	150		150,000
Wheels	1,000 series	600	600,000	
Gears	1,000 series	200		200,000
Cast iron boxes	1,000 series	160		160,000
Electrical system	1,000 series	200	200,000	
Chassis and linkages	350 tons	1,250	437,500	
Bearings	1,000 series	150		150,000
Miscellaneous	1,000 series	400	200,000	200,000
Total			**1,437,500**	**4,440,000**
Grand total			**5,877,500**	

3.2 ELECTRIC ENERGY

The installed power is 500 kW. The coefficient of utilization is 0.5. The cost of energy is 0.10 US$/kWh, therefore the annual expenditures will be 500 x 0.5 x 250 x 8 x 0,1 = US $ 50,000.

3.3 CONSUMABLES

The considered consumables are paint and varnishes, electrodes, chemical products, lubricants, diesel oil for testing.

The estimated cost of consumables is 200,000 US$/y, to be shared 50/50 per each type of tractor.

4. LOCATION

Before selecting the site it would be interesting to verify the possibility of installing the production equipment within the premises of Steyr, in Bauchi or within the premises of National Truck Manufacturing in Kano.

This solution would offer important advantages:

. reduction of investments for land, building and utilities

. availability of skilled manpower.Anyway, in the financial analysis, a new plant will be considered.

5. PROJECT ENGINEERING

The plant will be designed in accordance with the concept adopted by many industrialist, when they decide to make a new investment: reduce to a minimum the fixed investment costs and rely as much as possible on qualified sub-suppliers. This allows to keep to a minimum the stock of raw materials, parts, components, and sub-assemblies and, consequently, the working capital.

The project will encourage the local fabrication of its components with view to minimizing importation.

The proposed plant is a tractor assembling unit, exception made for the carpentry department, where all the equipment necessary for in house fabrication of the frame and linkages is installed.

5.1 PRODUCTION AND ANCILLARY EQUIPMENT

The plant consists of the following departments:

5.1.1 Receiving and parts, components and sub-assemblies store

The main equipment of this department consists of:

. electric fork lift

. diesel engine fork lift

. pallet trucks

. shelves

. steel containers

. wood boxes

. iron boxes

. miscellaneous materials

5.1.2 Carpentry department

The main equipment of this department consists of:

. hydraulic steel sheet shearing machine

. hydraulic bending machine

. goose-neck press

. tube bending machine

. hack-sawing machine

. pillar drilling machine

. pipe cutting machine

. welding machines (wire, arc, spot)

. grinder

. welding benches

. lot of hand tools

5.1.3 Painting department

The main equipment of this department consists of:

. pickling, washing, phosphatizing, priming and final automatic painting line, including disposed water treatment unit

. set of hand tools

5.1.4 Pre-assembling department

The main equipment of this department consists of:

. working benches

. pneumatic stud drivers

. hand tools

. hand trucks

5.1.5 Assembling department

The main equipment of this department consists of:

. specific hand trucks

. pneumatic stud drivers

. sets of hand tools

. machine for tyre mounting

. containers

5.1.6 Finished machines store and despatching department

The main equipment of this department consists of:

. electric fork lift

. grease gun

. oil feeder

. battery charger

5.1.7 Workshop and maintenance department

The main equipment of this department consists of:

. milling machine

. parallel lathe

. swing grinder

. pillar drilling machine

. welding machines

. working benches

. grinding machines

. sets of hand tools

. set of instruments

5.1.8 Utilities department

The main equipment of this department consists of:

. electrical sub-station, with stop-down transformer and emergency genset

. compressed air station

. anti-fire water tank and pumps

. industrial water pumping station

. diesel-oil deposit

5.1.9 After-sales service department

The main equipment of this department consists of:

. two truck mounted repair shops

. pick-ups

. fuel pumps and injectors testing bench

. sets of hand tools

5.1.10 Miscellaneous

It includes the lighting system, the compressed air distribution network, the electric power distribution system, the drinking and industrial water network, the earthing system.

5.1.11 Transport equipment

For the outside transports, two 30 tons capacity trucks with trailer and two passenger cars are envisaged.

5.2 LAY-OUT AND CIVIL WORKS

The plant will cover an area of 6,120 sq.m, while the total available area has to be at least 10,000 sq.m.

The building will be in steel structure and it will be divided in three bays of 20 by 102 m each.

The roofing will be of shed type, to ensure natural lighting and it will be provided with proper openings for the natural ventilation. It will be done using hot deep galvanized steel sheets. Its elevation will allow a clear height of 6 m.

In the right down corner of the plant the personnel facilities and the offices will be located, on two floors, for a total area of 430 sqm about.

The cladding, as well as the internal partition walls will be in cement blocks or clay bricks.

The floor of the industrial area will be of reinforced antidust concrete slabs, allowing an over load of 2,000 kg/sq.m.

The floors of the offices and sanitary rooms will be in ceramic tiles.

The sewerage consists of two sewer systems: one for rain water an one for sanitary water.

The water used in the painting department will be discharged, after the treatment, to the rainwater sewage.

5.3 INVESTMENT COSTS

The estimated investment costs are as follows:

Description	LC M$	FC M$	TOTAL M$
Machines and equipment F.O.B. European Port		2.5	2.5
Transport taxes and duties	0.5	0.25	0.75
Erection	0.8	0.2	1.0
Land and site preparation	0.2		0.2
Civil works and building	2.0		2.0
Spare parts		0.1	0.1
Total	**3.5**	**3.05**	**6.55**
Contingencies	**0.35**	**0.305**	
Grand total	**3.85**	**3.805**	**7.655**

The industrial life of the plant can be considered as 15 years. 4% of the machinery and equipment cost, can be assumed as the average annual value of the maintenance (US$ 100,000). In the financial evaluation the investment costs (contingencies included) are so subdivided:

preproduction expenditures	FC	M$ 0.000
Preproduction expenditures	LC	M$ 0.150
Machinery	FC	M$ 3.805
Machinery	LC	M$ 1.43
Land and site preparation	LC	M$ 0.22
Civil works and building	LC	M$ 2.2

		M$ 7.805

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

The manpower required for the plant operations does not need special training. Workers operating in the assembling lines can have 15 days training within the plant, assisted by the technology supplier. The carpentry department personnel shall have enough experience in metal working. The hiring of specialized personnel in this field does not constitute any problem in Nigeria. It is suggested that an expert, made available by the technology supplier. provides technical assistance for 1 year after the plant start up. The estimated cost is US $ 120,000.

7.1 MANAGEMENT

		N/Y
- General Manager	1	50,000
- Technical Manager	1	40,000
	2	90,000
	overheads 40%	36,000
		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPARTMENT

		N/Y
- Financial Manager	1	40,000
- Accountants	2	24,000
- Purchasing Department Head	1	12,000
- Purchasing Department Assist.	2	16,000
- Store Head	1	12,000
- Sales Dept. Head	1	12,000
- Salesmen	2	20,000
- After-sales Dept. Head	1	10,000
- After-sales technicians	4	32,000
- Clerks	10	80,000
- Drivers	10	80,000
- Guards	12	60,000
	47	398,000
	overheads 40%	159,200
		557,200
		(US$ 70,500)

7.3 PRODUCTION DEPARTMENT

		N/Y
- Production Manager	1	40,000
- Assistant Production Manager	1	30,000
- Shift foremen	8	96,000
- Skilled workers	10	100,000
- Semi-skilled workers	20	120,000
- Unskilled workers	20	80,000
- Clerks	3	24,000
	63	490,000
	overheads 40%	196,000
		786,000
		(US$ 86,800)

7.4 MAINTENANCE DEPARTMENT

		N/Y
- Chief engineer	1	40,000
- Mechanics	4	40,000
- electricians	4	40,000
- Others (maintenance dept.)	6	60,000
	15	180,000
	overheads 40%	72,000
		252,000
		(US$ 32,000)

Summary

Administration	49	US$ 86,500
Production	63	US$ 86,800
Maintenance	15	US$ 32,000
	127	US$ 205,300

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start-up the plant is in the range of 24 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 8,091,360 US Dollars. The portion in foreign currency accounts for 4,000,000 US Dollars.

Details of these figures are shown in chapter 5.4.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 2,120,000	US$ 1,601,000	US$ 3,721,000
- Foreign Loan (interest 8%)	US$ 1,000,000	US$ 2,284,000	US$ 3,284,000
- Local Loan (interest 15%)	US$ 100,000	US$ 700,000	US$ 800,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 30%

2nd year 60%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 3,876,868 US Dollars, the foreign portion being US$ 3,309,000.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 1,205,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 30% of its nominal capacity, the production costs amount to US$ 4,665,792.

In the third year, at full production, the costs amount to US $ 11,990,110, then they start a slight decrease year after year, to reach a constant amount of US $ 11,010,300 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 14,500,000. As said before, the production programme foresees that full production is reached gradually:

1st year 30% : revenue = US$ 4,350,000

2nd year 60% : revenue = US$ 8,700,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 16.97%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 29% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [2] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 7 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 3.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 34,959,820.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 34,959,820.

[2] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

SMALL TRACTORS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US$

Total initial investment during construction phase

fixed assets:	8091.36	49.638 % foreign
current assets:	0.00	0.000 % foreign
total assets:	8091.36	49.638 % foreign

Source of funds during construction phase

equity & grants:	3721.00	0.000 % foreign
foreign loans :	3284.00	
local loans :	800.00	
total funds :	7805.00	42.076 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	3518.30	11010.30	11010.30
depreciation :	764.77	720.77	110.00
interest :	382.72	131.36	0.00
production costs	4665.79	11862.43	11120.30
thereof foreign	67.61 %	70.68 %	70.41 %
total sales :	4350.00	14500.00	14500.00
gross income :	-315.79	2637.57	3379.70
net income :	-315.79	1582.54	2027.82
cash balance :	-1433.20	1892.81	2137.82
net cashflow :	-373.31	2434.67	2137.82

Net Present Value at: 10.00 % = 5123.82
Internal Rate of Return: 16.97 %
Return on equity1: 24.69 %
Return on equity2: 19.34 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	220.000	0.000
Buildings and civil works	1500.000	700.000
Auxiliary and service facilities .	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment . . .	1430.000	3805.000
Total fixed investment costs	3150.000	4505.000
Pre-production capital expenditures.	117.500	318.860
Net working capital	0.000	0.000
Total initial investment costs . . .	3267.500	4823.860
Of it foreign, in %	31.829	61.701

Total Current Investment in 1000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	1205.010	1125.933	1545.925
Total current investment costs	1205.010	1125.933	1545.925
Of it foreign, %	84.568	85.830	85.621

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	2602.500	5205.000	8675.000	8675.000	8675.000
Other raw materials	594.000	1188.000	1980.000	1980.000	1980.000
Utilities	15.000	30.000	50.000	50.000	50.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	86.800	86.800	86.800	86.800	86.800
Repair, maintenance	15.000	30.000	50.000	50.000	50.000
Spares	15.000	30.000	50.000	50.000	50.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	3448.300	6569.800	10891.800	10891.800	10891.800
Administrative overheads	70.000	71.100	118.500	118.500	118.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	764.772	764.772	742.772	720.772	720.772
Financial costs	382.720	309.880	237.040	164.200	131.360
Total production costs	4665.792	7715.552	11990.110	11895.270	11862.430
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	67.609	69.349	70.473	70.759	70.678
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	156.800	157.900	205.300	205.300	205.300

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	8675.000	8675.000	8675.000	8675.000	8675.000
Other raw materials	1980.000	1980.000	1980.000	1980.000	1980.000
Utilities	50.000	50.000	50.000	50.000	50.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	86.800	86.800	86.800	86.800	86.800
Repair, maintenance	50.000	50.000	50.000	50.000	50.000
Spares	50.000	50.000	50.000	50.000	50.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	10891.800	10891.800	10891.800	10891.800	10891.800
Administrative overheads	118.500	118.500	118.500	118.500	118.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	633.500	633.500	633.500	633.500	110.000
Financial costs	98.520	65.680	32.840	0.000	0.000
Total production costs	11742.320	11709.480	11676.640	11643.800	11120.300
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	70.761	70.679	70.597	70.514	70.412
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	205.300	205.300	205.300	205.300	205.300

Total Production Costs in 1000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	8675.000
Other raw materials	1980.000
Utilities	50.000
Energy	0.000
Labour, direct	86.800
Repair, maintenance	50.000
Spares	50.000
Factory overheads	0.000
Factory costs	10891.800
Administrative overheads	118.500
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	11010.300
Costs per unit (single product)	0.000
Of it foreign, %	71.115
Of it variable,%	0.000
Total labour	205.300

Net Working Capital in 1000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	293.192	553.408	917.525	917.525
Inventory and materials	72	5.0	638.917	1277.833	2129.722	2129.722
Energy	0	---	0.000	0.000	0.000	0.000
Spares	180	2.0	7.500	15.000	25.000	25.000
Work in progress	5	72.0	47.893	91.247	151.275	151.275
Finished products	30	12.0	293.192	553.408	917.525	917.525
Cash in hand	15	24.0	12.783	9.079	12.721	12.721
Total current assets			1293.476	2499.976	4153.768	4153.768
Current liabilities and						
Accounts payable	9	39.3	88.467	169.033	276.900	276.900
Net working capital			1205.010	2330.943	3876.868	3876.868
Increase in working capital			1205.010	1125.933	1545.925	0.000
Net working capital, local			185.951	345.493	567.785	567.785
Net working capital, foreign			1019.058	1985.450	3309.083	3309.083

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	2120.000	1601.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1000.000	2284.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	100.000	700.000
Loan C, local....	0.000	0.000
Total loan	1100.000	2984.000
Current liabilities	0.000	0.000
Bank overdraft	47.500	238.860
Total funds	3267.500	4823.860

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-410.500	-410.500	-410.500	-410.500	-410.500	-410.500
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-266.667	-266.667	-266.667	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000	0.000
Total loan	-677.167	-677.167	-677.167	-410.500	-410.500	-410.500
Current liabilities	88.467	80.567	107.867	0.000	0.000	0.000
Bank overdraft	1433.196	447.660	-25.613	-1873.109	-268.494	0.000
Total funds	844.496	-148.940	-594.913	-2283.609	-678.994	-410.500

Cashflow Tables, construction in 1000 US$

Year	1990	1991
Total cash inflow	3220.000	4585.000
Financial resources	3220.000	4585.000
Sales, net of tax	0.000	0.000
Total cash outflow	3267.500	4823.860
Total assets	3220.000	4585.000
Operating costs	0.000	0.000
Cost of finance	47.500	238.860
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	-47.500	-238.860
Cumulated cash balance	-47.500	-286.360
Inflow, local	2220.000	2301.000
Outflow, local	2227.500	1847.500
Surplus (deficit)	-7.500	453.500
Inflow, foreign	1000.000	2284.000
Outflow, foreign	1040.000	2976.360
Surplus (deficit)	-40.000	-692.360
Net cashflow	-3220.000	-4585.000
Cumulated net cashflow	-3220.000	-7805.000

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	4438.467	8780.566	14607.870	14500.000	14500.000	14500.000
Financial resources	88.467	80.567	107.867	0.000	0.000	0.000
Sales, net of tax	4350.000	8700.000	14500.000	14500.000	14500.000	14500.000
Total cash outflow	5871.663	9228.227	14582.250	12626.890	12607.190	12622.390
Total assets	1293.476	1206.500	1653.792	0.000	0.000	0.000
Operating costs	3518.300	6640.900	11010.300	11010.300	11010.300	11010.300
Cost of finance	382.720	309.880	237.040	164.200	131.360	98.520
Repayment	677.167	677.167	677.167	410.500	410.500	410.500
Corporate tax	0.000	393.779	1003.955	1041.891	1055.027	1103.072
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-1433.196	-447.660	25.611	1873.108	1892.812	1877.607
Cumulated cash balance	-1719.556	-2167.216	-2141.605	-268.497	1624.315	3501.922
Inflow, local	4431.608	8774.375	14599.170	14500.000	14500.000	14500.000
Outflow, local	1703.526	2917.263	4812.381	4222.192	4235.328	4283.373
Surplus (deficit)	2728.082	5857.112	9786.786	10277.810	10264.670	10216.630
Inflow, foreign	6.858	6.192	8.700	0.000	0.000	0.000
Outflow, foreign	4168.137	6310.963	9769.873	8404.700	8371.860	8339.020
Surplus (deficit)	-4161.278	-6304.771	-9761.173	-8404.700	-8371.860	-8339.020
Net cashflow	-373.310	539.387	939.819	2447.808	2434.672	2386.627
Cumulated net cashflow	-8178.310	-7638.922	-6699.104	-4251.295	-1816.623	570.004

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	14500.000	14500.000	14500.000	14500.000	14500.000	14500.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	14500.000	14500.000	14500.000	14500.000	14500.000	14500.000
Total cash outflow	12602.690	12582.980	12152.780	12362.180	12406.180	12406.180
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	11010.300	11010.300	11010.300	11010.300	11010.300	11010.300
Cost of finance	65.680	32.840	0.000	0.000	0.000	0.000
Repayment	410.500	410.500	0.000	0.000	0.000	0.000
Corporate tax	1116.208	1129.344	1142.480	1351.880	1395.880	1395.880
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1897.312	1917.016	2347.219	2137.819	2093.819	2093.819
Cumulated cash balance	5399.234	7316.250	9663.469	11801.290	13895.110	15988.930
Inflow, local	14500.000	14500.000	14500.000	14500.000	14500.000	14500.000
Outflow, local	4296.509	4309.645	4322.781	4532.181	4576.181	4576.181
Surplus (deficit)	10203.490	10190.360	10177.220	9967.819	9923.819	9923.819
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	8306.180	8273.340	7830.000	7830.000	7830.000	7830.000
Surplus (deficit)	-8306.180	-8273.340	-7830.000	-7830.000	-7830.000	-7830.000
Net cashflow	2373.491	2360.355	2347.219	2137.819	2093.819	2093.819
Cumulated net cashflow	2943.495	5303.850	7651.069	9788.889	11882.710	13976.530

Cashflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	14500.000	14500.000	14500.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	14500.000	14500.000	14500.000
Total cash outflow	12406.180	12406.180	12406.180
Total assets	0.000	0.000	0.000
Operating costs	11010.300	11010.300	11010.300
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1395.880	1395.880	1395.880
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	2093.819	2093.819	2093.819
Cumulated cash balance	18082.750	20176.570	22270.390
Inflow, local	14500.000	14500.000	14500.000
Outflow, local	4576.181	4576.181	4576.181
Surplus (deficit)	9923.819	9923.819	9923.819
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	7830.000	7830.000	7830.000
Surplus (deficit)	-7830.000	-7830.000	-7830.000
Net cashflow	2093.819	2093.819	2093.819
Cumulated net cashflow	16070.350	18166.170	20257.980

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	6001.59 at	10.00 %
Internal Rate of Return (IRRE1) ..	24.69 %	

b) Net Worth versus Net cash return:

Net present value	5360.54 at	10.00 %
Internal Rate of Return (IRRE2) ..	19.34 %	

c) Internal Rate of Return on total investment:

Net present value	5123.82 at	10.00 %
Internal Rate of Return (IRR) ..	16.97 %	

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	4350.000	8700.000	14500.000	14500.000	14500.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4350.000	8700.000	14500.000	14500.000	14500.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4283.072	7405.672	11753.070	11731.070	11731.070
Operational margin	66.928	1294.328	2746.928	2768.928	2768.928
As % of total sales	1.539	14.877	18.944	19.096	19.096
Cost of finance	382.720	309.880	237.040	164.200	131.360
Gross profit	-315.792	984.448	2509.888	2604.728	2637.567
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-315.792	984.448	2509.888	2604.728	2637.567
Tax	0.000	393.779	1003.955	1041.891	1055.027
Net profit	-315.792	590.669	1505.933	1562.837	1582.540
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-315.792	590.669	1505.933	1562.837	1582.540
Accumulated undistributed profit	-315.792	274.877	1780.810	3343.646	4926.187
Gross profit, % of total sales	-7.260	11.315	17.310	17.964	18.190
Net profit, % of total sales	-7.260	6.789	10.386	10.778	10.914
ROE, Net profit, % of equity	-8.487	15.874	40.471	42.000	42.530
ROI, Net profit+interest, % of invest.	0.743	8.885	14.920	14.784	14.671

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	14500.000	14500.000	14500.000	14500.000	14500.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	14500.000	14500.000	14500.000	14500.000	14500.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	11643.800	11643.800	11643.800	11643.800	11120.300
Operational margin	2856.200	2856.200	2856.200	2856.200	3379.700
As % of total sales	19.698	19.698	19.698	19.698	23.308
Cost of finance	98.520	65.680	32.840	0.000	0.000
Gross profit	2757.681	2790.521	2823.360	2856.200	3379.700
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	2757.681	2790.521	2823.360	2856.200	3379.700
Tax	1103.072	1116.208	1129.344	1142.480	1351.880
Net profit	1654.608	1674.312	1694.016	1713.720	2027.820
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1654.608	1674.312	1694.016	1713.720	2027.820
Accumulated undistributed profit	6580.795	8255.107	9949.124	11662.840	13690.660
Gross profit, % of total sales	19.018	19.245	19.471	19.698	23.308
Net profit, % of total sales	11.411	11.547	11.683	11.819	13.985
ROE, Net profit, % of equity	44.467	44.996	45.526	46.055	54.497
ROI, Net profit+interest, % of invest.	15.007	14.895	14.782	14.670	17.359

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	14500.000	14500.000	14500.000	14500.000	14500.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	14500.000	14500.000	14500.000	14500.000	14500.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	11010.300	11010.300	11010.300	11010.300	11010.300
Operational margin	3489.700	3489.700	3489.700	3489.700	3489.700
As % of total sales	24.067	24.067	24.067	24.067	24.067
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	3489.700	3489.700	3489.700	3489.700	3489.700
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3489.700	3489.700	3489.700	3489.700	3489.700
Tax	1395.880	1395.880	1395.880	1395.880	1395.880
Net profit	2093.820	2093.820	2093.820	2093.820	2093.820
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2093.820	2093.820	2093.820	2093.820	2093.820
Accumulated undistributed profit	15784.480	17878.300	19972.130	22065.950	24159.770
Gross profit, % of total sales	24.067	24.067	24.067	24.067	24.067
Net profit, % of total sales	14.440	14.440	14.440	14.440	14.440
ROE, Net profit, % of equity	56.270	56.270	56.270	56.270	56.270
ROI, Net profit+interest, % of invest.	17.924	17.924	17.924	17.924	17.924

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	3267.500	8091.360
Fixed assets, net of depreciation	0.000	3267.500
Construction in progress	3267.500	4823.860
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	3267.500	8091.360
Equity capital	2120.000	3721.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	1100.000	4084.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	47.500	286.360
Total debt	1147.500	4370.360
Equity, % of liabilities	64.881	45.987

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	8935.856	9377.585	9972.813	9252.041	10155.590
Fixed assets, net of depreciation	7326.588	6561.816	5819.044	5098.272	4377.500
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1280.693	2490.897	4141.047	4141.047	4141.047
Cash, bank	12.783	9.079	12.721	12.721	12.721
Cash surplus, finance available	0.000	0.000	0.000	0.000	1624.318
Loss carried forward	0.000	315.792	0.000	0.000	0.000
Loss	315.792	0.000	0.000	0.000	0.000
Total liabilities	8935.856	9377.585	9972.813	9252.041	10155.590
Equity capital	3721.000	3721.000	3721.000	3721.000	3721.000
Reserves, retained profit	0.000	0.000	274.877	1780.810	3343.646
Profit	0.000	590.669	1505.933	1562.837	1582.540
Long and medium term debt	3406.833	2729.667	2052.500	1642.000	1231.500
Current liabilities	88.467	169.033	276.900	276.900	276.900
Bank overdraft, finance required.	1719.556	2167.216	2141.603	268.494	0.000
Total debt	5214.856	5065.916	4471.003	2187.394	1508.400
Equity, % of liabilities	41.641	39.680	37.311	40.218	36.640

Projected Balance Sheets, Production in 1000 US$

Year	1997	1998	1999	2000	2001
Total assets	11399.700	12663.510	13947.020	15660.740	17688.560
Fixed assets, net of depreciation	3744.000	3110.500	2477.000	1843.500	1733.500
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	4141.047	4141.047	4141.047	4141.047	4141.047
Cash, bank	12.721	12.721	12.721	12.721	12.721
Cash surplus, finance availab.e	3501.927	5399.239	7316.256	9663.476	11801.300
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	11399.700	12663.510	13947.020	15660.740	17688.560
Equity capital	3721.000	3721.000	3721.000	3721.000	3721.000
Reserves, retained profit	4926.187	6580.795	8255.107	9949.124	11662.840
Profit	1654.608	1674.312	1694.016	1713.720	2027.820
Long and medium term debt	821.000	410.500	0.000	0.000	0.000
Current liabilities	276.900	276.900	276.900	276.900	276.900
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1097.900	687.400	276.900	276.900	276.900
Equity, % of liabilities	32.641	29.384	26.680	23.760	21.036

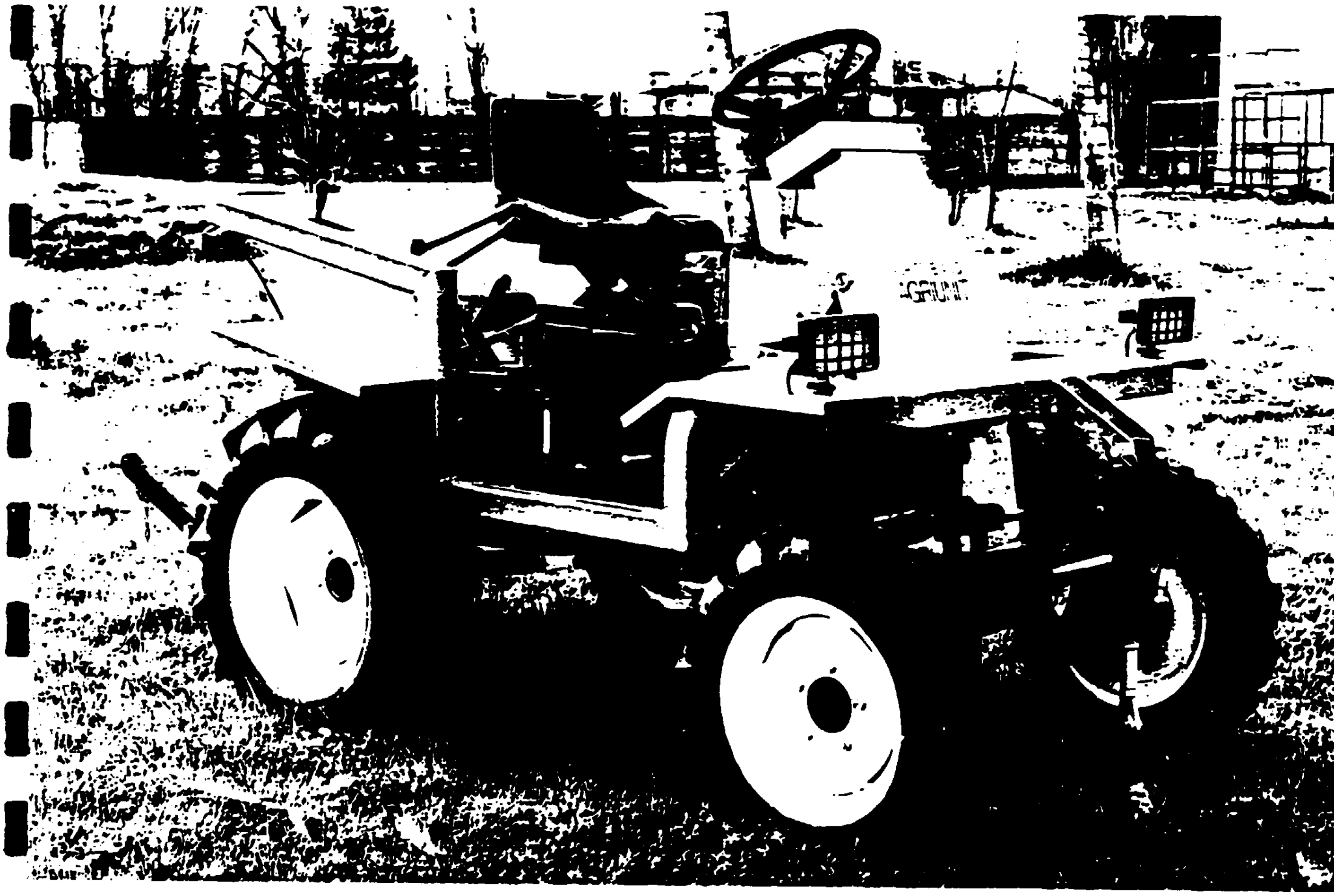
Projected Balance Sheets, Production in 1000 US$

Year	2002	2003	2004	2005	2006
Total assets	19782.380	21876.210	23970.030	26063.850	28157.670
Fixed assets, net of depreciation	1733.500	1733.500	1733.500	1733.500	1733.500
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	4141.047	4141.047	4141.047	4141.047	4141.047
Cash, bank	12.721	12.721	12.721	12.721	12.721
Cash surplus, finance available	13895.120	15988.940	18082.760	20176.580	22270.400
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	19782.380	21876.210	23970.030	26063.850	28157.670
Equity capital	3721.000	3721.000	3721.000	3721.000	3721.000
Reserves, retained profit	13690.660	15784.480	17878.300	19972.130	22065.950
Profit	2093.820	2093.820	2093.820	2093.820	2093.820
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	276.900	276.900	276.900	276.900	276.900
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	276.900	276.900	276.900	276.900	276.900
Equity, % of liabilities	18.810	17.009	15.524	14.276	13.215

ANNEXE 2

DATA & DWGS OF TRACTORS

Multipurpose Machine
Agriunit AGP/30/B 4WD



Technical specifications

Engine

Clutch

Gear box

Steering

Brakes

Hydraulic system

Lifting and trailing device

Electric and lifting system

Caractéristiques techniques

Moteur

Embrayage

Boite de vitesses

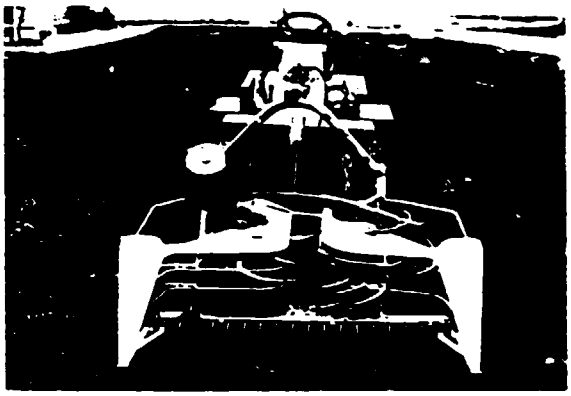
Direction

Freins

Installation Hydraulique

Dispositifs de relevage et traction

Installation électrique et de relevage



Reaper binder standard type
for weat, rice etc.
mod. AU/140

- Front mounted with hydraulic lift
- Cardan shaft transmission
- Working width 140 cm

Moissonneuse-lieuse
type standard pour ble, riz, etc.
mod. AU/140

- *Montage avant avec relevage hydraulique*
- *Transmission par arbre de cardan*
- *Largeur de travail 140 cm*

The Agriunit AGP/20/30
with: implements

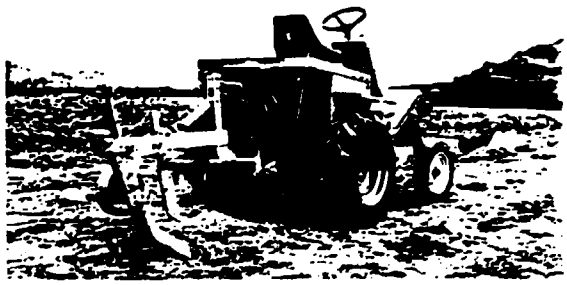
AGRIUNIT AGP/20/30
avec outils

Rotary tiller mod. AU/100

- Weight kg 135
- Working width 90 cm
- Working depth 10-18 cm
- 3 point linkage - cat. 1 - mounted type

Defonceuse rotative mod. AU/100

- *Poids 135 kg*
- *Largeur de travail 90 cm*
- *Profondeur de travail 10-18 cm*
- *Attelage 3 points Cat. 1*



Plough single furrow mod. AU/161-3P/A

- Working depth 15-20 cm
- Working width 25-30 cm
- Mounted type - 3 point linkage 1st cat.

Charrue monosoc mod. AU/161-3P/A

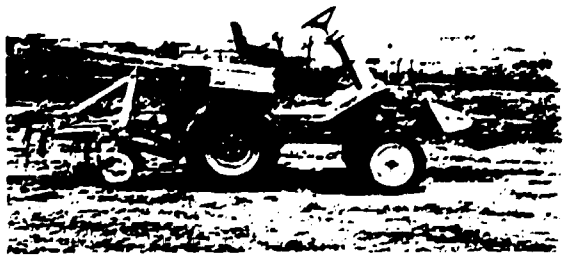
- *Profondeur de travail 15-20 cm*
- *Largeur de travail 25-30 cm*
- *Attelage 3 points - Cat. 1*

Disc plough - 2 discs - mod. AU/46

- Weight kg 94
- Working width 30 cm
- Working depth 16 cm
- 3 point linkage - cat. 1 - mounted type

Charrue a disques - mod. AU/46

- *Poids 94 kg*
- *Largeur de travail 30 cm*
- *Profondeur de travail 16 cm*
- *Attelage 3 points - Cat. 1*



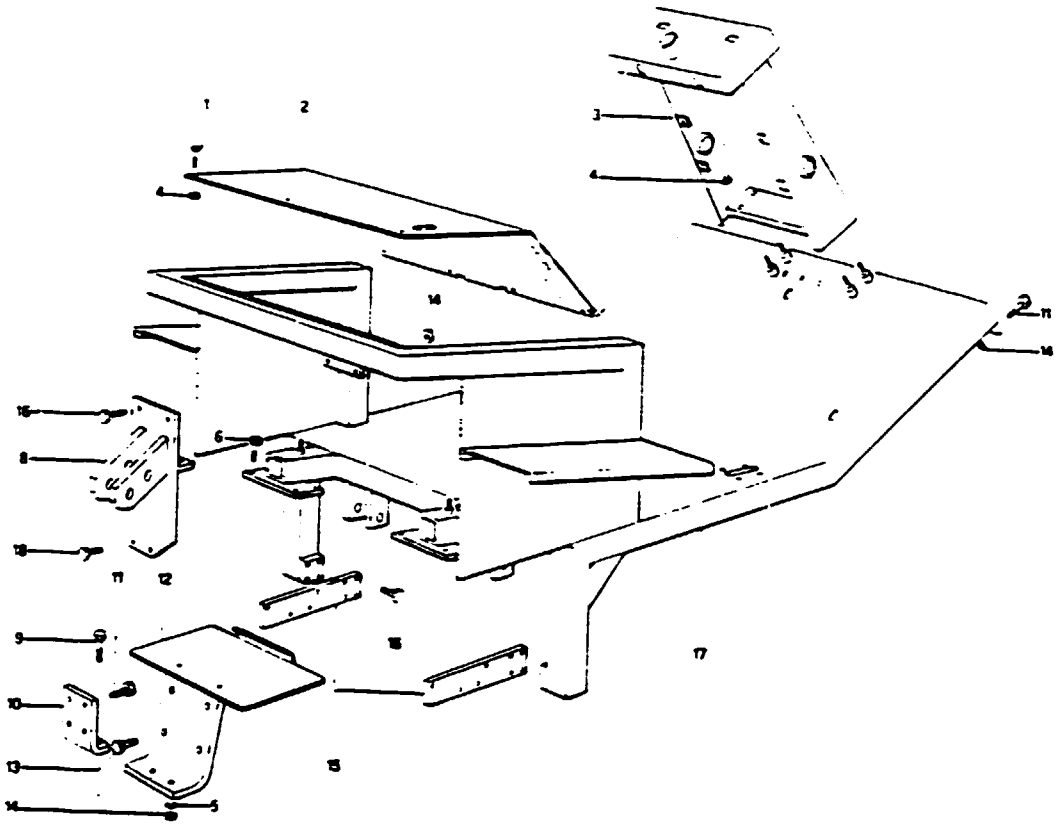
Tiller spring type mod. AU/5

- Weight kg 110
- Working width 115 cm
- Working depth 16 cm
- Mounted type 3 point linkage cat. 1

Defonceuse a ressort mod. AU/5

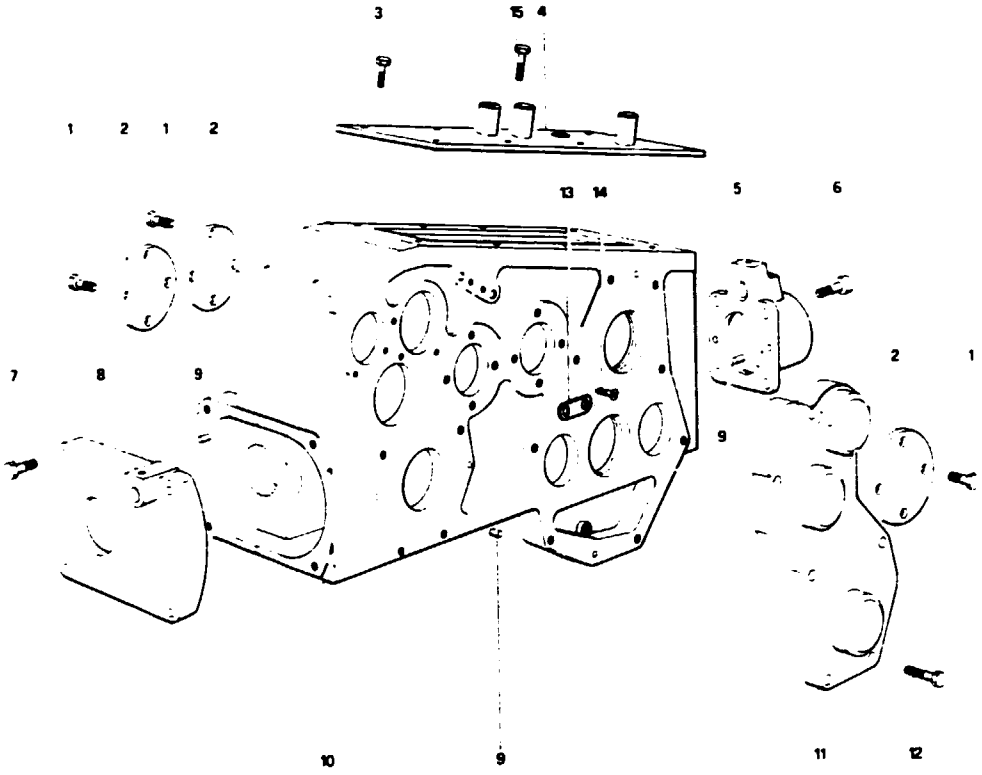
- *Poids 110 kg*
- *Largeur de travail 115 cm*
- *Profondeur de travail 16 cm*
- *Attelage 3 points Cat. 1*

Chassis frame



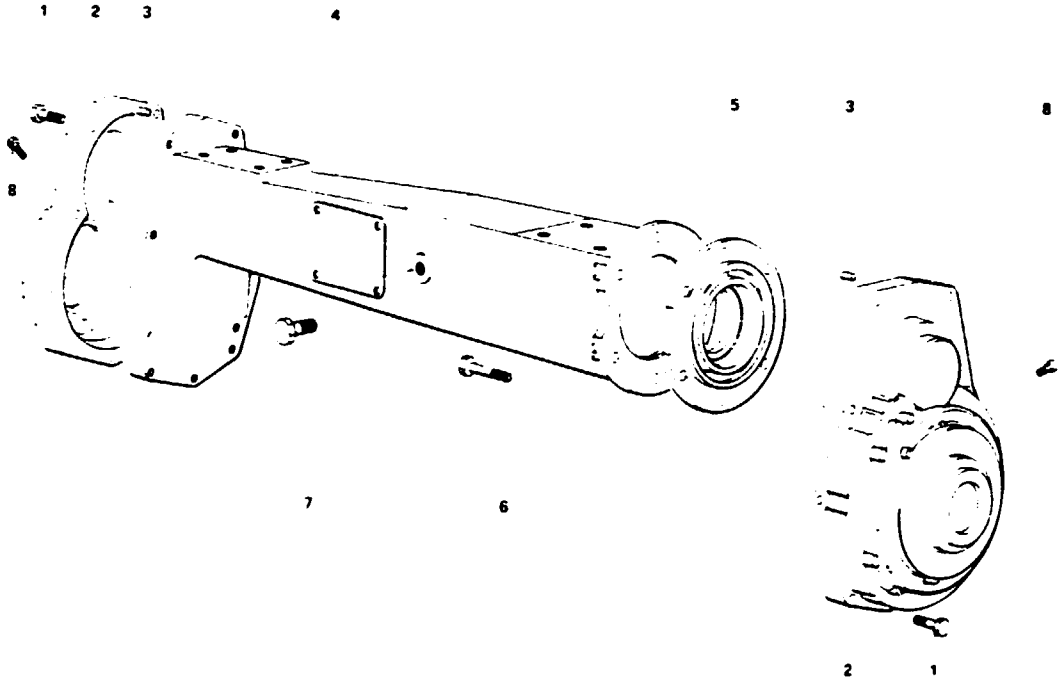
Pos.	Name
1	Screw
2	Rear Cover
3	Dashboard
4	Nut
5	Wasner
6	Screw
7	Nut
8	Support
9	Screw
10	Engine support
11	Screw
12	Support
13	Screw
14	Nut
15	Plate
16	Screw
17	Chassis frame
18	Screw

Gear box



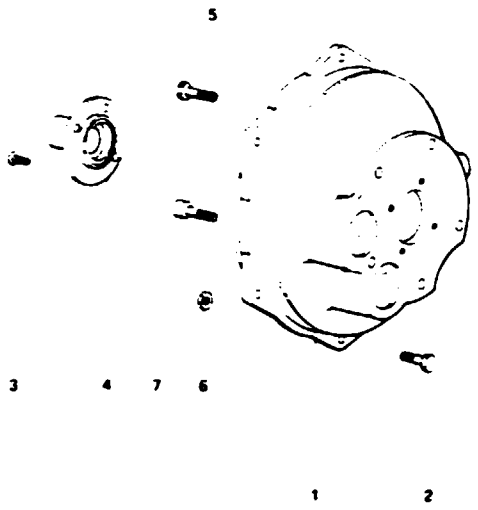
Pos.	Name
1	Screw
2	Small cover
3	Screw
4	Box cover
5	Front P.t.o. box
6	Screw
7	Screw
8	Rear cover
9	Pin
10	Gear box
11	Cover
12	Screw
13	Small plate
14	Screw
15	Screw

Reduction box.



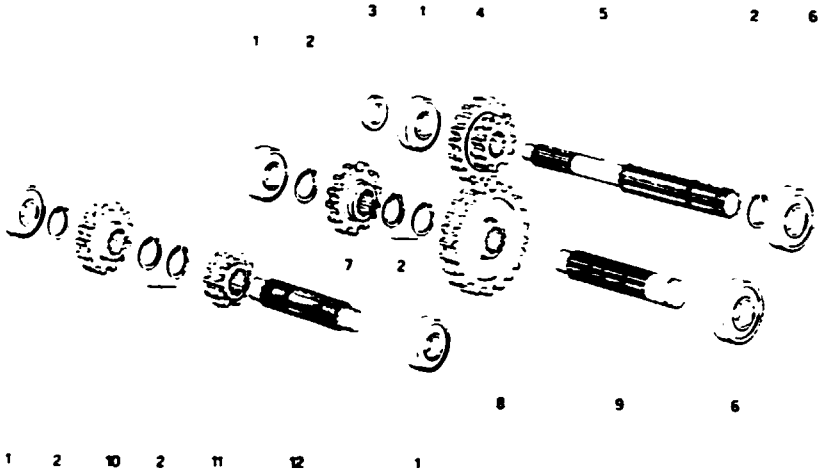
Pos.	Name
1	Screw
2	Cover
3	Pin
4	Left reduction box
5	Support
6	Screw
7	Screw
8	Screw

Clutch housing.



