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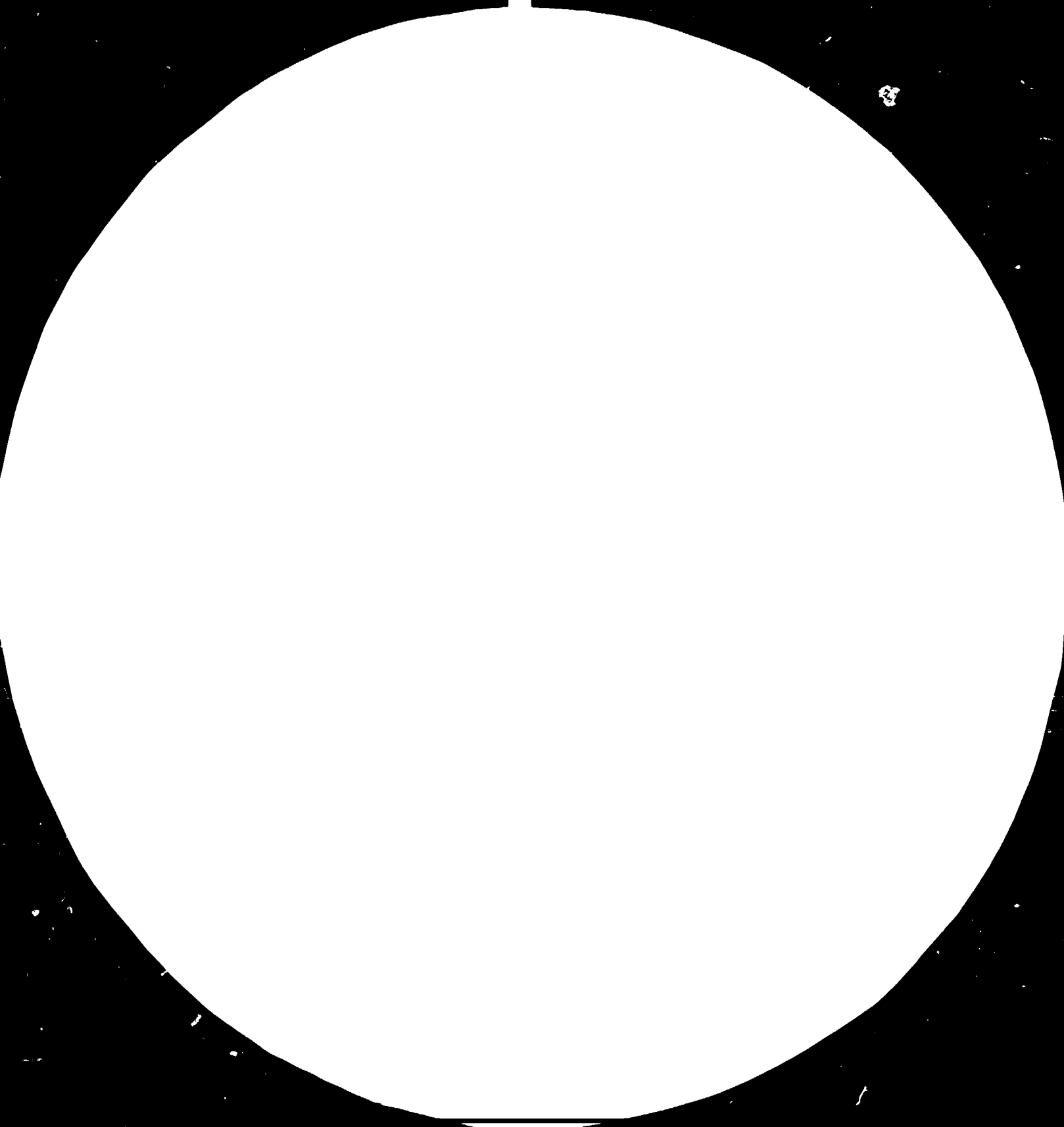

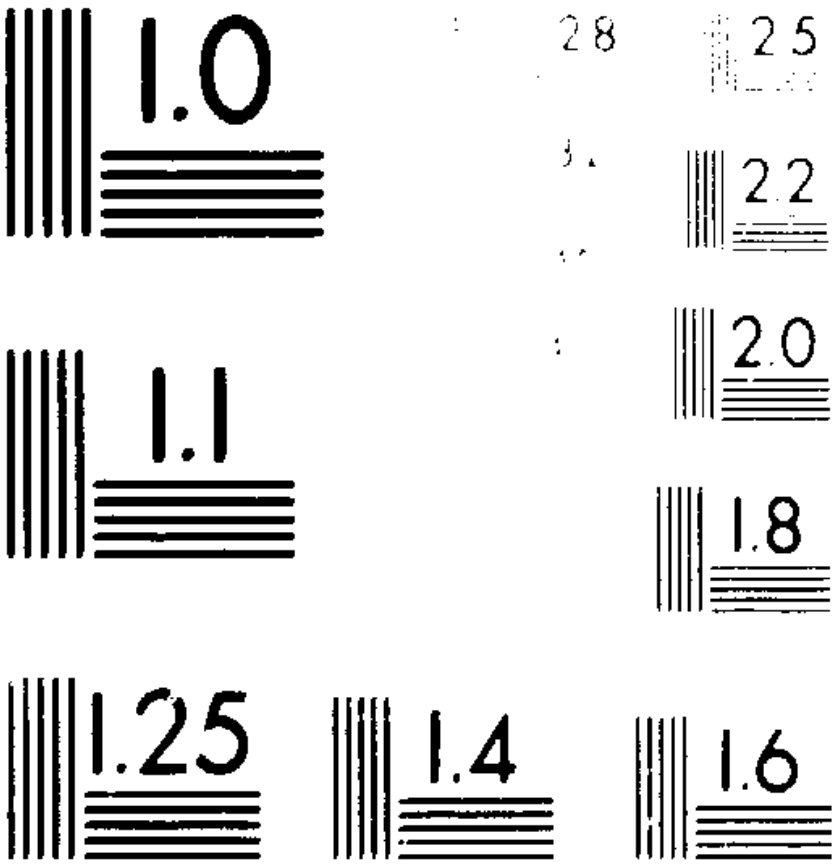

Meindersma Consulting Services

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Malawi.

TECHNO-ECONOMIC EVALUATION STUDY OF THE ESTABLISHMENT OF A VEGETABLE OIL SOLVENT EXTRACTION PLANT IN MALAWI

SI/MLW/82/801

FINAL REPORT

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TECHNO-ECONOMIC EVALUATION STUDY

OF THE ESTABLISHMENT OF A

VEGETABLE OIL SOLVENT EXTRACTION

PLANT IN MALAWI

November 1983

TECHNO-ECONOMIC EVALUATION STUDY FOR THE ESTABLISHMENT OF A VEGETABLE OIL SOLVENT EXTRACTION PLANT IN MALAWI

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SYMBOLS AND ABBREVIATIONS

ADMARC	Agricultural Development and Marketing Corporation
GRAMIL	Grain and Milling Company
LEVER	Lever Brothers (Malawi) Ltd
NOIL	National Oil Industries Ltd
NSO	National Statistics Office
SE	Solvent Extraction
SEC	Solvent Extraction Company
t	metric tonne
tpa	tonnes per annum
tpd	tonnes per day
m^3	cubic metre
k	Kwacha (US$0.90)

INTRODUCTION

L H Manderstam and Partners Limited have the honour to submit their report entitled "Techno-Economic Evaluation Study of the Establishment of a Vegetable Oil Solvent Extraction Plant in Malawi", prepared for the Government of Malawi on behalf of the United Nations Industrial Development Organisation, under Contract No 83/11, Project No SI/MLW/82/801.

The Terms of Reference of the present study are set out in Annex 3.

The study deals with a project which has been contemplated for a number of years by interested parties in Malawi.

A two-specialists team visited Malawi mid 1983, held extensive discussions with Government Agencies and private concerns, and collected pertinent data and information. Although the results of the present study are negative, the Consultants hope that its contents will assist the Government and the parties concerned in formulating the most appropriate course of action for the development of the oilmilling industry to the country's best interest.

The Consultants wish to thank in particular the following Ministries, Government Departments and private concerns for their most helpful assistance and co-operation extented to them during their stay in Malawi.

1. Ministry of Agriculture
   - Chief Agricultural Research Officer
   - Planning Division
   - Food and Nutrition Section
   - Department of Animal Health and Industry
   - Chitedze Agricultural Research Station
2. Ministry of Trade, Industry and Tourism
3. Office of the President and Cabinet-Treasury Section
4. Ministry of Finance, Development Division
5. Ministry of Works
6. Agricultural Development and Marketing Corp (ADMARC)
7. Malawi Development Corp (MDC)
8. National Oil Industries Ltd (NOIL)
9. Lever Bros (Malawi) Ltd (LEVER)

10. Grain and Milling Co Ltd (GRAMIL)
11. National Seed Company of Malawi (INSCM)
12. Malawi Export Promotion Council
13. Press (Holding) Ltd
14. Spearhead Enterprises Ltd
15. Naming'omba Tea Estate Ltd
16. Investment and Development Bank of Malawi Ltd
17. National Bank of Malawi
18. Manica Freight Services

SECTION ONE : SUMMARY AND RECOMMENDATIONS

1.1 STATUS OF THE VEGETABLE OIL INDUSTRY - POSSIBLE FUTURE DEVELOPMENT

1.1.1 In Section 2 of the report, a brief description of NOIL and LEVER processing facilities is given. By modifying the speed of the main worm shaft of the existing expellers and by altering the spacing of the cage lining bars, NOIL could process annually cottonseed meals from up to 12,000 tonnes of whole seed over 150 days by pre-pressing, and sunflower meals from some 11,000 tonnes of seed over the rest of the year. Although high oil content sunflower is not grown in Malawi to a significant extent, the indications are that this oilseed offers promising prospects. Similarly, LEVER could prepress up to 18,000 tonnes of groundnut over 300 working days, given the availability of high oil content material, particularly from estates.

1.1.2 The prepressed cottonseed and groundnut cakes containing 14% residual oil and the prepressed sunflower cake with 16% residual oil would constitute the feed to a solvent extraction plant. This procedure would maximise the overall oil recovery as compared with full pressing, which leaves at present around 6.5% oil in the cottonseed and groundnut cakes, at the same time minimising the capital outlay of both NOIL and LEVER required to achieve maximum oil production.

1.2 THE HOME MARKET FOR EDIBLE VEGETABLE OILS

1.2.1 The potential long term demand for oils is first assessed in Section 3 on the basis of nutrition targets based on recent surveys, taking into account apparent direct consumption of vegetable oils, and the calculated indirect consumption of all fats. The theoretical demand as found is very high, around 40,000 tonnes by 1988/89.

1.2.2 On practical grounds and taking into account the culinary habits of the country, a per capita consumption level of 1.5 kg is put forward (compared with 0.5 kg at present), corresponding to 12,000 tonnes in 1988/89, probably rising to nearly 14,000 tonnes by 1993/94.

1.2.3 The current prices of vegetable oils marketed by LEVER are indicated, with a broad comparison with levels prevailing in Western Europe.

1.3 THE MARKET FOR OILCAKES AND EXTRACTION MEALS

1.3.1 The present consumption of cottonseed and groundnut cakes by GRAMIL for feedstuffs compounding is about 2,100 tonnes annually. Plans for the expansion of livestock production are vague, and there is little justification in utilising compounds due to their high costs and low meat prices. A semi-liberisation of the latter would induce higher feed consumption, particularly in the poultry and pig sectors. A captive demand of about 10,000 tonnes per annum in 1992/93 is assumed in the study.

1.3.2 Exports of oilcakes from Malawi, mainly to Zimbabwe and Zambia fluctuated between 2,000 tonnes and 5,000 tonnes during the past five years. Little is known regarding the supply and demand situation of oilcakes in these two neighbouring countries as well as Mozambique. In the absence of reliable information, a projected probable export volume of oilcakes/meals of some 10,000 tonnes is assumed for the purpose of the study.

The export prices of meals, worked back to ex-mill levels, are indicated, based on recent international price trends.

1.4 THE RAW MATERIAL SITUATION

1.4.1 Groundnut

Owing to the limited availability of Manipintar nut and low quality fractions from ADMARC sorting operations, the tonnage which had been processed so far by LEVER is well below their milling capacity. The new SAC 58 improved groundnut variety is to replace Manipintar for crushing purposes. The removal of the restriction imposed on tobacco estates in the growing of other crops would easily enable the country to reach rapidly a high oil content groundnut production of, say, 20,000 tonnes per annum, particularly in the Central and Southern Regions.

1.4.2 Cottonseed

Output of seed cotton has declined abruptly in 1982/83. The recovery of this sub-sector is anticipated through higher farmers' price and contribution to the output by estates diversifying their production. Should the national output of the crop reach the same peak level as in 1978/79, the quantity of cottonseed which would be made available to NOIL could well amount to 12,000 tonnes in 3-4 years' time.

1.4.3 Sunflower

Improved varieties have been successfully grown in Malawi. Sunflower cultivation, particularly on estates, appears to be very promising and an annual output of 10,000 - 15,000 tonnes by the late 1980's would be possible to achieve. In terms of oil production, sunflower seed is a valuable raw material, both on account of high yield and oil quality.

1.4.4 Soyabean

Although soyabean meal is an essential component in poultry and pig feed formulations in developed economies, the cultivation of the crop on a large scale would not be justified in Malawi, if priority is to be given to the production of vegetable oils. Nevertheless, limited quantities of soyabean could be crushed mainly for cake or, alternatively, processed into full fat soya flour for animal feeding.

1.4.5 Rice Bran

In the relevant section of the report, it is shown that solvent extraction of rice bran in Malawi cannot be envisaged on economic grounds, due to elevated transport costs which are ultimately reflected in the high cost of the extracted oil after refining.

1.4.6 Maize Germ

Hominy chop, the maize germ and bran fraction obtained by GRAMIL in their mills, is low in oil and high in starch content. The latter feature would preclude the possibility of using the material as a feed to a solvent extraction unit due to technical considerations, while the former characteristic would lead to relatively high extraction costs.

1.4.7 Summarising the above, the production of high oil content groundnut of the crushing variety and the introduction of sunflower cultivation would be highly desirable in order to supplement the oil availability from cottonseed.

1.5 SOLVENT EXTRACTION PLANT UNDER CONSIDERATION

1.5.1 Section 6 of the report gives the production schedule of NOIL, LEVER and the Solvent Extraction Plant, assuming that the latter will come into operation in 1988 at reduced capacity, to increase gradually to full rated capacity in 1993 with the introduction of sunflower seed processing. The oil output would be in accordance with the progression of demand of the country.

1.5.2 The location of the Solvent Extraction Plant should be ideally in the viscinity of LEVER's oilmill where land is available as well as adequate supplies of electric power and water.

1.5.3 Capital costs are estimated in this section and would amount to:

	'000 K
Machinery and Equipment	2,700
Civil and Structural Works	1,400
Fixed Investment	4,100
Working Capital	531
Total Investment	4,631

1.5.4 Operating requirements, their unit and operating costs broken-down into main components are given from 1988 to 1993 onwards. In the latter years, these would amount to K 52.44 per tonne of extracted crude oil, excluding 10% p.a. depreciation and 16% p.a. interest on working capital, and at K513 per tonne when the latter two elements of cost are taken into account.

1.6 SELLING PRICES OF THE PRODUCTS

1.6.1 The relationship between NOIL, LEVER and the Solvent Extraction Company (SEC) can assume one of two alternatives:

a) Alternative I: SEC is a processing and trading company, selling extraction meals on the home and export market, and extracted crude sunflower oil to LEVER. Extracted crude cottonseed oil and groundnut oil would be taken by NOIL and LEVER respectively, free of charge.

The selling prices of the prepressed cakes from NOIL and LEVER are set at their "opportunity value", namely the levels at which the two oilmillers would anticipate if they were to have recourse to full oilseed pressing as compared with prepressing/solvent extraction in order to obtain the same margin, against necessary investments made independently.

b) Alternative II: SEC is a service company processing prepressed cakes from NOIL and LEVER against a fee which is computed on the basis that SEC would get an internal rate of return (IRR) around 20% to allow for negative effects of an under-estimation of two main parameters, investment and operating costs. All the meals would be taken back by the primary producers together with the crude oils extracted (with exception of sunflower oil, at least physically).

Substantiating calculations for the two options open to NOIL and LEVER are presented in Annex 1.

1.7 FINANCIAL EVALUATION

In Section 9, the Solvent Extraction Project is evaluated from different angles.

1.7.1 Alternative I: SEC is a Processing and Trading Concern.

With the "Opportunity values" of prepressed cake and the selling prices of the extraction meals, the IRR is virtually nil.

Alternative II: SEC as a Service Company

To show a financially sound financial IRR, placed at about 20% to allow for negative factors, the nominal processing fee per tonne of prepressed oilcake received is found to be K105/tonne.

1.7.2 From NOIL's and LEVER's point of view, and in particular in relation to the latter as LEVER would ultimately fully refine, pack and sell the oils, the charge of K105/tonne of prepressed cakes would lead to losses when compared with the 1982/83 level of average cost of oil, bulk basis. To achieve the same average cost, assuming that oilseeds costs remain constant and oilmeal prices do not decrease below the levels indicated, the purchase price of prepressed oilcakes by SEC should be decreased by a corresponding amount which is computed in that section of the report. The resulting price is such that, for NOIL and LEVER to break even, the IRR of SEC operations is 5% or less.

1.8 RECOMMENDATIONS

1.8.1 The Consultants recommend the promotion of increased crushing grade groundnut production and the development of sunflower cultivation, together with the obvious necessity of rehabilitating the cotton growing sector.

1.8.2 In the light of a close examination of the conditions applying at present in the oilmilling sector, the Consultants do not recommend the setting up of a solvent extraction plant in Malawi in the near future.

1.8.3 In view of the capital intensiveness of solvent extraction and the consequential processing costs, it is recommended that both NOIL and LEVER expand for the time being their expelling capacity to fully press cottonseed, sunflower and groundnut, forfeiting the extra yield in vegetable oils which would be obtained by solvent extraction. The fixed investment required would be about one-third of that needed to set up a solvent extraction plant.

1.8.4 Solvent extraction of oilseeds (prepressed or direct) can only be considered on economic grounds if:

a) the cost of groundnut and sunflower seed is low enough, through crop intensification;

b) the Government would concede a price increase for vegetable oils and hence a fair producer margin. Such a course of action can only be considered on the premise that some form of price liberalisation is adopted for other basic food commodities as well.

1.8.5 Any attempt to qualify or quantify the above statement would be of a speculative nature. The Consultants, therefore, recommend that the situation be reviewed in 4-5 years' time, in the light of the development of market demand and of potential oilseed availability.

SECTION 2 : PRESENT STATUS OF THE VEGETABLE OIL INDUSTRY - POSSIBLE FUTURE DEVELOPMENT

Edible vegetable oils are produced by NOIL and Lever Bros (Malawi) Ltd. The former process cottonseed and sell semi- refined oil to the latter for further refining, who also produce groundnut oil. Quantities of tung oil are produced by Naming'omba Tea Estate Ltd at Thyolo in the Southern Region.

In the present section of the report, a description of the manufacturing operations of NOIL and LEVER is given, together with an elaboration into the possibility of pre-expelling oilseeds instead of the present practice of full pressing, the resulting cakes being transferred to a new, appropriately located solvent extraction unit for further oil recovery.

2.1 NATIONAL OIL INDUSTRIES LTD (NOIL)

The oil mill is located in Blantyre. Cottonseed is delivered to the plant in bags by rail and the godown is situated alongside the rail siding. The space available is sufficient to store 3,200 tonnes in bags, stacked to a height of about 7.5 m.

2.1.1 Delinting and Decortication Section

The residual lint of the seed after ginning is not known but is believed to be 10-12%. Some of this lint is removed by single cut in four delinting machines. There is a second bank of four delinting machines but these were not in use at the time of the Consultant's visit. Most operators of delinting machines reckon to remove 5-6% of the lint in a single cut leaving the balance of the lint on the seed.

According to NOIL General Manager's milling report for January to 30 April 1983, the amount of high grade lint removed was only 0.18% and the amount of substandard lint was 1.18%. The amount of lint recovered in previous years was not known. The delinting equipment is old and suffers frequent breakdowns. If the equipment is refurbished and brought back to good condition and properly adjusted, the capacity should be about 10 tonnes per 24 hours per delinting machine when producing "mill run" linters. The recovered linters are sorted by hand into various grades.

The decortication section consists of two knife type hullers, each complete with a shaker separator. The cut seed from the decorticator is distributed over the shakes separator. The meats separate from the hulls and pass through the perforations. The hulls from the shaker separator then pass through a hull beater. The beating action separates meats contained in half cut seeds and small meats particles adhering to the hulls. The meats are fed back into the meats conveyor and the hulls fed to the boiler house. A proportion of hulls are mixed with the meats for feeding to the screw presses.

Due to inefficient delinting operation, the lint adhering to the cottonseed makes decortication difficult and prevents the efficient separation of meats from the hulls. An indication of the composition of the hulls discharge can be gained from the General Manager's report mentioned above, which shows the following:-

		tonnes	
Cottonseed crushed	=	2891	
Crude oil produced	=	479	
Cake produced	=	1284	
Oil in cake (6.2%)	=	79.6	
Lint recovered	=	39.2	(1.36%)
Hulls and lint removed	=	948	

From data communicated to the Consultants, the analysis of Malawi cottonseed can be assumed to be on a dry basis:

	%
Lint	12
Hulls	23
Meats	45
Oil	20
Total	100

For 2,891 tonnes of seed crushed early 1983, the following tonnages are calculated:

	tonnes
Lint	347
Hulls	665
Meats	1301
Oil	578
Total	2891

Crude oil produced, plus residual oil in the cake amount to 558.6 tonnes, which leaves 19.4 tonnes of oil lost in processing i.e., meats/oil lost in the hulls stream, oil spillage and oily foots.

