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1986
THE QUEEN'S AWARD
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International Marketing & Research
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Sierra Leone:

Rehabilitation and Development of the Pioneer Mills and Attached Oil Palm Estates

VOLUME I

Report prepared
for
UNIDO
and the
Government of Sierra Leone

(Project No. SI/SIL/85/802
UNIDO Contract Number 86/52)

PSL 5208/SFJ
November 1986

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ACKNOWLEDGEMENTS

The team wish to acknowledge the assistance given by many people during the course of the study. Thanks are due in particular to Mr. Alemayehu (UNIDO Senior Industrial Field Adviser in Sierra Leone), other United Nations staff and officials from the Ministry of Trade and Industry and the Land and Water Development Division of MANR who accompanied the team during fieldwork.

UNITS OF MEASUREMENT

A mixture of metric and imperial systems are used in Sierra Leone. In general, in this report we have followed the usual practice in Sierra Leone of using acres for areas and tons (long tons) for weight.

EXCHANGE RATES

Barclays Bank rates on 3.10.86 (rates in mid-March 1986 are given in brackets)

US$1 =	Leones	29	($1 = Le5)
£1 =	Leones	43	(£1 = Le7.3)

Further information on exchange rate movements is given in Section 2.1.

WEIGHTS, MEASURES AND CONVERSIONS

1 drum of palm oil	=	44 gallons
5.6 drums	=	1 ton of palm oil
249 gallons	=	1 ton of palm oil
1 drum	=	400 lbs of palm oil <u>or</u> 181 kg.
1 'pint' (local)	=	irregular measure in the range
	=	285 ml. - 330 ml.
1 hectare	=	2.471 acres
1 long ton	=	1.016 tonnes

ABBREVIATIONS

ffa	free fatty acid
FFB	fresh fruit bunches
ha	hectares
CFTC	Commonwealth Fund for Technical Cooperation
GOSL	Government of Sierra Leone
SLPMB	Sierra Leone Produce Marketing Board
SLPKOM	Sierra Leone Palm Kernel Oil Mill
NAPCO	National Produce Company
MANR	Ministry of Agriculture and Natural Resources
NOPC	National Oil Palm Company
ASSP	Agriculture Sector Support Programme
EIADP	Eastern Integrated Agricultural Development Programme
NIADP	Northern Integrated Agricultural Development Programme
TDRI	Tropical Development and Research Institute
NA	not available
t/p/h	tons per hour
t/p/d	tons per day
t/p/a	tons per annum
m	metre
km	kilometer
mm	millimetres
t/acre	tons per acre
t/ha	tonnes per hectare
UNIDO	United Nations Industrial Development Organization
Le	Leones
FC	Paramount Chief
FX	Foreign exchange

SUMMARY

1. Only a short summary is presented here. A chapter of conclusions and recommendations is given in Section 7.

2. The purpose of this study is to examine the seven Pioneer mills and their attached oil palm estates with a view to identifying rehabilitation and development potential.

3. Basic information about the estates is given below.

Plantation	Total Area (acres)	Remaining Area of Palms (acres)	Possible Rehab. Area (acres)	Pioneer Mill
Baoma	800	800	500	Yes
Kasse Kangha	1100	1100	1100	Yes, but severe water supply problems
Mange Bureh	3167	895	895	Yes
Masanki	1750	1750	600	Yes
Sahn Malen	1850	1200	1200	Yes
Telu (1)	242	110	110	Yes
Wanjei	500	100	100	Yes, has not operated since 1981
Total	9409	5955	4505	

(1) In addition to the plantation there are smallholder plots of about 1,000 acres in the vicinity of the Pioneer mill at Telu.

4. In general, the estates and mills are in a very poor state as a result of mismanagement and neglect. Combined total production of all the mills currently amounts to only about 100 tons of palm oil per annum. The plantations are quite small and badly maintained; the Pioneer mills are old, obsolete, with oil extraction rates of less than 80% (whereas modern commercial mills can extract up to 94%).

5. On the positive side, however, there are large parts of the plantations which are capable of rehabilitation and the Pioneer mills, which use an easy to operate process, could all be rehabilitated quite cheaply at an average cost of about Le 1 million. (Severe problems exist at the mills at Kangha and Wanjei).

6. However, for a variety of agricultural, engineering and commercial reasons, we do not recommend any specific action at this stage at Mange Bureh, Masanki or Wanjei. We do recommend, subject to obtaining the full support of local people, that a rehabilitation project should be commenced at Baoma. Also, the possibility exists of proceeding with a project at Telu based on the plantation and outgrowers.

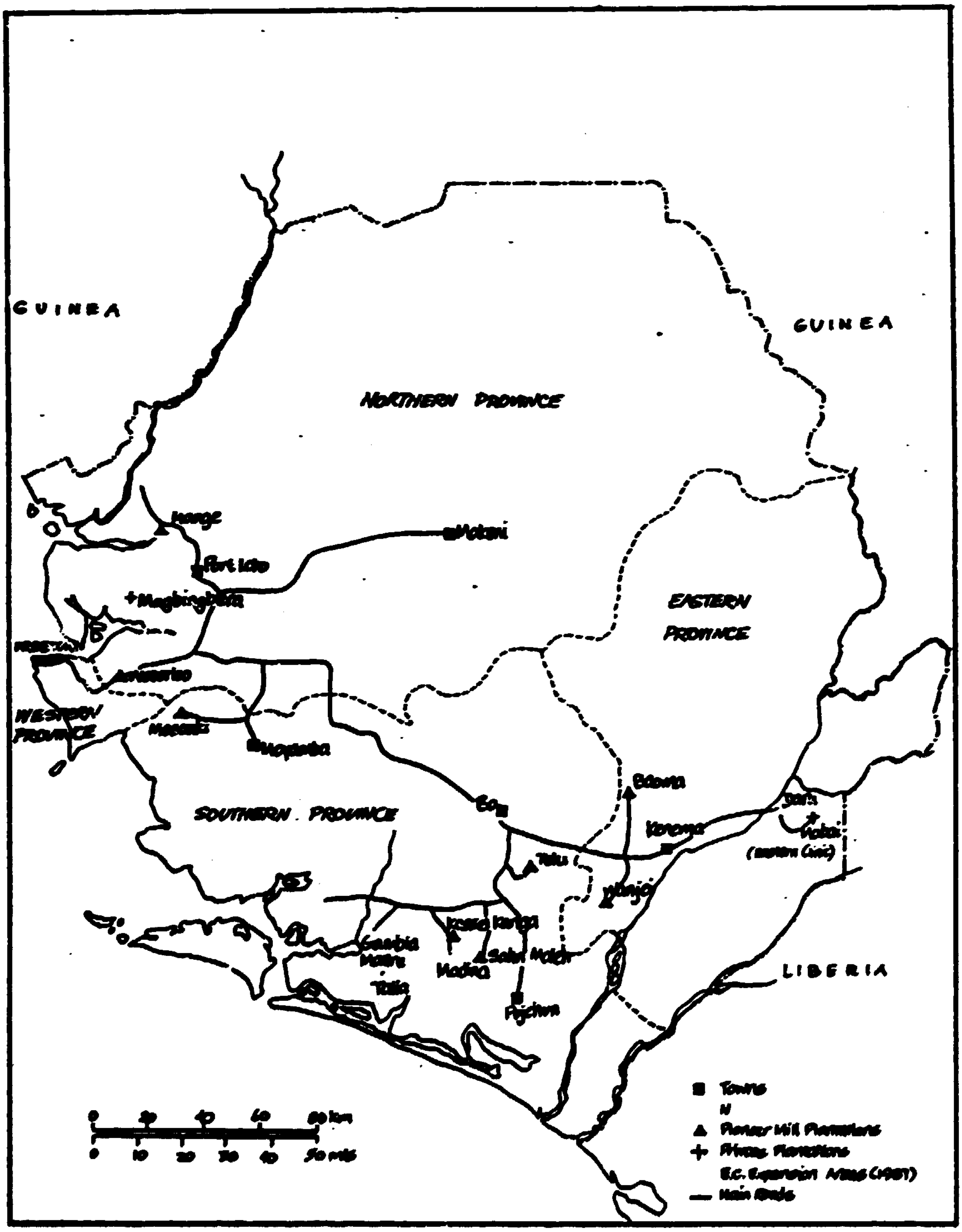
7. Rehabilitation alone offers only short term solutions which will have a small impact on the national shortage of palm oil. Our main recommendation is to proceed with a project at Kasse/Sahn Malen comprising of plantation rehabilitation, replanting and new planting together with Pioneer mili rehabilitation and new mill installation, resulting in a project with 6,000 acres and a 15 ton per hour mill.

8. The rates of return on this project are only moderate:-
IRR (financial) 10.0%
IRR (economic) 8.7%

But in our view it is necessary to make a judgement that this project is justified on the basis of the critical importance of increasing the supply of a basic staple and on broad developmental grounds.

9. In order to assist the Government of Sierra Leone it is recommended that appropriate aid-funding should be considered.

Sierra Leone : Location of Oil Palm Estates



SECTION 1

INTRODUCTION

1.1. Background to the Assignment

This feasibility study originates from a request by the Ministry of Trade and Industry to UNIDO to provide funding for a study of the Pioneer mills and estates. Produce Studies Ltd. was selected to undertake the assignment.

This is the latest in a number of studies which have focussed on the oil palm industry in Sierra Leone. All relevant studies are listed in the bibliography in Annex 3 (A.3.2.). In order to avoid frequent repetition, two of the earlier reports are widely quoted in this report.

1. Commonwealth Secretariat (1986). Sierra Leone: Rehabilitation of the Palm Oil Industry.

2. R. C. Cole (1986) Technical Study of Pioneer Palm Oil Mills in Sierra Leone. UNIDO.

The Commonwealth Secretariat report was written by Produce Studies Ltd. and was based on fieldwork undertaken in March 1986. The study includes a review of all vegetable oils in Sierra Leone but concentrates on the cil palm industry and the requirements for increasing production.

The second study, carried out under the auspices of UNIDO, was an entirely technical account of the Pioneer mills and the replacement parts required.

1.2. Aims of the Study

The full TOR are given in Annex 3 (A.3.1.).

In essence, the TOR require that the consultants should undertake an all-embracing review of the seven Pioneer mills and estates in Sierra Leone, consider their rehabilitation potential, assess the opportunities for development and, subject to viability being proved, recommend a project for implementation including proposals concerning the appropriate management structures.

1.3. Conduct of the Study

The Produce Studies Ltd. team consisted of:-

Stephen Jones	Team Leader
Simon Dimoline	Agriculturalist
Phillip Durham	Engineer
Mark Mitchell	Agricultural Economist

Fieldwork in Sierra Leone was carried out in September/October 1986. The agriculturalist spent four weeks in the country and the other team members, three weeks.

All the seven Pioneer mills and estates were visited. Also, meetings were held with Paramount Chiefs and landowners in the rural areas. A number of meetings with senior GOSL officials and other interested parties were held in Freetown.

1.4. Structure of the Report

The main findings of the report, including conclusions and recommendations, are presented in Volume 1.

Volume 2 consists of Annexes 1-4 which give detailed descriptions of the agricultural, engineering and financial/economic backgrounds. Volume 3 (with very limited distribution) presents copies of the computer tables of the analyses of the suggested projects at Kasse/Sahn Malen, Baoma and Telu.

SECTION 2

BACKGROUND TO THE OIL PALM INDUSTRY IN SIERRA LEONE

2.1. Economic Background

It is not intended to provide a general economic review, that can be obtained from other sources, but simply to highlight a number of important factors of direct relevance to this study.

Of greatest importance has been GOSL's decision, taken in mid 1986, to accept IMF conditions for a restructuring programme which included floatation of the Leone and the removal of subsidies (on rice, petrol, etc.). The effect of the floatation of the currency was a dramatic 500% devaluation of the Leone. In the early part of 1986 the official rate was about US$1 = Le 5 (the unofficial rate at that time was about double the official rate), but the rate fell very rapidly after floatation and by October 1986 had reached US$1 = Le 29. The future direction of exchange rate movements is difficult to predict but most observers in Freetown feel that the rate has steadied, at least for the time being.

Sierra Leone has experienced a chronic shortage of foreign exchange for many years and this has exacerbated difficulties in such matters as trying to obtain spare parts for palm oil mills and obtaining hard currency for authorised imports of vegetable oils. In general terms, obtaining foreign exchange for import purchases should become more straightforward since the Leone floatation but, of course, the cost of imports when converted to Leones has increased by many times.

It is generally reported that the rate of inflation currently exceeds 100% per annum.

Wages remain low (the minimum daily agricultural wage is fixed at Le 5.60) but there is considerable pressure for an "explosion" in wages and a high rate of increase can be expected. In our analysis we have worked on the basis of a minimum daily wage of about Le 9 or 10 for plantation workers.

2.2. Description of the Oil Palm Industry

For a general description of the oil palm industry in Sierra Leone readers are referred to the Commonwealth Secretariat report (1986) which was also prepared by Produce Studies Ltd.

In brief, the oil palm industry in Sierra Leone can be divided into the following sub-sectors:-

(i) The National Oil Palm Company (NOPC) which operates the "privatised" Daru and Gambia-Mattru plantations. NOPC is a recently-created joint venture company including GOSL and private companies.

(ii) The private estates at Eastern Clinic and Magbingbira.

(iii) The several small plantations and Pioneer mills operated by the Sierra Leone Produce Marketing Board (SLPMB).

(iv) Farmers' plots, mostly planted from seedlings supplied by regional agricultural projects.

(v) Wild palms, which still (in 1986) supply more palm oil than all the other sub-sectors put together.

(vi) Village processing (pits, etc.), mostly the processing of fruit from wild palms and farmers' plots, but also some plantation fruit.

(viii) Palm kernel oil which is produced in the villages and also by the Sierra Leone Palm Kernel Oil Mill (SLPKOM) for local consumption. (Some palm kernels are also exported).

2.3. The Shortage of Palm Oil

Palm oil is an important part of the diet in Sierra Leone being used as a cooking oil and as an ingredient. Palm oil is also in demand as the raw material for soap-making.

Our report for the Commonwealth Secretariat considered the subject of the shortage of palm oil in considerable depth and concluded that there is a serious problem of under-supply of this important item which is both a staple food and an industrial raw material.

Table 2.1. provides a summary of the supply and demand position for vegetable oils in Sierra Leone. It must be pointed out that the data base is very poor and that some of the figures, notably for wild palm, are no more than educated guesswork.