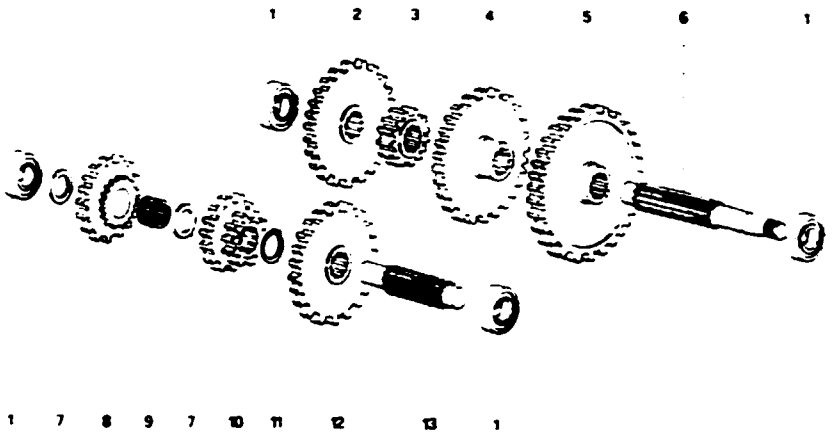
Pos.	Name
1	Clutch housing
2	Screw
3	Screw
4	Cover
5	Screw
6	Nut
7	Screw

Range gears.



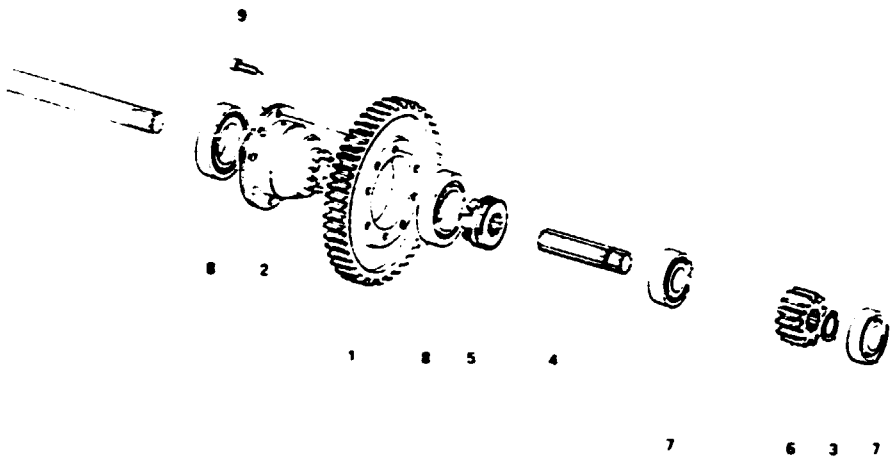
Pos.	Name
1	Bearing
2	Circlip
3	Shoulder
4	Gear
5	Shaft
6	Bearing
7	Gear
8	Gear
9	Shaft
10	Gear
11	Gear
12	Rever shaft

Speed gears.



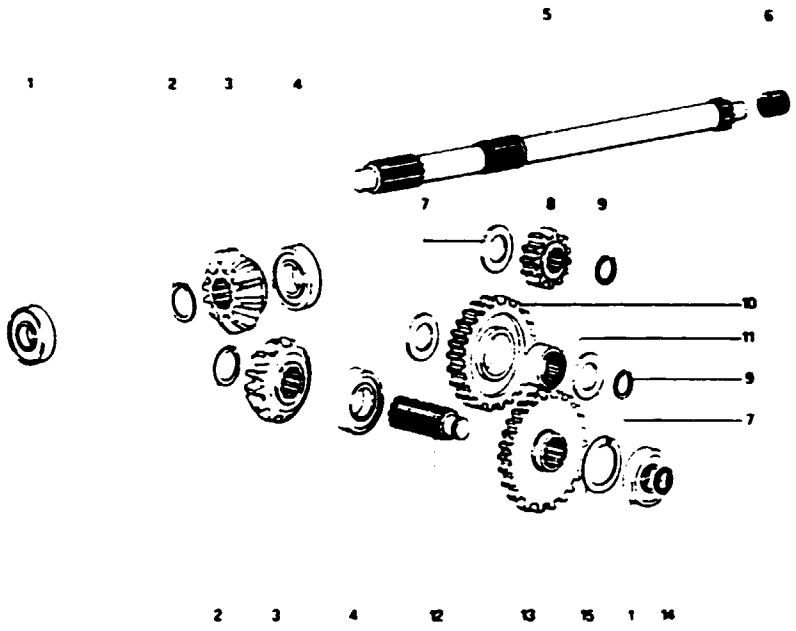
Pos.	Name
1	Bearing
2	Gear
3	Pinion
4	Gear
5	Gear
6	Countershaft
7	Washer
8	Gear
9	Roller cage
10	Gear
11	Circlip
12	Gear
13	Shaft

Differential.



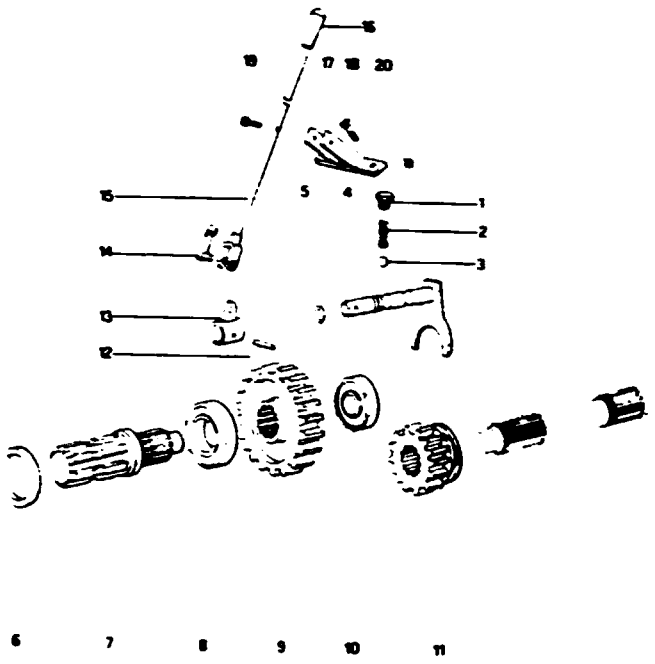
Pos.	Name
1	Spur ring gear
2	Differential
3	Circlip
4	Richt half-shaft
5	Sleeve
6	Gear
7	Bearing
8	Bearing
9	Screw

P.t.O. driving gears.



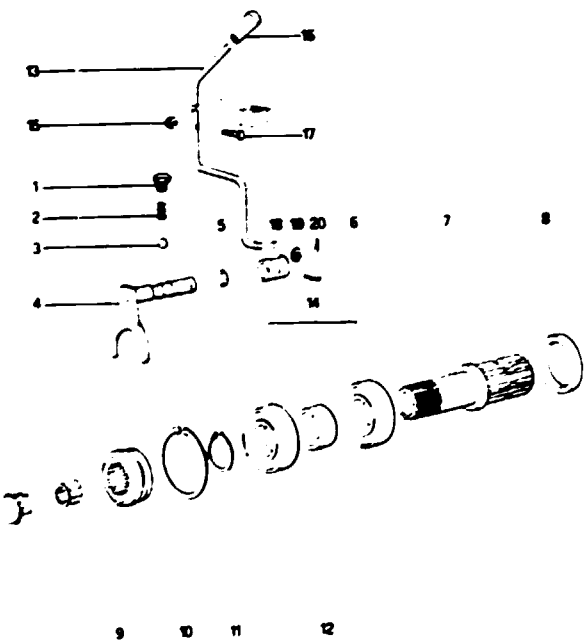
Pos.	Name
1	Bearing
2	Circlip
3	Bevel pinion
4	Bearing
5	P.t.O. shaft
6	Roller cage
7	Washer
8	Gear
9	Circlip
10	Gear
11	Bearing needle
12	P.t.O. shaft
13	Gear
14	Circlip
15	Circlip

Rear P.t.O.



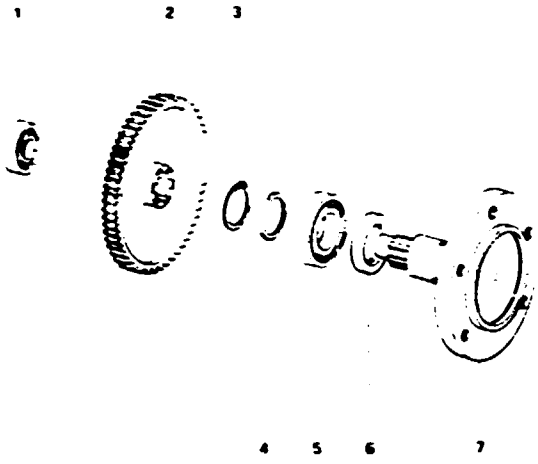
Pos.	Name
1	Screw
2	Spring
3	Ball
4	Fork
5	"O"ring
6	Rubber ring
7	P.t.O. shaft
8	Bearing
9	Gear
10	Bearing
11	Gear
12	Roll pin
13	Terminal
14	Stop
15	Lever
16	Knob
17	Support
18	Screw
19	Screw
20	Selflock nut

Front P.t.O.



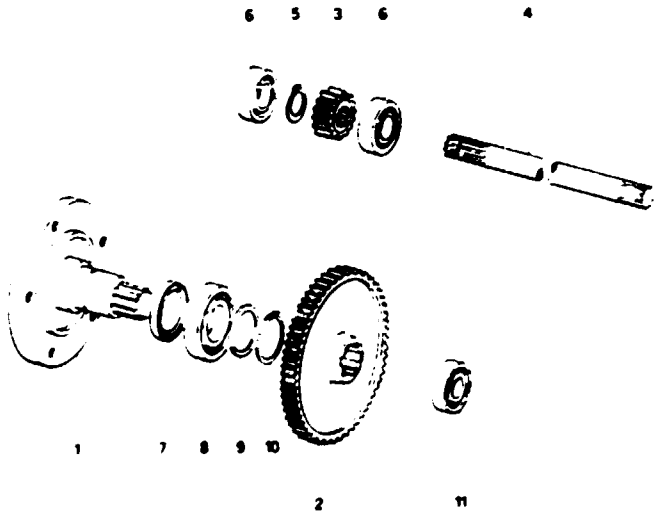
Pos.	Name
1	Screw
2	Spring
3	Ball
4	Fork
5	"O" ring
6	Bearing
7	P.t.O. shaft
8	Rubber ring
9	Sleeve
10	Circlip
11	Circlip
12	Shoulder
13	Lever
14	Roll pin
15	Selflock nut
16	Knob
17	Screw
18	Terminal
19	Wasner
20	Split pin

Right reduction.



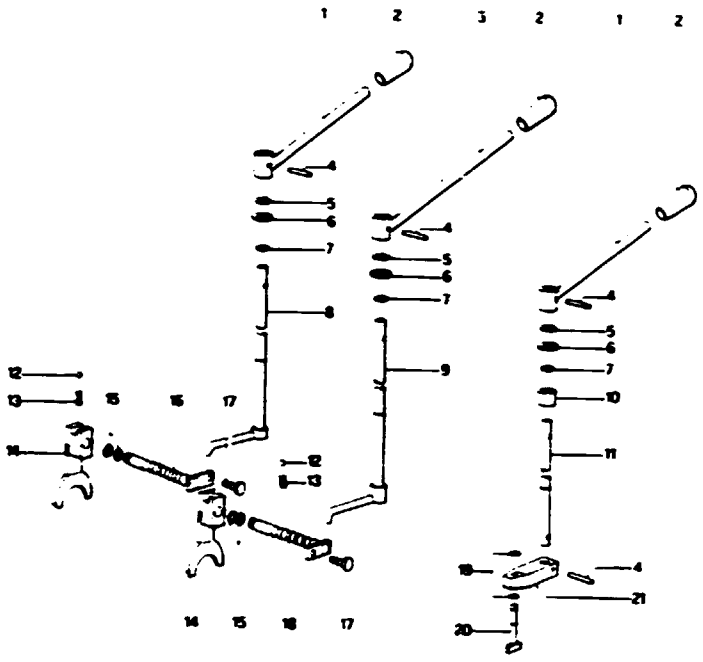
Pos.	Name
1	Bearing
2	Spur ring gear
3	Circlip
4	Washer
5	Bearing
6	Rubber ring
7	Wheel hub

Left reduction.



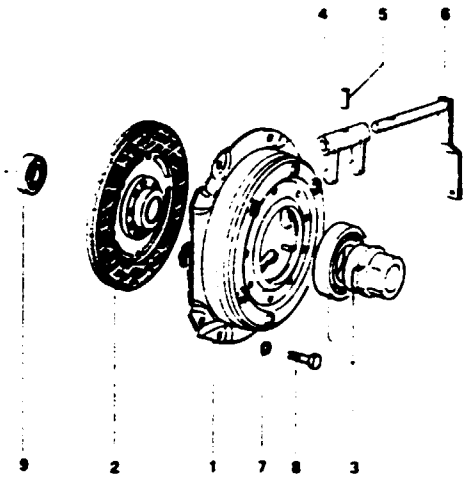
Pos.	Name
1	Wheel hub
2	Spur ring gear
3	Gear
4	Left half-shaft
5	Circlip
6	Bearing
7	Rubber ring
8	Bearing
9	Washer
10	Circlip
11	Bearing

Levers.



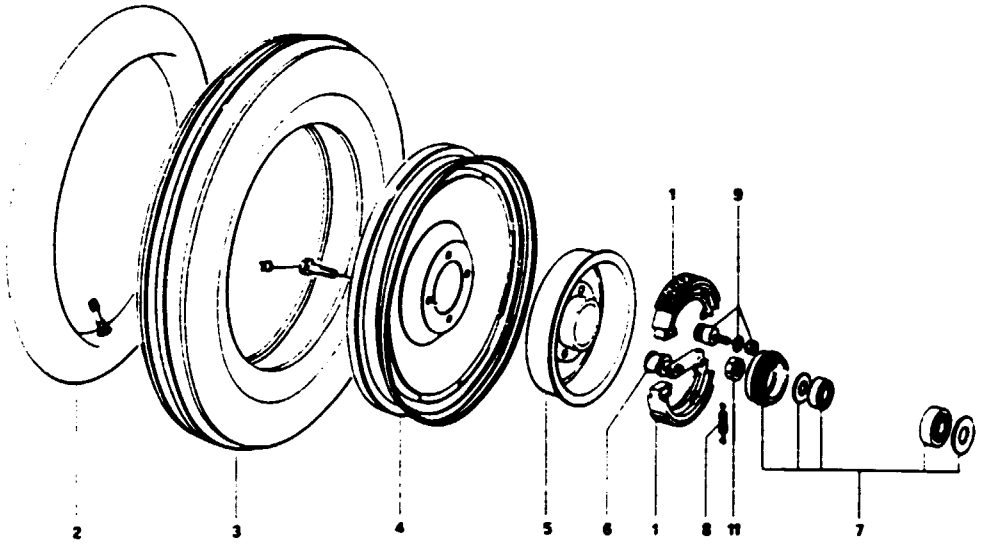
Pos.	Name
1	Lever
2	Knob
3	Lever
4	Roll pin
5	Circlip
6	Shoulder
7	"O" ring
8	Lever
9	Lever
10	Shoulder
11	Rod
12	Ball
13	Spring
14	Fork
15	"O" ring
16	Small shaft
17	Screw
18	Small shaft
19	Circlip
20	Shoe
21	Lever

Clutch.



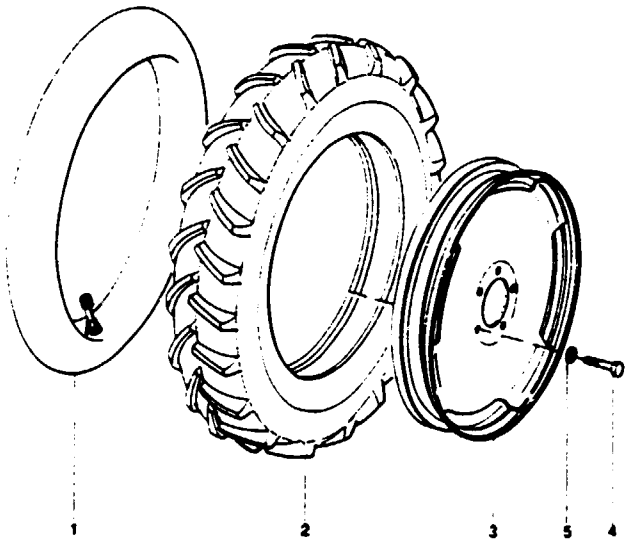
Pos.	Name
1	Pressure plate
2	Clutch disc
3	Bearing
4	Fork
5	Pin
6	Lever
7	Washer
8	Screw
9	Bearing

Front wheels and brakes.



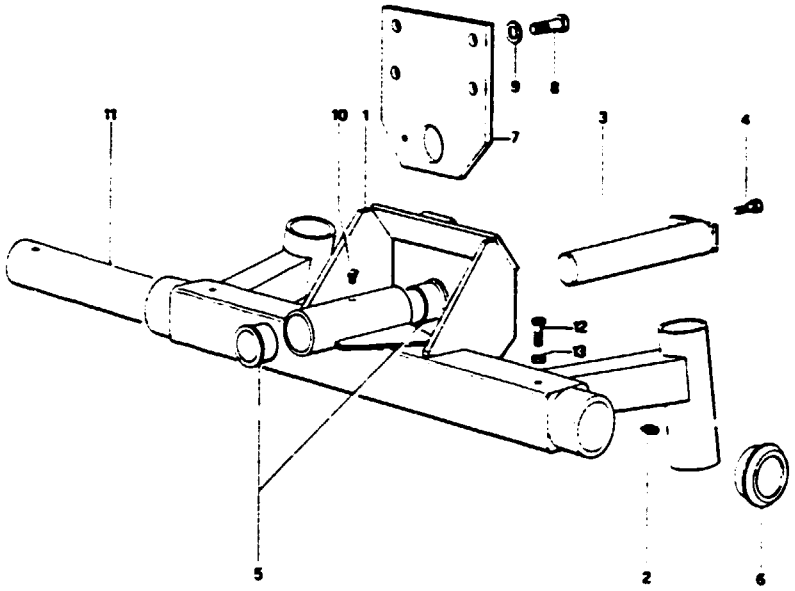
Pos.	Name
1	Brake shoe
2	Air chamber
3	Tyre
4	Rim
5	Brake drum
6	Half-terminal
7	Hub
8	Spring
9	Pin
10	Screw
11	Nut

Rear wheels.



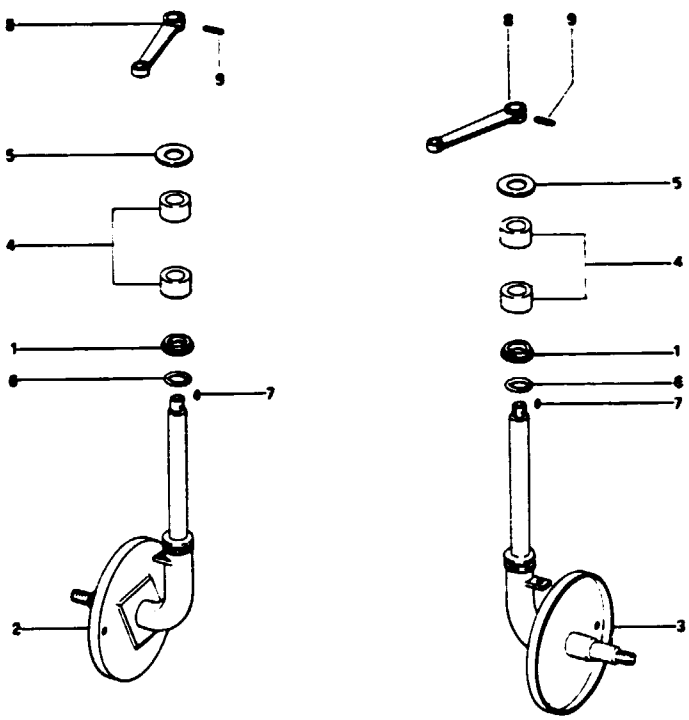
Pos.	Name
1	Air chamber
2	Tyre
3	Rim
4	Screw
5	Washer

Front axle.



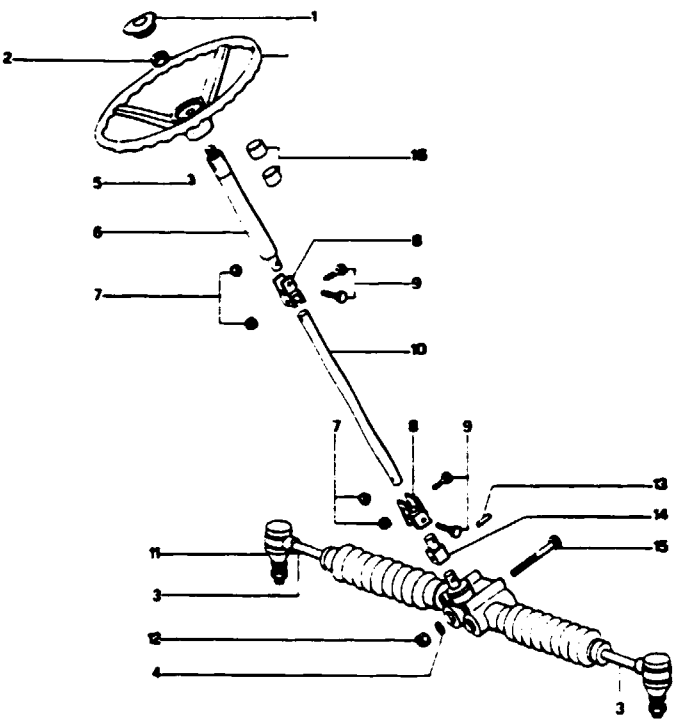
Pos.	Name
1	Axle
2	Lubricator
3	Pin
4	Screw
5	Bushing
6	Small cover
7	Support
8	Screw
9	Washer
10	Lubricator
11	Ballast
12	Screw
13	Nut

Steering pins and levers.



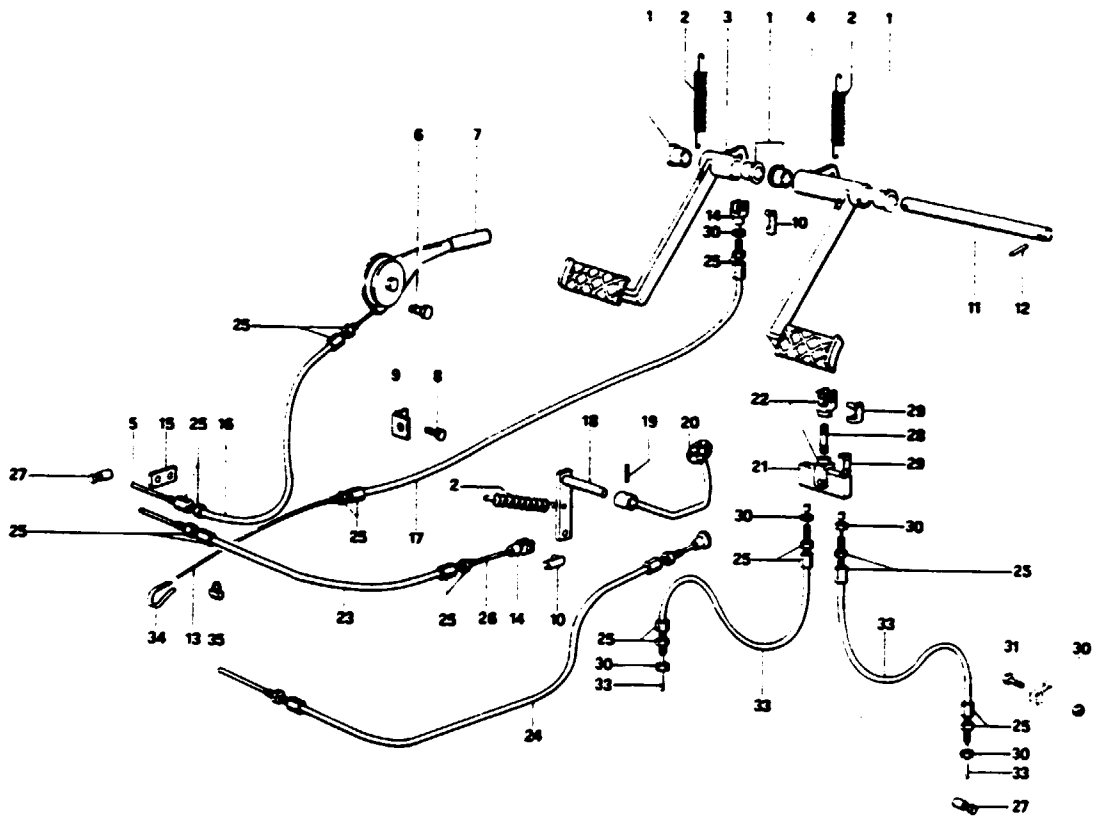
Pos.	Name
1	Shoulder
2	Left whell spindle
3	Right wheel spindle
4	Bushing
5	Shoulder
6	"O" ring
7	Rest
8	Steering lever
9	Roll pin

Steering.



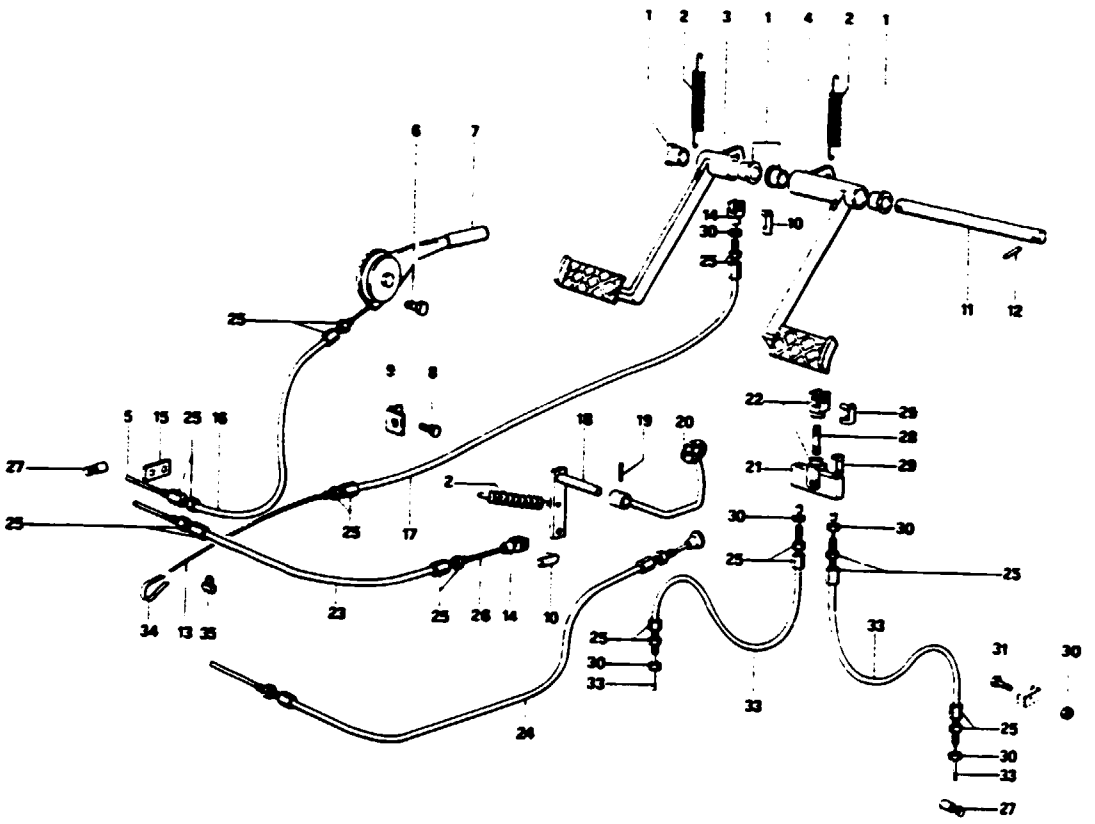
Pos.	Name
1	Steering wheel
2	Nut
3	Extension
4	Washer
5	Rest
6	Shaft
7	Selflock nut
8	Fork
9	Screw
10	Shaft
11	Steering box
12	Selflock nut
13	Roll pin
14	Tip
15	Screw
16	Bushing

Pedals.



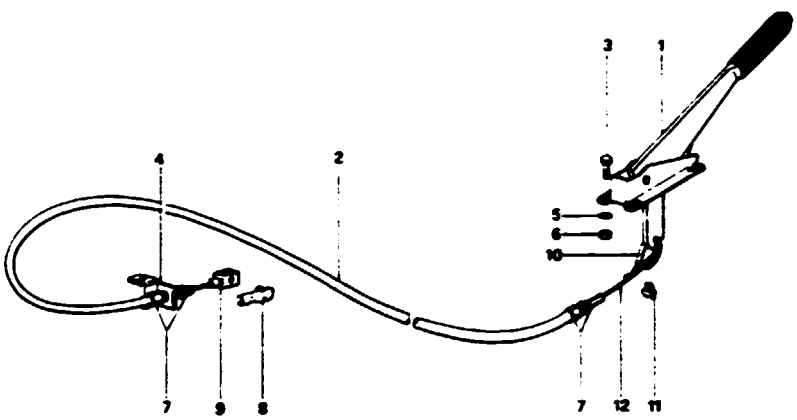
Pos.	Name
1	Bushing
2	Spring
3	Cluth pedal
4	Brake pedal
5	Steel wire
6	Screw
7	Gas hand lever
8	Screw
9	Bracket
10	Stop
11	Pin
12	Roll pin
13	Steel wire
14	Fork
15	Small plate
16	Sheath
17	Sheath
18	Lever for gas pedal
19	Roll pin
20	Gas pedal
21	Rocker

Pedals.



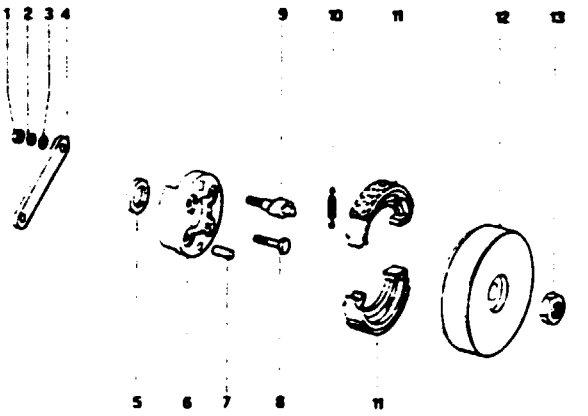
Pos.	Name
22	Fork
23	Sheath
24	Engine stop device
25	Register
26	Steel wire
27	Terminal
28	Stud bolt
29	Stop
30	Nut
31	Screw
32	Sheath
33	Steel wire
34	Radance
35	Terminal

Parking brake lever.



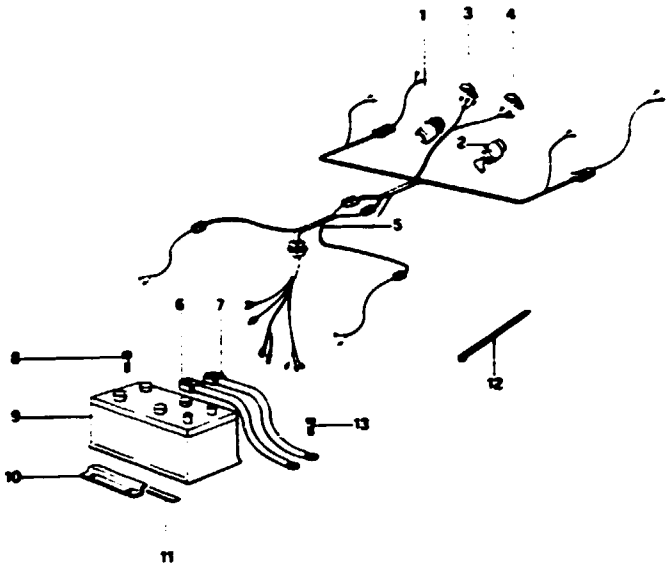
Pos.	Name
1	Brake lever
2	Sheath
3	Screw
4	Small plate
5	Washer
6	Nut
7	Register
8	Stop
9	Fork
10	Radance
11	Terminal
12	Steel wire

Parking brake.



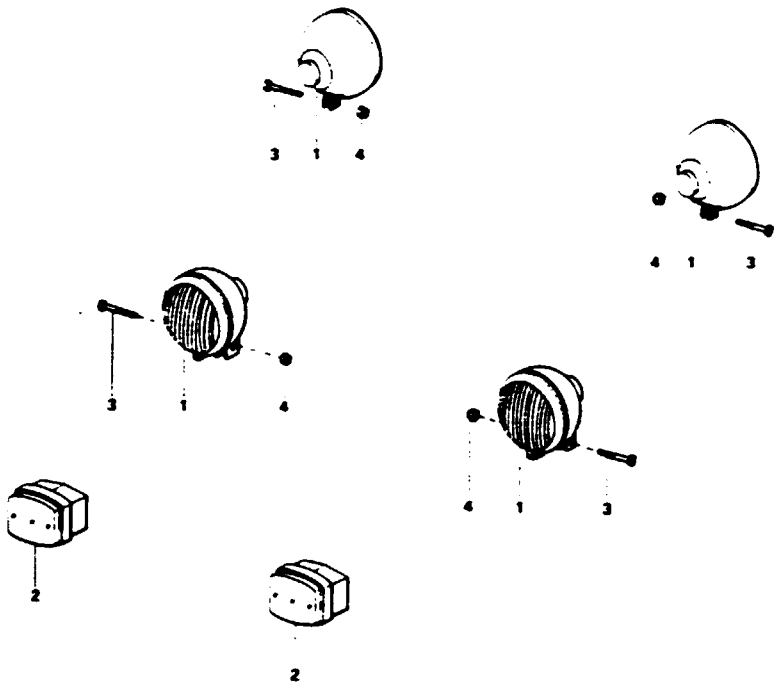
Pos.	Name
1	Nut
2	Lock washer
3	Washer
4	Small lever
5	Rubber ring
6	Support
7	Pin
8	Screw
9	Pin
10	Spring
11	Brake shoe
12	Brake drum
13	Nut

Battery and electrical system.



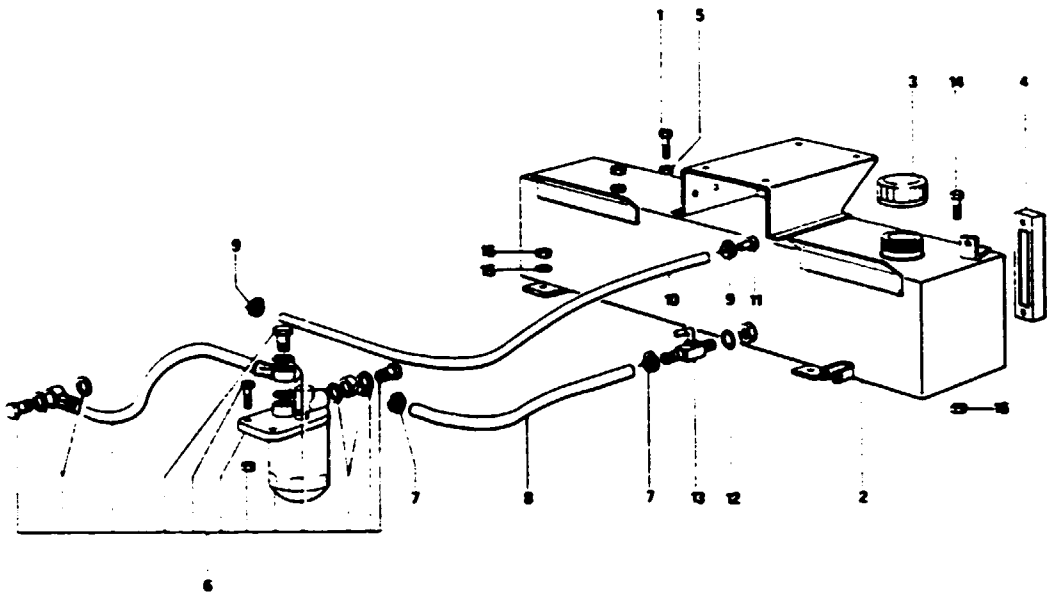
Pos.	Name
1	Switch
2	Engine starting key
3	Flashing lamp
4	Flashing lamp
5	Electrical system
6	Cable
7	Cable
8	Screw
9	Battery
10	Bracket
11	Block
12	Clamp
13	Screw

Lighting system.



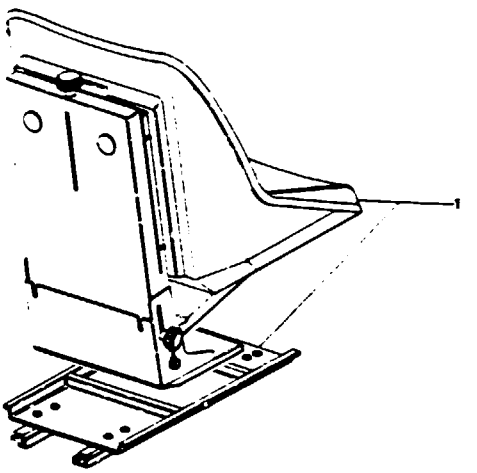
Pos.	Name
1	Headlight
2	Rear lamp
3	Screw
4	Nut

Tank.



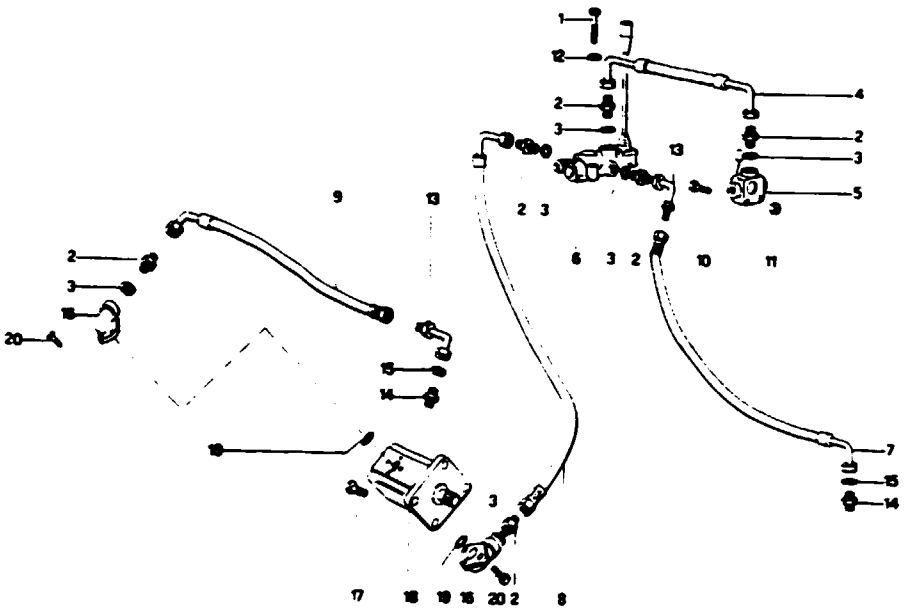
Pos.	Name
1	Screw
2	Tank
3	Plug
4	Lever indicator
5	Nut
6	Fuel filter
7	Clamp
8	Tube
9	Clamp
10	Tube
11	Pipe fitting
12	GasketT
13	Tap
14	Screw
15	Washer
16	Nut

Driver seat.



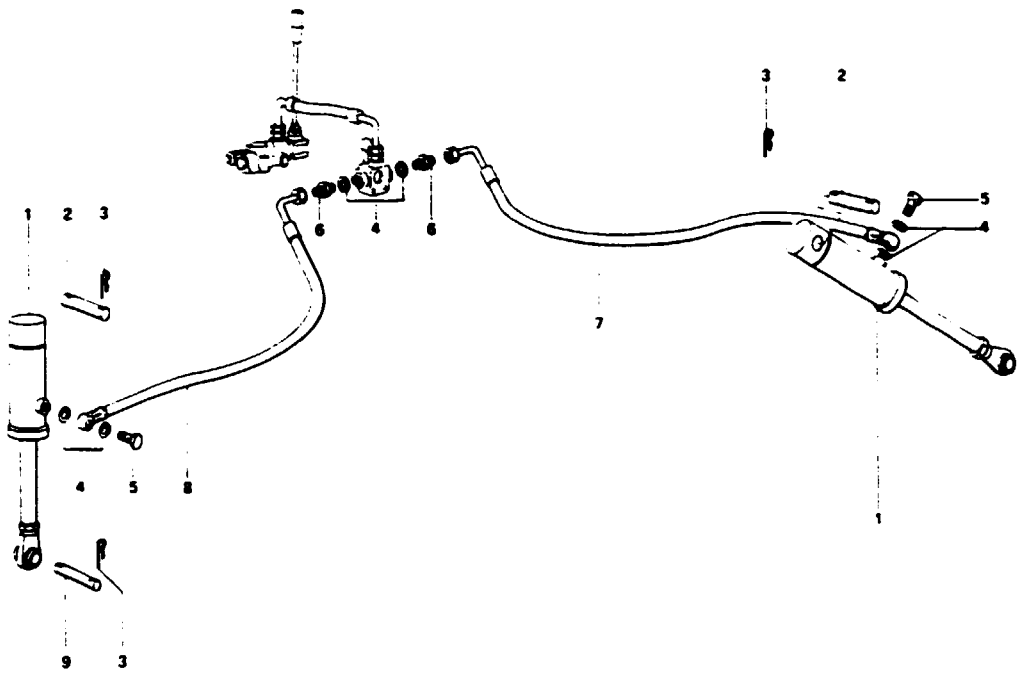
Pos.	Name
1	Driver seat

Hydraulic system.



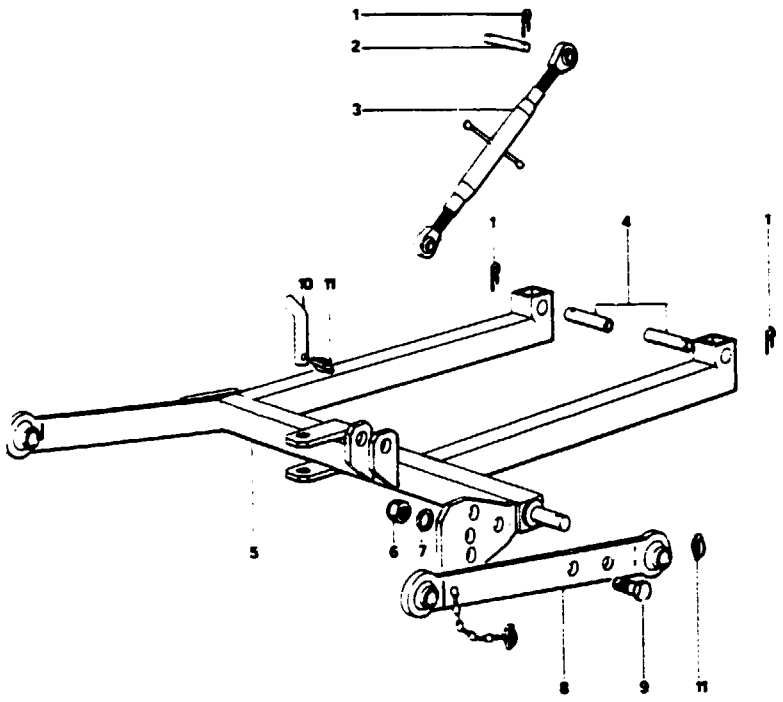
Pos.	Name
1	Screw
2	Pipe fitting
3	Gasket
4	Tube
5	3-ways distributor
6	Distributor
7	Tube
8	Tube
9	Tube
10	Screw
11	Nut
12	Washer
13	Elbow
14	Pipe fitting
15	Gasket
16	Flange
17	Screw
18	Pump
19	"O" ring
20	Screw

Hidraulic system.



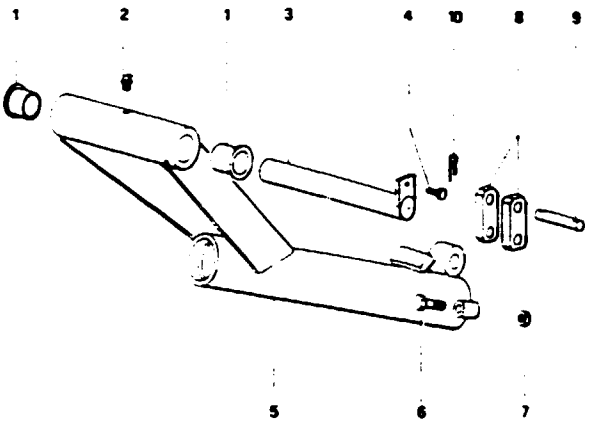
Pos.	Name
1	Jack
2	Pin
3	Split pin
4	Gasket
5	Pipe union
6	Pipe fitting
7	Tube
8	Tube
9	Pin

Rear 3-points linkage.



