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(Note: Final Report taken by Mr. Basak to Sudan on 13 October 1976)

(R) SUDAN.

AGRICULTURAL TRACTOR PROJECT.

76 p.

World Bank/UNIDO Co-operative Programme
Vienna, Austria
13 October, 1976

(Note: Final Report taken by Mr. Basak to Sudan on 13 October 1976)

S U D A N

AGRICULTURAL TRACTOR PROJECT

World Bank/UNIDO Co-operative Programme
Vienna, Austria
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Secretary R—— · 15/10/76.
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Acronyms:

MF - Massey-Ferguson Ltd.
Steyr - Steyr-Daimler-Puch AG.
KHD - Klöckner-Humboldt-Deutz AG.
CKD - Completely knocked down
CBU - Completely built up.

This report was prepared by Mr. Aroon K. Basak, Deputy Director, World Bank/UNIDO Co-operative Programme, and Mr. Swamy Rao A.A., Senior Inter-regional Adviser, UNIDO, assisted by Miss Herta P. Kaschits, Research Assistant, World Bank/UNIDO Co-operative Programme.

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SUDAN : AGRICULTURAL TRACTOR PROJECT

I. INTRODUCTION

Background

At the request of the Minister of Industry, Government of Sudan, the UNIDO Investment Co-operative Programme Office (UNIDO/World Bank Co-operative Programme) fielded a mission to Khartoum from 19 - 27 June 1976 for evaluating the proposals submitted to the Government by international manufacturers of agricultural tractors and automotive trucks, offering to set up the assembly and subsequent manufacture of these equipments in Sudan. The main mission team consisted of Mr. Aroon K. Basak, Deputy Director (Chief of the mission), and Miss Herta Kaschitz, Research Assistant of the UNIDO Investment Co-operative Programme Office, and Mr. Swamy Rao, the Senior Interregional Adviser on Engineering Industries, UNIDO.

The Government of Sudan presented to the mission a short list of the competing bidders which consisted of three proposals. Massey-Ferguson's proposal consisted of agricultural tractors, combines and agricultural machinery, the Steyr-Daimler-Puch proposal consisted of trucks, buses, tractors, combines and pumps, and the K.H.D. proposal consisted of trucks, buses, tractors, combines, agricultural machinery and engines.

Summary of Project Proposals

Three proposals have been received by the Government of Sudan from the following three international firms:

I. Massey-Ferguson Ltd. (MF), U.K.
II. Steyr-Daimler-Puch AG (SDP), Austria
III. Klöckner-Humboldt-Deutz AG (KHD), Federal Republic of Germany

I. Massey-Ferguson (Location Wad Medani, El Gezira)

A. Base Project: (six years with initial two years planning and four years operation)

(a) Product and Production Volume:

Tractors 3,000; combines (self propelled) 400; seven types of agricultural implements 5,050 per year;

(b) Physical Facilities:

Land 6 ha, covered area 18,415 m^2 (light machine shop, assembly, painting, drying, some heat treatment and plating). Existing facilities at Khartoum Central Foundry are to be also utilized through additional assistance;

(c) Proposed Final Local Content:

Tractor 40 per cent, combines 15 per cent and implements 40 per cent;

(d) Total staff (manpower) 475, including 7 M-F managerial permanent and 9 M-F technical (medium/long term contract) staff;

(e) Unit Cost: (stage IV last year of project of six years duration) for MF-275 tractor

(i)	CKD: delivered factory Wad Medani (Sudan) from UK	UK£ 2,652
(ii)	Local material cost	UK£ 834
(iii)	Direct labor and variable overhead	UK£ 130
(iv)	Total direct cost (unit cost: Sudan)	UK£ 3,617
(v)	Proposed selling price (Sudan)	UK£ 5,571

Note:

U.K. ex-works price assembled	UK£ 3,748
Deletion value (40%)	UK£ 1,578

(f) Investment: (as of April 1976)

Total capital investment US$ 18.5 million as stated by MF but not accepted by the mission. (See Annex 3, Chap. III)

Provided thus:

Sudanese (Government or private)	51 % *
Massey-Ferguson	25 %
Foreign third parties	24 % *

(Note: Both local and foreign debt and equity, including 51 % Sudanese requirements will be arranged by Massey-Ferguson)

B. Expansion Programme (after base project)

(a) Product and Production Volume:

Tractors 6,000; self-propelled combines 400; sugar cane harvesters 200; assorted type of implements 11,000 per year. Expansion through second shift.

(b) Physical facility:

Land: same 6 ha, covered area: additional 4,500 m^2 (at $ 200/m^2), same physical facilities as base project.

Existing facilities at Khartoum Central Foundry (with modest expansion if necessary) to be utilized.

(c) Proposed final local content:

Not given, assumed to be the same as base project;

(d) Total Staff:

Additional manpower 309, same MF staff as base plan;

Double shift: machine shop etc., single shift: tractor assembly and implement fabrication/assembly;

(e) Unit Cost:

Not given, assumed to be the same as base project;

(f) Additional Investment (as of April 1976):

Capital $ 1.25 million, not evaluated by the mission.

II. Steyr-Daimler-Puch AG,

(a) Products and Production Volume:

Tractors 2,000; trucks 600; buses 300; self-propelled combines 400; irrigation pumps 2,100;

(b) Physical Facilities:

Machine shop (fitting, cutting, turning, welding), assembly, paint shop, heat treatment. Land area 250,000 m^2, covered factory area 39,825 m^2 plus office area 3,056 m^2, outside covered storage 2,000 m^2 and outside non-covered storage 14,000 m^2. Building cost $ 8.4 million, total equipment cost $ 22.50 million, total building, equipment and start up (including layout and miscellaneous) cost, i.e. total fixed investment $ 38.1 million (note: additional investment for advanced installation for foundry, forge, special hardening and tool room around $ 137 million). Capital cost estimates not accepted by the mission.

The proposal also consists of (a) a modest separate foundry and forge facilities with total investment of US$ 18.6 or as an alternative (b) expansion of Khartoum Central Foundry through an investment of US$ 3.8 million.

(c) Unit Cost of Production:

Tractor US$ 9,000, truck (1290-240-044 model) $ 34,000, bus (890-150 model) $ 30,750, pump (150-20 model) $ 2,375.

(d) Total Staff:

Staff 880 (not including foundry and forgeshop facilities).

(e) Proposed local content in %:

Tractor 36, truck 36, bus 38, combine 38, pump 37.

III. Klöckner-Humboldt-Deutz AG.

Alternative 1 (without foundry and forge)

(a) Products and Production Volume:

Tractors 2,000; stationary engines 700; automotive engines 3,300; trucks/buses 900; combines (trailed/self-propelled) 600; 13 types of implements 7,200/year;

(b) Physical Facilities: General purpose

Machine shop, press shop, assembly, heat treatment, power station (5,700 kwh) etc., total building floor area 57,300 m^2 ($ 11.7 million) and equipment $ 55.3 million;

(c) Proposed final local content (% by value):

Tractors 20, engines 15, trucks 20.6, buses 68.8, self-propelled combines 40.7, agricultural implements 25;

(d) Total Staff:

1770 out of which 714 direct and 1056 indirect plus 30 permanent German staff plus 222 temporary German (first three years of operation) staff;

(e) Unit Cost: Tractor: 6806

	DM	UKL
CKD delivered to factory in Sudan (Unit cost at Sudan factory not available)	27,000	-
Note:		
Exworks of fully built Tractor at Licensor FRG;	22,200	-

(f) Investment:

KHD may take a minority equity share. They may assist in securing external finance (not very clear).

Alternative 2 (with foundry and forge)

(a) Products and Production Volume:

Tractors 3,000, stationary engines 700, automotive engines 4,300, buses/trucks 900, combines (self-propelled/trailed) 1,000; 13 types of implements 8,900 per year.

(b) Physical Facilities:

Special product machine shop, general machine shop, gear shop, press shop, assembly, heat treatment, etc. In addition foundry (9,000 t/year, 8,000 m^2), forge-shop (175 t/year, 7,248 m^2) and power station (5,700 kwh, 2,300 m^2). Total building floor area 87,548 m^2 ($ 23.2 million) and equipment $ 162.0 million; not evaluated by the mission.

(c) Proposed Final Local Content (% by value)

Tractors 55.0, engines 53.0, trucks 42.8, buses 74.8, self-propelled combines 40.7, agricultural machinery 60.0.

(d) Total staff:

3,747 out of which 1,191 direct, 2,556 indirect plus permanent 66 German staff (10 foundry, 6 forge and 50 factory) and 498 temporary (first three years of project) German staff.

(e) Unit Cost:

CKD delivered to factory in Sudan DM 18,600

Note: Unit cost at Sudan factory not available.

(f) Investment:

Same as alternative 1.

Government's Preliminary Concept on Project Development and Implementation

The Government would like to establish two industrial complexes: one small and one large.

The small complex might be located at Wad Medani, El Gezira. The products for assembly/manufacture are to be: agricultural implements and machinery, spare parts and around 3,000 units of agricultural tractors (65 - 70 Hp) per year. The physical facilities may involve a light machine shop, assembly, fabrication, painting, heat treatment, etc., and existing foundry facilities in Khartoum and elsewhere may be utilized for casting procurement.

The large complex might be located at Port Sudan. The products for local assembly/manufacture are to be trucks 600 units (30 - 40 tons capacity with 12 - 15 ton cab and 25 ton trailer); buses 300 units, self-propelled combines (400 units for wheat, cotton, sorghum and rice etc.) automotive engines, pumps as well as around 3,000 agricultural tractors (65 - 70 Hp). The physical facilities should include a new foundry and forgeshop in addition to machine shop, heat treatment, fabrication, assembly, etc.

The two complexes are to be established with two separate international manufacturers/partners. The reason given for including agricultural tractors (3,000 units/year each) in both complexes is to (i) promote competition between the two firms and (ii) not only meet internal demand but also facilitate export to neighbouring Arab/African countries. It is said that the proposed aid to Sudan by the Arab Fund for Economic and Social Development of around $ 2.4 billion for agricultural development over about 25 years is expected to result in a greater demand for tractors in Sudan, assuming a trend towards agricultural mechanization.

II. OVERALL EVALUATION OF PROJECT PROPOSALS

1. Project Scope and Location

Having given due consideration to the present lack of sufficient industrial infrastructure, the absence of adequate skills, the need for borrowing the whole of the large required investment, and the narrow margin of local content that the assembly operations would have to contend with for some time, the mission is in favour of restricting the project for the present to the agricultural machinery and equipment product lines. Such a restriction would seem justified by the need to deal with a number of complex issues - to be considered below - which in our judgement would make a more ambitious project financially and managerially undesirable at this time.

In view of the recommended concentration on a single product line, it would appear appropriate to defer for the present, further consideration of establishing more than one manufacturing complex. Although the mission has not made an in-depth analysis, it appears reasonable to plan on the Wad Medani location as enjoying a minimum of infrastructutral support and proximity to the market, yet furthering the objective of geographical decentralization of industry.

2. Evaluation of the Market

The Government proposes to build up annual production as rapidly as possible to 3,000 tractors, 400 combines, and 5,000 agricultural implements. The mission believes that these are realistic intermediate production and sales targets, even though they exceed recent average imports by about three times. However, the expected increase in demand depends upon the implementation with Arab funds of various large scale land development projects which are in different stages of preparation. The actual build-up of demand may, therefore, be somewhat slower - or even possibly faster - than anticipated, so that flexibility in the timing and phasing of major investment commitments would be highly desirable.

3. Economic Effects of the Project

The mission appreciates the Government's concept of the project as a logical and desirable element of its overall economic development programme. In addition to producing high priority capital equipment, it will expectedly lead to the expansion of technical and managerial skills which will be heavily relied upon as industrialization progresses.

At the same time the project is basically one of import substitution, and the Government would wish to satisfy itself that the long-term obligations involved are justified by realizable benefits. In this connexion the mission has briefly examined the questions of foreign exchange savings, pricing of imported materials, local manufacturing content, and beneficial linkages with other projects/sectors.

A. Foreign Exchange Savings

Import substitution through local assembly and parts production is "expected" to lead to substantial foreign exchange savings (in addition to creating employment and encouraging the development of an industrial infrastructure). For example, Massey Ferguson's proposal claims that US$ 35 million of foreign exchange will be saved annually.

This expected benefit needs to be qualified, conceptually as well as quantitatively. Foreign exchange savings are notional, and could be achieved only if the country has the ability to expend sufficient foreign currency resources to import either the finished products, or at least the "completely knocked down" (CKD) units. Hitherto, Sudan has obtained five years' credit to import finished tractors, but Massey Ferguson (MF) does not appear to contemplate extending credit terms on its CKD supplies. In fact, MF has apparently approached the Arab Investment Company in Riyadh for a revolving line of credit to Sudan to finance its imports of CKD assemblies. A Credit Draw-Down and Repayment Schedule presented by MF shows a peak credit build up of US$ 151 million.

The mission has recomputed the foreign exchange that might be saved annually at the end of Stage IV under the MF proposal as per Annex 1. It is seen that Sudan must spend US$ 30 million a year in foreign exchange to import CKD's, so as notionally to save US$ 7.4 million of foreign exchange, and to allow the plant to remain at 100% capacity utilization. Should future foreign exchange constraints reduce capacity utilization to below 50%, the country would in fact lose foreign exchange. Industrial investments in developing countries, that are based on heavy "maintenance imports" have too often in the past suffered from insufficient foreign supplies, because of foreign exchange shortages. The project's recurrent foreign exchange needs must, therefore, be recognized and accepted by the Government before the investment decision is made.

B. CKD Pricing and Deletion Values

Economic viability of the project depends upon importing a CKD kit for less than the cost of an equivalent completely assembled unit, and assembling the unit for less than the difference. In theory, potential profits increase as sub-assemblies and components are deleted from the imported kit and produced locally for less than their "deletion value".

After a certain point, each incremental deletion becomes more difficult to substitute locally at the same or a lower cost; it is the joint venture's opportunity and challenge to continue pushing the economic cut-off point towards full local manufacture.

Clearly, much depends on the original manufacturer's pricing of the CKD kit and his setting of the deletion values for assemblies and components. According to the proposals, these prices would be established unilaterally by the manufacturer, thus placing the joint venture at his economic mercy. It may be claimed that the pricing details are not very important, since the joint venture's eventual domestic selling price is determined by adding a percentage mark-up to the manufacturing cost. But adoption of this device would lead to the building up of a high-cost industry and impose a servere penalty on the Sudanese economy.

The mission strongly recommends that an acceptable procedure for determining CKD prices be worked out to protect the interests of the joint venture as well as the economy. Once a joint venture agreement is executed with a foreign manufacturer, the local assembly operation will be tied to the CKD's from that single source. The mission believes that the international prices of completely built tractors include a fair margin to cover maintenance and warranty services. In applying a "deletion value" as a deduction from the prices of CBU's (are these internationally competitive in the first place?) Massey Ferguson appears to have left this built-in margin in the prices of the CKD, while at the same time they propose to charge an additional "fee" per tractor to cover their contingent warranty expenditure. The economic return on the project will largely depend on the pricing structure of the CKD's, and as stated above, it would be no remedy to try to cover high buying prices with equally high selling prices at home. Some financial parameters and ratios which emerge from the cost/price relationships as given in the proposals are shown in Annex 2.

C. Local Manufacture of Sub-Assemblies and Components

Achievement of substantial local production content, as projected by the tendors, (e.g. MF projects 40% for tractors and implements, 15% for combines) will require major investment outlays over and above the basic assembly and mechanical workshop facilities. Successful use of these supplementary facilities (e.g. foundry, pressing and forging, heat treating facilities) will require lengthy training of local personnel and careful quality control.