Table 2.1. Sierra Leone: Estimates of Demand and Supply of Vegetable Oils, 1986 and 1990

('000 tons)

	1986	1990
Total potential demand (for cooking and soap-making)	67.0	74.0
Production of palm oil:		
Plantations[(i)]		
1. NOPC	5.8	7.4
2. Private estates	1.5	2.4
3. Pioneer mills/ estates [(ii)]	1.1	1.2
	8.4	11.0
Farmers' plots	1.4	2.7
Wild palms	20.0 - 30.0	20.0 - 30.0
Total palm oil	29.8 - 39.8	33.7 - 43.7
Production of other vegetable oils	2.0	3.0
Total production (rounded)	32.0 - 42.0	37.0 - 47.0
Estimated production shortfall	25.0 - 35.0	27.0 - 37.0

Source: Derived from figures presented in Commonwealth Secretariat report

Notes: (i) Plantation production includes plantation fruit processed locally e.g. Gambia-Mattru mill is not operational and FFB is processed in village pits

(ii) Production estimate is based on assumption of partial rehabilitation

It is estimated that the total potential demand for vegetable oils in 1986 amounts to about 67,000 tons, and largely because of the fairly rapid rate of population increase, this will rise to 74,000 tons by 1990. This is termed "potential" demand because it is a notional figure based on a target of 15 kg of vegetable oils per capita per year for food uses and a further allowance for soap-making.

Actual production of vegetable oils, mostly palm oil, is only about 32,000 - 42,000 tons. This leaves a production shortfall, in 1985, of between 25,000 and 35,000 tons. In other words, if Sierra Leone was to reach self-sufficiency in vegetable oils at the indicated rate of consumption then production would have to increase by about 30,000 tons per annum.

In theory, it would be possible for this shortfall to be met by imports. These imports could be in the form of palm oil, other vegetable oils such as groundnut oil, tallow for soap-making, soap and vegetable oil-based products such as margarine. To a greater or lesser extent all these products are imported, but the provision of import statistics, as pointed out in the Commonwealth Secretariat report, is often poor and inconsistent. We estimated that the value of imports of vegetable oils and margarine, but excluding tallow and soap, amounted to more than Le 9 million in 1985.

However, other factors must also be taken into account. Firstly, many unofficial imports enter the country. Secondly, the shortage of foreign exchange through official channels meant that imports were not brought in to the full extent required to make up the shortfall. In fact, we believe that actual consumption in Sierra Leone is well below the 67,000 tons figure in 1986 because per capita consumption and off-take to the soap-making sector are being held at a lower level because of limited availability of vegetable oils and of palm oil in particular.

2.4. Types of Palm Oil; Pricing and Marketing

At the retail level, two types of palm oil are available in the markets. The first product is known as "red" or "native" palm oil and the second as "Masanki" oil. The preferred product for use in stews and other dishes is "native" oil. This product is very red, tasty, quite high in FFA and originates from the fruit of wild palm trees. "Masanki" oil is produced from planted palms and may be processed either in mills or by traditional methods; it is primarily used for frying and for soap-making. There are various sub-divisions of the oils within each category.

In practice, the "red" oil sold in the markets is very often a mixture of "native" oil and "Masanki" oil but the consumer is not made aware that the product is mixed.

"Red" oil sells at a premium to "Masanki" oil. At the time of the fieldwork visit in October 1986 the retail prices in Freetown were:-

Red oil Le 6.50 per "pint" (local measure equal to about 300 ml).
Masanki oil Le 5.50 per "pint"

At the same time the small quantities available of imported refined oils such as groundnut oil or mixed vegetable oil from Singapore, were selling in the market for Le 7 or 7.50 per "pint".

A retail price series was presented in the Commonwealth Secretariat report. Prices have increased considerably in recent years. The average price for palm oil in 1984 was about Le 2 per "pint". Seasonal variation also has to be taken into account. The main period of availability of "red" oil begins in March/April and prices "dip" at that time.

The oil sold by SLPMB from the Pioneer mills is currently only available in very small quantities as explained in Section 3. The current selling price is Le 600 per drum of 45 gallons. (The standard drum measurement elsewhere in Sierra Leone is usually 44 gallons). The market reaction to oil from SLPMB is that it is very poor quality, contains water and impurities, tends to flare up when used for frying and is really only suitable for soap-making.

For the purposes of our feasibility study, the nearest equivalent mill oil is that produced by NOPC at Daru mill. If the pioneer mills were rehabilitated or replaced, the oil quality would be improved and would probably sell at about the same price as that from Daru. The ex-mill price at Daru has recently been nearly doubled from Le 720 to Le 1400 per drum of 44 gallons. (The fact that SLPMB is still selling at Le 600 is probably more to do with bureaucratic lethargy rather than market forces). The price is not varied seasonally. Previously a measure of government control over the fixing of ex-mill selling prices existed but it now appears that companies are free to set their own prices.

A brief sketch of the chain of distribution from the mill to the consumer is given below, with an indication of marketing costs. A first middleman buys at Daru mill and transports the drums to Freetown where the oil is sold to a second middleman (more accurately probably a middlewoman) who breaks bulk by buying in drums and selling in "tins" (4 gallons each). The retailer buys in "tins" and sells in "pints".

Example of price build-up (October 1986)

	per drum (44 gallons)
Daru ex-mill price	1400
First middleman	
Transport (approx. Le 6 per ton mile)	300
20% mark-up	340
	2040
Second middleman	
20% mark-up	408
	2448
Retailer	
33% mark-up	808
	3256 (= Le 5.3 per pint)

NOPC has considered selling in Freetown rather than at the factory gate but has not taken any action as yet. This option would also be available to any company operating the rehabilitated Pioneer mills.

2.5. Comparison with the World Price for Palm Oil

Comparisons of the Sierra Leone price for palm oil with the world price are difficult to make. The products are quite different. The Malaysian product, for example, is highly refined and traded in large quantities. The "red" oil and "Masanki" oil from Sierra Leone are unrefined products and are not traded internationally in anything more than very small quantities. Price comparisons, therefore, must be treated with caution.

Also, as shown below, the devaluation of the Leone has completely changed the comparative position in the space of six months.

Table 2.2. Palm Oil Price Comparison

	Daru ex-mill price Leones per drum	Leones per ton	Exchange Rate US$1 =	Equivalent Price $/t	Malaysian palm oil CIF Europe(1) $/t
March 1986	720	4032	5	806	265
October 1986	1400	7840	29	270	260

(1) Source: Financial Times

It is apparent that the ex-Daru price is now roughly equivalent to the landed price of Malaysian palm oil in Europe whereas, six months ago, the ex-Daru price (half of the present price) was about three times higher than the world price.

Whereas the exporting of palm oil from Sierra Leone, probably to West African countries, used to be out of the question on the basis of price, it now becomes a realistic possibility although it is obvious that the first priority should be supply to the local market.

One further point arises from this section. It should not be assumed that the world prices in Table 2.2. represent the prices at which Sierra Leone imports oils. In fact, very little palm oil is imported, it is mostly soyabean oil and mixed vegetable oils and the average import price in the years 1984 and 1985 was between $850-950 per ton.

2.6. Palm Kernels

The other major source of revenue for a mill, accounting for up to 5% or even 10% of total revenue, is palm kernels. The only major buyer of palm kernels, through its various buying agents, is SLPMB. The kernels are either exported or processed into palm kernel oil at the Sierra Leone Palm Kernel Oil Mill. A recommendation that the whole sub-sector of palm kernels should be investigated in a rehabilitation and development study was made in the Commonwealth Secretariat report.

The buying price of palm kernels in March 1986 was Le 0.40 per lb. and this has been increased to Le 0.60 per lb.

SECTION 3
THE PIONEER MILLS AND ESTATES

3.1. Location, Ownership and Background

We will not dwell on the historical background in any great detail. A summary of the main events is given below.

The existing 7 Pioneer mills and their attached estates, listed in alphabetical order, are located as follows.

Baoma	Eastern Province
Kasse Kangha	Southern Province
Mange Bureh	Northern Province
Masanki	Southern Province
Sahn Malen	Southern Province
Telu	Southern Province
Wanjei	Eastern Province

The Pioneer mills, purchased from Unilever, were installed during the period of the 1930s to the 1950s (Cole, 1986). A couple of mills have fallen into complete disrepair and disuse. Seven mills remain.

The original idea was that the mills would primarily process FFB from wild palms. Later, in the period of the 1950s and 1960s the estates were planted on adjoining land.

The issue of land ownership and leases is an important one in the history of the mills and estates. A full description of the land tenure system is well beyond the scope of this report but, in essence, the land is held in common by the people and authority is vested in the Paramount Chief (P.C.). The individuals and families who are allocated land are known, synonymously, as "landowners" or "landholders", but they do not normally have any rights to sell land.

In consequence, a plantation or other project, must lease the land. A system exists whereby there is a once-and-for-all payment to compensate for loss of established crops and, secondly, there is an annual lease payment. The latter is divided in one-third shares between the landholders, the chiefdom and the native administration section of the District Office.

The lease payments for the plantations were set at Le5 per acre but have been increased in more recent times, in some instances, to Le10 per acre. (Which many consider to be a derisorily small amount).

At each of the seven locations a separate lease exists for the site of the Pioneer mill and another lease for the plantation. Our attempts to locate copies of these leases met with very little successs in the limited time available during fieldwork.

A crucial episode in the history of the mills and estates occurred in 1967 during the period of the military government (known as NRC). Prior to that time the mills and estates had been in the hands of SLPMB but a decision was taken to return control of the plantations to the chiefdoms. At the same time a number of new Stork mills which had been ordered by SLPMB and had been delivered in crates to the country, became caught up in the confusion and were never installed. Recent reports indicate that there is now nothing recoverable from those Stork mills.

Since the NRC period there has been considerable confusion and disharmony surrounding the Pioneer mills and estates. In general, SLPMB has retained operational control of the Pioneer mills, but in many instances, it has exerted little control over the operations of the plantations. Also, in many cases, the relationship between SLPMB and the people of the local chiefdoms has been characterised by distrust and friction.

A position of near stagnation has existed for some time. Experiences have varied considerably between the different locations, but, in general, the plantations have been neglected and the mills are working at a fraction of their installed capacity (1.5 tons per hour).

The physical condition of the various facilities is described in the sub-sections 3.2 and 3.3.

The current status of the seven mills and estates is as follows:

(i) Mange Bureh. This is the only mill and estate which is managed directly from SLPMB headquarters in Freetown.

(ii) Masanki mill and estate were handed over to the Prisons' Department together with the plantation at Waterloo which used to have relatively easy road access to Masanki but, owing to the demise of a ferry, is now beyond reasonable travelling distance. The prisoners at the nearby prison to Masanki are included in the labour force of Masanki plantation.

(iii) Wanjei. The right to operate Wanjei mill is contested. Dr. Kobba of Eastern Clinic has letters which authorise him to take-over Wanjei mill but SLPMB contests the right of the signatories of the letters to make such a grant. The issue remains unresolved. Partly for this reason and partly for technical/economic reasons the mill has not worked for a number of years.

(iv) Baoma is one of the four mills which falls under the jurisdiction of SLPMB's Bo Production Division (see below). This mill is also claimed by Dr. Kobba but, it appears, with less vigour than the claim to Wanjei.

(v) Telu is a special case in that it is the only plantation attached to a Pioneer mill which includes an outgrower scheme.

(vi) Sahn Malen (no special comments at this stage)

(vii) Kasse Kangha is also a special case in that Kangha mill is situated in one chiefdom and Kasse plantation in another. Very recently, in October 1986, the chiefdom responsible for Kasse plantation informed SLPMB that the Board would have no further access to the plantation.

The Bo Production Division of SLPMB is primarily concerned with the management of the Board's interests at Baoma, Telu, Sahn Malen and Kasse Kangha. This includes operating the Pioneer mills and some operations (brushing, pruning, harvesting, etc.), usually on a very limited scale, at some of the plantations. The physical assets of the Board in the town of Bo include an office/store on one site, another store (for palm oil sales), a parts store and garage, and the Manager's house. We were informed that the total staff in Bo exceeded 40 persons. Apart from some very limited activities relating to other SLPMB interests, the Bo Production Division is exclusively concerned with palm oil operations.

3.2. The Current Condition of the Plantations

In general the Pioneer mill plantations have not been properly maintained or harvested since 1967 when they were handed back, at least in theory, to the landowners. No fertiliser has been applied to mature palms. Consequently, most of the estates are badly overgrown with large woody perennials and grasses competing against the palms. Only small patches of leguminous cover crop remain.

Since 1983 SLPMB has carried out some work at a few locations but funds are inadequate for full rehabilitation. Only parts of the plantations have been brushed and pruned and harvesting is irregular. Not enough labour is employed to carry out all the work necessary. Tractor power is often not available for transporting FFB because of a lack of spare parts and fuel.

Table 3.1. gives some summary details about each plantation.

Table 3.1. Area and Age Summary of Plantations

Plantation Name	Total Area (acres)	Age of Palms (years)	Notes
Baoma	800	20-21	
Kasse	1100	20-23	
Mange Bureh	3167	19-24	2272 acres abandoned
Masanki	1750	26-31	
Sahn Malen	1850	23-26	650 acres abandoned
Telu	242	23-26	
Wanjei	500	24-26	400 acres abandoned

Detailed information concerning the soils, location, state of the palms and plantation layout are given in Annex 1 for each plantation. Comparison of soil and crop data between the plantations is given in the conclusions to the fieldwork (Annex 1.3). The following summarises their present condition.

Baoma. Of the 800 acres, at least 300 have not been brushed for over 15 years. However, most of the area is still harvested, though access to the palms is limited. The rest of the plantation has been brushed once over the last 3-4 years. Palms are stunted compared to Sahn or Kasse.

Kasse. Most of the plantation has been brushed within the last 18 months. The northernmost tip has very gravelly soils and has been virtually abandoned. Palms are well grown relative to other plantations. More labour is employed at Kasse than other plantations and the wages are higher, reflecting the higher oil production figures.

Mange. The old part of the plantation (2272 acres) is abandoned, and some of the area has been cut down for local farming. The rest of the area (895 acres) is maintained and harvested. Palms are very variable in growth and height and in many places a full canopy has not developed. Some of the plantation is infested with elephant grass.

Masanki. Upkeep and harvesting by the Prison's Department is carried out on a regular basis but quite a large proportion of the plantation is behind schedule and is overgrown. About half the labour is recruited from the prison. Palms are tall but in places, especially on the drier areas, the palm canopy is thin. Palms grow best on the lower slopes near the swampy valley bottoms. A new tractor was recently donated to the plantation for collection of fruit but spare parts are already a major problem.