Pos.	Name
1	Split pin
2	Pin
3	3 point hitch
4	Pin
5	Chassis frame
6	Nut
7	Washer
8	Right arm
9	Screw
10	Pin
11	Stop

Front Arm



Pos.	Name
1	Bushing
2	Lubricator
3	Pin
4	Screw
5	Support
6	Screw
7	Nut
8	Bracket
9	Pin
10	Split pin

ANNEXE 3

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	3305.75	3284.00	21.75	1000.00	2284.00	6.86	6.19
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	3305.75	3284.00	21.75	1000.00	2284.00	6.86	6.19
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	.....	.....	.....	.....	.....	.....	.....
total foreign ourflow .	117180.80	4016.36	113064.50	1040.00	2976.36	4168.14	6310.96
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	3424.50	3805.00	-380.50	1000.00	2805.00	1025.92	972.58
imported materials . . .	108957.00	0.00	108957.00	0.00	0.00	2469.00	4698.00
repayment loans & overd.	3305.75	0.00	3305.75	0.00	0.00	410.50	410.50
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1393.60	211.36	1182.24	40.00	171.36	262.72	229.88
indirect costs	.....	.....	.....	.....	.....	.....	.....
net foreign exchge flow	-113775.10	-732.36	-113042.70	-40.00	-692.36	-4161.28	-6304.77
import substit'n effect	201550.00	0.00	201550.00	0.00	0.00	4350.00	8790.00
net forgn exchge effect	87774.91	-732.36	88507.27	-40.00	-692.36	188.72	2395.23

present values at	10.00 %
foreign exchange flow .	-52556.05
net forgn exchge effect	34959.82

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	8.70	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	8.70	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	9769.87	8404.70	8371.86	8339.02	8306.18	8273.34	7830.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	1332.33	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	7830.00	7830.00	7830.00	7830.00	7830.00	7830.00	7830.00
repayment loans & overd.	410.50	410.50	410.50	410.50	410.50	410.50	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	197.04	164.20	131.36	98.52	65.68	32.84	0.00
indirect costs							
net foreign exchge flow	-9761.17	-8404.70	-8371.86	-8339.02	-8306.18	-8273.34	-7830.00
import substit'n effect	14500.00	14500.00	14500.00	14500.00	14500.00	14500.00	14500.00
net forgn exchge effect	4738.83	6095.30	6128.14	6160.98	6193.82	6226.66	6670.00

present values at	10.00 %
foreign exchange flow .	-52556.05
net forgn exchge effect	34959.82

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	7830.00	7830.00	7830.00	7830.00	7830.00	7830.00	-3689.58
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-3711.33
imported materials . . .	7830.00	7830.00	7830.00	7830.00	7830.00	7830.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	21.75
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-7830.00	-7830.00	-7830.00	-7830.00	-7830.00	-7830.00	3689.58
import substit'n effect	14500.00	14500.00	14500.00	14500.00	14500.00	14500.00	0.00
net forgn exchge effect	6670.00	6670.00	6670.00	6670.00	6670.00	6670.00	3689.58

present values at	10.00 %
foreign exchange flow .	-52556.05
net forgn exchge effect	34959.82

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE ASSEMBLING OF DIESEL ENGINES IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for the assembling of diesel engines, imported in CKD components.

The envisaged assembly unit has an initial annual capacity of assembling 2,000 engines, with 20 HP and 30 HP which should be installed in the small tractors, object of another opportunity study in this subsector.(1)

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 3,548,960 (US$ 1,990,000 in foreign currency)
- Working capital (at full production): US$ 1,519,283 (US$ 1,495,000 in foreign currency)
- Internal Rate of Return: 16.55%
- Break-Even Point (at 5th year of production) 33.8%
- Pay-Back Period: less than 8 years (including construction period)
- Employees: 52

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 6,949,520 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

1.1 Diesel engines are particularly versatile machines; they can power almost any type of agricultural or industrial equipment: tractors, motocultivators, water pumps, generating sets, concrete mixers, dumpers, air compressors, boats, etc.

In order to facilitate the application of the engine to any machine, the manufacturers always try to develop a very large number of specific optional accessories, such as clutches, reduction gears, flanging bells, fly wheels, hydraulic pump fittings, flexible and centrifugal couplings, etc.

(1) For additional background material, see Volume I p.189.

Modern Diesel engines are developed to operate to high performance standards, required by the modern agricultural and industrial machinery, such as:

. high output

. high reliability

. fuel economy

. low vibrations and noise

. great durability, with a life of more than 10,000 hours

. reduced maintenance

. low operating expenses

Their power, for the applications mentioned above, ranges from 5 to 80 HP and above and the number of the cylinders varies from 1 to 6.

1.2 Generally, the major Diesel engines manufacturers who own plants, where a large number of engines are produced, have a Research and Development Centre, where the main engine parts are designed.

As far as the manufacturing cycle is concerned, the manufacturers keep inside the whole machining cycle of the most delicate engine parts (crankcase, crankshaft, camshaft, connecting rod, cylinder head, cylinder, crankcase cover, rocker arms).

Other parts, like steel sheet parts (filters, tanks etc.) flywheels, pulleys pins, oil pumps, governors, push rods, intake and exhaust manifolds covers-housings, levers etc. are manufactured by sub-suppliers on the basis of the drawings of the manufacturers.

There are other parts and subassemblies, like injection pumps, fuel injectors, pistons, piston rings, bearings, gaskets, flat and V belts, valves, valve guides and seats, electric starters, alternators, radiators, electric parts, fuel feeding pumps, gas oil and oil filters, that are supplied to the diesel engine manufacturers by companies that are active in the manufacture of one or more of the mentioned items.

This policy makes it possible to reduce dramatically the investments, without affecting the quality of the product and allows a great flexibility in the production.

1.3 There are several other Diesel engine manufacturers who are licensees of the major world companies. Main activity of these manufacturers is the assembly of parts and subassemblies, supplied by the licensors; in many cases, the activity is extended to the machining of some parts that can be made available by the licensor in raw form, or bought from third parties. As said before, the investment in machining lines is justified only if the production is high.

1.4 Exception made for few cases, licensees have started their activity by installing an assembling unit, designed for a minimum economic size.

This approach is considered the most appropriate for the present Nigerian situation. In the following chapter the analysis will take into consideration the assembling of 2 types of diesel engines, manufactured by Lombardini (Italy).

The selection of this manufacturers is justified by the fact that Lombardini is one of the world leaders in this field, owns several plants for diesel engine manufacture and granted the license to several private and public organizations in Spain, Jugoslavia, Turkey, Greece, India, Venezuela, Tunisia and, finally, is willing to cooperate with a Nigerian investor.

The types of the engines are selected taking into account the requirements of the small tractors, proposed in another opportunity study. Should a feasibility study be carried out, other manufacturers shall be considered.

2. MARKET AND PLANT CAPACITY

2.1 DEMAND

At present all Diesel engines are imported already coupled to the machines powered by them. It is hard to establish the type and the quantity of engines imported, because statistical data are not available. In any case, this project will supply Diesel engines for the proposed small tractors plant: 2000 units per year.

2.2 SUPPLY

There is no local production or assembly of Diesel engines in the range of 20-30 HP. They are imported mainly from Japan, U.K., FRG, AUSTRIA, ITALY, already coupled to the machines (generators, pumps, dumpers, etc.).

2.3 PLANT CAPACITY

The plant is designed for the assembling of 2000 Diesel engines/year imported in CKD form. (1000 units of 20 HP nominal power and 1000 units of 30 HP of nominal power).

The output is referred to 250 working days/year, 1 shift/day, 8 hours/shift. The production can be easily increased, by making the plant working on two shifts.

2.4 THE ENGINES

The proposed engines have the following technical data:

	20 HP	30 HP
Rated KW/HP	14/19	21/28.5
Cylinders Nos	2	3
Displacement cm3	871	1248
R.P.M.	3000	3000
Max torque Kgm	4.9 at 2000 RPM	7.5 at 2.200 RPM
Dry weight Kg	80	110
Diesel oil consumption g/Kwh	194	240

Other characteristics are:

. 4 stroke air cooled

. power take-off on crankshaft

. counterclockwise rotation

. direct injection on piston

. air cooling by fan

. gear pump forced fuel lubrication

. fuel flow oil filter

. automatic extra fuel starting device

. centrifugal governor

. torque regulator

. aluminium alloy tunnel crankcase

. cast iron, reborable independent cylinders

. aluminium alloy independent heads

. hydraulic pump double power-take-off on timing and blower side

2.5 SALE PRICES AND REVENUE

The following selling prices will be considered:

Engine 20 HP	US $ 2,500
Engine 30 HP	US $ 3,500

It is foreseen that 1000 units of each type will be produced and sold; the total revenues would be US $ 6,000,000.

3. MATERIAL AND INPUTS

3.1 MATERIALS

The materials consist in the finished parts and subassemblies, as represented in the Annexe 1, delivered in kits.

The components in Annexe 1 represent the Lombardini engines envisaged for this study. The possibility of manufacturing locally these components has not been considered at present, because of the low output of the envisaged plant and the low prospects of reaching a minimum economic size in the production of any of the components. However, when output expands to the required level, backward integration could be embarked upon.

The costs CIF of the complete kits is as follows:

Engine 20 HP (1000 units)	US $ 1,800,000
Engine 30 HP (1000 units)	US $ 2,600,000

based on quotation received by Lombardini.

3.2 ELECTRIC ENERGY

The installed power is 150 kW. The coefficient of utilization is 0.7. The cost of energy is 0.1 US $/kWh, therefore the annual expenditures will be:

$$150 \times 0.7 \times 250 \times 8 \times 0.1 = \text{US \$ } 21{,}000$$

3.3 CONSUMABLES

The considered consumables are paint and varnishes, diesel oil necessary for the testing of the engines and lubricants. The estimated expenditures for 2,000 units amounts to 10,000 US $.

4. LOCATION

The ideal location would be close to the small tractors manufacturing plant.

5. PROJECT ENGINEERING

5.1 PROJECT BASIC DATA

This project has been developed on the following data.

PRODUCTION

	Units/year
Engine rated HP 20 HP	1,000
Engine rated HP 30 HP	1,000
TOTAL	2,000

WORKING TIME

The working time foreseen is :

250 working days/year

1 shift/day

8 hours/shift

5.2 PRODUCTION EQUIPMENT

Details on the equipment are provided below.

The envisaged equipment is for the engine assembly, testing end finishing.

All engine parts will arrive in the assembly area and assembled; then all engines will be tested in the testing room and finished according to specifications.

The engines will be assembled on a "sliding track line" and there will be some roller conveyors from the assembly area to the testing room and from here to the finishing area.

5.2.1 Assembly area

This area is divided in two zones; the assembly line where the two engine types will be assembled on the same line and the subassembly zone for the preparation of various engine parts in order to shorten the operation times on the assembly line.

In the subassembly zone the preparation of the following parts is foreseen:

1. the cylinder head with injector, valves and relevant springs, studs and rocker arms

2. the ground connecting rod-piston-cylinder: the piston assembled with the connecting rod and the piston pin, then with the piston rings and inserted into the cylinder; assembled in this phase also the bearing of the connecting rod big end

3. the crankcase assembled with the crankshaft (with supports), with the connecting rod-piston-cylinder already assembled, with the oil pan, with the engine mounts.

4. the fuel tank with gasoil filter, vibration-damping supports and other small parts

5. the crankcase covers with the relevant seal rings

6. the engine plate: printing the serial number

7. various parts preparation requiring small operations that simplify the job on the assembly line: intake manifold, flanges, oil filters and other small parts.

The crankcases will then be mounted on the sliding track assembly line, 20 meters long, and assembled together with the other sub-assemblies already prepared and with all those parts necessary to test the engines on the testing benches; the remaining parts will then be mounted in the finishing area after the test.

In order to position the engines on the assembly line, in the most convenient way for the assembly operations, the crankcases are mounted on special engine carrying chucks fixed on the sliding track: the line is equipped with 30 chucks.

The speed of the assembly line is of course adjustable to the required productive pace that will depend on the production output. As far as the output of the assembly line is concerned, the yearly average will be 1 engine every 60 minutes.

Some tools and phase gauges, essential to undertake the assembly operations are hanged on a line upper scaffolding that is also the support for the compressed air system and for the electricity network of the line.

At the end of the assembly line, the engines will be provided with oil and filled up with gasoil for the test.

ASSEMBLY AREA EQUIPMENT

Crankcase and crankshaft sub-assembly

2	Equipped working bench
2	Special press for driving the crankshaft into the crankcase
2	Rotary basket washing machine
2	Equipment for engine mount alignment/assembly

2 Swing hoist (125 Kg)

2 Special tool set

2 Standard tool set

Con. rod-piston-cylinder subassembly

1 Equipped working bench

1 Set of special tools for the con.rod disassembly

1 Boring gauge for con.rod big end diam. control

1 Multiple device for piston ring assembly

1 Special washing machine for con.rid-piston

1 Electric oven for piston heating

1 Special tool set

1 Standard tool set

1 Balance

Cylinder head subassembly

1 Equipped working bench

1 Special device for valve and spring assembly

1 Special device for rocker arm journal assembly

1 Rotary basket washing machine

1 Special tool set

1 Standard tool set

Injection pump setting and various sub-assemblies

1 Equipped working bench

1 Special device for injection pump setting

1 Press with numbering machine

Crankcase cover fuel tank and various sub-assemblies

1 Equipped working bench

1 Hydraulic press

1 Set of specific devices (for each cover type)

1 Fuel tank support and assembly equipment

1 Clamp bending device

1 Special tool set

1 Standard tool set

Assembly line zone

1 Sliding track assembly line (20 mt long with 30 engine chucks)

2 TDC measurement gauges

2 Jigs for spark advance marking

2 Gauges for injection pump seat depth measurement

1 Thickness gauges for injection pump gasket control

1 Gear heating oven

1 Special tool set

25 Pneumatic screwers

1 Standard tool set

1 Oil/gasoil filling equipment

3 Swing hoists (125 Kg.)

5.2.2 Testing room

Once assembled, the engines will be transferred into the testing room on roller conveyors. In the testing room a complete test will be done on all assembled engines by means of test benches, each equipped with one hydraulic brake and one measurement device set for individual tests.

The following engine performances will be checked:

- engine speed
- power

  torque
- fuel consumption
- smoke
- exhaust temperature
- lubricating oil temperature and pressure

The test bench will be engaged for about 120 minutes. This time is required for:

- the engine installation on the bench with all the relevant connections
- the engine setting
- the engine running (about 90 minutes)
- the engine disassembly from the bench

As far as the handwork in the testing room is concerned, 30 minutes max for each engine are required.

It is important to underline that all engines that do not achieve, during the test, the standard performances are sent to the repairing zone, within the finishing area, repaired and then sent again in the testing room for another complete test cycle.

The testing room equipment, and especially the number of test benches, has been therefore defined considering the quantity of engines to be produced taking also into account the estimated percentage of engines to be repaired and tested again.

Together with the test benches for the normal production test, it has been foreseen also one additional test bench equipped with an electric brake; this will be used for the endurance tests (necessary to check the whole production process) and for any other special test: f.i. the engines to

be mounted into generating sets the governor performance must be verified.

Each test bench will consist of:

1 frame to be fixed on the floor

1 engine bed with vibration damping supports on which the engine can be fixed

1 brake support

1 hydraulic brake (electric for the special test bench)

1 soundproofing case

1 engine-brake coupling device

1 set of pick-up and the relevant cables

1 throttle control device with flexible cable

1 pneumatic screwer

1 engine starting equipment

1 exhaust scavenging system (a prolonged muffler)

1 rack with the electric apparatus and the test displays; one manometer for the oil pressure, one timer and one graduated buret for the fuel consumption measurement, one analogic tachometer, one exhaust temperature display.

The rack for the special test bench will be equipped also with one analogic display for the control of the governor performance.

The hydraulic brake allows the test of any engine (with clockwise or counterclockwise rotation) with a maximum power of 50 HP at 3000 RPM or a maximum torque of 11,9 KGM; the electric brake will have similar performances.

One important feature of the test bench is represented by the automatic safety device that stops the engine if the maximum engine rotation speed has been exceeded. The testing room will be provided with:

- the gasoil and the brake water distribution systems with the relevant piping within the testing room from the tanks till the test benches;

- the exhaust scavenging system collecting the exhausts from the test benches;

- the electric power distribution system;

- the lighting system;

- the compressed air network within the testing room and the relevant outlets;

- the underground tanks (water, gasoil);

- the fire fighting system;

- the cooling/demineralizing system for the brake water;

- the testing room ventilation system.

TESTING ROOM EQUIPMENT

2	test benches with hydraulic brake and control system with displays
1	test bench with electric brake and control system with displays
1	Gantry hoist
1	Portable smoke tester (Bosh test)
1	Portable tachometer
1	Chronometer

5.2.3 Finishing area

After the test all engines are transferred in the finishing area that consists of three zones:

- application zone where are assembled all those engine parts related to the specific engine version required by the customer, f.i. clutch, flanging, etc.;

- finishing zone where are assembled those parts not necessary during the test, (f.i. muffler);

- repairing zone where all engines that have not achieved during the test the standard performances, are checked, if necessary repaired, by replacing the defective parts, and then sent again in the testing room until the test has been overcome.

The estimated handwork to be considered for each engine in the Finishing Area (Application, Finishing and Repairing) is 90 minutes.

From the finishing area the engines are sent to the finished product store for shipment.

FINISHING AREA EQUIPMENT

Application zone

1 Engine oil and gasoil

1 Oil centrifugation equipment

2 Working benches

4 Pneumatic screwers

1 Roller conveyor

1 Standard tool set

1 Special tool set

1 Gantry hoist

Finishing zone

1 Working benches

2 Pneumatic screwers

1 Roller conveyor

1 Standard tool set

1 Special tool set

Repairing zone

1 Working benches

1 Titling engine chuck for repairing operations

2 Pneumatic screwers

1 Standard tool set

1 Special tool set

1 Gantry hoist

5.3 LAY-OUT AND CIVIL WORKS

The plant will cover an area of 1,500 sq.m.so subdivided:

200 sq.m. for offices and social services

500 sq.m. for store houses

500 sq.m. for the production area

300 sq.m. for utilities department

An expansion area shall be considered, in view of the installation of some machining lines, in case the production increases and justifies further investments.

The building will be in steel structure, with the roofing of shed type, to ensure natural lighting.

The cladding will be in cement blocks or clay bricks. The floor of the industrial area will b. of reinforced antidust concrete slabs, allowing an over load of 2000 Kg/sq.m. The floors of the offices and social services will be in ceramic tiles.

5.4 INVESTMENT COSTS

Quotation for machinery and equipment was obtained from Lombardini, Reggio Emilia, Italy. The costs for erection are not expressed as the percentage of the machine and equipment value. Actually, the equipment is very simple and its installation does not require heavy costs.

The estimated investment costs are as follows:

DESCRIPTION	LC M$	FC M$	Total M$
Machinery and equipment			
FOB European port	--	1.4	1.4
Transport, taxes and duties	0.28	0.14	0.42
Erection	0.12	0.08	0.2
Land & site preparation	0.05	--	0.05
Civil works and buildings	0.75	--	0.75
Spare parts	--	0.01	0.01
Total	1.2	1.63	2.83
Contingencies 10%	0.12	0.163	0.283
Grand total	1.32	1.793	3.113

The industrial life of the plant can be considered as 15 years. The average annual expenditures for maintenance are estimated 50,000 US $. In the financial evaluation the investment cost, including contingencies, are so subdivided:

Preproduction expenditures	FC	M$ 0.100
Preproduction expenditures	LC	M$ 0.130
Machinery	FC	M$ 1.793
Machinery	LC	M$ 0.44
Land & Site preparation	LC	M$ 0.055
Civil works and buildings	LC	M$ 0.825
TOTAL		M$ 3.343

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

The manpower employed in the production activities needs 15 days training within one of the plants of the licensor. The estimated expenditures are US $ 100,000. Supplementary on the job training can be provided by the personnel of the licensor during the first operation period. One expert will be made available by the technology supplier for the first 6 months after the plant start-up. The relevant expenses are estimated US $ 60,000.

7.1 MANAGEMENT

		N/Y
- General Manager	1	50,000
- Technical Manager	1	40,000
	---	--------
	2	90,000
	overheads 40%	36,000

		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPARTMENT

		N/Y
- Financial manager	1	40,000
- Accountant	1	12,000
- Purchasing Dept. Head	1	12,000
- Sales Dept. Head	1	12,000
- After sales technicians	2	16,000
- Clerks	4	32,000
- Drivers	4	32,000
- Guards	4	20,000
	18	176,000
	overheads 40%	70,400
		246,400
		(US$ 31,200)

7.3 PRODUCTION DEPARTMENT

		N/Y
- Production Manager	1	40,000
- Foremen	4	48,000
- Assemblers	20	120,000
	25	208,000
	overheads 40%	83,200
		291,200
		(US$ 36,900)

7.4 MAINTENANCE DEPARTMENT

		N/Y
- Chief Engineer	1	40,000
- Mechanics	2	20,000
- Electricians	2	20,000
- Helpers	2	12,000
	7	92,000
	overheads 40%	36,800
		128,800
		(US$ 16,300)

Summary

Administrative	20	US$ 47,200
Production	25	US$ 36,900
Maintenance	7	US$ 16,300
	---	----------
	52	US$ 100,400

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start-up the plant is in the range of 18 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 2.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 3,548,960 US Dollars. The portion in foreign currency accounts for 1,990,000 US Dollars.

Details of these figures are shown in chapter 5.5.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 435,000	US$ 584,000	US$ 1,019,000
- Foreign Loan (interest 8%)	US$ 500,000	US$ 1,024,000	US$ 1,524,000
- Local Loan (interest 15%)	US$ 300,000	US$ 500,000	US$ 800,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 30%

2nd year 60%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 1,519,283 US Dollars, the foreign portion being US$ 1,495,000.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 477,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 30% of its nominal capacity, the production costs amount to US$ 2,123,062.

In the third year, at full production, the costs amount to US $ 5,070,082, then they start a slight decrease year after year, to reach a constant amount of US $ 4,581,600 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 6,000,000. As said before, the production programme foresees that full production is reached gradually:

1st year 30% : revenue = US$ 1,800,000

2nd year 60% : revenue = US$ 3,600,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 16.55%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 33.8% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 8 years, including the construction period.

[1] Direct labour is considered as a variable cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 3.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

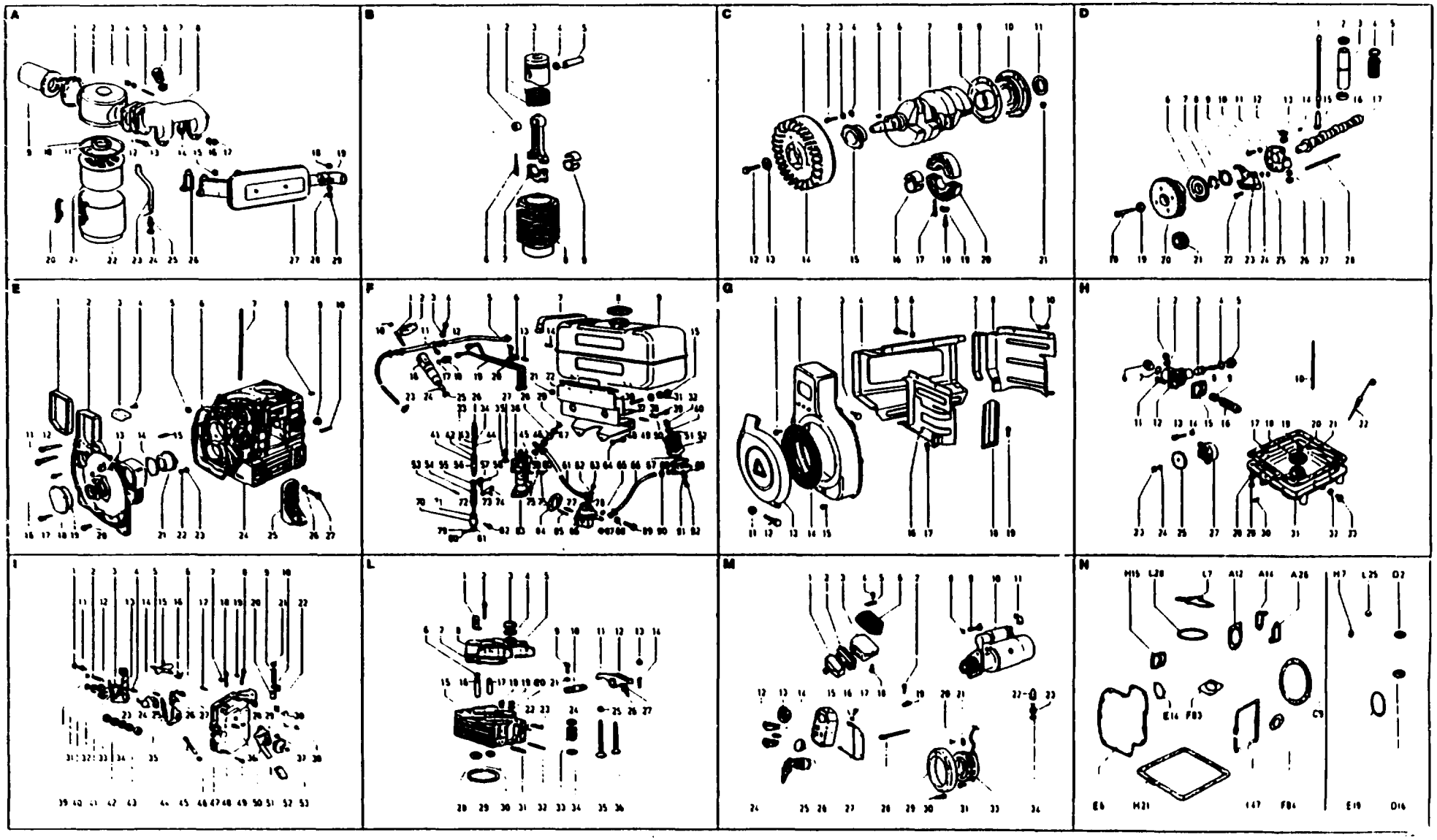
By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 6,949,520.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 6,249,520.

ANNEXE 1

ENGINE PARTS AND SUB-ASSEMBLIES

ENGINE PARTS AND SUBASSEMBLIES



ANNEXE 2

COMFAR SCHEDULES

DIESEL ENGINES
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US$

Total initial investment during construction phase

fixed assets:	3548.96	56.184 % foreign
current assets:	0.00	0.000 % foreign
total assets:	3548.96	56.184 % foreign

Source of funds during construction phase

equity & grants:	1019.00	0.000 % foreign
foreign loans :	1524.00	
local loans :	800.00	
total funds :	3343.00	45.588 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1518.40	4581.40	4581.40
depreciation :	362.74	351.74	41.25
interest :	241.92	60.96	0.00
production costs	2123.06	4994.10	4622.65
thereof foreign	81.41 %	94.22 %	95.72 %
total sales :	1800.00	6000.00	6000.00
gross income :	-323.06	1005.90	1377.35
net income :	-323.06	603.54	826.41
cash balance :	-894.43	764.78	867.66
net cashflow :	-195.34	1016.24	867.66

Net Present Value at: 10.00 % = 1992.05
Internal Rate of Return: 16.55 %
Return on equity1: 28.80 %
Return on equity2: 19.70 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	55.000	0.000
Buildings and civil works	500.000	325.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	630.000	1603.000
Total fixed investment costs	1185.000	1928.000
Pre-production capital expenditures.	92.500	343.460
Net working capital	0.000	0.000
Total initial investment costs	1277.500	2271.460
Of it foreign, in %	40.705	64.890

Total Current Investment in 1000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	476.941	442.553	599.789
Total current investment costs	476.941	442.553	599.789
Of it foreign, %	95.552	99.654	99.674

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	1323.000	2646.000	4410.000	4410.000	4410.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	21.000	21.000	21.000	21.000	21.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	36.900	36.900	36.900	36.900	36.900
Repair, maintenance	7.000	15.000	25.000	25.000	25.000
Spares	7.000	15.000	25.000	25.000	25.000
Factory overheads	60.000	0.000	0.000	0.000	0.000
Factory costs	1454.900	2733.900	4517.900	4517.900	4517.900
Administrative overheads	63.500	63.500	63.500	63.500	63.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	362.742	362.742	357.242	351.742	351.742
Financial costs	241.920	186.680	131.440	76.200	60.960
Total production costs	2123.062	3346.822	5070.082	5009.342	4994.102
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	81.411	89.075	93.409	94.238	94.220
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	100.400	100.400	100.400	100.400	100.400

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	4410.000	4410.000	4410.000	4410.000	4410.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	21.000	21.000	21.000	21.000	21.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	36.900	36.900	36.900	36.900	36.900
Repair, maintenance	25.000	25.000	25.000	25.000	25.000
Spares	25.000	25.000	25.000	25.000	25.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	4517.900	4517.900	4517.900	4517.900	4517.900
Administrative overheads	63.500	63.500	63.500	63.500	63.500
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	264.550	264.550	264.550	264.550	41.250
Financial costs	45.720	30.480	15.240	0.000	0.000
Total production costs	4891.670	4876.430	4861.190	4845.950	4622.650
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	95.060	95.065	95.029	95.013	95.724
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	100.400	100.400	100.400	100.400	100.400

Total Production Costs in 1000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	4410.000
Other raw materials	0.000
Utilities	21.000
Energy	0.000
Labour, direct	36.900
Repair, maintenance	25.000
Spares	25.000
Factory overheads	0.000
Factory costs	4517.900
Administrative overheads	63.500
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	4581.400
Costs per unit (single product)	0.000
Of it foreign, %	96.586
Of it variable,%	0.000
Total labour	100.400

Net Working Capital in 1000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	126.533	233.117	381.783	381.783
Inventory and materials	89	4.0	330.308	660.558	1100.892	1100.892
Energy	0	---	0.000	0.000	0.000	0.000
Spares	180	2.0	3.500	7.500	12.500	12.500
Work in progress	1	360.0	4.041	7.594	12.550	12.550
Finished products	2	175.8	14.803	19.242	25.325	25.325
Cash in hand	15	24.0	7.267	5.433	6.267	6.267
Total current assets			486.452	933.444	1539.316	1539.316
Current liabilities and						
Accounts payable	2	221.6	9.511	13.950	20.033	20.033
Net working capital			476.941	919.494	1519.283	1519.283
Increase in working capital			476.941	442.553	599.789	0.000
Net working capital, local			21.214	22.744	24.700	24.700
Net working capital, foreign			455.728	896.750	1494.583	1494.583

Note: mcc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	435.000	584.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	500.000	1024.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	300.000	500.000
Loan C, local....	0.000	0.000
Total loan	800.000	1524.000
Current liabilities	0.000	0.000
Bank overdraft	42.500	163.460
Total funds	1277.500	2271.460

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-190.500	-190.500	-190.500	-190.500	-190.500	-190.500
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-266.667	-266.667	-266.667	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000	0.000
Total loan	-457.167	-457.167	-457.167	-190.500	-190.500	-190.500
Current liabilities	9.511	4.439	6.083	0.000	0.000	0.000
Bank overdraft	894.428	385.071	141.763	-755.637	-764.781	-106.803
Total funds	446.772	-67.657	-309.321	-946.137	-955.281	-297.303

Source of Finance, production in 1000 US$

Year	1998-99
Equity, ordinary ..	0.000
Equity, preference.	0.000
Subsidies, grants .	0.000
Loan A, foreign .	-190.500
Loan B, foreign..	0.000
Loan C, foreign .	0.000
Loan A, local....	0.000
Loan B, local....	0.000
Loan C, local....	0.000
Total loan	-190.500
Current liabilities	0.000
Bank overdraft	0.000
Total funds	-190.500

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	1809.511	3604.439	6006.083	6000.000	6000.000	6000.000
Financial resources	9.511	4.439	6.083	0.000	0.000	0.000
Sales, net of tax	1800.000	3600.000	6000.000	6000.000	6000.000	6000.000
Total cash outflow	2703.939	3989.510	6147.846	5244.364	5235.220	5260.953
Total assets	486.453	446.992	605.872	0.000	0.000	0.000
Operating costs	1518.400	2797.400	4581.400	4581.400	4581.400	4581.400
Cost of finance	241.920	186.680	131.440	76.200	60.960	45.720
Repayment	457.167	457.167	457.167	190.500	190.500	190.500
Corporate tax	0.000	101.271	371.967	396.263	402.359	443.332
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-894.428	-385.071	-141.763	755.636	764.780	739.047
Cumulated cash balance	-1100.388	-1485.459	-1627.221	-871.585	-106.805	632.243
Inflow, local	1805.658	3600.917	6001.167	6000.000	6000.000	6000.000
Outflow, local	544.939	592.785	838.157	552.664	558.760	599.732
Surplus (deficit)	1260.720	3008.132	5163.010	5447.336	5441.240	5400.268
Inflow, foreign	3.853	3.522	4.917	0.000	0.000	0.000
Outflow, foreign	2159.000	3396.724	5309.690	4691.700	4676.460	4661.220
Surplus (deficit)	-2155.148	-3393.202	-5304.773	-4691.700	-4676.460	-4661.220
Net cashflow	-195.341	258.776	446.843	1022.336	1016.240	975.268
Cumulated net cashflow	-3538.341	-3279.565	-2832.722	-1810.386	-794.145	181.122

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	6000.000	6000.000	6000.000	6000.000	6000.000	6000.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	6000.000	6000.000	6000.000	6000.000	6000.000	6000.000
Total cash outflow	5251.809	5242.665	5043.021	5132.340	5148.840	5148.840
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	4581.400	4581.400	4581.400	4581.400	4581.400	4581.400
Cost of finance	30.480	15.240	0.000	0.000	0.000	0.000
Repayment	190.500	190.500	0.000	0.000	0.000	0.000
Corporate tax	449.428	455.524	461.620	550.940	567.440	567.440
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	748.191	757.335	956.979	867.660	851.160	851.160
Cumulated cash balance	1380.434	2137.770	3094.749	3962.409	4813.568	5664.728
Inflow, local	6000.000	6000.000	6000.000	6000.000	6000.000	6000.000
Outflow, local	605.829	611.924	618.021	707.340	723.840	723.840
Surplus (deficit)	5394.171	5388.076	5381.979	5292.660	5276.160	5276.160
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	-645.980	-630.740	-425.000	-425.000	-425.000	-425.000
Surplus (deficit)	-645.980	-630.740	-425.000	-425.000	-425.000	-425.000
Net cashflow	969.172	963.076	956.979	867.660	851.160	851.160
Cumulated net cashflow	1150.294	2113.369	3070.349	3938.008	4789.168	5640.328

Cashflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	6000.000	6000.000	6000.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	6000.000	6000.000	6000.000
Total cash outflow	5148.840	5148.840	5148.840
Total assets	0.000	0.000	0.000
Operating costs	4581.400	4581.400	4581.400
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	567.440	567.440	567.440
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	851.160	851.160	851.160
Cumulated cash balance	6515.888	7367.047	8218.207
Inflow, local	6000.000	6000.000	6000.000
Outflow, local	723.840	723.840	723.840
Surplus (deficit)	5276.160	5276.160	5276.160
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	4425.000	4425.000	4425.000
Surplus (deficit)	-4425.000	-4425.000	-4425.000
Net cashflow	851.160	851.160	851.160
Cumulated net cashflow	6491.487	7342.647	8193.807

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Cashflow Discounting:

a) Equity paid versus Net income flow:
Net present value ..... 2605.10 at 10.00 %
Internal Rate of Return (IRRE1) .. 28.80 %
b) Net Worth versus Net cash return:
Net present value ..... 2094.89 at 10.00 %
Internal Rate of Return (IRRE2) .. 19.70 %
c) Internal Rate of Return on total investment:
Net present value ..... 1992.05 at 10.00 %
Internal Rate of Return (IRR) .. 16.55 %
Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	1800.000	3600.000	6000.000	6000.000	6000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1800.000	3600.000	6000.000	6000.000	6000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1881.142	3160.142	4938.642	4933.142	4933.142
Operational margin	-81.142	439.858	1061.358	1066.858	1066.858
As % of total sales	-4.508	12.218	17.689	17.781	17.781
Cost of finance	241.920	186.680	131.440	76.200	60.960
Gross profit	-323.062	253.178	929.918	990.658	1005.898
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-323.062	253.178	929.918	990.658	1005.898
Tax	0.000	101.271	371.967	396.263	402.359
Net profit	-323.062	151.907	557.951	594.395	603.539
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-323.062	151.907	557.951	594.395	603.539
Accumulated undistributed profit	-323.062	-171.155	386.796	981.191	1584.730
Gross profit, % of total sales	-17.948	7.033	15.499	16.511	16.765
Net profit, % of total sales	-17.948	4.220	9.299	9.907	10.059
ROE, Net profit, % of equity	-31.704	14.907	54.755	58.331	59.229
ROI, Net profit+interest, % of invest.	-2.124	7.943	14.178	13.792	13.666

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	6000.000	6000.000	6000.000	6000.000	6000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	6000.000	6000.000	6000.000	6000.000	6000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4845.950	4845.950	4845.950	4845.950	4622.650
Operational margin	1154.050	1154.050	1154.050	1154.050	1377.350
As % of total sales	19.234	19.234	19.234	19.234	22.956
Cost of finance	45.720	30.480	15.240	0.000	0.000
Gross profit	1108.330	1123.570	1138.810	1154.050	1377.350
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1108.330	1123.570	1138.810	1154.050	1377.350
Tax	443.332	449.428	455.524	461.620	550.940
Net profit	664.998	674.142	683.286	692.430	826.410
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	664.998	674.142	683.286	692.430	826.410
Accumulated undistributed profit	2249.728	2923.870	3607.156	4299.586	5125.997
Gross profit, % of total sales	18.472	18.726	18.980	19.234	22.956
Net profit, % of total sales	11.083	11.236	11.388	11.541	13.774
ROE, Net profit, % of equity	65.260	66.157	67.055	67.952	31.100
ROI, Net profit+interest, % of invest.	14.617	14.492	14.366	14.241	16.996

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	6000.000	6000.000	6000.000	6000.000	6000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	6000.000	6000.000	6000.000	6000.000	6000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4581.400	4581.400	4581.400	4581.400	4581.400
Operational margin	1418.600	1418.600	1418.600	1418.600	1418.600
As % of total sales	23.643	23.643	23.643	23.643	23.643
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	1418.600	1418.600	1418.600	1418.600	1418.600
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1418.600	1418.600	1418.600	1418.600	1418.600
Tax	567.440	567.440	567.440	567.440	567.440
Net profit	851.160	851.160	851.160	851.160	851.160
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	851.160	851.160	851.160	851.160	851.160
Accumulated undistributed profit	5977.157	6828.317	7679.477	8530.637	9381.797
Gross profit, % of total sales	23.643	23.643	23.643	23.643	23.643
Net profit, % of total sales	14.186	14.186	14.186	14.186	14.186
ROE, Net profit, % of equity	83.529	83.529	83.529	83.529	83.529
ROI, Net profit+interest, % of invest.	17.505	17.505	17.505	17.505	17.505

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	1277.500	3548.960
Fixed assets, net of depreciation	0.000	1277.500
Construction in progress	1277.500	2271.460
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	1277.500	3548.960
Equity capital	435.000	1019.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	800.000	2324.000
Current liabilities	0.000	0.000
Bank overdraft, finance required	42.500	205.960
Total debt	842.500	2529.960
Equity, % of liabilities	34.051	28.713

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	3995.732	4079.982	4176.706	3653.809	3302.067
Fixed assets, net of depreciation	3186.218	2823.476	2466.234	2114.492	1762.750
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	479.186	928.011	1533.050	1533.050	1533.050
Cash, bank	7.267	5.433	6.267	6.267	6.267
Cash surplus, finance available	0.000	0.000	0.000	0.000	0.000
Loss carried forward	0.000	323.062	171.155	0.000	0.000
Loss	323.062	0.000	0.000	0.000	0.000
Total liabilities	3995.732	4079.982	4176.706	3653.809	3302.067
Equity capital	1019.000	1019.000	1019.000	1019.000	1019.000
Reserves, retained profit	0.000	0.000	0.000	386.796	981.191
Profit	0.000	151.907	557.951	594.395	603.539
Long and medium term debt	1866.833	1409.667	952.500	762.000	571.500
Current liabilities	9.511	13.950	20.033	20.033	20.033
Bank overdraft, finance required	1100.388	1485.458	1627.221	871.584	106.803
Total debt	2976.732	2909.075	2599.754	1653.618	698.337
Equity, % of liabilities	25.502	24.976	24.397	27.889	30.859

Projected Balance Sheets, Production in 1000 US$

Year	1997	1998	1999	2000	2001
Total assets	3669.761	4153.403	4646.189	5338.620	6165.030
Fixed assets, net of depreciation	1498.200	1233.650	969.100	704.550	663.300
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1533.050	1533.050	1533.050	1533.050	1533.050
Cash, bank	6.267	6.267	6.267	6.267	6.267
Cash surplus, finance available	632.245	1380.437	2137.773	3094.753	3962.413
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	3669.761	4153.403	4646.189	5338.620	6165.030
Equity capital	1019.000	1019.000	1019.000	1019.000	1019.000
Reserves, retained profit	1584.730	2249.728	2923.870	3607.156	4299.586
Profit	664.998	674.142	683.286	692.430	826.410
Long and medium term debt	381.000	190.500	0.000	0.000	0.000
Current liabilities	20.033	20.033	20.033	20.033	20.033
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	401.033	210.533	20.033	20.033	20.033
Equity, % of liabilities	27.767	24.534	21.932	19.087	16.529

Projected Balance Sheets, Production in 1000 US$

Year	2002	2003	2004	2005	2006
Total assets	7016.190	7867.350	8718.510	9569.670	10420.830
Fixed assets, net of depreciation	663.300	663.300	663.300	663.300	663.300
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1533.050	1533.050	1533.050	1533.050	1533.050
Cash, bank	6.267	6.267	6.267	6.267	6.267
Cash surplus, finance available	4813.573	5664.733	6515.893	7367.053	8218.213
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	7016.190	7867.350	8718.510	9569.670	10420.830
Equity capital	1019.000	1019.000	1019.000	1019.000	1019.000
Reserves, retained profit	5125.997	5977.157	6828.317	7679.477	8530.637
Profit	851.160	851.160	851.160	851.160	851.160
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	20.033	20.033	20.033	20.033	20.033
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	20.033	20.033	20.033	20.033	20.033
Equity, % of liabilities	14.524	12.952	11.688	10.648	9.778

ANNEXE 3

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	1536.29	1524.00	12.29	500.00	1024.00	3.85	3.52
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	1536.29	1524.00	12.29	500.00	1024.00	3.85	3.52
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	65466.59	1993.96	63472.63	520.00	1473.96	2159.00	3396.72
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	1713.70	1893.00	-179.30	500.00	1393.00	459.58	444.54
imported materials . . .	61567.00	0.00	61567.00	0.00	0.00	1387.00	2655.00
repayment loans & overd.	1536.29	0.00	1536.29	0.00	0.00	190.50	190.50
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	649.60	100.96	548.64	20.00	80.96	121.92	106.68
indirect costs							
net foreign exchge flow	-63930.30	-469.96	-63460.34	-20.00	-449.96	-2155.15	-3393.20
import substit'n effect	83400.00	0.00	83400.00	0.00	0.00	1800.00	3600.00
net forgn exchge effect	19469.70	-469.96	19939.66	-20.00	-449.96	-355.15	206.80

present values at	10.00 %
foreign exchange flow .	-29263.95
net forgn exchge effect	6949.52

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	4.92	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	4.92	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	5309.69	4691.70	4676.46	4661.22	4645.98	4630.74	4425.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	602.75	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	4425.00	4425.00	4425.00	4425.00	4425.00	4425.00	4425.00
repayment loans & overd.	190.50	190.50	190.50	190.50	190.50	190.50	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	91.44	76.20	60.96	45.72	30.48	15.24	0.00
indirect costs							
net foreign exchge flow	-5304.77	-4691.70	-4676.46	-4661.22	-4645.98	-4630.74	-4425.00
import substit'n effect	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
net forgn exchge effect	695.23	1308.30	1323.54	1338.78	1354.02	1369.26	1575.00

present values at	10.00 %
foreign exchange flow .	-29263.95
net forgn exchge effect	6949.52

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	4425.00	4425.00	4425.00	4425.00	4425.00	4425.00	-1673.88
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-1686.17
imported materials . . .	4425.00	4425.00	4425.00	4425.00	4425.00	4425.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	12.29
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-4425.00	-4425.00	-4425.00	-4425.00	-4425.00	-4425.00	1673.88
import substit'n effect	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	0.00
net forgn exchge effect	1575.00	1575.00	1575.00	1575.00	1575.00	1575.00	1673.88

present values at	10.00 %
foreign exchange flow .	-29263.95
net forgn exchge effect	6949.52

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE PRODUCTION OF AGRICULTURAL HAND TOOLS IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for the production of agricultural hand tools.