Such additional investment and training expenditures can be evaluated when specifications and broken down deletion values are available for the items they relate to. Until now this analysis has not been carried to the point of justifying very large additional investments on financial grounds. The mission recommends that a carefully phased approach to successive deepening of local production be adopted as a basic policy. One such approach is outlined below under "Action Proposals".

D. Linkages

The project 1/ would create about 486 jobs on the basis of the extent of local manufacture assumed at the end of Stage IV. With an estimated investment of $ 57 million - including a price inflation allowance of 10% per annum - this represents an investment of more than $ 100,000 per worker.

Additional linkages are desired to be established with other existing or planned industrial projects. Until now the only identified linkage with an existing project is with the Kartoum Central Foundry, which is proposed to be strengthened as a source of simple castings. The mission endorses the concept of establishing an adequate foundry capacity, available to all industries.

For the future it is possible that assembly and progressive manufacture of engines will be undertaken, and that trucks, buses, pumps, and other itmes will also be produced. These itmes share common technological processes; important linkages through sharing of facilities and management could therefore, be achieved.

With regard to any of these products, it is open for consideration whether rigid adherence to proprietary engineering specifications established on a world-wide basis by a technology partner, is justified as an absolute requirement. Such a condition, for example, is embodied in the trademark agreement proposed by MF. If a judicious local decision should require modification of specifications to encourage increased use of locally produced parts, the joint venture should be free to make such a move, especially since the product cannot be exported anyway.

1/ According to the MF proposal.

If a series of such modifications appear to be technically acceptable and financially attractive, the joint venture might be justified in adopting these changes as local standards. If the use of an international brand name is compromised by such local modification, perhaps a local brand name should be substituted. The principle of establishing the closest possible links with other local enterprises must be strongly supported, and contractual deterrents to this process need to be avoided.

4. Project Cost

The MF proposal is the only one in which project cost estimates apply exclusively to agricultural machinery and implements. The figures are summarized in Annex 3. It will be seen that the total investment including working capital through Stage IV (1982) is estimated at $ 57 million after allowing for 10 per cent p.a. price escalation on fixed assets. Of this total, $ 26.4 million or about 46 per cent would be invested in foreign exchange.

An additional investment of several million dollars, which may be needed to up-grade the Khartoum Central Foundry, has not been included in the MF proposal. Similarly, although it is believed that $ 5 million is likely to be spent on May Engineering to build up a sales and maintenance network, no such allowance has been included in the project cost estimate, which also excludes the cost of the services of a General Contractor as well as interest during construction.

Finally, it must be emphasized that the project costs presented by the tendors are only indicative estimates; they are not firm offers. Thus there is no assurance that eventual supply and construction tenders will remain even within the escalated cost estimates.

5. Financing Plan and Return

Annex 4 summarizes a possible financing plan, using the MF figures for illustration. It is assumed that the debt/equity ratio would be 60:40, and that the Government would hold 51% of the equity while foreign participants' shares would total 49%. Foreign equity plus foreign loans are designed to fully cover the initial foreign exchange requirement of the project. The scale of financing required is seen to be much higher than appears in the proposal, not only with regard to external but also domestic financing. The MF proposal assumes that retained earnings will build up fast enough, to cover the investment in working capital which would be as large as the investment in fixed assets. The mission feels that the project would be financially vulnerable, unless adequate arrangements for

domestic financing are made to cover working capital needs as indicated in Annex 4, since the construction and operational schedule may very easily slip from the optimistic projections that have been assumed by MF.

Financial projections made by MF in their proposal are based on hypothetical assumptions, not all of which the mission feels able to accept. No financial or economic return calculations have therefore been made, as any figures could be quite misleading Such return calculations may more meaningfully be made when one of the proposals is accepted, and before final investment decisions are made, particularly relating to the scope and size of the project.

6. Action Proposals

Having considered the above points, the mission recommends the following for the Government's consideration:

a. Preferred Partner

All three of the project proposals reviewed by the mission are incomplete or inadequate in important ways; thus any selection made by the Government at this stage should at most pave the way for an in-depth preparation of the project, before an investment decision is finally made.

Of the three proposers, only Massey Ferguson has submitted a reasonably complete proposal. They also offer assurance of product suitability and management capability to implement such a project in Sudan.

Nevertheless, the MF proposal contains some burdensome provisions (including financial assumptions) and some omissions, which would require extensive negotiations before acceptance by Government and outside financial participants. In addition to items identified above:

- Numerous routine management decisions are subject to MF veto through the vote of just one director;
- Substantial management and technical fees are payable without regard to project success;
- Sources of components, and markets, are tightly restricted;
- Benefits of eventual sharing of facilities and management for production of other products would not be readily available;
- Provisions for selecting and training of "shadow managers" are not convincing as to expectation of hand-over to the Sudanese managers within reasonable time;

- No provision is made for the assembly or manufacture of the Perkins engine.

b. Strengthening the Government's Project Team for Negotiations and Implementation

As discussed during the mission's stay in Sudan, many tasks remain to be completed by the project team. For example:

i. Establishing Joint Venture Agreement

- selecting Joint Venture Partner
- negotiating terms and conditions
- negotiating financing

ii. Construction and Start-up

- selecting General Contractor
- equipment procurement
- monitoring construction and installation
- selection and training of staff
- start-up and initial operation

iii. Forward Planning for Distribution/Service Network and Local Manufacture

It is proposed that the Government project team be strengthened as soon as possible by the recruitment of additional national staff and a qualified full-time adviser from outside to help ensure that the project is designed, negotiated, and executed for maximum benefit to the Sudanese economy and people. Since we believe that United Nations financing for such an adviser would not be available quickly enough, the Government could, in principle, hire such a man directly and include the cost as part of the project financing package. If requested, UNIDO could assist in preparing a job description and identifying candidates.

c. Phasing of Progessive Local Machinery Manufacture

The MF proposal calls for limiting local activities to assembly and testing for the first two years of operation. It would add "general purpose machining" during the third year and "heat treating, plating, gear and splined shaft machining" during the fourth. (It is likely, but not certain, that light pressing is included in the general purpose machining category.) These progressively more sophisticated functions are supported by additional machinery and tooling investments and by increases in planned employment; a partial analysis based on the limited data available is provided in Annex 5.

The mission generally endorses the MF approach during the initial operating years, although changes in emphasis and relative timing could be discussed. A basic proposal, however, is that opportunities to establish various "manufacturing intensification and diversification" facilities be identified and examined. Such facilities could include selections from the following list: additional foundry capacity, a separate forge shop, a gear plant,

a heavy press shop, an engine assembly plant, an advanced heat treating unit, an advanced quality control and inspection unit, and development of an ancillary industry manufacturing programme.

Since we have recommended that the project not undertake truck, bus, pump, and engine production at this initial stage, those items should be added to the above list for consideration and priority assessment. (For example, in order to keep an option open to assemble and manufacture engines later, it is recommended that the combine model MF-307 or MF-506 be adopted, in order to standardize on the same Perkins engine AD 248 for the tractor as well as the combine.)

It is suggested that implementation of projects selected from the above ought to begin during the 1982-84 period. At the same time we would expect production of the original product lines to be stepped up - perhaps doubled - through the addition of a second shift and necessary balancing equipment.

It is recommended that a 10 to 15-year phased programme be worked out in sufficient detail to provide an overview of the potential production and employment contributions, together with financial implications, so that the central planning authorities may make suitable provisions in their long-range resource allocations. Since the project pipeline is lengthy, it could be an advantage to arrange for a first stage identification study during 1977, with timing of more detailed work to depend on results of the survey.

One possible broadly phased 15-year programme designed by the mission is explained in Chapter IV.

III. DEMAND FOR TRACTORS AND AGRICULTURAL MACHINERY AND TRANSPORT VEHICLES

1. Past Imports and Usage:

(a) Tractors: Imports into Sudan during 1962 - 1975 were as follows:

1962 -	272 units	1969 -	530 units
1963 -	391 "	1970 -	1,240 "
1964 -	424 "	1971 -	743 "
1965 -	466 "	1972 -	1,004 "
1966 -	635 "	1973 -	132 "
1967 -	1,000 "	1974 -	970 "
1968 -	710 "	1975 -	990 "
		Total	**9,507 units**

1976 - 1,000 units ordered.

It may be assumed that tractors imported before 1966 are completely out of commission and should not be counted in the total park of tractors. The actual total number of licensed tractors in 1974 was 4,527 only. During 1962 - 1972, Sudan imported around US$ 20.5 million worth of agricultural tractors, both through private dealers and Government sectors. However, it is to be noted that in all these years, the Government did not have a definite allocation of funds in its budget and all imports have been on an ad-hoc basis depending upon availability of import credits. Therefore, the actual imports may have been lower than the demand would have warranted.

(b) Combine Harvesters: Imports were:

1965 -	28 units	1970 -	83 units
1966 -	17 "	1971 -	102 "
1967 -	72 "	1972 -	50 "
1968 -	85 "	1972 - 74	530 "
1969 -	132 "		
		Total	1,099 units

It is to be noted that although pulltype combines were also imported before, the recent trend is for self-propelled combines.

(c) Agricultural implements:

Imports during 1962 - 1972 and (1971 imports) were as follows:

Planter:	220 units	(120)	
Multipurpose Blade:	324 "	(19)	
Ditcher:	287 "	(40)	
Disc Plow:	1,006 "	(147)	
Tool Bar:	3,347 "	(450)	
Disc Harrow:	175 "	(10)	
Disc with Seeder:	3,321 "	(0)	in 1970: 955
Border Disc:	31 "	(7)	

From this it can be seen that the import trend regarding implements is not clear, and no conclusions can be drawn. It appears that imports were made on an ad-hoc basis.

(d) Trucks and buses:

Imports of motor vehicles were as follows:

Year	Buses	Lorries (trucks, delivery vans etc.)
1963	380	2,277
1964	315	1,454
1965	158	437
1966	212	431
1967	268	922
1968	351	661

Year	Buses	Lorries (trucks, delivery vans, etc.)
1969	601	612
1970	322	641
1971	370	440
1972	42	1,140

Again, the import figures do not point to a definite trend in demand. There are around eight national or inter-city bus companies and a number of intra-city bus companies. There are also a number of private trucking companies. Many trucks and buses are imported by private companies. The total number of licensed buses was 3,137 and licensed trucks was 22,908 in 1974.

2. Servicing and Maintenance of Tractor and Truck Fleet

(a) Tractors and agricultural machinery:

It is reported that there is a large number of tractors which are non-operative. The main reason may be due to the import of a large variety, makes and models of tractors without a sound and established local repair and maintenance, spare parts supply and training programme. One of the major problems is availability of spare parts (diesel engine parts, tyres and tubes, electricals and implement spares). There are a few regional level workshops maintained by the mechanized farming corporation. However, there appears to be no organized national and village level workshop and a repair and maintenance programme.

(b) Trucks and buses:

As most of these vehicles are owned by transport companies, some repair and maintenance facilities have been established. However, the life of a vehicle is only three to four years and there is no proper arrangement for spare parts supply and a repair and maintenance programme at a national level.

3. Future Pattern and Volume of Agricultural Crops

(a) The total area of Sudan is one million square miles or 600 million Feddans (1 Fed = 0.42 hectare). The population is around 20 million. 16 million Fed are arable. The cultivated land is 14.5 million Fed out of which about 4.0 million Fed are irrigated and 10.5 million Fed served by rain. Around 40% of the total area under cultivation is owned and managed by the State corporations which include nearly all of the irrigated areas and a part of the rain-fed mechanized farms.

(b) The major crops are cotton, sorghum, millet, sesame, ground nut and wheat.

(c) The present Government plans aim at achieving the following target by 1985.

	1972/73	1985
All crops	14.5 million Feddans	23.9 million Feddans

Selected major crops:

	Area (000 Feddans)		Production (000 m Tons)	
	1972	1985	1972	1985
Cotton	1,176	2,245	554	1,393
Dura	4,095	7,090	1,300	3,125
Dukn	2,548	3,427	355	1,029
Sesame	2,847	4,101	341	917
Ground nut	1,643	3,094	566	1,896
Tobacco	1,400	5,900	0.39	2.9

(d) The Gezira Board, the Mechanized Farming Corporation, the Agricultural Development Corporation, the Public Agricultural Production Corporation and Agricultural Reforms Corporation are some of the major corporations responsible for agricultural development within the framework of activities of the Ministry of Agriculture.

(e) The Government's emphasis on extension of irrigation, usage of fertilizer, reclamation of land, to increase the future scope for agricultural production in Sudan, appears to be correct.

4. Scope for Mechanized Farming:

(a) With large areas under the public sector corporations and with emphasis on land reclamation, there is good scope for mechanized farming. The irrigation facilities and the crops such as cotton, millets, ground nuts, wheat etc. lend themselves to mechanization.

(b) The Arab Fund is considering allocating in principle US$ 2.4 billion for investment in agricultural development projects in Sudan to be spread over the next 25 years.

(c) The actual specific projects proposed by the Arab Fund for agricultural development in Sudan are as follows (figures in million Sudan pounds, total project cost and foreign exchange):

Darfur complex 7 - 4, modernization Nuba mountain 5 - 2, Agrarian reform: pump irrigation 10 - 7, storages of wheat Gezira 5 - 4, mechanical farming at S. Funj 50 - 13, mechanical farming at S. Kordofan 50 - 13, development of Agrarian Reform (pump irrigation II) 22 - 15, sugar project 33 - 22, irrigation Upper at bara 120 - 90, South Regional Complex 5 - 2, sorghum storage 34 - 30 and wheat storage 12 - 9.

5. Projections of Demand for Tractors, Trucks and Buses

(a) Tractors:

The present annual import is around 1,000 units. The 1970 - 1975 plan hopes to bring 698,000 additional Feds into irrigation and additional 2.8 million Feds to be developed in rain fed areas. Thus, during 1976/77 a total area of 18.0 million Feds (4.7 million irrigated, 13.3 million Fed rain fed) will be cultivated out of which 9 million Fed will be suitable for mechanization. Assuming an annual replacement market of 1,000 tractors, and estimating a new market demand of around 2,000 tractors per year, the total annual demand by 1980/81 may be around 3,000 tractors. However, it is not possible to project demand figures beyond 1980/81. It is only when sufficient tractors are made available to the local market, repair and service facilities and credit schemes established, and an integrated training programme developed, that the actual market demand can be ascertained.

(b) Trucks:

(i) A number of major development plans have been undertaken since 1970. Khartoum-Medani (186 km), Medani-Gedarif (277 km), Gedarif-Kassala (220 km), Kassala-Haiya (347 km) and Haiya-Port Sudan (207 km) are some of the major schemes. As Port Sudan-Khartoum railway truck is highly burdened, emphasis is placed on road truck traffic.

(ii) The present import level is around 500 units (as in 1971/1972). In addition to a number of private trucking organizations, proposed Arab Fund financing to the Sudan Company for Road Transport is expected to be around £ 12 million(Sudanese Pounds)against estimated project costs of £ 13 million.

(iii) Taking into account the replacement and new demand, around 1,000 trucks/year appear to be a reasonable figure with reference to the annual total demand and a production target of 600 trucks/year seems acceptable.

(c) Buses:

The annual average imports have been around 300 units. The production target of 300 units per year is acceptable.

6. New Requirements for Servicing and Maintenance

If the above demand figures are met through local manufacture, there is a need to initiate an integrated service, repair and maintenance and spare parts supply scheme. Selected facilities such as regional and district workshops and central inventory stores may be common to tractors and transport vehicles. However, the tractor

sector will require a large number of sub-regional, district and village level workshops and an integrated repair and maintenance programme.

7. Development, Adaptation and Testing

In addition to local assembly/manufacture, there is a need to strengthen or establish new facilities for engineering development, adaptation and testing for agricultural machinery and implements. This programme should assist the manufacturing factory in product adaptation and improvement, and also through their own development and testing activities should assist the factory in manufacturing new products at a later date with special emphasis on suitability to local conditions.