If it is assumed the whole of this oil is lost in the hulls then this amounts to 2% of the hulls stream and the meats 5% of the hulls stream.

The proportion of hulls in the meats stream for screw pressing as currently practiced is low, amounting to less than 5%.

2.1.2 Oil Mill

2.1.2.1 Cottonseed Processing

The existing preparation arrangement bypasses the roller mill and the meats and hulls are fed directly to the cookers mounted above the screw presses.

Before cooking and conditioning, the decorticated seed (meats plus hulls) should be thoroughly rolled in order to rupture the cells and make them more liable to release oil during the subsequent conditioning and pressing.

The screw presses are of Rosedowns manufacture, namely:

2 - MK II long cage D type serial Nos. 536/2 and 5967/12.

2 - Maxoil Duplex serial (Nos unreadable).

Three of these screw presses are in working order and the fourth (Maxoil Duplex) is partially dismantled.

Four stage cooker/conditioners are mounted above the presses and operate with a steam pressure of 80 psig (at the boiler).

The capacity of the plant as it is set up at the present time is about 12,000 tonnes of cottonseed when operated 24 hrs/day over 300 working days. The seed is passed through four delinting machines, one decorticator and separator unit with the hull beater, bypassing the rolls, with the meats plus hulls going straight to the cooker/conditioner before being pressed in the two MK II presses and one of the Duplex screw presses.

The two MK II screw presses are presently handling about 12 tonnes per 24 hours each of meats, producing a cake with 6-7% residual oil.

The oil is channelled into a ground tank from where it is pumped through a filter press before storage in a further tank. The oil is then partially refined (neutralised) in a small Sharples centrifuge plant, having a capacity of 20 tonnes/24 hrs. Soapstock is drummed and, until recently, shipped to Mozambique.

The average FFA (Free Fatty Acid) content of the crude oil produced by NOIL over the past five years was:-

1979	1980	1981	1982	1983
7.6%	5.6%	5.8%	4.31%	3.8%

The neutralised oil received by Lever Bros averaged 0.05% FFA and colour 6.5 red in 1" cell.

Production data relating to cottonseed oil are given for the past four years in Table 2.1. The refining losses during the period January to 30 April 1983 show a substantial improvement over previous years. More can be done, however, in improving the storage conditions of the cottonseed at ginneries, intermediate stores and those at NOIL. Free fatty acids are formed during prolonged storage periods under adverse humidity and moisture conditions.

Cottonseed Prepressing

Increased oil production from cottonseed could be achieved by prepressing the seed to produce a cake suitable for solvent extraction. It is also important to improve the efficiency of the delinting and decortication section in order to remove more linters from the seed. A more careful control and maintenance of the hulls and meats separation system is also required to ensure that the meats/oil loss in the hulls is reduced to a minimum and rolling the meats/hulls before conditioning will also improve the oil recovery.

The two MK II presses can be modified to pre-presses producing a cake with about 14% residual oil by increasing the speed of the main wormshaft and altering the spacing of the cage bars. The capacity of each press would then reach approximately 30 tonnes of meats per 24 hours. If both presses are utilised, it would be necessary to bring in the second line of delinting machines. The two decorticators should be adequate but the capacity of the 48" double drive AA rolls is marginal (50 to 75 tonnes/24 hours, depending on the amount of rolling required).

In this study, a throughput of 12,000 tonnes of cottonseed over 150 working days per year (80 tonnes per 24 hours) is considered. It is assumed that the delinting, decortication and rolling equipment is refurbished to provide suitably prepared meats for two MK II presses.

If delinting is restored to maximum efficiency then yields of linters should be approximately 5% using a single cut operation. However, a 3% removal is conservatively assumed in the present calculations. Based on the following cottonseed analysis:

	%
Lint	12
Hulls	23
Meats	39
Oil	19.9
Moisture	6.1
TOTAL	100.0

the quantity of products per 80 tonnes of whole cottonseed are shown in Table 2.2, which also gives the corresponding quantities of solvent extracted oil and meal.

When operating as a prepress on decorticated cottonseed, the power absorbed would be approximately 85% of the installed horsepower of the press (45 HP). The power and steam consumption of the cooker will remain the same.

The life of the case-hardened pressure worms and cage lining bars would be increased from about 4 months to 9-10 months before requiring rebuilding or replacement. The cost of these items would be around K8,000 for each press.

The approximate cost of necessary parts to change the speed of the main worm shaft and the altering of the spacings of the cage lining bars on the MK II would be about K2,000 per press.

Spare parts for and refurbishing the delinting and decorticating plant, rolls, and modifications to conveyors would be of the order of K35,000, installed.

2.1.2.2 Sunflower Seed

In this sub-section of the report, the possibility of processing this seed is investigated.

After cleaning, the seed is decorticated and the hulls separated from the oil bearing meats; these can be used as fuel to raise steam in the existing boiler. A proportion of hulls, up to 10% is left in the meats in order to help the screw pressing operation.

In large capacity plants sunflower seed requires separate specialised dehulling equipment. In the case of NOIL, it is possible that the basic cottonseed dehuller and separator can be used. However, the abrasive shells of the sunflower seed will quickly cause excessive wear, both to the rotating and stationary knives of the decorticator. It would thus be advisable to acquire a separate dehuller/separator when processing a substantial tonnage sunflower.

Before pressing, the meats should be rolled but unlike cottonseed which requires heavy rolling, sunflower seed requires only a light rolling, one or two passes of the five-high stand being sufficient.

The capacity of the Rosedowns MK II screw press when prepressing sunflower seed meats would be the same as for cottonseed meats, namely 30 tonnes per 24 hours.

The power absorbed would be approximately 75% of the 45 HP installed.

The life of the case hardened pressure worms and cage lining bars would be about 9 to 10 months when prepressing decorticated sunflower seed. The approximate installed cost of parts to change the speed and alter spacings would be the same as for cottonseed.

Control of the moisture content of sunflower seed is particularly important for decortication. Above 8%, the hulls will take a plastic form and will be difficult to crack. A moisture content below 6% will result in the seed being excessively crushed, thus creating difficult in the separation of hulls from the meats.

The two MK II screw presses will handle up to 60 tones per 24 hours of sunflower seed meats, so for 150 days operation the total seed requirements would be some 11,000 tonnes (75 tonnes per 24 hours).

A typical analysis of sunflower seed given by NOIL is as follows:

	%
Oil	42
Meats	26.7
Hulls	25
Moisture	6.3
	100.0

For a daily input of 75 tonnes of seed the quantity of products from prepressing and solvent extraction are given in Table 2.3.

The NOIL plant through rehabilitation and addition of a cleaning machine, sunflower decortication and another set of AA rolls, and modifications to elevators and conveyors could process two oilseeds as follows:

a) 80 tonnes/24 hours of cottonseed through the refurbished delinting and decortication equipment and the resulting meats through the existing rolls and two MKII presses when refurbished and modified to prepressing. Crude oil filtering capacity will have to be increased.

b) 75 tonnes/24 hours of sunflower seed through a new cleaning machine, a new decorticator and separator (these should be able to handle also cottonseed), a new set of AA rolls, conveying and elevator system to the two MK II presses suitably modified to prepressing.

The installed cost of the sunflower seed cleaner, decorticator and separator is estimated at K187,000. A new crude oil filter and auxiliaries would cost about K60,000.

Annual seed requirements would be:-

Cottonseed :	12,000 tonnes over 150 days
Sunflower seed :	11,250 tonnes over 150 days

It should be noted that when storing sunflower seed cake or meal great care should be taken to avoid spontaneous combustion and it may be necessary to install ventilation equipment.

2.2 LEVER BROS (MALAWI) LTD

2.2.1 The plant at Limbe processes groundnut of the following varieties:-

Manipintar : grown in the central region and first choice for crushing. It can be machine shelled and produces a good crop even if rainfall is low.

Crushers : Chalimbana grade 'C' mixed.

GDX : Chalimbana, small, shrivelled and splits.

Chalimbana : export grade confectionery nuts, lower grades, A22 and B, make-up the crushing quota.

From samples analysed in Lever Bros, laboratory the average analysis from seven samples of each type is as follows:

	Manipintar	Crushers	GDX	Chalimbana
% Oil on Wet Basis	46.2	45.1	38.94	43.58
% Moisture	6.2	5.45	5.57	5.64
% Oil on Dry Basis	49.3	47.8	41.2	46.14
% FFA as OLEIC	1.3	1.52	0.64	0.65

A new variety SAC 58 to replace Manipintar is being promoted by te National Seed Co., and is claimed to have 2 or 3% more oil than Manipintar.

Groundnut kernels are delivered to the oilmill in bags and stacked in the same building as the mill.

2.2.2 The kernels are fed into the intake hopper and then elevated and conveyed to the two cookers mounted over two Rosedowns MK IIA screwpresses. These screwpresses are fairly new having been installed in 1977.

The groundnut presscake containing 6.8% residual oil on average is ground in a hammer mill before bagging.

The oil and foots are screened in an inclined scraper conveyor fitted with wedge wire screens, the foots returned with the kernels feed to the cookers and the oil pumped through two filter presses. The filtered oil is then stored before refining.

According to LEVER'S management, the maximum capacity of the oil mill is 9,000/10,000 tpa; this capacity was never reached owing to the shortage of raw material; the highest throughput achieved was about 5,000 tpa.

2.2.3 The refinery is of the batch type, consisting of two main processing vessels, a 5 tonne batch neutralising and bleaching vessel, and a 5 tonne batch deodorising vessel. Depending upon the quality of the crude oil 3 to 4 batches per day can be carried out in the neutraliser - bleacher and 3 batches per day in the deodoriser.

Neutralised cottonseed oil from NOIL is processed in the refinery and used in the production of a refined and deodorised blended oil which is sold under the brand name " KAZINGA", usually made up of 50% refined cottonseed oil and 50% refined groundnut oil. Pure refined and deodorised groundnut oil (brand name "COVO") is also produced.

LEVER also produce a hard margarine and have a 1 ton per hour Votator unit. There is no hydrogenation unit at the Limbe plant and hardened fish oils are imported from RSA and Northern Europe for blending with groundnut oil and non-fatty components.

The liquid oils "KAZINGA" and "COVO" are filled into plastic bottles of 125 ml, 500 ml and 1 litre size.

Lever Bros are obtaining a crude oil yield of 40% on input groundnut kernels and a refining yield of about 97% on crude oil.

2.2.4 The Case of Prepressing

The two MK IIA presses when modified to a prepressing function will each process up to 30 tonnes per day of groundnut kernels producing a cake containing approximately 14% residual oil.

As there is no pre-treatment plant involved before pressing, the only other equipment to check and modify, if necessary, the increased throughput, are the elevators and conveyors.

When operating as a prepress on groundnut kernels the power absorbed would be approximately 60% of the installed HP of the press (45 HP). The cooker power and steam consumption will remain the same.

The life of the case hardened pressure worms andd cage lining bars would be increased from about 3 months to 7 to 8 months before requiring re-building or replacement.

The approximate installed cost of the necessary parts to change the speed of the main worm shaft and alter the spacings of the cage linings on the MK IIA would be as in the case of NOIL (K2,000 per press).

Taking the Manipintar type of groundnut as a basis with an average analysis:

	%
Oil	46.2
Protein, carbohydrates, fibre	47.6
Moisture	6.2
	100.0

the quantity of products per 60 tonnes/24 hrs of groundnut kernels (18,000 tonnes over 300 days per annum), together with the corresponding tonnage of solvent extracted oil and meal are given in Table 2.4

Additional refining capacity will have to be installed if the full potential of the screw presses at NOIL and LEVER are to be exploited together with that of a solvent extraction plant.

TABLE 2.1

NOIL : PRODUCTION DATA - 1979 TO 1983

	1979	1980	1981	1982	1983*
Cottonseed Crushing					
Amount of cottonseed crushed (metric tons)	10200	9579	11210	10236	2891
Cottonseed expeller cake production (metric tons)	4024	3890	4586	4010	1284
Cottonseed expeller cake (% of throughput)	39.5	40.6	40.9	39.2	44.4
Crude oil production (metric tons)	1666	1698	1790	1521	479
Crude oil production (% of throughput)	16.3	17.7	16.0	14.9	16.6
Cottonseed hulls (metric tons)	3884	3506	4254	4088	948
Cottonseed hulls (% of throughput)	38.1	36.6	38.0	39.9	32.8
Neutralisation					
Crude oil input (metric tons)	1666	1680	1763	1515	479
Neutral oil production (metric tons)	1132	1277	1465	1296	429
Neutral oil production (% of input)	68.0	76.0	83.0	85.6	89.6
Soapstock production (metric tons)	430	373	445	397	103
Soapstock production (% of input)	25.8	22.2	25.3	26.2	21.7
Quality of Cottonseed and Expeller Cake					
Cottonseed					
Oil content in cottonseed (average)	18.8	19.4	19.3	19.7	19.9
Free fatty acid content on extracted oil (average)	7.6	5.6	5.8	4.31	3.8
Moisture content of cottonseed (average)	9.0	9.5	8.2	6.8	6.1
Cottonseed Expeller					
Fat content (average)	6.4	6.9	7.2	6.5	6.2
Protein content (average)	39.7	45.0	44.0	43.8	41.0
Moisture content (average)	3.9	3.9	4.4	3.4	3.0

* to 30/4/83 when all the cottonseed was exhausted

Source : NOIL

TABLE 2.2 : YIELD OF PREPRESSED CAKE MEAL AND CRUDE OIL FROM 80 TPD COTTONSEED

SEED ANALYSIS

	%
Lint	12
Hulls	23
Meats	39
Oil	19.9
Moisture	6.1
TOTAL	100.0

YIELDS

Oil in Cake	12%	13%	14%	15%
Moisture	7%	7%	7%	7%
Crude Oil, T	10.6	10.1	9.6	9
Cake, T	44	44.6	45.2	45.8
SE Meal (0.7%)	38.7	38.7	38.7	38.7
SE Crude Oil, T	5	5.5	6 (a)	6.6
Total Crude Oil, T	15.6	15.6	15.6	15.6
Total per annum (150d), T	2,340			

(a) 900 t from 12,000 t CS

TABLE 2.3 : YIELD OF PREPRESSED CAKE, MEAL AND CRUDE OIL FROM 75 TPD SUNFLOWER SEED

SEED ANALYSIS

	%
Oil	42
Meats	26.7
Hulls	25
Moisture	6.3
	100.0

YIELDS

Oil in Cake	14%	15%	16%	17%
Moisture	7%	7%	7%	7%
Crude Oil, T	26.4	26	25.6	25.2
Cake, T	32.9	33.3	33.8	34.2
SE Meal (0.7%)	28.2	28.2	28.2	28.2
SE Crude Oil, T	4.4	4.8	5.2	(a) 5.6
Total Crude Oil, T	30.8	30.8	30.8	30.8
Total per annum (150d), T	4,620			

(a) 780 from 11,250 SF

TABLE 2.4 : YIELD OF PREPRESSED CAKE, MEAL AND CRUDE OIL FROM 60 TPD MANIPINTAR TYPE GROUNDNUT

SEED ANALYSIS

	%
Oil	46.2
Protein, carbohydrates, fibre	47.6
Moisture	6.2
	100.0

YIELDS

Oil in Cake	12%	13%	14%	15%
Moisture	7%	7%	7%	7%
Crude Oil, T	23.5	23.1	22.6	22.2
Cake, T	35.3	35.7	36.2	36.7
SE Meal (0.7%)	31	31	31	31
SE Crude Oil, T	4	4.4	4.9	(a) 5.3
Total Crude Oil, T	27.5	27.5	27.5	27.5
Total per annum (300d), T	8,250			

(a) 1,470 t from 18,000 t GN

SECTION 3 : THE HOME MARKET FOR EDIBLE VEGETABLE OILS

3.1 CURRENT CONSUMPTION

3.1.1 Lever Bros (Malawi) Ltd are the sole producers of finished edible vegetable oils. They purchase semi-refined cottonseed oil from NOIL and the brands marketed by the company are COVO (groundnut oil) and KAZINGA (a 50:50 groundnut/cottonseed oil blend). In 1982, Lever Bros marketed 200 tonnes of sunflower oil imported from the RSA, under the brand name of SOLO. About 440 tonnes of sunflower oil were also imported in 1980 and used presumably in oil blends or hydrogenated compounds. The small-scale production of vegetable oils in rural areas is non-existent.

During the 1973-1982 period, sales of vegetable oils by Lever Bros fluctuated between 2,200 tonnes and 2,800 tonnes per annum.

3.1.2 During the same ten year period, sales of STORK margarine by Lever Bros averaged 420 tonnes per annum, and amounted to 680 tonnes in 1982. That of bakery fats increased irregularly from 42 tonnes in 1973 to 200 tonnes in 1982. Imports of margarines (mostly by private bakeries) decreased from about 700-800 tonnes in 1978-1979 to 25-77 tonnes in 1981-1982.

Lever Bros do not carry out the hydrogenation of vegetable oils but compound margarines and bakery fats from imported hydrogenated oils and locally produced groundnut oil, in the ratio of 1:1. Hydrogenated oils (largely fishoil) are imported from the RSA and Norway.

3.1.3 The above data point to an apparent consumption of refined vegetable oils in 1982 as calculated below:

TABLE 3.1 : APPARENT CONSUMPTION OF VEGETABLE OILS - 1982

	tonnes	Equivalent vegetable oils, tonnes
Lever Bros sales of refined oils	2,785	2,785
Lever Bros sales of margarine/fats	882	355
Imported margarine/fats	77	35
TOTAL		3,175

With a population estimated at 6 million, the overall average per capita consumption of vegetable oils is around 0.5 kg.

3.1.4 The staple food in Malawi is maize meal (Ufa). In rural areas, it is obtained by pounding the grain and separating the germ and bran. Extraction rates usually vary from 60 to 70%, depending on maize variety and whether the grain is soaked in water prior to pounding or processed dry. Extraction rates around 85% are achieved in industrial mills operated by GRAMIL.

Production and consumption figures for maize are not available but official sources estimate the national average per capita usage at 220 kg, corresponding to some 140 kg of Ufa. From results of analyses made available to the Consultants by the Chitedze Research Station, Ufa from current maize varieties contain about 2% oil from the residual germ fraction, so that an additional 3 kg of vegetable oil is indirectly consumed per capita.

3.1.5 Another source of vegetable oil in the food intake is groundnut consumed directly at farm level and, to a lesser extent, by the urban population. Production figures for the groundnut crop are not known but unofficial estimates place the groundnut consumption at around twice the tonnage handled by ADMARC. This would give a consumption for the country of the order of 40,000 tonnes per annum, equivalent to 6.6 kg per capita, which corresponds to about 2.5 kg of oil.

3.1.6 Summarising the above, the per capita consumption of vegetable oils in Malawi can be estimated as follows:

TABLE 3.2 : PER CAPITA CONSUMPTION OF VEGETABLE OILS

	kg/annum
Direct consumption	0.5
Indirect consumption:	
from Ufa, say	3.0
from groundnuts, say	2.5
TOTAL	6.0

3.2 POTENTIAL DEMAND

3.2.1 In 1979, food and nutrition surveys were carried out in Kasungu, (Centre region), South Mzimba (Northern region) and Phalombe Plain and Zomba East (Southern region), as part of the pilot National Sample Survey of Agriculture (NSSA). Sample households were visited daily for five days every two months over a total period of nine months. All food consumed by individual members of the households were quantitatively recorded and their energy content determined. Upon analysis of the data, the following average contribution of various food commodities to energy intakes was found:

	%
Cereals	75
Roots/Tubers	5.3
Groundnuts	5.7
Pulses	5.4
Vegetables	3.4
Animal products	3.1
Other	2.1
TOTAL	100.0

According to the Food and Nutrition Section of the Ministry of Agriculture, the national average daily energy intake is around 1,500 Cal, some 70% below the recommended level of 2,100 Cal, with fat contributing to the extent of 10% of the total. From the above tabulation, 3.1% of the energy intake is in the form of animal products (fish and meat), or about 65 Cal. These can be taken as averaging 15-18% protein and 18% fat, raw basis. Taking protein at 4 Cal/g and fat at 9 Cal/g, the calculated animal fat intake is 5 g/day or 1.8 kg/annum

The total per capita fat consumption as calculated in the foregoing paragraphs would thus be:

TABLE 3.3 : PER CAPITA TOTAL FAT CONSUMPTION

	kg/annum
- Vegetable oils, directly and indirectly consumed	6
- Animal fats	1.8
Total Fat	7.8

The calculated daily intake of all types of fats is thus 21g, equivalent to 189 Cal or 12.6% of the daily average energy intake; the latter figure is higher than the Ministry's estimate of 10%. The difference between the two percentages can be attributed to estimation errors and to the fact that the food and nutrition surveys which were carried out in four areas of the country in 1979 may not be fully representative of the overall nutritional pattern of the country.

3.2.2 The Food and Nutrition Section of the Ministry estimates the protein intake at 12% of the dietary energy or 45 g/day (mainly from pulses), which is adequate. On the other hand, the fat intake is low as a consequence of a "bulky", low energy density of food based on starchy components. The target of 2,100 Cal is set by the Ministry, with fat contributing ideally to the extent of 20% or 47 g/day (17 kg per annum). The latter could be provided, for instance, by more groundnut eaten and perhaps sesame seed (which is not grown in the country to a significant extent).

In the UK, about 30% of the daily energy intake is derived from fats, which is regarded to be high. The figure of 20% seems reasonable in the case of Malawi and countries with similar eating habits where cereals constitute the staple food.

3.2.3 If, say, 40 g/day/person is aimed at for total fat consumption, the question is how much should be the unsaturated to saturated fat (mainly animal) ratio. The human body requires a certain intake of essential, "polyunsaturated" fatty acids, namely linoleic and linolenic acids, which are present in such vegetable oils as cottonseed, sunflower and maize germ oil - this quite apart from the claimed anti-cholesterol effects of such oils as compared with saturated oils and fats.