The envisaged plant has a nominal annual output of 1,150,000 units including shovels, matchets, hoes, axes, hachets, picks, based on 250 working days, one shift/day.(1)

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 4,632,000 (US$ 2,780,000 in foreign currency)
- Working capital (at full production): US$ 958,000 (US$ 832,600 in foreign currency)
- Internal Rate of Return: 17.26%
- Break-Even Point (at 5th year of production) 38%
- Pay-Back Period: less than 8 years (including construction period)
- Employees: 73

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 13,523,150 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

In Nigeria, more than 70% of agricultural land is cultivated by peasants.

These small holders take care of all farming operations using hand tools.

The process of agricultural mechanization is proceeding at very slow speed and is mainly devoted to medium/big/farms, where the investment on tractors and agricultural machines can be economically justified.

Many State governments introduced the system of tractor hiring, but the results are far from being satisfactory.

Forged hand farm tools, such as spades, shovels, forks, rakes, picks, mattocks, matchets, axes, etc., will still be used for many years to come.

(1) For additional background material, see Volume I p. 191.

2. MARKET AND PLANT CAPACITY

2.1 DEMAND

The estimated demand [1] for agricultural handtools in Nigeria is as follows:

year	(000 pieces) matchets	other handtools
1989	7,620	4,572
1990	7,932	4,752
1991	8,256	4,945
1992	8,592	5,150
1993	8,940	5,365
1994	9,312	5,580

The estimates are based on the following assumptions:

1 - The national demand/consumption for 1988 (the base year) is made up of the average import data of 450,000 dozens for 1981-1987 plus the 5 year average output of Crocodile Matchets (Nig.) Ltd. (the only known major producer) of 14,600 dozens and estimated output of 15,000 dozens of the local blacksmiths 10% of Crocodile's output).

2 - That is further projected annually by the average growth rate of 4.8% of agricultural sector.

3 - The demand for other agricultural handtools os estimated to be 60% of that of the matchets.

2.2 SUPPLY

Agricultural hand tools market is met both by import mainly from Korea and U.K. and by local production.

[1] Source: N.I.D.B.

The local producers are the following:

- Industrial & Farm Equipment Co. Ltd., Ketu, Lagos
- Modern Agro Industrial Techniques Ltd., Lagos
- Plastics and Engineering works Co. Ltd., Kano
- Roadmaster Industries, Ltd., Onitsha
- Maxi Trade Company Ltd., Port Harcourt
- Crocodile Matchets (Nigeria) Ltd. Port Harcourt
- John Holt Agricultural Engineers Ltd., Zaria

The total installed capacity of these plants is estimated to be around 2.5 million units/year [2]

2.3 PLANT CAPACITY

The present economic situation in Nigeria suggests to take into consideration the minimum economical size of a plant, which shall be flexible enough to allow the production of several types of hand tools, changing the production mix in accordance with the demand.

Typical hand tools are shown in the annexe 1.

The plant is flexible enough to allow to change the production mix at least once a week, thus being in a position to promptly follow the market demand.

Herebelow a production mix is proposed. It reflects, roughly, the optimization of the production lines.

Tool	Units/Year
. shovels, square type	225,000
. shovels, round type	400,000
. matchets, straight type	130,000
. matchets, curve type	130,000
. matchets, flat type	115,000
. hoes, round eye type	60,000
. hoes, with fork	10,000
. hoes, with tongue	5,000
. axes	25,000
. hachets	30,000
. picks	20,000

[2] N.I.D.B. estimate

The production is based on 250 working days per year in one shift per day, 8 hours/day.

2.4 SALES PRICES AND TOTAL REVENUE

The prices of the various items vary according to the origin of the goods. The items imported from Eastern Countries are generally comparable to those indicated in table herebelow, eventhough the quality is very poor. To be conservative, the same prices will be considered in computing the revenue.

Tool	Unit price US $	Units/year	Total US$
. shovels, square type	3.5	225,000	787,500
. shovels, round type	3.5	400,000	1,400,000
. matchets, straight type	4	130,000	520,000
. matchets, curve type	4	130,000	520,000
. matchets, flat type	4	115,000	460,000
. hoes, round eye type	4	60,000	240,000
. hoes, with fork	4	10,000	40,000
. hoes, with tongue	4	5,000	20,000
. axes	7	25,000	175,000
. hachets	7	30,000	210,000
. picks	7	20,000	140,000
Total			**4,512,500**

The production of the hand tools makes available 567 tons of steel scraps, which can be sold to the steel works or foundries at 150 US $/ton, giving a revenue of 90,720 US $.

In the financial and economic analysis a total revenue of 4,602,720 US$ will be considered.

It is expected that the plant output increases gradually as follows:

1st year 40% of nominal capacity

2nd year 60% of nominal capacity

3rd year 80% of nominal capacity

from 4th to 15th year 100% of nominal capacity

3. MATERIALS AND INPUTS

3.1 RAW MATERIALS

3.1.1 Steel

Machetes and shovels will be fabricated from steel coils, while all other tools will be fabricated from steel bars.

Both coils and bars will have to be imported.

The quantity of steel required is as follows:

Tool	Net weight (kg)	Scrap (%)	Gross weight (kg)	units/y	Total weight/y (kg)
. matchets	.65	30	0.93	375,000	350,000
. shovels, square	1.3	30	1.86	225,000	420,000
. shovels, round	1.2	30	1.75	400,000	690,000
. hoes, round eye type	1.2	40	2.00	60,000	120,000
. hoes, with fork	.8	65	2.29	10,000	22,900
. hoes, with tongue	.5	65	1.430	5,000	7,150
. axes	1.5	40	2.50	25,000	62,500
. hachets	.8	40	1.33	30,000	39,900
. picks	1.5	35	2.30	20,000	46,000
Total					**1,758,450**

Considering the cost of steel at an average price of US$ 1,000 per ton, the annual expenditures amount to US$ 1,758,450 in FC.

3.1.2 Wood

Wood is the second raw material by importance. It is used for the handles fabrication.

Wood is locally available at 250 US $ per cu.mt. It is estimated that the quantity required (scrap included) is 2,200 cu.mt per year.

The annual expenditures amount to 550,000 US $ LC.

3.1.3 Other materials

Lacquers, rivets, nails labels are other minor materials necessary for the product finishing. They are available locally.

The annual expenditures are estimated at US$ 200,000 LC.

3.2 UTILITIES

Electric energy, compressed air and cooling water are the utilities required.

The cooling water is used to cool the induction furnaces in closed circuit, so the consumption is negligible. For this system and for the compressed air system only the electric energy will be considered.

The installed power, including the process equipment, the utilities and the lighting is estimated to be around 400 KW.

The coefficient of utilization is 0.5. The annual consumption will be:

$$400 \times 0.8 \times 8 \times 250 = 640{,}000 \text{ kWh/year.}$$

The annual expenditures will be:

$$640{,}000 \times 0.1 \text{ US\$} = \text{US\$ } 64{,}000$$

3.3 RAW MATERIALS PURCHASING AND STORAGE VOLUMES

Steel coils and bars, being imported materials will be bought on annual contract basis, which will foresee deliveries every four months.

Wood and other materials, locally available can be bought every two months.

As a result the minimum stock will be:

- steel	kg 586,150	equivalent to	US$	586,150
- wood	m3 367	equivalent to	US$	91,700
- other materials			US$	33,000

4. LOCATION

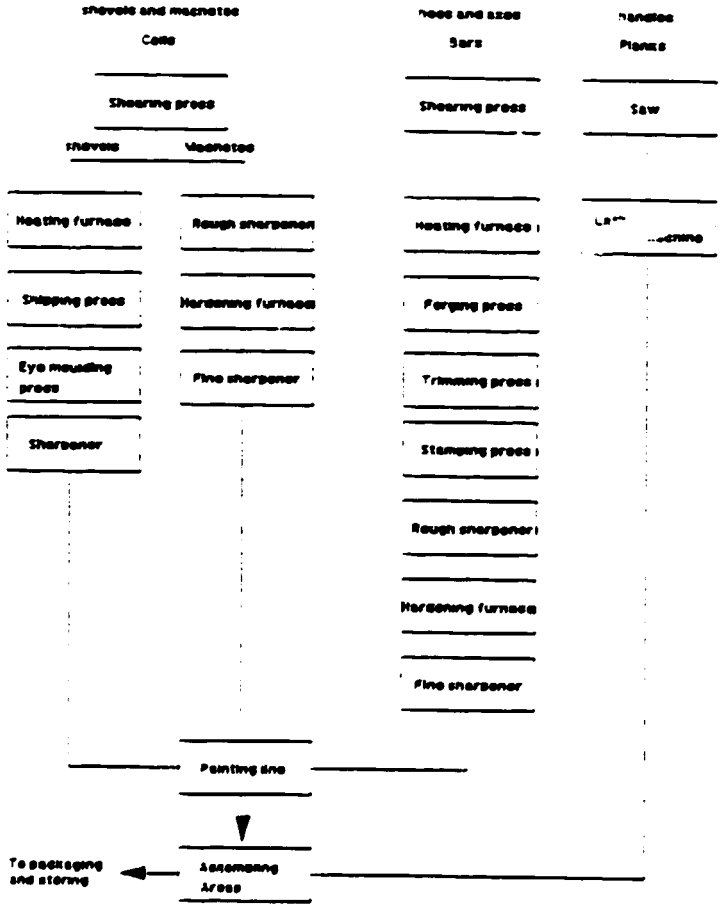
The plant can be located in any place, provided that the site is connected to the infrastructures and close to the wholesalers.

5. PROJECT ENGINEERING

5.1 PROCESS DESCRIPTION

The proposed plant consists, mainly, of three metal working lines plus a joinery for the tool handles fabrication. The lines will work per batches of economical size.

Schematically, the production steps are as follows:



5.1.1 Shovels production

The cold rolled stead coil is charged onto the uncoiler and the steel web is introduced into the shearing press of 300 tonnes, equipped with dies for the cutting off the flat shape of shovel. Each cut piece is introduced into an induction electric furnace and heated up to 1000 C, then it is shaped by a 200 tonne press. The bending and moulding of the shovel eye take place in a 40 tonne press.

After the sharpening, done by a grinding machine, the shovel is sent to the printing line and, finally, to the assembling area, where the handle is mounted. The finished shovel is transported to the storing area.

5.1.2 Matchets production

By using the same uncoiler and shearing press, utilized for the production of shovels, the shape of machetes are obtained. Each piece is than rough sharpened by using a grinding machine.

The hardening is obtained by heating the metal in an induction furnace and cooling it in oil. Fine sharpening (or lapping) is than carried out by using a grinding machine. When this operation is over, the piece is sent to the painting line and, finally, to the assembling area, where the handle is mounted. The finished machete is transferred to the storing area.

5.1.3 Hoes and axes production

Hoes and axes are fabricated in the same way and in the same line. Bars of desired width and thickness are cut into pieces, which are heated in an induction furnace before being forged. A grinding press is used to obtain the desired contour of the piece. The cutting edge is obtained by a stamping press, after which a rough sharpener is positioned. Before the fine sharpening operation, the piece is heated in an induction furnace.

As all other tools, also hoes and axes are painted in the same painting line and finally sent to the assembling area, where the handle is mounted.

Finished hoes and axes are transported to the storing area.

5.2 LAY-OUT AND CIVIL WORKS

The plant will cover an area of 2200 sq.mt about. The building, lodging the processing lines, the utilities, the stores and the offices will be in steel structure. The roofing, shed type, will allow the natural lighting. The cladding, as well as the internal partition walls will be made by using cement blocks or clay bricks. The floor of the industrial area will be in reinforced concrete slab, allowing an over load of 2000 kg/sq.mt.

The floors of the offices and sanitary rooms will be ceramic tiles. The sewerage consists of two sewer systems: one for rain water and one for sanitary water. Process polluted water is negligible, so no water treatment system is foreseen.

5.3 INVESTMENT COSTS

The quotation of machinery and equipment was obtained from ICOMSA, Padoa, Italy.

Description	LC M$	FC M$	TOTAL M$
- Machines and equipment including utilities F.O.B. European port		1.9	1.9
- Transport, taxes and duties	0.38	0.19	0.57
- Erection	0.30	0.20	0.50
- Land and site preparation	0.05		0.05
- Civil works & building	0.80		0.8
- Spare parts		0.08	0.08
Total	**1.53**	**2.37**	**3.90**
Contingencies 10%	**0.153**	**0.237**	**0.39**
Grand total	**1.683**	**2.607**	**4.29**

The industrial life of the plant can be considered as 15 years. 4% of the machinery and equipment costs can be assumed as the average annual expenditure for the maintenance (US $ 80,000).

In the financial evaluation the investment costs (contingencies included) are so subdivided:

Preproduction expenses	FC	0.050	million dollars
Preproduction expenses	LC	0.108	million dollars
Machinery	FC	2.607	million dollars
Machinery	LC	0.748	million dollars
Land and Site preparation	LC	0.055	million dollars
Civil work and building	LC	0.88	million dollars
		4.448	million dollars

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

No particular skill is required for any of the positions listed below, except for the technical manager and the production manager, who must attend a training course in the technology involved in the plant.

For the other personnel on the job training is suggested. The technology supplier will make available for one year after the plant start-up, an expert for that purpose.

The relevant cost is estimated US $ 120,000.

7.1 MANAGEMENT

		N/y
General manager	1	50,000
Technical Manager	1	40,000
	-	---
	2	90,000
		overheads 40% 36,000

		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPT.

		N/y
Financial Manager	1	40,000
Accountants	2	24,000
Purchasing Head	1	12,000
Purchasing assistant	1	8,000
Sales Head	1	12,000
Sales assistants	2	16,000
Warehouse keepers	2	20,000
Drivers	4	32,000
Secretaries and clerks	4	48,000
Guards	4	24,000
	--	---
	22	236,000
		overheads 40% 94,400

		330,400
		(US$ 41,800)

7.3 PRODUCTION DEPT.

		N/y
Production manager	1	40,000
Foremen	6	72,000
Shift operators	20	240,000
Semi-skilled workers	25	200,000
Clerks	2	24,000
	--	---
	54	576,000
		overheads 40% 230,400

		806,400
		(US$ 102,000)

7.4 MAINTENANCE DEPT.

		N/y
Chief Engineer	1	40,000
Foremen	2	24,000
Electricians	2	20,000
Mechanics	4	40,000
Semi-skilled workers	2	16,000
Unskilled workers	4	20,000
	---	---
	15	160,000
	overheads 40%	64,000

		224,000
		(US$ 28,350)

Summary

Administration	24	US$ 57,800
Production Dept.	44	US$ 102,000
Maintenance. Dept.	15	US$ 28,350
	---	---
TOTAL	83	US$ 188,150

8. IMPLEMENTATION SCHEDULE

From the moment the financing of the project is finalized, 24 months will be needed in order to design, build and commission the plant

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 2.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 4,632,000 US Dollars. The portion in foreign currency accounts for 2,780,000 US Dollars.

Details of these figures are shown in chapter 5.3.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 864,000	US$ 928,000	US$ 1,792,000
- Foreign Loan (interest 8%)	US$ 516,000	US$ 1,700,000	US$ 2,216,000
- Local Loan (interest 15%)	US$ 140,000	US$ 300,000	US$ 440,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 30

2nd year 50%

3rd year 70%

4th and subsequent years 100%

When the plant is in full production, the required working capital amounts to 958.065 US Dollars, the foreign portion being US$ 832,620.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 324,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 30% of its nominal capacity, the production costs amount to US$ 1,805,515.

In the fourth year, at full production, the costs amount to US $ 3,443,445, then they start a slight decrease year after year, to arrive to be constant to US $ 2,840,600 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US$ 4,602,720. As said before, the production programme foresees that full production is reached gradually:

1st year 30% : revenue = US$ 1,380,820

2nd year 50% : revenue = US$ 2,301,360

3rd year 70% : revenue = US$ 3,221,900.

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 17.26%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 38% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [3] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 8 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 3.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 13,523,150.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 13,523,150.

[3] Direct labour is considered as a variable cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

ANNEXE 1

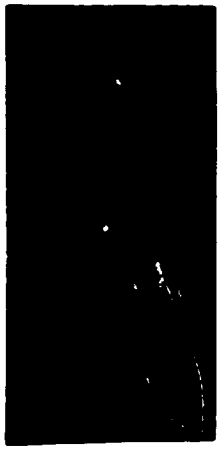
TYPICAL AGRICULTURAL HAND-TOOLS

ANNEXE 1

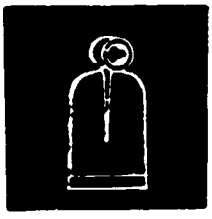
TYPICAL AGRICULTURAL HANDTOOLS

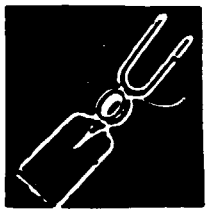
SHOVELS

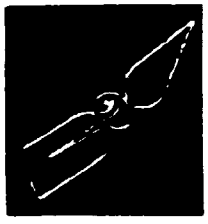
MACHETES

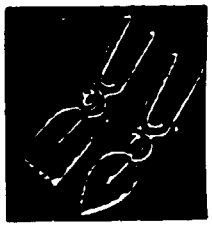


HOES

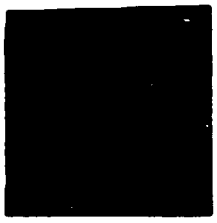






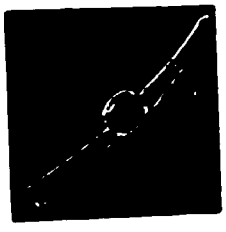


AXE



HACHET

PICK



ANNEXE 2

COMFAR SCHEDULES

AGRICULTURAL HAND TOOLS
MAY 1990
OPPORTUNITY STUDY

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000US$

Total initial investment during construction phase

fixed assets:	4631.92	60.168 % foreign
current assets:	0.00	0.000 % foreign
total assets:	4631.92	60.168 % foreign

Source of funds during construction phase

equity & grants:	1792.00	0.000 % foreign
foreign loans :	2216.00	
local loans :	440.00	
total funds :	4448.00	49.820 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1103.35	2840.60	2840.60
depreciation :	458.88	447.88	44.00
interest :	243.28	110.80	0.00
production costs	1805.51	3399.28	2884.60
thereof foreign	62.75 %	64.89 %	62.35 %
total sales :	1380.82	4602.72	4602.72
gross income :	-424.69	1203.44	1718.12
net income :	-424.69	722.06	1030.87
cash balance :	-289.18	892.95	1074.87
net cashflow :	-45.90	1280.75	1074.87

Net Present Value at: 10.00 % = 2615.71
Internal Rate of Return: 17.26 %
Return on equity1: 21.15 %
Return on equity2: 21.71 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1000US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	55.000	0.000
Buildings and civil works	500.000	380.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	907.000	2448.000
Total fixed investment costs	1462.000	2828.000
Pre-production capital expenditures	89.140	252.780
Net working capital	0.000	0.000
Total initial investment costs	1551.140	3080.780
Of it foreign, in %	43.687	68.466

Total Current Investment in 1000US$

Year	1992	1993	1994	1995
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000
Working capital	323.373	161.196	32.602	440.893
Total current investment costs	323.373	161.196	32.602	440.893
Of it foreign, %	83.353	91.271	17.647	93.039

Total Production Costs in 1000US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	30.000	50.000	70.000	100.000	100.000
Raw material 1	692.000	1105.000	1265.916	2308.450	2308.450
Other raw materials	60.000	100.000	140.000	200.000	200.000
Utilities	19.200	32.000	44.800	64.000	64.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	102.000	102.000	102.000	102.000	102.000
Repair, maintenance	12.000	20.000	28.000	40.000	40.000
Spares	12.000	20.000	28.000	40.000	40.000
Factory overheads	120.000	0.000	0.000	0.000	0.000
Factory costs	1017.200	1379.000	1608.716	2754.450	2754.450
Administrative overheads	86.150	86.150	86.150	86.150	86.150
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	458.884	458.884	453.384	447.884	447.884
Financial costs	243.280	243.280	199.120	154.960	110.800
Total production costs	1805.514	2167.314	2347.370	3443.444	3399.284
Costs per unit (single product)	1.308	0.942	0.729	0.748	0.739
Of it foreign, %	62.750	63.395	57.968	64.705	64.894
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	188.150	188.150	188.150	188.150	188.150

Total Production Costs in 1000US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	2308.450	2308.450	2308.450	2308.450	2308.450
Other raw materials	200.000	200.000	200.000	200.000	200.000
Utilities	64.000	64.000	64.000	64.000	64.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	102.000	102.000	102.000	102.000	102.000
Repair, maintenance	40.000	40.000	40.000	40.000	40.000
Spares	40.000	40.000	40.000	40.000	40.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	2754.450	2754.450	2754.450	2754.450	2754.450
Administrative overheads	86.150	86.150	86.150	86.150	86.150
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	379.500	379.500	379.500	379.500	44.000
Financial costs	88.640	66.480	44.320	0.000	0.000
Total production costs	3308.740	3286.580	3264.420	3220.100	2884.600
Costs per unit (single product)	0.719	0.714	0.709	0.700	0.627
Of it foreign, %	64.913	64.676	64.436	63.947	62.347
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	188.150	188.150	188.150	188.150	188.150

Total Production Costs in 1000US$

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	2308.450
Other raw materials	200.000
Utilities	64.000
Energy	0.000
Labour, direct	102.000
Repair, maintenance	40.000
Spares	40.000
Factory overheads	0.000
Factory costs	2754.450
Administrative overheads	86.150
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	2840.600
Costs per unit (single product)	0.617
Of it foreign, %	63.312
Of it variable,%	0.000
Total labour	188.150

Net Working Capital in 1000US$

Year	mdc	coto	1992	1993	1994	1995	1996-2006
Coverage							
Current assets &							
Accounts receivable	30	12.0	91.946	122.096	141.239	236.717	236.717
Inventory and materials	91	4.0	194.470	320.506	337.513	648.828	648.828
Energy	0	---	0.000	0.000	0.000	0.000	0.000
Spares	180	2.0	6.000	10.000	14.000	20.000	20.000
Work in progress	1	360.0	2.826	3.831	4.469	7.651	7.651
Finished products	15	24.0	45.973	61.048	70.619	118.358	118.358
Cash in hand	15	24.0	13.840	9.506	10.173	11.173	11.173
Total current assets			355.054	526.986	578.013	1042.727	1042.727
Current liabilities and							
Accounts payable	11	32.2	31.681	42.417	60.841	84.662	84.662
Net working capital			323.373	484.569	517.172	958.065	958.065
Increase in working capital			323.373	161.196	32.602	440.893	0.000
Net working capital, local			53.832	67.903	94.752	125.442	125.442
Net working capital, foreign			269.542	416.667	422.420	832.623	832.623

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000US$

Year	1990	1991
Equity, ordinary ..	864.000	928.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	516.000	1700.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	140.000	300.000
Loan C, local....	0.000	0.000
Total loan	656.000	2000.000
Current liabilities	0.000	0.000
Bank overdraft	31.140	152.780
Total funds	1551.140	3080.780

Source of Finance, production in 1000US$

Year	1992	1993	1994	1995	1996-2000
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	0.000	-277.000	-277.000	-277.000	-277.000
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	0.000	-146.667	-146.667	-146.667	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	0.000	-423.667	-423.667	-423.667	-277.000
Current liabilities	31.681	10.736	18.425	23.821	0.000
Bank overdraft	289.183	45.551	-518.655	0.000	0.000
Total funds	320.864	-367.379	-923.896	-399.846	-277.000

Cashflow Tables, construction in 1000US$

Year	1990	1991
Total cash inflow . .	1520.000	2928.000
Financial resources .	1520.000	2928.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	1551.140	3080.780
Total assets	1520.000	2928.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	31.140	152.780
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-31.140	-152.780
Cumulated cash balance	-31.140	-183.920
Inflow, local	1004.000	1228.000
Outflow, local	873.500	971.500
Surplus (deficit) .	130.500	256.500
Inflow, foreign . . .	516.000	1700.000
Outflow, foreign . . .	677.640	2109.280
Surplus (deficit) .	-161.640	-409.280
Net cashflow	-1520.000	-2928.000
Cumulated net cashflow	-1520.000	-4448.000

Cashflow tables, production in 1000US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow . .	1412.500	2312.096	3240.325	4626.541	4602.720	4602.720
Financial resources .	31.681	10.736	18.425	23.821	0.000	0.000
Sales, net of tax . .	1380.820	2301.360	3221.900	4602.720	4602.720	4602.720
Total cash outflow . .	1701.684	2357.647	2718.491	4347.651	3709.774	3723.832
Total assets	355.054	171.932	51.027	464.714	0.000	0.000
Operating costs . . .	1103.350	1465.150	1694.866	2840.600	2840.600	2840.600
Cost of finance . . .	243.280	243.280	199.120	154.960	110.800	88.640
Repayment	0.000	423.667	423.667	423.667	277.000	277.000
Corporate tax . . .	0.000	53.618	349.812	463.711	481.375	517.592
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-289.183	-45.551	521.833	278.890	892.946	878.888
Cumulated cash balance	-473.103	-518.655	3.179	282.068	1175.014	2053.902
Inflow, local	1410.670	2311.427	3240.300	4624.070	4602.720	4602.720
Outflow, local	594.032	855.573	1371.677	1726.567	1523.524	1559.742
Surplus (deficit) .	816.638	1455.854	1868.623	2897.503	3079.196	3042.978
Inflow, foreign . . .	1.831	0.669	0.025	2.471	0.000	0.000
Outflow, foreign . . .	1107.652	1502.074	1346.814	2621.084	2186.250	2164.090
Surplus (deficit) .	-1105.822	-1501.405	-1346.789	-2618.613	-2186.250	-2164.090
Net cashflow	-45.903	621.395	1144.620	857.517	1280.746	1244.528
Cumulated net cashflow	-4493.903	-3872.508	-2727.888	-1870.371	-589.625	654.903

Cashflow tables, production in 1000US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow . .	4602.720	4602.720	4602.720	4602.720	4602.720	4602.720
Financial resources .	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax . .	4602.720	4602.720	4602.720	4602.720	4602.720	4602.720
Total cash outflow . .	3710.536	3697.240	3670.648	3527.848	3545.448	3545.448
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs . . .	2840.600	2840.600	2840.600	2840.600	2840.600	2840.600
Cost of finance . . .	56.480	44.320	0.000	0.000	0.000	0.000
Repayment	277.000	277.000	277.000	0.000	0.000	0.000
Corporate tax . . .	526.456	535.320	553.048	687.248	704.848	704.848
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	892.184	905.480	932.072	1074.872	1057.272	1057.272
Cumulated cash balance	2946.087	3851.567	4783.639	5858.512	6915.784	7973.057
Inflow, local	4602.720	4602.720	4602.720	4602.720	4602.720	4602.720
Outflow, local	1568.606	1577.470	1595.198	1729.398	1746.998	1746.998
Surplus (deficit) .	3034.114	3025.250	3007.522	2873.322	2855.722	2855.722
Inflow, foreign . . .	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign . . .	2141.930	2119.770	2075.450	1798.450	1798.450	1798.450
Surplus (deficit) .	-2141.930	-2119.770	-2075.450	-1798.450	-1798.450	-1798.450
Net cashflow	1235.664	1226.800	1209.072	1074.872	1057.272	1057.272
Cumulated net cashflow	1890.568	3117.368	4326.440	5401.313	6458.585	7515.857

Cashflow tables, production in 1000US$

Year	2004	2005	2006
Total cash inflow	4602.720	4602.720	4602.720
Financial resources	0.000	0.000	0.000
Sales, net of tax	4602.720	4602.720	4602.720
Total cash outflow	3545.448	3545.448	3545.448
Total assets	0.000	0.000	0.000
Operating costs	2840.600	2840.600	2840.600
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	704.848	704.848	704.848
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	1057.272	1057.272	1057.272
Cumulated cash balance	9030.329	10087.600	11144.870
Inflow, local	4602.720	4602.720	4602.720
Outflow, local	1746.998	1746.998	1746.998
Surplus (deficit)	2855.722	2855.722	2855.722
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	1798.450	1798.450	1798.450
Surplus (deficit)	-1798.450	-1798.450	-1798.450
Net cashflow	1057.272	1057.272	1057.272
Cumulated net cashflow	8573.130	9630.402	10687.670

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	2392.91	at	10.00 %
Internal Rate of Return (IRRE1) ..	21.15 %		

b) Net Worth versus Net cash return:

Net present value	2793.26	at	10.00 %
Internal Rate of Return (IRRE2) ..	21.71 %		

c) Internal Rate of Return on total investment:

Net present value	2615.71	at	10.00 %
Internal Rate of Return (IRR) ..	17.26 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	1380.820	2301.360	3221.900	4602.720	4602.720
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1380.820	2301.360	3221.900	4602.720	4602.720
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1562.234	1924.034	2148.250	3288.484	3288.484
Operational margin	-181.414	377.326	1073.650	1314.236	1314.236
As % of total sales	-13.138	16.396	33.324	28.553	28.553
Cost of finance	243.280	243.280	199.120	154.960	110.800
Gross profit	-424.694	134.046	874.530	1159.276	1203.436
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-424.694	134.046	874.530	1159.276	1203.436
Tax	0.000	53.618	349.812	463.711	481.375
Net profit	-424.694	80.428	524.718	695.566	722.062
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-424.694	80.428	524.718	695.566	722.062
Accumulated undistributed profit	-424.694	-344.266	180.451	876.017	1598.079
Gross profit, % of total sales	-30.757	5.825	27.143	25.187	26.146
Net profit, % of total sales	-30.757	3.495	16.286	15.112	15.688
RCE, Net profit, % of equity	-23.699	4.438	29.281	38.815	40.294
ROI, Net profit+interest, % of invest.	-3.802	6.563	14.578	15.733	15.406

Net Income Statement in 1000US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	4602.720	4602.720	4602.720	4602.720	4602.720
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4602.720	4602.720	4602.720	4602.720	4602.720
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	3220.100	3220.100	3220.100	3220.100	2884.600
Operational margin	1382.620	1382.620	1382.620	1382.620	1718.120
As % of total sales	30.039	30.039	30.039	30.039	37.328
Cost of finance	88.640	66.480	44.320	0.000	0.000
Gross profit	1293.980	1316.140	1338.300	1382.620	1718.120
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1293.980	1316.140	1338.300	1382.620	1718.120
Tax	517.592	526.456	535.320	553.048	687.248
Net profit	776.388	789.684	802.980	829.572	1030.872
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	776.388	789.684	802.980	829.572	1030.872
Accumulated undistributed profit	2374.467	3164.151	3967.132	4796.704	5827.576
Gross profit, % of total sales	28.113	28.595	29.076	30.039	37.328
Net profit, % of total sales	16.868	17.157	17.446	18.024	22.397
ROE, Net profit, % of equity	43.325	44.067	44.809	46.293	57.526
ROI, Net profit+interest, % of invest.	16.001	15.837	15.673	15.345	19.069

Net Income Statement in 1000US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	4602.720	4602.720	4602.720	4602.720	4602.720
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4602.720	4602.720	4602.720	4602.720	4602.720
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2840.600	2840.600	2840.600	2840.600	2840.600
Operational margin	1762.120	1762.120	1762.120	1762.120	1762.120
As % of total sales	38.284	38.284	38.284	38.284	38.284
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	1762.120	1762.120	1762.120	1762.120	1762.120
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1762.120	1762.120	1762.120	1762.120	1762.120
Tax	704.848	704.848	704.848	704.848	704.848
Net profit	1057.272	1057.272	1057.272	1057.272	1057.272
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1057.272	1057.272	1057.272	1057.272	1057.272
Accumulated undistributed profit	6884.848	7942.120	8999.392	10056.660	11113.940
Gross profit, % of total sales	38.284	38.284	38.284	38.284	38.284
Net profit, % of total sales	22.971	22.971	22.971	22.971	22.971
ROE, Net profit, % of equity	59.000	59.000	59.000	59.000	59.000
ROI, Net profit+interest, % of invest.	19.557	19.557	19.557	19.557	19.557

Projected Balance Sheets, construction in 1000US$

Year	1990	1991
Total assets	1551.140	4631.920
Fixed assets, net of depreciation	0.000	1551.140
Construction in progress	1551.140	3080.780
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	1551.140	4631.920
Equity capital	864.000	1792.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	656.000	2656.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	31.140	183.920
Total debt	687.140	2839.920
Equity, % of liabilities	55.701	38.688

Projected Balance Sheets, Production in 1000US$

Year	1992	1993	1994	1995	1996
Total assets	4952.784	4665.832	4186.226	4137.680	4582.741
Fixed assets, net of depreciation	4173.036	3714.152	3260.768	2812.884	2365.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	341.214	517.480	567.840	1031.554	1031.554
Cash, bank	13.840	9.506	10.173	11.173	11.173
Cash surplus, finance available	0.000	0.000	3.178	282.069	1175.014
Loss carried forward	0.000	424.694	344.266	0.000	0.000
Loss	424.694	0.000	0.000	0.000	0.000
Total liabilities	4952.784	4665.832	4186.226	4137.680	4582.741
Equity capital	1792.000	1792.000	1792.000	1792.000	1792.000
Reserves, retained profit	0.000	0.000	0.000	180.451	876.017
Profit	0.000	80.428	524.718	695.566	722.062
Long and medium term debt	2656.000	2232.333	1808.667	1385.000	1108.000
Current liabilities	31.681	42.417	60.841	84.662	84.662
Bank overdraft, finance required.	473.104	518.655	0.000	0.000	0.000
Total debt	3160.784	2793.405	1869.508	1469.662	1192.662
Equity, % of liabilities	36.182	38.407	42.807	43.309	39.103

Projected Balance Sheets, Production in 1000US$

Year	1997	1998	1999	2000	2001
Total assets	5082.130	5594.813	6120.794	6673.366	7704.238
Fixed assets, net of depreciation	1985.500	1606.000	1226.500	847.000	803.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1031.554	1031.554	1031.554	1031.554	1031.554
Cash, bank	11.173	11.173	11.173	11.173	11.173
Cash surplus, finance available	2053.903	2946.087	3851.567	4783.639	5858.511
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	5082.130	5594.813	6120.794	6673.366	7704.238
Equity capital	1792.000	1792.000	1792.000	1792.000	1792.000
Reserves, retained profit	1598.079	2374.467	3164.151	3967.132	4796.704
Profit	776.388	789.684	802.980	829.572	1030.872
Long and medium term debt	831.000	554.000	277.000	-0.000	-0.000
Current liabilities	84.662	84.662	84.662	84.662	84.662
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	915.662	638.662	361.662	84.662	84.662
Equity, % of liabilities	35.261	32.030	29.277	26.853	23.260

Projected Balance Sheets, Production in 1000US$

Year	2002	2003	2004	2005	2006
Total assets	8761.510	9818.782	10876.050	11933.330	12990.600
Fixed assets, net of depreciation	803.000	803.000	803.000	803.000	803.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1031.554	1031.554	1031.554	1031.554	1031.554
Cash, bank	11.173	11.173	11.173	11.173	11.173
Cash surplus, finance available	6915.783	7973.055	9030.327	10087.600	11144.870
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	8761.510	9818.782	10876.050	11933.330	12990.600
Equity capital	1792.000	1792.000	1792.000	1792.000	1792.000
Reserves, retained profit	5827.576	6884.848	7942.120	8999.392	10056.660
Profit	1057.272	1057.272	1057.272	1057.272	1057.272
Long and medium term debt	-0.000	-0.000	-0.000	-0.000	-0.000
Current liabilities	84.662	84.662	84.662	84.662	84.662
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	84.662	84.662	84.662	84.662	84.662
Equity, % of liabilities	20.453	18.251	16.477	15.017	13.795

ANNEXE 3

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	2221.00	2216.00	5.00	516.00	1700.00	1.83	0.67
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	2221.00	2216.00	5.00	516.00	1700.00	1.83	0.67
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	29749.41	2786.92	26962.49	677.64	2109.28	1107.65	1502.07
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	2396.30	2657.00	-260.70	657.00	2000.00	271.37	147.79
imported materials . . .	24049.31	0.00	24049.31	0.00	0.00	659.00	900.00
repayment loans & overd.	2221.00	0.00	2221.00	0.00	0.00	0.00	277.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1082.80	129.92	952.88	20.64	109.28	177.28	177.28
indirect costs							
net foreign exchge flow	-27528.41	-570.92	-26957.49	-161.64	-409.28	-1105.82	-1501.41
import substit'n effect	62136.71	0.00	62136.71	0.00	0.00	1380.82	2301.36
net forgn exchge effect	34608.30	-570.92	35179.22	-161.64	-409.28	275.00	799.96

present values at	10.00 %
foreign exchange flow .	-12968.00
net forgn exchge effect	13523.15

Foreign Exchange Effect in 1000US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	0.02	2.47	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.02	2.47	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	1346.81	2621.08	2186.25	2164.09	2141.93	2119.77	2075.45
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	5.78	412.67	0.00	0.00	0.00	0.00	0.00
imported materials . . .	908.92	1798.45	1798.45	1798.45	1798.45	1798.45	1798.45
repayment loans & overd.	277.00	277.00	277.00	277.00	277.00	277.00	277.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	155.12	132.96	110.80	88.64	66.48	44.32	0.00
indirect costs							
net foreign exchge flow	-1346.79	-2618.61	-2186.25	-2164.09	-2141.93	-2119.77	-2075.45
import substit'n effect	3221.90	4602.72	4602.72	4602.72	4602.72	4602.72	4602.72
net forgn exchge effect	1875.11	1984.11	2416.47	2438.63	2460.79	2482.95	2527.27

present values at	10.00 %
foreign exchange flow .	-12968.00
net forgn exchge effect	13523.15

Foreign Exchange Effect in 1000US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	1798.45	1798.45	1798.45	1798.45	1798.45	1798.45	-1093.32
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-1098.32
imported materials . . .	1798.45	1798.45	1798.45	1798.45	1798.45	1798.45	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	5.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-1798.45	-1798.45	-1798.45	-1798.45	-1798.45	-1798.45	1093.32
import substit'n effect	4602.72	4602.72	4602.72	4602.72	4602.72	4602.72	0.00
net forgn exchge effect	2804.27	2804.27	2804.27	2804.27	2804.27	2804.27	1093.32

present values at	10.00 %
foreign exchange flow .	-12968.00
net forgn exchge effect	13523.15

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE INSTALLATION OF A FOUNDRY PRODUCING ALLOY CAST IRON PARTS FOR THE CEMENT AND MINING INDUSTRIES

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0 SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a foundry for the production of alloy cast iron spare parts for the cement and mining industry.[1]

The envisaged foundry has a nominal annual capacity of 3,500 T, based on 250 working days, 2 shifts day, 8 hours/shift.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 9,099,530 (US$ 5,550,000 in foreign currency)
- Working capital (at full production): US$ 1,819,200 (US$ 1,720,000 in foreign currency)
- Internal Rate of Return: 18.50%
- Break-Even Point (at 5th year of production) 32%
- Pay-Back Period: less than 7 years (including construction period)
- Employees: 150

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 23,741,550 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

There are seven cement companies in Nigeria; their cement plants have a total annual nominal capacity exceeding 5,000,000 tonnes.

They are:

- Ashaka Cement Company Ltd, Ashaka, Bauchi State.
- Bendel Cement Company Ltd, Upkilla, Bandel State
- Benue Cement Company Ltd, Yandew; Benue State
- Calabar Cement Company Ltd, Calabar, Cross River State
- Nigerian Cement Company Ltd, Nkalagu, Anambra State

[1] For additional background material, see Volume I p. 193.

- The Cement of Northern Nigeria, Sokoto, Sokoto State

- West African Portland Cement Company, Ogun and Lagos States

Cement plants are large consumers of abrasion and wear resistant parts, that are in alloy cast iron. The availability of these parts is essential for keeping the plants running; moreover, some of them, like the wear resistant plates, are required to be of a very high quality, for safety of the equipment.

An investigation made contacting some European cement producers, revealed that only few specialized foundries exist in Europe able to satisfy their demand. Actually, the owners or the management try to keep their plants running for more than one year, before stopping them for maintenance. The higher price they pay for high reliable spare parts is largely compensated by the increased productivity.

The number of cement plants in Nigeria suggests the installation of a modern foundry. which could satisfy the cement sector and produce other kind of products of high quality, required by other industries.

It is important to mention that the new foundry would not affect the activity of the foundry shops installed in Nigeria. Only few of them can be considered adequate to fabricate quality products (see Adenowale Engineering Services Ltd, Railway Corporation, Nigeria Ports Authority, Delta Steel Foundry, Ajakouta Steel, Bamfords International). All the others are poorly equipped and in the majority of the cases, they are not equipped at all other than with make-shift facilities.

2. MARKET AND PLANT CAPACITY

2.1 DEMAND

Like any industry, cement and mining industries require some basic spare parts to continue in production. Some of the important ones include Grinding Media, Crusher Hammers and liner plates.

The annual requirements of the seven cement companies in Nigeria are shown in the following table (figures are expressed in MT):

	Grinding Media	Crusher Hammers	Liner Plates	Total
- West Afr. Portland Cem. Co.	1,500	90	215	1,805
- Benue Cement Company	500	30	64	594
- Ashaka Cement Company	600	50	70	720
- Nigerian Cement Company	600	44	105	749
- Calabar Cement Company	250	20	43	313
- Bendel Cement Company	200	17	36	253
- Cement Company of Northern Nigeria	250	20	43	313
	3,900	271	576	4,747

Although no reliable data of the requirements of the mining companies are available, it can be assumed that up to 1/4 of the requirements of the cement companies in Nigeria will also be needed in these mining companies.

The projected demand for cement/mining spare parts will be based on the present requirements of the seven cement companies and the demand of the mining companies assumed to be about 1,187 tonnes.

This gives a grand total of about 5,934 tonne of cement/mining industrial spare parts required in the country per annum. The figure will be held constant as there are no known potential new entrants, into the sub-sectors.

2.2 SUPPLY

The demand for these spare parts is presently being met by both domestic production and importation. However, due to the low value of the Naira which has made importation very expensive, the volume of imports have dwindled considerably in recent years. Greater attention is now placed on the few local foundries, such as Nigerian Foundries Ltd, Delta Steel Foundry Ltd, Bamfords International, who are known to have the capabilities for producing grinding balls. There is no domestic producers of wear-resistant spare-parts in the country.

There exists only a project for upgrading the existing facilities of the Nigerian Foundries, in order to enable this complex to produce special alloy castings, steel castings and wear-resistant spare parts for cement companies.

2.3 PLANT CAPACITY

In consideration of what was stated above, it seems justified the installation of a modern foundry having a nominal annual output of 3,500 T, based on 250 working days, 2 shifts, 8 hours per shift.

The product mix assumed is the following:

- grinding media	60% = 2100 tons
- lining plates	15% = 525 tons
- grid-bars and other parts	25% = 875 tons

2.4 SALES PRICES AND TOTAL REVENUE

The costs of imported spare parts paid by the cement producers are as follows:

- grinding media	2.80 US$/Kg
- lining plates	3.50 US$/Kg
- grid bears and other parts	4,25 US$/Kg

The ex-works prices considered for the calculation of the revenue are:

- grinding media	1.75 US$/Kg
- lining plates	2.5 US$/Kg
- grid bars and other parts	3.5 US$/Kg

It is expected that the foundry output increases gradually giving the revenue as follows:

	Revenue (US$)
1st year 30% of nominal capacity	2,415,000
2nd year 50% of nominal capacity	4,025,000
3rd year 70% of nominal capacity	5,635,000
from 4th year to 15th 100% of nominal capacity	8,050,000

3. MATERIALS AND INPUTS

3.1 RAW MATERIALS AND FERRO-ALLOYS

Main raw materials, i.e. steel scrap and iron scrap are available in large quantity. Their present cost is 200 US$/tonne for steel scrap and 160 US$ for iron scraps. To make sure that the quality of casting corresponds to the specifications, a certain quantity of pig iron (25% of needs) has to be imported, along with all the required ferro alloys. For the envisaged mix of production the quantity of each material and the relevant cost for one year of production are reported in the following table.