8. Marketing Organization

In addition to the local manufacturing programme there will be a need to set up an integrated marketing organization for (a) tractors and agricultural machinery, (b) trucks and buses. The development of service facilities, extending credit facilities and developing the training programme are very necessary.

IV. COMPARATIVE ANALYSIS OF THREE PROJECT PROPOSALS AND RECOMMENDATIONS

1. Number of Complexes/Choice of Alternatives

In addition to financial considerations, the establishment of two industrial complexes at two different places (one for tractors, combines and agricultural machinery, one for trucks, buses, engines, pumps and maybe tractor of different make) may have serious disadvantages as detailed below:

(i) If both complexes include 3,000 tractors per year each, it will result in repetitive import of technology, non-standardization of components, non-utilization of full production capacity and emphasis on a larger number of tractor production with low local content rather than intensification of local production with increased local content. It should also be noted that expansion from 3,000 tractors to 6,000 tractors/year in the same production unit could easily be achieved with a second shift and balancing equipment. Establishment of two separate units for 3,000 units each of a separate model of tractor will only result in dispersion of resources and will pose very serious technological and managerial problems to Sudan at the present, especially during the base phase of the project.

(ii) Having two complexes (one for tractors, combines and implements and one for trucks, buses, engines and pumps) at two different places is also not very desirable. This will call for greater man power requirement and organizational and managerial capabilities. This will

result in dispersion of domestic resources, non-identification of local production programme, lower utilization of production capacities, and will pose technological and managerial/organization problems. It will call for a total man power (and training programme) of about 2,500 workers, when one integrated complex may call for around 1,000 workers.

(iii) A single industrial complex with a proper perspective production planning programme will facilitate planned expansion and achieve better control over factory operation.

2. Specification of Products:

The specifications of tractors of 65 - 70 Hp, self-propelled 100 - 120 Hp combines, 12 and 36 ton trucks, 50 - 60 passenger buses, automotive engines (3, 4, 6 and 8 cylinder), irrigation pumps and selected agricultural machinery that have been proposed for local assembly/manufacture are acceptable. However, the need for rationalization of products with special reference to interchangeability of engines, components and spare parts should be given serious consideration in selecting the eventual products and product mix for local assembly/manufacture.

3. Products for Local Assembly/Manufacture:

The three project proposals consist of following products (base project proposals):

Product	Units/year	MF	Steyr	KPD
Tractor	3,000	✓	✓	✓
SP combine	400	✓	✓	✓
Agricultural implements	5,500	✓	x	✓
Automotive Engines	x	x	✓	✓
Irrigation Pumps	2,100	x	✓	x
Trucks	600	x	✓	✓
Buses	300	x	✓	✓

(i) Massey-Ferguson:

Massey-Ferguson proposal only includes tractors, combines and implements. It does not include local assembly/manufacture of Perkins engines for tractors. As it is a full proprietory item, the Government of Sudan may have to enter into a separate agreement with Perkinds if it is to be locally assembled/manufactured at an appropriate later date. There is a case for standardising the tractor engine (Perkins AD 248) on the combine also, instead of the proposed PERKINS A6-354 engine, even it if means a slightly lesser combine width of cut and capacity. This step will facilitate a possible future local assembly of 3,400 engines per year and will reduce the problems of spare parts import and promote interchangeability of components.

(ii) Steyr-Daimler-Puch:

The Steyr proposal does not include agricultural implements. The proposal includes tractors, combines, pumps, engines, trucks, buses and implements. Regarding the engines, four types of engines are proposed to be assembled. It is recommended that a unified system of engines is considered for local assembly.

(iii) Klockner-Humboldt-Deutz:

The proposal includes tractors, combines, implements, engines, trucks and buses. Five types of engines are proposed. It is recommended that four cylinders (type 912) are standardized for all general purposes and for tractors and six cylinders (type 912) are standardized for trucks, buses and combines).

4. Scale of Production: (assembly/manufacture)

The base project of all proposals consists of the following scale of production (annual production in units)

Product	MF	Steyr	KHD
Tractor	3,000	2,000	3,000
SP Combine	400	400	400
Implements	5,500	-	7,200
Engines	~~###~~	2,000 * (tractor)	5,200
Pumps	-	2,100	-
Trucks	-	600	600
Buses	-	300	300

Note: ~~###~~ All engines to be imported CBU (Completely Built Unit)

* Other engines to be imported CBU, tractor engines to be assembled CKD in phase IV.

The base volume (1977 - 1982) of annual production target of 3,000 tractors, 400 combines, 2,000 pumps, 600 trucks, 300 buses, 6,000 - 8,000 implements and assembly of engines can be considered as a feasible level for local assembly/manufacture with due consideration to the market demand. It is also recommended that the question of making 6,000 tractors per year (either through two tractor units producing 3,000 tractors each or one unit producing 6,000 tractors) be deferred for the present. This is based on the fact that while 3,000 tractors/year may be regarded as an acceptable figure for the annual demand by 1980-81, the actual demand figures can only be established after making available freely sufficient number of tractors backed by service and credit. This situation may be reviewed during 1980. In addition, as the increase of 3,000 units/year could be achieved through a second shift and with marginal investment, it is recommended that during the base phase, an investment is made only for 3,000 units of tractors/year.

5. Production Facilities:

(i) The production facilities in the three proposals vary and so do the investment figures. A comparison is given in the following table.

	MF	Steyr	KHD
Land	6.0 ha	250,000 m^2	-
Covered factory area	18,415 m^2	38,825 m^2	55,000 m^2
Office area	-	3,056 m^2	-
Machine shop	✓	✓	✓
Press shop	x	x	✓
Gear shop	x	x	
Heat treatment	✓	✓	✓
Plating	✓	✓	✓
Painting	✓	✓	✓
Drying	✓	✓	✓
Assembly	✓	✓	✓
Toolroom	✓ (minimum)	✓ (minimum)	✓
Foundry	KCF	KCF	-
Alternative foundry	x	2,400t/year	9,000t/year
Forge	x	25t/year	175t/year

(ii) However, it should be noted that the level or degree of physical facilities proposed also vary. However, it is interesting to note that if all the three facilities were rationalized, the investment figures become more comparable, within limits.

(iii) In this connexion, it should be mentioned that MF and Steyr proposals include expansion of Khartoum Central Foundry (around US$ 3.4 million investment). As an alternative, Steyr recommends a moderate foundry (2,400 t/year) and a forge 25 t/month), whereas KHD recommends a foundry (9,000 t/year) and forge (175 t/year).

6. Local Content:

(i) Local Content proposed by manufacturers:

The following table gives the percentage of local content proposed by three manufacturers:

Percentage of Local Content Proposed

	MF	Steyr	KHD	
			I	II
Tractor	40.0	36.0	20.0	55.0
Combine	15.0	38.0	40.7	40.7
Implements	40.0	-	32.0	60.0
Truck		36.0	20.6	42.8
Bus		38.0	68.8	74.8
Pump		37.0	-	-
Engine	-	-	15.0	53.0

Note: MF with KCF (Khartoum Central Foundry) facilities
Steyr with KCF facilities
KHD I with no foundry, but with press shop
KHD II with separate foundry and forge shop.

(ii) The local content is achieved through (a) factory inplant manufacture of selected components, (b) local purchase of components and (c) factory assembly operations. While inplant manufacture of components and factory assembly operations depend on available factory production facilities, the degree of locally purchased components depends upon the level of existing ancillary industries. The major items of local purchase mentioned are batteries, tyres, wheel weights, paint, etc. As the wheel weight is not an item on the standard tractor, its contribution to the local content should not be taken into account. Since the tyre factory has only been approved by the Government, it is doubtful if tyres could be

obtained locally during the operational phase of the project. All other items of local purchase will depend upon development of an ancillary local mechanical engineering industry which does not presently exist on an extensive scale. Therefore, taking into account all factors, the average local content that may be achieved in the base plan (without separate foundry and forgeshop) by any of the three manufacturers may be as follows:

Tractors	20%
Combines	15%
Implements	25%
Trucks	20%
Buses	30%
Pumps	15%
Engines	5%

(iii) Need for development of ancillary industry:

(a) As only batteries are locally manufactured in Sudan, there are no immediate possibilities to increase the local content of tractors through local purchase of other components. Therefore it is recommended that the Government of Sudan undertakes an indepth analysis for local manufacture of selected ancillary components (including field replacement) such as gaskets, oil and air filters, leaf and coil springs, oil seals, radiators, clutch facings, brake linings, electrical wiring harness, bulbs, tyres, rubber parts, fan belts, etc. in addition to paints, hardware (bolts and nuts, etc.), steering wheels, etc. Also, possible local manufacture of agricultural discs, tyne points etc. for implements should be explored. Although it may not be possible to establish manufacturing facilities for all these items, priorities should be established and a manufacturing development/investment programme should be undertaken.

(b) The proposed manufacturing programme should take into account possible development of local subcontracting facilities for metal fabrication, simple machining, grey iron castings, simple forgings, sheet metal parts, selected hardware etc. The Government of Sudan should undertake an analysis of existing mechanical and foundry facilities in the country and identify specific possibilities for subcontracting local manufacture of selected components. This will also involve analysis of existing foundry/machine tools and quality control facilities, management capability and financial resources to work out the specific actions that may be needed to develop each of the existing facilities into a potential component manufacturing sub-contractor both with respect to tractor and implements component/parts manufacture. A number of non-critical parts for tractors and implements may be developed through a programme of assistance to the local mechanical engineering and foundry industry.

In this connexion, special attention has to be given to the Khartoum Central Foundry and Mechanical Engineering Workshop. All efforts are to be made to develop KCF into a successful sub-contractor.

7. Unit Cost of Production

As the degree of details and mode of presentation of data in each of the three proposals is different, inter-comparison of figures is difficult. However, adding an element of estimation, the unit cost of local production of the tractor under the three proposals, appears to be as follows:

Ex-factory Sudan Cost

	US$
MF 275 Tractor	6,150
Steyr (model 760)	9,000
KHD (model 6805)	12,440*

(* US$ 11,020 landed price of CKD's plus assumed US$ 1,420 for local value added in line with MF assumption).

Although the above costs emerge from the proposals, the mission emphasises that varying assumptions make a meaningful comparison difficult.

8. Manpower Requirement (total staff)

MF	Steyr	KHD I	KHD II
475	880	1,770	3,747

(Note: KHD I: without foundry and forge but with press shop
KHD II: with separate foundry and forge).

9. Fixed Asset Cost

Fixed assets cost estimates given in the proposals have been adjusted by the mission to allow for price escalation on equipment at 10% per annum:

(i) For Base Project *Adjusted figures (without foundry and forge)

	Fixed Asset US$ million
MF*	28.5
Steyr*	43.5
KHD	67.0

(# includes pressshop and wider production facilities)

KHD 185.2

(alternative II with forge and foundry for greater production facilities. ** see item iii below).

(ii) Separate Foundry and Forge

Steyr	18.6
KHD	36.3

(iii) KHD Greater Production Facilities **

Alternative II, equipment US$ million

Gear shop	15.6
Engine Special Component Prod.	20.4
Tractor Special Component Prod.	6.4
Foundry	19.6
Forge	16.7

(iv) Power Station 78.7

KHD	3.9
KHD	13.1

(Alternative II)

(v) Expansion of KCF

MF	not known
Steyr	US$ 3.8 million investment

10. Khartoum Central Foundry

Regarding Khartoum Central Foundry (KCF) which MF and Steyr have proposed to utilise, it should be noted that an investment of around US$ 3.8 million in addition to assistance in technological, management and organization aspects should convert it into an acceptable ancillary component supplier to the tractor/truck factory. However, it should be noted that even then they would only be able to supply wheel weights and a few simple castings. There will be a need for an advanced foundry and forge shop at a later date, which KHD has recommended.

11. Conclusions and Recommendations

(i) Volume of Production

An assembly/production plant in Sudan, with an annual production volume of 3,000 tractors, 400 combines, 600 trucks, 300 buses, 5,000 - 6,000 implements, 2,000 water pumps and assembly of engines is a technically feasible proposal.

(ii) A 15-Year Five Phase Manufacturing Programme

It must be remembered that a factory is not just a physical facility. A successful factory incorporates a dynamic manufacturing programme with a phased development and with special emphasis on (a) increased physical facilities for production, (b) increased local content, (c) training of local personnel, (d) expansion of production, (e) quality control and (f) management techniques. Therefore, it is recommended that in Sudan, with respect to the proposed factory, a phased manufacturing programme is undertaken with emphasis on phase A at the present.

A production programme may involve the following phases:

Phase A: Assembly/manufacturing phase (1977 - 1981)

(five years, with two years planning and three years operational)

(a) with physical facilities: light machine shop, assembly, light press shop, fabrication shop, heat treatment, assembly and painting.

(b) Utilizing foundry facilities of Khartoum Central Foundry with necessary but modest improvements.

Phase B: Analysis of manufacturing intensification (1979 - 80)

(a) Possible establishment of a separate foundry (8,000 - 9,000 t/year capacity);

(b) Possible establishment of a separate forge shop (175 - 200 t capacity/month);

(c) Possible establishment of a gear plant;

(d) Possible establishment of a heavy press shop;

(e) Possible establishment of an engine assembly plant;

(f) Possible establishment of an advanced heat treatment unit;

(g) Possible establishment of advanced quality control and inspection unit;

(h) Possible establishment of a separate implement factory;

(i) Development of ancillary industry manufacturing programme.

(Note: The analysis and study for selected above items may start in 1979/1980).

Phase C: Manufacturing expansion and intensification programme (1982 - 1984)

(a) Expansion of phase A production facilities to produce 6,000 tractors, and appropriately increased number of other products through second shift and provision of balancing equipment;

(b) Establishment of selected manufacturing intensification facilities as detailed in Phase B.

Phase D: Achieving highest degree of local content (1985 - 1990)

(a) Stabilization of phase C manufacturing programme;

(b) Operational phase of established intensified physical facilities;

(c) Establishing/expanding ancillary industry facilities;

(d) Establishing remaining intensified physical facilities as detailed in phase B, but not realized in phase C.

Phase E: Stabilized manufacturing phase with possible product diversification (1980 - 1985)

(a) Achieving a maximum local content level and maximum utilization of production capacity, quality of products and organizational/management maturity;

(b) Possible product diversification.

(iii) Immediate Production Phase:

(a) If the above concept is acceptable, then it is recommended that the proposed Sudan manufacturing project is limited to the first phase with respect to investment (building and equipment), but takes into account the other phases with respect to land and building design and equipment layout.

(b) It is recommended that such a project as the first phase may consist of assembly/manufacture of 3,000 tractors, 400 combines, 600 trucks, 300 buses, 2,000 pumps, 6,000 implements in one complex. The physical facilities may involve light machine shop, light press shop, fabrication and welding, assembly, paint shop, heat treatment. The project should include modernization of Khartoum Central Foundry. The maximum local content that may be expected to be achieved in this phase is 20 - 25 % for tractors, implements 25 %, combines 10 %, buses 20 %,

trucks 25 % and pumps 15 %. The total manpower requirement may be around 600.
The concept of the project initiation will facilitate the minimum investment, the maximum extensive training of local personnel and a chance to develop further on a rational basis.