Animal fat is contributing to a minor extent to the total fat intake in the Malawi diet. When meat (beef or lamb) is bought from the butcher, fat is purchased, sometimes together with bones, at a price almost equal to that of lean meat. Meat is consumed generally in Malawi for special occasions and fish is more confined to the population living along Lake Malawi and urban centres. It can be said, therefore, that the fat intake derived from such food sources is small, as shown by the results of the food and nutrition surveys mentioned above. However, with rising incomes, an increase in the consumption of animal products can be expected in the longer term.

It is apparent that a substantial proportion of the targeted complementary fat intake should be in the form of vegetable oils of some kind, with preferably a relatively high percentage of the polyunsaturated types. Broadly speaking, the latter are important in avoiding skin infection or skin-scaly conditions, while most of vegetable oils contain Vitamin E, which is conducive to vascular health, although this vitamin is abundant is other foodstuffs such as vegetables.

3.2.4 Within the scope of the present study, it would be futile to attempt to determine with a high degree of confidence the probable demand for vegetable oils in relation to an overall target of total fat intake of 40 g/person/day. In view of the above considerations, the Consultants place this target at around 30 g, or 11 kg per capita, with the assumption that the intake of fat from meat and fish will double from the present level. With the improvement of the national diet through higher incomes and healthier foodstuffs being made available, it seems reasonable to assume that an increase from the estimated present level of 6 kg could not be all in the form of directly consumed oil bearing materials such as groundnuts and Ufa. On this premise, the potential demand of the country for finished vegetable oils by 1988/89, when the population is likely to reach 8 million, would be some 40,000 tonnes per annum, more than tenfolds the present apparent direct consumption.

3.2.5 The above tonnage of finished vegetable oils was arrived at based on nutritional grounds, assuming the average energy intake is about 2,000 Cal per day and that the per capita consumption of animal products will double by 1988/89. This theoretical approach does not take account of the eating habits predominant in Malawi. Shallow oil frying is confined to stew preparations eaten with N'sima, while fried food items such as potatoes and other vegetables are available only in a restricted number of restaurants, mainly in hotels.

In the absence of regional household expenditure surveys, it is not possible to derive a pattern for the consumption of vegetable oil by income group and in various parts of the country. Such a commodity is relatively expensive, the retail price being equivalent to K2.50 - K2.60 per litre. The minimum daily wage is less than one Kwacha, while that of a semi-skilled operator may be in the region of K2.

In the Population Census of 1977, the average number of persons per dwelling was 3 in the Central and Southern Regions and 3.3 in the Northern Region. From enquiries made by the Consultants, an urban household may consume 500 ml of oil monthly. Assuming that incomes will rise with a semi-liberisation of meat price control, more people will be able to buy animal products and use vegetable oil in cooking, both in the traditional and "borrowed" manner for non-meat dishes.

Another constraint in vegetable oil consumption is the remoteness of certain areas from the production centre (Blantyre/Limbe) and the associated marketing and distribution problems; these can be translated into a cost factor which, within the limits imposed by the availability of raw materials and economic considerations, constitute negative factors. Given a higher consumption of meat and fish through higher incomes, and an intensified distribution system, it would be reasonable to postulate that the per capita demand for liquid vegetable oil will treble by 1988/89, to reach 1.5 kg, corresponding to 12,000 tonnes per annum, when the population will reach 8 million. Beyond that period of time,

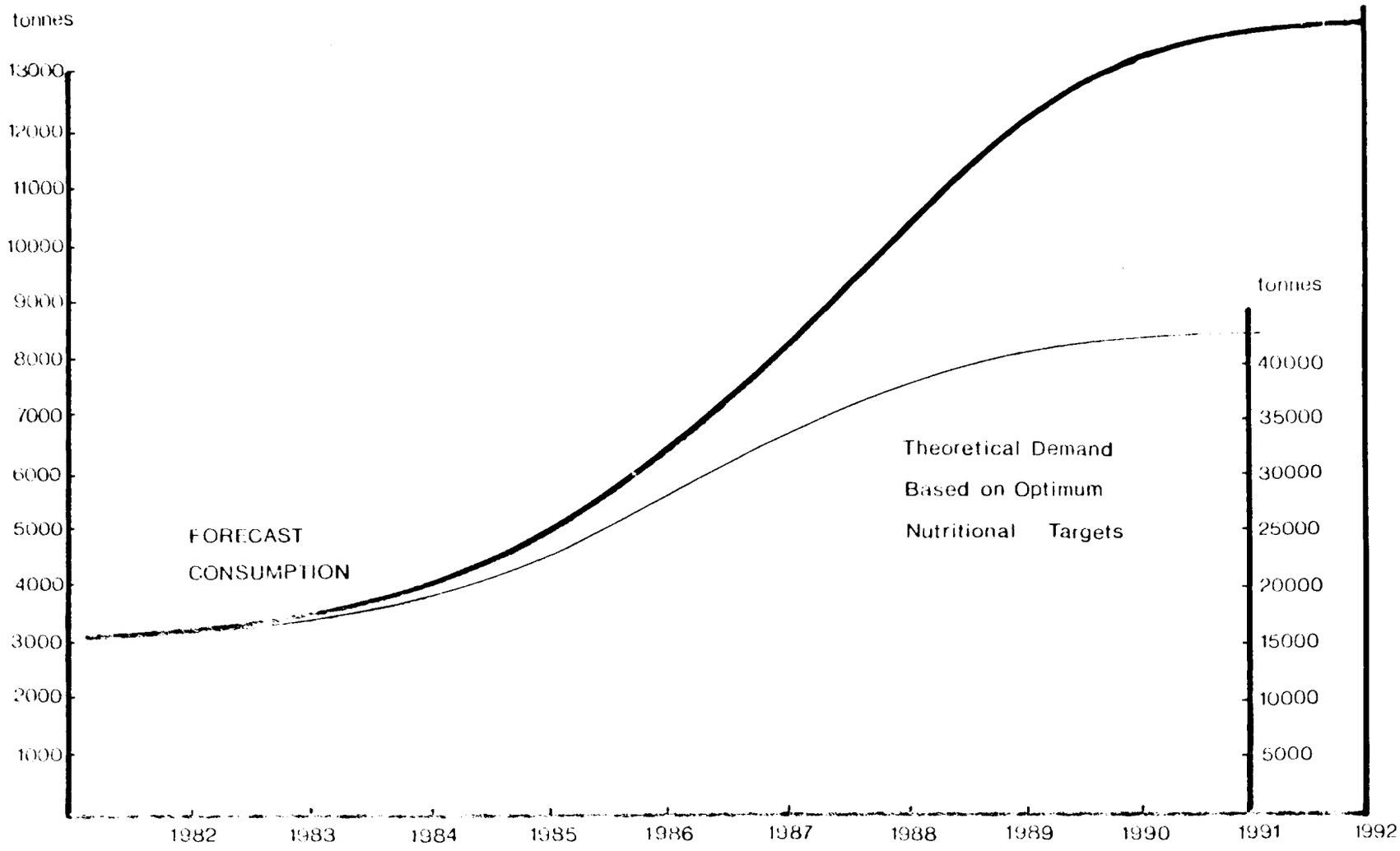
consumption is likely to increase slowly, at a probable rate somewhat higher than that of the population growth, to reach possibly 13,500 - 14,000 tonnes by 1993/94.

3.2.6 Sales forecasts for 1988 are placed by LEVER at 4,950 tonnes of liquid oils (COVO and KAZINGA) and 1,300 tonnes of margarine and bakery fats. The latter would require 540 tonnes of vegetable oils to be blended with imported hardened fats, giving a total oil requirements of about 5,500 tonnes.

LEVER believe that their forecasts are below the actual demand, particularly for liquid oil. Such forecasts take into account constraints relating to the availability of oilseeds and to the maximum expeller capacity of their plant as well as that of NOIL, based on full pressing.

3.2.7 As shown in Section 6, given the availability of cottonseed, groundnut and sunflower seed in adequate quantities, and having recourse to pre-pressing followed by solvent extraction of the cakes from these seeds, up to 15,200 tonnes of crude oils could be obtained annually (corresponding to some 14,000 tonnes of finished oils), when the expellers of both LEVER and NOIL are converted to pre-presses and utilised at full capacity.

3.2.8 To take into account the tonnage of oil which would be required for blending into margarine (used as spread and not for cooking) and bakery fats by 1993/94, the probable volume of demand of these products is placed at 2,000 tonnes, double the present consumption level. Such a modest rate of growth is justifiable, considering the fact that bread consumption is unlikely to increase significantly outside urban areas with a population now amounting to 6% of the total. Thus, 2,000 tonnes of margarines and bakery fats would correspond to 800 tonnes of liquid oils. Such a quantity represents 6% of the liquid vegetable oil demand of 14,000 tonnes, which is well within the limits of accuracy of the present assessments. For the purpose of this study, the actual production target of edible vegetable oils is taken as being 12,000 tonnes in 1988/89, rising to 14,000 tonnes in 1993/94.



THEORETICAL DEMAND & FORECAST CONSUMPTION OF REFINED EDIBLE OILS DIAGRAM 'A'

3.3 THE MARKETING OF VEGETABLE OILS - PRICE LEVELS

3.3.1 LEVER sell their vegetable oils through two main distribution channels, wholesalers and "nuclear distributors". Some 45% of the oil is distributed by the latter group on consignment from LEVER. The number of such distributors amounts to 20 having each 300-350 retail outlets and covering virtually the whole country. Nuclear distributors receive about 6% commission on the wholesale price which, in the case of 500 ml COVO bottles, now amounts to K14.99/ dozen. Wholesalers, who buy from LEVER on a cash or 30 days credit basis, get about 3.5%. The retailers' margin is about 11%.

The retail prices, which are fixed by the Government, were increased in March 1983 by 18% as a result of the introduction of the 20% surtax are as follows:

TABLE 3.4 : RETAIL PRICES OF OIL BRANDS

	Pre-Surtax Price	Post-Surtax Price	Equivalent Price per tonne
		Kwacha	
COVO			
500 ml	1.18	1.39	3,089
1,000 ml	2.22	2.61	2,900
KAZINGA			
125 ml	0.28	0.33	2,933
500 ml	1.07	1.26	2,800

3.3.2 LEVER's sales volume is about 25% of the total in Blantyre District and 20% in Lilongwe District, the combined population of which was 1.1 million, out of a total of 5,562,000 in 1977, (Table 3.5). The 22 remaining districts share the balance of the sales averaging 2.5% each. On a regional basis, 60% of the sales are directed to the Southern Region, 30% to the Central and 10% to the Northern Region.

3.3.3 In their costing of the road transport of products, LEVER apply a flat rate, amounting to 23 tambala/tonne-mile within a 100 miles radius from Limbe, and to 21 tambala/tonne-mile for greater distances (13-14 tambala/tonne-km).

3.3.4 The retail prices of the edible vegetable oils in Malawi is high in comparison with the levels prevailing in Western Europe. This is due to a combination of factors, mainly size of the processing facilities, higher packaging, costs, distribution costs per unit, and surtax. In 1983, LEVER sold 2,700 tonnes of oils. In Annex 2, a tentative estimate of the average ex-mill cost is given. The purpose of such an estimate is primarily to evaluate the feasibility of the Solvent Extraction Project when an increased production of cottonseed and groundnut oil, together with the possible introduction of sunflower oil, are achieved.

3.3.5 In Malawi, the share of groundnut (100% and blended) in the market is high, around 70% of the total. Although this oil is not extensively consumed in Europe, except in France, its retail price is appreciably lower than in Malawi. In the UK, a minor user of this oil, it can be purchased at around £.St.1.20/litre, equivalent to K2/litre. Soyabean, sunflower and blended oils (with rapeseed) are commonly used in the UK and on the Continent.

As mentioned above, consideration should be given to the production of sunflower oil in Malawi to supplement advantageously the tonnage of cottonseed and groundnut oils. In the UK, the retail price of this oil in supermarkets is now around £.St.0.72 (K1.20) per litre. However, in the Financial Evaluation of the project (Section 8), its price is taken as being the same as that of groundnut oil. This would be justifiable on account of the relatively low local production of the sunflower crop which can be foreseen and of the prevailing price structure of edible oils on the home market.

TABLE 3.5 : POPULATION CENSUS - 1977

	Region	Total	Density persons/km^2	Dwelling units/km^2	Average persons/unit
ALL MALAWI		5,561,821	59	19.32	3.05
	Northern	643,485	23.89	7.14	3.35
	Central	2,122,010	59.62	19.94	2.99
	Southern	2,796,326	88.06	28.95	3.04

24 Districts : Figures Rounded off

	Region	Population '000	Density persons/km^2
BY DISTRICT			
Chitipa	Northern	72.6	16.92
Karonga	Northern	104.2	31.10
Nkhata Bay	Northern	108.6	26.55
Rumphi	Northern	64.1	13.44
Mzimba	Northern	293.9	28.18
Kasumgu	Central	190.0	24.11
Nkhota Kota	Central	93.8	22.02
Ntchisi	Central	86.4	52.05
Dowa	Central	249.0	81.91
Salima	Central	126.7	57.59
Lilongwe	Central	694.2	112.69
Mchinji	Central	158.7	47.23
Dedza	Central	293.1	80.97
Ntcheu	Central	230.2	67.31
Mangochi	Southern	295.7	47.16
Machinga	Southern	342.5	57.47
Zomba	Southern	349.3	135.39
Chiradzulu	Southern	168.1	21.92
Blantyre	Southern	410.1	204.03
Mwanza	Southern	73.5	32.10
Thyolo	Southern	341.1	199.47
Mulanje	Southern	496.8	144.00
Chikawa	Southern	205.9	43.26
Nsanje	Southern	113.3	58.40

Source:
National Statistics Office

SECTION 4 : THE MARKET FOR OILCAKES AND EXTRACTION MEALS

4.1 HOME MARKET

4.1.1 NOIL and LEVER sell part of their cake output to Grain and Milling Co Ltd (GRAMIL) who operate a stockfeed mill in Limbe and a feedstuff mixing plant based on concentrates in Lilongwe, each unit having a capacity of 5 tonnes/hour. Surplus cake is exported.

Production of all types of feedstuffs amounted to 11,100 tonnes in 1981/82 and to 9,800 tonnes in 1982/83. About 70% of the output is destined for poultry, 20% for pigs and 10% for cattle.

The raw material usage in 1982/83 was as follows:

TABLE 4.1 : GRAMIL: RAW MATERIAL USAGE IN FEEDSTUFFS

	tonnes
Cottonseed cake	1,300
Groundnut cake	807
Hominy chop (Maize germ and bran meal)	240
Wheat offals	2,220
Fishmeal	564
Maize, minerals, vitamins,	Balance to
Total	9,800

4.1.2 The total production of hominy chop from GRAMIL maize mills amounted to 3,415 tonnes in 1982/83 (Sub-section 5.6 of the report). Apart from the tonnage utilised in feedstuffs formulations, most of this by-product is sold to farmers at a price of K5/70kg bag (K 71.43/t) ex-mill, which is also the transfer price from Limbe maize mill to the adjacent stockfeed mill. Some quantities are being exported at an fob price of K80/t. Wheat offals obtained in GRAMIL flour mill at Limbe are priced at K135/t. The current prices of the protein concentrates delivered to the Limbe mill are tabulated below.

TABLE 4.2 : PRICES OF PROTEIN CONCENTRATES

	Profat Content	Price
	%	K/t
Cottonseed cake	47-49	141
Groundnut cake	47-48	116.81
Hominy chop	16-17	71.43
Wheat offals	18	135
Fishmeal (imported)	65-70	667

4.1.3 The current ex-mill prices of the main feedstuff formulations are given below. Prices are controlled by the Ministry of Trade and Industry.

TABLE 4.3 : EX-MILL PRICES OF MAIN FEEDSTUFF FORMULATIONS

	Crude Protein	Price
	%	K/t
Broiler starter	24	220
Broiler finisher	20	209
Chick mash	20	205
Growers mash	18	186
HE layers mash	16	170
Beef mash	14	149
Dairy mash	15	125
Pig weaner	19	174
Pig finisher	15	165

4.1.4 Sales of compounds are effected to farmers ex-mill at Limbe, at Lilongwe and at Mzuzu selling points. The cost of transport from Limbe to Lilongwe is K 22/t and from Limbe to Mzuzu K 51/t (PRESS transport rates), which adds 10-25% to the basic ex-mill price. This prompted GRAMIL to consider shifting Limbe mill to Lilongwe and the mixing plant of the latter location to Mzuzu in the North where no mixing facilities exist, and to installing a new compounding unit in Limbe, possibly with pelletising facilities. This course of action would ensure a smoother price differential of the compounds in the hree regions of Malawi.

4.1.5 A relatively important outlet for feedstuffs in Malawi is the poultry sector. There are six large poultry producers and some 150 small commercial producers producing annually 400,000-450,000 broilers. Egg production on a commercial scale is estimated at about 1 million dozen per annum. It is a marginal operation due to low productivity and high cost of feed.

Broiler production appears to be more remunerative, according to the "Livestock and Meat Study" carried out by Booker Agriculture International Ltd early 1983. The average liveweight per bird is 1.7 kg with a feed conversion ratio of 2.5-3.0:1; dressed weight is about 1.2 kg. Retail prices are fixed and amount to K 1.90/kg in Blantyre, K 2.50/kg in Lilongwe and about K 3/kg in Mzuzu (dressed basis). The relocation of the Limbe feedmill from Limbe to Lilongwe and the acquisition of a new compounding unit for Limbe would help to narrow the price differential between the three urban centres.

4.1.6 No forecasts have been made on the future demand for poultry by the Department of Animal Health and Industry. However, poultry formulations in Malawi are largely based at present on maize, hominy chop, wheat offals and fishmeal with little oilcakes being used. Although fishmeal can be advantageously substituted with soyabean meal, the processing of soya in limited quantity would not contribute to alleviating the vegetable oil shortage of the country to a significant extent. Given the increased availability of extraction meals from cottonseed, groundnut and sunflower seed, the need for developing balanced, least cost formulations would be highly desirable.

4.1.7 Estimates of the pig population vary from 200,000 to 360,000. According to the Booker's Report (loc. cit), growth is slow (less than 2% p.a.) and the producer margin is very low at present pork prices. This is reflected by the low sales of pig feed, estimated by GRAMIL at around 2,000 tpa.

4.1.8 With regard to cattle, stall feeding of steers with crop residues is carried out during the dry season and little compounded feedstuffs is used in rations. ADMARC operates two feedlot schemes which are said to be marginal. Rations used in one of them consist of whole cottonseed, molasses, urea and bagasse.

The low margins obtained generally are due to the depressed prices of beef which are fixed and remained unchanged since 1980. Animals are slaughtered by Cold Storage Company, who sell whole carcasses to retailers at K 1.43/kg, realising a gross margin of K 0.30 - K 0.55 per kg.

4.1.9 Booker's study advocates a pricing policy consisting of a partial liberalisation of products consumed by high income groups such as prime beef and broilers, and continued control for products purchased by low income groups (lower grades of meat and eggs). It places the supply deficit of meat by 1990 at about 4,100 tonnes and of eggs at 1.15 million dozen (Blantyre/Lilongwe only), on the assumption that real per capita income grows at 1.5% p.a. With zero growth, these deficits would amount to 800 tonnes and 0.42 million dozen, respectively.

4.1.10 In view of the foregoing facts and considerations, it would be extremely difficult to assess the home demand for extraction meals or oilcakes within the next 5-10 years. The Department of Animal Health and Industry put forward to the Consultants a probable compounded feedstuff requirements of 70,000-80,000 tonnes by 1988 for the livestock sector as a whole. Even with partial price liberalisation, this level seems optimistic.

For the purpose of the present study, it is assumed that half of the tonnage of meal obtained in the solvent extraction plant by 1992/93, or nearly 10,000 tonnes would be captive, and an equal quantity exported.

4.2 EXPORT PROSPECTS

4.2.1 Past Performance

During the 1978/82 period, exports of groundnut and cottonseed cake fluctuated between 2,030t and 5,042 tonnes (Table 4.7). The bulk of the tonnage goes to Zimbabwe and, to a lesser extent, to Zambia. The average export prices of oilcakes during 1981 and 1982 are tabulated below.

TABLE 4.4: AVERAGE EXPORT PRICES OF OILCAKES - 1981 AND 1982

	1981	1982
	K/tonne, bagged	
Groundnut cake		
To Zimbabwe	152.57	163.15
To Zambia	181.72	202.37
Cottonseed cake		
To Zimbabwe	121.96	147.95
To Zambia	143.25	-
To Mozambique	-	124.60

In 1982/83, LEVER have been selling groundnut cake to GRAMIL at a preferential price of K 105/t ex-mill, while the overall average value of home and export sales was K 132/t. During the same period, NOIL were selling cottonseed cake at K 145/t ex-mill for both the home and export market. (The unit values for cottonseed cake for 1982 as deducted from the data in Table 4.7 must relate erroneously to ex-mill and not FOB prices.)

4.2.2 Imports of Oilcakes to Neighbouring Countries

The Consultants referred to various sources of information on the imports of oilcakes/meals to Zambia, Zimbabwe and Mozambique, but were unable to secure any reliable data for the past 4-5 years.

In the absence of relevant information, it is postulated in this study that Malawi would be able to export some 8,000-10,000 tonnes of meals annually by 1989/90 at prices comparable to those of international sources, either to be used in the above three countries or to be re-exported overseas.

The recent formation of Southern Africa Development Coordination Committee (SADCC) is conducive to the development of a smooth inter-trade relationship between member countries and would reveal the supply and demand picture for commodities such as oilcakes, which would enable Malawi to derive substantial advantages. The role which the Malawi Export Promotion Council would play in this respect is undoubtedly prominent.

4.2.3 International Price Levels

Price trends for the oilcakes and meals under review over the past five years, can be visualised from Table 4.8. Prices of the corresponding vegetable oils are also shown for further reference.

Prices fluctuate fairly widely depending on the supply and demand situation, the former being particularly sensitive to oilcrop output in major producing countries. The last three years' average level deduced from the data in Table 4.8 are shown below.