The melting furnaces (see chapter 5) are of induction type; they will allow the production of various kinds of castings.

In order to calculate the average consumption of raw materials and ferro-alloys, iron castings with the following chemical composition have been considered:

C 2.7 to 3.2%; Si 0.3 to 0.8%; Mn 0.2 to 0.6%; Ni 3%; Cr 1.5 to 3.5%; Mo 0.5% max; P 0.15% max; S 0.15% max.

For an annual output of 3,500 tons of parts, the consumption and the cost of the raw materials and ferro-alloys are shown in the table 3.1 here-below.

MATERIAL	Q.TY (T)	UNIT COSTS (US$)		TOTAL COST	
		LC	FC	LC	FC
Pig iron	920		480		441,600
Steel scraps	1100	200		220,000	
Iron scraps and return	1650	160		264,000	
FeMn at 50%	30		800		24,000
FeCr at 25%	295		2,500		737,000
Ni (drops)	100		16,000		1,600,000
Other ferro-alloys	15		800		12,000
SUB-TOTAL				484,000	2,815,100
GRAND TOTAL				3,299,100	

3.2 SAND

3.2.1 Sand for Moulding

For the production of the parts indicated in the production mix it is foreseen the use of about 1000 moulding boxes of various sizes, allowing the casting of a number of pieces totaling 15 kg to 40 Kg of metal per box.

At full capacity, the estimated need of sand is around 250 tons/day.

Taking into consideration that 90% of the sand will be recovered and regenerated, the actual sand consumed is 25 tons/day or 6,000 tons/year.

The sand is available in Nigeria at 60 US$/tons, delivered to the foundry; the annual expenditure will therefore be:

US$ 36.000 in L.C.

3.3 OTHER MATERIALS

The consumption of other materials, like binders, graphite, varnishes etc. is not calculated. According to the experience, the relevant expenditures are estimated 40 US$/tons of finished product.

At full capacity, the expenditures will amount to:

US$ 140.000 in F.C.

3.4 ELECTRIC ENERGY

The expenditures for electric energy are:

US$ 294.000 (in L.C.).

This sum is the result of the calculations done here-below.

3.4.1. Melting furnaces

Two induction electric furnaces are foreseen, with nominal capacity of 5000 Kg/h each and installed power of 1500 KW each.

The production of 3,500 tons of finished parts, requires about 6,000 tons of molten metal.

The average consumption of electric energy is 650 kWh/ton of molten metal.

It is foreseen that the two furnaces operate together alternating the supply of 2,000 to 2,500 Kg/h of molten metal for 16 hours/day. (see operating diagram, in Annexe 1).

With this kind of operation, a large quantity of molten metal will remain in the furnace, allowing the reduction of energy consumption to 60%.

The annual expenditures for the electric energy will be 6,000 tons/ y x 650 KWh/t x 0.6 x 0.1 US$/KWh =

US$ 234,000.

3.4.2 Other equipment and utilities

For the other process equipment and for the utilities, the installed power is estimated 300 KW. The coefficient of utilization is considered 0.5, therefore the annual expenditures will be:

300 kW x (16 x 250) x 0.5 x 0.1 = US $ 60,000

3.5 PATTERNS

Almost all the patterns will be in cast iron, but a certain number of wooden patterns will be required for general parts and special requests.

Cast iron patterns are considered in the cost of the equipment.

The annual expenditure for the wooden patterns is estimated at

10,000 US $ in L.C.

4. LOCATION

The plant shall be located not far from Lagos, in a site a) connected with the road network, which can assure direct delivery of the products to the cement plants, b) close to the power distribution grid, c) close to the harbour to facilitate the delivery of imported materials.

5. PROJECT ENGINEERING

5.1 THE PROCESS

The proposed foundry consists mainly of the following departments:

5.1.1 Core making dept.

This department is divided in two sections: in the first section it is placed the equipment foreseen for the production of cores using pre-coated sands (shell-moulding process);
in the second section it is located the equipment foreseen for the production of cores, using washed sand and resins or oil (cold process).

5.1.2 Moulding dept.

This department is divided in three sections: in the first section the equipment for the storing and the regeneration of the sand is installed; in the second section the equipment for the automatic moulding of large mould boxes; in third one the equipment for a semi-automatic moulding of smaller mould boxes is installed.

5.1.3 Melting dept.

The melting department consists of two tilting induction electric furnaces, having each a nominal capacity of 5000 kg and an installed power of 1500 kW, an electric rooms, where transformers capacitors and electric panels are installed. Space for the installation of a third furnace is foreseen.

The molten metal is poured in ladles of 500 kg which are conveyed to the casting areas by a chain conveyor.

5.1.4 Knock out

After the cooling, the moulds are knocked out in two different machines. The sand is collected and sent back to the sand regeneration plant; the parts are collected in containers and brought to the finishing department.

5.1.5 **Finishing dept.**

In this department all equipment such as grinding machines, sand blasting, etc. necessary to remove the sand, scale and excess of metal, is installed.

5.1.6 **Heat treatment dept.**

A heath treatment furnace is foreseen for a continuous operation. It will be designed in a way allowing the inside accommodation of all kind of parts and taking into consideration the different conditions of treatment required by the various parts.

5.1.7 **Finished product storage**

A suitable area is foreseen to accommodate the finished parts before the dispatching. The necessary equipment for the packaging (when needed) will be available in the store.

5.1.8 **Laboratory**

A chemical-metallurgical laboratory is foreseen.
It will accommodate a spectrophotometer, a microscope, hardness testers and all other equipment required by a modern foundry.

5.1.9 **Pattern shop**

Almost all the patterns will be of metallic type; nevertheless it may occur that for some parts that are not foreseen in the product mix require wodden patterns.
In such a case a wooden pattern will be manufactured using equipment foreseen for the purpose.

The pattern shop will also allow the fabrication of moulding boxes having different size of those foreseen for the normal operation. When necessary they will be repaired in the same shop.

5.1.10 Maintenance shop

A shop is foreseen for the current mechanical and electrical maintenance operations. It will be equipped with few and small machine tools, welding machines, working benches and hand tools.

5.1.11 Transport equipment

For the internal transportation of raw materials, containers, parts, etc. diesel engine powered fork lifts will be provided.

2 cars and 1 truck for the external services are also foreseen.

5.2 LAY-OUT AND CIVIL WORKS

The plant will cover an area of about 4,350 sqm. The building will be in steel structure. The roofing will be provided with proper openings for the fume evacuation and will be done using hot deep galvanized steel sheets. The cladding as well as the internal partition walls will be in cement blocks or clay bricks.

The floor of the industrial area will be of reinforced concrete slabs, allowing an overload of 2,000 kg/sqm.

The floors of the offices and sanitary rooms will be in ceramic tiles. The sewerage consists of two sewer systems: one for rain water and one for sanitary water.

5.3 INVESTMENT COSTS

A quotation for the machinery and equipment was obtained from STAO, Torino, Italy.

The estimated investment costs are shown in the table here-below:

Description	LC M$	FC M$	Total M$
Machinery and equipment FOB European port	--	4.00	4.00
Transport, taxes and duties	0.8	0.40	1.2
Erection	0.4	0.20	0.60
Land and site preparation	0.1	--	0.10
Civil work and building	1.5	--	1.50
Spare parts	--	0.12	0.12
Total	**2.8**	**4.72**	**7.52**
Contingencies 10%	**0.28**	**0.472**	**0.752**
Grand total	**3.08**	**5.192**	**8.272**

The industrial life of the plant can be considered as 15 years. The maintenance costs are estimated 3% of the machinery and equipment, that is US$ 120,000.

In the financial evaluation the investments costs (contingencies included) are subdivided as follows:

Preproduction expenditures	FC	0.120	million dollars
Preproduction expenditures	LC	0.100	million dollars
Machinery	FC	5.192	million dollars
Machinery	LC	1.320	million dollars
Land and site preparation	LC	0.11	million dollars
Civil works and building	LC	1.65	million dollars
Total		8.492	million dollars

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

The manpower required for the foundry operation is indicated here-below. In general there is no need of special training, exception made for the production manager and the shift foremen. The shift operators need a short training course. The training can be carried out in Nigeria within the most reputed foundries, with the assistance of the technology supplier, who will make available one expert for the first two years of operation. The relevant cost is estimated US$ 240,000.

7.1 MANAGEMENT

		N/y
General manager	1	50,000
Technical Manager	1	40,000
	-	---
	2	90,000
		Overheads 40% 36,000

		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPT.

		N/y
Financial Manager	1	40,000
Accountants	2	24,000
Purchasing Head	1	12,000
Store Head	1	12,000
Sales dept.	1	12,000
Clerks	5	60,000
Guards	6	36,000
Drivers	4	32,000
	---	----------
	21	228,000
		Overheads 40% 91,200

		319,200
		(US$ 50,000)

7.3 PRODUCTION DEPT.

		N/y
Production manager	1	40,000
Assistant production manager	1	30,000
Shift Foremen	8	96,000
Shift operators	16	160,000
Semi-skilled workers	40	320,000
Unskilled workers	40	200,000
Metallurgist	1	30,000
Chemist	1	25,000
Clerks	4	48,000
	--	----------
	112	949,000
		Overheads 40% 379,600

		1,328,600
		(US$ 168,000)

7.4 MAINTENANCE DEPT.

		N/y
Chief Engineer	1	40,000
Mechanics	4	40,000
Electricians	4	40,000
Others (maintenance shop)	6	60,000
	---	----------
	15	180,000
		Overheads 40% 72,000

		252,000
		(US$ 32,000)

Summary

Administration	23	66,000	US Doll.
Production	112	168,000	US Doll.
Maintenance	15	32,000	US Doll.
	----	---------	
Total	150	266,000	US Doll.

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start-up the plant is in the range of 24 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 9,099,530 US Dollars. The portion in foreign currency accounts for 5,550,000 US Dollars.

Details of these figures are shown in chapter 5.3.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 1,850,000	US$ 1,458,800	US$ 3,308,800
- Foreign Loan (interest 8%)	US$ 1,200,000	US$ 3,213,200	US$ 4,413,200
- Local Loan (interest 15%)	US$ 200,000	US$ 800,000	US$ 1,000,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 30%

2nd year 50%

3rd year 70%

4th and subsequent years 100%

When the plant is in full production, the required working capital amounts to 1,819,200 US Dollars, the foreign portion being US$ 1,719,575.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 580,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 30% of its nominal capacity, the production costs amount to US$ 2,979,990.

In the fourth year, at full production, the costs amount to US $ 5,284,965, then they start a slight decrease year after year, to reach a constant amount of US $ 4,165,100 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 8,050,000. As said before, the production programme foresees that full production is reached gradually:

1st year 30% : revenue = US$ 2,415,000

2nd year 50% : revenue = US$ 4,025,000

3rd year 70% : revenue = US$ 5,635,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 18.50%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 32% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 7 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 3.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 21,990,000.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 21,990,000.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

CEMENT INDUSTRY SPARE PARTS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US$

Total initial investment during construction phase

fixed assets:	9099.53	61.372 % foreign
current assets:	0.00	0.000 % foreign
total assets:	9099.53	61.372 % foreign

Source of funds during construction phase

equity & grants:	3308.80	0.024 % foreign
foreign loans :	4413.20	
local loans :	1000.00	
total funds :	8722.00	50.608 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1555.73	4165.10	4165.10
depreciation :	921.21	899.20	82.50
interest :	503.06	176.53	0.00
production costs	2979.99	5240.83	4247.60
thereof foreign	64.88 %	69.63 %	67.69 %
total sales :	2415.00	8050.00	8050.00
gross income :	-564.99	2809.17	3802.40
net income :	-564.99	1685.57	2281.44
cash balance :	-1107.58	2033.06	2363.94
net cashflow :	280.46	2761.23	2363.94

Net Present Value at: 10.00 % = 6240.43
Internal Rate of Return: 18.50 %
Return on equity1: 24.34 %
Return on equity2: 22.76 %

Index of Schedules produced by COMFAR

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	260.000	80.000
Buildings and civil works	1000.000	650.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	1820.000	4692.000
Total fixed investment costs	3080.000	5422.000
Pre-production capital expenditures.	233.000	364.528
Net working capital	0.000	0.000
Total initial investment costs	3313.000	5786.528
Of it foreign, in %	50.347	67.684

Total Current Investment in 1000 US$

Year	1992	1993	1994	1995
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000
Working capital	578.815	359.158	510.615	370.613
Total current investment costs	578.815	359.158	510.615	370.613
Of it foreign, %	92.005	95.756	97.015	93.830

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	989.730	1649.550	2590.880	3299.100	3299.100
Other raw materials	55.800	93.000	130.200	186.000	186.000
Utilities	88.200	147.000	205.800	294.000	294.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	168.000	168.000	168.000	168.000	168.000
Repair, maintenance	18.000	30.000	42.000	60.000	60.000
Spares	18.000	30.000	42.000	60.000	60.000
Factory overheads	120.000	120.000	0.000	0.000	0.000
Factory costs	1457.730	2237.550	3178.880	4067.100	4067.100
Administrative overheads	98.000	98.000	98.000	98.000	98.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	921.206	921.206	910.206	899.206	899.204
Financial costs	503.056	408.924	314.792	220.660	176.528
Total production costs	2979.992	3665.680	4501.878	5284.966	5240.832
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	64.876	67.[illegible]	70.117	69.886	69.633
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	266.000	266.000	266.000	266.000	266.000

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	3299.100	3299.100	3299.100	3299.100	3299.100
Other raw materials	186.000	186.000	186.000	186.000	186.000
Utilities	294.000	294.000	294.000	294.000	294.000
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	168.000	168.000	168.000	168.000	168.000
Repair, maintenance	60.000	60.000	60.000	60.000	60.000
Spares	60.000	60.000	60.000	60.000	60.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	4067.100	4067.100	4067.100	4067.100	4067.100
Administrative overheads	98.000	98.000	98.000	98.000	98.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	733.700	733.700	733.700	733.700	92.500
Financial costs	132.396	88.264	44.132	0.000	0.000
Total production costs	5031.196	4987.064	4942.932	4898.800	4247.600
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	70.097	69.832	69.563	69.288	67.688
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	266.000	266.000	266.000	266.000	266.000

Total Production Costs in 1000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	3299.100
Other raw materials	186.000
Utilities	294.000
Energy	0.000
Labour, direct	168.000
Repair, maintenance	60.000
Spares	60.000
Factory overheads	0.000
Factory costs	4067.100
Administrative overheads	98.000
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	4165.100
Costs per unit (single product)	0.000
Of it foreign, %	69.028
Of it variable,%	0.000
Total labour	266.000

Net Working Capital in 1000 US$

Year	mdc	coto	1992	1993	1994	1995	1996-2005
Coverage							
Current assets &							
Accounts receivable	30	12.0	129.644	194.629	273.073	347.092	347.092
Inventory and materials	140	2.6	439.260	732.100	1165.695	1464.200	1464.200
Energy	0	---	0.000	0.000	0.000	0.000	0.000
Spares	180	2.0	9.000	15.000	21.000	30.000	30.000
Work in progress	1	360.0	4.049	6.215	8.836	11.298	11.298
Finished products	5	72.0	21.607	32.438	45.512	57.849	57.849
Cash in hand	15	24.0	17.583	18.583	14.583	16.083	16.083
Total current assets			621.144	998.966	1528.694	1926.521	1926.521
Current liabilities and							
Accounts payable	10	37.8	42.329	60.993	80.106	107.320	107.320
Net working capital			578.815	937.973	1448.588	1819.202	1819.202
Increase in working capital			578.815	359.158	510.615	370.613	0.000
Net working capital, local			46.276	61.519	76.763	99.628	99.628
Net working capital, foreign			532.539	876.453	1371.826	1719.574	1719.574

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	1850.000	1458.800
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	1200.000	3213.200
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	200.000	800.000
Loan C, local....	0.000	0.000
Total loan	1400.000	4013.200
Current liabilities	0.000	0.000
Bank overdraft	63.000	314.528
Total funds	3313.000	5786.528

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-551.650	-551.650	-551.650	-551.650	-551.650
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	-333.333	-333.333	-333.333	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-884.983	-884.983	-884.983	-551.650	-551.650
Current liabilities	42.329	18.664	19.113	27.214	0.000
Bank overdraft	1107.583	107.343	-194.480	-1397.974	0.000
Total funds	264.928	-758.976	-1060.351	-1922.410	-551.650

Cashflow Tables, construction in 1000 US$

Year	1990	1991
Total cash inflow	3250.000	5472.000
Financial resources	3250.000	5472.000
Sales, net of tax	0.000	0.000
Total cash outflow	3313.000	5786.528
Total assets	3250.000	5472.000
Operating costs	0.000	0.000
Cost of finance	63.000	314.528
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	-63.000	-314.528
Cumulated cash balance	-63.000	-377.528
Inflow, local	2050.000	2258.000
Outflow, local	1645.000	1870.000
Surplus (deficit)	405.000	388.000
Inflow, foreign	1200.000	3214.000
Outflow, foreign	1668.000	3916.528
Surplus (deficit)	-468.000	-702.528
Net cashflow	-3250.000	-5472.000
Cumulated net cashflow	-3250.000	-8722.000

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	2457.329	4043.664	5654.113	8077.214	8050.000	8050.000
Financial resources	42.329	18.664	19.113	27.214	0.000	0.000
Sales, net of tax	2415.000	4025.000	5635.000	8050.000	8050.000	8050.000
Total cash outflow	3564.914	4151.007	5459.632	6441.251	6016.945	6056.667
Total assets	621.144	377.822	529.728	397.827	0.000	0.000
Operating costs	1555.730	2335.550	3276.880	4165.100	4165.100	4165.100
Cost of finance	503.056	408.924	314.792	220.660	176.528	132.396
Repayment	884.983	884.983	884.983	551.650	551.650	551.650
Corporate tax	0.000	143.728	453.249	1106.013	1123.667	1207.521
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-1107.584	-107.343	194.480	1635.963	2033.055	1993.333
Cumulated cash balance	-1485.112	-1592.455	-1397.975	237.988	2271.043	4264.375
Inflow, local	2454.600	4042.067	5652.067	8075.600	8050.000	8050.000
Outflow, local	1142.409	1387.371	1851.692	2444.479	2413.667	2497.521
Surplus (deficit)	1312.191	2654.695	3800.375	5631.122	5636.333	5552.479
Inflow, foreign	2.729	1.597	2.046	1.614	0.000	0.000
Outflow, foreign	2422.504	2763.636	3607.940	3996.772	3603.278	3559.146
Surplus (deficit)	-2419.775	-2762.039	-3605.894	-3995.158	-3603.278	-3559.146
Net cashflow	280.455	1186.564	1394.256	2408.273	2761.233	2677.378
Cumulated net cashflow	-8441.545	-7254.981	-5860.725	-3452.452	-691.219	1986.159

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	8050.000	8050.000	8050.000	8050.000	8050.000	8050.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	8050.000	8050.000	8050.000	8050.000	8050.000	8050.000
Total cash outflow	6030.188	6003.709	5425.580	5686.060	5719.060	5719.060
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	4165.100	4165.100	4165.100	4165.100	4165.100	4165.100
Cost of finance	88.264	44.132	0.000	0.000	0.000	0.000
Repayment	551.650	551.650	0.000	0.000	0.000	0.000
Corporate tax	1225.174	1242.827	1260.480	1520.960	1553.960	1553.960
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	2019.812	2046.291	2624.420	2363.940	2330.940	2330.940
Cumulated cash balance	6284.187	8330.477	10954.900	13318.840	15649.780	17980.710
Inflow, local	8050.000	8050.000	8050.000	8050.000	8050.000	8050.000
Outflow, local	2515.174	2532.827	2550.480	2810.960	2843.960	2843.960
Surplus (deficit)	5534.826	5517.173	5499.520	5239.040	5206.040	5206.040
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	3515.014	3470.883	2875.100	2875.100	2875.100	2875.100
Surplus (deficit)	-3515.014	-3470.883	-2875.100	-2875.100	-2875.100	-2875.100
Net cashflow	2659.726	2642.073	2624.420	2363.940	2330.940	2330.940
Cumulated net cashflow	4645.885	7287.958	9912.377	12276.320	14607.260	16938.200

Casnflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	8050.000	8050.000	8050.000
Financial rescurces	0.000	0.000	0.000
Sales, net of tax	8050.000	8050.000	8050.000
Total cash outflow	5719.060	5719.060	5719.060
Total assets	0.000	0.000	0.000
Operating costs	4165.100	4165.100	4165.100
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	1553.960	1553.960	1553.960
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	2330.940	2330.940	2330.940
Cumulated cash balance	20311.650	22642.590	24973.530
Inflow, local	8050.000	8050 000	8050.000
Outflow, local	2843.960	2843.960	2843.960
Surplus (deficit)	5206.040	5206.040	5206.040
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	2875.100	2875.100	2875.100
Surplus (deficit)	-2875.100	-2875.100	-2875.100
Net cashflow	2330.940	2330.940	2330.940
Cumulated net cashflow	19269.130	21600.070	23931.010

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	6167.77 at	10.00 %
Internal Rate of Return (IRRE1) ..	24.34 %	

b) Net Worth versus Net cash return:

Net present value	6557.26 at	10.00 %
Internal Rate of Return (IRRE2) ..	22.76 %	

c) Internal Rate of Return on total investment:

Net present value	6240.43 at	10.00 %
Internal Rate of Return (IRR) ..	18.50 %	

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	2415.000	4025.000	5635.000	8050.000	8050.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	2415.000	4025.000	5635.000	8050.000	8050.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2476.936	3256.756	4187.086	5064.306	5064.304
Operational margin	-61.936	768.244	1447.914	2985.694	2985.696
As % of total sales	-2.565	19.087	25.695	37.089	37.089
Cost of finance	503.056	408.924	314.792	220.660	176.528
Gross profit	-564.992	359.320	1133.122	2765.034	2809.168
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-564.992	359.320	1133.122	2765.034	2809.168
Tax	0.000	143.728	453.249	1106.013	1123.667
Net profit	-564.992	215.592	679.873	1659.020	1685.501
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-564.992	215.592	679.873	1659.020	1685.501
Accumulated undistributed profit	-564.992	-349.400	330.473	1989.493	3674.994
Gross profit, % of total sales	-23.395	8.927	20.109	34.348	34.896
Net profit, % of total sales	-23.395	5.356	12.065	20.609	20.938
ROE, Net profit, % of equity	-17.075	6.516	20.547	50.140	50.940
ROI, Net profit+interest, % of invest.	-0.666	6.465	9.780	17.832	17.664

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	8050.000	8050.000	8050.000	8050.000	8050.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	8050.000	8050.000	8050.000	8050.000	8050.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4898.800	4898.800	4898.800	4898.800	4247.600
Operational margin	3151.200	3151.200	3151.200	3151.200	3802.400
As % of total sales	39.145	39.145	39.145	39.145	47.235
Cost of finance	132.396	88.264	44.132	0.000	0.000
Gross profit	3018.804	3062.936	3107.068	3151.200	3802.400
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3018.804	3062.936	3107.068	3151.200	3802.400
Tax	1207.521	1225.174	1242.827	1260.480	1520.960
Net profit	1811.282	1837.761	1864.241	1890.720	2281.440
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	1811.282	1837.761	1864.241	1890.720	2281.440
Accumulated undistributed profit	5486.276	7324.038	9188.278	11079.000	13360.440
Gross profit, % of total sales	37.501	38.049	38.597	39.145	47.235
Net profit, % of total sales	22.500	22.829	23.158	23.487	28.341
RCE, Net profit, % of equity	54.741	55.542	56.342	57.142	68.951
ROI, Net profit+interest, % of invest.	18.439	18.271	18.104	17.936	21.643

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	8050.000	8050.000	8050.000	8050.000	8050.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	8050.000	8050.000	8050.000	8050.000	8050.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	4165.100	4165.100	4165.100	4165.100	4165.100
Operational margin	3884.900	3884.900	3884.900	3884.900	3884.900
As % of total sales	48.260	48.260	48.260	48.260	48.260
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	3884.900	3884.900	3884.900	3884.900	3884.900
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	3884.900	3884.900	3884.900	3884.900	3884.900
Tax	1553.960	1553.960	1553.960	1553.960	1553.960
Net profit	2330.940	2330.940	2330.940	2330.940	2330.940
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2330.940	2330.940	2330.940	2330.940	2330.940
Accumulated undistributed profit	15691.380	18022.320	20353.260	22684.200	25015.130
Gross profit, % of total sales	48.260	48.260	48.260	48.260	48.260
Net profit, % of total sales	28.956	28.956	28.956	28.956	28.956
RCE, Net profit, % of equity	70.447	70.447	70.447	70.447	70.447
ROI, Net profit+interest, % of invest.	22.113	22.113	22.113	22.113	22.113

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	3313.000	9099.528
Fixed assets, net of depreciation	0.000	3313.000
Construction in progress	3313.000	5786.528
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	3313.000	9099.528
Equity capital	1850.000	3308.800
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	1400.000	5413.200
Current liabilities	0.000	0.000
Bank overdraft, finance required.	63.000	377.528
Total debt	1463.000	5790.729
Equity, % of liabilities	55.841	36.362

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	9364.457	8821.073	8225.004	7612.214	8746.063
Fixed assets, net of depreciation	8178.321	7257.115	6346.909	5447.703	4548.499
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	603.561	980.383	1514.111	1910.438	1910.438
Cash, bank	17.583	18.583	14.583	16.083	16.083
Cash surplus, finance available	0.000	0.000	0.000	237.989	2271.243
Loss carried forward	0.000	564.992	349.400	0.000	0.000
Loss	564.992	0.000	0.000	0.000	0.000
Total liabilities	9364.457	8821.073	8225.004	7612.214	8746.063
Equity capital	3308.800	3308.800	3308.800	3308.800	3308.800
Reserves, retained profit	0.000	0.000	0.000	330.473	1989.493
Profit	0.000	215.592	679.873	1659.020	1685.501
Long and medium term debt	4528.217	3643.234	2758.250	2206.601	1654.951
Current liabilities	42.329	60.993	80.106	107.320	107.320
Bank overdraft, finance required.	1485.111	1592.455	1397.974	0.000	0.000
Total debt	6055.657	5296.682	4236.330	2313.920	1762.270
Equity, % of liabilities	35.334	37.510	40.229	43.467	37.832

Projected Balance Sheets, Production in 1000 US$

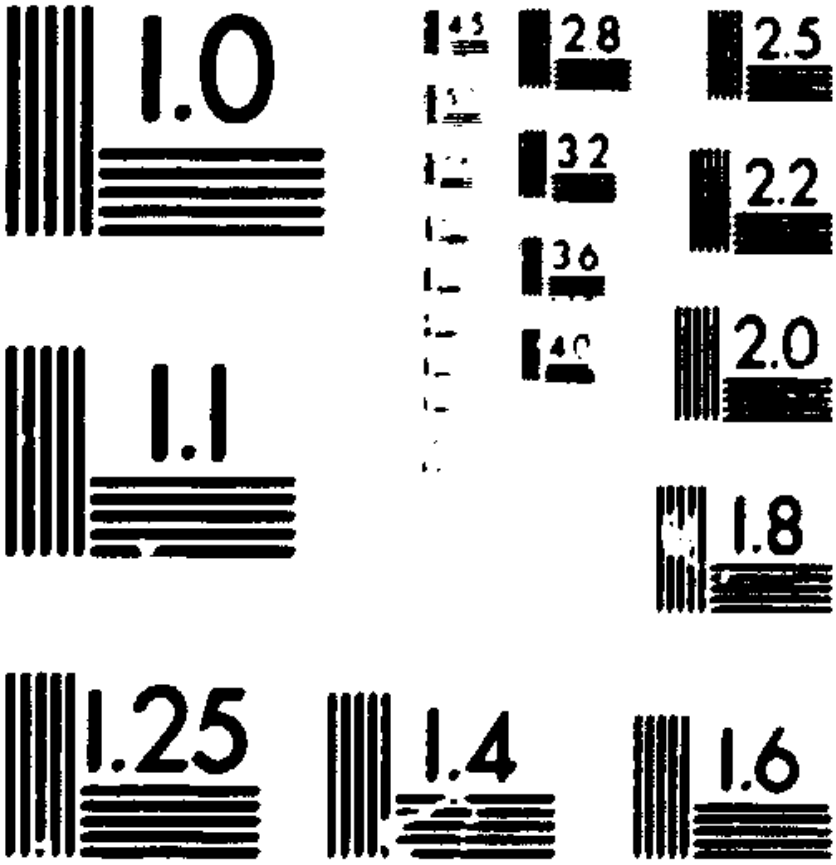
Year	1997	1998	1999	2000	2001
Total assets	10005.700	11291.810	12604.400	14495.120	16776.560
Fixed assets, net of depreciation	3814.799	3081.099	2347.399	1613.699	1531.199
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1910.438	1910.438	1910.438	1910.438	1910.438
Cash, bank	16.083	16.083	16.083	16.083	16.083
Cash surplus, finance available	4264.376	6284.187	8330.477	10954.900	13318.840
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	10005.700	11291.810	12604.400	14495.120	16776.560
Equity capital	3308.800	3308.800	3308.800	3308.800	3308.800
Reserves, retained profit	3674.994	5486.276	7324.038	9188.278	11079.000
Profit	1811.282	1837.761	1864.241	1890.720	2281.440
Long and medium term debt	1103.301	551.651	0.000	0.000	0.000
Current liabilities	107.320	107.320	107.320	107.320	107.320
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	1210.620	658.970	107.320	107.320	107.320
Equity, % of liabilities	33.069	29.303	26.251	22.327	19.723

Projected Balance Sheets, Production in 1000 US$

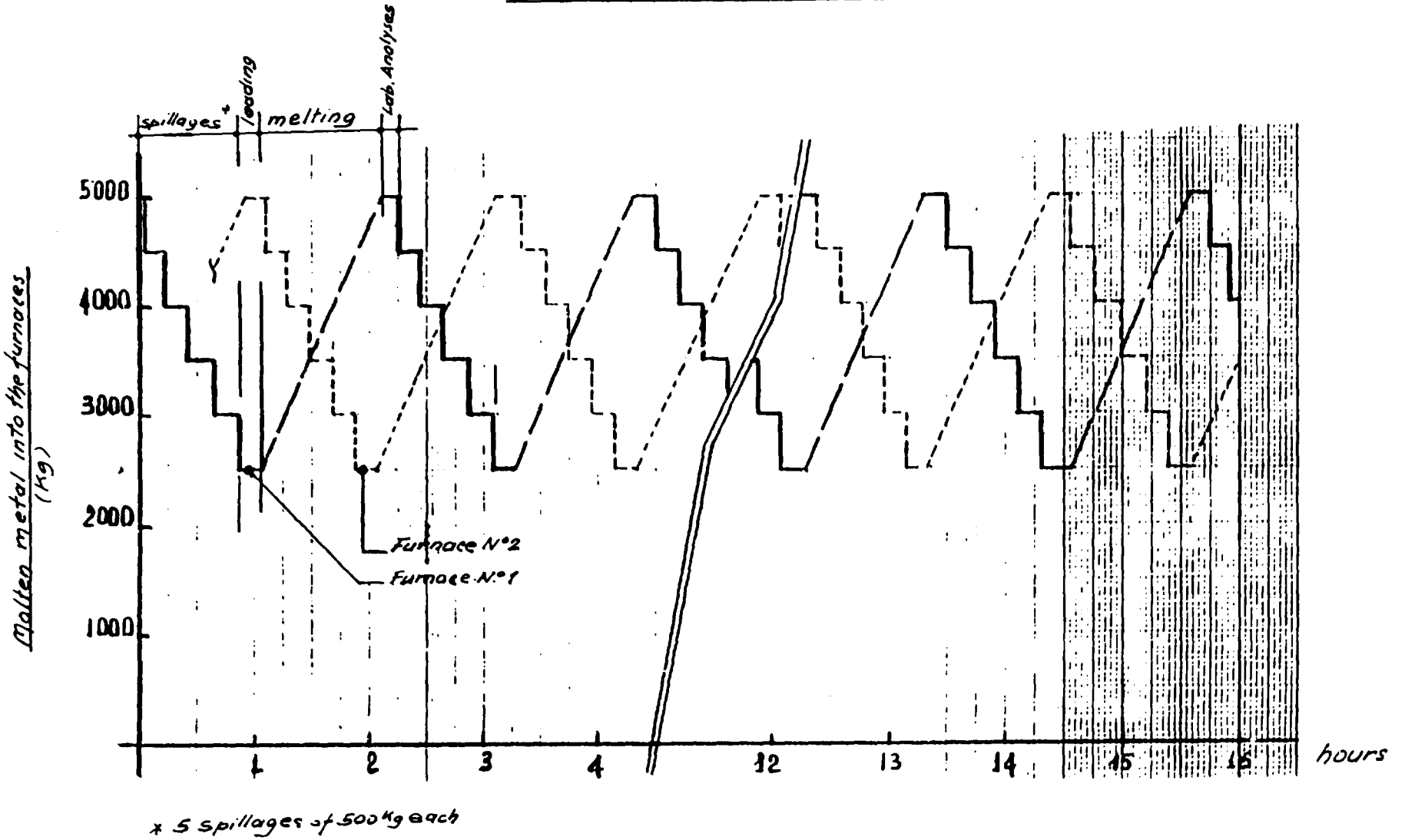
Year	2002	2003	2004	2005	2006
Total assets	19107.500	21438.440	23769.380	26100.320	28431.260
Fixed assets, net of depreciation	1531.199	1531.199	1531.199	1531.199	1531.199
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1910.438	1910.438	1910.438	1910.438	1910.438
Cash, bank	16.083	16.083	16.083	16.083	16.083
Cash surplus, finance available	15649.780	17980.720	20311.660	22642.600	24973.540
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	19107.500	21438.440	23769.380	26100.320	28431.260
Equity capital	3308.800	3308.800	3308.800	3308.800	3308.800
Reserves, retained profit	13360.440	15691.380	18022.320	20353.260	22684.200
Profit	2330.940	2330.940	2330.940	2330.940	2330.940
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	107.320	107.320	107.320	107.320	107.320
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	107.320	107.320	107.320	107.320	107.320
Equity, % of liabilities	17.317	15.434	13.920	12.677	11.638

ANNEXE 2

FURNACES OPERATING DIAGRAM



2 FURNACES OPERATING DIAGRAM



* 5 spillages of 500 Kg each

ANNEXE 3

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	4421.99	4414.00	7.99	1200.00	3214.00	2.73	1.60
equity capital	0.80	0.80	0.00	0.00	0.80	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	4421.19	4413.20	7.99	1200.00	3213.20	2.73	1.60
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	50410.63	5584.53	44826.11	1668.90	3916.53	2422.50	2763.64
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	4792.80	5312.00	-519.20	1620.00	3692.00	535.27	345.51
imported materials . . .	39335.36	0.00	39335.36	0.00	0.00	982.53	1557.55
repayment loans & overd.	4421.19	0.00	4421.19	0.00	0.00	551.65	551.65
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	1861.28	272.53	1588.75	48.00	224.53	353.06	308.92
indirect costs							
net foreign exchge flow	-45988.65	-1170.53	-44818.12	-468.00	-702.53	-2419.78	-2762.04
import substit'n effect	108675.00	0.00	108675.00	0.00	0.00	2415.00	4025.00
net forgn exchge effect	62686.35	-1170.53	63856.88	-468.00	-702.53	-4.78	1262.96

present values at	10.00 %
foreign exchange flow .	-22590.56
net forgn exchge effect	23741.55

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	2.05	1.61	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	2.05	1.61	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	3607.94	3996.77	3603.28	3559.15	3515.01	3470.88	2875.10
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	497.42	349.36	0.00	0.00	0.00	0.00	0.00
imported materials . . .	2294.08	2875.10	2875.10	2875.10	2875.10	2875.10	2875.10
repayment loans & overd.	551.65	551.65	551.65	551.65	551.65	551.65	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	264.79	220.66	176.53	132.40	88.26	44.13	0.00
indirect costs							
net foreign exchge flow	-3605.89	-3995.16	-3603.28	-3559.15	-3515.01	-3470.88	-2875.10
import substit'n effect	5635.00	8050.00	8050.00	8050.00	8050.00	8050.00	8050.00
net forgn exchge effect	2029.11	4054.84	4446.72	4490.85	4534.99	4579.12	5174.90

present values at	10.00 %
foreign exchange flow .	-22590.56
net forgn exchge effect	23741.55

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	2875.10	2875.10	2875.10	2875.10	2875.10	2875.10	-2238.77
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-2246.76
imported materials . . .	2875.10	2875.10	2875.10	2875.10	2875.10	2875.10	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	7.99
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-2875.10	-2875.10	-2875.10	-2875.10	-2875.10	-2875.10	2238.77
import substit'n effect	8050.00	8050.00	8050.00	8050.00	8050.00	8050.00	0.00
net forgn exchge effect	5174.90	5174.90	5174.90	5174.90	5174.90	5174.90	2238.77

present values at	10.00 %
foreign exchange flow .	-22590.56
net forgn exchge effect	23741.55

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE INSTALLATION OF A FOUNDRY PRODUCING SPARE PARTS FOR THE TEXTILE INDUSTRY IN NIGERIA

PROJECT SF/NIR/88/001

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a small foundry for the casting of spare parts for the textile industry. The envisaged foundry has a nominal annual capacity of 150,000 kg of iron castings, 20,000 kg of aluminium castings and 10,000 kg of bronze castings.(1)

The outputs are based on 250 working days/y, 1 shift/day.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 1,798,780 (US$ 846,000 in foreign currency)
- Working capital (at full production): US$ 63,921 (US$ 42,820 in foreign currency)
- Internal Rate of Return: 21.65%
- Break-Even Point (at 5th year of production) 35%
- Pay-Back Period: less than 7 years (including construction period)
- Employees: 48

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 5,332,210 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

There are more than 56 textile mills in Nigerian concentrated in 4 zones:

- 25 in Lagos area
- 15 in Kano
- 15 in Kaduna
- 3 in Aba

It is known that this kind of industry consumes a large number of foundry sourced spare parts, whose main characteristics are the small dimensions. Generally, the pieces have a weight ranging from 200

(1) For additional background material, see Volume I p. 195.

grams to 1.5 Kgs, with the exception of some pieces, whose weight is around 10 Kg. As a consequence, the textile mills are not able to get spare parts in small quantities, (numer and weight), because no foundry or workshops accept small orders.

The only way to overcome this constraint is to place orders for at least of two years operation (increase of inventory), thus allowing the foundry to work on economical lots.

In many countries it is normal practice, when a textile mill of a relevant importance is installed, to provide it with is own small foundry and its maintenance workshop, equipped with simple machine tools. In this case the foundry and the workshop are not direct profit generating centers, but still are of vital importance for assuring the continuous operation of the mill.

More than 50 foundry shops are installed in Nigeria. Only few of them can be considered adequate to fabricate quality products. These are: The Foundries at Adebowale Engineering Services Ltd; Nigeria Railway Corporation; Nigeria Ports Authority; Nigeria Foundries Ltd; Delta Steel Foundry; Ajakouta Steel; Bamfords International Ltd. Nevertheless, none of these foundries have been designed to produce textile spare parts.

The rest of the foundries are poorly equipped and in the majority of the cases, they are not equipped at all other than with make shift facilities. What is noticed is:

- the non-existence of pattern making shops;
- the non-existence of sand treatment equipment;
- the impossibility of the selection of scrap;
- the non-existence of the minimum testing equipment, such as carbon equivalent and temperature measuring instruments.

To that it can be added:

- inadequate advanced technological man-power and know-how in foundry technology;
- inadequacy of educational and training facilities;
- preference of the management of the plants toward imported parts and components;
- import duty regimes which favour imported finished foundry products over imported raw materials.

The Ministry of Industry, various institutions and several representations of various sectors of the industries, including managers of some foundries, formed an ad hoc committee which analysed in depth the situation of the foundries in Nigeria.

The committe explored all the main and secondary aspects such as the mix of the demand, the availability of raw materials and consumables, the characteristics of the existing foundries, the skill of the manpower, the existing training centers, etc. A comprehensive report was prepared in Dec. 1986. It contains the suggestions expressed by the committee in order to organize the foundry sector in a way that the needs of the country are satisfied. Something has been done in the right direction: at the request of the Ministry of National Planning and of the Nigerian Industrial Development Bank, the Industrial Development Unit (IDU) of the Commonwealth Fund for technical cooperation, visited a certain number of foundries, chosen among those considered potentially adequante to operate satisfactorily, after a proper rehabilitation.

It is hard to say when and how the rehabilitation will take place and if, after that, some foundry will be in a position to satisfy the demand, wholly or partially, of the textile industry.
For that reason, it seems justified to analyse the convenience of installing one (or more) foundry specialilzed in the production of iron and non iron metal castings for the textile industry.

2. MARKET AND PLANT CAPACITY

2.1 DEMAND

Estimates provided by N.I.D.B. indicate that the demand of iron castings is exceeding 1000 tons/year and is referred, mainly to the following parts:

. Levers

. Spindlers

. Rotors

. Screw wheel

. Insulating plate

. Bearings

. Centre Fork Bunter

. Centre Fork Crankshaft

. Centre Drum/Diaphragm

. Bobbin Rest Body

. Picks Stick Shop

. Shafts

. Gears

. Supports

. Others.

To the iron castings, aluminium and bronze castings shall be added, even though these are required in smaller quantities.

2.2 SUPPLY

Almost all the demand is satisfied by imported parts. Local supply does not exceed 5% of the demand and it consists in the production of parts that are used to replace broken or consumed parts for the time necessary for the mills to have available imported original spare parts.

2.3 PLANT CAPACITY

On the basis of the estimated demand it would be natural to think of a foundry having a capacity of 1000 tons/y (or more) of iron castings, plus the aluminium and bronze castings. A foundry of such a capacity is relatively small, but if the dimensions and weight of the various parts are considered, it appears evident that only a highly automatized foundry would be able to have the necessary flexibility allowing a smooth production.

According to the experience of the consultant and the philosophy followed by the textile industry, it is advisable to consider a foundry having an annual capacity of:

- 150,000 kg of iron castings
- 20,000 Kg of aluminium castings
- 10,000 Kg of bronze castings

This capacity is based on 8 hours/day, 250 days/year. Making the foundry work in two shifts, the output can be doubled, thus allowing peak demand to be satisfied.

Another reason than can justify the choice of a small capacity foundry is that, most probably, the Nigerian textile mills would prefer having their own foundry or, at least, being in a position to rely on two or three shops. (competion will be beneficial for the quality and will keep the prices acceptable).

2.4 SALES PRICES AND TOTAL REVENUE

The following selling prices are assumed:

- iron castings 5 US$/Kg
- aluminium castings 12 US$/Kg
- bronze castings 7 US$/Kg

It is expected that the foundry output increases gradually giving the revenues as follows:

1st year				
Description	**Output (%)**	**Output (Kg)**	**Unit Price US/Kg**	**Total Revenues US$**
Iron castings	40%	60,000	5	300,000
Aluminium castings	40%	8,000	12	96,000
Bronze castings	40%	4,000	7	28,000
TOTAL				**424,000**

2nd year				
Description	**Output (%)**	**Output (Kg)**	**Unit Price US/Kg**	**Total Revenues US$**
Iron castings	60%	90,000	5	450,000
Aluminium castings	60%	12,000	12	144,000
Bronze castings	60%	6,000	7	42,000
TOTAL				**636,000**

3rd year				
Description	**Output (%)**	**Output (Kg)**	**Unit Price US/Kg**	**Total Revenues US$**
Iron castings	100%	150,000	5	750,000
Aluminium castings	100%	20,000	12	240,000
Bronze castings	100%	10,000	7	70,000
TOTAL				**1,060,000**

3. MATERIALS AND INPUTS[2]

3.1 IRON CASTINGS

3.1.1 Raw materials and ferro alloys

The melting furnace is of induction type (see chapter 5); it will allow the production of various kinds of castings. In order to calculate the average consumption of raw materials and ferro-alloys, a mechanical iron cast having the following chemical composition has been considered: Ctot 3 to 3.2%; Si 1.8 to 2%; Mn 0.5 to 0.8%; Cu 0.5%; Cr 0.5%; Ni traces; S<0.1%.

For an annual output of 150,000 Kg of parts, the consumption and the cost of the raw materials and ferro-alloys are shown in the table 3.1 herebelow.