V. THE MASSEY-FERGUSON PROPOSAL

A. Scope of the Project

1. Choice of Products:

(a) As agreed by Massey-Ferguson and the Government Technical Committee, the product line and the annual base production programme consist of:

Tractor MF275 67 hp	3,000 units
Combine Harvester MF507, 14 - 16 ft	400 "
(Agricultural implements	5,050 ")
Offset Disc Harrow MF34, 2.2 m	1,500 "
Tool Bar MF351, 4.88 m	1,500 "
Heavy Duty Plow MF90, 3 - 5 discs	600 "
Seed Drill/Fertilizer Box MF30, 3 m	150 "
Wide Level Disc Harrow/Seed and Fertilizer Box MF360, 4.6 m	1,000 "
Cotton/Ground Nut Planter/Fertilizer Attachment, MF40, 4 rows	300 "

(b) The source of the MF 275 tractor (Perkins AD 248 engine 66 hp at 2,000 rpm) is Brazil. It is reported that the MF 275 is also manufactured in U.K. This should be ascertained. From the point of view of component and technology supply, Brazil, as a source, should be carefully evaluated especially if it is going to result in higher charges on CKD freight and technical documentation translation. Secondly, it is reported that the model MF 275 has not been tried in Sudan on an extensive scale. Therefore, it is recommended that careful consideration be given to an alternative model MF 185 or MF 188 (with Perkins engine AD 248) which is manufactured in U.K. and which has been reported to be widely used in Sudan. However, if the local manufacture of MF 275 in Sudan poses no special problems, it is recommended that it be taken up for local manufacture.

(c) The source of MF 507 bagger self-propelled combine (engine Perkins A.6-354, 95 hp at 2,000 rpm, table width 3.0 m or 3.6 m) is France. The question of a combine with a different model of engine (Perkins A.6-345) should be carefully examined taking into account the engine (Perkins AD 248) on the tractor. It is recommended that engine specifications are standardized, even if it means local assembly of a combine with a lesser capacity. Having the same engine on a tractor and on combines has obvious merits. The resulting advantage with reference to spare parts supply, maintenance, and possible local manufacture (increased demand) of engines of one type in Sudan should be seriously taken into account. Therefore, it is recommended that serious consideration be given to local assembly/manufacture of combine models MF-307 (table size 2.5 m or 3.0 m) or MF-506 (table size 3.0 m or 3.6 m) which have the same Perkins engine AD 248 as that of the tractor.

(d) Regarding the implements, it is recommended that first priority for total local manufacture be given to plow MF 90), harrow (MF 34 and MF 360), tool carrier (MF 351), with assembly of seed drill (MF 30), and planter (MF 40). It is also recommended that emphasis is placed on local manufacture of agricultural discs as the demand for implements and spares is significant.

2. Scale of Production:

(a) The base assembly programme of achieving an annual target of 3,000 tractors, 400 combines and 5,050 implements at the end of six years, with the first two years for implementation, planning and project development, is reasonable.

(b) An expansion phase proposes a total annual production of 6,000 tractors, 11,000 implements and sugar cane harvesters in addition to combine harvesters.

(c) Although such an expansion programme may be worthy of consideration after the end of the fourth year of the basic phase, it is recommended that, except for provision of additional land and scope for expansion of the factory building (with emphasis on expanded or re-adjusted plant layout), no investment is undertaken for such an expanded phase for the present. In other words, emphasis should be given to the successful implementation of the basic phase only, for the first four years.

3. Location:

(a) The proposed location is Wad Medani, El Gezira, although no final opinion has been expressed on this subject.

(b) The three major locations which may be considered in principle are Port Sudan, Khartoum and Wad Medani. Port Sudan may be suitable from the point of view of receipt of components and raw materials. However, the disadvantages are the lack of proper roads to the marketing centres and agricultural areas, high costs of rail transport and lack of supporting industry around. Khartoum has advantages with reference to stock of material in market, road, transport and communication facilities, Government and commercial activities, existence of the Khartoum Central Foundry and some mechanical engineering/ fabricating facilities, availability of selected facilities at Khartoum University. However, the Government policy encourages establishment of industrial units in rural areas. Wad Medani has good communication/road facilities from Khartoum and other areas except towards South, but roads are planned to Sennar and Gedaref. Wad Medani is also the heart of the agricultural area.

(c) However, in selecting the final location, many considerations are to be taken into account including investment on transport, electricity, water, communications, housing, etc. At this stage it is recommended that priority be given to Wad Medani, Khartoum and Port Sudan (in that order) and further investigations be undertaken before selecting the final location.

4. Phasing of Assembly and Manufacture:

(a) The following is the proposed local assembly/manufacturing programme spread over six years including the first two years of planning:

End of 1st Year: (0-1)	Tractors:	Planning and implementation
	Implements:	Planning and implementation
	Combines:	Planning and implementation
End of 2nd Year: (1-2)	Tractors:	Planning and implementation
	Implements:	Planning and implementation
	Combines:	Planning and implementation
End of 3rd Year: (2-3)	Tractors:	Local purchase of tyres, batteries, wheel weights, fuel etc. (local content 10.7 %)
		Import of sub-assembly (combine rear axle, transmission, hydraulic lift cover, engine) and all other parts (CKD I)
		Local assembly, painting and testing (local content 3.3 %)
	Implements:	Planning and implementation
	Combines:	Planning and implementation

End of 4th Year: (3-4)	**Tractors:**	Local purchase: the same (local content 10.7 %)
		Import of all tractor components in semi knocked down condition and total engine (CKD II)
		Local assembly, including pre-loading of bearings, assembly from parts, painting, inspection etc. (CKD II) (additional 2 % local content over previous 3.3 %) achieving a total local content of 16.0 %
	Implements:	Local purchase of components (local content 5 %)
		Import of CKD assembly
		Local assembly, (local content 5 %), achieving total content of 10 %
	Combines:	Planning and implementation
End of 5th Year: (4-5)	**Tractors:**	Local purchase: the same (local content 10.7 %)
		Import of CKD II pack (components, semi knocked down assembly and complete engine assembly)
		Local manufacture of 58 selected components such as turned parts, special bolts, studs, rods, machining of selected imported castings and forgings, welding (additional local content 8 %) plus assembly, paint and testing as before (total local content 24.0 %)
	Implements:	Local purchase: same as before (local content 5.0 %)
		Import of major sub-assembly
		Local selected fabrication (local content 30 %)
		Local assembly (local content 5 %), thus achieving a total local content of 40 %
	Combines:	Local purchase (5.0 %), imports of all major components and assembly (local content 10 %) thus achieving a total local content of 15 %
End of 6th Year: (5-6)	**Tractors:**	Local purchase: same (local content 10.7 %)
		Import of CKD II including engine

Further local production of 77 components such as turned parts, some forgings and castings plus machining of gears, spline shaft plus heat treatment and plating (up to additional local content of 16 %). Thus achieving a total local content of 40 %

Implements: 40 % local content as before through fabrication

Combines: 15 % local content as before

(b) The mission has the following comments on the above proposed assembly/manufacturing programme:

(i) Tractors:

The locally purchased components remain the same throughout the four years' operational programme (from third to sixth year of the project) and amount to 10.7 % local content. However, this assumes local purchase of wheel weights (which is not considered usually as an integral part of the standard tractor) and tyres, for which there are no local manufacturing facilities or a viable manufacturing plan or programme. Therefore, it is felt that effective local content through local purchase may be only around 5 %.

(ii) As a result of the import of tractor assemblies and parts (CKD I and II) during the first two years of the operational programme (third and fourth year of the project) the local assembly results only in an additional local content of 5.3 %. However, this does not take into account the foreign exchange requirements for 9.5 liters paint, thinners and accessories per tractor as well as around 47.7 liters of lubricating oil grease and diesel per tractor required to fill the tractor before delivery from the factory, which have to be imported. Therefore, the effective local content due to these local operations may be around 3.0 % only.

(iii) During stage III in the third year of operation (that is the fifth year of the project), the local machining of 58 components including turned components from the bar stock is represented to contribute 8.0 % to the local content. These 58 components are simple components, requiring no special heat treatment. Although the actual local content representation cannot be accurately judged now, it may be assumed that the actual local content may represent around 5.0 %.

(iv) During stage IV, in the fourth year of operation (that is the sixth year of the base project), the local machining of additional 77 components (turned parts, some castings and forgings), including heat treatment

and plating is represented to contribute an additional 16.0 % to the local content. However, based on the analysis of components it is felt that this stage may represent around 10.0 % only.

(v) In this connexion, it should be noted that in stage III and IV, the local content is mainly due to machining and heat treatment/plating of selected 132 components and represents mainly value-added due to the local processing of imported components. In addition, the foreign exchange value of the imported bar stock from which components are turned locally should be taken into account.

(vi) Thus, the total base project may actually result in achieving a local content of around 23 - 25 % maximum at the end of the sixth year of the project (or fourth year of operation).

(c) Implements:

Only around 10 % of the total value are proposed to be secured from local sources and additional 30 % through local fabrication. Although this is reported to represent a total of 40 % local content, based on the analysis of the production programme, it appears that around 25 % (maximum) local content may be achieved by the end of the base project period.

(d) Combines:

The proposed figures of 15 % local content are high, and one may assume to achieve 8 - 10 % of the local content only.

The Massey-Ferguson proposed list of plant machine tools and equipment, components to be locally produced, process planning and technology of production, building area required and man power requirement, organization and management, appears to be reasonable. The details on production control, quality control, training, general engineering, organization (with seven permanent M.F. managerial personnel plus 9 M.F. technical staff on medium/long term assignment) are also reasonable.

5. Increased Local Content:

(a) The local content in the proposed manufacturing programme is through (i) local purchase of tyres, batteries and wheel weights, (ii) local inplant production of selected components, (iii) assembly and painting operations.

(b) However, no detailed programme for development of local ancillary industries is given.

TABLE 1

Massey-Ferguson Proposal

Phasing of Assembly and Local Manufacture: Volume and Percentage

	Years 0	1	2	3	4	5	6
TRACTORS:	Stage	NIL	NIL	I	II	III	IV
	Operation	Planning and Implementation		CKD I	CKD II	General Purpose Machining (GPMS)	GPMS + Gears Heat Treatment + Plating (HT + PL)
	Tractor Production (Units)	0	0	2,000	3,000	3,000	3,000
	Manpower (Permanent Staff)	2	3	124	216	387	475
	Stage Local Content%	-	-	14 (local purchase 10.7, I CKD 3.3)	2.0	8.0	16.0
	Total Local Content%	-	-	14	16	24	40
IMPLEMENTS:	Stage (5,050 units/year)	I ← Planning and Implementation →			II CKD	III Assembly and	IV Fabrication
	Stage Local Content%	-	-	-	10 (local purchase 5, assembly 5)	30 Fabrication	30 Fabrication
	Total Local Content%	-	-	-	10	40	40
COMBINES:	Stage (400/year)	I ← Planning and Implementation →			II CKD	-	-
	Stage Local Content%	-	-	-	15 (local purchase 5, assembly 10)	-	-
	Total Local Content%	-	-	-	15	15	15

(c) Therefore, the manufacturing programme aims at a limited local content only under the proposed physical facilities of the project.

(d) Foundry: In this connexion, Massey-Ferguson's Report on "Sourcing of Massey-Ferguson's Castings on Khartoum Central Foundry" which was prepared by Massey-Ferguson's experts' visit to K.C.F. has highlighted the following:

(i) The principle castings required are for wheel weights, for rear and front tyres each weighing 32 kg. The wheel weight requirement for a tractor project with 3,000 units of tractors per year is 400 t/year. The present output of castings from K.C.F. is reported to be about 450 t/year.

(ii) Whilst Massey-Ferguson's wheel weights castings are comparatively simple in design and require a low grade iron, they could not be presently produced in the required quantities or to a consistently acceptable standard without making some significant changes to existing production processes of Khartoum Central Foundry (K.C.F.).

(iii) The increased moulding or moulding system that permits moulds to be stored and poured in large batches, utilization of chemically bonded sand, better and correct core making procedures are some of the major areas which require attention.

(iv) Massey-Ferguson has recommended a four phase programme for K.C.F. which will result in raising the present output level of about 450 t/year to approximately 800 t/year of saleable castings. This programme is projected over four years.

(v) This programme will involve further equipment procurement, training and technology transfer with Massey-Ferguson assistance. The overall financial terms for such assistance are to be worked out on a separate basis.

(e) No details on possible other methods of increasing local content are given. In this connexion, it should be noted that the increased local content through local resources or through potential local manufacturers is subjected to the "legal aspects" of the contract between Massey-Ferguson Services and the Sudan Licensee (Tractor Factory) with reference to "licensed products" and "authorized sub-contractors" as well as provision of technical aid by the M-F Services.

6. Transfer of Technology:

(a) The various aspects of the technology transfer are detailed in the legal documents which include (i) founders agreement, (ii) license and technical assistance agreement, (iii) management assistance agreement, (iv) supply agreement, (v) trade mark agreement and (vi) operational assistance agreement (not yet submitted by Massey-Ferguson).

(b) The "Founders Agreement" requires further careful study especially on membership of board of directors, voting and policy discussions. As presently drafted it requires sales of products only through MF distributors prohibits sales of other tractors, and provides for tax-free dividends for the first seven years.

(c) The "License and Technical Assistance Agreement" appears to have the following drawbacks:

(i) The "component parts" manufacture/procurement could be only undertaken by the licensee within the territory of Sudan for incorporation in licensed products, with the permission of M.F. "Services", and such permission excludes replacement parts for licensed products. It is recommended that the licensee should have the right to demand local assembly/procurement of "component parts" and should include replacement parts for licensed products. In addition, the licensee should have the right to procure the same from any source even from outside territory.

(ii) "Authorized sub-contractor" refers to the company/body within the territory nominated by the licensee and approved by the "Services" for the purpose of carrying out on behalf of the licensee the manufacture/assembly of any of the said products. It is recommended that the area covers "outside the territory" also.

(iii) The supply of technical aid should specify the language (both English and Arabic).

(iv) The reimbursement of the expenses by the licensee to "Services" or any other M.F. Group should be better defined and the amount should be specified for the total project (for technical documentation) and for each year (for technical assistance for agreed upon man months). This expense should be reflected in the cost of the project/product.

(v) The"training of the licensee personnel" should define the total man-months for the whole base project with an annual breakdown and total expenses should be specified and the same included in the cost of the project/product.

(vi) The "technical documentation" should be defined in specific terms.

(vii) The Services "right to amend specification" should give the licensee an agreed upon period notice for any amendment and guarantee parts supply during the period.

(viii) The agreement also prevents the licensee to export the products outside the territory. This clause should be negotiated so that the licensee is free to export to the neighbouring Arab and African countries.

(ix) "The payment for the license rights" should be included in the project cost. The proposed $ 750,000 technical planning fee, plus a licence fee of 3.6 % on ex-works prices minus CKD imports and 3.6 % on spare parts manufactured, procured and sold by the licensee for a duration of ten years, require careful further negotiations.

(d) The following aspects of the "management assistance agreement" require further study:

(i) The proposed lump sum fee of $ 750,000, plus a fee equal to 2.0 % of the ex-works company (licensee) selling price of all licensed products and spare parts for a five-year duration, requires further careful study and negotiation.

(ii) The concept of appointing a "contractor" by the "licensee" in consultation with the "Services" in assisting in project/factory/equipment planning, procurement, erection and installation is reasonable. In this connexion, it is recommended that the agreement makes it clear that procurement of plant equipment is made through international tenders. In addition, the mode of appointing the "contractor" should be defined.

(iii) The provision of management assistance by the "Services" to the licensee (seven permanent managerial staff for ten years and nine technical staff on a medium/long duration) is reasonable. However, the expenses involved should be incorporated in the cost of the project/product.

(e) The following aspects of "supply agreement" (ten years duration) require further consideration:

(i) The licensee should be authorised to procure/manufacture products through subcontractors outside the territory also.

(ii) Such outside territory subcontractors may include Massey-Ferguson manufacturers in other countries and their subcontractors.

(f) Co-operation with other Massey-Ferguson manufacturers in other developing countries:

In this connexion, it is recommended that the licensee (Sudan) establishe a strong co-operative technology transfer and training programme with other Massey-Ferguson manufacturing projects in other developing countries, and all efforts be made for procurement of components and training.

7. Training of Supervisors/Workers:

(a) The seven managerial and nine technical personnel to be provided by Massey-Ferguson Services to the licensee (Sudan) are expected to train the local managers and senior technical personnel to help them to take over at a later stage, but no time-frame is indicated.