Sahn Malen. Of the 1850 acres,about 650 are abandoned. The rest has been brushed in the last 2-3 years and is harvested. Pruning has not been carried out so extensively. Palms are generally tall with good canopy development but more variable in height than at Kasse. Not enough labour is employed to carry out all the operations needed.

Telu. The plantation was planted at the same time as Sahn but the palms are generally smaller except for some limited areas on better soils. Maintenance has not been carried out for about eight years. There is no tractor available for collection of FFB. The plantation is too small to support the mill. A total of 242 acres were originally leased but only about 170 were planted, of which 60-70 acres have been abandoned.

Wanjei. Of the original leased area of 500 acres, only 100 remains intact, the rest has been abandoned or cut down for annual crops. The 100 acres is harvested only by local farmers for pit processing. No maintenance has been carried out since Eastern Clinic tried, unsuccessfully, to operate the plantation in 1980/81.

3.3. The Current Condition of the Pioneer Mills

A detailed account of the Pioneer mills is given in Annex 2.

The process technology used in the Pioneer palm oil mills has been obsolete for a number of years (they were designed and constructed mainly in the period between 1930 to 1960).

Their oil extraction efficiencies are unlikely to exceed 80%. Modern mini-mills of comparable capacities (say within the range of 1 to 3 tons/hr. FFB) would be expected to achieve oil extraction efficiencies of between 85% and 90%, whilst commercial mills (5 tons/hr. to 60 tons/hr.) can achieve up to 94%. The resulting additional oil revenues can significantly affect financial returns.

Notwithstanding the above, Pioneer mills are relatively easy to understand and operate, with the technology confined to straightforward mechanical engineering coupled with the use of a simple low pressure steam boiler and single cylinder steam engine as prime mover.

All the seven mills visited display various degrees of neglect in standards of maintenance but the position is by no means irretrievable.

Our own observations very largely endorse the conclusions of the Cole report. We have also widened the perspective to include such important elements as the condition of the mill buildings, the mill water supply, other buildings and security aspects. Staff and labour resources and training have also been considered.

In general, once building repairs have been effected (involving new roofs in some cases), unreliable water supplies rectified, stocks of essential spare parts acquired and the management of mills improved, there is every reason to expect that the mills should be able to operate successfully for another 10 years, possibly longer.

However, it will also be necessary to provide maintenance workshop tools, which are almost completely non-existent at present, and training for the mill supervisor, mechanic and other staff before the full benefits of mill rehabilitation can be realised. It is also essential that mill management responds to technical problems with a much greater degree of urgency than displayed in the past and this infers that the financial resources, including foreign exchange for purchases of imported spare parts, must be available.

3.4. The Production Record

Full production records are not available for the various mills. Our best estimates for the production of palm oil from the four mills within the Bo Division is given in Table 3.2.

Table 3.2. SLPMB Production Division (Bo) Palm Oil Production 1981/82-1985/86

	Unit	1981/82	1982/83	1983/84	1984/85	1985/86
Baoma	Drums	72	124	85	71	77
Telu	Drums	37	-	-	-	26
Sahn	Drums	20	196	50	135	132
Kangha	Drums	562	535	151	331	216
Total	Drums	691	855	286	537	451
Total	Tons	125	155	52	97	82

By any measure, production can be seen to be pathetically small, having not even reached 100 tons in any of the last three years. This reflects the virtual collapse of the plantations and mills as efficient units.

Actual production of FFB from the plantations is higher than would be imagined from an estimation based on calculating back from the palm oil figures. This is because large quantities of FFB are taken by the local people for processing in the villages.

Palm kernels are also produced although a large percentage of these are either wasted or used as fuel. We have no statistics but we believe that sales of palm kernels through the Bo office amount to only about 10 tons per annum.

Production figures are not available for the other three Pioneer mills although it is known that Wanjei mill has not worked for some years and the mill at Masanki is only producing very small quantities. Production is higher at Mange Bureh as indicated by the financial figures presented in the next sub-section.

3.5. The Financial Record

The available figures on SLPMB's financial record for its oil palm estates is given in Table 3.3. The main points to emerge are that, firstly, the scale of operations is very small indeed and, secondly, where profit and loss figures can be seen, the Bo office is shown to be consistently loss-making. In fact the losses in the table are understated because the Manager's salary and benefits are excluded.

Table 3.3. Profit/Loss of SLPMB's Oil Palm Estates 1980/81 - 1985/86

('000 Leones)

	1980/81	1981/82	1982/83	1983/84	1984/85	1985/86
A. Bo Division:						
Revenue						
Palm oil	139	109	111	71	271	293
Kernels	6	19	2	8	11	7
Total	146	129	113	79	282	300
Production Cost	140	100	113	49	253	191
Contribution	5	29	1	29	29	108
Admin/costs(1)	NA	174	191	NA	223	NA
Profit (Loss)	NA	(146)	(191)	NA	(194)	NA
B. Mange Bureh:						
Revenue						
Palm oil	29	28	37	85	86	NA
Kernels	2	2	1	3	8	NA
Total	31	30	38	89	94	NA
Production Cost	8	23	17	62	62	NA
Contribution	23	6	20	27	32	NA
Admin/costs	NA	NA	NA	NA	NA	NA
Profit (Loss)	NA	NA	NA	NA	NA	NA

Notes (1) Admin costs at Bo do not include Manager's salary and benefits

General: totals do not sum due to rounding

Sources: 1980/81 - 1984/85 SLPMB Annual Reports
1985/86 - Estimates from Bo office

SECTION 4

OPPORTUNITIES AND OPTIONS FOR REHABILITATION AND DEVELOPMENT

4.1. The Need for an Integrated Approach

In the Commonwealth Secretariat report (1986) we advanced the argument that rehabilitation alone will not make a substantial impact on the National problem of palm oil shortage. We recognised that rehabilitation schemes can offer attractive rates of return in particular cases and that they can have important local consequences for particular areas but that any worthwhile contribution to overcoming the National problem requires either a new development scheme or a combined rehabilitation/development scheme.

Our basic approach in this study has been to look at the rehabilitation prospects at each of the seven sites and also to search for a rehabilitation/development project.

However, development projects now appear rather less commercially attractive than they did before devaluation. All foreign exchange costs, in a Leone analysis, become much more expensive. Therefore all imported items such as new mills, tractors, trailers, fertilisers, seeds and other foreign exchange costs, such as the employment costs of expatriates, now appear very expensive. The problem is less severe for rehabilitation projects because the foreign exchange component is much smaller.

In the remaining sub-sections of this part of the report we examine the various critical factors relating to the future possibilities for plantation, mill and project development.

4.2. Plantation Options

There are four basic plantation options.

1) Rehabilitation
2) Replanting
3) Expansion
4) Abandonment

In the case of the Pioneer mill plantations, a combination of these options is usually the most appropriate. Full consideration of all the factors is given in Annex 1 and a summary is given here.

Because the plantations have been neglected for many years the first consideration is potential for rehabilitation (being the cheapest option). In the absence of any records on past performance of the palms, the following groups of technical factors have been considered in judging the potential of each plantation for rehabilitation:

Climate
Soils and Land
Crop Information

These factors are used to estimate the potential yield of each plantation over a number of years after rehabilitation and the useful area available from which that yield can be expected.

a) Climate is explained in Annex 1 (A.1.1.4.) and Map 1 shows the most suitable areas in the country for oil palm development.

b) Soil and Land Data
   - Percentage gravel and texture in the top metre of soil
   - Topography
   - Chemical status of soil

Considerable reliance is placed on percentage of gravel and topography in judging the plantation soils. Chemical analysis results are used as an additional backup.

c) Crop Data:

- Age of the palms
- Height of palms
- How well the palms appear to have grown
- Maintenance history (if known)
- How many palms are still standing

The age of the palms is known with some accuracy and together with an estimate of their average height, some estimate of the growth rate can be made. Together with an estimate of the percent of palms still standing and more subjective measures regarding their general appearance, a judgement can be made on how well they have grown and thus how well they may yield. The assumptions in projecting yields of FFB for each plantation are outlined in Annex 1 but basically the older the palms, the less the expected response to rehabilitation.

Soils and land data are used to estimate the area that can reasonably be expected to produce this yield. Areas of bad topography, high gravel content and areas subject to water logging have been eliminated. Some marginal areas are included in the estimated acreage, as at least some yield can be obtained.

Rehabilitation is a short-term answer and if the plantations are to be viable in the long run, palms must be replaced at some point. Replanting is the next option considered because costs are less than for planting new areas. Yields and area suitability are estimated on the basis of the same criteria as described above. Palms should be replanted when a) too many palms become too tall to harvest easily and economically or, b) yield is so low that replacement with high yielding young palms would give a higher return.

All the Pioneer mill plantations are fairly small by commercial oil palm standards and expansion possibilities must be examined carefully. However, expansion is the most expensive option. Large uniform areas of flat, relatively gravel free soils are desirable both to obtain yields and to minimise development and running costs.

Apart from agronomic factors it must also be remembered that the production of FFB, and thus the area required, should be matched to the capacity of the mill to process the fruit.

Taking into account agronomic factors and mill requirements for FFB, the following comments are made about the plantation potential at each of the seven sites. The maps at the beginning of Annex 1 give complementary information, although it should be emphasised that these notes and the maps give information on potential, rather than actual, recommendations for action. Our recommendations are elaborated in Sections 5, 6 and 7.

(i) Baoma

About 500 acres is suitable for rehabilitation. A further 150 acres could be immediately replanted and another 150 acres abandoned. The potential for expansion is limited by geographical factors (river, hills) but it is reasonable to assume that another 500 acres of suitable land (with yield potential of 3.6 tons per acre) could be found.

(ii) Kasse

About 1,000 acres is suitable for rehabilitation, which would require replanting in 5-10 years. Another 100 acres should be abandoned. The yield potential for expansion in the area is 4 tons per acre and large areas of suitable land are understood to be available.

(iii) Mange Bureh

The estate is located in an area climatically less suited to large scale oil palm development, compared to the south east of the country. Higher water deficits give lower potential yields and even on the better soils at Mange the yield estimate is only 3.1 tons per acre. The area is not recommended for further commercial scale development.

(iv) Masanki

Higher water deficits than in the south-east of Sierra Leone make this area relatively unfavourable for oil palm. The palms are old, at least 26-31 years and possibly older, and there is little scope for rehabilitation. About 1000 acres could be replanted, with an expected yield of about 3.5 tones per acre, but there are areas elsewhere which are likely to be considered more favourable.

(v) Sahn Malen

The area is favourable for oil palm. About 1200 acres of the existing plantation is suitable for rehabilitation. After 4-8 years about 1000 acres would be worth replanting. Of the existing plantation, 850 acres would be abandoned, partly immediately and partly after rehabilitation. Expansion potential is good. The expected yield for new planting, as for Kasse plantation, is 4 tons per acre and these are the highest figures for all the sites.

(vi) Telu

The scope for rehabilitation at Telu is very small - only 110 acres. This would be insufficient acreage to supply the required FFB for the efficient operation of the mill. A large expansion programme could be considered but the yield estimate for new planting is only 3.5 tones per acre. The preferred alternative would be to investigate rehabilitation, replanting and expansion potential amongst the outgrowers/ smallholders, which is an exercise beyond the scope of the present study.

(vii) Wanjei

There is very little scope for rehabilitation of the plantation. Much of the area has been reclaimed by local landowners. Any project would need to supply sufficient FFB to run a mill efficiently and this would require substantial replanting and new planting which would seem to be impractical.

4.3 Mill Options

There are three main options to be considered in providing the required facilities for processing the FFB into palm oil and kernels.

(i) Rehabilitation of the existing Pioneer mills to provide processing capacities of about 1½ ton/hr FFB, equivalent to 2,500 tons FFB per annum approximately, (assuming 20% peak months and 336 working hours per month).

(ii) Installation of new mini-mills of similar capacity either in new buildings or within the existing Pioneer mill buildings as a replacement for the existing machinery and equipment.

(iii) Installation of new commercial mills of considerably larger capacity in selected new locations.

The estimated capital costs for each of the three options may be compared as follows:

(a) Rehabilitated Pioneer Mills - Total Equivalent ~nes

		Full Cost[1]	Minimum Cost[1]
Baoma	(2500 t.p.a. FFB)	1,332,000	929,000
Kasse Kangha	(2500 t.p.a. FFB)	-	1,150,000
Mange Bureh	(2500 t.p.a. FFB)	1,336,000	933,000
Masanki	(2500 t.p.a. FFB)	1,613,000	1,157,000
Sahn Malen	(2500 t.p.a. FFB)	2,620,000	1,121,000
Telu	(2500 t.p.a. FFB)	1,664,000	1,029,000
Wanjei	(2500 t.p.a. FFB)	1,470,000	879,000

Note (1) The components of the costs and the explanation of the difference between Full Cost and Minimum Cost are given in Annex 2.

(b) New Mini-mills and Buildings

	Total Equivalent Leones
2 t/hr FFB (3,300 t.p.a. FFB)	18,000,000
3 t/hr FFB (5,000 t.p.a. FFB)	27,000,000

New Mini-mills in existing Pioneer Mill Buildings

2 t/hr FFB (3,300 t.p.a. FFB)	12,000,000
3 t/hr FFB (5,000 t.p.a. FFB)	18,000,000

(c) New Commercial Mills and Buildings

5 t/hr FFB (8,500 t.p.a. FFB)	41,500,000
10 t/hr FFB (17,000 t.p.a. FFB)	72,000,000
5 t/hr + 10 t/hr FFB (22,500 t.p.a. FFB)	90,000,000

In summary, all the seven Pioneer mills are technically capable of rehabilitation, on a minimum cost basis of about Le 1 million (this includes foreign exchange costs converted to Leones). There are particular doubts about the mill at Kangha because of the water supply position. A full cost option, including some non-essential items, is also given for the other six mills. Full descriptions of the requirements and costs at each mill are given in Annex 2.

The cost of new mills is substantially higher than the cost of rehabilitation but such costs must be incurred because the expected working life of a rehabilitated Pioneer mill is only about 10 years. In Section 6 we outline a proposal for a development project at Kasse/Sahn Malen which would involve the installation of a new 15 ton per hour mill (Malaysian), installed in two stages (5 t/hr + 10 t/hr) at a total cost of Le 90 million.

4.4. The Outgrower Option

Successful oil palm projects in some other countries have been organised on the basis of nucleus estate and outgrower schemes.

The previous experience of outgrower-based systems in Sierra Leone is very poor, as exemplified by Daru, Gambia-Mattru and Telu. All have outgrower schemes but none have worked according to plan. The reasons include poor management, poor services (FFB collection, fertiliser supply, etc.) and low prices offered for FFB, leading smallholders to prefer pit-methods of processing.