For the good quality of the product, it is advisable to use at least 25% of pig iron, which has to be imported along with the ferro alloys.

Pig iron can be replaced by iron scraps collected in Nigeria, once the personnel has become well experienced in the dosage of raw materials to be introduced in the furnace. This implies a carefull chemical analysis of all the scrap entering the foundry and their correct storage.

Table 3.1

Material	Quantity (T)	Unit Cost US$	Total Cost LC	FC
Pig iron	[3]37.5	480		18,000
Steel scrap	[4]40	200	8,000	
Iron scrap and return	[3]84.5	160	13,520	
Ferro-alloys[4]				4,000
		Total	**21,520**	**22,000**
		Grand total	**43,520**	

[2] For material and inputs costs screening up see table 3.2., page 83

[3] Quantities are increased by 5%.

[4] Ferro-alloys are expressed in percentage (10% of raw material costs)

3.1.2 Sand for moulding

The estimated quantity of sand needed for moulding is 1,500 Tons/y. Taking into consideration that 90% of the sand will be recovered and regenerated, the actual sand consumed is 150 Tons/y.

The sand is available in Nigeria at 60 US$/ton, delivered to the foundry. The annual expenditure will therefore be US$ 9,000 in L.C.

3.1.3 Sand for cores

Two core making systems are foreseen: one using precoated sands; the second using washed sand mixed with oil or resin.

The estimated annual consumptions and costs of sands are as follows:

- precoated sand	100 tons/y x 300 US$/ton	=	US$ 30,000	in FC
- washed sand	50 tons/y x 60 US$/ton	=	US$ 3,000	in LC
Total			US$ 33,000	

3.1.4 Other materials

The consumption of other materials, like binders, graphite, varnishes etc is not calculated. According to the experience the relevant expenditures are estimated at 40 US$/tons of finished product. At full capacity, the expenditures will amount to US$ 6,000 in FC.

3.1.5 Electric Energy

3.1.5.1 Melting furnace

The electric induction furnace has a nominal capacity of 800 Kg/h and its installed power is 200 KW. For the production of 150,000 kg of fisnished parts, it is necessary to have available 250,000 Kg of molten metal.

The average consumption of electric energy is 650 KWh/ton of metal. The expenditures for the electric energy will be:

250,000 x 0,65 x 0,1 US$/Kwh = US$ 16,250

3.2 ALUMINIUM CASTINGS

3.2.1 Raw materials

Scraps of aluminium are foreseen as raw materials for the alumium castings. For the production of 20,000 Kg/y of parts, 25,000 Kg of scraps are required.

The cost is estimated at 2.5 US$/Kg, therefore the total expenditures will be 25,000 x 2,5 = 62.500 US$ in LC.

3.2.2 Sands[5]

The sands for moulds and cores needed for the casting of aluminium parts are the same type as those envisaged for the iron castings.

The estimated quantities and related expenditures are as follows:

- sands for moulding: 30 t x 60 US$/t = US$ 1800 in LC
- precoated sand for cores : 3 t x 300 US$/t = US$ 900 in FC

3.2.3 Other materials

The consumption of other materials, like binders, varnishes etc. is estimated at 40 US$/ton of finished product.

The annual expenditures, at full capacity, will be = US$ 800 in FC.

3.2.4 Fuel oil

The furnace foreseen for aluminium (and bronze) melting is oil fired. The expenditures, at full capacity, are estimated at US$ 500 in LC.

[5] In case of production in large series of same type of parts, the casting should be done in permanent moulds.

3.3 BRONZE CASTINGS

3.3.1 Raw materials

Scraps of bronze are foreseen as raw materials for the bronze castings.

For the production of 10,000 Kg/y of parts 12,000 Kg of scrap are required. The cost of scraps is estimated to be 2,5 US$/Kg, therefore the total expenditures will be 10,000 x 2,5 = US$ 25,000 in LC.

3.3.2 Sands

Sands for moulds and cores needed for the casting of bronze parts are of same type of those foreseen for the iron and aluminum castings.

The estimated quantities and the related expenditures are as follows:

- sand for moulding : 15 t x 60 US$/t = US$ 900 in LC
- precoated sand for core: 3 t x 300 US$/t = US$ 900 in FC.

3.3.3 Other materials

The consumption of other material, like binders, varnishes etc. is estimated at 40 US$/ton of finished product. The annual expenditures, at full capacity, will be = 400 US$.

3.3.4 Fuel-oil

The annual expenditures for the fuel-oil used in the melting furnace are estimated to be = US$ 1000 in LC.

3.4 PATTERNS

Wooden patterns will be used for all type of castings. The types of patterns will increase according to the demand of castings.

If well handled and stored, the patterns can be used over several years. The annual costs of the patterns are estimated as follows:

- iron castings US$ 5,000
- aluminium castings US$ 1,000
- bronze castings US$ 500

When the foundry has reached the point where the demand becomes stable and the mix does not change, metallic patterns can be considered as a new investment.

Table 3.2 - Material and inputs costs

Description	Iron castings US $		Aluminium castings US $		Bronze castings US $	
	LC	FC	LC	FC	LC	FC
Raw materials	21,520	22,000	62,500		25,000	
Sand for moulding	9,000		1,800		900	
Sand for cores	3,000	30,000		900		900
Other materials		6,000		800		400
Electric Energy	16,250					
Fuel-oil			500		1000	
Patterns	5,000		1,000		500	
Sub-total	54,770	58,000	65,800	1,700	27,400	1,300
Grand total	112,770		67,500		28,700	

4. LOCATION

The foundry should be located in one of the three zones where textile mills are installed.

5. PROJECT ENGINEERING

5.1 THE PROCESS

The proposed foundry consists mainly of the following departments:

5.1.1 **Core making Department**

This department is divided in two sections: in the first section is placed the equipment foreseen for the production of cores, using precoated sands (shell-moulding process); in the second section is located the equipment foreseen for the production of cores, using washed sand and resin or oil (cold process).

5.1.2 **Moulding Department**

In this department it is installed the equipment foreseen for a semi-automatic moulding system.

5.1.3 **Melting Department**

The melting department consists of two melting furnaces, batch operated;

1 M.F.electric induction tilting furnace, 800 Kg/h capacity, 200 KW installed power, complete with control electric equipment; 0.4 - 0.5 KW/Kg.

1 oil fired crucible type furnace for the melting of aluminium and bronze.

The molten metal will be transported to the casting by means of ladles attached to an overhead chain type conveyor.

5.1.4 **Knockout**

Semi-mechanical knockout is foreseen. For this operation, an area is provided. Moulding boxes, after the casting, are transported to this area by means of a car, running on rails. Emptied moulding boxes are returned to the moulding department by means of a roller table. The sand, after havinf been treated in a muller, is transported to the moulding department, by means of a belt conveyor.

5.1.5 **Finishing**

For the finishing, a shot blasting machine, a tumbler and pedestal grinding machines are installed in the finishing department. Manual hand tools are also envisaged.

5.1.6 **Heat treatment**

An electric heated furnace is foreseen for those pieces that require heat treatment.

5.1.7 **Finished product storage**

A suitable area is foreseen to accommodate the finished parts before the despatching.

5.1.8 **Laboratory**

A chemical metallurgical laboratory is foreseen.

It will be equipped with a spectrometer, a microscope, hardness tester, durometer and other equipment required for the quality control.

5.1.9 **Pattern Shop**

The pattern shop will be equipped with the necessary equipment for the fabrication of wooden patterns.

5.1.10 **Maintenance Shop**

A shop is foreseen for the current mechanical and electrical maintenance operations. It will be equipped with few and small machine tools, welding machines, working benches and hand tools.

5.1.11 **Transport equipment**

Two fork lifts, diesel engine powered, are foreseen for the internal transport.

Two cars and 1 lorry for the external services are also foreseen.

5.2 LAY-OUT AND CIVIL WORKS

The plant will cover an area of about 1800 sq.mt. The building will be in steel structure. The roofing will be provided with proper openings for the fume evacuation and will be done using hot deep galvanized steel sheets.

The cladding, as wel as the internal partition walls will be in cement blocks or clay bricks. The floor of the industrial area will be of reinforced concrete slabs, allowing an overload of 2,000 Kg/sq.mt.

The floor of the officed and sanitary rooms will be in ceramic tiles. The sewarage consists of two systems: one for rain water and one for sanitary water.

5.3 INVESTMENT COSTS

The machines and equipment have been quoted by STAO, Torino, Italy.

The estimated investment costs are shown in the table here below.

Description	LC M$	FC M$	TOTAL M$
Machines and equipment FOB European Port		0.60	0.60
Transport, taxes and duties	0.12	0.06	0.18
Erection	0.1	0.05	0.15
Land and site preparation	0.05		0.05
Civil works and building	0.5		0.5
Spare parts		0.02	0.02
Total	**0.77**	**0.73**	**1.5**
Contingencies 10%	**0.077**	**0.073**	**0.15**
Grand total	**0.847**	**0.803**	**1.65**

The industrial life of the plant can be considered as 15 years. 3% of the machinery and equipment cost can be assumed as the average annual expenditures of the maintenance.

In the financial evaluation the investment costs (contingencies included) are so subdivided:

- Preproduction expenses	FC	0	million dollars
- Preproduction expenses	LC	0.060	million dollars
- Machinery	FC	0.803	million dollars
- Machinery	LC	0.242	million dollars
- Land and site preparation	LC	0.055	million dollars
- Civil works and building	LC	0.55	million dollars

		1.710	million dollars

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an indipendedrt organization.

Should the plant be associated to a textile complex, a saving in investment and operating vost could be obtained.

7. MANPOWER

In Nigeria, there are many foundry-shops, eventhough only few of them can be considered of good level. The production personnel to be hired for this foundry can be easily found with sufficient experience. Therefore it is not suggested to pay any technical assistance to the technology supplier.

7.1 MANAGEMENT

		N/Y
- General manager	1	50,000
- Technical manager	1	40,000
	2	90,000
	Overheads 40%	36,000
		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPARTMENT

- Accountant	1	12,000
- Purchasing Dept. head	1	12,000
- Storehead	1	12,000
- Clercks	3	36,000
- Guard	4	24,000
- Drivers	5	40,000
	15	136,000
	Overheads 40%	54,400
		190,400
		(US$ 24,100)

7.3 **PRODUCTION DEPARTMENT**

- Production manager	1	40,000
- Core making Dept.	4	24,000
- Moulding Dept.	4	32,000
- Melting Dept.	6	48,000
- Finishing Dept.	8	48,000
	23	192,000
	Overheads 40%	76,800
		268,800
		(US$ 34,000)

7.4 **MAINTENANCE**

- Mechanics	2	15,000
- Electricians	2	15,000
- Maintenance Dept.	2	15,000
- Pattern shop	4	30,000
	10	75,000
	Overheads 40%	25,000
		100,000
		(US$ 13,210)

Summary

Administration	15	US$ 24,100
Production	23	US$ 34,000
Maintenance	10	US$ 13,210
	48	US$ 71,300

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start up the plant is in the range of 15 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 1,798,780 US Dollars. The portion in foreign currency accounts for 846,000 US Dollars.

Details of these figures are shown in chapter 5.3.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 585,000	US$ 193,000	US$ 778,000
- Foreign Loan (interest 8%)	US$ 300,000	US$ 382,000	US$ 682,000
- Local Loan (interest 15%)	US$ 100,000	US$ 200,000	US$ 300,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 40%

2nd year 60%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 63,921 US Dollars.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 40% of its nominal capacity, the production costs amount to US$ 405,650.

In the third year, at full production, the costs amount to US $ 513,000, then they start a slight decrease year after year, to reach a constant amount of US $ 300,180 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 1,000,000. As said before, the production programme foresees that full production is reached gradually:

1st year 40% : revenue = US$ 424,000

2nd year 60% : revenue = US$ 636,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 21.65%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 35%

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

[1] Direct labour is considered as a variable cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

9.2.3 **Pay-back Period**

The pay-back period is less than 6 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 5,323,210.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 5,323,000.

ANNEXE 1

COMFAR SCHEDULES

TEXTILE INDUSTRY SPARE PARTS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000US$

Total initial investment during construction phase

fixed assets:	1798.78	47.492 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1798.78	47.492 % foreign

Source of funds during construction phase

equity & grants:	778.00	0.000 % foreign
foreign loans :	682.00	
local loans :	300.00	
total funds :	1760.00	38.750 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	143.59	300.18	300.18
depreciation :	162.50	151.50	27.50
interest :	99.56	27.28	0.00
production costs	405.65	478.96	327.68
thereof foreign	39.51 %	37.28 %	21.67 %
total sales :	424.30	1060.30	1060.00
gross income :	18.35	581.04	732.32
net income :	11.01	348.62	439.39
cash balance :	-37.52	414.87	466.89
net cashflow :	247.29	527.40	466.89

Net Present Value at: 10.00 % = 1577.76
Internal Rate of Return: 21.65 %
Return on equity1: 25.82 %
Return on equity2: 26.16 %

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Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	55.000	0.000
Buildings and civil works	550.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	300.000	745.000
Total fixed investment costs	905.000	745.000
Pre-production capital expenditures	49.500	99.280
Net working capital	0.000	0.000
Total initial investment costs	954.500	844.280
Of it foreign, in %	26.401	71.337

Total Current Investment in 1000US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities .	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment . .	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	25.778	16.830	21.314
Total current investment costs . . .	25.778	16.830	21.314
Of it foreign, %	59.656	68.874	74.366

Total Production Costs in '000US$

Year	'992	'993	'994	'995	'996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	48.410	78.612	'31.020	'31.020	'31.020
Other raw materials	24.080	36.120	60.200	60.200	60.200
Utilities	6.500	9.750	'6.250	'6.250	'6.250
Energy	0.600	0.900	'.500	'.500	'.500
Labour, direct	34.000	34.000	34.000	34.000	34.000
Repa maintenance	5.000	8.000	'0.000	'0.000	'0.000
Spares	5.000	8.000	'0.000	'0.000	'0.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	123.590	'75.382	262.970	262.970	262.970
Administrative overheads	20.000	37.210	37.210	37.210	37.210
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	162.500	162.500	157.000	151.500	'51.500
Financial costs	99.560	'7.740	55.920	34.100	27.280
Total production costs	405.650	452.832	513.100	485.780	478.960
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	39.507	38.125	37.462	38.165	37.285
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Tot	54.000	71.210	71.210	71.210	71.210

Total Production Costs in 1000US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	131.020	131.020	131.020	131.020	'31.020
Other raw materials	60.200	60.200	60.200	60.200	60.200
Utilities	16.250	16.250	16.250	16.250	'6.250
Energy	1.500	1.500	1.500	1.500	1.500
Labour, direct	34.000	34.000	34.000	34.000	34.000
Repa maintenance	10.000	10.000	'0.000	10.000	'0.000
Spares	10.000	10.000	10.000	10.000	'0.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	262.970	262.970	262.970	262.970	262.970
Administrative overheads	37.210	37.210	37.210	37.210	37.210
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	132.000	132.000	132.000	132.000	27.500
Financial costs	20.460	13.640	6.820	0.000	0.000
Total production costs	452.640	445.820	439.000	432.180	327.680
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	37.946	36.997	36.018	35.009	31.567
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Tot	71.210	71.210	71.210	71.210	71.210

Total Production Costs in 1000US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	131.020
Other raw materials	60.200
Utilities	16.250
Energy	1.500
Labour, direct	34.000
Repair, maintenance	10.000
Spares	10.000
Factory overheads	0.000
Factory costs	262.970
Administrative overheads	37.210
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	300.180
Costs per unit (single product)	0.000
Of it foreign, %	23.652
Of it variable,%	0.000
Total labour	71.210

Net Working Capital in '000US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	11.966	17.716	25.015	25.015
Inventory and materials	72	5.0	14.559	24.838	41.397	41.397
Energy	1	360.0	0.002	0.003	0.004	0.004
Spares	180	2.0	2.500	4.000	5.000	5.000
Work in progress	1	360.0	0.343	0.487	0.730	0.730
Finished products	5	72.0	1.994	2.953	4.169	4.169
Cash in hand	15	24.0	2.667	3.634	3.800	3.800
Total current assets			34.031	53.630	80.116	80.116
Current liabilities and						
Accounts payable	22	16.2	8.253	11.022	16.195	16.195
Net working capital			25.778	42.608	63.921	63.921
Increase in working capital			25.778	16.830	21.314	0.000
Net working capital, local			10.400	15.638	21.102	21.102
Net working capital, foreign			15.378	26.969	42.819	42.819

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000US$

Year	1990	1991
Equity, ordinary ..	585.000	193.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	300.000	382.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	100.000	200.000
Loan C, local....	0.000	0.000
Total loan	400.000	582.000
Current liabilities	0.000	0.000
Bank overdraft	0.000	38.780
Total funds	985.000	813.780

Source of Finance, production in 1000US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-85.250	-85.250	-85.250	-85.250
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	-100.000	-100.000	-100.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total Loan	-185.250	-185.250	-185.250	-85.250
Current Liabilities	8.253	2.769	5.172	0.000
Bank overdraft	37.518	-70.321	-5.977	0.000
Total Funds	-139.479	-252.801	-186.055	-85.250

Cashflow Tables, construction in 1000US$

Year	1990	1991
Total cash inflow	985.000	775.000
Financial resources	985.000	775.000
Sales, net of tax	0.000	0.000
Total cash outflow	954.500	844.280
Total assets	935.000	775.000
Operating costs	0.000	0.000
Cost of finance	19.500	69.280
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	30.500	-69.280
Cumulated cash balance	30.500	-38.780
Inflow, local	685.000	393.000
Outflow, local	702.500	242.000
Surplus (deficit)	-17.500	151.000
Inflow, foreign	300.000	382.000
Outflow, foreign	252.000	602.280
Surplus (deficit)	48.000	-220.280
Net cashflow	-935.000	-775.000
Cumulated net cashflow	-935.000	-1710.000

Cashflow tables, production in 1000US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow	432.253	638.769	1065.172	1060.000	1060.000	1060.000
Financial resources	8.253	2.769	5.172	0.000	0.000	0.000
Sales, net of tax	424.000	636.000	1060.000	1060.000	1060.000	1060.000
Total cash outflow	469.771	568.449	786.596	649.218	645.126	648.834
Total assets	34.031	19.600	26.486	0.000	0.000	0.000
Operating costs	143.590	212.592	300.180	300.180	300.180	300.180
Cost of finance	99.560	77.740	55.920	34.100	27.280	20.460
Repayment	185.250	185.250	185.250	85.250	85.250	85.250
Corporate tax	7.340	73.267	218.760	229.688	232.416	242.944
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	-37.518	70.321	278.577	410.782	414.874	411.166
Cumulated cash balance	-76.298	-5.977	272.600	683.382	1098.256	1509.422
Inflow, local	432.182	638.716	1065.099	1060.000	1060.000	1060.000
Outflow, local	289.112	379.214	573.502	458.868	461.596	472.124
Surplus (deficit)	143.070	259.502	491.597	601.132	598.404	587.876
Inflow, foreign	0.071	0.053	0.073	0.000	0.000	0.000
Outflow, foreign	180.658	189.235	213.093	190.350	183.530	176.710
Surplus (deficit)	-180.588	-189.182	-213.020	-190.350	-183.530	-176.710
Net cashflow	247.292	333.311	519.747	530.132	527.404	516.876
Cumulated net cashflow	-1462.708	-1129.397	-609.650	-79.518	447.886	964.762

Cashflow tables, production in 1000US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow	1060.000	1060.000	1060.000	1060.000	1060.000	1060.000
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	1060.000	1060.000	1060.000	1060.000	1060.000	1060.000
Total cash outflow	644.742	640.650	551.308	593.108	604.108	604.108
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	300.180	300.180	300.180	300.180	300.180	300.180
Cost of finance	13.640	6.820	0.000	0.000	0.000	0.000
Repayment	85.250	85.250	0.000	0.000	0.000	0.000
Corporate tax	245.672	248.400	251.128	292.928	303.928	303.928
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	415.258	419.350	508.692	466.892	455.892	455.892
Cumulated cash balance	1924.680	2344.030	2852.722	3319.614	3775.506	4231.398
Inflow, local	1060.000	1060.000	1060.000	1060.000	1060.000	1060.000
Outflow, local	474.852	477.580	480.308	522.108	533.108	533.108
Surplus (deficit)	585.148	582.420	579.692	537.892	526.892	526.892
Inflow, foreign	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign	169.890	163.070	71.000	71.000	71.000	71.000
Surplus (deficit)	-169.890	-163.070	-71.000	-71.000	-71.000	-71.000

Net cashflow	514.148	511.420	508.692	466.392	-55.392	-55.392
Cumulated net cashflow	1478.910	1990.330	2499.022	2965.414	3421.806	3877.198

Cashflow tables, production in 1000US$

Year	2004	2005	2006
Total cash inflow	1060.000	1060.000	1060.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	1060.000	1060.000	1060.000
Total cash outflow	604.108	604.108	604.108
Total assets	0.000	0.000	0.000
Operating costs	300.180	300.180	300.180
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	303.928	303.928	303.928
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	455.892	455.892	455.892
Cumulated cash balance	4687.291	5143.183	5599.075
Inflow, local	1060.000	1060.000	1060.000
Outflow, local	533.108	533.108	533.108
Surplus (deficit)	526.892	526.892	526.892
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	71.000	71.000	71.000
Surplus (deficit)	-71.000	-71.000	-71.000
Net cashflow	455.892	455.892	455.892
Cumulated net cashflow	4333.590	4789.482	5245.375

Cashflow Discounting:

a) Equity paid versus Net income flow:
Net present value ..... 1387.94 at 10.00 %
Internal Rate of Return (IRRE1) .. 25.82 %

b) Net Worth versus Net cash return:
Net present value ..... 1582.11 at 10.00 %
Internal Rate of Return (IRRE2) .. 26.16 %

c) Internal Rate of Return on total investment:
Net present value ..... 1577.76 at 10.00 %
Internal Rate of Return (IRR) .. 21.65 %

Net Worth = Equity paid plus reserves

Net Income Statement in 1000US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	424.000	636.000	1060.000	1060.000	1060.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	424.000	636.000	1060.000	1060.000	1060.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	306.090	375.092	457.180	451.680	451.67
Operational margin	117.910	260.908	602.820	608.320	608.320
As % of total sales	27.809	41.023	56.870	57.389	57.389
Cost of finance	99.560	77.740	55.920	34.100	27.280
Gross profit	18.350	183.168	546.900	574.220	581.040
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	18.350	183.168	546.900	574.220	581.040
Tax	7.340	73.267	218.760	229.688	232.416
Net profit	11.010	109.901	328.140	344.532	348.624
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	11.010	109.901	328.140	344.532	348.624
Accumulated undistributed profit	11.010	120.911	449.051	793.583	1142.207
Gross profit, % of total sales	4.328	28.800	51.594	54.172	54.815
Net profit, % of total sales	2.597	17.280	30.957	32.503	32.889
ROE, Net profit, % of equity	1.415	14.126	42.177	44.284	44.810
ROI, Net profit+interest, % of invest.	6.370	10.706	21.650	21.344	21.191

Net Income Statement in 1000US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	1060.000	1060.000	1060.000	1060.000	1060.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1060.000	1060.000	1060.000	1060.000	1060.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	432.180	432.180	432.180	432.180	327.680
Operational margin	627.820	627.820	627.820	627.820	732.320
As % of total sales	59.228	59.228	59.228	59.228	69.087
Cost of finance	20.460	13.640	6.820	0.000	0.000
Gross profit	607.360	614.180	621.000	627.820	732.320
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	607.360	614.180	621.000	627.820	732.320
Tax	242.944	245.672	248.400	251.128	292.928
Net profit	364.416	368.508	372.600	376.692	439.392
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	364.416	368.508	372.600	376.692	439.392
Accumulated undistributed profit	1506.623	1875.131	2247.731	2624.423	3063.815
Gross profit, % of total sales	57.298	57.942	58.585	59.228	69.087
Net profit, % of total sales	34.379	34.765	35.151	35.537	41.452
ROE, Net profit, % of equity	46.840	47.366	47.892	48.418	56.477
ROI, Net profit+interest, % of invest.	21.696	21.543	21.389	21.235	24.770

Net Income Statement in 1000US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	1060.000	1060.000	1060.000	1060.000	1060.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1060.000	1060.000	1060.000	1060.000	1060.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	300.180	300.180	300.180	300.180	300.180
Operational margin	759.820	759.820	759.820	759.820	759.820
As % of total sales	71.681	71.681	71.681	71.681	71.681
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	759.820	759.820	759.820	759.820	759.820
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	759.820	759.820	759.820	759.820	759.820
Tax	303.928	303.928	303.928	303.928	303.928
Net profit	455.892	455.892	455.892	455.892	455.892
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	455.892	455.892	455.892	455.892	455.892
Accumulated undistributed profit	3519.707	3975.599	4431.491	4887.383	5343.275
Gross profit, % of total sales	71.681	71.681	71.681	71.681	71.681
Net profit, % of total sales	43.009	43.009	43.009	43.009	43.009
ROE, Net profit, % of equity	58.598	58.598	58.598	58.598	58.598
ROI, Net profit+interest, % of invest.	25.700	25.700	25.700	25.700	25.700

Projected Balance Sheets, construction in 1000US$

Year	1990	1991
Total assets	985.000	1798.780
Fixed assets, net of depreciation	0.000	954.500
Construction in progress	954.500	844.280
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	30.500	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	985.000	1798.780
Equity capital	585.000	778.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	400.000	932.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	0.000	38.780
Total debt	400.000	1020.780
Equity, % of liabilities	59.391	43.252

Projected Balance Sheets, Production in 1000US$

Year	1992	1993	1994	1995	1996
Total assets	1670.311	1527.410	1669.495	1928.777	2192.152
Fixed assets, net of depreciation	1636.280	1473.780	1316.780	1165.280	1013.780
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	31.364	49.996	76.316	76.316	76.316
Cash, bank	2.667	3.634	3.800	3.800	3.800
Cash surplus, finance available	0.000	0.000	272.599	683.381	1098.255
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	1670.311	1527.410	1669.495	1928.777	2192.152
Equity capital	778.000	778.000	778.000	778.000	778.000
Reserves, retained profit	0.000	11.010	120.911	449.051	793.583
Profit	11.010	109.901	328.140	344.532	348.624
Long and medium term debt	796.750	611.500	426.250	341.000	255.750
Current liabilities	8.253	11.022	16.195	16.195	16.195
Bank overdraft, finance required.	76.298	5.977	0.000	0.000	0.000
Total debt	881.301	628.499	442.445	357.195	271.945
Equity, % of liabilities	46.578	50.935	46.601	40.336	35.490

Projected Balance Sheets, Production in 1000US$

Year	1997	1998	1999	2000	2001
Total assets	2471.318	2754.576	3041.926	3418.618	3858.010
Fixed assets, net of depreciation	881.780	749.780	617.780	485.780	458.280
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	76.316	76.316	76.316	76.316	76.316
Cash, bank	3.800	3.800	3.800	3.800	3.800
Cash surplus, finance available	1509.422	1924.680	2344.030	2852.722	3319.614
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	2471.318	2754.576	3041.926	3418.618	3858.010
Equity capital	778.000	778.000	778.000	778.000	778.000
Reserves, retained profit	1142.207	1506.623	1875.131	2247.731	2624.423
Profit	364.416	368.508	372.600	376.692	439.392
Long and medium term debt	170.500	85.250	0.000	0.000	0.000
Current liabilities	16.195	16.195	16.195	16.195	16.195
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	186.695	101.445	16.195	16.195	16.195
Equity, % of liabilities	31.481	28.244	25.576	22.758	20.166

Projected Balance Sheets, Production in 1000US$

Year	2002	2003	2004	2005	2006
Total assets	4313.902	4769.794	5225.686	5681.578	6137.470
Fixed assets, net of depreciation	458.280	458.280	458.280	458.280	458.280
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	76.316	76.316	76.316	76.316	76.316
Cash, bank	3.800	3.800	3.800	3.800	3.800
Cash surplus, finance available	3775.506	4231.398	4687.290	5143.182	5599.074
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	4313.902	4769.794	5225.686	5681.578	6137.470
Equity capital	778.000	778.000	778.000	778.000	778.000
Reserves, retained profit	3063.815	3519.707	3975.599	4431.491	4887.383
Profit	455.892	455.892	455.892	455.892	455.892
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	16.195	16.195	16.195	16.195	16.195
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	16.195	16.195	16.195	16.195	16.195
Equity, % of liabilities	18.035	16.311	14.888	13.693	12.676

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	682.20	682.00	0.20	300.00	382.00	0.07	0.05
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	682.20	682.00	0.20	300.00	382.00	0.07	0.05
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	2643.42	854.28	1789.14	252.00	602.28	180.66	189.24
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	671.42	803.00	-131.58	240.00	563.00	15.45	11.64
imported materials . . .	993.00	0.00	993.00	0.00	0.00	25.40	44.60
repayment loans & overd.	682.20	0.00	682.20	0.00	0.00	85.25	85.25
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	296.80	51.28	245.52	12.00	39.28	54.56	47.74
indirect costs							
net foreign exchge flow	-1961.22	-172.28	-1788.94	48.00	-220.28	-180.59	-189.18
import substit'n effect	14840.00	0.00	14840.00	0.00	0.00	424.00	636.00
net forgn exchge effect	12878.78	-172.28	13051.06	48.00	-220.28	243.41	446.82

present values at	10.00 %
foreign exchange flow .	-1162.10
net forgn exchge effect	5323.21

Foreign Exchange Effect in 1000US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	0.07	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.07	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	213.09	190.35	183.53	176.71	169.89	163.07	71.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	15.92	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	71.00	71.00	71.00	71.00	71.00	71.00	71.00
repayment loans & overd.	85.25	85.25	85.25	85.25	85.25	85.25	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	40.92	34.10	27.28	20.46	13.64	6.82	0.00
indirect costs							
net foreign exchge flow	-213.02	-190.35	-183.53	-176.71	-169.89	-163.07	-71.00
import substit'n effect	1060.00	1060.00	1060.00	1060.00	1060.00	1060.00	1060.00
net forgn exchge effect	846.98	869.65	876.47	883.29	890.11	896.93	989.00

present values at	10.00 %
foreign exchange flow .	-1162.10
net forgn exchge effect	5323.21

Foreign Exchange Effect in 1000US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	71.00	71.00	71.00	71.00	71.00	71.00	-174.40
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-174.60
imported materials . . .	71.00	71.00	71.00	71.00	71.00	71.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.20
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-71.00	-71.00	-71.00	-71.00	-71.00	-71.00	174.40
import substit'n effect	1060.00	1060.00	1060.00	1060.00	1060.00	1060.00	0.00
net forgn exchge effect	989.00	989.00	989.00	989.00	989.00	989.00	174.40

present values at	10.00 %
foreign exchange flow .	-1162.10
net forgn exchge effect	5323.21

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE INSTALLATION OF A SHOCK ABSORBER PRODUCING PLANT IN NIGERIA

PROJECT SF/NIR/88/001

baldo & c.
CONSULTING ENGINEERS

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant designed for the assembly of vehicles shock absorbers, importing the various parts and component from a licensor.

The envisaged unit has a nominal annual capacity of 50,000 shock absorbers, based on 250 working days/y 1 shift/day, 8 hours/day.(1)

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 1,952,800 (US$ 1,130,000 in foreign currency)
- Working capital (at full production): US$ 405,150 (US$ 392,000 in foreign currency)
- Internal Rate of Return: 13.91%
- Break-Even Point (at 5th year of production) 40%
- Pay-Back Period: less than 5 years (including construction period)
- Employees: 23

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 28,060,650 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

1. INTRODUCTION

Shock absorbers are parts of the vehicles that play two main important roles: they assure stability to the vehicles and comfort to the passengers.

They are subject to deterioration, especially in those vehicles, like trucks, that are used in severe conditions and run very often on rough roads.

It is known that manufacturers of vehicle design the shock absorbers suitable for the specific vehicle on which they have to be mounted.

Almost all vehicles manufacturers do not fabricate the shock absorbers in their plant, but they buy these components from sub-suppliers, who have installations suitable to fabricate any kind of shock

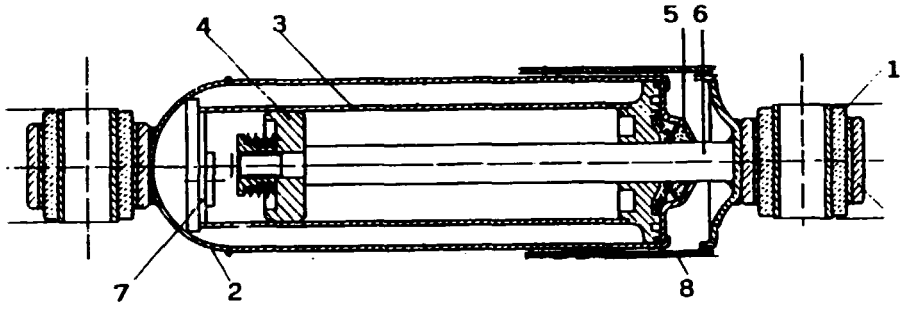
(1) For additional background material, see Volume I p. 198.

The investments required for the equipment allowing the machining of each part largely exceed 20,000,000 US $. This kind of investment is justified only if the production is over 2 million pieces per year.

For a relative small market like the one of Nigeria an investment of such a magnitude cannot be considered, for the time being.

The best approach to enter in this field, is to start with a small assembly facility of shock absorbers, by importing the finished parts.

As said before, there are several types of shock absorbers, but, basically they consist of similar parts, even though of different shapes. Herebelow there is an example showing the main parts of a shock absorber.



1 connecting part
2 outer cylinder
3 inner cyclinder
4 piston
5 gasket
6 piston stern
7 oil flow regulator
8 desk protection part

2. MARKET AND PLANT CAPACITY

2.1 DEMAND

Estimated numbers of registered vehicles in Nigeria by December, 1986 (in units)

Year	Saloon & private cars	Scraps	Heavier vehicles trucks etc.	Scraps
1986	21,572	2,157	19,211	1,921
1985	63,941	12,788	35,561	7,112
1984	73,878	22,163	39,713	11,914
1983	77,379	30,952	72,847	29,139
1982	104,191	52,096	96,109	48,055
1981	106,079	63,647	92,685	55,611
1980	75,413	52,789	93,165	65,216
1979	61,679	49,343	92,519	74,015
1978	71,050	63,945	95,100	85,590
1977	125,000	125,000	102,375	102,375
Total number	780,182	474,881	739,285	480,947
Less scraps	474,881		480,947	
Balance as at December, 1986	305,301		258,338	

To establish the replacement demand for the vehicles shock absobers, it is assumed that since an average vehicle uses 4 shock absorbers, their replacement demand will be at least two of this item per vehicle by-annually, in view of the bad conditions of most Nigeria roads. The N.I.D.B. estimate of the demand for primary and replacement shock absorbers is reported in the following table.

Total estimated primary and replacement demand for shock absorbers

Estimated Quantity of Shock Absorbers (in Units) for:			
Year	**Saloon Cars & Private Vehicles**	**Heavy Commercial Vehicles and Trucks**	**Total**
1990	1,363,746	1,102,578	2,466,324
1991	1,616,975	1,316,854	2,933,829
1992	1,920,850	1,573,984	3,494,835
1993	2,285,500	1,882,541	4,168,041
1994	2,723,080	2,252,809	4,975,890

2.2 SUPPLY

Apart the O.E. imported by Peugeot, Volkswagen, Mercedes and others assemblers, the demand is mainly satisfied by shock absorbers imported from Far Eastern Countries (Korea, Taiwan, Singapore). Even if they are marked as original equipment, the products coming from these countries are imitations and this is known to everybody, but the selling prices are much lower than the O.E., so the users give preference to them.

2.3 PLANT CAPACITY

The proposed plant is designed for an annual out put of 50,000 units. This quantity is based on 250 working days/year, 1 shift of 8 hours/day.

It is suggested that in the first phase the plant should concentrate its production on assembling shock absorbers, for trucks where the competition is lower and the value added is higher. In the second phase, the plant can expand into producing shock absorber for other types of vehicles.

The study will be developed on this basis.

In this study the plant is concerned with the production of shock absorbers for trucks only.

2.4 SALES PRICES AND REVENUE

The following average selling price will be considered:

US $ 37 per unit

It is expected that the plant will reach its nominal capacity in the third year of operation which will give enough time to penetrate the market.

The revenue will be as follows:

1st year	(30% capacity)	US $ 555,000
2nd year	(60% capacity)	US $ 1,110,000
from the 3rd to the 15th year	(100% capacity)	US $ 1,850,000

3. MATERIALS AND INPUTS

At this stage a potential partner could be C.F.A. of Florence, Italy, which provided the following information.

3.1 MATERIALS

All the parts will be imported already machined, ready for the assembling and finishing phases, with the exception of the tubes, which will be imported in bars 6 m long and cut in the desired lengths within the plant.

The costs of the parts and tubes are US $ 23 per unit.

The cost for 50,000 units, will amount to US $ 1,150,000.

3.2 ELECTRIC ENERGY

The installed power is 100 kW. The coefficient of utilization is 0.6.

The kWh consumed in one year will be

$$100 \times 0.6 \times 8 \times 250 = 120{,}000 \text{ kWh}$$

The relevant cost, considering 0.1 US$/kWh is US $ 12,000.

3.3 COMPRESSED AIR

Compressed air at 6 bar is used for pneumatic tools and for blowing.

50 l/sec are necessary.

The relevant cost is already considered in the electric energy expenditures.

3.4 WATER

The annual consumption of water is negligible.

3.5 OTHER INPUTS

The finishing of shock absorbers consists in coating the shock absorber with epoxy resins.

The estimated expenditures for 50,000 units is US $ 5,000.

4. LOCATION

The plant should be located in an important market area.

5. PROJECT ENGINEERING

5.1 PRODUCTION PROCESS

The main steps are the following:

tube cutting
tube washing
tube beveling + marking
welding
piston mounting
assembling + oil filling
blocking
antidust tube welding
coating
storing

5.1.1 **Tube cutting**

Two kinds of tubes are used:

- carbon steel tubes, cold drawn, with the internal diameter tolerance not exceeding 1/100 of diameter.

  This tubes are used for the internal part of the shock absorber and will contain the oil.

- carbon steel tubes, cold drawn, commercial type, to be used as antidust protection.

The cutting is done by using an automatic shearing machine, provided with tubes holder.

As spare, it is foreseen a manual shearing machine, disc type.

5.1.2 **Tube washing**

After the cutting, the tubes are washed to remove any trace of oil or other surface impurities, preparing them for coating.

The washing is done in three steps using water additioned with chemicals.

5.1.3 **Tube beveling**

After the washing the tubes are beveled in automatic machine, provided with a revolving loader.

This machine is designed to mark the tubes with serial number, date or other information.

5.1.4 **Welding**

The parts that have to be welded are the lower mounting ring, the bottom and the reservoir.

5.1.5 **Piston mounting**

This operation is carried out on a bench equipped with all necessary tools.

The stem is assembled with the piston and all relevant parts, i.e. spring, nut, etc.

5.1.6 Assembling and oil filling

The pre-assembled parts are put together with the cylinder and the reservoir, plus all other single pieces.

Once the above operations are over, the reservoir is filled with oil by means of an automatic dosing device, connected to an oil tank.

5.1.7 Seal and fatigue testing

This testing is carried out by a special machine, which is designed to simulate the working conditions.

The operato: checks any oil leak ıge and verifies the normal function of the shock absorber.

When requested, the machine carries out also the fatigue test, which consists in making the shock absorber collapse and open 1,000,000 times.

5.1.8 Blocking

After the positive test, the shock absorber is completed by bending the reservoir edge against the lower cup.

The operations is done by a hydraulic machine.

5.1.9 Antidust tube welding

At this stage, the shock absorber is completed by mounting and welding the antidust tube.

5.1.10 Storing

The shock absorbers, after painting are moved to the packaging area and from there to the finished products store.

5.2 PRODUCTION AND AUXILIARY EQUIPMENT

1 automatic shearing machine

1 manual shearing machine

1 washing system

1 beveling and marking machine

3 automatic welding machines

1 automatic oil dosing device

1 seal and fatigue testing machine

1 hydraulic press

1 coating line

3 working benches

1 set of tools

5.3 ANCILLARY EQUIPMENT

- electrical substation, which includes an emergency gen-set
- the compressed air system
- the store racks
- pallets, etc.

5.4 TRANSPORT EQUIPMENT

The internal transport of material will be done using two electrical fork lifts and 2 manual transpallets.

For the external transport a pick-up is foreseen.

5.5 LAY-OUT AND CIVIL WORKS

The plant will cover an area of about 850 sq.m so subdivided:

- cutting, washing, finishing areas	300 sq.m
- assembling area	200 sq.m
- warehouse	200 sq.m
- offices and social services	100 sq.m
- utilities	50 sq.m

The total area required, considering the access roads and yards will be 1500 sq.m, about.

The building will be in concrete structure, with a roofing in asbestos-cement sheets, supported by light steel structure.

The walls will be in cement blocks or clay bricks.

The floor will be of antidust concrete slabs, allowing an overload of 1,000 kg/sq.m.

The floor of the offices and social services will be in ceramic tiles.

5.6 INVESTMENT COSTS

The quotation of machinery and equipment was obtained from C.F.A. of Florence, Italy.

The estimated investment costs are as follows:

Description	LC $	FC $	Total $
Machinery & equipment FOB European Port		800,000	800,000
Freight, taxes and duties	160,000	80,000	240,000
Erection	160,000	80,000	240,000
Land and site preparation	50,000	--	50,000
Civil works and building	320,000	--	320,000
Spare parts	--	25,000	25,000
Total	**690,000**	**985,000**	**1,675,000**
Contingency 10%	**69,000**	**98,000**	**167,000**
Grand total	**759,000**	**1,083,000**	**1,842,000**

The industrial life of the plant can be considered as 15 years.

US $ 20,000 can be assumed as the average annual expenditures for maintenance (see Comfar).

In the financial evaluation the investment cost, including contingencies are so subdivided:

Preproduction expenditures	FC	$	0
Preproduction expenditures	LC	$	50,000
Machinery	FC	$	1,083,000
Machinery	LC	$	352,000
Land and site preparation	LC	$	55,000
Civil works and building	LC	$	352,000
Total		$	1,892,000

6. PLANT ORGANIZATION

The plant has been considered as an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

The manpower required for the plant operation does not need special training. It is recommended, anyway that the welders have on the job training, carried out by the supplier of the technology, who will make available an expert for 6 months. The relevant cost is estimated at 60,000 US Dollars.

7.1 MANAGEMENT

	N.	N/Year
General manager	1	50,000
Technical manager	1	40,000
	2	90,000
		overheads 40% 36,000
		126,000
		(US $ 16,000)

7.2 ADMINISTRATIVE DEPT.

	N.	N/Year
Accountant	1	12,000
Purchasing dept.	1	12,000
Sales dept.	1	12,000
Store keeper	1	12,000
Clerks	2	10,000
	6	58,000
		overheads 40% 13,500
		81,200
		(US $ 10,300)

7.3 PRODUCTION DEPT.

	N.	N/Year
Production manager	1	40,000
Shift operators	10	80,000
	11	120,000
		overheads 40% 48,000
		168,000
		(US $ 21,200)

7.4 MAINTENANCE DEPT.

	N.	N/Year
Mechanic	1	10,000
Electrician	1	10,000
Helpers	2	12,000
	4	32,000
		overheads 40% 12,800
		44,800
		(US $ 5,700)

Summary

Administrative	8	US $ 26,300
Production	11	US $ 21,200
Maintenance	4	US $ 5,700
	23	US $ 53,200

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start the plant is in the range of 18 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 1,952,000 US Dollars. The portion in foreign currency accounts for 1,130,000 US Dollars.

Details of these figures are shown in chapter 5.6.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 527,000	US$ 445,000	US$ 972,000
- Foreign Loan (interest 8%)	US$ 300,000	US$ 620,000	US$ 920,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 30%

2nd year 60%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 406,000 US Dollars, the foreign portion being US$ 390,000.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 3 months before the plant starts to produce.

The necessary sum is US$ 140,000.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 30% of its nominal capacity, the production costs amount to US$ 725,900.