(b) The "license and technical assistance agreement" includes provision for training of the licensee personnel. There are to be a maximum of five numbers at a given time. In this connexion, it is recommended that all efforts be made by the licensee (Sudan) to initiate a technology transfer training programme with other Massey-Ferguson manufacturing organizations in other developing countries.

(c) The Massey-Ferguson proposal includes establishment of a training facility with $ 10,000 investment on training aids, with a training manager and a few trainers. MF proposes that most of the training is undertaken in the tool room and in the factory as the assembly/manufacture progresses. In this connexion, it is recommended that the training in assembly technique starts during the early part of the "planning and implementation period" (first two years) rather than in the second half of the second year, and that an adequate training school is established separately.

B. Project Implementation

Project Construction Schedule:

(a) The base project (3,000 tractors, 400 combines and 5,050 implements per year) is spread over six years, the first two of which are for project planning and implementation.

(b) The proposed total site area is 60,000 sqm. with 18,415 sqm as covered area. The details of the facilities, materials used, layout and other physical facilities are acceptable. The factory construction is to be undertaken through an appointed "contractor". However, the Massey-Ferguson proposal does not give details of the project construction schedule (bar chart). It is recommended that this be provided.

C. Cost of Production

1. Man-power Requirements:

(a) The base programme (3,000 tractors, 400 combines and 5,050 implements per year) has the following man-power requirements:

Years	1	2	3	4	5	6
No. of Permnanet Staff	2	3	124	216	387	475

The classification of the total permanent staff is as follows:

Stage	Stage I	Stage II	Stage III	Stage IV
Year	3rd	4th	5th	6th
Production Direct	22	82	199	256
" Indirect	3	18	40	52
Ancillary	92	109	141	160
Expatriates	7	7	7	7
Total	124	216	387	475

(b) The distribution of production labour during the sixth year is as follows (sixth year, stage IV):

	Direct	Indirect
Assembly Tractor	55	5
Assembly Implements	13	6
Assembly Combine	14	7
Machining	72	17
Heat Treatment	12	3
Implements Fabrication	90	14
Total	256	52
GRAND TOTAL		308

(c) The ratio of the direct production workers to the total production labour is around 80%, which is acceptable. The percentage of the production labour to the total

number of employees is around 63% which is a bit low as compared to similar established engineering industries. However, as the base project emphasis is more on assembly, this figure is acceptable. The seven ex-patriates and 27 senior supervisory staff (out of 160 ancillary staff) constitute the total supervisory force of 34. The percentage of the supervisory personnel to the production workers is around 10 % which is high compared to similar engineering industries. However, this figure is acceptable, remembering conditions in Sudan. It is also noted that 20 technical personnel will be in inspection and quality control, in addition to the quality manager, assistant quality manager and metallurgist. This is highly acceptable. Only three toolroom and maintenance supervisory staff with one maintenance manager are provided. This area may require additional staff. In the field of engineering design, only three engineers including the general manager and assistant general manager are provided. It is highly desirable that this area be further strengthened with special reference to implements adaptation and re-design. In addition, there is a need to provide two to three field testing engineers to work with the design liaison engineer.

(d) In this connexion, it is noted that the project proposal does not detail the marketing, service, distribution, and repair and maintenance aspects. There is a need to elaborate this aspect and to incorporate it in the manufacturing proposal.

2. <u>Assemblies, Sub-assemblies</u>

(a) The import of tractor components during the first three years (stage I) is based on the CKD I kit, consisting of major sub-assemblies such as rear axle, transmission, hydraulic lift cover, engine etc. representing a total deletion percentage of 15.347 % (on tractor UK ex-works) or UK£ 575.18. However, no breakdown of the sub-assembly prices is available. Similarly, the imported CKD kit II during stage II (fourth year) consists of majority components with a few sub-assemblies and the total engine, representing a deletion percentage of 17 % worth UK£ 638.90. Again, no breakdown of the individual component prices is available. Similarly, no breakdown on individual items or sub-assemblies of combines and implements is available.

(b) The following are the details of the factory direct costs (Wad Medani) for the tractor and combine at the fourth year of the operational base phase of the project (last year).

	MF 275 Tractor	MF 507 Combine
Ex-works UK, CBU price	UK£ 3,747.85	US$ 26,877.40
Ex-works UK, CKD	2,169.86	22,778.40

Unit CKD pack CIF Port Sudan	2,504.86	-
Delivered factory cost Wad Medani	2,652.48	25,263.17
Local material cost	834.26	1,332.00
Total material cost factory at Wad Medani	UK£ 3,486.74	US$ 26,595.17

(c) Similarly, the total material cost on selected implements is as follows:

	MF 360 Disc Harrow	MF 34 Offset Disc Harrow
Ex-work UK, CBU	US$ 3,549.00	US$ 1,412.00
Ex-works UK, CKD	2,129.00	622.69
Delivered factory cost Wad Medani	2,910.72	776.76
Total material cost Wad Medani	3,620.72	1,171.42

3. Direct Labour and Overhead Costs:

(a) At the sixth year of the base project, the following labour and overheads are presented regarding the factory (Wad Medani) cost in Sudan £. (Note Sudan £ 1.00 = UK£ 1.25)

	Direct Labour (Sudan £)	Variable Overhead (Sudan £)
B 275	42.78	59.89
MF 507	24.23	33.92
MF 360	44.25	61.95
MF 34	22.22	31.11

(b) These direct labour and variable overhead charges appear to be low.

4. Unit Cost of Products:

(a) Taking the figures given at the "face value", the unit cost at stage IV, sixth year of the project (i.e. the fourth year of the operational base phase 1982) is projected as follows:

MF 275 Tractor

Ex-works UK unpacked erected	UK£ 3,747.85
Deletion value (deletion percentage 40%)	(1,577.99)
Ex-works UK, CKD price	2,169.86

Delivered factory cost to Sudan Wad Medani	2,652.48
Local material and processing cost	834.26
Total material cost (CKD from UK + local material)	3,486.74
Factory Direct Cost (Wad Medani)	
Direct Material	3,486.74
Direct Labour	53.48
Variable Overheads	76.86
Total direct cost to factory (Wad Medani) (Ex-factory cost Sudan)	3,617.08
Proposed selling price (Sudan) to the distributor	5,571.65
Difference between proposed selling price and ex-factory cost	1,954.57

(b) The following comments are relevant:

(i) The ex-works (UK) CBU price of UK£ 3,747.85 in 1975, and the CKD price of UK£ 2,169.86, may be far higher in 1982 on account of inflation.

(ii) Since only around 23 % to 25 % local content may in the event be achieved, the deletion value would perhaps be lower than £ 1,577.99.

(iii) Even assuming the deletion value of £ 1,577.99, it is noted that the local material and processing cost (for deleted items to be manufactured at Wad Medani, Sudan) is shown as £ 834.26 which is only 50 % of the deleted value. This figure appears to be underestimated.

(c) The ex-factory (UK) price, Wad Medani unit cost, selling price (transfer price to the sales department) and mark up are given below in U.K. pounds:

	UK Ex-works	CKD Wad Medani	Unit Cost Wad Medani Ex-works	Transfer Price	Mark up
Tractor MF 275	£ 3,748	2,652	3,617	5,571	1,954
Combine MF 507	£26,877	25,263	13,370	20,569	7,199

(d) The profit margin incorporated into the proposed Sudan selling prices appears too high by international standards.

VI. STEYR-DAIMLER-PUCH AG PROPOSAL

A. Scope of the Project

1. Choice of products:

(a) The following products are offered for local assembly/ manufacture:

1.	Tractor 760 - 60 DIN (66 hp SAE)	2,000 units/year
2.	Vehicles	
2.1.	Truck 1290.230.K34/4x2 12 t Tipper	600 total
2.2	Truck 1290.230.044/4x2 12 t	
2.3	Truck 1490.230.S29/6x4 36 t	
2.4	Bus - 890 (50 seater)	300
3.	Combine Self-propelled (Epple mobil 1240 - 115 hp 4.2 m)	400
4.	Pumps (Irrigation)	2,100
4.1	Bauer pump 10F 150-20 $Q = 280\ m^3/h$	
4.2	Bauer pump 10F 65-20 $Q = 70\ m^3/h$	

(b) The types of engines to be imported are detailed below: (Tractor engines will be assembled locally from CKD parts in Phase IV)

Type of Engine	No./year and usage
Steyr 4 cylinder Diesel 66 hp at 2,200 rpm	2,000 tractors
Steyr 6 cylinder Diesel 250 hp at 2,600 rpm	600 trucks
WD 610-10	300 buses
6 cylinder 115 hp DIN	400 combines
Total	3,300 units

(c) It is recommended that efforts be made to standardize engines and components whenever possible.

2. Scale of Production:

The duration of the project is six years. The manufacturing schedule consists of two years of planning and four years of production, with annual phases as detailed below:

Year	1	2	3	4	5	6
Manufacturing Phase	Planning		I	II	III	IV
Tractors	-	-	800	1,400	1,800	2,000
Trucks	-	-	150	250	400	600
Buses	-	-	50	100	200	300
Combines	-	-	25	75	150	400
Pump Sets	-	-	600	1,100	1,600	2,100

The physical facilities in the plant are light machine shop assembly, and painting. The proposed facilities are suitable for the above detailed production volume.

3. Number of Complexes and Alternatives:

(a) The project is to be implemented in four phases of production achieving around 36 - 38 % local content.

(b) Locally purchased components are tyres, batteries and simple castings. It is interesting to note that a number of other items are also mentioned in their list of local purchase items, for which no definite present manufacturing facilities or known plans for actual realization exist. Therefore, it can be assumed that only "inplant manufactured items and assembly" contribute to the local content percentage for all practical purposes.

(c) The proposal mentions Khartoum Central Foundry (KCF) expansion. Steyr estimates a total investment of 1.5 million Sudan Pounds or US$ 4.5 million to enable KCF to reach the required tonnage and quality of castings required. Steyr is prepared to provide to KCF staff, supply of Steyr know-how and technology under a separate financial agreement between KCF and Steyr.

(d) The Steyr proposal consists of two alternatives regarding foundry/forge shop. It proposes (i) a separate foundry/forge shop and (ii) based on the visit to Khartoum Central Foundry, Steyr recommends utilisation of KCF facilities through expansion. The details are given below.

(i) Separate Foundry and Forgeshop Facilities

The Steyr proposal also includes as an alternative, the establishment of a foundry (200 t/month), forgeshop (25 t/month) with common building facilities. In addition, the auxiliary shops (pattern shop, maintenance, testing department, laboratory) are also to be common for both forge and foundry. The total investment is as follows:

Foundry/Forge Building	US$ 3.0 million
Auxiliary Shops	1.7 "
Foundry Equipment	10.7 "
Forgeshop Equipment	2.1 "
Total	US$ 17.5 million
plus if gas is not available and if electricity to be used, additional cost for power installation and equipment	US$ 1.1 million
Grand Total	US$ 18.6 million

Foundry:

(a) The foundry is to be a separate entity with production facilities for grey, malleable and aluminium castings. The capacity is to be 200 tons per month on a single shift, of which 150 tons are required for the factory and 50 tons may be for outside requirements.

The following parts are to be produced in the foundry:

For tractors and trucks:

Cylinder head cover	5.3 kg
Pulley	3.3 kg
Suckton tube	5.5 kg
Flange for bearing	12.0 kg
Bearing housing	13.0 kg
Front end weights	47.0 kg
Rear wheel weights	57.0 kg

Front wheel weights		51.0 kg
Front axle bounting		55.0 kg
Oil sump		19.0 kg
Exhaust manifold		6.7 kg
Manifold		0.8 kg
Intermediate manifold		4.4 kg
Total		1,610.0 t/per year

For combine harvesters:

Pulley	approx.	33.0 kg
Hubs		28.0 kg
Bearing and tensioner		15.0 kg
Total		160.0 t/per year

For irrigation pumps:

Pump housing	55.0 kg
Bearing sockets	20.0 kg
Total	106.0 t/year

Total castings per year 1,875 tons.

(b) The cost of equipment for the foundry will be US$ 12.1 million (melting device: two crucible furnaces of medium frequency induction heating with separate generator and output 1 t/hour each, aluminium melting furnace, casting moulds, ladles; core shop, moulding shop, casting, cleaning, annealing and sand blasting, paint shop, casting store, vehicles for internal transport, conveyors).

Forge Shop:

(a) This is to produce simple forgings. The capacity will be 25 tons per month of which ten tons are for the factory and 15 tons for outside requirements.

(b) The cost of equipment for the forge shop is US$ 2.1 million. (metal cutting, hammers, annealing and blasting installations, strengthening and grinding shop).

If gas is not available, the additional charge for the electric generator installation and equipment is US$ 1.1 million for the whole foundry/forge complex.

(ii) Development of Khartoum Central Foundry (KCF)

(a) As an alternative to a separate foundry, based on the visit of the Steyr expert to KCF, Steyr proposes that KCF facilities are made use of to meet the casting requirement of the proposed factory (1,600 t/year). Steyr is prepared

to supply the know-how, technology, training and management to develop the existing KCF to a standard which could meet the requirements of the proposed factory. Steyr proposes an additional investment of US$ 3.8 million for this expansion.

(b) In this connexion, it should be noted that by using the facilities of KCF, only the existing land and building are utilized and an investment of $ 3.8 million will result in production of wheel weights and ballasts only.

4. Phasing of Assembly and Local Content:

(a) Each of the four phases is expected to develop and locally manufacture in the plant a selected number of components as detailed below:

	Number of Parts to Be Manufactured Locally (cumulative figures)			
Phase	I	II	III	IV
Tractor	25	85	165	250
Truck	20	60	100	130
Combine	100	400	1,200	1,400

(b) During the fourth phase (last year) of the programme for local inplant manufacturing programme of the components, the following raw materials are required per year:

Cast iron	422 t/per year
Forged parts	34 "
Steel bars	417 "
Fine rolled sheet	540 "
Medium and coarse rolled sheet	250 "
Welding steel tubing	23,000 meters
Steamless drawn tubing	28,000 meters
Square and rectangular tubing	30,000 meters.

(c) The value of the local content of the inplant production is expected to be as follows (in percentage) in each phase:

	I	II	III	IV
Tractor	25	30	33	36
Truck	25	30	33	36
Bus	30	32	35	38
Combine	15	20	33	38
Pump set	23	30	36	37.

(d) In order to achieve the above, the physical facilities consist of machine tools and equipment for machine shops (fitting, turning, cutting) welding shop, heat treatment, paint and assembly.

- The total building area will be 39,825 sqm (production area 28,553, storage 10,566, office and installation 3,065 and outside area 14,000, and sheltered store area 2,000 sqm). The total land area will be 250,000 sqm.

- The factory building cost (at 1976 prices for building at AUS 3,900/sqm or $ 200/sqm) is $ 8.4 million.

- The total equipment cost will be $ 22.50 million.

- The total fixed investment (building, equipment, layout, starting and miscellaneous) will be $ 38.1 million.

(e) The cost of foundry, forge, special heat treatment, tool departments and specialised production facilities will be around $ 137 million.