In view of this poor experience in Sierra Leone we have not given in-depth consideration to outgrower schemes because they would probably be thought unacceptable. However, such schemes are potentially low cost and should not be altogether forgotten. An outgrower element could be "added on" to our recommendations which are outlined in the remainder of the report.

4.5. Ownership and Management

There appears to be general recognition, except by SLPMB, that the record of SLPMB in its oil palm operations is very bad and that any development project must involve a new ownership/management structure. Most chiefdoms that we contacted would insist on this as a pre-requisite of agreeing to any new scheme.

Various financing and ownership options for a new company can be considered. These are briefly outlined below. They are by no means mutually exclusive and a combination of financing and ownership options could be considered.

(i) Landowners and local people receive/purchase a shareholding. For landowners this could be organised on some basis whereby a long leasehold is represented by equity in the company. For other local people, bank loans might be available, particularly from the Development Bank of Sierra Leone, to take a shareholding.

(ii) GOSL might take a shareholding, probably a minority stake as in the case of NOPC. Government might also be represented by a very small shareholding offered to SLPMB. This would be one way for the new company to avoid having to pay compensation to SLPMB for taking over assets such as Pioneer mills (which are fully depreciated in any case), and houses and other buildings at mill sites.

(iii) Private investors could be encouraged to take shares. As already noted, bank loans for such purposes are reported to be available. Financial sources in Sierra Leone give the opinion that such investment opportunities should be attractive but there is very little previous experience of offering shares to the general public. Some large-scale Sierra Leonean entrepreneurs have expressed interest. It has also been suggested that shareholders in NOPC (the Greenfields consortium) should not be allowed shares because of the apparent dangers of monopoly ownership in the oil palm industry.

(iv) Sierra Leonean institutions, such as banks, could be included.

(v) Overseas investors might possibly be attracted if the projects offered were commercially attractive.

(vi) Aid agencies could be approached for funding assistance.

With regard to management there are a few people in Sierra Leone with some of the required technical skills for operating mills and plantations, but there is a serious lack of people with the experience, drive and determination to run a technically and commercially successful enterprise. In these circumstances, there is a clear preference for expatriate management, at least in the early years of a project, but this preference must be tempered by commercial realities. Since devaluation, expatriates in Sierra Leone are now very expensive and only quite large projects could cover the cost of even one expatriate.

4.6. The Relationship with Landowners

The relationship with landowners is an absolutely crucial element of any new scheme. No project, either rehabilitation or new planting, should be considered without the full agreement and involvement of the P.C., landowners and local people.

In the course of our fieldwork we attempted to meet as many P.C.s, landowners and local people as possible. In particular we had discussions with those at Sahn Malen, Kasse, Telu and Baoma. All are anxious to rehabilitate and develop oil palm on a new company basis. Considerable interest is expressed in planting new areas if appropriate mill arrangements are made.

As a preliminary step these "soundings" have given promising results but, before any project proposal is developed further, there needs to be a programme of in-depth discussions with the P.C.s and appropriate local people. The question of local shareholding should be discussed. Also, it is very important that unrealistic expectations concerning the provision of social amenities such as housing, schools, roads and hospitals should not be allowed to get out of hand. To be brutally realistic, it is highly unlikely that any oil palm project based on the Pioneer mill plantations could offer many "free" facilities, at least in the early years. They could, however, offer a lot of employment, plus lease payments and, possibly, dividends.

If it is confirmed that the local people want to proceed, there would need to be negotiations concerning the creation of new long-term leases for the existing plantation sites and for any new areas of planting. It is likely that the lease would be made out in the name of the Government, with a sub-lease to the operating company.

SECTION 5

REHABILITATION OF THE PIONEER MILLS AND PLANTATIONS

5.1. Introduction

In this section of the report we look at individual rehabilitation plans (not including any replanting or expansion) for each of the seven sites in order to assess financial viability.

The reader is referred to the relevant annexes to this report for background information.

- Annex 1 gives the agricultural background with detailed accounts at each site of the fieldwork results and potential for rehabilitation.

- Annex 2 gives the engineering background with detailed assessments of the seven Pioneer mills and the requirements and costs for rehabilitation.

- Annex 4 gives the background to the financial analyses with the rehabilitation model described in A.4.2.

Given the existing plantation areas and mills, the cost of rehabilitation has been calculated and estimates made of the output which could be achieved and the associated operating costs, over a ten year period. Using these figures, cash flow has been calculated for each year and discounted to provide the Net Present Value (NPV) and the Internal Rate of Return (IRR) for each plantation treated as an individual project. The ten year period was assumed to represent the maximum period for which the mills could be maintained and for which the existing oil palms could be expected to produce reasonable quantities of fruit.

Management is assumed to be undertaken by Sierre Leonean personnel with one overall plantation manager at each site with a senior supervisor and an assistant supervisor. The Telu scheme is assumed to require an extra supervisor and assistant (probably trained in agricultural extension) to advise and assist outgrowers. The involvement of expatriate personnel is not feasible (for cost reasons) for any given individual site when these are considered for rehabilitation alone.

While allowance is made, as far as possible, for all the costs involved in running such small plantations, the initial financial analysis errs on the optimistic side. In particular it is assumed that a ready market for the oil exists on an ex-mill basis and that fertiliser and other inputs are readily available. Only where the analysis yields results indicative of a project with reasonable prospects, is feasibility pursued in more detail.

5.2. Financial Analysis (Rehabilitation)

The work undertaken regarding the quality of soils and the general conditions in the plantation areas indicated that the seven plantations could be divided into two groups. Mange Bureh, Masanki and Wanjei, all of which have relatively poor soils, were assumed to be capable of producing yields of FFB twenty per cent lower than Sahn Malen, Kasse, Baoma and Telu (excluding outgrowers).

Prices and costs are based on those prevailing in October 1986. Possible deviations from these levels are discussed in relation to individual plantations and in more detail in Section 6. Using the values set out in Annex 4 (A.4.2.) and assuming the recovery values of capital items to be zero, Table 5.1. presents the results of the financial analysis.

Table 5.1. Financial Analysis of Plantation and Pioneer Mill Rehabilitation

Plantation	Area (Acres)	Yield Factor	IRR (per cent)	NPV (MLe) (15% discount rate)
Wanjei	100	0.8	-	-3.6
Masanki	600	0.8	-	-1.3
Mange Bureh	895	0.8	9.1	-0.5
Sahn Malen	1200	1.0	45.7	3.0
Kasse Kangha	1100	1.0	45.7	3.4
Baoma	500	1.0	24.3	0.5
Telu (1)	110	1.0	35.0	2.0
Outgrowers	1000			

Note: (1) The analysis for Telu includes outgrowers for reasons given in the text. The plantation would not be viable without outgrowers.

5.2.1. Wanjei, Masanki and Mange Bureh

Wanjei and Masanki offer virtually no prospect of a reasonable financial return. The main reason for their poor prospects is that they combine poor yields and very limited acreage. The analysis would seem to offer no justification for rehabilitation. Mange Bureh, due to the larger area available for rehabilitation, offers a return which, though not especially attractive in itself, indicates that there may be sufficient potential to make a small project worthwhile. However, the geographical isolation of Mange Bureh from the other plantations and the fact that alone it only represents a very small project, do not favour its development.

5.2.2. Kasse Kangha and Sahn Malen

The best financial results are achieved by Sahn Malen and Kasse Kangha. However, an extra word of explanation is required about the rehabilitation potential of Kangha mill, because, as pointed out in Annex 2 (A.2.1.2.) the mill water supply is in need of a complete new system which is not costed in the rehabilitation financial analysis. For this and several other reasons, we propose that a major development project, incorporating Sahn Malen and Kasse (which are about 8 miles apart), should be pursued, as described in Section 6, but this would not include rehabilitation of Kangha mill.

5.2.3. Baoma and Telu

As indicated in Table 5.1. both Baoma and Telu offer attractive rates of return as rehabilitation projects.

However, in each case the projects would be very small and would have to be based on local management. They would not be large enough to sustain new investments such as new mills.

Also, as pointed out in Annex 1, both Baoma and Telu offer some potential for expansion of oil palm acreage. We have looked at both sites in terms of their potential for both rehabilitation and some element of expansion.

Baoma has potential for around 500 acres of expansion. A project based on rehabilitation and replanting of the existing 500 acres and the clearance and expansion of a further 500 acres was considered in outline form. A crude financial analysis (not presented here in detail), based on management costs equivalent to one third of those currently incurred by SLPMB at Bo, indicates an IRR of 14.6 per cent over a 25 year period. However, this analysis excludes any expatriate personnel. The cost of a single expatriate makes the project non-viable in financial terms. Since expansion, replanting and the installation of a new mill, if they are to be successful, require expertise not available in the area, or even in Sierra Leone, there does not appear to be the potential for a full-blown project. Therefore, the best alternative would be to proceed with a locally managed rehabilitation project with the expectation that, once the project is established, limited expansion might be considered. The possibility of an arrangement with the proposed Kasse-Sahn Malen project (should this go ahead) could be explored with the objective of facilitating the purchase of seeds, fertiliser, etc. and possibly co-operation in marketing.

The biggest obstacle to the development of oil palm in Baoma is undoubtedly the lack of technical expertise and management. If a small company could be formed, with participation by financial bodies, such as the National Development Bank and the local landholders, it might be possible to attract Sierra Leoneans with the necessary skills. This being the case, there would appear to be every prospect of a successful small-scale development project.

The situation at Telu differs considerably from the other six plantation sites. The original plantation itself has been reduced to one hundred and ten acres of palms. However, there are many landholders in the area who are either growing oil palms or would plant if conditions were attractive, especially in relation to marketing. Informal discussion with local landholders indicated that in excess of 1,000 acres of small-holder oil palm (within ten miles) is currently in production (see Annex 1). Most of the fruit is currently processed in village pits but small quantities are sold to SLPMB and processed at the mill. For the purposes of making a simple assessment of the possible financial viability of a project based on rehabilitation and outgrowers, an outline scheme based on 1,000 acres of smallholder (outgrower) oil palm was assessed. The cost to the project of FFB was assumed to include only the price paid to smallholders and the cost of providing transport for fruit collection. The latter included tractor and trailer purchase and estimates of the fuel required. The basic assumptions are set out below.

Telu Outgrowers Assumptions

Area under smallholder oil palm within ten miles of the mill (acres)		1,000
Average distance travelled on one return trip for fruit collection (miles)		10
Yields (FFB t/ha) (1)	Year 1	1.0
	Year 2	1.2
	Year 3	1.5
	Year 4	2.0

Note (1) Yield implies FFB available for purchase rather than total production. Hence the increasing availability of FFB is postulated not only on improved yields in the agronomic sense but an increasing flow of marketed FFB as the collection system is developed.

The quantity of FFB available to the mill from outgrowers is obviously crucial to the success of the project. Under the yield assumptions an area of 700 acres corresponds to an expected IRR of 14.7 per cent; 500 acres implies a completely non-viable project with a negative undiscounted cash flow; 1,500 acres corresponds to an IRR of 69.5 per cent and an NPV of 5.3 million Leones at a discount rate of 15 per cent. Hence detailed appraisal work at Telu on the likely availability of FFB would be crucial to any decision regarding investment.

SECTION 6

A PROJECT PLAN FOR KASSE-SAHN MALEN

6.1. Background to the Project Plan

As pointed out in Section 4.1 there is a need for projects in Sierra Leone to progress beyond rehabilitation if the perceived objective is to have a long term and substantial impact on overcoming the national palm oil shortage.

However, as also pointed out in Section 4.1, all development proposals involving replanting/new planting/new mills involve substantial foreign exchange expenditures. In a nutshell, the fivefold increase in import cost at a time when internal prices of palm oil (based on Daru ex-mill selling prices) have only doubled, means that it is extremely difficult to identify projects which could offer an attractive rate of return.

The first proposal we investigated, which was based on the objective of developing a large project capable of having a large impact on the problem, highlighted these difficulties. The idea was based on taking the four mills and estates currently operated by the Bo Production Division i.e. Baoma, Telu, Kasse Kangha and Sahn Malen. Each site would have been rehabilitated (both plantation and Pioneer mill) with subsequent replanting, new planting and installation of new mills. The project headquarters would have remained at Bo with two expatriate staff responsible for overall project management. Several scales of operation were investigated with varying plantation expansion plans but it soon became clear that all were commercially unattractive. Additionally, the team had doubts about the practicability of management staff in Bo being able to achieve effective supervision at sites up to 50 miles distant from Bo over very poor roads.

Many other proposals were investigated by the team, the most attractive of which is the Kasse-Sahn Malen option which is described and assessed in the remainder of this section.

6.2. Outline of the Kasse-Sahn Malen Project Plan

The first point to emphasise is that this specific plan was not discussed in Sierra Leone. It emerged as the leading candidate only after the team returned to the U.K. and carried out analysis of the various options. However, the broad idea of oil palm development at Kasse and Sahn Malen was discussed with the PCs and local people at each location who gave their enthusiastic preliminary support.

The essential elements of the plan, involving the creation of a single project based on combining Kasse and Sahn Malen, are described in the following points:

1. Rehabilitation of Sahn Malen Pioneer mill and plantation (about 1,000 acres)
2. Replanting of Kasse plantation (about 1,000 acres)
3. Commencement of new planting in the Kasse-Sahn Malen area on suitable sites allocated by the chiefdoms (about 4,000 acres).
4. Installation of a new mill (Malaysian) at new central site to process eventually, all FFB from 6,000+ acres. New mill installation will occur in two stages in year 5 and year 10 to give a total capacity of 15 tons per hour.
5. The rehabilitated Sahn Malen Pioneer mill will be phased out (unless still operational and retained for reasons applicable to circumstances at the time)

6. Kangha Pioneer mill is not included in the plan for reasons of water supply and insistence of Kasse people that new mill is sited in their chiefdom.
7. One expatriate manager is included in the project plan. (The team would prefer two expatriates but only one is included in the analysis for cost limitation reasons).

The basic rationale for the scheme is that the rehabilitation activities at Sahn Malen will provide cash flow for the project in the early years while the development programme progresses. Eventually the project will consist of 6,000+ acres of oil palm, with a 15 t/p/hr mill, yielding in excess of 5,000 tons of palm oil.