In the third year, at full production, the costs amount to US $ 1,474,000, then they start a slight decrease year after year, to arrive to be constant to US $ 1,242,200 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 1,850,000. As said before, the production programme foresees that full production is reached gradually:

1st year 30% : revenue = US$ 555,000

2nd year 60% : revenue = US$ 1,111,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 13.91%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 40% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 5 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 2,928,080.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 2,928,080.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

ANNEXE 1

COMFAR SCHEDULES

SHOCK ABSORBERS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US$

Total initial investment during construction phase

fixed assets:	1952.80	58.572 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1952.80	58.572 % foreign

Source of funds during construction phase

equity & grants:	972.00	0.000 % foreign
foreign loans :	920.00	
local loans :	0.00	
total funds :	1892.00	48.626 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	470.20	1242.20	1242.20
depreciation :	182.10	171.10	17.60
interest :	73.60	36.80	0.00
production costs	725.90	1450.10	1259.80
thereof foreign	81.26 %	90.14 %	92.24 %
total sales :	555.00	1850.00	1850.00
gross income :	-170.90	399.90	590.20
net income :	-170.90	239.94	354.12
cash balance :	-244.82	296.04	371.72
net cashflow :	-56.22	447.84	371.72

Net Present Value at: 10.00 % = 587.46
Internal Rate of Return: 13.91 %
Return on equity1: 15.04 %
Return on equity2: 15.92 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	55.000	0.000
Buildings and civil works	352.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	400.000	1035.000
Total fixed investment costs	807.000	1035.000
Pre-production capital expenditures.	32.000	78.800
Net working capital	0.000	0.000
Total initial investment costs	839.000	1113.800
Of it foreign, in %	37.187	74.681

Total Current Investment in 1000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	141.021	105.808	158.328
Total current investment costs	141.021	105.808	158.328
Of it foreign, %	92.468	99.189	99.144

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	30.000	60.000	100.000	100.000	100.000
Raw material 1	345.000	690.000	1150.000	1150.000	1150.000
Other raw materials	2.000	3.000	5.000	5.000	5.000
Utilities	0.000	0.000	0.000	0.000	0.000
Energy	4.000	7.000	12.000	12.000	12.000
Labour, direct	21.200	21.200	21.200	21.200	21.200
Repair, maintenance	3.000	6.000	10.000	10.000	10.000
Spares	3.000	7.000	12.000	12.000	12.000
Factory overheads	60.000	0.000	0.000	0.000	0.000
Factory costs	438.200	734.200	1210.200	1210.200	1210.200
Administrative overheads	32.000	32.000	32.000	32.000	32.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	182.100	182.100	176.600	171.100	171.100
Financial costs	73.600	64.400	55.200	46.000	36.800
Total production costs	725.900	1012.700	1474.000	1459.300	1450.100
Costs per unit (single product)	0.048	0.034	0.029	0.029	0.029
Of it foreign, %	81.265	85.879	89.925	90.201	90.139
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	53.200	53.200	53.200	53.200	53.200

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	1150.000	1150.000	1150.000	1150.000	1150.000
Other raw materials	5.000	5.000	5.000	5.000	5.000
Utilities	0.000	0.000	0.000	0.000	0.000
Energy	12.000	12.000	12.000	12.000	12.000
Labour, direct	21.200	21.200	21.200	21.200	21.200
Repair, maintenance	10.000	10.000	10.000	10.000	10.000
Spares	12.000	12.000	12.000	12.000	12.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	1210.200	1210.200	1210.200	1210.200	1210.200
Administrative overheads	32.000	32.000	32.000	32.000	32.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	161.100	161.100	161.100	161.100	17.600
Financial costs	27.600	18.400	9.200	0.000	0.000
Total production costs	1430.900	1421.700	1412.500	1403.300	1259.800
Costs per unit (single product)	0.029	0.028	0.028	0.028	0.025
Of it foreign, %	90.705	90.645	90.584	90.522	92.237
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	53.200	53.200	53.200	53.200	53.200

Total Production Costs in 1000 US$

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	1150.000
Other raw materials	5.000
Utilities	0.000
Energy	12.000
Labour, direct	21.200
Repair, maintenance	10.000
Spares	12.000
Factory overheads	0.000
Factory costs	1210.200
Administrative overheads	32.000
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	1242.200
Costs per unit (single product)	0.025
Of it foreign, %	93.544
Of it variable,%	0.000
Total labour	53.200

Net Working Capital in 1000 US$

Year			1992	1993	1994	1995-2006
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	39.183	63.350	103.517	103.517
Inventory and materials	60	6.0	57.667	115.250	192.083	192.083
Energy	1	360.0	0.011	0.019	0.033	0.033
Spares	1	360.0	0.008	0.019	0.033	0.033
Work in progress	3	120.0	3.652	6.118	10.085	10.085
Finished products	30	12.0	39.183	63.850	103.517	103.517
Cash in hand	15	24.0	4.967	2.758	3.133	3.133
Total current assets			144.671	251.866	412.402	412.402
Current liabilities and						
Accounts payable	2	164.3	3.650	5.036	7.244	7.244
Net working capital			141.021	246.829	405.157	405.157
Increase in working capital			141.021	105.808	158.328	0.000
Net working capital, local			10.621	11.479	12.835	12.835
Net working capital, foreign			130.400	235.350	392.322	392.322

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	527.000	445.300
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	300.000	620.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	0.000
Total loan	300.000	620.000
Current liabilities	0.000	0.000
Bank overdraft	12.000	48.800
Total funds	839.000	1113.800

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995	1996-99
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-115.000	-115.000	-115.000	-115.000	-115.000
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000
Total loan	-115.000	-115.000	-115.000	-115.000	-115.000
Current liabilities	3.650	1.386	2.208	0.000	0.000
Bank overdraft	244.821	-19.672	-128.872	-157.078	0.000
Total funds	133.471	-133.286	-241.664	-272.078	-115.000

Cashflow Tables, construction in 1000 US$

Year	1990	1991
Total cash inflow	827.000	1065.000
Financial resources	827.000	1065.000
Sales, net of tax	0.000	0.000
Total cash outflow	839.000	1113.800
Total assets	827.000	1065.000
Operating costs	0.000	0.000
Cost of finance	12.000	48.800
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	-12.000	-48.800
Cumulated cash balance	-12.000	-60.800
Inflow, local	527.000	445.000
Outflow, local	527.000	282.000
Surplus (deficit)	0.000	163.000
Inflow, foreign	300.000	620.000
Outflow, foreign	312.000	831.800
Surplus (deficit)	-12.000	-211.800
Net cashflow	-827.000	-1065.000
Cumulated net cashflow	-827.000	-1892.000

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow . .	558.650	1111.386	1852.208	1850.000	1850.000	1850.000
Financial resources .	3.650	1.386	2.208	0.000	0.000	0.000
Sales, net of tax . .	555.000	1110.000	1850.000	1850.000	1850.000	1850.000
Total cash outflow . .	803.471	1091.714	1723.336	1559.480	1553.960	1552.440
Total assets	144.671	107.194	160.536	0.000	0.000	0.000
Operating costs . . .	470.200	766.200	1242.200	1242.200	1242.200	1242.200
Cost of finance . . .	73.600	64.400	55.200	46.000	36.800	27.600
Repayment	115.000	115.000	115.000	115.000	115.000	115.000
Corporate tax . . .	0.000	38.920	150.400	156.280	159.960	167.640
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-244.821	19.672	128.872	290.520	296.040	297.560
Cumulated cash balance	-305.621	-285.950	-157.077	133.443	429.483	727.043
Inflow, local	557.517	1110.583	1850.917	1850.000	1850.000	1850.000
Outflow, local	75.338	109.562	232.872	236.480	240.160	247.840
Surplus (deficit) .	482.179	1001.022	1618.044	1613.520	1609.840	1602.160
Inflow, foreign . . .	1.133	0.803	1.292	0.000	0.000	0.000
Outflow, foreign . . .	728.133	982.153	1490.464	1323.000	1313.800	1304.600
Surplus (deficit) .	-727.000	-981.350	-1489.172	-1323.000	-1313.800	-1304.600
Net cashflow	-56.221	199.072	299.072	451.520	447.840	440.160
Cumulated net cashflow	-1948.221	-1749.150	-1450.077	-998.557	-550.717	-110.557

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow . .	1850.000	1850.000	1850.000	1850.000	1850.000	1850.000
Financial resources .	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax . .	1850.000	1850.000	1850.000	1850.000	1850.000	1850.000
Total cash outflow . .	1546.920	1541.400	1420.880	1478.280	1485.320	1485.320
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs . . .	1242.200	1242.200	1242.200	1242.200	1242.200	1242.200
Cost of finance . . .	18.400	9.200	0.000	0.000	0.000	0.000
Repayment	115.000	115.000	0.000	0.000	0.000	0.000
Corporate tax . . .	171.320	175.000	178.680	236.080	243.120	243.120
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	303.080	308.600	429.120	371.720	364.680	364.680
Cumulated cash balance	1030.123	1338.723	1767.844	2139.563	2504.244	2868.924
Inflow, local	1850.000	1850.000	1850.000	1850.000	1850.000	1850.000
Outflow, local	251.520	255.200	258.880	316.280	323.320	323.320
Surplus (deficit) .	1598.480	1594.800	1591.120	1533.720	1526.680	1526.680
Inflow, foreign . . .	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign . . .	1295.400	1286.200	1162.000	1162.000	1162.000	1162.0
Surplus (deficit) .	-1295.400	-1286.200	-1162.000	-1162.000	-1162.000	-1162
Net cashflow	436.480	432.800	429.120	371.720	364.680	
Cumulated net cashflow	325.923	758.723	1187.843	1559.563	1924.244	

Cashflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	1850.000	1850.000	1850.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	1850.000	1850.000	1850.000
Total cash outflow	1485.320	1485.320	1485.320
Total assets	0.000	0.000	0.000
Operating costs	1242.200	1242.200	1242.200
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	243.120	243.120	243.120
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	364.680	364.680	364.680
Cumulated cash balance	3233.604	3598.284	3962.964
Inflow, local	1850.000	1850.000	1850.000
Outflow, local	323.320	323.320	323.320
Surplus (deficit)	1526.680	1526.680	1526.680
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	1162.000	1162.000	1162.000
Surplus (deficit)	-1162.000	-1162.000	-1162.000
Net cashflow	364.680	364.680	364.680
Cumulated net cashflow	2653.604	3018.284	3382.964

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	478.39 at	10.00 %
Internal Rate of Return (IRRE1) ..	15.04 %	

b) Net Worth versus Net cash return:

Net present value	670.45 at	10.00 %
Internal Rate of Return (IRRE2) ..	15.92 %	

c) Internal Rate of Return on total investment:

Net present value	587.46 at	10.00 %
Internal Rate of Return (IRR) ..	13.91 %	

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	555.000	1110.000	1850.000	1850.000	1850.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	555.000	1110.000	1850.000	1850.000	1850.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	652.300	948.300	1418.800	1413.300	1413.300
Operational margin	-97.300	161.700	431.200	436.700	436.700
As % of total sales	-17.532	14.568	23.308	23.605	23.605
Cost of finance	73.600	64.400	55.200	46.000	36.800
Gross profit	-170.900	97.300	376.000	390.700	399.900
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-170.900	97.300	376.000	390.700	399.900
Tax	0.000	38.920	150.400	156.280	159.960
Net profit	-170.900	58.380	225.600	234.420	239.940
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-170.900	58.380	225.600	234.420	239.940
Accumulated undistributed profit	-170.900	-112.520	113.080	347.500	587.440
Gross profit, % of total sales	-30.793	8.766	20.324	21.119	21.616
Net profit, % of total sales	-30.793	5.259	12.195	12.671	12.970
ROE, Net profit, % of equity	-17.582	6.006	23.210	24.117	24.685
ROI, Net profit+interest, % of invest.	-4.786	5.741	12.224	12.207	12.047

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	1850.000	1850.000	1850.000	1850.000	1850.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1850.000	1850.000	1850.000	1850.000	1850.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1403.300	1403.300	1403.300	1403.300	1259.800
Operational margin	446.700	446.700	446.700	446.700	590.200
As % of total sales	24.146	24.146	24.146	24.146	31.903
Cost of finance	27.600	18.400	9.200	0.000	0.000
Gross profit	419.100	428.300	437.500	446.700	590.200
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	419.100	428.300	437.500	446.700	590.200
Tax	167.640	171.320	175.000	178.680	236.080
Net profit	251.460	256.980	262.500	268.020	354.120
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	251.460	256.980	262.500	268.020	354.120
Accumulated undistributed profit	838.899	1095.879	1358.379	1626.399	1980.519
Gross profit, % of total sales	22.654	23.151	23.649	24.146	31.903
Net profit, % of total sales	13.592	13.891	14.189	14.488	19.142
ROE, Net profit, % of equity	25.870	26.438	27.006	27.574	36.432
ROI, Net profit+interest, % of invest.	12.148	11.988	11.828	11.667	15.416

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	1850.000	1850.000	1850.000	1850.000	1850.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1850.000	1850.000	1850.000	1850.000	1850.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	1242.200	1242.200	1242.200	1242.200	1242.200
Operational margin	607.800	607.800	607.800	607.800	607.800
As % of total sales	32.854	32.854	32.854	32.854	32.854
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	607.800	607.800	607.800	607.800	607.800
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	607.800	607.800	607.800	607.800	607.800
Tax	243.120	243.120	243.120	243.120	243.120
Net profit	364.680	364.680	364.680	364.680	364.680
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	364.680	364.680	364.680	364.680	364.680
Accumulated undistributed profit	2345.199	2709.879	3074.559	3439.239	3803.919
Gross profit, % of total sales	32.854	32.854	32.854	32.854	32.854
Net profit, % of total sales	19.712	19.712	19.712	19.712	19.712
ROE, Net profit, % of equity	37.519	37.519	37.519	37.519	37.519
ROI, Net profit+interest, % of invest.	15.875	15.875	15.875	15.875	15.875

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	839.000	1952.800
Fixed assets, net of depreciation	0.000	839.000
Construction in progress	839.000	1113.800
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	839.000	1952.800
Equity capital	527.000	972.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	300.000	920.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	12.000	60.800
Total debt	312.000	980.800
Equity, % of liabilities	62.813	49.775

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	2086.271	2011.366	1936.922	1786.744	1911.684
Fixed assets, net of depreciation	1770.700	1588.600	1412.000	1240.900	1069.800
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	139.704	249.107	409.268	409.268	409.268
Cash, bank	4.967	2.758	3.133	3.133	3.133
Cash surplus, finance available	0.000	0.000	0.000	133.442	429.482
Loss carried forward	0.000	170.900	112.520	0.000	0.000
Loss	170.900	0.000	0.000	0.000	0.000
Total liabilities	2086.271	2011.366	1936.922	1786.744	1911.684
Equity capital	972.000	972.000	972.000	972.000	972.000
Reserves, retained profit	0.000	0.000	0.000	113.080	347.500
Profit	0.000	58.380	225.600	234.420	239.940
Long and medium term debt	805.000	690.000	575.000	460.000	345.000
Current liabilities	3.650	5.036	7.244	7.244	7.244
Bank overdraft, finance required.	305.621	285.950	157.078	0.000	0.000
Total debt	1114.271	980.986	739.322	467.244	352.244
Equity, % of liabilities	46.590	48.325	50.183	54.401	50.845

Projected Balance Sheets, Production in 1000 US$

Year	1997	1998	1999	2000	2001
Total assets	2048.144	2190.124	2337.624	2605.644	2959.764
Fixed assets, net of depreciation	908.700	747.600	586.500	425.400	407.800
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	409.268	409.268	409.268	409.268	409.268
Cash, bank	3.133	3.133	3.133	3.133	3.133
Cash surplus, finance available	727.042	1030.122	1338.722	1767.842	2139.562
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	2048.144	2190.124	2337.624	2605.644	2959.764
Equity capital	972.000	972.000	972.000	972.000	972.000
Reserves, retained profit	587.440	838.899	1095.879	1358.379	1626.399
Profit	251.460	256.980	262.500	268.020	354.120
Long and medium term debt	230.000	115.000	0.000	0.000	0.000
Current liabilities	7.244	7.244	7.244	7.244	7.244
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	237.244	122.244	7.244	7.244	7.244
Equity, % of liabilities	47.458	44.381	41.581	37.304	32.840

Projected Balance Sheets, Production in 1000 US$

Year	2002	2003	2004	2005	2006
Total assets	3324.443	3689.124	4053.803	4418.484	4783.164
Fixed assets, net of depreciation	407.800	407.800	407.800	407.800	407.800
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	409.268	409.268	409.268	409.268	409.268
Cash, bank	3.133	3.133	3.133	3.133	3.133
Cash surplus, finance available	2504.241	2868.922	3233.602	3598.282	3962.962
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	3324.443	3689.124	4053.803	4418.484	4783.164
Equity capital	972.000	972.000	972.000	972.000	972.000
Reserves, retained profit	1980.519	2345.199	2709.879	3074.559	3439.239
Profit	364.680	364.680	364.680	364.680	364.680
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	7.244	7.244	7.244	7.244	7.244
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	7.244	7.244	7.244	7.244	7.244
Equity, % of liabilities	29.238	26.348	23.977	21.998	20.321

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	923.23	920.00	3.23	300.00	620.00	1.13	0.80
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	923.23	920.00	3.23	300.00	620.00	1.13	0.80
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	18440.13	1143.80	17296.33	312.00	831.80	728.13	982.15
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	913.90	1083.00	-169.10	300.00	783.00	131.53	105.75
imported materials . . .	16211.00	0.00	16211.00	0.00	0.00	408.00	697.00
repayment loans & overd.	923.23	0.00	923.23	0.00	0.00	115.00	115.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	392.00	60.80	331.20	12.00	48.80	73.60	64.40
indirect costs							
net foreign exchge flow	-17516.90	-223.80	-17293.10	-12.00	-211.80	-727.00	-981.35
import substit'n effect	25705.00	0.00	25705.00	0.00	0.00	555.00	1100.00
net forgn exchge effect	8188.10	-223.80	8411.90	-12.00	-211.80	-172.00	118.65

present values at	10.00 %
foreign exchange flow .	-8230.22
net forgn exchge effect	2928.08

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	1994	1995	1996	production 1997	1998	1999	2000
total foreign inflow . .	1.29	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	1.29	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	1490.46	1323.00	1313.80	1304.60	1295.40	1286.20	1162.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	158.26	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	1162.00	1162.00	1162.00	1162.00	1162.00	1162.00	1162.00
repayment loans & overd.	115.00	115.00	115.00	115.00	115.00	115.00	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	55.20	46.00	36.80	27.60	18.40	9.20	0.00
indirect costs							
net foreign exchge flow	-1489.17	-1323.00	-1313.80	-1304.60	-1295.40	-1286.20	-1162.00
import substit'n effect	1850.00	1850.00	1850.00	1850.00	1850.00	1850.00	1850.00
net forgn exchge effect	360.83	527.00	536.20	545.40	554.60	563.80	688.00

present values at	10.00 %
foreign exchange flow .	-8230.22
net forgn exchge effect	2928.08

SHOCK ABSORBERS

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	1162.00	1162.00	1162.00	1162.00	1162.00	1162.00	-561.42
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-564.65
imported materials . . .	1162.00	1162.00	1162.00	1162.00	1162.00	1162.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	3.23
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-1162.00	-1162.00	-1162.00	-1162.00	-1162.00	-1162.00	561.42
import substit'n effect	1850.00	1850.00	1850.00	1850.00	1850.00	1850.00	0.00
net forgn exchge effect	688.00	688.00	688.00	688.00	688.00	688.00	561.42

present values at	10.00 %
foreign exchange flow .	-8230.22
net forgn exchge effect	2928.08

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE INSTALLATION OF A CONTACT SETS PRODUCING PLANT

PROJECT SF/NIR/88/001

baldo & c.
INDUSTRIAL ENGINEERS

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing s plant for manufacturing contact sets, as spare parts for the automotive sector.[1]

The envisaged facility has a nominal annual capacity of 500,000 sets, based on 250 working days/1 shift of 8 hours/day.

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 1,165,110 (US$ 635,115 in foreign currency)
- Working capital (at full production): US$ 181,160 (US$ 170,878 in foreign currency)
- Internal Rate of Return: 23.48%
- Break-Even Point (at 5th year of production) 25%
- Pay-Back Period: less than 6 years (including construction period)
- Employees: 27

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 3,825,420 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

[1] For additional background material, see Volume I p. 200.

1. INTRODUCTION

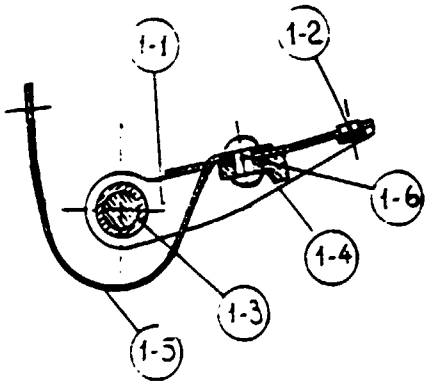
The contact set is the part of the ignition distributor mounted in a gasoline engine for providing the necessary voltage to the spark-plugs.

The set, being subjected to movements and electric sparks, deteriorates and it should be replaced as sugggested by the car manufacturer (every 10,000 km for a car). There are several types of contact sets, but, basically, they consist of similar parts, even though they have different shapes: herebelow, there is an example of the main parts of a set.

CONTACT SET
(TYPICAL)

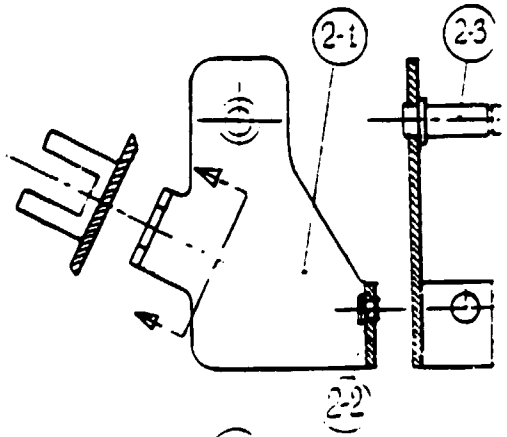
1 - ARM SUB-ASSEMBLY

1-1 STAMPED ARM
1-2 CONTACT
1-3 INSULATING BUSHING
1-4 PAD
1-5 FLAT SPRING

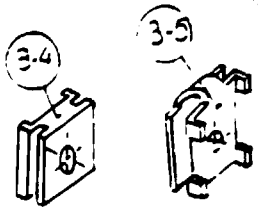


2 - SUPPORT SUB-ASSEMBLY

2-1 SUPPORT PLATE
2-2 CONTACT
2-3 BRASS PIVOT



3-4 INSULATING BLOCK
3-5 FASTENER



2. MARKET AND PLANT CAPACITY

2.1 DEMAND

Circulating cars, in 1986 were around 660,000 units. From 1986 up to now, the number should not be increased substantially considering that due to the adverse trend of economy, the demand of new cars fell dramatically. The car assembling plants reduced their production below the break-even point (Peugeot did not exceed 25% of its nominal capacity, while Volkswagen reached only the 7%).

The first consequence of this situation is the increase of the life span of a car, which, generally, is considered to be 5 years. The evaluation of the contact sets demand will be based on the following assumptions provided by N.I.D.B.:

a) circulating cars = 700,000

b) set replacement = 3 replacements per car per year = 2,100,000

2.2 SUPPLY

At present, there are no facilities in Nigeria manufacturing contact sets. The demand is satisfied by imports, mainly from far eastern countries. Their quality is usually low.

2.3 PLANT CAPACITY

The proposed plant is designed for an annual output of 500,000 contact sets. The production is based on 250 working days/year, 1 shift/day, 8 hours/shift.

2.4 SALE PRICES AND REVENUE

In the international market the price of contacts set vary according to the type of car. As an average, 2.5 US Dollars per set can be considered, at present the selling price. For Nigeria the following average selling price will be considered:

1 contact set = US $ 2

It is expected that the plant will reach its nominal capacity in the third year of operation, passing through two steps:

1st year 30%

2nd year 60%

3rd year 100%

The revenues will be as follows:

1st year	US $ 300,000
2nd year	US $ 600,000
from the 3rd to the 15th year	US $ 1,000,000

3. MATERIALS AND INPUTS

3.1 MATERIALS

Here below, the materials required for the production of the contact sets as well as the relevant costs are reported. The figures are related to 1000 sets. All materials have to be imported. The costs were obtained from various sources, among which Elettromeccanica, Milan, Italy.

Description	Unit	kg	Cost US $
Steel strip 40 x 0.5 mm		10.6	12
Tungsten contacts	2000		160
SiMo Steel strip for spring		7	17
Steel strip 1.2 mm thick		32	42
Brass bar diam. 8 mm		10	45
Insulating block	1000		30
Delrin bar diam. 10 mm		2.5	35
Bakelite profile for pad		2	40
Seeger	1000		20
Fastener	1000		40
Screw	1000	8	12
Nickel for electroplating		8	30
			483

For the production of 500,000 sets, the expenditure for raw materials will be US $ 241,500 in FC

3.2 ELECTRIC ENERGY

The installed power is 150 kW. The coefficient of utilization is 0.8. The kWh consumed in one year will be:

$$150 \times 0.6 \times 8 \times 250 = 180.000 \text{ kWh}$$

The relevant cost, considering 0.1 US$/kWh, is US$ 18,000.

3.3 COMPRESSED AIR

Compressed air is needed in small quantity. The relevant cost is already considered in the elelctric energy expenditures.

3.4 INDUSTRIAL WATER

Electroplating plant requires 15,500 m^3 of industrial water per year. The relevant cost is estimated to be US $ 100.

4. LOCATION

The plant should be located in the vicinity of the major market.

5. PROJECT ENGINEERING

5.1 PRODUCTION EQUIPMENT

All parts, with the exception of:

- contacts
- seegers
- insulating blocks

which have to be imported in finished form, can be manufactured in Nigeria, by using the equipment listed herebelow.

The production unit consists of the following sections:

A - Raw material storage

B - Storage of finished pieces, subassemblies and contact sets

C - Metal working section

D - Cleaning and electroplating section

E - Utilities (power and compressed air) station

F - Offices

The required basic equipment is the following:

Guillotine type shear

2 presses 60 T

2 presses 40 T

1 press 30 T

2 semi automatic lathes

1 small universal milling machine

1 drilling machine

3 riveting machines

3 working benches for riveting machines

2 working benches for the final assembling, testing and setting

1 electroplating system, manually operated

The above machines will be supported with special tools, designed to produce different types of contact sets.

These special tools are mainly stamps and moulds.

For the first years of production, 2 series of special tools will be envisaged.

5.2 AUXILIARY EQUIPMENT AND INSTALLATIONS

Auxiliary equipment consists mainly of electrical substation, (which includes an emergency gen-set), the compressed air equipment and the industrial water pumping station.

The installations are: the power distribution, the lighting and earthing systems, the compressed air, the industrial and drinking water networks.

5.3 TRANSPORT EQUIPMENT

The internal transport of material will be done with the help of a manual transpallet or by hand. For the external transport a pick-up is considered necessary.

5.4 LAY-OUT AND CIVIL WORKS

The plant will cover an area of 400 sq.m., subdivided as follows:

- store room: 40 sq.m.
- metal working area: 200 sq.m.
- cleaning and electroplating area: 40 sq.m.
- utilities: 40 sq.m.
- offices and services : 60 sq.m. - maintenance department: 20 sq.m.

The building will be in concrete structures and its dimensions will be 10 x 40 x 6 hm.

The roofing will be in asbestos-cement sheets, supported by a light steel structure.

The walls will be in cement blocks or clay bricks plastered both internally and externally.

The floor will be of antidust concrete slabs, allowing an overload of 1000 kg/sq. m. The floors of the offices and sanitary rooms will be in ceramic tiles.

5.5 INVESTMENT COSTS

The machinery and equipment have been quoted by ELETTROMECCANICA, Milano, Italy.

The estimated investment costs are as follows:

Description	LC US$	FC US$	Total US$
Machinery and equipment			
FOB European port	--	450,000	450,000
Transport, taxes and duties	90,000	45,000	135,000
Erection	70,000	45,000	115,000
Land & site preparation	20,000	--	20,000
Civil works and buildings	240,000	--	240,000
Spare parts	--	10,000	10,000
Total	**420,000**	**550,000**	**970,000**
Contingencies	**42,000**	**55,000**	**97,000**
Grand total	**462,000**	**605,000**	**1,067,000**

The industrial life of the plant can be considered as 15 years. US $ 13,500 can be assumed as the average annual cost of the maintenance. In the financial evaluation the investment costs, including contingencies, are subdivided as follows:

Preproduction expenditures	FC	US$	0
Preproduction expenditures	LC	US$	50,000
Machinery	FC	US$	1,083,500
Machinery	LC	US$	352,000
Land & Site preparation	LC	US$	22,000
Civil works and buildings	LC	US$	264,000
TOTAL		US$	1,771,500

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of an independent organization.

7. MANPOWER

The manpower required for the plant operation does not need special training. The supplier of technology will provide one month training to the operating personnel before the commissioning of the plant and will assist the management for the first 6 months of operation. The relevant cost is estimated at US$ 60,000.

7.1 MANAGEMENT

		N/Y
- General Manager	1	50,000
- Technical Manager	1	40,000
	2	90,000
	overheads 40%	36,000
		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPARTMENT

		N/Y
- Accountant	1	12,000
- Purchasing Department	1	12,000
- Sales Dept.	1	12,000
- Store keeper	1	12,000
- Clercks	2	10,000
	6	58,000
	overheads 40%	23,200
		81,200
		(US$ 10,300)

7.3 PRODUCTION DEPARTMENT

		N/Y
- Production Manager	1	40,000
- Shift operators	14	112,000
	15	152,000
	overheads 40%	60,800
		212,800
		(US$ 27,000)

7.4 MAINTENANCE DEPARTMENT

		N/Y
- Mechanics	1	10,000
- Electricians	1	10,000
- Helpers	2	12,000
	4	32,000
	overheads 40%	12,800
		44,800
		(US$ 5,700)

Summary

Administrative	8	US$ 26,300
Production	15	US$ 27,000
Maintenance	4	US$ 5,700
	27	US$ 59,000

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start-up the plant is in the range of 18 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 1,165,110 US Dollars. The portion in foreign currency accounts for 652,400 US Dollars.

Details of these figures are shown in chapter 5.5.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 466,750	US$ 136,000	US$ 602,750
- Foreign Loan (interest 8%)	US$ 344,250	US$ 170,000	US$ 514,250

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 30%

2nd year 60%

3rd and subsequent years 100%

When the plant is in full production, the required working capital amounts to 181,160 US Dollars, the foreign portion being US$ 170,878.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 73,200.

9.1.4 Total production costs

The total production costs vary according to the plant output, interest and depreciation. The first year of operation, when the plant operates at 30% of its nominal capacity, the production costs amount to US$ 347,770.

In the third year, at full production, the costs amount to US $ 466,455, then they start a slight decrease year after year, to reach a constant amount of US $ 332,100 from the 11th to 15th year.

9.1.5 Sales revenue

When the plant is in full production, the revenue is US $ 1,000,000. As said before, the production programme foresees that full production is reached gradually:

1st year 30% : revenue = US$ 300,000

2nd year 60% : revenue = US$ 600,000

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 23.48%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 25%

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 4 years, including the construction period.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 3,825,420.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 3,825,420.

ANNEXE 1

COMFAR SCHEDULES

CONTACT SETS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000US$

Total initial investment during construction phase

fixed assets:	1165.11	56.056 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1165.11	56.056 % foreign

Source of funds during construction phase

equity & grants:	602.75	0.000 % foreign
foreign loans :	514.25	
local loans :	0.00	
total funds :	1117.00	46.038 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	200.93	332.10	332.10
depreciation :	105.70	101.30	13.20
interest :	41.14	20.57	0.00
production costs	347.77	453.97	345.30
thereof foreign	68.17 %	73.26 %	72.84 %
total sales :	300.00	1000.00	1000.00
gross income :	-47.77	546.03	654.70
net income :	-47.77	327.62	392.82
cash balance :	-79.55	364.64	406.02
net cashflow :	25.87	449.49	406.02

Net Present Value at: 10.00 % = 1455.61
Internal Rate of Return: 23.48 %
Return on equity1: 28.65 %
Return on equity2: 29.10 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	22.000	0.000
Buildings and civil works	264.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment	505.000	276.000
Total fixed investment costs	791.000	276.000
Pre-production capital expenditures.	33.770	64.340
Net working capital	0.000	0.000
Total initial investment costs	824.770	340.340
Of it foreign, in %	50.774	68.855

Total Current Investment in 1000US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	73.200	38.745	69.215
Total current investment costs	73.200	38.745	69.215
Of it foreign, %	88.019	98.328	98.752

Total Production Costs in 1000US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	30.000	60.000	100.000	100.000	100.000
Raw material 1	72.450	144.900	241.500	241.500	241.500
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	5.430	10.860	18.100	18.100	18.100
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	27.000	27.000	27.000	27.000	27.000
Repair, maintenance	1.050	2.100	3.500	3.500	3.500
Spares	3.000	6.000	10.000	10.000	10.000
Factory overheads	60.000	0.000	0.000	0.000	0.000
Factory costs	168.930	190.860	300.100	300.100	300.100
Administrative overheads	32.000	32.000	32.000	32.000	32.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	105.700	105.700	103.500	101.300	101.300
Financial costs	41.140	35.998	30.855	25.712	20.570
Total production costs	347.770	364.557	466.455	459.113	453.970
Costs per unit (single product)	2.318	1.215	0.933	0.918	0.908
Of it foreign, %	68.174	67.862	73.502	73.558	73.258
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	59.000	59.000	59.000	59.000	59.000

Total Production Costs in 1000US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	100.000	100.000	100.000	100.000	100.000
Raw material 1	241.500	241.500	241.500	241.500	241.500
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	18.100	18.100	18.100	18.100	18.100
Energy	0.000	0.000	0.000	0.000	0.000
Labour, direct	27.000	27.000	27.000	27.000	27.000
Repair, maintenance	3.500	3.500	3.500	3.500	3.500
Spares	10.000	10.000	10.000	10.000	10.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	300.100	300.100	300.100	300.100	300.100
Administrative overheads	32.000	32.000	32.000	32.000	32.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	91.300	91.300	91.300	91.300	13.200
Financial costs	15.427	10.285	5.142	0.000	0.000
Total production costs	438.828	433.685	428.543	423.400	345.300
Costs per unit (single product)	0.878	0.867	0.857	0.847	0.691
Of it foreign, %	74.614	74.313	74.005	73.689	72.835
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	59.000	59.000	59.000	59.000	59.000

Total Production Costs in 1000US$

Year	2002- 6
% of nom. capacity (single product).	100.000
Raw material 1	241.500
Other raw materials	0.000
Utilities	18.100
Energy	0.000
Labour, direct	27.000
Repair, maintenance	3.500
Spares	10.000
Factory overheads	0.000
Factory costs	300.100
Administrative overheads	32.000
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	332.100
Costs per unit (single product)	0.664
Of it foreign, %	75.730
Of it variable,%	0.000
Total labour	59.000

Net Working Capital in 1000US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	16.744	18.572	27.675	27.675
Inventory and materials	168	2.1	36.240	72.480	120.800	120.800
Energy	0	---	0.000	0.000	0.000	0.000
Spares	180	2.0	1.500	3.000	5.000	5.000
Work in progress	5	72.0	2.346	2.651	4.168	4.168
Finished products	30	12.0	16.744	18.572	27.675	27.675
Cash in hand	3	104.1	2.792	0.420	0.590	0.590
Total current assets			76.366	115.694	185.909	185.909
Current liabilities and						
Accounts payable	6	62.1	3.166	3.749	4.749	4.749
Net working capital			73.200	111.945	181.160	181.160
Increase in working capital			73.200	38.745	69.215	0.000
Net working capital, local			8.770	9.418	10.282	10.282
Net working capital, foreign			64.430	102.527	170.878	170.878

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000US$

Year	1990	1991
Equity, ordinary ..	466.750	136.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	344.250	170.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	0.000
Total loan	344.250	170.000
Current liabilities	0.000	0.000
Bank overdraft	13.770	34.340
Total funds	826.770	340.340

Source of Finance, production in 1000US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-64.281	-64.281	-64.281	-64.281
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-64.281	-64.281	-64.281	-64.281
Current liabilities	3.166	0.583	0.999	0.000
Bank overdraft	79.552	-127.661	0.000	0.000
Total funds	18.437	-191.360	-63.282	-64.281

Cashflow Tables, construction in 1000US$

Year	1990	1991
Total cash inflow . .	811.000	306.000
Financial resources .	811.000	306.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	824.770	340.340
Total assets	811.000	306.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	13.770	34.340
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-13.770	-34.340
Cumulated cash balance	-13.770	-48.110
Inflow, local	466.750	136.000
Outflow, local	406.000	106.000
Surplus (deficit) .	60.750	30.000
Inflow, foreign . . .	344.250	170.000
Outflow, foreign . . .	418.770	234.340
Surplus (deficit) .	-74.520	-64.340
Net cashflow	-811.000	-306.000
Cumulated net cashflow	-811.000	-1117.000

Cashflow tables, production in 1000US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow . .	303.166	600.583	1000.999	1000.000	1000.000	1000.000
Financial resources .	3.166	0.583	0.999	0.000	0.000	0.000
Sales, net of tax . .	300.000	600.000	1000.000	1000.000	1000.000	1000.000
Total cash outflow . .	382.718	456.643	710.869	638.449	635.363	636.278
Total assets	76.366	39.328	70.215	0.000	0.000	0.000
Operating costs . . .	200.930	222.860	332.100	332.100	332.100	332.100
Cost of finance . . .	41.140	35.998	30.855	25.712	20.570	15.427
Repayment	64.281	64.281	64.281	64.281	64.281	64.281
Corporate tax . . .	0.000	94.177	213.418	216.355	218.412	224.469
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-79.551	143.940	290.131	361.551	364.637	363.722
Cumulated cash balance	-127.661	16.278	306.409	667.960	1032.597	1396.319
Inflow, local	302.790	600.540	1000.720	1000.000	1000.000	1000.000
Outflow, local	77.040	167.325	295.602	296.955	299.012	305.069
Surplus (deficit) .	225.750	433.215	705.118	703.045	700.988	694.931
Inflow, foreign . . .	0.376	0.043	0.279	0.000	0.000	0.000
Outflow, foreign . . .	305.677	289.318	415.267	341.494	336.351	331.209
Surplus (deficit) .	-305.301	-289.275	-414.987	-341.494	-336.351	-331.209
Net cashflow	25.870	244.218	385.267	451.545	449.488	443.431
Cumulated net cashflow	-1091.130	-846.912	-461.645	-10.100	439.388	882.819

CONTACT SETS --- OCTOBER 1990

Cashflow tables, production in 1000US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow . .	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000
Financial resources .	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax . .	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000
Total cash outflow . .	633.192	630.107	562.740	593.980	599.260	599.260
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs . . .	332.100	332.100	332.100	332.100	332.100	332.100
Cost of finance . . .	10.285	5.142	0.000	0.000	0.000	0.000
Repayment	64.281	64.281	0.000	0.000	0.000	0.000
Corporate tax . . .	226.526	228.583	230.640	261.880	267.160	267.160
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	366.808	369.893	437.260	406.020	400.740	400.740
Cumulated cash balance	1763.127	2133.020	2570.280	2976.300	3377.040	3777.780
Inflow, local	1000.000	1000.000	1000.000	1000.000	1000.000	1000.000
Outflow, local	307.126	309.183	311.240	342.480	347.760	347.760
Surplus (deficit) .	692.874	690.817	688.760	657.520	652.240	652.240
Inflow, foreign . . .	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign . . .	326.066	320.924	251.500	251.500	251.500	251.500
Surplus (deficit) .	-326.066	-320.924	-251.500	-251.500	-251.500	-251.500

Net cashflow	441.374	439.317	437.260	406.020	400.740	400.740
Cumulated net cashflow	1324.193	1763.510	2200.771	2606.791	3007.531	3408.271

Cashflow tables, production in 1000US$

Year	2004	2005	2006
Total cash inflow	1000.000	1000.000	1000.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	1000.000	1000.000	1000.000
Total cash outflow	599.260	599.260	599.260
Total assets	0.000	0.000	0.000
Operating costs	332.100	332.100	332.100
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	267.160	267.160	267.160
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	400.740	400.740	400.740
Cumulated cash balance	4178.521	4579.261	4980.001
Inflow, local	1000.000	1000.000	1000.000
Outflow, local	347.760	347.760	347.760
Surplus (deficit)	652.240	652.240	652.240
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	251.500	251.500	251.500
Surplus (deficit)	-251.500	-251.500	-251.500
Net cashflow	400.740	400.740	400.740
Cumulated net cashflow	3809.010	4209.750	4610.491

Cashflow Discounting:

a) Equity paid versus Net income flow:
Net present value ..... 1361.57 at 10.00 %
Internal Rate of Return (IRRE1) .. 28.65 %
b) Net Worth versus Net cash return:
Net present value ..... 1518.05 at 10.00 %
Internal Rate of Return (IRRE2) .. 29.10 %
c) Internal Rate of Return on total investment:
Net present value ..... 1455.61 at 10.00 %
Internal Rate of Return (IRR) .. 23.48 %
Net Worth = Equity paid plus reserves

Net Income Statement in 1000US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	300.000	600.000	1000.000	1000.000	1000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	300.000	600.000	1000.000	1000.000	1000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	306.630	328.560	435.600	433.400	433.400
Operational margin	-6.630	271.440	564.400	566.600	566.600
As % of total sales	-2.210	45.240	56.440	56.660	56.660
Cost of finance	41.140	35.998	30.855	25.712	20.570
Gross profit	-47.770	235.443	533.545	540.888	546.030
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	-47.770	235.443	533.545	540.888	546.030
Tax	0.000	94.177	213.418	216.355	218.412
Net profit	-47.770	141.266	320.127	324.533	327.618
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-47.770	141.266	320.127	324.533	327.618
Accumulated undistributed profit	-47.770	93.495	413.622	738.155	1065.773
Gross profit, % of total sales	-15.923	39.240	53.354	54.089	54.603
Net profit, % of total sales	-15.923	23.544	32.013	32.453	32.762
ROE, Net profit, % of equity	-7.925	23.437	53.111	53.842	54.354
ROI, Net profit+interest, % of invest.	-0.557	14.424	27.037	26.980	26.822

Net Income Statement in 1000US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	1000.000	1000.000	1000.000	1000.000	1000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1000.000	1000.000	1000.000	1000.000	1000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	423.400	423.400	423.400	423.400	345.300
Operational margin	576.600	576.600	576.600	576.600	654.700
As % of total sales	57.660	57.660	57.660	57.660	65.470
Cost of finance	15.427	10.285	5.142	0.000	0.000
Gross profit	561.172	566.315	571.458	576.600	654.700
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	561.172	566.315	571.458	576.600	654.700
Tax	224.469	226.526	228.583	230.640	261.880
Net profit	336.703	339.789	342.875	345.960	392.820
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	336.703	339.789	342.875	345.960	392.820
Accumulated undistributed profit	1402.477	1742.266	2085.140	2431.100	2823.920
Gross profit, % of total sales	56.117	56.632	57.146	57.660	65.470
Net profit, % of total sales	33.670	33.979	34.287	34.596	39.282
ROE, Net profit, % of equity	55.861	56.373	56.885	57.397	65.171
ROI, Net profit+interest, % of invest.	27.125	26.967	26.808	26.650	30.260

Net Income Statement in 1000US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	1000.000	1000.000	1000.000	1000.000	1000.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	1000.000	1000.000	1000.000	1000.000	1000.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	332.100	332.100	332.100	332.100	332.100
Operational margin	667.900	667.900	667.900	667.900	667.900
As % of total sales	66.790	66.790	66.790	66.790	66.790
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	667.900	667.900	667.900	667.900	667.900
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	667.900	667.900	667.900	667.900	667.900
Tax	267.160	267.160	267.160	267.160	267.160
Net profit	400.740	400.740	400.740	400.740	400.740
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	400.740	400.740	400.740	400.740	400.740
Accumulated undistributed profit	3224.660	3625.400	4026.140	4426.880	4827.621
Gross profit, % of total sales	66.790	66.790	66.790	66.790	66.790
Net profit, % of total sales	40.074	40.074	40.074	40.074	40.074
ROE, Net profit, % of equity	66.485	66.485	66.485	66.485	66.485
ROI, Net profit+interest, % of invest.	30.870	30.870	30.870	30.870	30.870

Projected Balance Sheets, construction in 1000US$

Year	1990	1991
Total assets	824.770	1165.110
Fixed assets, net of depreciation	0.000	824.770
Construction in progress	824.770	340.340
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	824.770	1165.110
Equity capital	466.750	602.750
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	344.250	514.250
Current liabilities	0.000	0.000
Bank overdraft, finance required.	13.770	48.110
Total debt	358.020	562.360
Equity, % of liabilities	56.592	51.733

Projected Balance Sheets, Production in 1000US$

Year	1992	1993	1994	1995	1996
Total assets	1183.547	1133.452	1342.527	1602.779	1866.115
Fixed assets, net of depreciation	1059.410	953.710	850.210	748.910	647.610
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	73.575	115.274	185.318	185.318	185.318
Cash, bank	2.792	0.420	0.590	0.590	0.590
Cash surplus, finance available	0.000	16.278	306.409	667.960	1032.597
Loss carried forward	0.000	47.770	0.000	0.000	0.000
Loss	47.770	0.000	0.000	0.000	0.000
Total liabilities	1183.547	1133.452	1342.527	1602.779	1866.115
Equity capital	602.750	602.750	602.750	602.750	602.750
Reserves, retained profit	0.000	0.000	93.495	413.622	738.155
Profit	0.000	141.266	320.127	324.533	327.618
Long and medium term debt	449.969	385.688	321.406	257.125	192.844
Current liabilities	3.166	3.749	4.749	4.749	4.749
Bank overdraft, finance required.	127.661	0.000	0.000	0.000	0.000
Total debt	580.797	389.437	326.155	261.874	197.592
Equity, % of liabilities	50.927	53.178	44.897	37.607	32.300

Projected Balance Sheets. Production in 1000US$

Year	1997	1998	1999	2000	2001
Total assets	2138.538	2414.045	2692.639	3038.599	3431.419
Fixed assets, net of depreciation	556.310	465.010	373.710	282.410	269.210
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	185.318	185.318	185.318	185.318	185.318
Cash, bank	0.590	0.590	0.590	0.590	0.590
Cash surplus, finance available	1396.319	1763.127	2133.020	2570.280	2976.300
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	2138.538	2414.045	2692.639	3038.599	3431.419
Equity capital	602.750	602.750	602.750	602.750	602.750
Reserves, retained profit	1065.773	1402.477	1742.266	2085.140	2431.100
Profit	336.703	339.789	342.875	345.960	392.820
Long and medium term debt	128.563	64.281	0.000	0.000	0.000
Current liabilities	4.749	4.749	4.749	4.749	4.749
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	133.311	69.030	4.749	4.749	4.749
Equity, % of liabilities	28.185	24.968	22.385	19.836	17.566

Projected Balance Sheets, Production in 1000US$

Year	2002	2003	2004	2005	2006
Total assets	3832.159	4232.899	4633.639	5034.379	5435.119
Fixed assets, net of depreciation	269.210	269.210	269.210	269.210	269.210
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	185.318	185.318	185.318	185.318	185.318
Cash, bank	0.590	0.590	0.590	0.590	0.590
Cash surplus, finance available	3377.040	3777.780	4178.521	4579.260	4980.000
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	3832.159	4232.899	4633.639	5034.379	5435.119
Equity capital	602.750	602.750	602.750	602.750	602.750
Reserves, retained profit	2823.920	3224.660	3625.400	4026.140	4426.880
Profit	400.740	400.740	400.740	400.740	400.740
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	4.749	4.749	4.749	4.749	4.749
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	4.749	4.749	4.749	4.749	4.749
Equity, % of liabilities	15.729	14.240	13.008	11.973	11.090

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000US$
Economic Analysis including indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	514.95	514.25	0.70	344.25	170.00	0.38	0.04
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	514.95	514.25	0.70	344.25	170.00	0.38	0.04
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total foreign outflow .	4800.43	653.11	4147.32	418.77	234.34	305.68	289.32
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	496.39	605.00	-108.61	405.00	200.00	64.81	38.14
imported materials . . .	3555.85	0.00	3555.85	0.00	0.00	135.45	150.90
repayment loans & overd.	514.95	0.00	514.95	0.00	0.00	64.28	64.28
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	233.24	48.11	185.13	13.77	34.34	41.14	36.00
indirect costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net foreign exchge flow	-4285.48	-138.86	-4146.62	-74.52	-64.34	-305.30	-289.28
import substit'n effect	13900.00	0.00	13900.00	0.00	0.00	300.00	600.00
net forgn exchge effect	9614.52	-138.86	9753.38	-74.52	-64.34	-5.30	310.72

present values at	10.00 %
foreign exchange flow .	-2210.16
net forgn exchge effect	3825.42

Foreign Exchange Effect in 1000US$
Economic Analysis including indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	0.28	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.28	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total foreign outflow .	415.27	341.49	336.35	331.21	326.07	320.92	251.50
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	68.63	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	251.50	251.50	251.50	251.50	251.50	251.50	251.50
repayment loans & overd.	64.28	64.28	64.28	64.28	64.28	64.28	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	30.85	25.71	20.57	15.43	10.28	5.14	0.00
indirect costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net foreign exchge flow	-414.99	-341.49	-336.35	-331.21	-326.07	-320.92	-251.50
import substit'n effect	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00
net forgn exchge effect	585.01	658.51	663.65	668.79	673.93	679.08	748.50

present values at	10.00 %
foreign exchange flow .	-2210.16
net forgn exchge effect	3825.42

CONTACT SETS

Foreign Exchange Effect in 1000US$
Economic Analysis including indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects	0.00	0.00	0.00	0.00	0.00	0.00	0.00
total foreign outflow .	251.50	251.50	251.50	251.50	251.50	251.50	-279.49
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-280.19
imported materials . . .	251.50	251.50	251.50	251.50	251.50	251.50	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.70
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net foreign exchge flow	-251.50	-251.50	-251.50	-251.50	-251.50	-251.50	279.49
import substit'n effect	1000.00	1000.00	1000.00	1000.00	1000.00	1000.00	0.00
net forgn exchge effect	748.50	748.50	748.50	748.50	748.50	748.50	279.49

present values at	10.00 %
foreign exchange flow .	-2210.16
net forgn exchge effect	3825.42

CONTACT SETS

U.N.I.D.O.