5. Increasing Local Content

(a) The proposed schedule for local factory manufacture and items purchased from local market including raw material for four phases of the project for tractors, trucks, buses, combines and pumps is given below (each phase includes items of the previous phase):

1. Tractor: 760 .

	Local factory manufacture	Purchase from local market and raw material
I	Start of final assembly finishing, painting, inplant production (IP) 25 parts	Tyres, batteries, bolts, nuts, oil, paints, simple castings
II	Front axle assembly Electrical pre-assembly IP: 85 parts	Drivers seat, general body complete muffler, plastics and rubber parts, rivets and washers etc., intermediate casting
III	Gear box and rear axle assembly, hydraulic lift assembly, IP: 165 parts	Radiators, filters, brake lining, brake pipes, complicated castings
IV	Engine assembly complete mud-guard and tank pre-assembly, IP: 250 parts	Head lamps, tail lights, small electrical parts

2. Truck: 1290/1490

	Local Factory Manufacture	Purchase from local market and raw material
I	Start a vehicle assembly, furnishing body assembly, inplant production: IP: 20 parts	Tyres, batteries, parts of body, tipper body, trailer body, bolts and nuts, simple casting
II	Painting, part of chassis assembly, IP : 60 parts	Drivers seat, passenger seat, cabin equipment, tipper-trailer body complete rivets, washers, oil grease etc. intermediate casting
III	Cabin equipment chassis assembly complete IP: 100 parts	Exhaust system, brake lining filters, plastics and rubber parts, welded tubing
IV	Cabin assembly, cabin painting, IP: 130 parts	Springs, radiators, brake pipes, small parts for electrical installation

3. Bus: 890

	Local Factory Manufacture	Purchase from Local Market and Raw Material
I	Body assembly furnishing IP: 20 parts	Tyres, batteries, bolts, nuts, etc.
II	Part of chassis assembly IP: 60 parts	Driver's seat, passenger's seat, furnishing material for bus body, oil grease etc.
III	Chassis assembly complete IP: 100 parts	Exhaust system, brake lining, filter, plastics and rubber parts
IV	IP: 130 parts	Springs, radiator, brake pipe, small electrical parts for electrical installation

4. Combine: Mobile 1240

	Local Factory Manufacture	Local purchase parts and raw material
I	Part of final assembly, painting, IP: 100 parts	Tyres, batteries, paints, bolts and nuts
II	Spotwelding assembly IP: 400 parts	Drivers seat, oil, grease etc.
III	Assembly completed IP: 1,200 parts	Radiator part, plastics and rubber parts
IV	IP: 1,400 parts	Radiator complete, head lamp, tail lamp

5. Irrigation Pump Sets DBS 10/F and DBA 10/F

	Local Factory Manufacture	Purchase from local market and raw material
I	Final assembly, welding of frameparts, painting of inplant parts, IP: 65	Paint, bolts and nuts, oil, grease etc.
II	Assembly of pumps, painting of inplant, IP: 120 components	Castings of intermediate grade
III	Pre-assembly and final assembly of pumps, painting of inplant items IP: 183 parts	Castings of first grade
IV	Painting of inplant items IP: 246 parts	-

(b) For all practical purposes, only items proposed to be locally manufactured in the plant are to be regarded as something definite, as no facilities exist for local plant parts manufacture and supply. In addition, the locally purchased parts (such as tyres, etc.) may be items which are imported. It is better that the factory imports directly all such items in order to save customs duty etc. and dealers' profit margin.

(c) It is not known how local ancillary industry is to be developed, although a proposal has been given for the development of the Khartoum Central Foundry.

6. Transfer of Technology:

(a) The Sudan company should have the following equity structure: Sudan Government 51 %, Steyr and associates 49 % of which Steyr will have between 20 - 25 %. Steyr shall procure foreign exchange loan for all Governments' equity.

(b) Steyr will charge 2.5 % of the Ex-Sudan factory price to those components produced by Steyr's know-how, technology, production methods, techniques and technical drawings and documentation. There will be no other extra costs for new development, ideas and management techniques. This agreement is for ten years.

(c) A start up cost of £S 1,416,400 or US$ 2.54 million is to be charged by Steyr for start up activities including training of personnel, production workers, plant set-up, activities for the increase of plant output and increase of local added value. This start-up cost will include training of local personnel in Sudan and at Steyr works.

(d) Steyr agrees to facilitate the export to other countries. In this connexion, it is to be noted that Steyr estimates an export potential from the Sudan factory to twelve Arab and African countries to be 200 tractors and 180 trucks per year.

(e) The "Founders Agreement" requires careful consideration. The composition of the Board of Directors and provision of all managerial services (under an agreement), technical marketing, administrative and financial services by Steyr require detailed study. In addition, Steyr is to be the (i) the contracting authority, (ii) managing agent, (iii) procurement agent, (iv) supervisor of construction, (v) operating manager of the company in all aspects (organizational, financial, personnel, production marketing and financial planning recruitment etc.), (vi) training manager, and Steyr is to be paid an agreed upon management fee.

(f) The agreement also prevents Sudan from licensing other similar products for local manufacture.

7. Training:

The Steyr proposal includes an integrated training programme at a managerial level; skilled workers (automotive mechanics, electricians, forgesmiths, welders, turners, milling, shaping etc.) in Sudan and in Austria under a separate agreement.

B. Project Implementation

Project Construction Schedule:

The first two years (1977 - 1978) are to be for planning, building, construction and machinery installation. Trial production is to start during the last quarter of 1978 and production to start (phase I) in 1979.

C. Cost of Production

1. Man-power Requirements:

(a) The total staff strength in stage I will be 369 and the total final staff strength will be 880 (phase IV).

(b) During the fourth phase, the distribution pattern of the man-power requirements will be as follows:

Senior Management	2
Middle Management	37
Administrative Staff	121
Supervisor	38
Foreman	48
Skilled Workers	347
Unskilled Workers	287
Total	880

2. Unit Cost of Production:

(a) The completely built unit (CBU) costs for Steyr products in Sudan are as follows: (note: 1 Sudan £ = 2.5 US$)

	CIF Port Sudan US$	CIF Port Sudan + Duty US$
Truck 1290-240-044	26,600	39,900
Truck 1290-240 K34	27,500	41,500
Truck 1490-240 29S	43,700	65,700
Tractor 760	8,200	9,400
Bus 890-150	31,500	47,200
Combine 1250	28,300	32,600
Irrigation Pump 65-20	1,320	1,660
Irrigation Pump 150-20	2,380	2,970

(b) The unit cost of production in the Sudan plant, transfer price (to sales organization) and profit in US Dollars are presented below:

	Unit Cost US$	Factory Sales Price (Transfer Price)	Margin
Truck 1290-240-044	34,000	39,890	5,890
Truck 1290-240 K34	35,500	39,375	5,822
Truck 1490-240-295	57,000	65,662	8,662
Tractor 760	9,000	9,430	430
Bus 890-150	40,250	47,235	6,985
Combine 1250	30,750	32,575	1,825
Irrigation Pump 65-20	1,325	1,657	332
Irrigation Pump 150-20	2,375	2,970	595.

VII. KLOCKNER-HUMBOLDT-DEUTZ AG (KHD) PROPOSAL

A. Scope of the Project

1. Choice of Products:

(a) The KHD (FRG) proposes to act as the sole partner with the Government of Sudan in establishing a factory for local assembly/manufacture of diesel engines, trucks, buses, tractors, combines and agricultural machinery. For this purpose KHD will form a "Consortium of licensers" with the Fahr AG for combines, Magirus-Deutz AG for trucks and buses, and Eberhardt (Ulm) or Rau (Weilheim-Teck), Rabe-Werke (Bad Esser) for agricultural implements with KHD directly licensing engines and tractors. In addition a "Consortium of Suppliers" will be formed by KHD with various FRG and foreign suppliers of building (2 - 3 companies), machine tools (20 - 25 companies), foundry and forge equipment (5 - 6 companies) and KHD will also directly supply special tools, jigs, fixtures etc.

(b) The following products are envisaged to be locally assembled/manufactured in the alternative programme No. II with foundry and forge facilities (units/year): (** please see foot note also)

1.	Tractor D-6806 SAE 72 hp (KHD)	3,000
2.	Diesel Engine (additional to tractor and vehicles and combine engines) (KHD)	700
3.	Vehicles	
3.1	Truck M-232 D 24 FL 6 x 4 (MD) and/or M232 DFFL 6 x 4 (MD)	600
3.2	Bus M-130 EV 90	300
4.	Combines	
4.1	Self-propelled M 1000 (FAHR)	600 #
4.2	Trailed M 66 TS (FAHR)	*
5.	Agricultural machinery # # : 9,000 units	
5.1	Disc plow: Haher-3 (RABE)	625
5.2	Conventional plow: Meise II (RABE)	875
5.3	Disc harrow: Reiher-20 (RABE)	1,250
5.4	Cultivator: GRF-92 (RAU)	500
5.5	Drill: DAS-250 (RAU)	625
5.6	Seed precision drill: Exacta 30 (RAU)	625
5.7	Potato Planter: FLO-4 (RAU)	400
5.8	Potato Digger: 13-S (RAU)	400
5.9	Ridger: 6HG-1 (RAU)	750
5.10	Hoeing machine (RAU)	700
5.11	Spring tooth cultivator: Mammut (RAU)	1,250
5.12	Rotary hoe: RF 200 SG	500
5.13	Grader: TPB-650	500

** Note: The alternative programme No. I envisaged local assembly/manufacture of 2,000 tractors, 700 engines, 900 vehicles (trucks and buses), 600 combines and a lesser number of agricultural implements. Programme No. I does not propose foundry and forge facilities.

The Government of Sudan has prefered the alternative programme No. II with the following changes: * delete the trailed combines, and ** standardise the self-propelled combines.

(c) The engine production, usage and specification will be as follows:

Specification	Usage	Units/yr	Total/yr
3 Cylinder (model 912)	General Purpose	200	200
4 Cylinder (model 912)	General Purpose	200	
	Tractor	3,000	3,200
6 Cylinder (model 912)	General Purpose	100	
	Buses	300	
	Combines	600	1,000
6 Cylinder (model 413)	General Purpose	100	
	Trucks	600	700
8 Cylinder (model 413)	General Purpose	100	100
		Total	5,200

(d) Comments:

Although the tractors, engines and vehicles are well-known and are suitable to Sudan conditions, as the combines and other agricultural machinery have not been widely used in Sudan, it is difficult to give an opinion on its suitability. However, if the production programme incorporates local adaptation and design, then it is acceptable.

In case of engines, it is recommended that four cylinder (type 912) engines are standardised for all general purposes and for tractors with a view to achieve a production level of 3,700 units/year and six cylinder (type 912) is standardised for buses, trucks and combines with 1,500 units/year.

2. Scale of Production:

(a) The scale of production in alternative I and II is similar, except that alternative II aims at a higher local content.

(b) The physical facilities for alternative I are general machine shop, press shop, heat treatment and assembly and a power station. The alternative II consists of a machine shop, special (precession) machine shop, press shop, heat treatment, gear production, foundry, forge and a larger power station.

(c) From the point of view of the production volume, alternative I physical facilities provide the minimum requirements. However, from the point of view of the increased local content, the alternative II will facilitate local production of castings and forgings, gears and special parts.

(d) It is evident that the establishment of a foundry (9,000 t/year) and a forge shop (175 t/month) and a larger power station (5,700 kwh) will certainly facilitate development of the Sudanese engineering industry on a sound technical footing. However, the economic aspects require careful analysis. In addition, the proposed two years operational period for reaching foundry and forge capacities may not be realistic. It is felt that four to five years of operational duration together with a sound internal training/management programme are necessary. Lastly the raw material import magnitude, foreign exchange requirement and viability of the project require detailed study within the framework of the total project as well as possibilities of meeting the country's other forging/foundry requirements though this project requires further study.

(e) In this connexion, it is to be pointed out that alternative II will call for an additional fixed investment of $ 118.2 million as compared to the total investment of $ 67.0 million for alternative I.

(f) From the technical point of view, with reference to the envisaged production volume, the alternative I provides minimum facilities. However, if final considerations permit, then alternative II could be considered.

3. Number of Complexes or Alternatives:

(a) The alternative I consists of a machine shop, press shop, store, assembly (and a power station 2,500 kwh). Alternative II, in addition to the machine shop, press shop, gear shop, store and assembly includes a foundry, a forge shop (and a power station 5,700 kwh).

(b) The total factory building area and the approximate costs are as follows: (excluding the power plant from alternative I and excluding foundry, forge and power plant in alternative II):

	Area	Approximate costs
Alternative I	55,000 sqm	DM 28 mill ($ 11.1 million)
Alternative II	69,000 sqm	DM 34.5 mill ($ 13.8 mill)

(at around DM 500 per 1 sqm)

(c) The manufacturing equipment for the Sudan plant is as follows, based on the single shift operation of assembly, auxiliary section (partly), sales and service, and the two shifts of product oriented section, centralized section and auxiliary section (partly).

(d) The details of the foundry, forge and power plant for alternative II are given below:

Foundry:

In order to meet the factory demand of 5,000 t/year of casting (grey, malleable, cast steel) and taking into account 15 % reject and 65 % utilization, a foundry with a capacity of 9,000 t/year is proposed (two shifts). In addition, a small aluminium diecast foundry (350 t/year) is also proposed. The proposed covered area is 8,000 sqm with a total building cost of DM 12.0 million (6.4 for factory hanger including craneway and power installation, 3.6 for foundation and 2.0 for planning, roads etc., assuming that the land is free). This will amount to US$ 4.8 million (1 $ = 2.5 DM). The cost of foundry equipment and allied investment (equipment cost to be paid 100 %) through irrevocable letter of credit against shipping documents will be US$ 14.8 million. The foundry will employ 300 persons out of whom are direct labour 190, and indirect labour 110 and will require ten German technical personnel. The foundry will require 3,000 kwh power.

Forgeshop:

In order to meet the factory forging requirements, it is proposed to establish a forge shop with a capacity of 175 tons/month taking into account 60 % utilization on a single shift. (Second shift may be used for other forging requirements of the country). The total covered area will be 7,248 sqm. The total cost of the building will be DM 10.1 million or US$ 4.02 million ($ 2.3 million super structure, 1.0 million for foundation and $ 0.72 million for infrastructure/roads). The total investment of forge equipment and accessories will be $ 12.7 million (machines around $ 10.0 million, installation of jigs around $ 2.7 million). The forgeshop will employ a labour force of 167 out of which 100 are direct and 67 indirect staff. It will require additional six German technical staff. The power requirement will be 700 kwh and water consumption will be 20 m^3/hour.

Power Station:

To meet the electrical/power requirement of the factory including foundry and forge, a power station for around 2,500 kwh or 5,700 kwh or 9,000 kwh will be established. For a 5,700 kwh power station (4 Deutz engine, 4 Siemens alternators and switch gears), a building of 2,300 sqm area (cost $ 0.6 million) and equipment (6 Deutz engines, 6 Siemens alternators and switch gears etc.) worth $ 12.5 million are required. It will consume 63 tons diesel fuel and 420 kg lubricating oil per day. It will require six supervisors.

(e) The total fixed investment (building and plant equipment) for a factory (assembly section, special produot oriented production section, centralized production section consisting of general production, gear production, press shop and heat treatment, production planning and material handling section, sales purchase and administration section and social facilities), foundry, forge shop and power station at the present cost structure will be:

Alternative I: $ 67.0 million
Alternative II: $ 185.2 million

The details are given in the following table:

Note: In this connexion, additional charges for engineering consulting etc. (approximately 15 %) are expected to be as follows:

Alternative I: $ 9.0 million
Alternative II: $ 21.5 million

Details of Fixed Investment Costs: KHD

	Alternative I	Alternative II
Land	free	free
Building area sqm		
Factory	55,000	69,000
Foundry	-	8,000
Forge	-	7,248
Total	55,000	85,248
Power plant	2,300	2,300
Grand Total	57,300	87,548

	Alternative I	Alternative II
Building costs ($ million)		
Factory	11.1	13.8
Foundry	-	4.8
Forge	-	4.0
Total	11.1	22.6
Power plant	0.6	0.6
Grand Total	11.7	23.2

	Alternative I	Alternative II
Investments: Factory (Machine tools/equipment) (million $)		
Factory	52.0	122.0
Foundry	-	14.8
Forge	-	12.7
Total	52.0	149.5
Power Plant	3.3	12.5
Grand Total	55.3	162.0
Total Fixed Investment (Building + equipment) (million $)		
Factory	63.1	135.8
Foundry	-	19.6
Forge	-	16.7
Total	63.1	172.1
Power Plant	3.9	13.1
Grand Total	67.0	185.2

(f) Therefore, the choice between alternatives (I or II) is purely a financial one.