TABLE 4.5: PRICES OF SELECTED OILCAKES, EXTRACTION MEALS AND EDIBLE OILS - 1978/79 TO 1982/83 AVERAGE

	US$/tonne, bulk	Tendency
Cottonseed meal, pellet, 38% cif Denmark	193	Fair stability
Groundnut meal, 48/50% cif Rotterdam	207	Pronounced fall
Sunflower meal, 37/38% cif Rotterdam	180	Steady decrease
Cottonseed oil, cif Rotterdam	609	Fair stability
Groundnut oil, cif Rotterdam	775	Strong fall
Sunflower oil, ex-tank Rotterdam	567	Steady decrease

It is impossible to predict a future price range which each of the above product would fetch. However, due to the fact that market prices undergo cycles of elevated and depressed levels, the above three years' averages can be taken as a basis for the assessment of the probable export values of the extraction meals from Malawi.

4.2.4 Probable Future Export Prices of Extraction Meals from Malawi

These are broadly assessed at current prices as follows, assuming that the products were to be imported competitively from Western Europe.

TABLE 4.6 : COMPUTATION OF PROBABLE EX-MILL PRICE OF MEALS

	Cottonseed Meal	Groundnut Meal	Sunflower Meal
		US$/tonne	
FOB Amsterdam bulk	193	207	180
Freight to East African Port	80	80	80
CIF East African Port	273	287	260
Less: Cost of road transport: Blantyre area/Harare or Lusaka K 65			
Cost of road transport Harare or Lusaka/East African Port (say Beira) K 60 / K125	113	113	113
Calculated selling price ex-mill, bulk basis	160	174	147
Less: 10% allowance for discounts and world prices fluctuations	16	17	15
	144	157	132
		Kwacha/tonne	
Probable ex-mill price, bulk basis	160	174	147

TABLE 4.7 : EXPORTS OF GROUNDNUT AND COTTONSEED CAKES FROM MALAWI

Q = tonnes; V = '000 K

	1978		1979		1980		1981		1982	
Groundnut cake	Q	V	Q	V	Q	V	Q	V	Q	V
Zimbabwe, Zambia	-		-		2267	387				
Zimbabwe							681	103.9	589	96.1
Zambia							1045	189.9	338	68.4
Total (i)					2267	387	1726	293.8	917	164.5
Cottonseed cake										
Zimbabwe, Zambia, Mozambique	4351	516.5	2030	181.8	2775	299.6				
Zimbabwe							1949	237.7	2025	299.6
Zambia							289	41.4	-	-
Mozambique							-	-	496	61.8
Total (ii)	4351	516.5	2030	181.8	2775	299.6	2238	279.1	2521	361.4
Grand Total (i) + (ii)	4351	516.5	2030	181.8	5042	686.6	3964	572.9	3438	525.9

Source: National Statistical Office

TABLE 4.8 : INTERNATIONAL PRICES OF SELECTED OILCAKES, EXTRACTION MEALS AND EDIBLE OILS - 1978/79 TO 1982/83

US$/tonne, bulk

	Oct/Sept				Oct/Aug
	1978/79	1979/80	1980/81	1981/82	1982/83
Cottonseed meal, pellet, 38% cif Denmark	183	202	226	187	165
Groundnut meal, Indian, 48% cif Rotterdam	207	224	260	195	182
Groundnut meal, Argent. 48/50% cif Rotterdam	228	238	-	192	208
Sunflower meal, Argent, pellet, 37/38% cif Rotterdam	180	186	212	177	152
Cottonseed oil, US, cif Rotterdam	780	680	666	582	580
Groundnut oil, any origin, cif Rotterdam	980	784	1,111	667	546
Sunflower oil, any origin, ex-tank Rotterdam	768	634	666	557	477

Source: OILWORLD Weekly Issues

SECTION 5 : THE RAW MATERIAL SITUATION

5.1 GROUNDNUT

5.1.1 ADMARC is the sole buyer and seller of groundnut. National production data are not available, but it is estimated that output amounts to 2-3 times the tonnage purchased by ADMARC. Groundnut is a component in the Malawian diet and large quantities are auto-consumed at farm/village level.

About 90% of the area under groundnut is said to be planted with the Chalimbana variety which is of the confectionery type. Manipintar, a high oil content variety, is being grown in the Salima area adjoining Lake Malawi in the Central Region; the nut is destined for oilmilling. Malimba, a dual purpose nut, grown in the Southern Region, is being phased out.

ADMARC purchases shelled nuts in three grades:

GDA : Chalimbana type; large, whole, clean kernels
GDB : Smaller, whole, clean kernels
GDX : Split and shrivelled nuts

The nuts are graded in a modern factory located at Liwonde, having a capacity of 10,000 tonnes per month. Confectionery type nuts are graded according to size: Super, A/1, A/21, A/22, B, P and C "crushers" (less than 7 mm in diametre). Manipintar purchased unshelled is shelled in a plant at Salima.

The approximate break-down of the grades obtained at the Liwonde sorting plant is as follows:

Grade	%
Super	15.4
A/1	21.1
A/21	22.8
A/22	8.9
B	17.5
P	0.9
C	13.4
	100.0

Grades Super to A/21 are all exported, while grades A/22 down to C are partly allocated to Lever Bros for crushing.

5.1.2 ADMARC purchases and exports of groundnut have fluctuated widely over recent years as shown by the data in the following table.

TABLE 5.1: ADMARC PURCHASES AND EXPORTS OF GROUNDNUT - 1974 TO 1983

	Purchases(a)	Exports(b)	Exports Value	Unit Value
	Short tons		'000K	K/tonne
1974	31,726	22,767	5,202	
1975	36,165	28,455	6,503	
1976	35,923	28,716	11,253	
1977	20,349	16,774	8,866	
1978	12,285	7,513	4,673	
1979	Metric tonnes			
1980	24,291	25,556	15,937	624
1981	31,421	11,121	10,622	955
1982	19,494	7,209(c)	4,621	641
1983	12,000(d)			

a) Financial years (April - March) b) Jan/Dec

c) Jan/Oct d) Estimated

ADMARC forecast for 1983/84 is about 12,000 tonnes, equal to the level in the preceding year. This is attributed to poor rainfall and the increase in the farmers' price for maize, although the purchase price of groundnut is to be increased for the current season.

5.1.3 ADMARC purchase prices at collection points for 1982/1983 and those proposed for 1983/84 are as follows:

	1982/83	1983/84
	Tambala/kg	
Chalimbana, shelled		
Grade A	37	55
Grade B	26	30
Grade X	9	10
Manipintar		
Shelled	20	30
Unshelled	13	19

5.1.4 Lever Bros purchases of all grades of groundnut during recent years were as follows:

TABLE 5.2 : LEVER'S PURCHASES OF GROUNDNUT

	Quantity	Total Value	Average Unit Price
	tonnes	'000K	K/tonne
1978/79	2,864		
1979/80	2,518		
1980/81	3,836	1,489	388
1981/82	2,297	813	354
1982/83	4,954	2,435	492

Sources: ADMARC and Lever Bros.

Lever Bros received an average of 15% of ADMARC purchases during the period 1979/80 - 1982/83.

ADMARC propose selling price levels to the Ministry of Trade, Industry and Tourism who fix the final prices. Towards the end of 1982, Lever Bros were paying K445/tonne for Manipintar, Crushers and Splits and K500 for confectionery grades, delivered to their Limbe oilmill. The high differential between ADMARC and Lever Bros Purchase price is attributable to elevated transport costs and handling charges.

ADMARC transport charges are 13.8 - 15 Tambala/tonnes-km on bitumen roads and 17.8 - 19.6 Tambala/tonne-km on non-bitumen roads. For remote areas, the latter unit rate could reach 27.7 Tambala.

5.1.5 Manipintar yields on smallholder farms in the Salima area are around 2.5 tonnes/ha, shelled basis. Some estates achieved twice that yield with disease control. A new variety, SAC 58, with higher oil content is to replace gradually Manipintar groundnut, with somewhat higher yields. Seeding requirements amount to 58 kg/ha, at a cost of K 0.60/kg.

5.1.6 The average oil content of groundnut received by Lever Bros is as follows:

	% Oil (dry basis)
Manipintar	49.3
Crushers	47.8
GDX	41.2
Chalimbana (splits, rejects)	46.1

The National Seed Co. of Malawi gave an oil content of 51-52% for SAC 58.

5.1.7 The restriction imposed on tobacco estates to grow other crops has been lifted recently. The Ministry of Agriculture is cutting-down substantially the tobacco acreage, so that most estates will have to diversify their activities. This is seriously being considered by the large estate groups such as Press (Holdings) Ltd, General Farming Co Ltd and Spearhead Enterprises Ltd. Rotational crop production plans being envisaged cover soyabean, groundnut, maize, sunflower, cotton and grass in selected locations. Thus, estates could become fairly rapidly large scale producers of groundnut and other oilseeds. If, say, a total of 5,000 ha is allocated annually to groundnut, some 20,000 tonnes could be made available for crushing, should the economics of crop production be favourable and the nut sold for crushing at a remunerative price.

5.2 COTTONSEED

5.2.1 Seed cotton is a traditional smallholder crop grown under rainfed conditions. Purchases are carried out by ADMARC who operate a 4,500 tpa ginnery at Chikwawa in the South. The bulk of the cotton output is processed by Cotton Ginneries Ltd at Bangula further South. The plant has a ginning capacity of 27,000 tpa and is operated by the British Cotton Growers Association against a processing fee. For the last two years, lint was all sold to the textile group David Whitehead Ltd.

The Southern Region accounts for some 70% of the country's production. ADMARC purchases of seedcotton over the past ten years are given below.

TABLE 5.3 : ADMARC PURCHASES OF SEED COTTON - 1973 to 1983

Year (a)	Short tons
1973	24,350
1974	17,863
1975	23,700
1976	19,632
1977	19,734
1978	24,867
1979	26,693
1980	24,704
	Metric tonnes
1981	23,114
1982	21,740
1983	14,799

(a) April to March

Source : ADMARC

Cotton output reached a peak of about 24,000 metric tonnes in 1979. The decline in recent years is attributed to ADMARC producer prices which did not provide a sufficient incentive to farmers. The prices for 1983 for the various grades have been, however, increased from the previous year:

		1983	1982
		Tambala/kg	
Grade	A (unstained)	38	28.5
	B (slightly stained)	32	22
	C (stained)	27	18

A relatively quick improvement of the situation is to be expected in view of the above price increase. Moreover, the country's output is anticipated to grow steadily from the contribution of estates.

5.2.2 Lint yield upon ginning at Bangula is 33.8%, giving 65% cottonseed, after allowing for losses. Planting requirements amount currently to 2,000 tonnes annually; about 1,500 tonnes of cottonseed are also required by Cattlefeedlot Co Ltd in Ngabu in the Lower Shire.

5.2.3 The Consultants were unable to secure from ADMARC the delivered price of cottonseed processed by NOIL. ADMARC who have a 50% shareholding in the latter venture, show the following values for seed cotton, lint, seed for planting and "cotton by-products":

TABLE 5.4 : ADMARC COSTING OF COTTON PRODUCTS

	1981/82	1980/81	1979/80
		K/tonne	
Seed cotton average purchase price	214.15	219.54	218.76
Lint average selling price	1,228.10	943.88	1,102.85
Selling price of seed for planting	8.05	44.19	19.82
Selling price of "cotton by-products"	109.34	87.36	65.24

Source: ADMARC - Cotton Trading Accounts

It is not clear whether the figures relating to "cotton by-products" refer to the sales of cottonseed cake, oil and by-products produced by NOIL or to the "internal costing" of cottonseed processed (or transfer price to NOIL). In an attempt to clarify the latter point, the cottonseed processing yields and ex-mill unit selling prices of the products from NOIL operations during the 1980/1982 three year period have been obtained and are tabulated below. The Consultants were informed that prices remained unchanged during that period.

TABLE 5.5 : PROCESSING YIELDS AND SELLING PRICES OF COTTONSEED PRODUCTS AT NOIL FACTORY - 1980/82 PERIOD

	Average Yield on Cottonseed %	Selling Prices, K/tonne
Expeller cake	40.23	145
Crude oil	16.20	
Neutral oil	13.30	480
Soapstock	3.92	100 (a)
Hulls	38.12	17 (b)
Linters	1.3 (c)	240 (d)

(a) Excluding the cost of drums

(b) As valued by ADMARC, presumably relative to coal; some quantities sold to Carlsberg brewery at K50/tonne, bulk basis.

(c) In early 1983; includes sub-standard material

(d) Average of all grades

It can be calculated from the data in Table 5.4 that the income derived from the sales of cottonseed products amounts to K135.70 per tonne of raw material, which is widely different from the range of K65.24 - 109.34 shown in Table 5.3. The latter figures, therefore, do not relate to the price of cottonseed as costed by ADMARC in respect of NOIL operations. Wide discrepancies are apparent when comparing the value of production by NOIL with that of the sales of the products by ADMARC during the period under review, and this infers that the transfer price of cottonseed to NOIL is rather arbitrarily fixed, even allowing for changes in stocks of raw

material and finished products. Such a feature is emphasised upon examination of the figures in Table 5.3 appertaining to the purchase price of seed cotton (which did not change appreciably over the three year period), the selling price of lint and that of seed for planting.

In the absence of detailed costings, it is not possible to place a current value for cottonseed processed by NOIL. It would appear that, because of the large differential between the unit cost of seed for planting and the income derived from cottonseed products, the former is heavily subsidised, a justifiable course of action. Irrespective of the above considerations, the main issue concerning the present study is the determination of the transfer price of pre-pressed cottonseed cake to the solvent extraction plant, taking into account its oil content.

5.2.4 As said previously, the prospects for the recovery of the cotton growing sector within 3-5 year's time are encouraging due to a combination of favourable factors (increase in the farmers' price, contribution to output by estates, partial irrigation). It would be reasonable to assume that the total annual production of seed cotton will somewhat exceed the peak level of some years ago and reach 25,000 tonnes per annum. In terms of the cottonseed tonnage which could be made available to the oilmilling industry, the following tentative pattern of utilisation may be envisaged:

	tpa
Cottonseed production	16,250
Less Seed for planting	2,250
Less Fodder seed, say	2,000
Quantity available to NOIL	12,000

5.3 SUNFLOWER SEED

5.3.1 The black, low oil content seed (around 35%) is being grown in Malawi and quantities are exported as bird feed. Improved varieties from RSA have been successfully grown, such as SO 208/209 and SO 320 averaging 45-48% oil, dry basis, giving yields of 1.5-2t/ha on smallholdings, and up to 3t/ha on estates. Seeding requirements amount to 3 kg/ha, costing K 2.50 - K 3/kg.

5.3.2 Small quantities of sunflower seed have been crushed for oil, undecorticated, on an estate producing tung oil. Interest in this oil bearing material is being manifested in Malawi both as a cooking oil and a diesel oil substitute. Like groundnut, sunflower seed offers an attractive source of oil with its high fat content and yield per hectare. Sunflower cultivation in Malawi, particularly on estates, appears to be promising and, given favourable economic factors, an annual output of 10,000 - 15,000 tonnes could well be achieved towards the end of the present decade.

5.4 SOYABEAN

5.4.1 Several varieties have been tried in different areas of the country and the results obtained are encouraging. Among the promising ones varieties are Geduld, Hardee, Davis and Bossier.

A review of soyabean research in Malawi was compiled by Dr Paul Davis in 1979 for Chitedze Agricultural Research Station. It summarises the results of research work carried out at research stations on different varieties under various inputs and conditions (Rhizobium innoculation, planting time, fertiliser application, weed and pest control, harvesting time, etc). Yields in excess of 2.5 tonnes/ha (up to 3.5 tonnes/ha with Zimbabwan and South African varieties) can be achieved with efficient farm management.

The crop is suitable for smallholder cultivation and offers a large potential. A limiting factor is the deleterious effect on subsequent tobacco crops owing to their susceptibility to nematodes, which could be minimised or even nullified through an appropriately devised rotational system.

5.4.2 Soyabean is more valuable for its protein than for its oil content (18%). Soyabean expeller cake, extraction meal or full fat flour are an essential ingredient in poultry and pig feedstuffs formulations, and for the former, fishmeal, an expensive material, can be dispensed with giving a marked cost advantage.

If the prime objective is to alleviate the shortage of vegetable oil, as in the case of Malawi, preference should be given to the processing of other potentially available oilseeds, such as sunflower seed which has an oil content at least twice as high as that of soyabean. Soya protein for animal feed could always be produced in the form of full fat flour (20% oil, 40-42% protein) with adequate moist heat treatment to inactivate anti-nutritional factors (mainly trypsin inhibitors and hemagglutinnins). Alternatively, soyabean can be rolled, cooked and pressed in expellers to give cake and soya oil (which, in this case, can be regarded as a "by-product"), such cake being suitable for animal feeding. The residual fat would contribute to the energy requirements in balanced formulations.

5.5 RICE BRAN

5.5.1 Paddy is purchased by ADMARC and processed by NOIL in five milling units with a combined capacity of around 36,000 t.p.a. The location and capacity of the rice mills and their distance from Limbe, the recommended location of the solvent extraction plant, is given below.

TABLE 5.6 : LOCATION AND CAPACITY OF RICE MILLS

Region	City	Nominal Capacity t/hr	Distance from Limbe km
Southern	Blantyre	2	5
Central	Nhkotakota	2 x 1	453
Northern	Chilumba	1	928
Northern	Kambwe	1.5	1,027

Purchases of paddy by ADMARC, the quantities milled and the tonnage of rice bran produced during recent years are given in Table 5.6. Rice bran output averaged 7.7% - 8.6% of throughput.

TABLE 5.7 : PADDY PURCHASES BY ADMARC, QUANTITIES MILLED BY NOIL, TONNAGE OF RICE BRAN PRODUCED AND EXPORTS OF MILLED RICE - 1979 TO 1982

	Paddy Purchases	Paddy Milled	Milled Rice Produced(a)	Rice Bran Produced	Exports of Milled Rice
			tonnes		
1979	29,494	19,112	13,000	1,354	6,960
1980	20,590	28,345	18,700	2,194	9,803
1981	16,858	21,484	13,900	1,848	8,061
1982	14,629	12,219	7,900	1,048	2,617

(a) Estimated

Sources : ADMARC, NOIL and NSO

Paddy output has been declining steadily in recent years. Rice is not a staple food in Malawi (the data in Table 5.6 evoke a per capita consumption around 1 kg), but rather a foreign exchange earner, exports being directe largely to Zambia and Zimbabwe.

5.5.2 In terms of future availability of rice bran, assuming that paddy production will increase to reach a high of 30,000 tonnes annually, the quantity of rice bran will not exceed some 2,400 tonnes. The by-product is at present wasted and it would not be economically feasible to envisage the recovery of its oil content by solvent extraction for the following reasons:-

a) From analyses carried out by NOIL, the total fat content (glycerides plus free fatty acids) of the material is between 13% and 15%. In one sample analysed, the FFA content of the fat was 11.4% and moisture 10.9%. Quantities of such bran were expelled to give a cake having the following key components:

	%
Residual oil	9.6
Crude protein	13.8
Moisture	4.1

The expeller oil was neutralised in the laboratory giving a refined oil yield of 75% and an FFA content of 0.86%.

Hypothetically, if the total potential production of 2,400 tonnes of rice bran at, say, 14% total fat is solvent extracted, about 320 tonnes of crude rice bran oil would be recovered. Assuming a plant refining loss of 30% for an FFA of 11-12%, the quantity of refined oil obtained would be 225 tonnes approximately.

The FFA content of rice bran increases very rapidly if the material is not solvent extracted shortly after rice milling. Under hot and high humidity conditions, the FFA can increase within a day or two from 2-3% to over 20-25%, as experienced in rice producing countries such as Japan, India and Thailand. The refining loss of the crude oil produced could amount to 2.3-2.5 times its FFA content, so that the refined oil yield would not exceed 65% of the throughput, assuming a realistic FFA content of 15% for the oil in the bran entering the extractor. Thus, 2,400 tonnes of rice bran would yield as little as 210 tonnes of refined oil, less than 2% of the target annual production of 12,000 tonnes of vegetable oils, which can readily be achieved through the processing of groundnut, cottonseed and sunflower.

b) As mentioned in a subsequent section of the report, the solvent extraction plant under consideration should ideally be located at Limbe, in the immediate viscinity of LEVER's processing facilities. The figures in Table 5.5 suggest broadly that 40% of the bran would originate from of the mills in the Northern Region, 30% from those in the Central Region and 30% from Blantyre near Limbe. Ignoring the cost of transport from the latter source to the solvent extraction plant, it can be calculated that, based on a rate of 15 tambala/tonne-km, the cost of transport of 2,400 tonnes of rice bran alone would amount to about K200,000 per annum, corresponding to some K1,000 per tonne of extracted oil after refining, or K0.90 per litre, bulk, which is excessive when considering that the retail price of finished and packed vegetable oil is K2.50-K2.60/litre.

5.6 MAIZE GERM

5.6.1 Maize is the main staple food in Malawi (see 3.1.4). ADMARC purchases of this grain, shown in Table 5.7 for recent years, are not all processed into maize flour; quantities are resold in maize deficient areas and a strategic stockpile of 180,000 short tons is maintained.

TABLE 5.8 : ADMARC PURCHASES OF MAIZE - 1978 TO 1982

	Tonnes
1978	89,124
1979	115,068
1980	81,518
1981	91,717
1982	136,591

5.6.2 Large quantities of maize are pounded into meal in rural areas with low extraction rates. The germ and bran fraction obtained is used in animal feeding rations.

Maize flour, which is destined largely for urban areas, is produced by GRAMIL who operate three mills. The extraction rate is about 85% and actual output over the past two years averaged 28,000 tpa over one shift/day.

Maize germ is not separated from bran and a whole fraction, "hominy chop", is obtained at a rate averaging 13% on throughput.