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

N.I.D.B.

NIGERIAN INDUSTRIAL DEVELOPMENT BANK

OPPORTUNITY STUDY FOR THE INSTALLATION OF A DOMESTIC PUMPS ASSEMBLING PLANT IN NIGERIA

PROJECT SF/NIR/88/001

baldo & c.

TABLE OF CONTENT

0. SUMMARY AND CONCLUSIONS

This study analyses the opportunity of installing a plant for the assembling of domestic water pumps.

The envisaged unit has a nominal annual capacity of assembling 50,000 pumps : 25,000 having a flow rate of 50 litres/minute at 25 mHead (pump 81); 25,000 having a flow rate of 50 litres/minute at 28,5 mHead (pump 100) designed and manufactured by DAB, Padua, Italy.(1)

The financial analysis of such a project was carried out.

Details are given in chapter 9.

The salient data of the project are as follows:

- Fixed assets: US$ 1,974,400 (US$ 987,000 in foreign currency)
- Working capital (at full production): US$ 1,058,420 (US$ 1,045,500 in foreign currency)
- Internal Rate of Return: 30.28%
- Break-Even Point (at 5th year of production) 16%
- Pay-Back Period: less than 5 years (including construction period)
- Employees: 33

The evaluation of the foreign exchange effect was also carried out.

It shows a saving of US$ 9,379,160 (as present value at 10%).

On the basis of the analysis in this study it is recommended that a feasibility study be undertaken.

(1) For additional background material, see Volume I p. 201.

1. INTRODUCTION

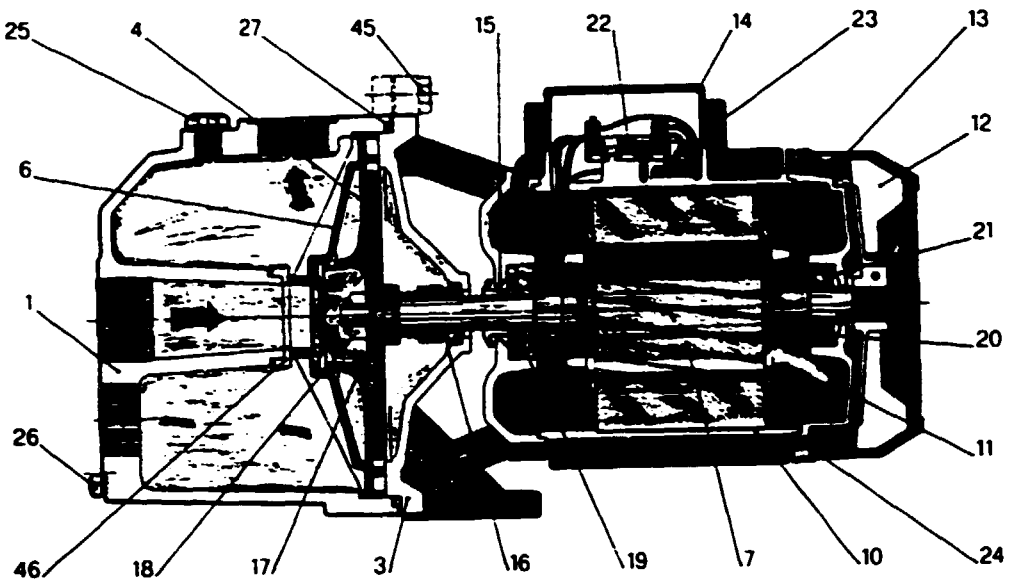
Domestic pumps are hydraulic machines widely used in Nigeria for the distribution of water in dwellings, for pumping water from wells and for raising the pressure provided by the main regular flow.

The pumps which are considered in this project are horizontal centrifugal self priming types and their main features are:

- body and support in cast iron
- impeller, diffusor, ventury and nozzle in TECHNOPOLYMER A
- shaft in chrome stainless steel
- high quality mechanical seal
- rotor supported by ball bearings
- single phase electrical motor (0.59 kW and 0.74 kW), IP44 protection, windings in class F, capacitor permanently built in

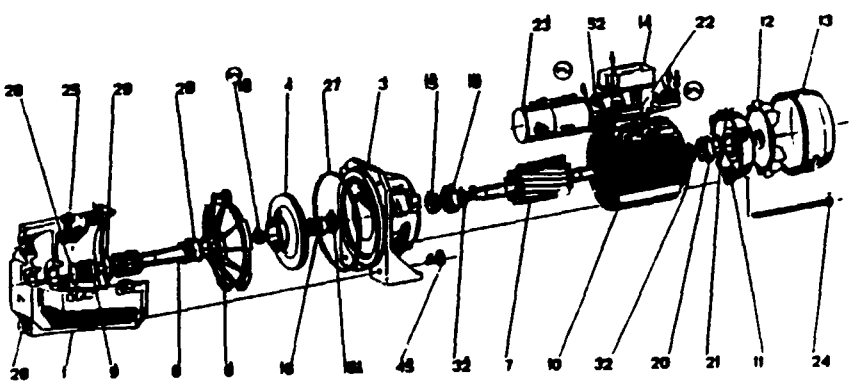
	Delivery (Q in litres/minute)							
	0	5	10	15	20	30	40	50
	Manometric lift (in metres)							
. pumps type 81	50	46	42.5	39	36	30	20	25
. pump type 100	53	50	47.5	44.5	42	37	32.5	28.5

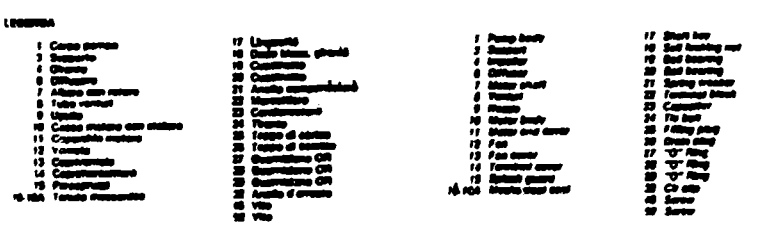
Here below the section view and the exploded drawing showing all the parts of the pump are included.



DP 80-100

1 Pump body
2 Ejector body
3 Support
4 Impeller
6 Diffusor
7 Motor shaft
8 Venturi
9 Nozzle
10 Motor body
11 Motor end cover
12 Fan
13 Fan cover
14 Terminal cover
15 Splash guard
16 Mechanical seal
17 Shaft key
18 Self locking nut
19 Ball bearing
20 Ball bearing
21 Spring washer
22 Terminal block
23 Capacitor
24 Tie bolt
25 Filling plug
26 Drain plug
27 "O" Ring
30 Impeller space
45 Screw
46 Seal





2. MARKET AND PLANT CAPACITY

The pumps object of this study are suitable to be employed for raising water for domestic, agricultural and industrial uses. They are commonly used to pump water from artesian wells.

2.1 DEMAND AND SUPPLY

According to the data supplied by N.I.D.B., the demand of this kind of pumps exceeds 300,000 units per year.

The demand is satisfied by imports. The sources of suppliers are from Italy, Spain and Germany.

2.2 PLANT CAPACITY

The proposed plant is designed for the assembling, annually, 25,000 units of pumps type 81 and 25,000 units of pumps type 100, imported in CKD. This production is based on 250 working days/year, 1 shift/day, 8 hours/shift. This is the first step of a programme which foresees, for the future, the local production of almost all the parts of the pumps.

In the second phase, the engineering industries in Nigeria (like foundries and electro-mechanical workshops) will be able to supply parts and sub-assemblies, including the electric motor. This requires capital investment in modern automatic machines tools, and can be implemented when the 1st phase has reached the goal in penetrating a large segment of the market.

2.3 SALE PRICE AND REVENUE

At the present, these pumps are sold in Nigeria at US$ 115 and US$ 135 respectively. The following ex-works selling prices will be assumed:

Pump type 81	US $ 90
Pump type 100	US $ 100

It is expected that the plant will reach its nominal output in the 3rd year of operation, passing through two steps. The revenue will be as follows:

1st year (60%)	US$ 2,850,000
2nd year (80%)	US$ 3,800,000
3rd year (100%)	US$ 4,750,000

3. MATERIALS AND INPUTS

3.1 MATERIALS

The various components are shown under chapter 1.

The relevant costs are as follows:

Pump type 81 25,000 x 56 =	US $ 1,400,000
Pump type 100 25,000 x 65 =	US $ 1,625,000
For a total of	US $ 3,025,000

3.2 ELECTRIC ENERGY

The installed power is 50 kW

The coefficient of utilization is 0.6

The kWh consumed in 1 year will be

$$50 \times 0.6 \times 250 \times 8 = 60{,}000 \text{ kWh}$$

The relevant cost considering 0.1 US $/kWh is US $ 6,000.

3.3 COMPRESSED AIR

The compressed air is needed in small quantity for the operating of pneumatic tools and for other services.

The relevant cost is already considered in the electric energy expenditures.

3.4 INDUSTRIAL WATER

Industrial water is needed for the testing of the pumps. The quantity required is negligible.

4. LOCATION

The plant should be located in an industrial area in order to have the possibility to utilize the services needed.

5. PROJECT ENGINEERING

5.1 PRODUCTION EQUIPMENT

The production equipment will consist mainly of:

- 15 assembly benches equipped with pneumatic and normal tools
- 1 machine for the bearings mounting
- 1 pump testing unit
- 2 electric motors testing units
- 1 painting unit

It is worth mentioning that by adding other minor equipment it will be possible to assemble other types of pumps whose demand, at present, is not considered important.

5.2 ANCILLARY EQUIPMENT

The ancillary equipment consists of:

- containers
- store shelves
- packaging equipment
- others

5.3 AUXILIARY EQUIPMENT AND INSTALLATIONS

Auxiliary equipment consists mainly of electrical substation (which includes an emergency gen-set), the compressed air equipment and the industrial pumping station.

The installations are:

- the power distribution
- the lighting and earthing systems
- the compressed air
- the industrial and drinking water networks

5.4 TRANSPORT EQUIPMENT

The internal transport of material will be done with the help of manual trans-pallets or by hand.

For the external transport a pick-up is considered necessary.

5.5 LAY-OUT AND CIVIL WORKS

The plant will cover an area of about 1,600 sq. meters subdivided as follows:

- assembly and finishing areas	600 sq. mts
- intermediate store areas	200 " "
- CKD store-room	300 " "
- finished product store-room	300 " "
- utilities room	50 " "
- offices and social services	150 " "

The building will be in concrete structures and its dimensions will be 40 x 40 x 6h.

The roofing will be in asbestos cement sheets supported by a light steel structure.

The walls will be in cement blocks or clay bricks, plastered both internally and externally. The floor will be of antidust concrete slabs, allowing an overload of 1000 Kgs/sq.mt.

The floors of the offices and sanitary rooms will be in ceramic tiles.

5.6 INVESTMENT COSTS

The machinery and equipment have been quoted by InterDAB, Padua, Italy.

The investment costs are estimated as follows:

Description	LC	FC	Total
Machinery and equipment FOB European Port	--	500,000	500,000
Transport, taxes and duties	100,000	50,000	150,000
Erection	50,000	280,000	330,000
Land and site preparation	50,000	--	50,000
Civil works and buildings	640,000	--	640,000
Spare parts	--	10,000	10,000
Total	**840,000**	**840,000**	**1,680,000**
Contingencies 10%	**84,000**	**84,000**	**168,000**
Grand total	**924,000**	**924,000**	**1,848,000**

The industrial life of the plant can be considered as 15 years.

The annual expenditures for maintenance are estimated at US $ 10,000.

In the financial evaluation the investment costs, including contingencies are so sub-divided:

Preproduction expenditures	FC	US$ 25,000
Preproduction expenditures	LC	US$ 50,000
Machinery	FC	US$ 924,000
Machinery	LC	US$ 165,000
Land and site preparation	LC	US$ 55,000
Civil work and building	LC	US$ 704,000

TOTAL		US$ 1,923,000

6. PLANT ORGANIZATION

The plant is considered an autonomous unit, complete with utilities and facilities, operating under the direction of na independent organization.

7. MAN-POWER

The man-power required for the plant operation does not need special training. It is anyway recommended that at least 5 persons attend a 15 days training course within the premises of the supplier.

The relevant cost is estimated at US $ 25,000.

Moreover, a technical assistance provided by one expert made available by InterDAB for 6 months after the start-up is suggested. The relevant cost is estimated at 100,000 US Dollars.

7.1 MANAGEMENT

		Salary (Naira/year)
General manager	1	50,000
Technical manager	1	40,000
	2	90,000
	Overheads 40%	36,000
		126,000
		(US$ 16,000)

7.2 ADMINISTRATIVE DEPT.

		Salary (Naira/year)
Accountant	1	12,000
Purchasing Dept.	1	12,000
Sales dept.	1	12,000
Store keeper	1	12,000
Clerks	2	10,000
	6	58,000
	Overheads 40%	23,200
		81,200
		(US$ 10,300)

7.3 PRODUCTION DEPT.

		Salary (Naira/year)
Production manager	1	40,000
Shift operators	20	160,000
	21	200,000
	Overheads 40%	80,000
		280,000
		(US$ 35,500)

7.4 MAINTENANCE DEPT.

		Salary (Naira/year)
Mechanics	1	10,000
Electrician	1	10,000
Helpers	2	12,000
	4	32,000
	Overheads 40%	12,800
		44,800
		(US$ 5,700)

Summary

Administrative	8	US$ 26,300
Production	21	US$ 35,500
Maintenance	4	US$ 5,700
	33	US$ 67,500

8. IMPLEMENTATION SCHEDULE

The time needed to design, build and start-up the plant is in the range of 18 months.

9. FINANCIAL EVALUATION

The financial evaluation was carried out by means of the COMFAR, whose schedules are enclosed as Annexe 1.

In addition to the coefficients and parameters indicated in the foreword, the following was considered:

9.1 INPUTS

9.1.1 Investment costs

The total investment costs amount to 1,974,400 US Dollars. The portion in foreign currency accounts for 987,000 US Dollars.

Details of these figures are shown in chapter 5.6.

9.1.2 Source of finance

The financing was assumed as follows:

	1st disbursement	2nd disbursement	Total
- Equity	US$ 675,000	US$ 463,000	US$ 1,138,000
- Foreign Loan (interest 8%)	US$ 250,000	US$ 535,000	US$ 785,000

- Bank overdraft: (interest 15%) : It has been introduced in the input data to cover the interests to be paid during the construction period and calculated by the COMFAR. It can be used to cover part of the working capital before the plant starts the production.

9.1.3 Working capital

The working capital is proportional to the production programme, which, according to the assumptions, is as follows:

1st year 60%

2nd year 80%

3rd year 100%

When the plant is in full production, the required working capital amounts to 1,058,423 US Dollars in foreign currency.

It is worth mentioning that raw materials shall be available just before the commissioning and start-up of the plant. This means that a portion of the working capital (say for the first year of operation) shall be available at least 6 months before the plant starts to produce.

The necessary sum is US$ 663,082.

9.1.4 Total production costs

The total production costs vary according to the plant output, interests and depreciation. The first year of operation, when the plant operates at 60% of its nominal capacity, the production costs amount to US$ 2,237,280. In the third year, at full production, the costs amount to US$ 3,330,480, then they start a sllight decrease year after year to reach a constant amount of US $ 3,108,000 from the 11th to the 15th year.

9.1.5 Sales revenue

When the plant operates at full capacity the revenue is US$ 4,750,000.

As said before, the production programme foresees that full production is reached gradually:

1st year 60% : revenue = US$ 2,850,000

2nd year 80% : revenue = US$ 3,800,000.

9.2 EVALUATION RESULTS

9.2.1 Internal Rate of Return

The internal Rate of Return is: 30.28%.

9.2.2 Break-Even Point

The Break-Even Point at 5th year is: 16% of production.

It has been calculated according to the formula

$$\frac{\text{fixed costs}}{\text{revenue - variable costs}}$$

The fixed costs include: labour (direct [1] + administrative), depreciation and financial costs.

9.2.3 Pay-back Period

The pay-back period is less than 5 years, including the construction period.

[1] Direct labour is considered as a fixed cost, due to the necessity to have well trained people for the operation of the plant, regardless of capacity utilization.

10. FOREIGN EXCHANGE EFFECT

The evaluation of the foreign exchange effect is shown in Annexe 2.

All the figures used in the computation as "inflows" and "outflows" correspond to the inputs given to the COMFAR for the same items.

The yearly imported quantities and value have been assumed equal to the production programme.

While the foreign exchange flow results negative, the net foreign exchange effect is positive.

By discounting the annual net foreign exchange effect at the rate of 10% the calculation shows a net foreign exchange effect amounting to US$ 9,379,160.

Hence, the amount of foreign exchange earned and saved by implementing this project is such that after having repaid the foreign loan and related interests, there is still a surplus which in term of present value amounts to US$ 9,379,160.

ANNEXE 1

COMFAR SCHEDULES

DOMESTIC PUMPS
OCTOBER 1990
OPPORTUNITY STUDY - FINAL ISSUE

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: 1000 US$

Total initial investment during construction phase

fixed assets:	1974.40	50.669 % foreign
current assets:	0.00	0.000 % foreign
total assets:	1974.40	50.669 % foreign

Source of funds during construction phase

equity & grants:	1138.00	0.000 % foreign
foreign loans :	785.00	
local loans :	0.00	
total funds :	1923.00	40.822 % foreign

Cashflow from operations

Year:	1	5	10
operating costs:	1994.10	3108.50	3108.50
depreciation :	180.38	169.38	35.20
interest :	62.80	31.40	0.00
production costs	2237.28	3309.28	3143.70
thereof foreign	93.44 %	95.76 %	96.38 %
total sales :	2850.00	4750.00	4750.00
gross income :	612.72	1440.72	1606.30
net income :	367.63	864.43	963.78
cash balance :	-213.20	935.69	998.98
net cashflow :	-52.27	1065.21	998.98

Net Present Value at: 10.00 % = 4249.80
Internal Rate of Return: 30.28 %
Return on equity1: 44.55 %
Return on equity2: 36.02 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Total Initial Investment in 1000 US$

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	55.000	0.000
Buildings and civil works	500.000	204.000
Auxiliary and service facilities .	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant machinery and equipment . . .	350.000	739.000
Total fixed investment costs	905.000	943.000
Pre-production capital expenditures.	30.000	96.400
Net working capital	0.000	0.000
Total initial investment costs . . .	935.000	1039.400
Of it foreign, in %	33.155	66.423

Total Current Investment in 1000 US$

Year	1992	1993	1994
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	663.082	248.703	146.648
Total current investment costs	663.082	248.703	146.648
Of it foreign, %	98.134	99.896	99.823

Total Production Costs in 1000 US$

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	1815.000	2600.000	3025.000	3025.000	3025.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	0.000	0.000	0.000	0.000	0.000
Energy	3.600	4.800	6.000	6.000	6.000
Labour, direct	35.500	35.500	35.500	35.500	35.500
Repair, maintenance	3.000	4.000	5.000	5.000	5.000
Spares	5.000	5.000	5.000	5.000	5.000
Factory overheads	100.000	0.000	0.000	0.000	0.000
Factory costs	1962.100	2649.300	3076.500	3076.500	3076.500
Administrative overheads	32.000	32.000	32.000	32.000	32.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	180.380	180.380	174.880	169.380	169.380
Financial costs	62.800	54.950	47.100	39.250	31.400
Total production costs	2237.280	2916.630	3330.480	3317.130	3309.280
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	93.438	94.891	95.625	95.773	95.763
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	67.500	67.500	67.500	67.500	67.500

Total Production Costs in 1000 US$

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	3025.000	3025.000	3025.000	3025.000	3025.000
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	0.000	0.000	0.000	0.000	0.000
Energy	6.000	6.000	6.000	6.000	6.000
Labour, direct	35.500	35.500	35.500	35.500	35.500
Repair, maintenance	5.000	5.000	5.000	5.000	5.000
Spares	5.000	5.000	5.000	5.000	5.000
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	3076.500	3076.500	3076.500	3076.500	3076.500
Administrative overheads	32.000	32.000	32.000	32.000	32.000
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	144.100	144.100	144.100	144.100	35.200
Financial costs	23.550	15.700	7.850	0.000	0.000
Total production costs	3276.150	3268.300	3260.450	3252.600	3143.700
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	96.026	96.016	96.007	95.997	96.383
Of it variable,%	0.000	0.000	0.000	0.000	0.000
Total labour	67.500	67.500	67.500	67.500	67.500

Total Production Costs in 1000 US$

Year	2002- 6
% of nom. capacity (single product).	0.000
Raw material 1	3025.000
Other raw materials	0.000
Utilities	0.000
Energy	6.000
Labour, direct	35.500
Repair, maintenance	5.000
Spares	5.000
Factory overheads	0.000
Factory costs	3076.500
Administrative overheads	32.000
Indir. costs, sales and distribution	0.000
Direct costs, sales and distribution	0.000
Depreciation	0.000
Financial costs	0.000
Total production costs	3108.500
Costs per unit (single product)	0.000
Of it foreign, %	97.475
Of it variable,%	0.000
Total labour	67.500

Net Working Capital in 1000 US$

Year	mdc	coto	1992	1993	1994	1995-2006
Coverage						
Current assets &						
Accounts receivable	30	12.0	166.175	223.442	259.042	259.042
Inventory and materials	60	6.0	302.500	433.333	504.167	504.167
Energy	1	360.0	0.010	0.013	0.017	0.017
Spares	180	2.0	2.500	2.500	2.500	2.500
Work in progress	5	72.0	27.251	36.796	42.729	42.729
Finished products	30	12.0	166.175	223.442	259.042	259.042
Cash in hand	15	24.0	7.313	3.188	3.229	3.229
Total current assets			671.924	922.713	1070.725	1070.725
Current liabilities and						
Accounts payable	1	248.4	8.842	10.928	12.292	12.292
Net working capital			663.082	911.786	1058.433	1058.433
Increase in working capital			663.082	248.703	146.648	0.000
Net working capital, local			12.374	12.633	12.892	12.892
Net working capital, foreign			650.708	899.153	1045.542	1045.542

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in 1000 US$

Year	1990	1991
Equity, ordinary ..	675.000	463.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	250.000	535.000
Loan B, foreign..	0.000	0.000
Loan C, foreign .	0.000	0.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	0.000
Total loan	250.000	535.000
Current liabilities	0.000	0.000
Bank overdraft	10.000	41.400
Total funds	935.000	1039.400

Source of Finance, production in 1000 US$

Year	1992	1993	1994	1995-99
Equity, ordinary ..	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000
Loan A, foreign .	-98.125	-98.125	-98.125	-98.125
Loan B, foreign..	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000
Total loan	-98.125	-98.125	-98.125	-98.125
Current liabilities	8.842	2.086	1.364	0.000
Bank overdraft	213.195	-264.595	0.000	0.000
Total funds	123.912	-360.634	-96.761	-98.125

Cashflow Tables, construction in 1000 US$

Year	1990	1991
Total cash inflow . .	925.000	998.000
Financial resources .	925.000	998.000
Sales, net of tax . .	0.000	0.000
Total cash outflow . .	935.000	1039.400
Total assets	925.000	998.000
Operating costs . . .	0.000	0.000
Cost of finance . . .	10.000	41.400
Repayment	0.000	0.000
Corporate tax . . .	0.000	0.000
Dividends paid . . .	0.000	0.000
Surplus (deficit) .	-10.000	-41.400
Cumulated cash balance	-10.000	-51.400
Inflow, local	675.000	463.000
Outflow, local	625.000	349.000
Surplus (deficit) .	50.000	114.000
Inflow, foreign . . .	250.000	535.000
Outflow, foreign . . .	310.000	690.400
Surplus (deficit) .	-60.000	-155.400
Net cashflow	-925.000	-998.000
Cumulated net cashflow	-925.000	-1923.000

Cashflow tables, production in 1000 US$

Year	1992	1993	1994	1995	1996	1997
Total cash inflow . .	2858.842	3802.086	4751.364	4750.000	4750.000	4750.000
Financial resources .	8.842	2.086	1.364	0.000	0.000	0.000
Sales, net of tax . .	2850.000	3800.000	4750.000	4750.000	4750.000	4750.000
Total cash outflow . .	3072.037	3438.512	3969.545	3819.023	3814.313	3819.715
Total assets	671.924	250.789	148.012	0.000	0.000	0.000
Operating costs . . .	1994.100	2681.300	3108.500	3108.500	3108.500	3108.500
Cost of finance . . .	62.800	54.950	47.100	39.250	31.400	23.550
Repayment	98.125	98.125	98.125	98.125	98.125	98.125
Corporate tax . . .	245.088	353.348	567.808	573.148	576.288	589.540
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-213.195	363.574	781.819	930.977	935.687	930.285
Cumulated cash balance	-264.595	98.978	880.797	1811.774	2747.461	3677.746
Inflow, local	2853.508	3800.183	4750.183	4750.000	4750.000	4750.000
Outflow, local	335.070	430.090	646.750	651.648	654.788	668.040
Surplus (deficit) .	2518.438	3370.093	4103.433	4098.352	4095.212	4081.960
Inflow, foreign . . .	5.333	1.903	1.181	0.000	0.000	0.000
Outflow, foreign . . .	2736.967	3008.422	3322.794	3167.375	3159.525	3151.675
Surplus (deficit) .	-2731.633	-3006.519	-3321.614	-3167.375	-3159.525	-3151.675
Net cashflow	-52.270	516.649	927.044	1068.352	1065.212	1051.960
Cumulated net cashflow	-1975.270	-1458.622	-531.577	536.775	1601.986	2653.946

Cashflow tables, production in 1000 US$

Year	1998	1999	2000	2001	2002	2003
Total cash inflow . .	4750.000	4750.000	4750.000	4750.000	4750.000	4750.000
Financial resources .	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax . .	4750.000	4750.000	4750.000	4750.000	4750.000	4750.000
Total cash outflow . .	3815.005	3810.295	3707.460	3751.020	3765.100	3765.100
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs . . .	3108.500	3108.500	3108.500	3108.500	3108.500	3108.500
Cost of finance . . .	15.700	7.850	0.000	0.000	0.000	0.000
Repayment	98.125	98.125	0.000	0.000	0.000	0.000
Corporate tax . . .	592.680	595.820	598.960	642.520	656.600	656.600
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	934.995	939.705	1042.540	998.980	984.900	984.900
Cumulated cash balance	4612.741	5552.446	6594.986	7593.966	8578.866	9563.766
Inflow, local	4750.000	4750.000	4750.000	4750.000	4750.000	4750.000
Outflow, local	671.180	674.320	677.460	721.020	735.100	735.100
Surplus (deficit) .	4078.820	4075.680	4072.540	4028.980	4014.900	4014.900
Inflow, foreign . . .	0.000	0.000	0.000	0.000	0.000	0.000
Outflow, foreign . . .	3143.825	3135.975	3030.000	3030.000	3030.000	3030.000
Surplus (deficit) .	-3143.825	-3135.975	-3030.000	-3030.000	-3030.000	-3030.000

Net cashflow	1048.820	1045.680	1042.540	998.980	984.900	984.900
Cumulated net cashflow	3702.766	4748.446	5790.986	6789.966	7774.866	8759.767

Cashflow tables, production in 1000 US$

Year	2004	2005	2006
Total cash inflow	4750.000	4750.000	4750.000
Financial resources	0.000	0.000	0.000
Sales, net of tax	4750.000	4750.000	4750.000
Total cash outflow	3765.100	3765.100	3765.100
Total assets	0.000	0.000	0.000
Operating costs	3108.500	3108.500	3108.500
Cost of finance	0.000	0.000	0.000
Repayment	0.000	0.000	0.000
Corporate tax	656.600	656.600	656.600
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	984.900	984.900	984.900
Cumulated cash balance	10548.670	11533.570	12518.470
Inflow, local	4750.000	4750.000	4750.000
Outflow, local	735.100	735.100	735.100
Surplus (deficit)	4014.900	4014.900	4014.900
Inflow, foreign	0.000	0.000	0.000
Outflow, foreign	3030.000	3030.000	3030.000
Surplus (deficit)	-3030.000	-3030.000	-3030.000
Net cashflow	984.900	984.900	984.900
Cumulated net cashflow	9744.667	10729.570	11714.470

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	4449.96	at	10.00 %
Internal Rate of Return (IRRE1) ..	44.55 %		

b) Net Worth versus Net cash return:

Net present value	4320.07	at	10.00 %
Internal Rate of Return (IRRE2) ..	36.02 %		

c) Internal Rate of Return on total investment:

Net present value	4249.80	at	10.00 %
Internal Rate of Return (IRR) ..	30.28 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 US$

Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	2850.000	3800.000	4750.000	4750.000	4750.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	2850.000	3800.000	4750.000	4750.000	4750.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	2174.480	2861.680	3283.380	3277.880	3277.880
Operational margin	675.520	938.320	1466.620	1472.120	1472.120
As % of total sales	23.702	24.693	30.876	30.992	30.992
Cost of finance	62.800	54.950	47.100	39 250	31.400
Gross profit	612.720	883.370	1419.520	1432.870	1440.720
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	612.720	883.370	1419.520	1432.870	1440.720
Tax	245.088	353.348	567.808	573.148	576.288
Net profit	367.632	530.022	851.712	859.722	864.432
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	367.632	530.022	851.712	859.722	864.432
Accumulated undistributed profit	367.632	897.654	1749.366	2609.088	3473.520
Gross profit, % of total sales	21.499	23.247	29.885	30.166	30.331
Net profit, % of total sales	12.899	13.948	17.931	18.099	18.199
ROE, Net profit, % of equity	32.305	46.575	74.843	75.547	75.961
ROI, Net profit+interest, % of invest.	16.644	20.635	30.147	30.152	30.047

Net Income Statement in 1000 US$

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	4750.000	4750.000	4750.000	4750.000	4750.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4750.000	4750.000	4750.000	4750.000	4750.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	3252.600	3252.600	3252.600	3252.600	3143.700
Operational margin	1497.400	1497.400	1497.400	1497.400	1606.300
As % of total sales	31.524	31.524	31.524	31.524	33.817
Cost of finance	23.550	15.700	7.850	0.000	0.000
Gross profit	1473.850	1481.700	1489.550	1497.400	1606.300
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1473.850	1481.700	1489.550	1497.400	1606.300
Tax	589.540	592.680	595.820	598.960	642.520
Net profit	884.310	889.020	893.730	898.440	963.780
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	884.310	889.020	893.730	898.440	963.780
Accumulated undistributed profit	4357.830	5246.850	6140.580	7039.020	8002.800
Gross profit, % of total sales	31.028	31.194	31.359	31.524	33.317
Net profit, % of total sales	18.617	18.716	18.815	18.915	20.290
ROE, Net profit, % of equity	77.707	78.121	78.535	78.949	84.691
ROI, Net profit+interest, % of invest.	30.450	30.345	30.240	30.134	32.326

Net Income Statement in 1000 US$

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	4750.000	4750.000	4750.000	4750.000	4750.000
Less: variable costs, incl. sales tax.	0.000	0.000	0.000	0.000	0.000
Variable margin	4750.000	4750.000	4750.000	4750.000	4750.000
As % of total sales	100.000	100.000	100.000	100.000	100.000
Non-variable costs, incl. depreciation	3108.500	3108.500	3108.500	3108.500	3108.500
Operational margin	1641.500	1641.500	1641.500	1641.500	1641.500
As % of total sales	34.558	34.558	34.558	34.558	34.558
Cost of finance	0.000	0.000	0.000	0.000	0.000
Gross profit	1641.500	1641.500	1641.500	1641.500	1641.500
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	1641.500	1641.500	1641.500	1641.500	1641.500
Tax	656.600	656.600	656.600	656.600	656.600
Net profit	984.900	984.900	984.900	984.900	984.900
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	984.900	984.900	984.900	984.900	984.900
Accumulated undistributed profit	8987.700	9972.601	10957.500	11942.400	12927.300
Gross profit, % of total sales	34.558	34.558	34.558	34.558	34.558
Net profit, % of total sales	20.735	20.735	20.735	20.735	20.735
ROE, Net profit, % of equity	86.547	86.547	86.547	86.547	86.547
ROI, Net profit+interest, % of invest.	33.034	33.034	33.034	33.034	33.034

Projected Balance Sheets, construction in 1000 US$

Year	1990	1991
Total assets	935.000	1974.400
Fixed assets, net of depreciation	0.000	935.000
Construction in progress	935.000	1039.400
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	0.000	0.000
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	935.000	1974.400
Equity capital	675.000	1138.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	250.000	785.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	10.000	51.400
Total debt	260.000	836.400
Equity, % of liabilities	72.193	57.638

Projected Balance Sheets, Production in 1000 US$

Year	1992	1993	1994	1995	1996
Total assets	2465.944	2635.332	3390.283	4151.880	4918.187
Fixed assets, net of depreciation	1794.020	1613.640	1438.760	1269.380	1100.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	664.611	919.526	1067.496	1067.496	1067.496
Cash, bank	7.313	3.188	3.229	3.229	3.229
Cash surplus, finance available	0.000	98.979	880.798	1811.775	2747.462
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	2465.944	2635.332	3390.283	4151.880	4918.187
Equity capital	1138.000	1138.000	1138.000	1138.000	1138.000
Reserves, retained profit	0.000	367.632	897.654	1749.366	2609.088
Profit	367.632	530.022	851.712	859.722	864.432
Long and medium term debt	686.875	588.750	490.625	392.500	294.375
Current liabilities	8.842	10.928	12.292	12.292	12.292
Bank overdraft, finance required.	244.595	0.000	0.000	0.000	0.000
Total debt	960.312	599.678	502.917	404.792	306.667
Equity, % of liabilities	46.149	43.182	33.567	27.409	23.139

Projected Balance Sheets, Production in 1000 US$

Year	1997	1998	1999	2000	2001
Total assets	5704.372	6495.267	7290.872	8189.312	9153.092
Fixed assets, net of depreciation	955.900	811.800	667.700	523.600	488.400
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1067.496	1067.496	1067.496	1067.496	1067.496
Cash, bank	3.229	3.229	3.229	3.229	3.229
Cash surplus, finance available	3677.747	4612.742	5552.447	6594.986	7593.967
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	5704.372	6495.267	7290.872	8189.312	9153.092
Equity capital	1138.000	1138.000	1138.000	1138.000	1138.000
Reserves, retained profit	3473.520	4357.830	5246.850	6140.580	7039.020
Profit	884.310	889.020	893.730	898.440	963.780
Long and medium term debt	196.250	98.125	0.000	0.000	0.000
Current liabilities	12.292	12.292	12.292	12.292	12.292
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	208.542	110.417	12.292	12.292	12.292
Equity, % of liabilities	19.950	17.520	15.609	13.896	12.433

Projected Balance Sheets, Production in 1000 US$

Year	2002	2003	2004	2005	2006
Total assets	10137.990	11122.890	12107.790	13092.690	14077.590
Fixed assets, net of depreciation	488.400	488.400	488.400	488.400	488.400
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	1067.496	1067.496	1067.496	1067.496	1067.496
Cash, bank	3.229	3.229	3.229	3.229	3.229
Cash surplus, finance available	8578.867	9563.768	10548.670	11533.570	12518.470
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	10137.990	11122.890	12107.790	13092.690	14077.590
Equity capital	1138.000	1138.000	1138.000	1138.000	1138.000
Reserves, retained profit	8002.800	8987.700	9972.601	10957.500	11942.400
Profit	984.900	984.900	984.900	984.900	984.900
Long and medium term debt	0.000	0.000	0.000	0.000	0.000
Current liabilities	12.292	12.292	12.292	12.292	12.292
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	12.292	12.292	12.292	12.292	12.292
Equity, % of liabilities	11.225	10.231	9.399	8.692	8.084

ANNEXE 2

FOREIGN EXCHANGE EVALUATION

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	.....construction..... 1990	1991	1992	production 1993
total foreign inflow . .	793.42	785.00	8.42	250.00	535.00	5.33	1.90
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	793.42	785.00	8.42	250.00	535.00	5.33	1.90
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	45899.02	1000.40	44898.62	310.00	690.40	2736.97	3008.42
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	856.60	949.00	-92.40	300.00	649.00	656.04	250.35
imported materials . . .	43915.00	0.00	43915.00	0.00	0.00	1920.00	2605.00
repayment loans & overd.	793.42	0.00	793.42	0.00	0.00	98.13	98.13
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	334.00	51.40	282.60	10.00	41.40	62.80	54.95
indirect costs							
net foreign exchge flow	-45105.60	-215.40	-44890.20	-60.00	-155.40	-2731.63	-3006.52
import substit'n effect	68400.00	0.00	68400.00	0.00	0.00	2850.00	3800.00
net forgn exchge effect	23294.40	-215.40	23509.80	-60.00	-155.40	118.37	793.48

present values at	10.00 %
foreign exchange flow .	-21181.27
net forgn exchge effect	9379.16

DOMESTIC PUMPS

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	1994	1995	1996	1997	1998	1999	2000
total foreign inflow . .	1.18	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	1.18	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	3322.79	3167.38	3159.52	3151.68	3143.82	3135.98	3030.00
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	147.57	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	3030.00	3030.00	3030.00	3030.00	3030.00	3030.00	3030.00
repayment loans & overd.	98.13	98.13	98.13	98.13	98.13	98.13	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	47.10	39.25	31.40	23.55	15.70	7.85	0.00
indirect costs							
net foreign exchge flow	-3321.61	-3167.38	-3159.52	-3151.68	-3143.82	-3135.98	-3030.00
import substit'n effect	4750.00	4750.00	4750.00	4750.00	4750.00	4750.00	4750.00
net forgn exchge effect	1428.39	1582.63	1590.48	1598.32	1606.18	1614.02	1720.00

present values at	10.00 %
foreign exchange flow .	-21181.27
net forgn exchge effect	9379.16

Foreign Exchange Effect in 1000 US$
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	2001	2002	2003	production 2004	2005	2006	2007
total foreign inflow . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect effects							
total foreign outflow .	3030.00	3030.00	3030.00	3030.00	3030.00	3030.00	-1137.94
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	-1146.36
imported materials . . .	3030.00	3030.00	3030.00	3030.00	3030.00	3030.00	0.00
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	8.42
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs							
net foreign exchge flow	-3030.00	-3030.00	-3030.00	-3030.00	-3030.00	-3030.00	1137.94
import substit'n effect	4750.00	4750.00	4750.00	4750.00	4750.00	4750.00	0.00
net forgn exchge effect	1720.00	1720.00	1720.00	1720.00	1720.00	1720.00	1137.94

present values at	10.00 %
foreign exchange flow .	-21181.27
net forgn exchge effect	9379.16