(g) In this connexion, it is to be stated that the alternative II is given because the following machine tools and equipment are additionally required as major items as compared to alternative I:

	US$ million
Foundry	14.8
Forge	12.7
Gearshop	15.6
Engine Special Component Production	20.4
Tractor Special Component Production	6.4
	69.9

(h) If in alternative I, only tractors, combines and agricultural machinery assembly and allied part production (excluding press shop and gear production) and other service facilities are considered, (alternative IA), the total equipment cost is $ 26.55 (excluding building) as shown in the following table.

KHD Alternative I A

Plant equipment cost (adjusted equipment cost) without assembly: engines, buses, trucks; special product production: buses, trucks; centralized production: gearshop and press shop.
(Note: this does not include building)

Assembly

Tractor Assembly	$ 0.48 million
Combine Assembly	1.85 "
Agricultural Machinery including planters	1.84 "

Special Product Production

Tractor	$ NIL
Combine	7.32 "
Agricultural Machinery	2.84 "

Centralized Production

General Production	$ 6.68 "
Heat treatment	0.88 "
Production Planning and material handling	4.66 "
Total	$26.55 million

4. Location:

No recommendation on the choice of location is included in the proposal. The Government is considering Port Sudan or Wad Medani.

5. Phasing of Assembly and Manufacture:

(a) The project is for a duration of five years of which the first three years are planning and implementation and the next two years are operational.

(b) The alternative I mainly concentrates on import of CKD including all castings and forgings and local manufacture of very simple parts (steel bar stock turned, some press parts, simple sheet metal, piping etc.), simple machining, assembly and painting. The alternative II aims at local production of forgings and castings and machinery.

(c) The annual requirements of raw material for alternative I and II are as follows:

Type of Material	Annual Requirement tons/year		Established Cost/ton	Raw Material Cost per year (000 DM)	
	I	II	DM/Ton	I	II
Grey cast iron	240*	5,700	2,200	-	12,540
Spare cast iron	130*	760	3,700	-	2,812
Malleable cast iron	-	220	2,700	-	594
Al.pr. die cast	-	25	7,200	-	180
Al.gr. die cast	-	125	12,000	-	1,500
Alloyed forging	6	1,700	2,800	-	4,760
Non-alloyed forging	-	650	2,200	-	1,430
Non-ferro metals	10	12	2,500	25	30
Steel tubing	430	920	2,000	800	1,840
Steel profile	1,300	3,300	700	910	2,310
Alloyed bar	240	720	840	210	604
Non-alloyed bar	320	840	710	227	596
Heavy sheet metal	1,000	2,100	750	750	1,575
Medium sheet metal	1,250	1,680	845	1,056	1,420
Thin sheet metal	1,700	3,300	840	1,428	2,772
Total	-	-	-	5,466	34,963

* Note: to be imported

(d) Thus a total raw material cost/year for alternative I will be DM 5.466 million (US$ 2.18 million) and for alternative II will be DM 34.963 DM ($ 13.9 million).

(e) The KHD proposal also aims at securing selected supplies (engines: starter dynamo, piston/ring, oil/fuel/air filter, injection, valve, oil cooler, oil seat and tractors: tyres, rims, batteries, lamps, instruments, seats, exhausts, hydraulic pump, clutch, brake, steering etc.) from special suppliers from abroad.

(f) However, the proposal does not detail any plans for development of local ancillary industry potential.

(g) The proposal aims at establishing six operational sections (material handling, assembly, product oriented production, centralized production section, auxiliary section, technology sales and service section). This concept is acceptable.

6. Increasing Local Content:

(a) The following inplant production by value is anticipated in alternative I and II project (% by value)

Item	Assembly		Manufacture		Total	
	I	II	I	II	I	II
Tractor	9.5	9.5	10.5	45.5	20.0	55.0
Engines	8.5	8.5	6.5	44.5	15.0	53.0
Vehicles						
Trucks	6.2	6.2	14.4	36.6	20.6	42.8
Buses	31.0	31.0	37.2	43.8	68.8	74.8
Self-propelled Combine	13.9	13.9	26.8	26.8	40.7	40.7
Implements (average)	7.0	7.0	25.0	53.0	32.0	60.0

(b) The local % content in alternative I is acceptable as a maximum for tractors, engines and trucks although the actual criteria for such a presentation is not mentioned. However, it is not known how around 68.8 % for buses and 40.7 % for combines and 32.0 % for implements could be achieved. Similarly, although the alternative II includes foundry and forge, the possible achievement of 55 % local content for tractors etc. within two years of operational

T A B L E

Foreign Exchange Requirement for Material

	Foreign Exchange Requirement for Completely Built Unit Import			Foreign Exchange Required for National Manufacturers					
	Value/Unit	Total		Alternative I (CIF million DM)			Alternative II (CIF million DM)		
		I: CIF	II: CIF						
	Thousand DM/unit	Mill. DM per year	Mill. DM per year	Raw Material	Specialized Items	Total	Raw Material	Specialized Items	Total
Tractor	25.4	50.7	76.1	-	42.1	42.1	-	43.3	43.3
Engine	-	6.5	6.5	-	5.7	5.7	-	4.4	4.4
Truck	119.2	71.5	71.5	-	57.8	57.8	-	44.2	44.2
Buses	144.7	43.4	43.4	-	15.7	15.7	-	11.6	11.6
Spare parts combine	77.9	31.2	46.8	1.2	23.9	25.1	-	31.8	31.8
Tractor combine	39.5	7.9	15.8	0.08	3.9	4.0	-	7.9	7.9
Total Agricult. Implements	-	57.0	71.7	-	38.8	47.7	-	31.1	31.0
Total		268.2	331.8	1.28	187.9	189.1	0.9	174.3	174.2

period is doubtful. However, it is to be recognized that these physical facilities do provide a potential to achieve the proposed local content, probably after four to five years of operational period.

(c) No specific plans have been given in the proposal regarding development of local ancillary potential and procurement of locally made components.

7. Transfer of Technology:

(a) The consortium of licensers with KHD as a sole negotiator shall grant the right to the Sudanese Licensee the usual rights to manufacture and sell, and written technical and other documentation shall be made available. However, product adaptation, redesign, change in quality etc. is subject to further separate studies and negotiations.

(b) It is said that separate product license contracts (twelve years duration) should be concluded with KHD (for tractors and engines); Fahr (for combines minus engines); MD (for trucks and buses minus engines); Rabe, Eberhard and Rau (for different implements). It is not very clear if the Sudanese Licensee should conclude a separate contract or KHD as the sole partner shall negotiate with the Sudanese Licensee.

(c) The proposal also states that the Sudanese Licensee should provide a lump sum payable on signature of the individual contracts ($ 3.4 million on alternative I and $ 5.0 million on alternative II).

In addition, a royalty of 4.0 % on actual sales minus CKD deleted value to be given to each contractor on a running basis.

(d) The total investment in foundry (9,000 t/year) excluding building will be $ 14.8 million. Regarding the foundry equipment, payment is to be effected 100 % by the Licensee to KHD against usual shipment documents out of an irrevocable letter of credit. KHD will, under a separate agreement, provide the know-how, the technical documentation, technical assistance (9 personnel), establish organizational, management, engineering aspects, prepare tenders, analyse tenders and secure equipment, and supervise erection and start-up.

However, the total fee is to be negotiated with KHD for this service.

(e) Similar participation in establishment of a forge shop (175 tons/day with a total investment of $ 12.7 million excluding building), KHD participation is available.

However, the total fee is to be negotiated with KHD for this service.

(f) The KHD proposal also includes 15 % engineering consultancy charges on all assistance rendered in machine tool selection and procurement, engineering know-how procurement etc.

(g) KHD also proposes separate payment for the training programme and for provision of the German experts.

8. Training:

(a) The following man months training is envisaged:

	in Germany	in Sudan
Alternative I	354	831
Alternative II	685	1,419

(b) For this purpose KHD will delegate KHD experts as

	Permanently placed	Temporary (first 3 years)
Alternative I	30	222
Alternative II	66	498

(c) The expenses involved for this training and foreign experts' services are to be charged separately on a man months basis.

(d) In this connexion, it should be noted that the alternative I labour force is 1770 (with 37 engines, 82 foremen and 1,072 semi and skilled workers. The corresponding figures for alternative II are 3,742, 42, 112 and 2,520.) Therefore, it is to be said that the training programme suggested in this proposal is a little weak.

B. KHD: Project Implementation

Project Construction Schedule:

The total project duration is five years. The setting up period is estimated to be three years (engineering preparation, procurement, delivery and installation of plant, recruiting and training, operating and administrative personnel, developing local sub-suppliers and importers etc.). The production target is expected to be achieved in the fourth year.

C. KHD: Cost of Production

1. Man-power Requirements:

Alternative I

	indirect	direct	total
Executives	11	-	11
Works Managers/Engineers	37	-	37
Foremen	82	-	82

	indirect	direct	total
Supervisors/Clerks etc.	311	-	311
Typist	103	-	103
Skilled Workers	55	350	405
Semi-skilled Workers	80	587	667
Unskilled Workers	35	119	154
Total	714	1,056	1,770

Alternative II

	direct	indirect	total
Directors	11	-	11
Works Manager/Engineer	42	-	42
Foremen	112	-	112
Supervisors/Clarks	503	-	503
Typists	152	-	152
Skilled Workers	112	880	992
Semi-skilled Workers	179	1,349	1,528
Unskilled Workers	80	327	407
Total	1,191	2,556	3,747

2. Unit Cost of Production:

(a) The following are prices of completely built units (CBU) for selected items:

DM '000

	Tractor 6806	Engine 3FL 912	Engine 6FL 912	Engine 8FL 413	Truck	Bus	SF Com-bine
Exworks Licensor	22.2	4.2	6.96	18.05	199.2	132.6	59.0
FOB packed	23.5	4.5	7.38	19.14	111.4	135.3	60.8
CIF Port Sudan	25.2	4.8	7.89	20.48	119.2	144.7	77.9
Landed Cost Sudan Factory (LCSF) with customs duty	33.3	7.1	11.64	30.21	184.9	251.2	100.9
LCSF without customs duty	32.1	6.1	10.65	26.11	152.0	184.5	99.4

Note: LCSF includes 15.0 % exchange rate, 3.5 % clearance and 6.0 % internal transport.

(b) The following figures give the price CKD per unit for selected items:

DM '000

	Tractor 6806	Engine 3FL 912	Engine 6FL 912	Engine 8FL 413	Truck	Bus	SF Combine
Alternative I							
Landed cost Sudan Factory (LCSF) with customs duty	28.1	5.9	10.1	27.9	152.9	107.7	76.6
LCSF without customs duty	27.0	5.1	8.7	23.9	144.9	80.4	75.2
Alternative II							
Landed cost Sudan Factory (LCSF) with customs duty	19.3	3.6	5.8	26.0	116.6	88.7	73.8
LCSF without customs duty	18.6	3.1	4.9	21.8	94.5	66.2	71.1

Note: LCSF includes 15.0 % exchange rate, 3.5 % clearance and 6.0 % internal transport.

(c) As the details on local manufacturing (direct material, labour and variable overhead costs) are not available, it is not possible to calculate the unit costs of the Sudan Factory.

VIII. UNIDO ASSISTANCE IN MANAGEMENT OF PROJECT IMPLEMENTATION

1. Phases of Project Implementation

As emphasised already by the mission, since none of the proposers is offering a turnkey project, the Government of Sudan will need to organise the numerous detailed steps that are required to implement the project. A schematic diagram of the various functions which must be performed, is attached.

The detailed steps to project implementation are:

(a) Full feasibility study/appraisal including definition of project scope and broad engineering specifications.

(b) Agreement with foreign collaborator for technology and management transfer.

(c) Broad agreement on external and domestic financing.

(d) Appointment of engineering contractor.

(e) Appointment of general contractor, and as necessary civil, mechanical, and electrical contractors.

(f) Finalisation of external financing.

(g) International procurement of equipment.

(h) Project construction.

(i) Proving and take-over of plant.

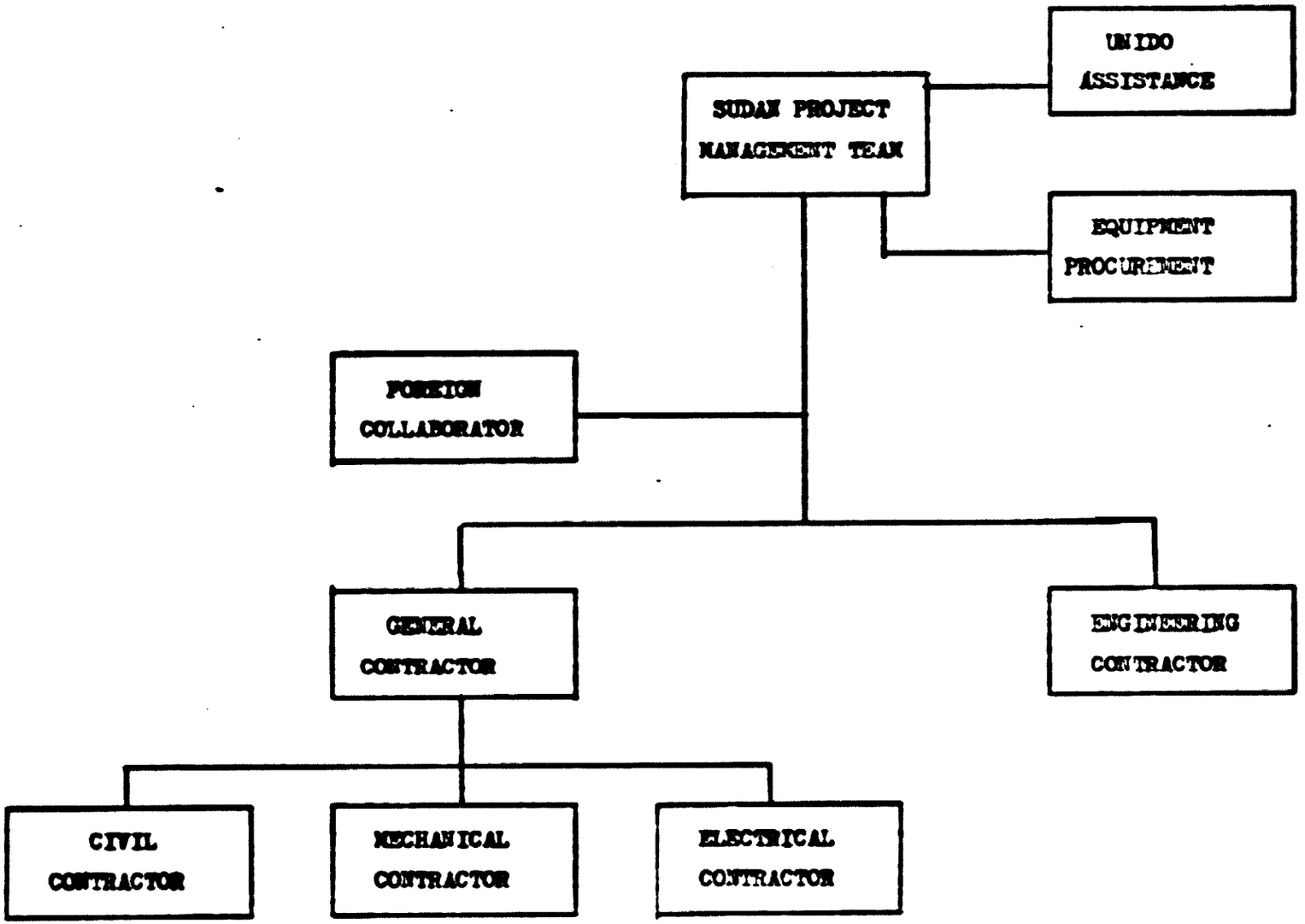
The Sudan Project Management Team must be set up as early as possible, appointments being made in the following order:

(i) Project Director
(ii) Technical Manager
(iii) Financial Manager
(iv) Procurement Manager
(v) Administration/Personnel Manager

2. UNIDO Assistance

UNIDO will be glad to undertake the role of "owner's representative", and assist the Sudan Project Management Team in all the steps (a) through (i) detailed above. Such assistance can be at varying depths and over the whole implementation cycle, as may be desired by the Sudan Government.