TABLE 5.9 : LOCATION AND CAPACITY OF MAIZE MILLS AND HOMINY CHOP PRODUCTION - 1982/83

Location	Capacity	Distance from Limbe	Hominy Chop Production
	tonnes/24 hrs	km	tonnes
Limbe	216	-	1,780
Lilongwe	109	352	1,050
Mzuzu	86	640	585
		Total	3,415(a)

(a) April 1982 to March 1983; total throughput : 25,253 tonnes

Source : GRAMIL

Hominy chop is utilised by GRAMIL in feedstuffs formulations, particularly for poultry. The fraction obtained in rural areas (Madea) is a source of cash for small farmers not engaged in intensive animal feeding.

5.6.3 The average analysis of the maize germ and bran meal fraction as given by GRAMIL is as follows:

	%
Fat	7-8
Crude protein	8.75
Fibre	7.85
Moisture	9.6

By difference, the carbohydrate content of the by-product would be of the order of 65%, mainly in the form of starch. This feature would preclude the possibility of feeding a solvent extractor with Hominy Chop as obtained at present, as this would cause severe operational trouble due to the formation of fines in the miscella, even after peletting prior to extraction, thus leading to frequent stoppages for cleaning purposes. From experience gained elsewhere, the starch content should not exceed 40-42%. Moreover, maize germ fractions destined for solvent extraction should be dried to a moisture content of 5-6% if they are to be stored for some time, even for a few days only as the FFA content of the oil would increase fairly rapidly to unacceptable levels through an enzymatic action similar to that in the case of rice bran. In a plant located in South Africa, maize germ containing 14% oil and 12% moisture showed an increase in FFA content from 2.5 to 7 after three weeks, while no appreciable increase was noted when dried at 5% moisture for the same period of time. Drying of maize germ obtained at GRAMIL mills to 5-6% moisture would be a costly operation due to the elevated price of fuel in Malawi.

5.6.4 Maize germ fractions obtained by the dry degerming process, as opposed to the wet process in the proper sense (when manufacturing maize starch) contain normally 14-16% oil. In view of the low fat content of the fraction from GRAMIL units, its high starch and moisture contents, the Consultants asked GRAMIL to carry out a trial run consisting of segregating at mill level the maize germ rich fraction from the bran fraction, and to carry out the following determinations:-

a) Analysis of maize germ and of bran (fat, FFA, protein, moisture carbohydrate). This would indicate whether or not the oil content of the germ would increase and the starch content decrease to an acceptable level.

b) Determination of the FFA of the oil in the separated germ fraction and its moisture content after storage in bags for one week and four weeks in the flour store, to evaluate the stability of the oil versus time.

At the time of the writing of the present report, no answer was received on the above determinations from GRAMIL.

5.6.5 The widespread practice of pounding maize in rural areas rather than the purchase of Ufa produced by GRAMIL (under the name of Cream of Maize) is clearly attributable to cost factors as underlined by the following:-

In 1982, ADMARC purchase price of maize at collection centres was K4.50/90 kg bag or 5 tambala per kg. With a pounding yield of 65-70% at farm level, maize meal would then cost 7-8 tambala/kg, against a retail price of K3.77/20 kg (about 19 tambala/kg) for cream of maize; the latter was increased to 26 tambala for the current year following a higher producer price being paid by ADMARC.

In addition, the farmer can either sell madea (maize bran) and/or use it to feed his animals, depending on the opportunity cost. In 1982 and up to February 1983, the selling price of Hominy Chop ex-GRAMIL mills was 9 tambala/kg; this was reduced to K5/70 kg bag (K71.43/tonne) in April 1983.

The above considerations point to the high probability of a slow growth in the output of Cream of Maize taking place, somewhat higher than the rate of increase of the urban population, possibly 3.5-4% per annum, so that GRAMIL annual output may reach some 35,000 tonnes by 1988, corresponding to 5,300 tonnes of Hominy Chop.

5.6.6 The local white flint maize predominantly grown by smallholders is being gradually displaced by high yielding composite and hybrid varieties. Among the former, the agricultural authorities are recommending CCA and UCA for high and low altitudes, respectively and for the latter MH12, giving yields of 4-6 tonnes per hectare. Hybrid MH12 is essentially a cash crop to the farmer, being a soft grain giving high pounding loss.

With regard to the maize oil content of the above mentioned varieties, it is relevant to note the results of analyses communicated by the Chitedze Agricultural Research Station.

TABLE 5.10 : FAT CONTENT OF SOME RECOMMENDED COMPOSITE AND HYBRID MAIZE AND THAT OF MADEA

	Whole Grain	Madea
CCA	5.27	12.40
UCA	5.99	8.25
MH12	5.52	15.10

The samples of Madea which analysed were obtained in the laboratory. Corresponding yields of Ufa and Madea are not available. Although it is not possible to determine the probable oil content of the Hominy Chop which would be obtained by GRAMIL, should composite and hybrid varieties be predominantly processed, it can be said that the by-product will tend to contain more oil than at present (7-8%).

For the purpose of the present study, assuming that

a) a purer maize germ with less bran can be practically obtained, averaging 12% in oil content;

b) the volume of the maize germ fraction will be of the order of 5,000 tpa;

c) the starch content of that fraction is below 40-42%,

then the total crude oil content would amount to 600 tonnes which, after refining, would yield about 520 tonnes of finished oil, on the basis of an FFA content of the crude oil of, say, 2-3%.

5.6.7 Compared with rice bran, the incidence of the cost of transport of maize germ fraction to a solvent extraction plant located in Limbe is much critical, as shown by the following computations under circumstances which would apply in five years' time, given the above assumptions, taking 15 tambala/tonne-km for transport cost (see Table 5.9).

Origin	Quantity of Maize germ tonnes/annum	Cost of Transport to Limbe K/annum
Limbe	2,500	-
Lilongwe	1,250	61,600
Mzuzu	1,250	112,000
Total	5,000	173,600

In terms of an output of 520 tonnes of refined maize oil, the unit cost of transport of maize germ to the solvent extraction plant would be K334/tonne, or about K0.30/litre, substantially lower than the corresponding figure of K0.90/litre for rice bran oil. Taking as a basis the current retailed price of K2.60/litre for cooking oil, the processing of maize germ by solvent extraction appears, on the face of it, economically feasible, with the provisos mentioned above. However, as long as the starch content of the maize germ fraction is over 40%, such a raw material could not be solvent extracted.

TABLE 5.11

PLANTING AND HARVESTING TIME OF SOME CROPS IN MALAWI

	Planting	Harvesting
Groundnut	November/December	April/June
Maize	" "	" "
Tobacco	" "	
Wheat	March	July/August
Cotton	November/December	June to August
Sunflower	December/January	May/June
Beans	January	March
	March	May
Soyabean	December/January	April/May

SECTION 6 : SOLVENT EXTRACTION PLANT UNDER CONSIDERATION

6.1 RATED CAPACITY AND PRODUCTION SCHEDULE

6.1.1 As mentioned in Section 2, the modifications of the two presses at NOIL together with the installation of auxiliary equipment would enable the pre-pressing of cottonseed meats in quantities equivalent to 12,000 tpa of whole seed, when operating 150 days a year. Similarly the presses at LEVER could be modified to pre-pressing to handle 18,000 tpa of groundnu 300 working days.

In Section 5, mentioned was made of the favourable prospects regarding the future availability of both cottonseed and of the new high oil content groundnut variety SAC 58, which is to replace the Manipintar variety, to the above mentioned tonnages, namely 12,000 tpa and 18,000 tpa respectively.

Pre-pressed cottonseed cakes and groundnut cakes containing around 14% residual oil would be sent to the Solvent Extraction Plant for further processing. The calculated yields of the product as derived from the data in Tables 2.2 to 2.4 in Section 2 are as follows:

TABLE 6.1 : CALCULATED YIELDS OF COTTONSEED AND GROUNDNUT PRODUCTS

	Expeller Crude Oil	Pre-pressed Cake	Solvent Extracted Oil	Extraction Meal	Total Crude Oil
	tonnes per annum				
12,000 tpa Cottonseed	1,440	6,780	900	5,800	2,340
18,000 tpa Groundnut	6,780	10,860	1,470	9,300	8,250
TOTAL	8,220	17,640	2,370	15,100	10,590

Based on past results of refinery operations at NOIL and LEVER, the above total quantity of crude oil would correspond to some 10,000 tonnes of fully refined oil, 2,000 tonnes short of the forecast demand of 12,000 tonnes by 1988/89.

6.1.2 While a higher output of seed cotton and of crushing grade groundnut above the levels considered in this report may be difficult to achieve by that time, the intensive cultivation of high yielding, high oil content sunflower appears to be very promising, particularly on estate farms, judging from results already obtained. Sunflower seed gives a high quality edible oil and a valuable meal for feedstuff compounding.

NOIL converted expellers could operate a further 150 days annually on sunflower seed meats at a rate equivalent to 75 tpd of whole seed to produce 5,070 tpa of prepressed cake at 16% residual oil, which would be fed to the Solvent Extraction Plant, and 3,840 tpa of crude oil. As mentioned in Section 2, it would be advisable that NOIL install a separate sunflower seed decorticating unit to minimise oil losses in the hulls, instead of utilising the cottonseed hullers/ separators. The hulls would be used as fuel in the existing boiler which is fired with cotton seed hulls.

The various outputs of the three oilmilling operations would be as follows:

TABLE 6.2 : OUTPUT OF COTTONSEED, GROUNDNUT AND SUNFLOWER PRODUCTS FROM ENVISAGED OILMILLING OPERATIONS

	Expeller Crude Oil	Pre-pressed Cake	Solvent Extracted Oil	Extraction Meal	Total Crude Oil
12,000 tpa Cottonseed	1,440	6,780	900	5,800	2,340
18,000 tpa Groundnut	6,780	10,860	1,470	9,300	8,250
11,250 tpa Sunflower	3,840	5,070	780	4,230	4,620
TOTAL	12,060	22,710	3,150	19,330	15,210

This total quantity of crude oil would give nearly 14,500 tpa of refined oil, which is the probable home demand arrived at in the present study for 1993/94.

6.1.3 If NOIL operate the pre-expellers on cottonseed and sunflower seed at full capacity over 300 days/annum, and LEVER theirs on groundnut over the same number of working days, the throughput to the Solvent Extraction Plant would be around 75 tonnes/24 hrs. This rated capacity is taken in the present study as a target throughput for 1993. Between 1988 and 1992, it could be operated at 80-95% capacity when fed with prepressed cake from 5,625 - 8,440 tonnes of sunflower obtained at NOIL factory with only one press working on this seed instead of two, together with the full tonnage of prepressed cottonseed and groundnut cakes. The total expeller and solvent extraction oil obtained would amount to 12,000 - 13,000 tonnes.

The production schedule assumed in this study for NOIL, LEVER and the Solvent Extraction Plant is shown in Table 6.3.

TABLE: 6.3

NOIL, LEVER AND SOLVENT EXTRACTION PLANT PRODUCTION SCHEDULE

	Seed	Quantity Crushed tpa	Crude Oil Produced tpa	Prepressed cake Produced tpa	Year
NOIL	CS	12,000	1,440	6,780	1987/88+
	SFS	5,625	1,920	2,535	1988/89
	SFS	5,625	1,920	2,535	1989/90
	SFS	8,440	2,880	3,800	1990/91
	SFS	8,440	2,880	3,800	1991/92
	SFS	11,250	3,840	5,070	1992/93+
LEVER	GN	18,000	6,780	10,860	1987/88+
Totals (1)		30,000	8,220	17,640	1987/88
(2)		35,625	10,140	20,175	1988/89
(3)		35,625	10,140	20,175	1989/90
(4)		38,440	11,100	21,440	1990/91
(5)		38,440	11,100	21,440	1991/92
(6)		41,250	12,060	22,710	1992/93+

SOLVENT EXTRACTION PLANT

	Cake Throughput tpa	Operating Capacity(a) tpa	% of max	Crude Oil Extracted tpa	Meal Produced tpa	Year
(1)	17,640	59	78	2,370	15,100	1987/88
(2)	20,175	67	90	2,760	17,215	1988/89
(3)	20,175	67	90	2,760	17,215	1989/90
(4)	21,440	71	94	2,955	18,275	1990/91
(5)	21,440	71	94	2,955	18,275	1991/92
(6)	22,710	75	100	3,150	19,330	1992/93+

TOTAL CRUDE OIL PRODUCED, tonnes

		Estimated Refined Oil Equivalent (b)	
(1)	10,590	10,000	1987/88
(2)	12,900	12,200	1988/89
(3)	12,900	12,200	1989/90
(4)	14,055	13,300	1990/91
(5)	14,055	13,300	1991/92
(6)	15,210	14,400	1992/93+

CS = Cottonseed SFS = Sunflower seed GN = Groundnut

(a) On the basis on 300 operating days per annum

(b) Assuming total refining loss of about 14% for crude cottonseed oil and 4% for crude sunflower and groundnut oil. Crude cottonseed and sunflower oil from Solvent Extraction Plant would be semi-refined by NOIL and despatched to LEVER for full refining; groundnut oil would be refined by LEVER.

6.2 LOCATION

NOIL mill being located in Blantyre and LEVER mill in Limbe, a solvent extraction plant based on prepressed cakes from both enterprises should be located near or in the viscinity of either mills.

In an expanded industry, LEVER would play a key role in the finishing, packing and marketing of vegetable oils. It would be only logical that the solvent extraction plant be located as close as possible to their processing facilities. In actual fact, space is available within LEVER's plot, and the 2 hectares (5 acres) required for the new solvent extraction unit could be accommodated within that area; crude vegetable oils (except cottonseed oil which would be withdrawn by NOIL for semi refining at their Blantyre mill, at about 5 km distance) would be thus pumped "across the fence".

The Consultants were informed by LEVER that the availability of electric power and of water would not create any problem.

6.3 PROCESS DESCRIPTION

Prepressed cake is passed through a breaker and fed to the extractor. The latter can be either of the rotary type or of the continuous conveyor type. The former is cylindrical and rotates around a vertical axis. It is divided in vertical sections carrying the cake, with a wire mesh at the bottom. The conveyor type is usually an endless perforated belt.

In both cases, the solvent is fed counter-currently to the cake and percolates through the bed of material. The miscella from each stage is pumped away and fed to the next stage and the final, oil rich miscella pumped to a tank.

The wet extracted meal is fed to a desolventiser-toaster (DT) where it is dried and freed from residual solvent. The DT is a cylindrical vessel with heated plate partition and direct steam injection. The meal is ground, pelletised and the pellets cooled prior to intermediate storage and bagging.

The oil is freed from the solvent in distillation and stripping columns equipped with condensers, cooled and filtered before leaving the solvent extraction plant.

The vapours and air from the various sections of the plant (meal and miscella/oil circuits) are finally freed from solvent through a scrubbing system, usually using mineral oil, before being discharged into the atmosphere.

6.4 CAPITAL COSTS

6.4.1 Machinery and Equipment

The following estimates expressed in U.S. Dollars are based on preliminary quotations secured recently by the Consultants from leading suppliers of solvent extraction plants. Local fabrication facilities exist in the Blantyre area covering such items as tankage, ducting, fans, cyclones, and an allowance has been made accordingly for the local currency element of the capital cost. It is assumed that the project will benefit from a waiver of import duties as it falls within development priorities.

TABLE 6.4 : COST OF MACHINERY AND EQUIPMENT

	Cost	of which payable in Kwacha
	'000$	'000K
Cake preparation	184	
Solvent extraction	528	
Meal pelleting/cooling	65	10
Meal storage (bulk)	265	40
Meal weighing/bagging	37	
Crude oil storage	30	20
Boiler house	130	
Cooling tower	60	
Transformer house	20	
Interconnections	40	10
Workshop	80	20
Laboratory	30	
Spare parts (1 year)	75	
TOTAL fob W. Europe	1,544	110
Freight to Harare	230	
Transport Harare/Limbe	20	
Erection	360	240
Start-up, commissioning	80	30
Contingencies	220	20
TOTAL ERECTED PLANT	2,454	400
	(K 2,7 million)	

6.4.2 Civil and Structural Works

A layout typifying the arrangement of the solvent extraction plant and auxiliary facilities is appended to be report. It is based on an "ideal" site characterised by a fairly flat surface and good soil characteristics. Should the suggestion that the Solvent Extraction Plant would be best located on LEVER's land plot in the viscinity of their existing processing facilities be adopted, the typical arrangement shown would have to be modified in order to achieve an optimum flow of materials and traffic. The area requirements amount to about 2 hectares (5 acres). The cost of land has been excluded from the present assessments of the capital investment.

Based on data and unit costs supplied by the Ministry of Works, the cost of civil and structural works has been computed and is shown in the following table.

TABLE 6.5 : COST OF CIVIL AN STRUCTURAL WORKS

	'000K
Grading, fencing	53
Internal roads	130
Cake store	93
Cake preparation	109
Solvent extraction	167
Meal pelleting/cooling	51
Meal weighing/bagging	105
Bulk meal storage	26
Boiler house	50
Stores (spares, consumables)	40
Workshop	40
Garage	30
Administrative block, laboratory	120
Amenities, first aid	120
Miscellaneous (gatehouse, fencing, weighbridge, cooling tower)	106
Contingencies	160
TOTAL	1,400

6.4.3 Fixed Investment

	'000K
Machinery and equipment	2,700
Civil and structural works	1,400
	4,100

of which K1,800,000 would be incurred in local currency.

6.4.4 Working Capital

		'000K
Hexane	6 months	102
Coal	3 months	29
Utilities	1 month	11
Bags	2 months	16
Salaries and related costs	2 months	21
Maintenance materials	8 months	110
Overheads	3 months	50
Meal stocks (at cost)	2 months	192
		531

It is assumed that debtors and creditors cancel out each other.

Interest charges on working capital are taken at 16% p.a., the current commercial rate.

6.5 OPERATING REQUIREMENTS

6.5.1 Hexane

The solvent loss normally amounts to 5 kg per tonne of cake fed to the extractor. When operated at the full capacity of 75 tpd over 300 days per annum, the solvent extraction unit would require 114 tonnes of make-up hexane.

6.5.2 Utilities

(a) Steam consumption would be around 300 kg per tonne of material entering the extractor or 6,700 tonnes annually at maximum plant capacity. This would require 740 tonnes of Zimbabwan coal at 6,700 kcal/kg.

(b) Requirements of recirculating cooling water are estimated at 18 m^3 per tonne of oilcake. Allowing for evaporation loss and make-up boiler feed water, the total annual water consumption is of the order of 30,000 m^3.

(c) Expressed in terms of input to the plant, power consumption is estimated at 76 kwh/t, or about 1.7 million kWh/annum.

6.5.3 Bags

Meal would be despatched from the Solvent Extraction Plant in 70 kg Hessian bags. The bags to be exported would be emptied at the harbour for bulk shipment and the bags returned to the factory. It is estimated that the average rate of replacement is 35% or 5 bags per tonne of product.

6.5.4 Manpower

The requirements of labour and personnel for the various sections of the plant are shown in Table 6.6, categorised according to a salary scale given in Sub-section 6.6.

TABLE 6.6 : LABOUR AND PERSONNEL REQUIREMENTS

Plant Section	Number of shifts/24 hrs	Total number	Category
Raw material reception	2	6	A
Cake preparation	3	6	C
	day	1	E
Solvent extraction	3	6	C
	3	3	D
	day	1	E
Meal pelleting/storage	3	3	C
	3	3	D
Meal weighing/bagging	2	6	B
	3	3	D
	day	1	E
Meal despatch	2	8	A
	2	2	D
Crude oil storage/despatch	3	3	C
	3	3	D
	day	1	E
Boiler house	3	3	B
	3	3	C
Workshop/Maintenance crew	3	6	B
	2	4	C
	3	3	D
	day	1	E
Laboratory	2	4	C
	day	1	E
Stores	2	2	B
	2	2	D
	day	1	E
Transport	3	6	C
	day	1	E
Gatehouse, amenities, miscellaneous	3	6	D
	2	2	C
	2	10	B

TABLE 6.6 : (Continued)

	Number of shifts/24 hrs	Total number	Category
Plant Manager	day	1	F
Assistant Managers	3	3	G
Clerical staff	2	6	H
TOTAL		121	

Summary

Category		Total number
A	Unskilled	14
B	Semi-skilled	27
C	Operators	37
D	Shift Supervisers/Fitters	25
E	Foreman	8
F	Plant Manager	1
G	Assistant Manager	3
H	Clerical Staff	6
	TOTAL	121

6.5.5 Maintenance Materials

Their cost is taken at 5% p.a. on machinery and equipment and at 2% p.a. on civil and structural works. The cost of maintenance labour is included in the cost of manpower.

6.6 OPERATING COSTS

6.6.1 The following unit costs were secured by the Consultants from parastatal organisations and private enterprises in Malawi.

	Unit	Delivered Cost, K
Hexane	tonne	1,840
Coal (Zimbabwan)	tonne	180
Make-up water	m^3	1
Electric power	KWh	0.06
Hessian bags	unit	1,80

6.6.2 Manpower

Grade	Basic salary K/month	Basic salary k/annum
A	20	
B	55	
C	100	
D	220	
E	300	
F		14,000
G		8,500
H		3,000

Company's burden (insurance, pension, sickness benefits, various allowances) may average annually K3,000 per person employed.

6.6.3 Plant Overheads

These include plant and stocks insurance (averaging 1.7% per annum of value) plus an allowance of K130,000 for general expense, and would amount to K200,000/annum.

6.6.4 Depreciation

A 10% p.a. rate of depreciation is taken on machinery and equipment and 5% on buildings.

6.6.5 Working Capital

This would amount to K 531,000.

6.6.6 Operating Costs

On the basis of the above costs and data contained in the preceeding sub-section, the operating costs at various production levels are shown in Table 6.7.