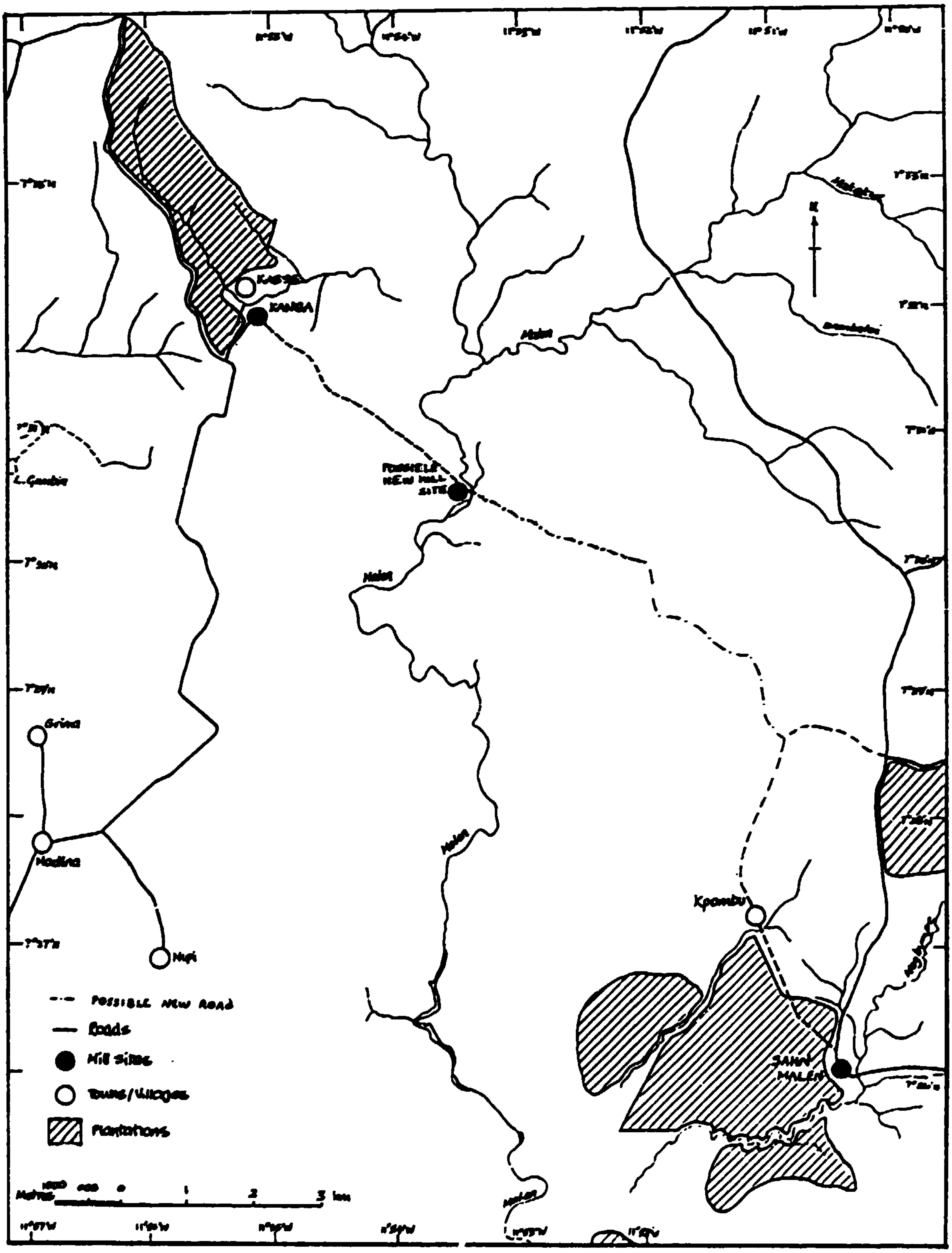
The map shows the positions of the existing mills and plantations plus a possible site, on the Malen River, for a new mill. Ideally, the plantation expansion areas would be located on suitable land between the existing plantations and within as short a distance as possible of the new mill. At appraisal stage, considerable further work is required on the siting of expansion areas, the new mill and the new road.

Details relating to the agricultural and engineering aspects of the proposals are given in the appropriate annexes.

- Annex 1 includes many references to Kasse/Sahn Malen. Of particular relevance to the development aspects of the project are A.1.3.2. (yield potential), A.1.4.2. (expansion potential), A.1.6. (requirements for replanting and expansion, including bar chart of operations) and A.1.7.1. (further work).

- Annex 2 gives all the required information about the requirements and costs of rehabilitation of Sahn Malen Pioneer mill. Sections A.2.3. and A.2.4. elaborate the options and costs for new mills together with particular comments about the proposed project.

Kasse/Sahn Malen Project



- Annex 4 presents details of the Kasse/Sahn Malen financial model (A.4.3.) including a summary table of costs and revenues, and the economic model (A.4.4.).

6.3. Kasse-Sahn Malen Oil Palm Project - Financial and Economic Appraisal

In order to facilitate the financial and economic analyses of the proposed Kasse-Sahn Malen development project, an accounting model was developed using a conventional micro-computer based spreadsheet. This model lists in considerable detail the costs and revenues associated with the rehabilitation and replanting of the original plantations and an expansion area of 4,000 acres. Using conventional discounting techniques, the Net Present Value (NPV) and Internal Rate of Return (IRR) were calculated under a range of assumptions concerning prices, yields, etc.

In the financial analysis prices are, as far as possible, related to conditions in Sierra Leone as they applied at the time of the team's visit. As mentioned earlier, this visit took place some 3-4 months after the floatation of the Leone and the consequent dramatic decline in the exchange rate. In addition, inflation was estimated by the Bank of Sierra Leone to be in excess of 100 per cent per annum. Hence the validity of the implied price relationships, especially those between imported and domestically produced goods, may be questioned in the context of a project with a thirty year life span. As far as possible sensitivity analysis has been used to alleviate this problem but, as will become clear, the results are directly related to key assumptions concerning the relative prices of inputs, palm oil and to a lesser extent, palm kernels.

Similar reservations apply to the economic analysis but the greater use of international prices in such analysis reduces the extent to which such assumptions have to be made. However, to the uncertainties concerning price trends, economic analysis adds the inevitable difficulties of assessing opportunity costs. While, in the present Sierra Leonean context, the market in agricultural labour is sufficiently free to permit the opportunity cost of hired labour to be equated with its market price, the opportunity cost of family labour remains a problem. The value of family labour and the land used within the existing farming system cannot be assessed fully in a study such as this.

Traditional farming systems are based on shifting agriculture with long fallows (e.g. ten years), multiple and inter-cropping and traditional systems of land tenure and usage rights. The impact of expanding a plantation on such systems, and the social, economic and political structures into which they are integrated, is extremely difficult to assess. An attempt is made here to calculate the impact in simple monetary terms which is all that could reasonably be attempted at this stage. A full social benefit-cost analysis may be considered necessary at appraisal stage.

6.3.1. Financial Analysis

The results of the financial analysis are:

IRR = 10.0%

NPV = Le - 33.0 million (assuming a 15% discount rate)

The basic assumptions are set out in Annex 3 (A.4.3.). Of particular importance among these are the ex-mill price of palm oil which is set at Le1300 per drum (which is slightly below the equivalent price at Daru) and the wage rates for unskilled and semi-skilled set at Le9 and Le12 per day respectively. In the economically volatile conditions prevailing in Sierra Leone at the time of the study, it is extremely difficult to forecast price and wage levels. The Daru price has recently doubled but there is no real evidence upon which to base a forecast other than using a figure close to the current Daru price. With regard to wage levels we have used rates higher than the government minimum levels (Le5.60 per day) prevailing at the time of our visit to allow for substantial increases which were expected to be made in actual rates in the near future and also to allow for some element of additional non-cash remuneration, such as subsidised rice, which it is customary for plantation workers to receive. However, there are some people who would argue that the wage rates we have used are still below the rates which will soon exist in Sierra Leone.

As already stated, the IRR under base assumptions is 10.0 per cent. Table 6.1. sets out the IRR under different assumptions regarding the expansion area, the price of palm oil, the exchange rate, the wage rate, the fertiliser price, the lease paid to landholders, the oil extraction rate and yields from newly planted and rehabilitated areas. For each variable, the IRR and NPV are presented given a ten per cent increase and decrease in its value, assuming other variables are held at their base values. Some other calculations of particular interest are also presented.

Table 6.1. Kasse/Sahn Malen Financial Analysis

Internal Rate of Return: Sensitivity Analysis

Base Values: IRR 10.0 per cent, NPV (Discount 15%) -33.0 (MLe)

Variable	Base Value	Value	% Change	IRR	NPV
Expansion Area (acres)	4,000	3,200	-20	8.7	-38.9
		4,800	+20	11.1	-27.2
		3,600	-10	9.4	-35.9
		4,400	+10	10.6	-30.1
Palm Oil Price (Le/drum)	1,300	1,430	+10	11.4	-24.4
		1,170	-10	8.5	-41.6
		2,000	+54	16.8	+13.4
		3,500	+269	28.0	+112.9
Exchange Rate (Le/US$)	29	31.9	+10	9.0	-41.5
		26.1	-10	11.1	-24.6
		17.6	-39	15.0	0.2
Wage Rate (Le) (Semi and unskilled)	12/9	13.2/9.9	+10	9.9	-34.2
		10.8/8.1	-10	10.2	-31.8
		18/13.5	+50	9.2	-39.0
		6/4.5	-50	10.8	-27.1
Fertiliser Price (US$ per tonne)	200	220	+10	9.7	-34.8
		180	-10	10.3	-31.2
		100	-50	11.4	-24.1
Lease (Le)	50	55	+10	10.0	-33.3
		45	-10	10.1	-32.8
		25	-50	10.2	-31.8
Extraction Rate (oil)	0.22	0.242	+10	11.3	-25.3
		0.198	-10	8.6	-40.7
Yield factor (not rehab.)	1	1.1	+10	11.3	-25.5
		0.9	-10	8.6	-40.6
Number of expatriates*	1	2		9.8	-44.2
		0		11.3	-21.9

*Assumed to be employed for the first 9 years of the project, i.e. 3 years after the planned installation of the new mill.

From Table 6.1. several observations may be made:

(i) For changes of ± 10 per cent the IRR changes in a fairly narrow range.

(ii) Increasing the expansion area leads to higher returns. However, this result only holds true within limits, since no account is taken of increases in overheads (e.g. central management) or milling capacity.

(iii) Future price developments are difficult to predict, but it may be noted that a price level of Le2,000 per drum, representing a 54 per cent increase, yields an IRR of just over 15 per cent which is commonly used as a criterion of acceptability.

(iv) The results from varying the exchange rate are probably best interpreted as short term. Although account is taken of the impact of the exchange rate on the price of materials imported directly by the project and goods whose price is likely to be set in US$ terms. (e.g. the new mill, fertiliser, tractors, spare parts). Other prices are assumed to be independently determined. This assumption is obviously dubious over the medium and long term.

(v) The impact on the IRR of changing the wages paid to project workers or the lease payments to land holders is relatively slight. This reflects the low proportion of total costs such payments account for at current price/wage levels. The lower wage rate of Le9 per day is equivalent to just 31 US cents at the base exchange rate.

(vi) The base value of $200 per tonne assumed for the fertiliser price is derived from the approximate cost of muriate of potash, up country in August 1986, assuming no subsidy is provided. The latter assumption is made on the grounds that under the terms of the recent loan agreement with the World Bank, such subsidies will be phased out. However, at the time of the team's visit, discussions were still being held regarding how quickly to phase out the existing subsidy which amounted to 70-80 per cent of the full economic cost. As can be seen, the continuation of a substantial fertiliser subsidy would significantly improve the financial return from the project.

(vii) The oil extraction rate is dependent on both the quality of the fruit and the effectiveness of mill management. Management is also critical to the yield which a plantation can be expected to produce. The importance of these variables in determining the rate of return serves to emphasise that the IRR and NPV figures are only valid insofar as good quality management is provided.

(viii) Although the cost of employing expatriates is very high, these costs have to be related to the impact of (perhaps greatly) reduced yields or extraction rates which would result from poor quality management. The ideal solution would be the use of suitably qualified and experienced Sierra Leoneans but under current circumstances such people do not appear to be available. The assumption made is that suitable nationals will receive training while employed on the project. This will enable them to take over the management function after replanting at Sahn Malen has been completed and the new mill has been established at Kasse.

As can be seen from Table 6.1. the broad conclusion from the financial analysis is that it would be unwise to expect returns much above 10 per cent, given current price levels. However, it may be argued that the current price of palm oil does not reflect its true value to the country, given the foreign exchange problems. This, and other, considerations are rightly the province of economic, rather than financial, analysis and are discussed in the next section. Nevertheless, it is perhaps worth emphasising the importance of medium and long term assumptions made regarding the price of palm oil and the factors which determine it. The underlying situation, in which a fairly fixed supply of palm oil from wild palms is juxtaposed with a population growing at around 2.5 per cent per annum, points to an opportunity for increasing production of oil from palm plantations. Even though current international vegetable oil prices are very depressed, the CIF price of imported oils is higher (in equivalent terms) than the current palm oil price. Hence there would appear to be some potential for oil prices to rise. The extent to which they do so will depend largely on whether potential demand is translated into effective demand through a growth in aggregate purchasing power. This in turn will depend on the growth in the economy as a whole and the distribution of income. The prospects for an oil palm project such as that analysed here, in financial terms, rest to a large extent on the wide economic outlook.

6.3.2. Cash Flow and Cost Breakdown

Arising from the financial analysis at base values, which has already been discussed, we have produced a number of figures which highlight some important aspects of the proposed project.