ARRANGEMENTS FOR MANAGEMENT OF PROJECT IMPLEMENTATION



In addition, UNIDO can help in two other specific ways:

(a) Assisting to send a three-man Sudanese technical team for a few weeks to other developing countries that have already set up tractor manufacturing facilities in collaboration with multi-national firms. This team could visit tractor and automobile industries, ancillary manufacturers and Government officials to discuss mutual problems, and absorb the experience gained by these countries.

(b) Identify, select, and depute expatriate personnel to fill those key positions in the Sudan Project Management Team, for which suitable Sudanese nationals may not immediately be available.

SUDAN: AGRICULTURAL TRACTOR PROJECT

ANNUAL FOREIGN EXCHANGE SAVINGS:

On Massey-Ferguson Proposal Stage IV

(i n U S $)

I. Products	CBU Price landed Sudan	CKD Cost landed Sudan	Gross Foreign Exchange Savings
a) Tractor MF 275	24,608,520	15,029,160	9,579,360
b) Combine MF 507	11,973,344	10,337,916	1,635,428
c) Disc harrow MF 360	4,720,170	2,831,570	1,888,600
d) Disc plough MF 765	1,095,585	634,410	461,175
e) Tool carrier MF 351	495,040	45,383	449,657
f) Tiller MF 38	560,560	278,600	281,960
g) Disc harrow MF 34	1,711,120	754,610	956,510
h) Spinner broadcaster MF 11	217,042	172,986	44,056
Total	45,381,381	30,084,635	15,296,746

II.	GROSS FOREIGN EXCHANGE SAVINGS ON PRODUCTS		15,296,746
	Less		
	1. Licence and Engineering Fee	1,150,000	
	2. Planning Fee	75,000	
	3. Management Assistance	75,000	
	4. Management Fee	1,240,000	
	5. Trade Mark Licensing Fee	1,000	
	6. Implementation Agreement Fee	150,000	
	7. Interest on l.t. foreign debt	1,368,360	
	8. L.t. debt capital repayment	1,520,400	
	9. Warranty payments	145,250	
	10. Expatriate salaries	450,000	
	11. Inputs of components and consumables	601,693	
	12. Dividends to foreign shareholders	1,118,000	7,894,703
	Net annual foreign exchange savings		7,402,043

SUDAN: AGRICULTURAL TRACTOR PROJECT

COMPARISON OF PERFORMANCE: FINANCIAL STAGE IV

	Massey-Ferguson	Steyr
Financial Parameters (US$ '000)		
Annual Sales Turnover	62.000	80.852
Annual Cost of Sales	40.000	69.524
Fixed Assets	28.538	43.487
Working Capital	28.500	24.373
Capital Employed	57.038	67.860
RATIOS		
Cost of Sales/Sales Turnover	0.65	0.86
Working Capital/Turnover	0.46	0.30
Sales Turnover/Fixed Assets	2.17	1.86
Cost of Sales/Fixed Assets	1.40	1.60
Output/Capital	1.09	1.19

ANNEX 3

MF = Massey-Ferguson
ST = Steyr

SUDAN: AGRICULTURAL TRACTOR PROJECT

COMPARISON OF FIXED ASSETS AND WORKING CAPITAL INVESTMENT

(US$ '000)

Development Stages	I		II		III		IV		TOTAL		
	MF	ST	MF	ST	MF	ST	MF	ST	MF	ST	
Building	5,386	2,896	-	2,300	-	1,532	-	256	5,386	6,984	
Machinery	121	588	-	2,357	3,293	2,798	2,870	1,855	6,284	7,598	
Equipment and Office Furniture and Office Machinery	1,462	2,715	437	2,064	1,275	2,112	731	1,064	3,905	7,955	
Automobiles	108	276	71	92	122	294	80	249	381	911	
Production Tooling	18	122	24	324	1,438	846	1,118	556	2,598	1,848	
Start-up costs	1,250	1,758	500	903	250	954		632	2,000	4,247	
Contingencies		808		581		436		225		2,050	
Fixed Assets Expenditure	8,345	9,163	1,032	8,621	6,378	8,972	4,799	4,837	20,554	31,593	
Cumulative Fixed Investment	8,345	9,163	9,377	17,784	15,755	26,756	20,554	31,593	20,554	31,593	
Cumulative Fixed Investment with 10% p.a. price escalation	10,098	11,087	11,472	22,561	20,810	35,698	28,538	43,487	28,538	43,487	*)
Working Capital	-	5,307	7,250	10,351	16,750	14,326	28,500	24,373	28,500	24,373	
Total Investment	10,098	16,394	18,722	32,912	37,560	50,024	57,038	67,860	57,038	67,860	

*) This would appear to have been grossly under-estimated, in comparison to the more realistic estimate of MF.

SUDAN: AGRICULTURAL TRACTOR PROJECT

ILLUSTRATIVE FINANCING PLAN (based on MF)

(US$ '000)

I. Project Investment: Cumulative

	Stage I	Stage II	Stage III	Stage IV
Local Currency				
40% of buildings (2154) + Working Capital	2,154	9,404	18,904	30,654
Foreign Exchange				
(Fixed assets plus 60% of buildings)	7,944	9,318	18,656	26,384
Total Investment	10,098	18,722	37,560	57,038

II. Financing Plan: Stage IV

Principles:

Debt/Equity Ratio 60 : 40

Government/Foreign Shareholders Equity Ratio 51 : 49

Complete coverage of foreign exchange requirements with foreign equity plus foreign loans.

	Local Currency	Foreign Exchange	Total
Equity			
Government	11,635		
Foreign		11,180	22,815
Long Term Debt			
For building (part)	2,154		
Other fixed assets		15,204	17,358
Short-term Debt			
For working capital	16,865		16,865
	30,654	26,384	57,038

ANNEX 5

SUDAN: AGRICULTURAL TRACTOR PROJECT

PARTIAL ROUGH ANALYSIS OF MF PROPOSAL FOR PROGRESSIVE LOCAL MANUFACTURE **)

Stage	Year	Local Production Activities	Progression of Deletion Values for MF 275 Tractor (%)	Incremental Deletion Value: Total for 3000 Tractors ($'000)	Previous Years New Equipment Investment ($'000)	Increase in Employment (Number of additional Empl.)
Stage I	(1979)	Assembly, test, local purchase	15	2,070 (only 2000 tractors)	3,000	117
Stage II	(1980)	Add: Major component assembly	17	{ 1,035 * / 345 }	1,750	92
Stage III	(1981)	Add: General purpose machining	25	1,620	6,500	171
Stage IV	(1982)	Add: Heat treating, plating, gear and splined shaft machining	42	3,450	4,250	88
				8,520	15,500	468

*) The 1035 arises from increased production quantity compared with previous year.

**) Of course, the equipment investment (and personnel) contribute also to production of combines and implements; but the tractors account for over half of the local production value.

SUDAN: AGRICULTURAL TRACTOR PROJECT

Progression of Deletion Values and Incremental Deletion Values for MF Implements

Stage	Year	Wide Level Disc Harrow MF 360 (annual volume 1000)		Disc Plough MF 765 (anual volume 1500)		Tool Bar MF 351 (anual volume 1300)		Tiller MF 38 annual volume 500)		Mounted Disc Harrow MF 34 anual volume 1000)		Spinner-Boradcaster MF 11 (anual volume 200)	
		Progression of Del. Val. (%)	Incr. Del. Val. ($'000)	Progression of Del. Val. (%)	Incr. Del. Val. ($'000)	Progression of Del. Val. (%)	Incr. Del. Val. ($'000)	Progression of Del. Val. (%)	Incr. Del. Val. ($'000)	Progression of Del. Val. (%)	Incr. Del. Val. ($'000)	Progression of Del. Val. (%)	Incr. Del. Val. ($'000)
Stage I	(1979)	—	—	—	—	—	—	—	—	—	—	—	—
Stage II	(1980)	5	177	2.6	23	—	—	5	25	4.5	64	3	4
Stage III	(1981)	40	1,243	47.8	392	90.85	402	50	227	55.9	725	20	22
Stage IV	(1982)	40	1,243	47.8	392	90.85	402	50	227	55.9	725	20	22

ANNEX 5 b

SUDAN: AGRICULTURAL TRACTOR PROJECT

PARTIAL BENEFIT ANALYSIS OF MF PROPOSAL FOR PROGRESSIVE LOCAL MANUFACTURE (IMPLEMENTS) **)

Stage	Year	Local Production Activities	Progression of Deletion Values for MF Implements (weighted %)	Incremental Deletion Values: Total for 5500 Implements ($'000)	Previous Years New Equipment Investment ($'000)	Increase in Employment (Number of additional Empl)
Stage I	(1979)	—	—	—	—	—
Stage II	(1980)	Assembly	5	293	1,750	92
Stage III	(1981)	add: fabrication, machining	44	3,011	6,500	171
Stage IV	(1982)	- " -	44	3,011	4,250	88
				6,315	12,500	351

**) Of course, the equipment investment (and personnel) contribute also to production of tractors and combines.

Detailed figures for the implements as regards progression of deletion value and incremental deletion value on seperate sheet.

ANNEX 5 c

SUDAN: AGRICULTURAL TRACTOR PROJECT

PARTIAL BENEFIT ANALYSIS OF MF PROPOSAL FOR PROGRESSIVE LOCAL MANUFACTURE (COMBINES) **)

Stage	Year	Local Production Activities	Progression of Deletion Values for MF 507 Combines (%)	Incremental Deletion Value: Total for 400 Combines ($'000)	Previous Years New Equipment Investment ($'000)	Increase in Employment (Number of additional Employees)
Stage I	(1979)	—	—	—	—	—
Stage II	(1980)	Assembly, paint and test	15	1,640	1,750	92
Stage III	(1981)	- " -	15	1,640	6,500	171
Stage IV	(1982)	- " -	15	1,640	4,250	88
				4,920	12,500	351

**) Of course, the equipment investment (and personnel) contribute also to production of tractors and implements.

ANNEX 5 d

SUDAN: AGRICULTURAL TRACTOR PROJECT

PARTIAL ROUGH ANALYSIS OF MF PROPOSAL FOR PROGRESSIVE LOCAL MANUFACTURE (Tractors, Combines, and Implements) and RATIO: EQUIPMENT/DELETION VALUE; and RATIO: DELETION VALUE/JOBS

Stage	Year	MF 275 Tractor(3000)		MF 507 Combines(400)		MF Implements(5500)		Total MF products		Previous Years New Equipment Investment ($'000)	Increase in Employment (Number of add. Employees)	Equipment/Deletion Value (Ratio)	Deletion Value per Job ($'000)
		Progression of Deletion Values (%)	Incremental Del. Value ($'000)	Progression of Deletion Values (%)	Incremental Del. Value ($'000)	Progression of Deletion Values (%)	Incremental Deletion Value ($'000)	Progression of Del. Values (adjusted %)	Incremental Deletion Value ($'000)				
Stage I	(1979)	15	2,070 (only 2000 tractors)	—	—	—	—	15	2,070	3,000	117	1.44	17,692
Stage II	(1980)	17	(1,035 *) 345	15	1,640	5	293	15	3,313	1,750	92	0.52	36,010
Stage III	(1981)	25	1,620	15	1,640	44	3,011	32	6,271	6,500	171	1.03	36,670
Stage IV	(1982)	42	3,450	15	1,640	44	3,011	37	8,101	4,250	88	0.52	92,050
			8,520		4,920		6,315		19,755	15,500	468		

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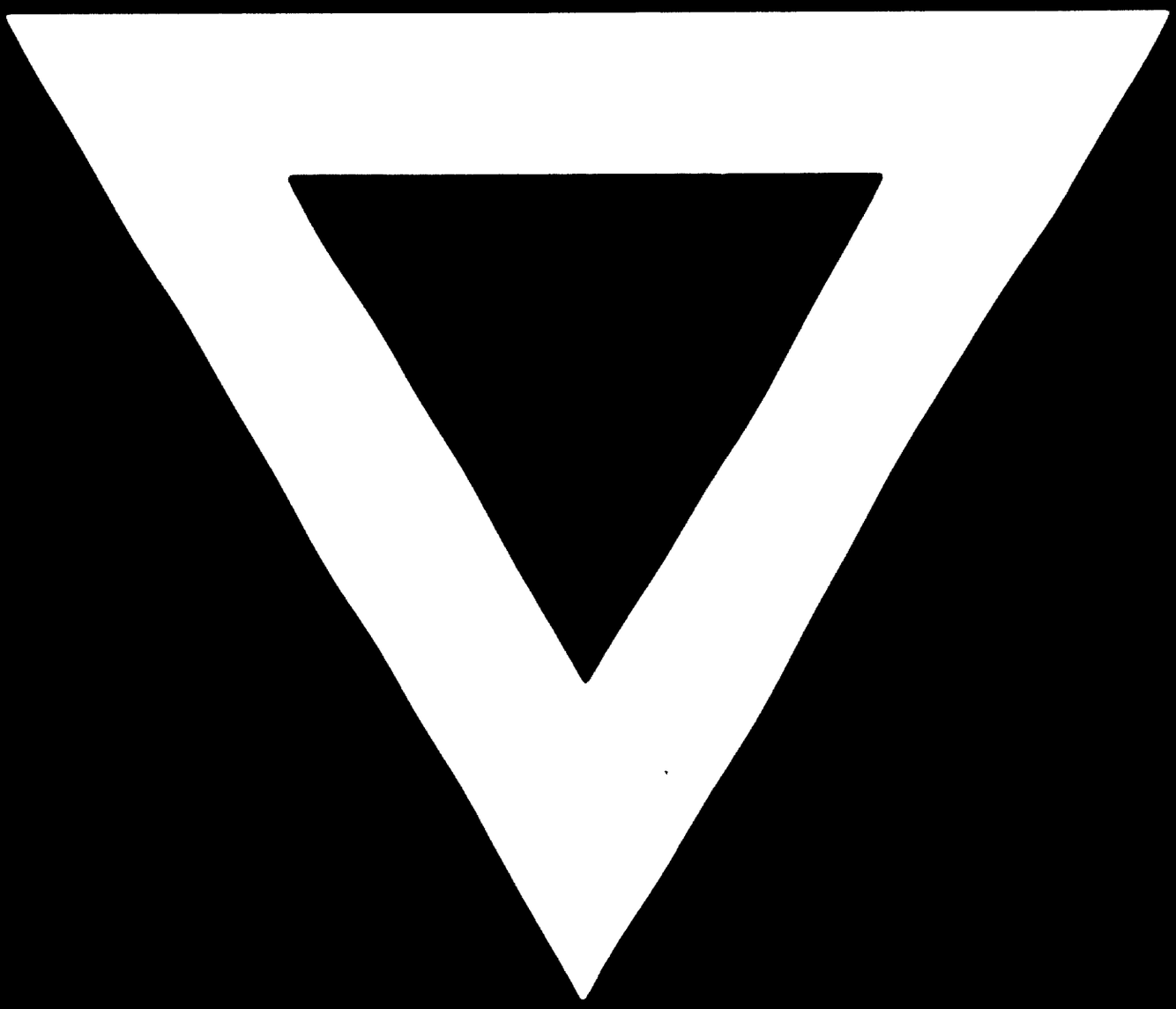

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