TABLE : 6.7 OPERATING COSTS

	1988	1989	1990	1991	1992	1993+
Cake throughput, tonnes	17,640	20,175	20,175	21,440	21,440	22,710
Crude oil extracted, tonnes	2,370	2,760	2,760	2,955	2,955	3,150
Meal produced, tonnes	15,100	17,215	17,215	18,275	18,275	19,330

Item	Cost in '000K per annum					
Hexane	162.5	186	186	195	195	210
Coal	105	120	120	130	130	133
Make-up water	28	29	29	30	30	30
Electric power	90	96	96	100	100	102
Bags	75.5	86	86	91	91	96
Sub-total (1)	455	517	517	546	546	571
Manpower	254	254	254	254	254	254
Maintenance Materials	166	166	166	166	166	166
Plant overheads	200	200	200	200	200	200
Sub-total (2)	620	620	620	620	620	620
Depreciation (3)	340	340	340	340	340	340
Interest on working capital (4)	85	85	85	85	85	85

6.6.6 Total Operating Costs

(1)+(2)	1,075	1,137	1,137	1,166	1,166	1,191
(1)+(2)+(3)	1,415	1,477	1,477	1,506	1,506	1,531
(1)+(2)+(3)+(4) =	1,508	1,562	1,562	1,591	1,591	1,616

SECTION 7 : SELLING PRICES OF THE PRODUCTS

7.1 RELATIONSHIP BETWEEN THE OILMILLS

7.1.1 Diagram B appended at the end of the present section illustrates the transfer of materials between NOIL, LEVER and the "Solvent Extraction Company" (SEC).

SEC could operate as a processing and trading concern (Alternative I) or purely as a service company (Alternative II).

In the case of Alternative I, NOIL and LEVER would sell their prepressed cakes to SEC at a price related to their "opportunity value", which is explained under 7.2 below. With such an alternative.

a) NOIL would sell prepressed cottonseed cake to SEC and receive back solvent extracted crude cottonseed oil free of charge. After neutralisation of the latter and of expeller oil, NOIL would sell semi-refined oil to LEVER as practiced at present. NOIL would also sell prepressed sunflower cake to SEC and expeller crude sunflower oil to LEVER.

b) LEVER would sell prepressed groundnut cake to SEC and receive back solvent extracted crude groundnut oil free of charge. LEVER would fully refine, pack and market all the vegetable oils.

c) SEC would sell solvent extracted crude sunflower oil direct to LEVER, crediting NOIL of the corresponding amount, and all extraction meals on the local and export markets.

In the case of Alternative II, SEC would process prepressed cakes from NOIL and LEVER against a fee. NOIL would get back cottonseed and sunflower meals, and crude cottonseed oil. Solvent extracted sunflower oil would be transferred to LEVER who would pay NOIL for its value. The latter would also sell expeller crude sunflower oil to LEVER. LEVER would get back crude groundnut oil and groundnut meal from SEC.

The economics of such type of operation are elaborated upon in Section 8.

7.2 SELLING PRICES OF PREPRESSED CAKES, CRUDE OILS AND MEALS - ALTERNATIVE I

7.2.1 The Consultants' approach to the determination of prices to be paid by SEC for prepressed cakes involves the principle that both NOIL and LEVER could invest in additional full expelling capacity to produce more oil instead of having recourse to prepressing and be dependent on a new solvent extraction venture. This enables the determination of the "minimum economic" selling price of the cakes which gives the same profit margin to each of the two established companies for both options.

Annex 1 of the report shows the relevant calculations for cottonseed, sunflower and groundnut cakes.

a) NOIL should sell prepressed cottonseed cake to SEC at K 71/t and prepressed sunflower cake at K 179/t. Expeller crude sunflower oil would be sold to LEVER at K 1,100/t, the value of crude groundnut oil to LEVER. The price of semi-refined cottonseed oil to LEVER is K 480/t, as at present.

b) LEVER should sell prepressed groundnut cake to SEC at K 77/t to break-even.

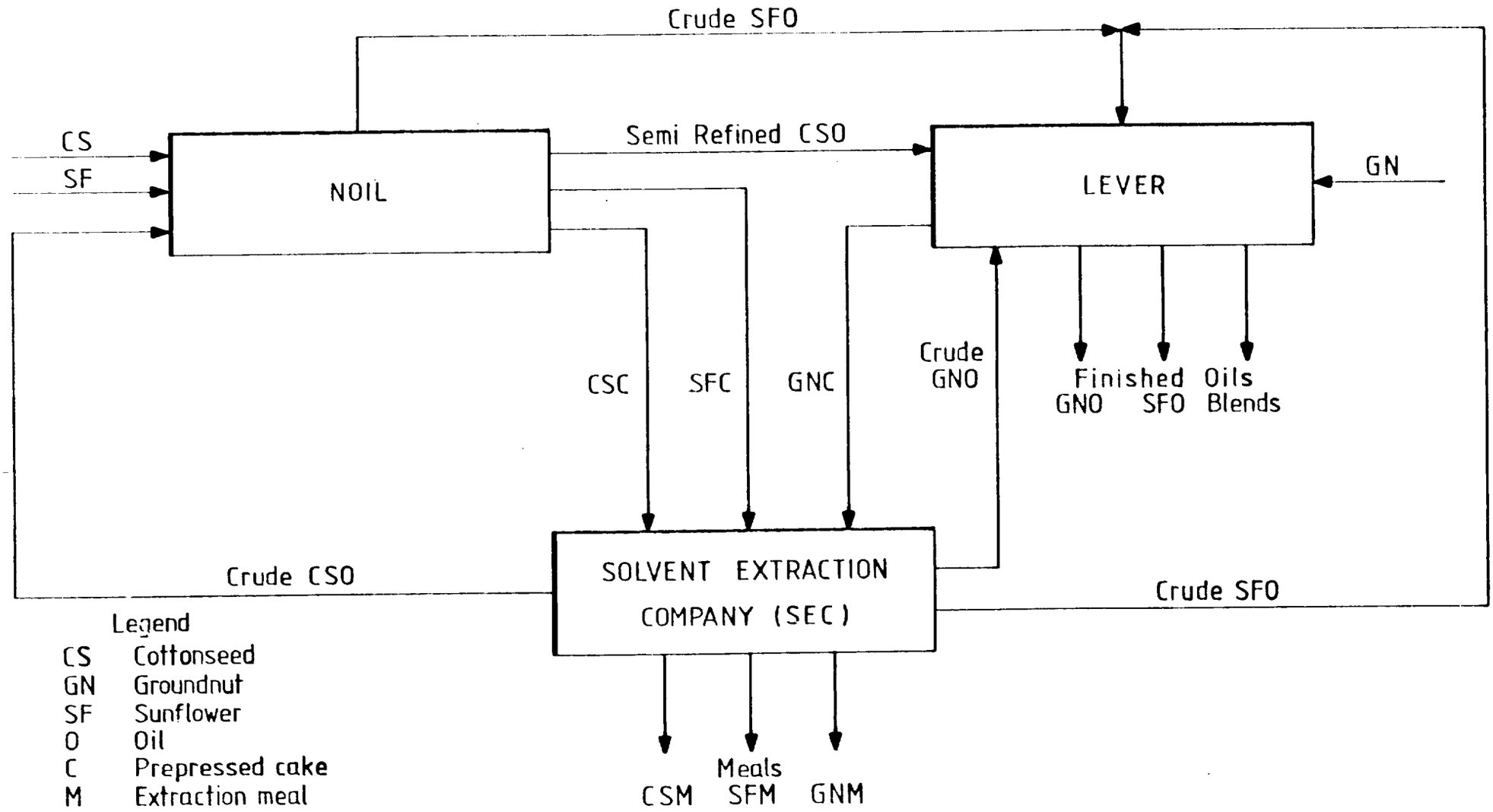
7.2.2 SEC would sell solvent extracted crude sunflower oil to LEVER at K 1,100/t. Selling prices of the extraction meals on the home and export markets are taken as being the same as those of oilcakes with around 6.5% residual oil, as the profat content is almost the same in both cases at equal moisture content. The average prices taken for assessment purposes are:

	K/t
Cottonseed meal	150
Groundnut meal	160
Sunflower meal	130

7.2.3 While NOIL's existing cottonseed crude oil neutralisation capacity can cope with an increased throughput, LEVER's refining capacity will have to be expanded, as well as that of their bottling/packaging section. This does not, however, affect the economics of the solvent extraction project as all prices relate to unrefined oils, bulk basis.

7.3 SELLING PRICES OF CRUDE OILS AND MEALS - ALTERNATIVE II

The prices of oilmeals will be the same as for Alterntive I. While the price of crude sunflower and groundnut oils are taken at Kl,100/t as for Alternative I, that of semi-refined cottonseed oil from solvent extracted crude oil is readjusted to allow for cost differentials relating to NOIL's operations. This is explained in Section 8.



MATERIAL TRANSFER BETWEEN NOIL LEVER AND SEC

DIAGRAM 'B'

SECTION 8 : FINANCIAL EVALUATION

8.1 BASIS AND ASSUMPTIONS

8.1.1 A two year pre-production period and a fifteen year project life are assumed, as this is normal for a project of the type under consideration. Investment outlays are shown in Table 8.1.

It is assumed that the plant will be on stream in 1988, operating at reduced throughput, to reach maximum capacity in 1993.

8.1.2 Operating costs include variable costs, the cost of manpower and maintenance, and plant overheads. These are detailed in Table 6.7 of Section 6.

8.1.3 Transfer and selling prices of intermediate and finished products taken for the purpose of the financial evaluation are those submitted in Section 7 and Annex 1 of the report.

8.1.4 The following considerations appertain to the two alternative schemes, Alternative I and II, under which the Solvent Extraction Company (SEC) would operate, as explained in Section 7.

8.2 ALTERNATIVE I : 'SEC' AS A PROCESSING AND TRADING CONCERN

8.2.1 Table 8.1 shows the gross cash flow for the entire life of the project. The Internal Rate of Return (IRR) is practically nil.

The cash flow and the IRR are sensitive mainly to the revenue and the cost of prepressed cakes to SEC.

The revenue is unlikely to be higher than shown as meal prices are believed to be realistic and the price of crude sunflower oil is on the high side compared with the world at large.

Lower prices of prepressed cakes cannot be considered as this would automatically lead to high crude oil costs to both NOIL and LEVER, with consequent increases passed on to the consumer.

8.2.2 As shown by the data contained in Annex 1 under "Option A", NOIL and LEVER could in principle invest advantageously in additional processing facilities to fully press the same tonnages of oilseeds and derive the same profit margin as in the case of prepressing/ solvent extraction ("Option B"), even at the expense of an overall reduced oil production, as indicated in the following tabulation (see also Table 6.2, Section 6).

	Seed	Option A		Option B
			Crude oil tpa	
NOIL	12,000 tpa cottonseed	1,980		2,340
	11,250 tpa sunflower	4,365		4,620
LEVER	18,000 tpa groundnut	7,600		8,250
	TOTAL	13,945		15,210
Option A - Option B			1,265	
Additional Fixed Investment (Estimated)			Kwacha	
NOIL		819,000		95,000
LEVER		597,000		60,000
	TOTAL	1,416,000		155,000
Option A - Option B			1,271	

In terms of fixed investment in the oilmilling sector, about K 1.3 million would generate 13,945 tonnes of crude oils, against K 4.1 million required for the solvent extraction plant to extract an additional 1,265 tonnes.

8.3 ALTERNATIVE II: 'SEC' AS A SERVICE CONCERN

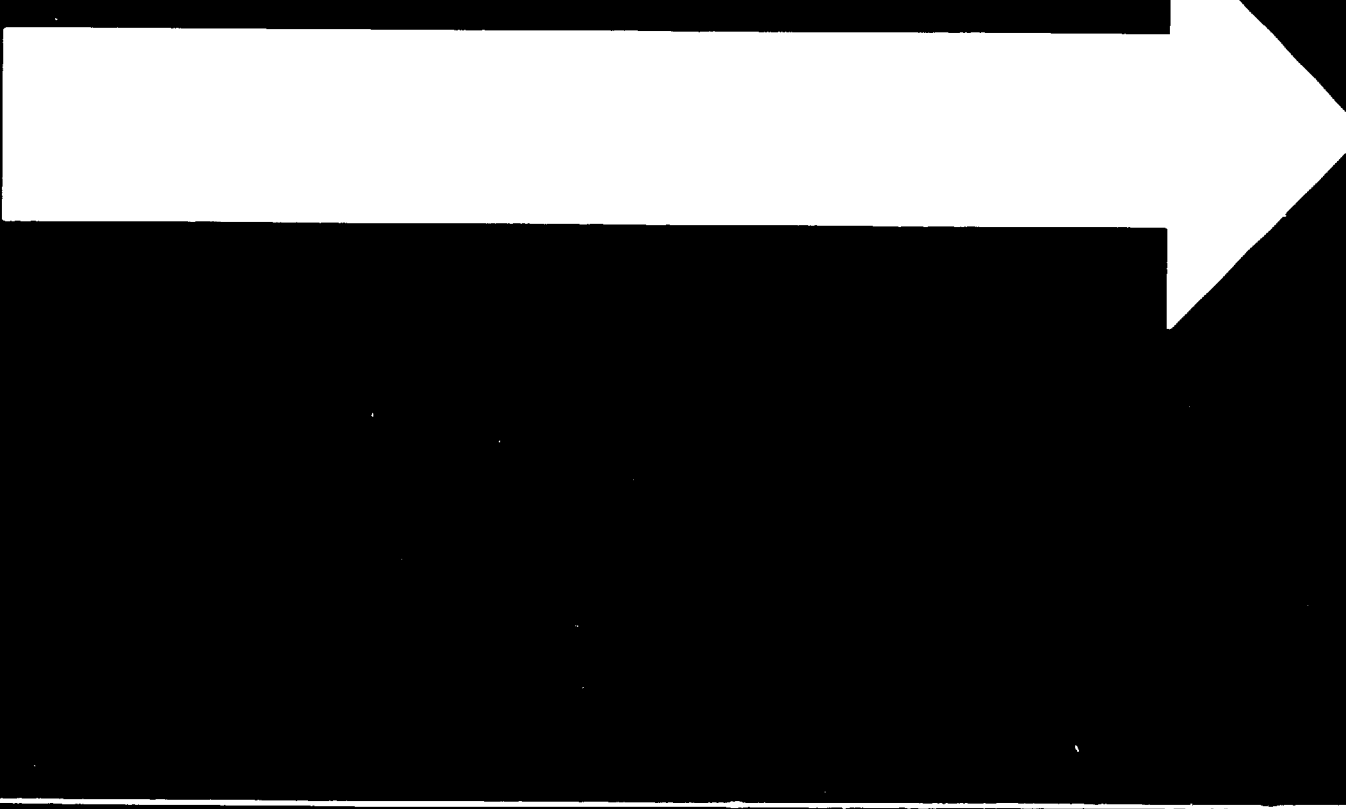
8.3.1 With reference to Section 7, SEC would charge a processing fee per tonne of prepressed cake and send back the extracted crude vegetable oils and meals to its two customers.

The Consultants' approach to the determination of the unit processing fee is that SEC operations should show an IRR in the region of 20% with investment and operating costs being the same as for Alternative I, if an allowance is to be made for the degree of accuracy of the estimates of these costs as arrived at in the study. The Consultants place such limits at ± 20% for the total investment and at ± 10% for the operating costs.

8.3.2 The gross cash flow for Alternative II is given in Table 8.2. By charging a fixed fee of K 105/tonne of prepressed cake, the IRR is 20.4% for Base Case A.

The same table shows the results of the sensitivity analysis, as follows:

	IRR, %
Base Case A	20.4
Case B	
Total Investment + 20%	16.3
Case C	
Total Investment +20% and	
Operating Costs + 10%	14.7
Case A'	
As for Case A but plant operated at	
89% capacity from 1989 onwards	19.2
Case C'	
As for Case C but plant operated at	
89% capacity from 1989 onwards	13.5



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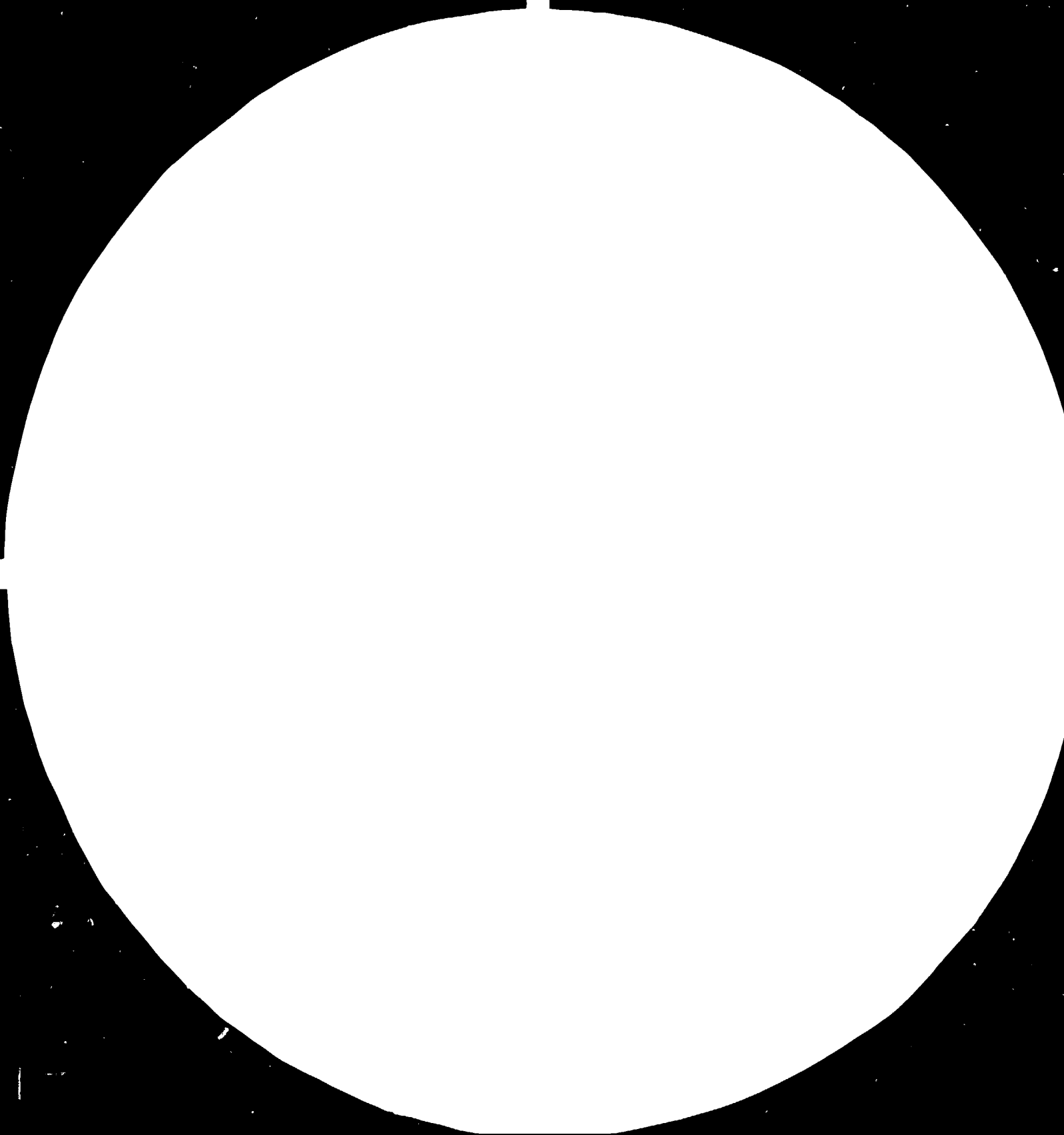
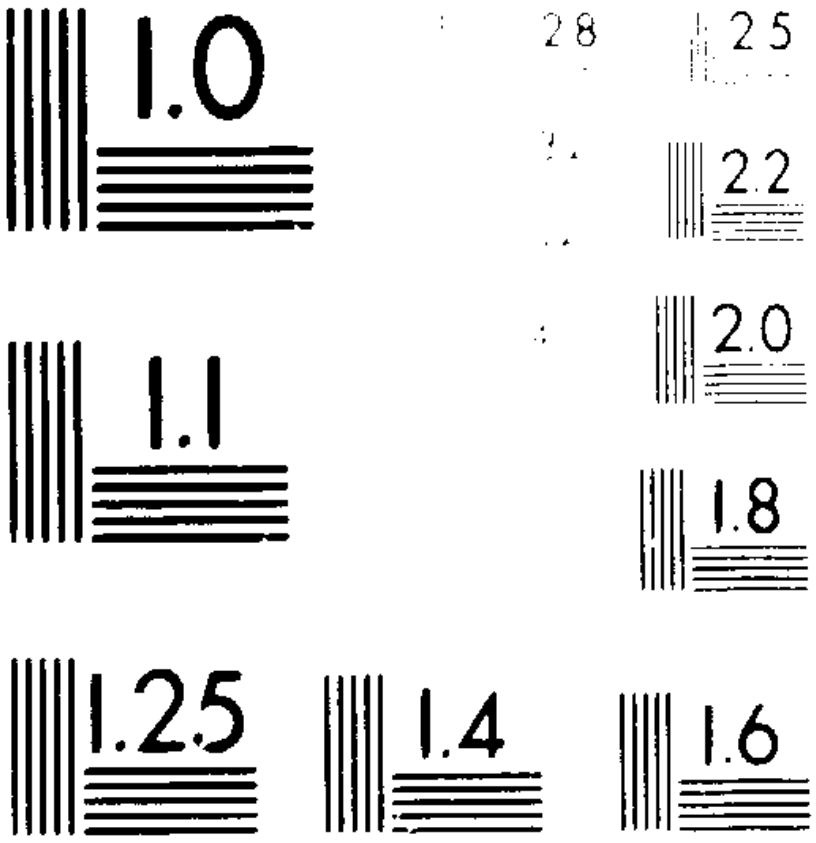




The operation appears to be viable for Cases A, A' and B, but for Cases C or C', it would be far less attractive and possibly marginal depending on the method of financing.

8.3.3 NOIL's Costs and Margin

a) For the processing of 6,780 tonnes of prepressed cottonseed cake, NOIL would pay SEC a fee of 6,780t x K105 = K711,900 p.a.