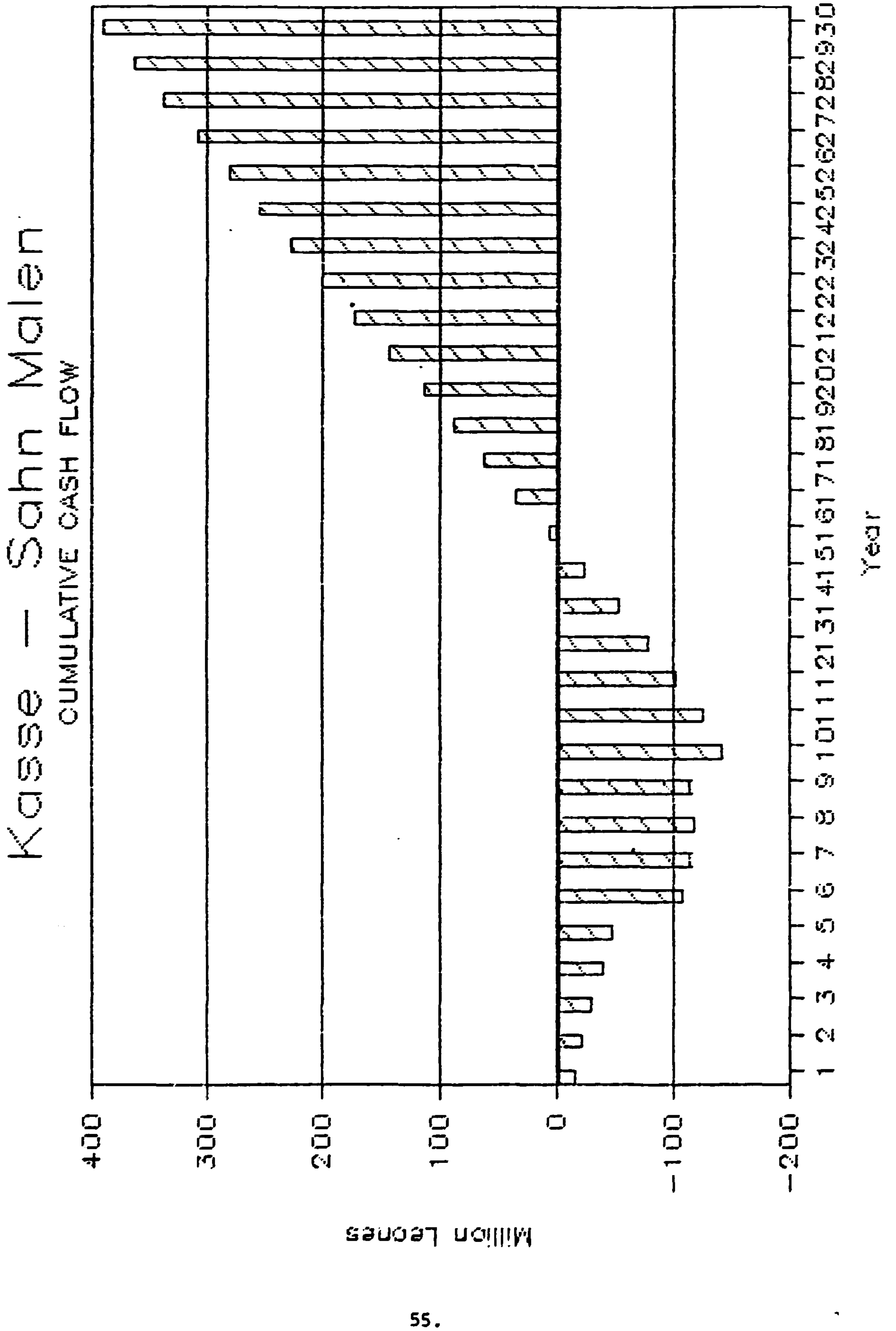
The figure entitled "Cumulative Cash Flow", shows, typically for tree crop projects, that the cumulative cash flow remains negative for many years. In this case, for the first 15 years. Potential investors will be, at least partly, deterred by this but they may also be encouraged by the rapid increase in cumulative cash flow from that date onwards.

The remaining three figures give various breakdowns of total costs, local costs and foreign exchange costs throughout the duration of the project. The new mill installation dominates the cost profile. Whereas total foreign exchange requirements in most years are in the range $200,000 to $350,000, in the years of the new mill installation they are:-

Year 6	$1.6 million
Year 10	$1.2 million

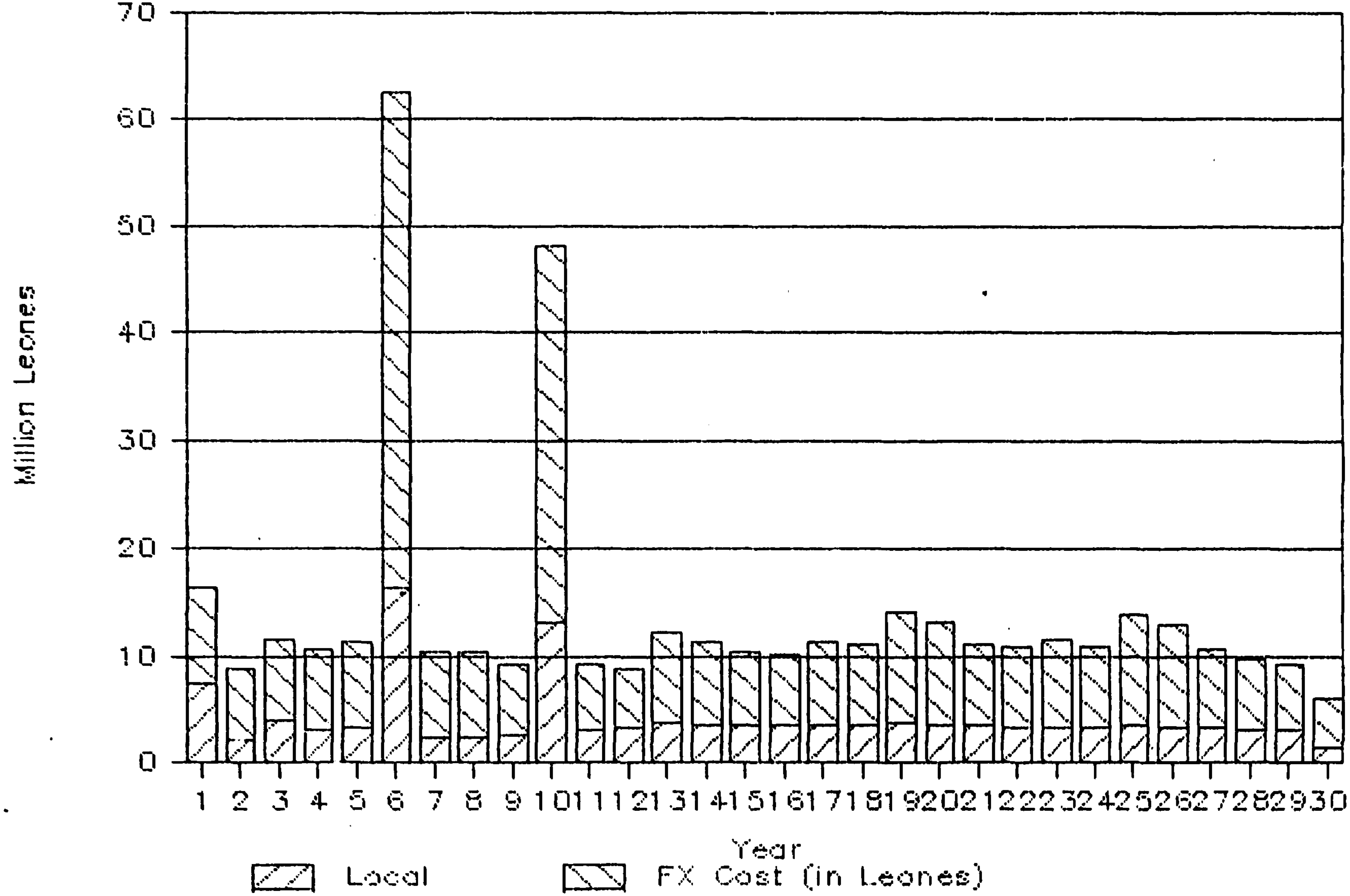
Local currency costs are also greatest in years 6 and 10; there are also considerable Leone costs in year 1. In rounded terms, the local currency costs in these three years are

Year 1	Le 7 million
Year 6	Le 17 million
Year 10	Le 13 million


Kasse — Sahn Malen
CUMULATIVE CASH FLOW
Million Leones
400
300
200
100
0
-100
-200
Year
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

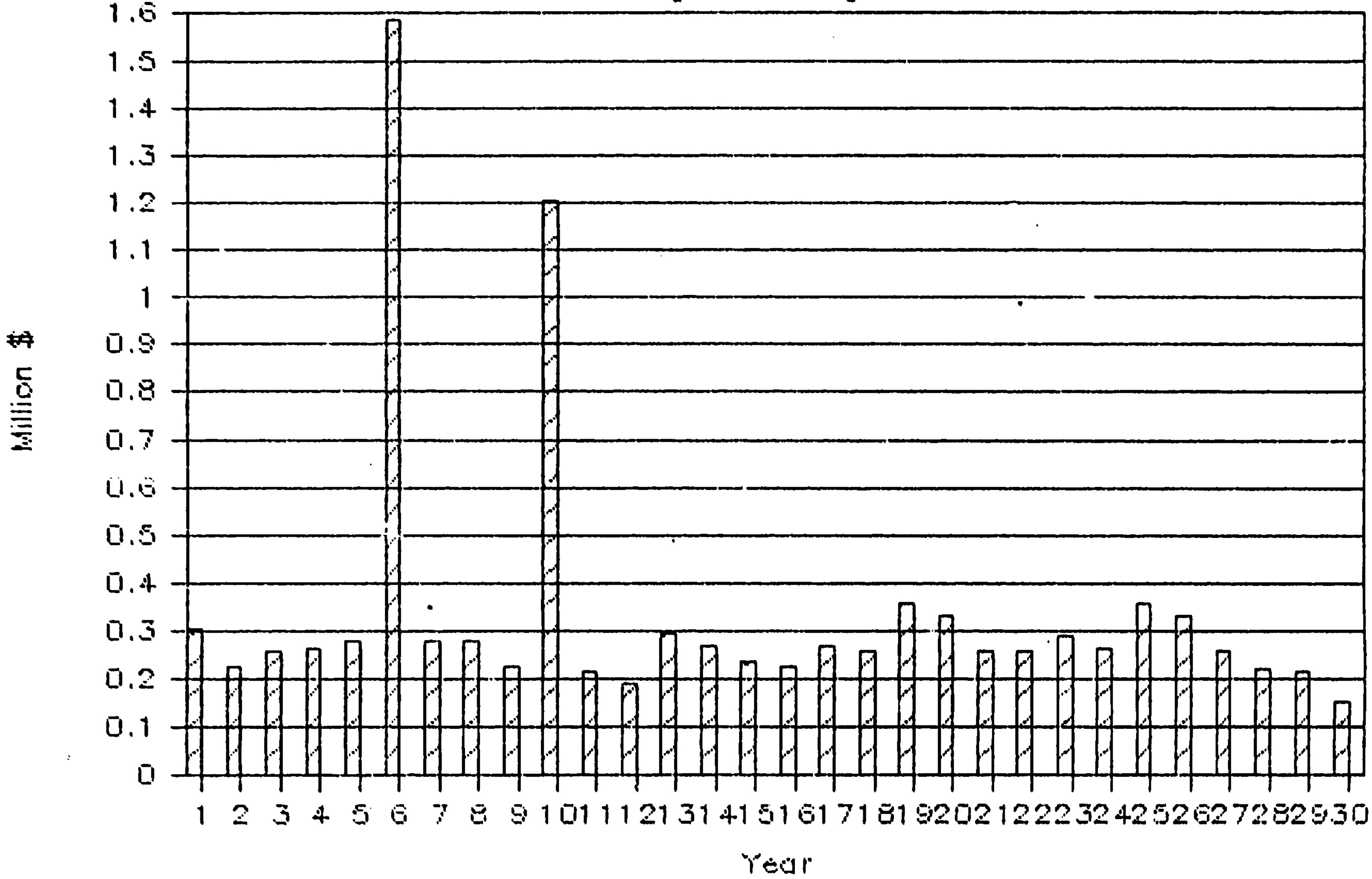
Kasse — Sahn Malen

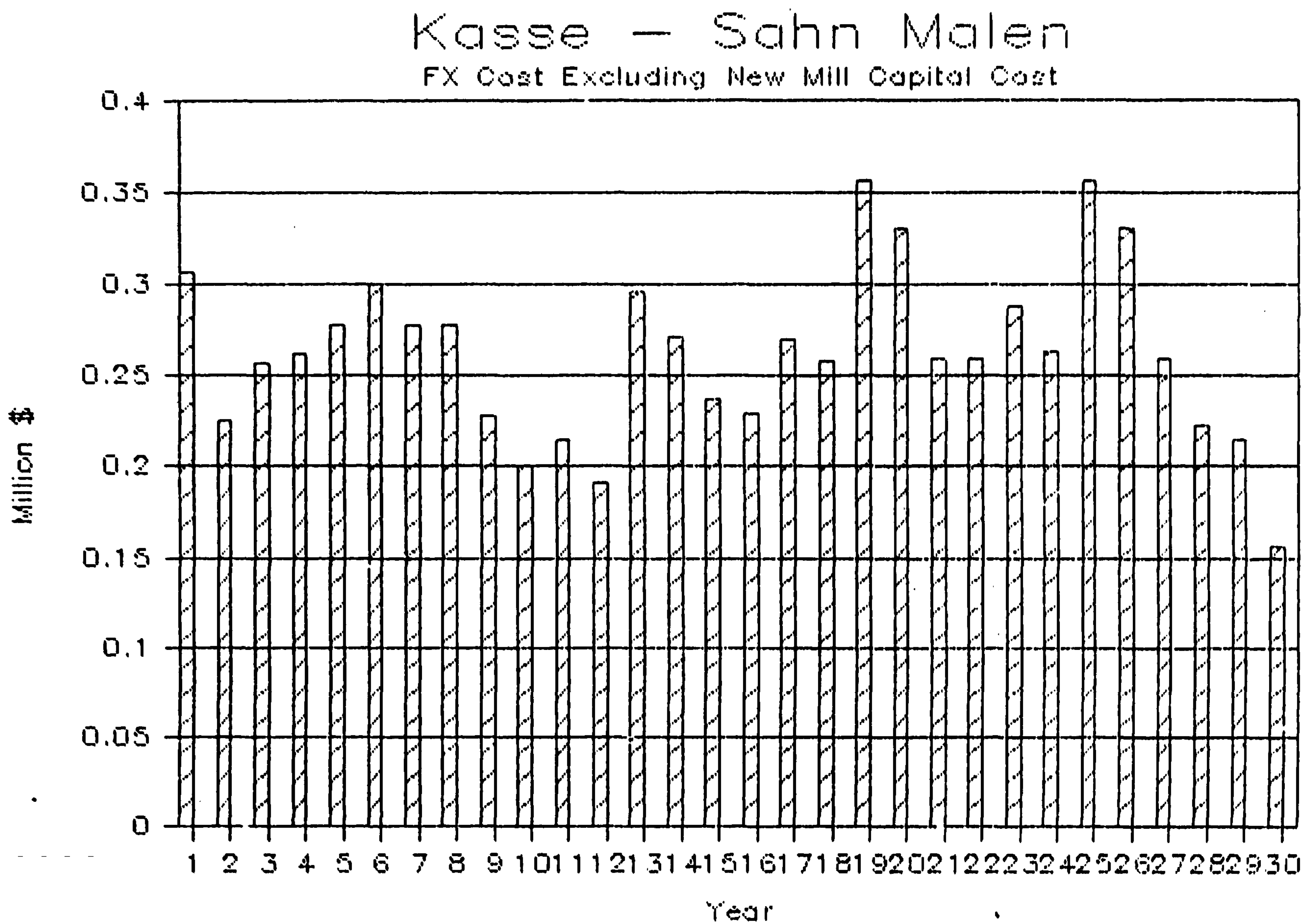
Total Cost in Leones



Kasse — Sahn Malen

Foreign Exchange Cost




Kasse - Sahn Malen
FX Cost Excluding New Mill Capital Cost
Million $
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30
Year

6.3.3. Economic Analysis

The basis model structure used for economic analysis is very similar to that used for financial analysis. The important differences are that allowance is made for the opportunity cost of resources, where this differs from the costs used in financial analysis, and the prices used for outputs reflect border prices for possible alternatives rather than current market prices. The base values are set out in Annex 4 (A.4.4.). The differences from those used in the financial analysis are:

(i) The introduction of a shadow revenue for land converted to oil palm from traditional farming. The figure of Le 1800 per acre per year is based on work done by the Bo/Pujehun Development Project team and based on a mixed cropping system of upland rice. The gross revenue from such systems is estimated at Le 18000/acre for each area planted at October 1986 prices and in particular Le400 per 50kg bag of rice. This converts to Le1800/acre assuming a ten year fallow.

(ii) Family labour used on the mixed cropping system is given a shadow wage equal to the lower of the two wage rates used for hired labour.

(iii) No allowance is made for the lease since this represents an internal transfer. The same applies to compensation to SLPMB for the take-over of buildings.

(iv) The price of oil is set at Le2000/drum at the mill. This corresponds to a figure of $500 per tonne (CIF Freetown) for imported vegetable oils. This figure is considered to be representative of the mix of oils imported and the likely medium-run price level.

(v) The IRR and NPV calculations, rather than accounting cash flows, account net benefit based on the differences between net project revenues and the sum of the revenues from existing SLPMB operations and the opportunity cost of the land used for expansion.

The IRR (economic) of 8.7 per cent, does not, at first sight, appear attractive.

However, as in assessing the financial return, it is important to take into account the circumstances and the likely prospects for prices. After a devaluation on the scale experienced by Sierra Leone, the prices of imported goods are likely to seem artificially high in relation to domestic products such as palm oil. As discussed earlier, the full impact of the devaluation has not, as yet, worked its way through the system. Hence a project involving substantial imports, but generating a product whose market price reflects domestic costs, is unlikely to appear particularly attractive. If the prices of imported vegetable oils are assessed at their levels of 1984, a representative price CIF Freetown would be approximately $750 per tonne. The equivalent ex-mill price at the base exchange rate would be Le 3,500 per drum. At this price level the IRR (economic) would be 17.5 per cent.

As with the financial IRR, the result is sensitive to changes in assumptions regarding costs, yields, etc. In particular, the IRR is sensitive to the shadow prices used for assessing the opportunity cost of land. Table 6.2. sets out the implications of some alternative, quite plausible, values for shadow wages and revenues on the assumption that the economic value of the oil is Le 2,000 per drum.

Table 6.2. Kasse-Sahn Malen Economic Analysis

The Implications of Alternative Shadow Prices

Base IRR 8.7 per cent

	Base Value	Value	IRR
Shadow Revenue (Le/acre)	1,800	1,600	9.5
		1,400	10.3
		1,200	11.2
		0	18.3
Shadow Wage (family labour) (Le/day)	9	12	9.0
		15	9.3
		5	8.3
		0	7.8

Apart from the economic return as calculated, there are a variety of other considerations which are difficult to quantify but nevertheless important. First among these considerations is the stimulus to the general economy which will result from investment in a project such as this.

At present Sierra Leone is in a very depressed state economically and is undergoing a period of considerable uncertainty following the floatation of the currency. Under these circumstances a straightforward IRR calculation (financial or economic) for any project aimed at a locally consumed product, using substantial quantities of imported expertise and material, is unlikely to produce a high rate of return. However, in a context where opportunities for investment by local interests are very weak, such projects can provide a much needed economic stimulus. The multiplier effect, even if it cannot be quantified, is likely to be significant. A consequence of this is that a range of projects undertaken over the same period is likely to be self-reinforcing. In a depressed economy the problem for many such projects, as in the case with oil palm, is the lack of domestic demand which can only be rectified by substantial investment. If this investment is inhibited there is a danger that the depression will become self-sustaining.

A second consideration is the medium to long term effect of lower levels of palm oil supply. As already stated, palm oil is a basic foodstuff in Sierra Leone. If domestic production is inadequate to sustain consumption at a level considered acceptable by the population, the government is faced with a dilemma. The choice will be between possible social and political discontent arising from 'high' price levels for oil and the pressure on the balance of payments which would arise from higher imports. The cost of high price levels could, in theory, be quantified in terms of the loss of consumer surplus, but this is not practical given the lack of data. Balance of payments pressure, or rather the value of relieving it, can be assessed by the use of shadow exchange rates. Table 6.3. presents the results of using different exchange rate assumptions. It is perhaps worth emphasising that the impact on the project IRR of devaluation (or revaluation) is in the opposite direction to that portrayed in Table 6.1. The reason is because in an economic analysis, where substitute oils are assumed to be imported, a change in the exchange rate affects the (shadow) price of palm oil (in Leone terms) as well as the cost of imported inputs.

Table 6.3.

Economic Return and the Exchange Rate

$ Exchange Rate	(% change)	Palm Oil Price (Le)	IRR
29.0	(-)	2,000	8.7
31.9	(+10)	2,200	9.4
26.1	(-10)	1,800	7.8
40.0	(+38)	2,759	11.1
58.0	(+100)	4,000	13.4

The main implication which can be drawn from Table 6.3. is that a weak Sierra Leone balance of payments makes the project IRR more attractive (assuming the exchange rate remains market-based). Put another way, the higher IRR figures associated with a further devaluation of the Leone reflects the value of the project's contribution to the balance of payments. The effect would be further amplified if a variable exchange rate, with the Leone declining against the US$ over the life of the project, were to be assumed; the major foreign exchange costs arise early in the project and the consequent increases in revenue later, hence a declining exchange rate makes the former appear 'cheaper'.

In summary, the formal economic analysis of the project revealed a modest internal rate of return of 8.7 per cent. However, the real value of the project to the economy, when allowance is made for the impact of the multiplier and the positive contribution to the balance of payments, indicates a higher rate of return. Unfortunately this cannot be quantified precisely and hence the assessment of the true worth of the project must still involve an element of judgement.

SECTION 7

CONCLUSIONS

7.1. Recommendations for Projects

Our purpose in this study has been to examine all the issues relating to the Pioneer mills and estates, with a view to giving firm recommendations for action.

With regard to rehabilitation alone, we have noted that all seven mills and estates could, theoretically, be rehabilitated but that a number of estates are not located in particularly suitable parts of the country and that rehabilitation of some estates and mills would not be economically worthwhile. We suggest that the most suitable location a pilot project would be Baoma and that Telu might also be considered. These points are elaborated in Sections 7.1.2. and 7.1.3.

In addition to rehabilitation we have sought to find a development project capable of producing large quantities of palm oil, thus making a positive contribution to overcoming the national problem of vegetable oils shortage. The problem is that, whereas rehabiltation can be shown to offer quite high rates of return, projects based on a combination of rehabilitation and new development only offer fairly low rates of return. This is because these schemes involve new plantings and new mill installations with substantial foreign exchange cost outlays.

However, it can be argued that a broader evaluation of the situation is required than a simple assessment based on rates of return. In the first place, the situation relating to costs and revenues is so volatile at the present time that the figures within the financial and economic analyses could soon become out-of-date. Secondly, it is necessary to take a rather broader view of Sierra Leone's vegetable oil supply position. Even though the world price for most vegetable oils is currently very depressed, it is not realistic to imagine that Sierra Leone would have sufficient foreign exchange available to buy a substantial proportion of its requirements from overseas suppliers. Also, historically, the price paid for imported oils in Sierra Leone has been very high, presumably because of high transport costs, and this is a further reason for trying to limit foreign exchange expenditure by concentrating on domestic production.

If this argument is accepted, it is then necessary to examine the relative attractiveness of different types of domestic production. One argument is that attention should be paid to labour intensive and low foreign exchange cost approaches to oil palm production and processing. As a partial solution to the problem, we would agree with this viewpoint, in fact we have already (in the Commonwealth Secretariat report 1986) advocated further encouragement of smallholder plots and appropriate forms of processing, such as hand-presses. Since the option of developing plantations with new mills appears to offer only moderate rates of return, it may now be the right time to carry out a full-scale investigation of smallholder oil palm developments (currently being pursued in an uncoordinated manner by a number of different projects) and the various options for processing the fruit locally (traditional methods, hand-presses and mini-mills).

That said, we are also convinced that the scale of the oil palm shortage in Sierra Leone requires some medium to large scale projects. Accordingly, we have developed the Kasse/Sahn Malen project proposal.

7.1.1. Kasse/Sahn Malen Project

The two existing plantations, which offer the highest potential yields (4 tones per acre) of any of the plantations under review, are located about 10 miles apart. It is our proposal that the two plantations should be combined into one project with a new mill and a substantial new planting programme.

The P.C.s responsible for each plantation have voiced considerable enthusiasm for oil palm development in their chiefdoms and have indicated that large areas for new planting could be made available. However, the proposal for a joint project has not yet been put to them and needs to be presented in a clear and careful manner. Local support and participation are essential.

The main advantage of a combined project lies in the sharing of a single new mill which could be installed, probably on the Malen River, between the two plantations. New plantings, as far as possible, would be located in blocks in the vicinity of the new mill. Detailed studies, at the appraisal stage, need to be carried out on mill location areas for expansion and new roads. Labour availability in sufficient numbers also requires further examination.

The total project would eventually consist of 6,000 acres and would supply approximately 2,640 tons of palm oil in year 10 and 5,280 tons in year 15 (refer to Annex 2 (A.2.4.).

The major item of investment is the new mill (15 tons per hour) which would be installed in two stages (years 5 and 10) at a total foreign exchange cost of $2.3 million and a local currency cost of Le23 million. There are other substantial costs, as described in Section 7, mostly for the plantations, tractors/trailers and expatriate management. The rehabilitation of Sahn Malen Pioneer mill in the early stages of the project requires only $26,000 and Le367,000 in local currency (although the rather more expensive full cost rehabilitation option might be preferred).

The continuing requirement for foreign exchange throughout the project is a tricky question that will require consideration. Without spare parts and other imported items the project will collapse. One possible solution would be to allow the project to export some of its output (probably to West African markets) in order to earn foreign exchange, a percentage of which would be retained to pay for imports. However, the current foreign exchange regulations in force in Sierra Leone would probably not allow this approach.

Most of the output of palm oil would be sold on the local market. We have based our analysis on ex-mill sales of palm oil and sales of palm kernels to SLPMB. However, three other ideas could be considered for increasing total revenue. Firstly, palm oil could be transported to Freetown or other markets, in order to earn a higher mark-up on the product. Secondly, the experience of Eastern Clinic could be followed whereby a soap-making component is included in the project. Thirdly, it is conceivable that machinery could be installed for the on-site production of palm kernel oil using the same steam, the same management and the same overheads as the main project. This latter suggestion also, perhaps, offers an opportunity for earning foreign exchange.

The financial rate of return on the project is 10%. This might be considered unattractive in purely financial terms but may also be considered as quite high in terms of vegetable oil projects in Africa. The economic rate of return is similar (8.7%), although if we allow that Sierra Leone's import cost of vegetable oils may be nearer to $750 per ton (CIF) rather than $500, then the figure increases to 17.5% which appears considerably more attractive. (The high cost of Sierra Leone's imports of vegetable oils is referred to in Section 2.5.).

It might be argued that the Kasse/Sahn Malen project should be proceeded with for developmental reasons rather than purely commercial ones. If, for example, the costs of expatriate management (and short-term consultancies) could be met from external sources then the project would appear more commercially attractive. This is important, because we would argue that the project should be run by a commercial company with a widespread shareholding (as described in Section 4.5.).

7.1.2. Baoma

As described in Section 5, a rehabilitation project at Baoma offers the attractive rate of return of 24%. This would involve rehabilitating 500 acres and rehabilitating the Pioneer mill on a "minimum" cost basis (foreign exchange costs $23,000, local costs Le 262,000). The project output would be 875 tons of palm oil in year 3, declining to 450 tons in year 10.

Total costs for year 1 of the Baoma rehabilitation project amount to Le 2.3 million (equal to less than $80,000) as shown in Table 7.1. which is summarised from the full computer table presented in Annex 5.

Table 7.1. Baoma Financial Analysis
(Million Leones)

	Years									
	1	2	3	4	5	6	7	8	9	10
Costs	2.3	0.6	0.6	0.6	0.6	0.6	0.6	0.4	0.4	0.2
Revenues	0.6	0.9	1.2	1.2	1.2	1.2	1.0	0.6	0.6	0.5
Net Cash Flow	-1.6	0.3	0.6	0.6	0.6	0.6	0.4	0.2	0.2	0.3

Our proposal is that the initiative for a rehabilitation project should come from the local people and that a local private company should be formed to operate the mill and plantation. Local management would be used, supplemented by aid-funded short-term consultancies by visiting experts, particularly an oil palm agriculturalist.

We suggest that the project should begin with a rehabilitation phase and that aid funds should be sought for the foreign exchange requirements. Expansion of the plantation and installation of a new mill to replace the Pioneer mill could be considered at a later date if the rehabilitation phase proves successful. The potential for expansion is limited to about 500 acres which would give a total plantation of about 1,000 acres.

As a first step, the findings of this study should be communicated to the P.C. and local people of the Baoma area. If considerable local enthusiasm and commitment is evident, GOSL, UNIDO and others should assist the community in formulating a project to create a local company which would seek local investment funds and external assistance.

If the Kasse/Sahn Malen project is implemented it should be possible to assist Baoma in various ways, including purchasing of inputs and general agronomic/engineering advice.

The quality of the local management that would be recruited to operate the project is probably the key to the success or failure of this proposal. Another important consideration, as with any project in Sierra Leone, is access to foreign exchange for spare parts and essential imports.

7.1.3. Telu

A rehabilitation programme along the lines advocated for Baoma could also be considered for Telu, although the situation is complicated by the existence of smallholder outgrowers.

Again, the first step should be to communicate with the local people and assess their commitment to developing their local resource. If sufficient enthusiasm exists, it would be worthwhile to undertake a study of the smallholders' plots to ascertain the actual acreage of oil palm available, their age, condition and availability of inputs and roads.