NOIL would get back 900t of crude cottonseed oil, equivalent to 775t of semi-refined oil, plus 5,800 tonnes of cottonseed meal. Referring to Annex 1, if NOIL adopts the full pressing procedure (Option A) instead of prepressing/solvent extraction, a tonnage of cake higher than that of extraction meal would be obtained. The cost to NOIL of solvent extracted cottonseed oil after refining would thus be as follows:

	Kp.a.	
SEC processing fee	711,900	
Plus Neutralisation cost of 900 t crude oil	27,000	
Loss on meal sales (6,200t - 5,800t) x K150	60,000	
Cost to NOIL of 775t semi-refined cottonseed oil:	798,900	(i)

This would correspond to K1,030.84/t, well above the selling price to LEVER of K480/t.

b) For the processing of 5,070 tonnes of prepressed sunflower cake (1993 onwards), NOIL would pay SEC a fee of 5,070t x K105 = K532,350 p.a.

NOIL would get back 4,230t of sunflower meal and would be credited by LEVER of the value of 780t of solvent extracted crude sunflower oil at K1,100/tonne. The cost to NOIL of prepressed sunflower cake processing would be:

	Kp.a.	
SEC processing fee	532,350	
Loss on meal sales relative to the full pressing option: (4,455t - 4,230t) x K130	29,250	
	561,600	(ii)

c) The income derived by NOIL from the sales of solvent extracted oils to LEVER would be:

	Kp.a.	
Semi-refined cottonseed oil from 900t of crude oil 775t x K480	372,000	
Crude sunflower oil 780t x K1,100	858,000	
	1,230,000	(iii)
Loss: (iii) - (i) - (ii)	130,500	(iv)

From the data in Annex 1, the savings on operating costs (power, spares) with cottonseed and sunflower prepressing compared with full pressing are estimated at about K107,000 p.a., so that the net loss would amount to K23,500 p.a. To break even, NOIL should sell, say, the 775t of semi-refined cottonseed oil at about K480 + K30 = K510/tonne.

8.3.4 LEVER's Costs and Margin

a) For the processing of 10,860 tonnes of prepressed groundnut cake, LEVER would pay SEC a fee of 10,860t x K105 = K1,140,300 p.a.

LEVER would get back 1,470t of crude groundnut oil plus 9,300t of groundnut meal. With reference to Annex 1, if LEVER have recourse to full pressing instead of prepressing/solvent extraction, a tonnage of cake higher than that of extraction meal would be obtained. The cost to LEVER of solvent extracted crude groundnut oil would be as follows:

	Kp.a.	
SEC processing fee	1,140,300	
Plus: Loss on meal sales		
(10,380t - 9,300t) x K160	172,800	
Cost to LEVER of 1,470t solvent extracted crude groundnut oil:	1,313,100	(i)

The corresponding cost per tonne is K893.26, which is below the level of K1,100 for the 1982/83 period.

b) The overall cost to LEVER of all oils can be calculated as follows (1993 basis):

Oil	Source	tpa	K/t	Cost to LEVER Kp.a.
Semi-refined cottonseed	Expeller,NOIL	1,240	480	595,200
" " "	SEC/NOIL	775	510	395,250
Crude sunflower	Expeller,NOIL	3,840	1,100	4,224,000
" "	SEC/NOIL	780	1,100	858,000
Crude groundnut	Expeller,LEVER	6,780	1,100	7,458,000
" "	"			
saving on processing cost with prepressing (power, spares)				(88,000)
Crude groundnut	SEC	1,470	893.26	1,313,100
TOTAL		14,885		14,775,550

The overall average cost per tonne of crude sunflower and groundnut oils and semi-refined cottonseed oil is found to be K992.65/t. The present average cost of refined groundnut and cottonseed oils is K973/t ex-mill (bulk basis), as estimated in Annex 2. Refining costs would probably average K35/t, so that the average ex-mill cost of the three oils under review would be in the neighbourhood of K1,028/t, which is K55/t (or 5.6%) higher than the current level.

8.4 ALTERNATIVE II : EFFECT OF A LOWER PROCESSING FEE ON THE RATE OF RETURN

8.4.1 As LEVER are the ultimate refiners and sellers of vegetable oils, the processing fee of K105 per tonne of prepressed cake which would give SEC a comfortable return on investment must be reduced in such a way that the overall average cost to LEVER of semi-refined cottonseed, crude groundnut and crude sunflower oils is the same as at present, namely K938/t as deduced from the figures in 8.3.4 above, with the assumptions that the cost of cottonseed and groundnut remain unchanged, and that the selling prices of oil meals are as indicated in the study. This corresponds to a reduction of K55/t of all oils prior to finishing at LEVER's mill. The annual SEC fee reduction required to bring about an economic cost level for the oils is shown below:

	1988	1989	1990	1991	1992	1993+
Prepressed cakes, t	17640	20175	20175	21440	21440	22710
Total crude oils produced by NOIL, LEVER and SEC, t	10590	12900	12900	14055	14055	15210
Equivalent semi-refined cottonseed, crude groundnut and crude sunflower oils, t	10265	12575	12575	13730	13730	14885
Required reduction in SEC annual fee, '000K	564	692	692	755	755	819
Equivalent fee reduction per tonne of cake, K	32	34	34	35	35	36
Maximum fee chargeable per tonne of cake, K	73	71	71	70	70	69

8.4.2 SEC Gross Cash Flow as derived from Table 8.2 would then be as follows:

	1986	1987	1988	1989	1990	1992	1993..	2001	2002
'000 K	(1331)	(3300)	?13	359	359	335	375	375	906

The IRR is found to be 2.7%. If, within the limits of accuracy of the present estimates, the gross cash flow is 20% higher than the above, the IRR is found to be about 5%.

It can be concluded that the solvent extraction project is not viable under the present circumstances.

TABLE 8.1

SOLVENT EXTRACTION COMPANY
CASH FLOW - ALTERNATIVE I
'000 K

	1986	1987	1988	1989	1990	1991	1992	1993	1994...2001	2002
1. Revenue			2358	3062	3062	3414	3414	3766	3766	3766
2. Prepressed cakes			1317.6	1771.4	1771.4	1998.2	1998.2	2225.1	2225.1	2225.1
3. Operating costs (a)			1075	1137	1137	1166	1166	1191	1191	1191
4. Total investment	1331	3300								(531) (b)
5. Total outgoings (2 + 3 + 4)	1331	3300	2392.6	2908.4	2908.4	3164.2	3164.2	3416.1	3416.1	3416.1 2885.1
6. Gross cash flow (1 - 5)	(1331)	(3300)	(34.6)	153.6	153.6	249.8	249.8	349.9	349.9	349.9 880.9
IRR = 0.4%										
1. CSM @ K150/t			870	870	870	870	870	870	870	870 870
GNM @ K160/t			1488	1488	1488	1488	1488	1488	1488	1488 1488
SFM @ K130/t				275	275	412.5	412.5	550	550	550 500
SFO @ K1,100/t				429	429	643.5	643.5	858	858	858 858
Total			2358	3062	3062	3414	3414	3766	3766	3766 3766
2. CSC @ K71/t			481.4	481.4	481.4	481.4	481.4	481.4	481.4	481.4 481.4
GNC @ K77/t			836.2	836.2	836.2	836.2	836.2	836.2	836.2	836.2 836.2
SFC @ K179/t				453.8	453.8	680.6	680.6	907.5	907.5	907.5 907.5
Total			1317.6	1771.4	1771.4	1998.2	1998.2	2225.1	2225.1	2225.1 2225.1
4. Investment Schedule										
Buildings	700	700								
Plant	600	2100								
Working Capital	31	500								
	1331	3300								

(a) excluding depreciation and interest on working capital
(b) Working capital

CS = Cottonseed; GN = Groundnut; SF = Sunflower; M = Meal; C = Cake; O = Oil

TABLE 8.2

SOLVENT EXTRACTION COMPANY
CASH FLOW - ALTERNATIVE II
'000 K

	1986	1987	1988	1989	1990	1991	1992	1993	1994...2001	2002
1. Processing Fee (a)			1852	2118	2118	2251	2251	2385	2385	2385
2. Operating Costs			1075	1137	1137	1161	1161	1191	1191	1191
3. Gross Margin (1-2)			777	1051	1051	1090	1090	1194	1194	1194
4. Total Investment	1331	3300								(531)
5. Gross Cash Flow (3-4)	(1331)	(3300)	777	1051	1051	1090	1090	1194	1194	1725
Base Case (A) IRR = 20.4%										
Case B : (4) 20% higher										
5. Gross Cash Flow	(1597)	(3960)	777	1051	1051	1090	1090	1194	1194	1831
IRR = 16.8%										
Case C : (4) 20% higher and (2) 10% higher										
5. Gross Cash Flow	(1597)	(3960)	669.5	937	937	974	974	1075	1075	1712
IRR = 14.7%										
Case (A'): if plant operates at 89% capacity (1989+), other parameters as in Case (A)										
5. Gross Cash Flow	(1331)	(3300)	777	1051	1051	1051	1051	1051	1051	1688
IRR = 19.2%										
Case (C'): if plant operates 89% capacity (1989+), other parameters as in Case (C)										
5. Gross Cash Flow	(1597)	(3960)	669.5	937	937	937	937	937	937	1574
IRR = 13.5%										

(a) at K 105/tonne of prepressed cake

ANNEX 1

CALCULATION OF THE SELLING PRICES OF PREPRESSED CAKES FOR SOLVENT EXTRACTION

1. Given the increased availability of cottonseed and high oil content groundnut, together with the development of sunflower production, the question arises whether NOIL should prepress cottonseed and sunflower seed, and LEVER groundnut, and the prepressed cakes sold to the "Solvent Extraction Company" (SEC), or invest in additional expelling facilities leaving about 6.5% residual oil in the cake. The calculations which follow lead to the assessment of the selling prices of the prepressed cakes to SEC which would enable NOIL and LEVER to realise the same margin under the two options. These prices serve as a basis for the financial analysis of the Solvent Extraction Project.

2. The calculations are based on the following unit values:

a) The selling prices of semi-refined cottonseed oil is K 480/t, which has not changed over recent years.

b) The value of crude groundnut oil to LEVER is K 1,100/t, a level which was applying during the 1982/83 compaign.

c) The value of crude sunflower oil is taken as being the same as that of groundnut oil, although the price of the latter on the international market is higher than that of the former. The reason for such a choice is that the retail price of vegetable oil in Malawi is substantially higher, even after deduction of the Government surtax.

d) Conversely, the selling price of groundnut cake (fully expelled) is taken at a higher price than that of cottonseed cake, based on world price levels. Groundnut cake is higher in protein content and is more valuable feedstuff component. The Aflatoxin problem does not arise in Malawi (LEVER mention less than 0.1 ppm in the cake) and there should be no reason why the material could not fetch more remunerative prices. If this has not been achieved so far is probably due to a limited marketing effort.

e) On the assumption that half of the fully pressed oilcakes (or solvent extraction meals) produced would be consumed internally and the balance exported, the ex-mill selling prices of the three types of materials taken for the present purposes are as follows:

	Home	Export	Average
		k/t	
Cottonseed cake	155	145	150
Groundnut cake	165	155	160
Sunflower cake	135	125	130

The above prices of cottonseed cake are broadly within the range achieved by NOIL over recent years, while those of sunflower cake are based on international levels relative to the two other cakes.

3. It is pointed out that although the above oilcakes prices may vary, the overall result will be the same on a comparative basis when considering either options, full pressing or prepressing. Insofar as the economics of the solvent extraction project are concerned, with given vegetable oil values, any change in the assumed prices of oilcakes will affect the income of the solvent extraction operation by an equal amount.

4. A similar reasoning may be applied to the cost of seed. That of cottonseed (and its processing costs) has not been disclosed to the Consultants, but the selling price of cottonseed cake and semi-refined oil has remained unchanged over the past few years.

Based on cost data supplied by LEVER, the value (cost of production) of crude groundnut oil is K 1,100/t, which is taken in the following calculations, with groundnut costing K 500/t and when pricing fully expelled cake at K 160/t.

The cost of sunflower seed to NOIL as calculated from the relevant computations which follow is found to amount to K 463.50/t (US$ 417/t), as compared with the last three years' average Rotterdam price of US$ 296/t. The latter figure is arrived at by deduction and does not necessarily reflect the future price level which would apply.

NOIL - COTTONSEED PROCESSING

Option A : Full pressing of 12,000 tpa over 150 days per annum.

(i) Estimated installed cost of new equipment required

	K
- Refurbishing of delinting and decortication section, modification to conveyors	35,000
- 3 new Mark II expellers with cookers (shared with sunflower)	537,000
- New filter press, oil and foots handling, filtered oil tank	60,000
TOTAL	632,000

(ii) Output

	tpa
Crude cottonseed oil	1,980
Semi-refined cottonseed oil	1,707
Cottonseed cake at 6.5% residual oil	6,200

(iii) Operating cost (cookers/presses and neutralisation only)

	K p.a.
Power, 60 kWh/t whole seed equivalent @ K 0.06/kWh	36,000
Steam - nil cost of fuel (hulls)	(nominal)
Spares, K 5/t seed	60,000
Crude oil neutralisation, K 30/t crude	59,400
10% depreciation of new equipment (shared with sunflower): $0.1 \times \frac{632,000 - 35,000}{2}$	29,850
TOTAL	185,250

(iv) Income

	K p.a.
Semi-refined oil 1,707 t x K 480	819,360
Oilcake 6,200 t x K 150	930,000
TOTAL	1,749,360

(v) Gross margin (iv) - (iii) 1,564,110
(excluding the cost of seed)

Option B : Prepressing of 12,000 tpa over 150 days per annum.

(i) Estimated installed cost of new equipment required

	K
- Refurbishing of delinting and decortication section	35,000
- Crude oil section	60,000
TOTAL	95,000

(ii) Output

	tpa
Crude cottonseed oil	1,440
Crude cottonseed oil from SEP	900
Total crude oil	2,340
Semi-refined cottonseed oil	2,017
Prepressed oilcake @ 14% residual oil	6,780

(iii) Operating cost (cookers/presses and neutralisation only)

	K p.a.
Power, 45 kWh/t seed @ K 0.06/kWh	32,400
Steam	(nominal)
Crude oil neutralisation, K 30/t crude (estimated)	70,200
Spares, K 1/t seed	12,000
10% depreciation of new equipment (shared with sunflower): $\frac{0.1 \times 60,000}{2}$	3,000
TOTAL	117,600

(iv) Income

NOIL would sell 6,780 tpa of prepressed cottonseed cake to SEC at a certain price and get back solvent extracted crude oil free of charge. To obtain the same margin as in Option A, the calculated price of the cake is about K 71/t, arrived at as follows:

	K p.a.
Gross margin, Option A	1,564,110
Less: Operating cost	117,600
	1,446,510
Less: Value of semi-refined cottonseed oil: 2,017 x K 480	968,160
Required income from prepressed cake: 6,780 t x K 70.55	478,350

NOIL - SUNFLOWER SEED PROCESSING

Option A: Full pressing of 11,250 tpa over 150 days per annum (Year 1993+)

(i) Estimated installed cost of new equipment

		K
- Seed cleaner, decorticator, hull beater/separator system		187,000
- 3 new Mark II expellers with cookers, new filter press, crude oil circuit (shared with cottonseed half of the year)		298,500
	TOTAL	485,500

(ii) Output

	tpa
Crude sunflower oil	4,365
Oilcake @ 6.5% residual oil	4,455

(iii) Operating costs (including dehulling)

	K p.a.
Power, 75 kWh/t seed @ K 0.06	50,625
Steam - nil cost of fuel (hulls)	(nominal)
Spares, K 6/t seed	67,500
10% depreciation of new equipment	48,550
TOTAL	166,675

(iv) Income

	K p.a.
Crude oil 4,365 t x K 1,100	4,801,500
Oilcake 4,455 t x K 130	579,150
TOTAL	5,380,650

(v) Gross margin (iv) - (iii) 5,213,975
(excluding the cost of seed)

Option B: Prepressing of 11,250 tpa over 150 days per annum (Year 1993+)

(i) Estimated installed cost of new equipment

Seed cleaner, decorticator, hull beater/separator system	K 187,000

(ii) Output

	tpa
Crude sunflower oil (sold to LEVER)	3,840
(Solvent extracted oil sold direct by SEC to LEVER)	
Prepressed oilcake @ 16% residual oil	5,070

(iii) Operating cost

	K p.a.
Power, 60 kWh/t seed @ K 0.06	40,500
Steam	(nominal)
Spares, K 2/t seed	22,500
10% depreciation of new equipment	18,700
TOTAL	81,700

To get the same margin as in Option A, NOIL would have to sell the prepressed cake to SEC at about K 179/t, which is derived as follows:

	K p.a.
Gross margin, Option A	5,213,975
Less: Operating cost	81,700
	5,132,275
Less: income from crude sunflower oil: 3,840t x K 1,100	4,224,000
Required income from prepressed cake: 5,070t x K 179.15	908,275

NB : 780t of solvent extracted sunflower oil sold by SEC to LEVER (Alternative I of the Financial Analysis) or credited to NOIL by SEC (Alternative II).

LEVER - GROUNDNUT PROCESSING

Option A: Full pressing of 18,000 tpa over 300 days per annum; high oil content nut (taken at 46%)

(i) Estimated installed cost of new equipment required

	K
- 3 new Mark II expellers with cookers	537,000
- New filter press, oil and foots handling, filtered oil tank	60,000
	597,000

(ii) Output

	tpa
Crude groundnut oil	7,600
Groundnut cake at 6.5% residual oil	10,380

(iii) Operating cost

	K p.a.
Power, 60 kWh/t @ K 0.06/kWh	64,800
Steam, 110 kg/t (coal cost only)	39,200
Spares, K 5/t	90,000
10% depreciation of new equipment	59,700
TOTAL	253,700

(iv) Income

	K p.a.
Crude oil (at present LEVER's cost) 7,600t x K 1,100	8,360,000
Oilcake: 10,380t x K 160	1,660,800
TOTAL	10,020,800

(v) Gross margin (iv) - (iii) 9,767,100
(excluding the cost of groundnut)

Option B: Prepressing of 18,000 tpa over 300 days per annum

			K
(i)	Estimated installed cost of new equipment		60,000
(ii)	Output		tpa
	Crude groundnut oil		6,780
	Prepressed cake @ 14% residual oil		10,860
(iii)	Operating cost		K p.a.
	Power, 45 kWh/t @ K 0.06/kWh		48,600
	Steam (same as in Option A)		39,200
	Spares, K 1/t		18,000
	10% depreciation of new equipment		6,000
		TOTAL	111,800

(iv) Income

LEVER would sell 10,860 tpa of groundnut prepressed cake to SEC at a certain price and get back 1,470 tpa solvent extracted crude oil free of charge. To obtain the same margin as in Option A, the calculated price of the cake is K 77/t, derived as follows:

	K p.a.
Gross margin, Option A	10,020,800
Less: Operating cost	111,800
	9,909,900
Less: value of 6,780t + 1,470t = 8,250t of crude groundnut oil @ K 1,100/t	9,075,000
Required income from prepressed cake: 10,860t x K 76.79	834,000

ANNEX 2

ESTIMATE OF LEVER'S EX-MILL COST OF VEGETABLE OILS

1. Should the Solvent Extraction Project materialise, LEVER would fully refine, pack and market the vegetable oils produced by themselves, by NOIL and by the Solvent Extraction Company (SEC), as they have a well established internal marketing system.

   If SEC were to be a "service company" which would process prepressed oilcakes from NOIL and LEVER against a fee, and send back crude oils and extraction meals to these two primary producers, then it is essential to examine the price structure of oils, in order to evaluate the attractiveness or otherwise of the solvent extraction operation of the service type (as NOIL is in relation to ADMARC).

2. In an attempt to arrive at such ex-mill oil price levels, and for the purpose of feasibility assessments, an examination of the cost structure as was applying mid-1983 is made on the basis of internal cost data supplied by LEVER to the Consultants.

3. LEVER market 100% groundnut oil under the brand name of COVO and a 50:50 blend of groundnut oil and cottonseed oil under the brand name of KAZINGA. From past records, COVO sales amount to about 40% and KAZINGA to 60% of the total. In 1982, they totalled about 2,700 tonnes. The overall ratio of groundnut to cottonseed oil was thus around 70:30.

4. LEVER receives semi-refined (neutralised) cottonseed oil from NOIL at K 480/t. With an oil loss of probably 3% upon bleaching and deodorising, and an estimated K 35/t refining cost, the cost of refined cottonseed to LEVER as calculated is K 530/t, bulk.

   LEVER's cost of production of crude groundnut oil was about K 1,088.50/t during the first quarter of 1983, after crediting for cake at K 132/t, and with a raw material cost of K 480/t. With a reported refining yield of 96.6%, the cost of production of refined groundnut oil was K 1,162.75/t, bulk.

5. From the above unit costs of the two oils and their usage ratio, the average ex-mill cost of the refined oils, bulked basis, was:

0.3 + K 530 + 0.7 x K 1,162.50 = K 972.90/t

6. The recent cost of plastic bottles and corrugated cases were as follows:

Bottles		Cases	
Size	K/'000 units	K/'000 units	No of Bottles/cases
125 ml	54.52	251	25
500 ml	129.97	350	12
1,000 ml	223.76	510	12

From the above unit costs, the cost of packaging per tonne of oil is:

	Brand	K/t
In 125 ml bottles	Kazinga	573.85
In 500 ml bottles	Kazinga/Covo	353.63
In 1,000 ml bottles	Covo	295.85

7. The Consultants understood from LEVER that sales of 1 litre Covo bottles were relatively small due to the high retail price in relation to the spending power. On the other hand, the ratio of sales of 125 ml Kazinga bottles to 500 ml size is high on account of cheapness "per unit purchased", possibly in the ratio of 60:40, as against 10:90 for 1,000 ml and 500 ml Covo bottles.

Taking the above ratios as a basis, and from the sales ratio of Kazinga: Covo of 60:40%, the overall cost of packaging per tonne of oil can be calculated from the following equation:

$$P = 0.6 \times 0.6\,[\text{Kaz } 125] + 0.4 \times 0.6\,[\text{Kaz } 500] + 0.9 \times 0.4\,[\text{Cov } 500] + 0.1 \times 0.4\,[\text{Cov } 1000]$$

where [ ] denotes the cost of packaging for each brand and bottle size.

P is found to be K 430.60/t

8. From (5) and (7) above, the average ex-mill cost of the packed oils per tonne is:

K 972.90 + K 430.60 = K 1,403.50

9. The retail prices of the brands, including 20% surtax, are:

	Size	K/bottle	K/tonne
KAZINGA	125 ml	0.33	2,933.30
KAZINGA	500 ml	1.26	2,800.00
COVO	500 ml	1.39	3,088.90
COVO	1,000 ml	2.61	2,900.00

10. The difference between the retail prices and the average ex-mill cost covers Government surtax, commissions and retail margins, transport costs, sales expenses, company overheads and gross profit margin. With an expanded market, this difference would be reduced per unit sold.

Terms of reference

for

The preparation of a techno-economic evaluation study for the establishment of a vegetable oil solvent extraction plant in Malawi

1. Description of the project

In order to lay the techno-economic basis for a decision to be taken by a group of industries supported by the authorities on the setting-up of a solvent extraction plant in Malawi, a detailed techno-economic evaluation of the existing situation is to be carried out by UNIDO. The evaluation study to be prepared has to combine locally available study results and policy considerations with new substantive assessments and financial considerations supported by valid figures and data.

2. Background information

Cottonseed and groundnuts are the only two raw material varieties presently used in Malawi for the domestic production of edible oil. Processing is solely carried out by mechanical pressing operations using the common screw press (expeller) system which necessarily results in the production of oil cakes with a residual oil content of 6 - 10 per cent. Considerable quantities of vegetable oil, therefore, are lost for human consumption.

The only method for optimum oil extraction is the solvent extraction technology, the application of which results in the production of an extracted meal with residual oil contents of less than one per cent. The introduction of the solvent extraction technology in Malawi would, therefore, not only enable industrialists to finally extract available oil cakes and obtain considerable additional quantities of vegetable oil but would also allow the utilization of available unutilized oil bearing raw materials such as soyabeans, maize germs and rice bran.

The domestic market demand on vegetable oils is annually about 3200 tons. Only part of this quantity can, however, be produced by the local industry and vegetable oil imports have so far been unavoidable. Such imports would, however, not be required in case the country's available oil bearing raw materials could fully be used by the domestic industry for edible oil production which is only possible in modern solvent extraction operations. The Government's national policy of reaching self-sufficiency in edible oil production will not only be achieved but additional foreign exchange might possibly be earned by surplus vegetable oil exports.

The Government authorities are, therefore, considering the establishment of a modern solvent extraction plant and wish to make use of UNIDO assistance to undertake a basic techno-economic evaluation study to this effect.

3. Responsibilities and duties of the contractor

The contractor is expected to carry out the following activities.

a) Assess the short and long-term market for the products to be produced by the solvent extraction consisting of vegetable oil and extracted meal with emphasis to be laid on the domestic market demands but also considering possible exports:

b) Assess the locally available oil bearing raw materials with regard to varieties and quantity on a short and long-term basis. In this context special attention is to be paid to cottonseed, groundnuts and groundnut cakes as well as maize germs as available raw material resources and to sunflower, rice bran and soya beans as potential future raw materials for solvent extraction operations.

c) Based on the results obtained from the market survey and raw material assessment, define the size and type of solvent extraction plant most suitable to be established including service installations that may be required for appropriate solvent extraction operations.

d) Estimate the investment costs involved, divided into imports and possible local fabrications as well as the likely operation costs based on relevant operation data such as labour, power, water, maintenance, quality control, management administration etc.

e) Review the infrastructural requirements and assess and evaluate the relationship between the established vegetable oil factories (companies) and the solvent extraction plant proposed to be established.

f) Considering the situation with regard to existing oilseed processing operations, infrastructural requirements, raw material supplies and marketing of oil and meal define the most suitable location of the solvent extraction plant proposed to be set up.

g) Review the domestic market price structure for vegetable oil extracted meal in comparison with world market prices and in relation to the production costs of the solvent extraction plant, proposed to be set up and the selling price derived therefrom. Recommend relevant price support measures if applicable.

h) Outline relevant marketing arrangements that need to be made from all view points in order to permit successful marketing activities. In this context special attention is to be paid to packaging, transport, storage and distribution.

i) Recommend relevant financing schemes in co-operation with the authorities and outline useful financial and technical management structures and methods in view of ensuring the successful operation and efficient production of the solvent extraction plant proposed to be set up.

Important

a) The components of the techno-economic evaluation study as listed under para. 3 above, are not necessarily exhaustive of those required for the preparation of a meaningful study report. The contractor is, therefore, required to collect, evaluate and present any additional information which he considers essential for obtaining optimum results.

b) The contractor's report shall contain all data and sources of information which have been used as the basis for the conclusions and recommendations arrived at.

4. Language qualification: English

5. General programme schedule

a) The contractor's personnel is to be available at UNIDO Headquarters, Vienna, for detailed breifing within two weeks from the date of authorizing the contract.

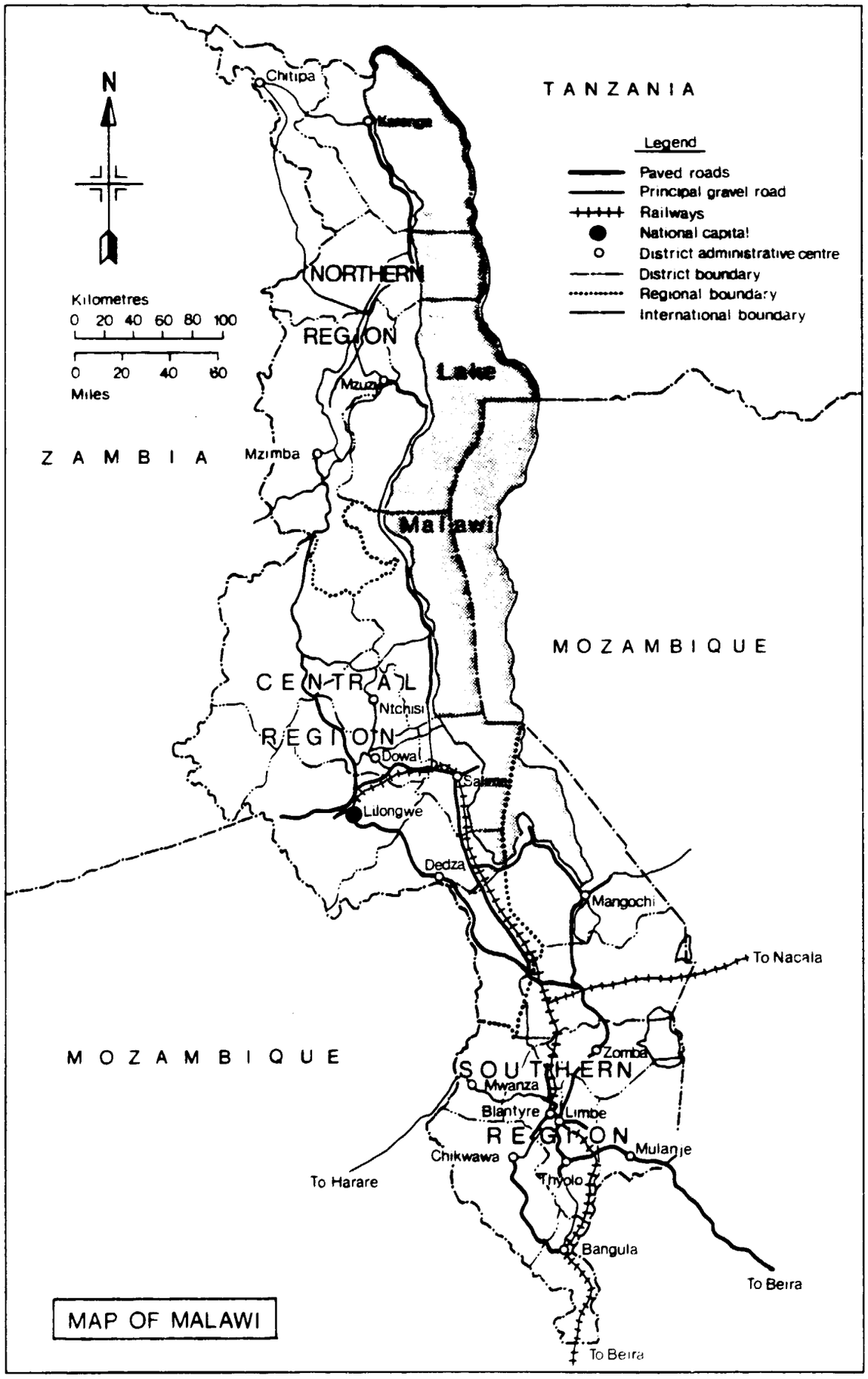
b) The entire study work - field work and home office work, as outlined in principle under para. 3 above - is to be completed within four months from the date of signing the contract.

c) The contractor shall submit to UNIDO three copies of his comprehensive draft final report covering the activities as in principle outlined under para. 3 above within four months and two weeks from the date of signing the contract.

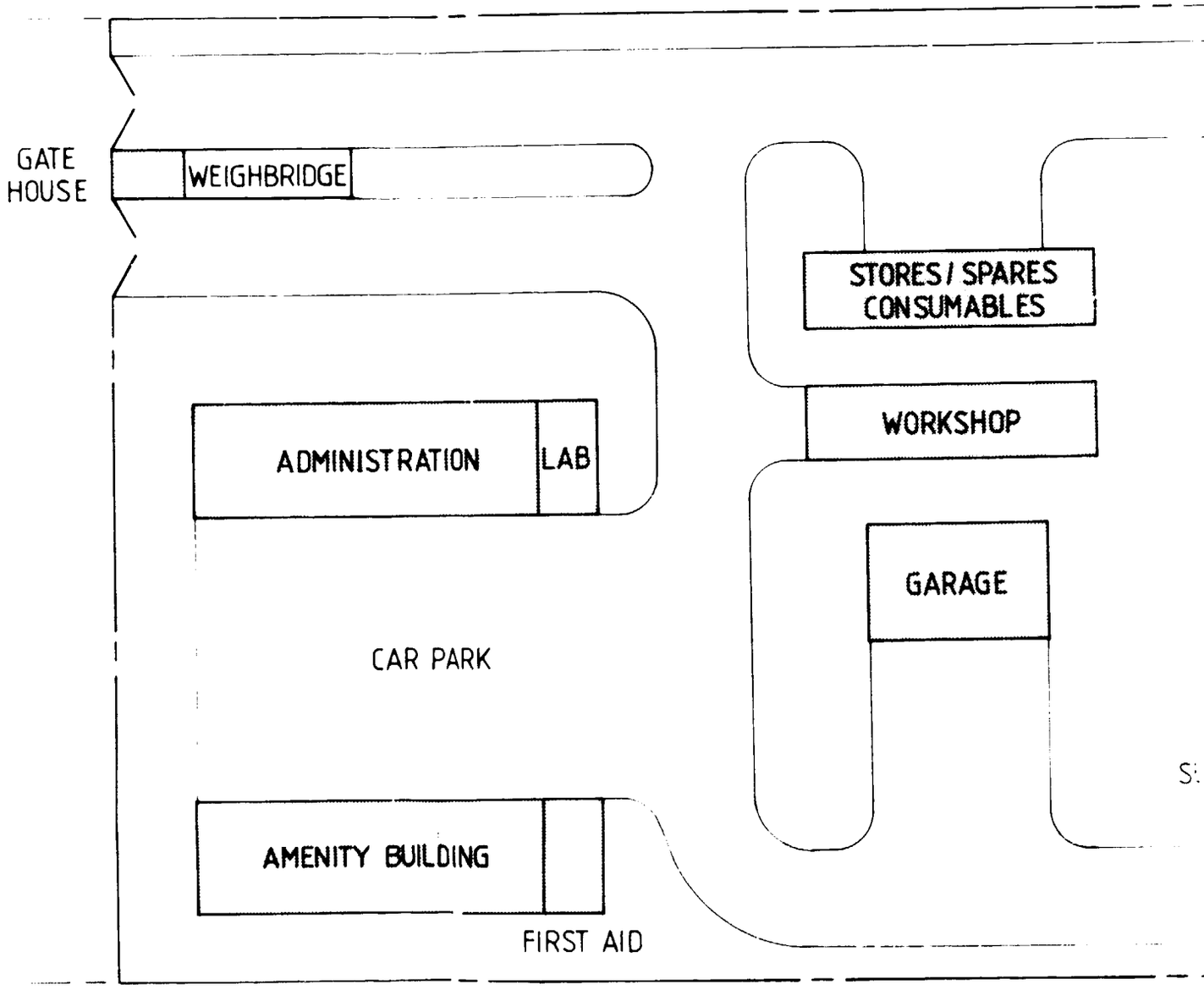
d) UNIDO will prepare its comments on the contractor's draft final report within fourteen days of receipt.

e) The contractor will take into consideration the comments made by UNIDO by preparing his final report which is to be submitted to UNIDO within, maximum, one month after receipt of UNIDO's comments on the draft final report as referred to under para. 5 c) above.

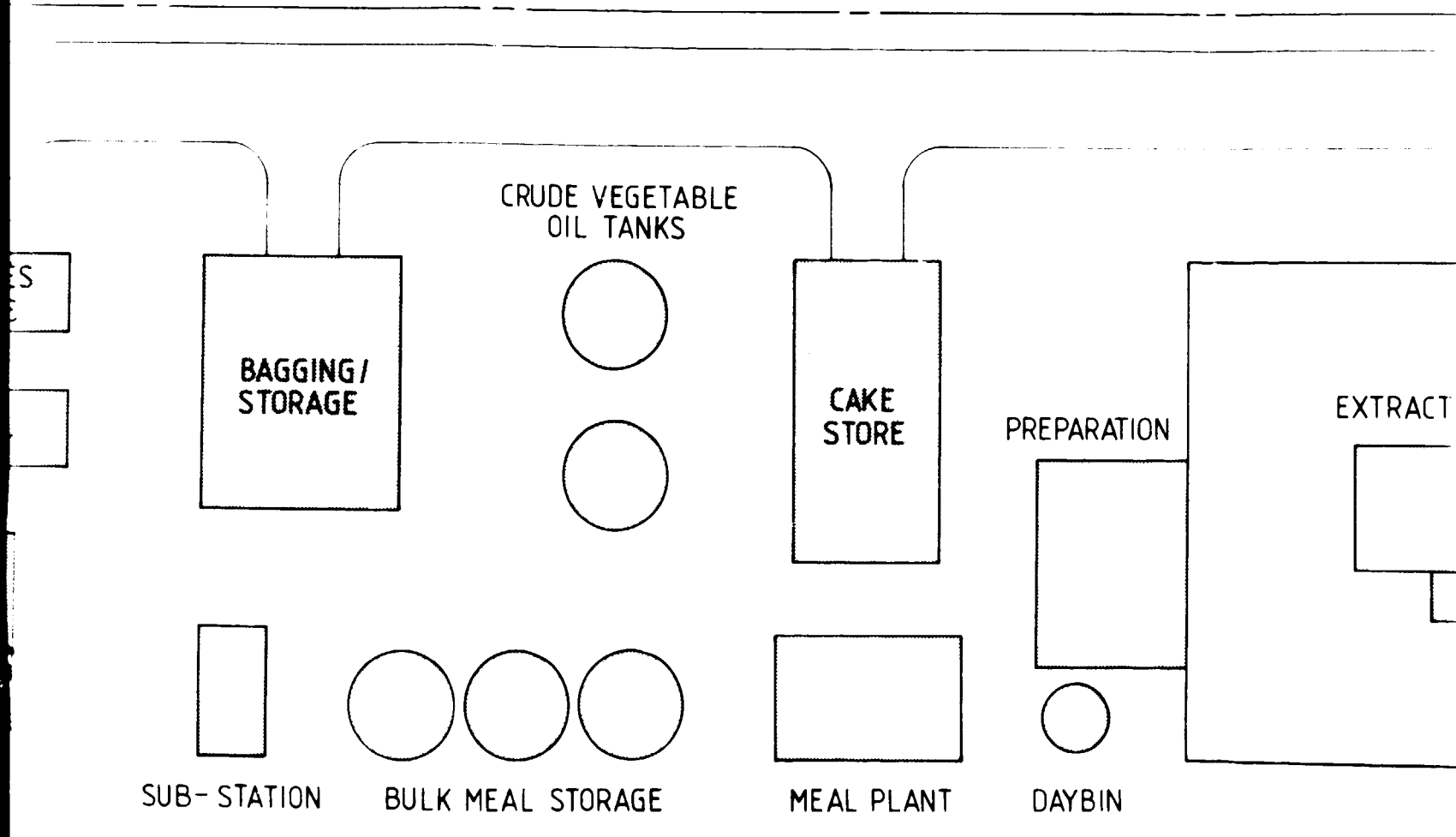
f) Relevant substantive or other discussions - if required - between the contractor and UNIDO substantive staff will take place at the contractor's office or UNIDO Headquarters at a date and time to be agreed upon.



MAP OF MALAWI

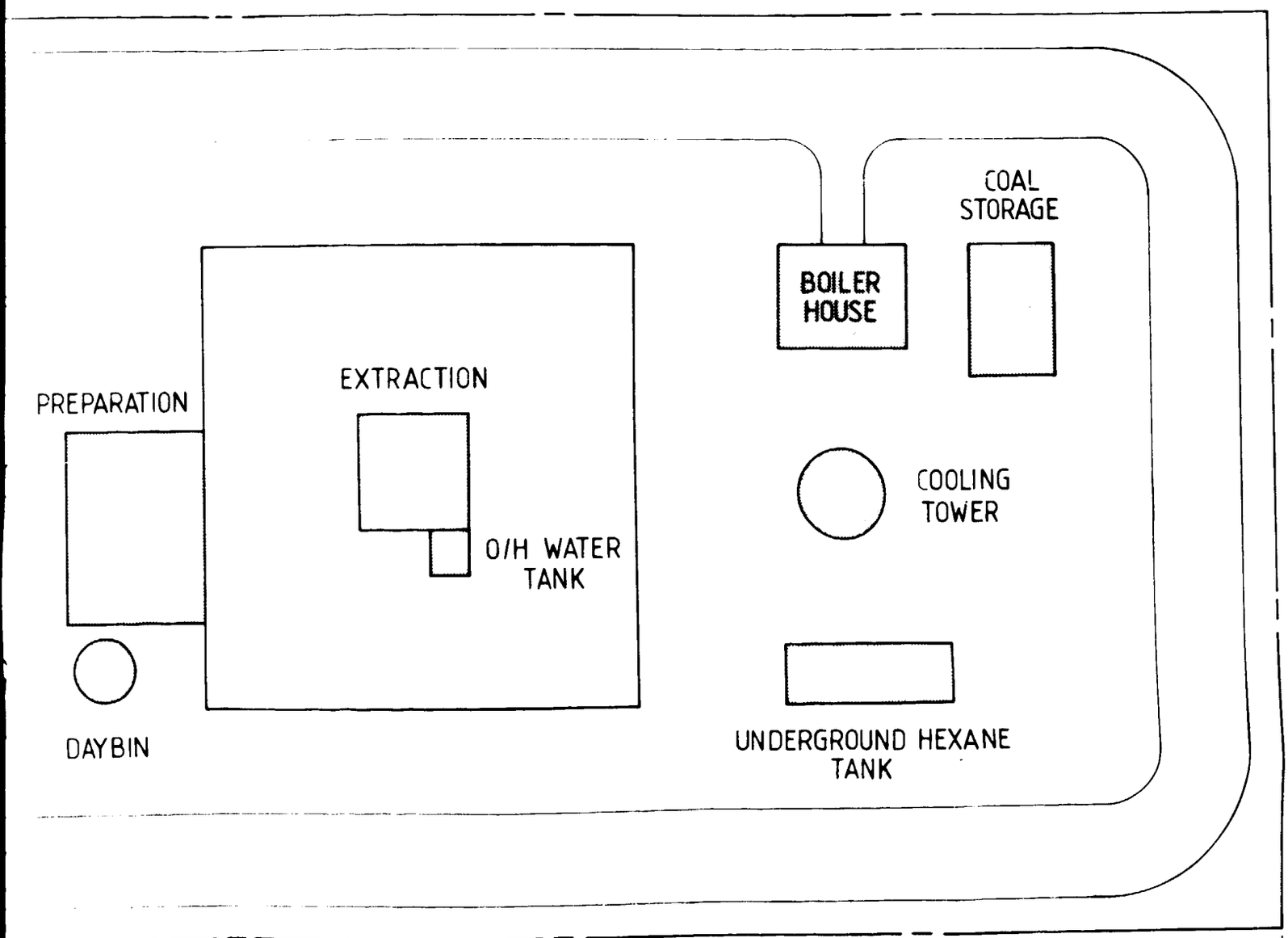

GATE HOUSE
WEIGHBRIDGE
STORES / SPARES CONSUMABLES
WORKSHOP
ADMINISTRATION
LAB
GARAGE
CAR PARK
AMENITY BUILDING
FIRST AID
80 M

SECTION 1



SECTION 2

275 M


COAL
STORAGE
BOILER
HOUSE
EXTRACTION
PREPARATION
COOLING
TOWER
O/H WATER
TANK
DAYBIN
UNDERGROUND HEXANE
TANK

SECTION 3

TANK

REV.	DATE	DESCRIPTION	BY	CH'D	
A					

SOLVENT EXTRACTION PLANT

MALAWI

L. H. MANDERSTAM & PARTNERS LTD.
CONSULTING ENGINEERS
38 GROSVENOR GARDENS, LONDON, S.W.1.

TYPICAL PLOT PLAN

JOB No :- 466-83		DATE	SCALE :- 1:500	REV.
DRAWN	A TOWNSEND	OCT 83	DRG. NO. 466-83-A-1	0
CH'K'D	C.H.	Oct. 83.		
APP'D	H.C.	Oct. 83.		
SHEET SIZE 594 x 841mm		A1