It is conceivable that about 1,000 acres of plots might be available. The smallholders could be encouraged to rehabilitate their own plots as a pre-requisite for aid-assisted rehabilitation of the Pioneer mill. The "minimum cost" option for the mill rehabilitation is $28,000 in foreign exchange and Le 217,000 in local costs. The small plantation could also be rehabilitated.

Our financial analysis in Section 5 (with computer tables in Annex 5) is based on inadequate data but the rate of return of 35% may be considered encouraging.

Operation by a local company is again recommended. The quality of local management, as in the case of Baoma, would be critical. Some visiting expert assistance, particularly by an oil palm agriculturalist, would be required.

7.1.4. Other Locations

No specific recommendations are made about the other locations i.e. Mange Bureh (Pioneer mill and plantation), Masanki (Pioneer mill and plantation), Kangha (Pioneer mill) and Wanjei (Pioneer mill and plantation). As described in the report, the plantations at Mange Bureh, Masanki and Wanjei are generally unsuitable for development and the mill at Kangha has considerable technical problems.

However, we do not discount the possibility of some rehabilitation at these locations. The required cost information is given in the report and the protagonists for any particular course of action can use the information in an effort to make a case for their own particular area.

7.2. Implementation Procedures and Project Funding

Our recommendation is that immediate steps should be taken to proceed with projects at:-

1. Baoma (rehabilitation only)
2. Kasse/Sahn Malen

In each case, considerable effort should be made to communicate with the local people and obtain their support.

If GOSL and the local people are united in their purpose, they will be in a strong position to approach both local and external sources of funding.

Aid funding could be sought for both projects. In the case of Baoma this would primarily consist of a relatively small amount of foreign exchange required for mill rehabilitation and other costs. Even allowing for inflation, it is unlikely that foreign exchange costs for Baoma would exceeed $50,000. UNIDO could be approached for assistance with engineering work at the mill. It would also be necessary to seek assistance for short-term consultancy visits from an oil palm agriculturalist.

In the case of Kasse/Sahn Malen considerably larger amounts of investment funds are required, in particular Le 90 million for new mill installation, of which $2.3 million is required in foreign exchange. For projects of this size it is probable that GOSL will need to approach the major lending agencies such as the World Bank or the African Development Bank. It may be possible to fund expatriate management and other forms of technical assistance from UNDP sources. Potential investors from the private sector, both local and foreign, could also be approached.

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Mutual Responsibilities.

In the absence of any agreement to the contrary, research specifications provided by a client, and proposals provided by an agency at the request of a client when the agency receives neither the commission nor payment for the proposals, remain the property of the client or agency respectively. Their contents may not be revealed to third parties without permission.

Records.

Completed records shall be the property of the research agency. The agency shall be entitled to destroy such records without reference to the client two years, but no sooner, after the end of the fieldwork.

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(2 of 3)

Sierra Leone:

Rehabilitation and Development of the Pioneer Mills and Attached Oil Palm Estates

VOLUME II

Report prepared
for
UNIDO
and the
Government of Sierra Leone

(Project No. SI/SIL/85/802
UNIDO Contract Number 86/52)

PSL 5208/SFJ
November 1986

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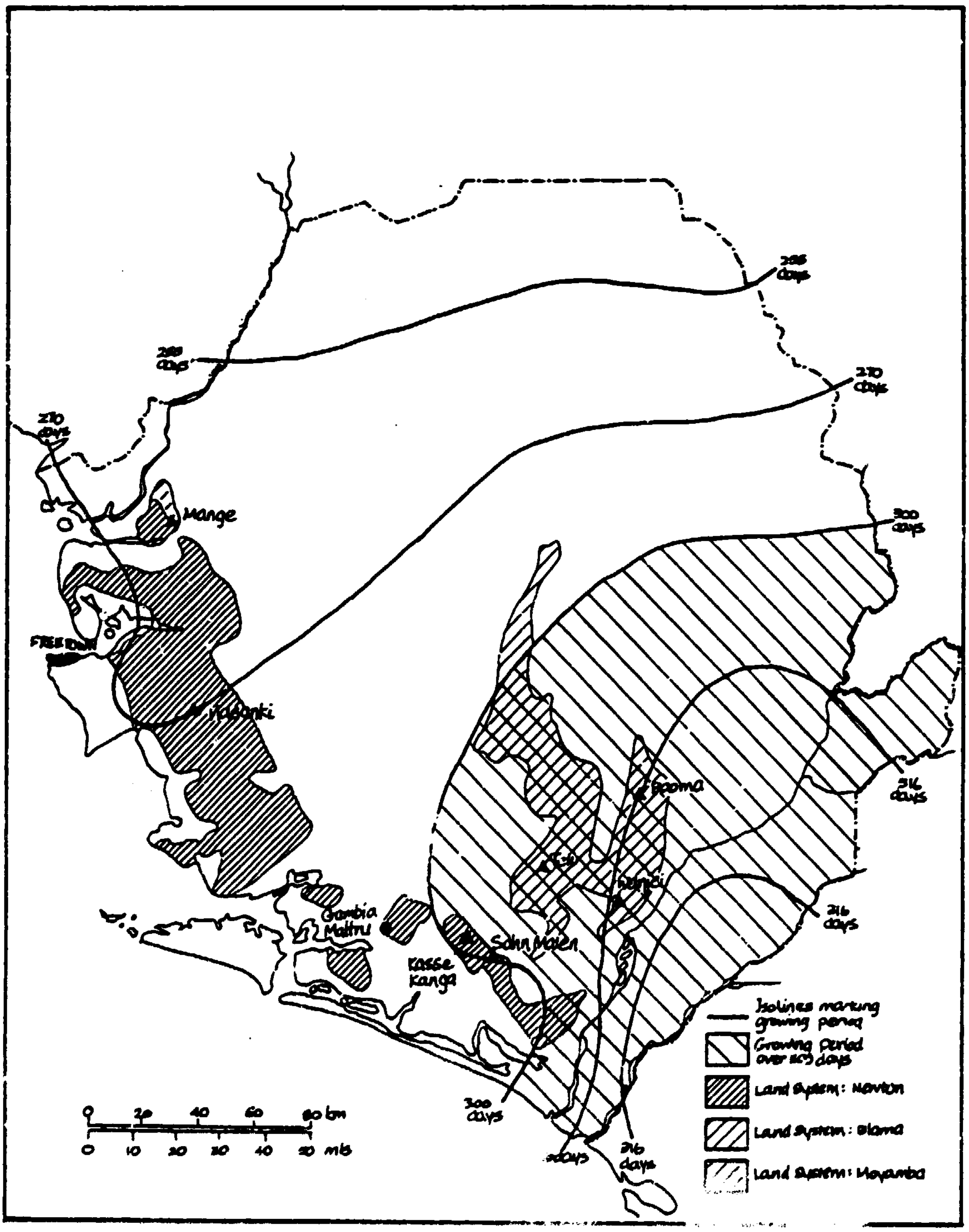

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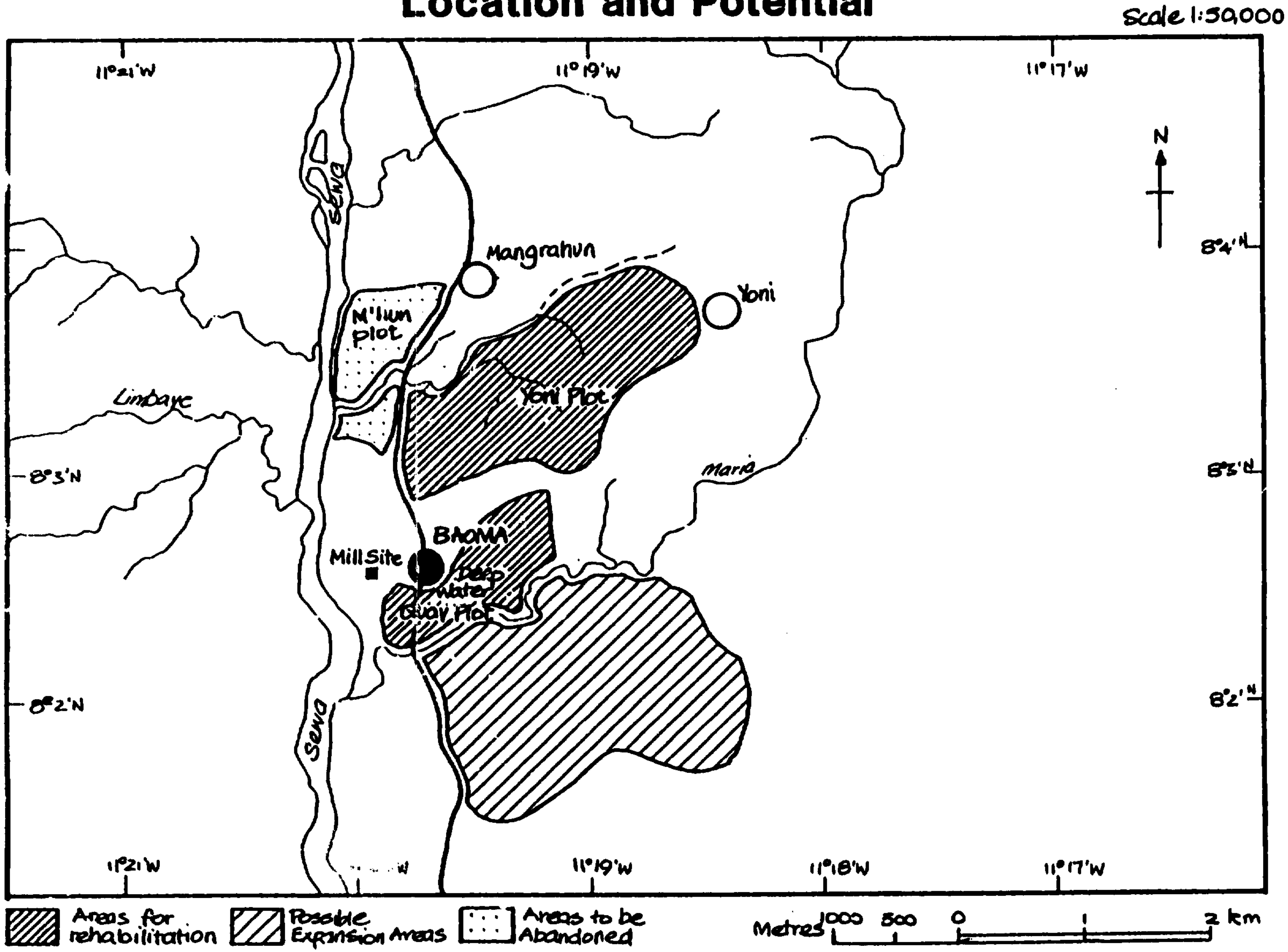

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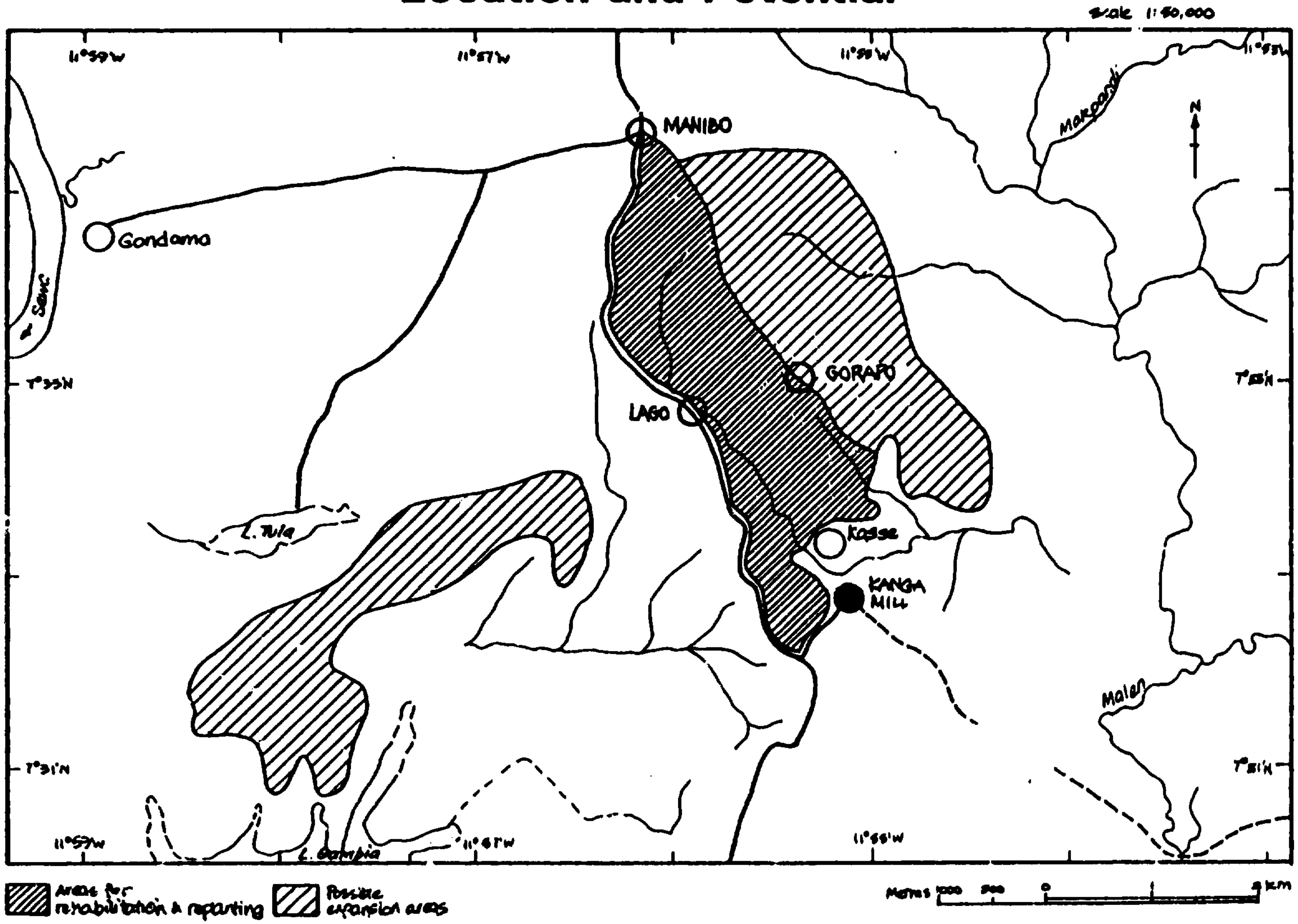

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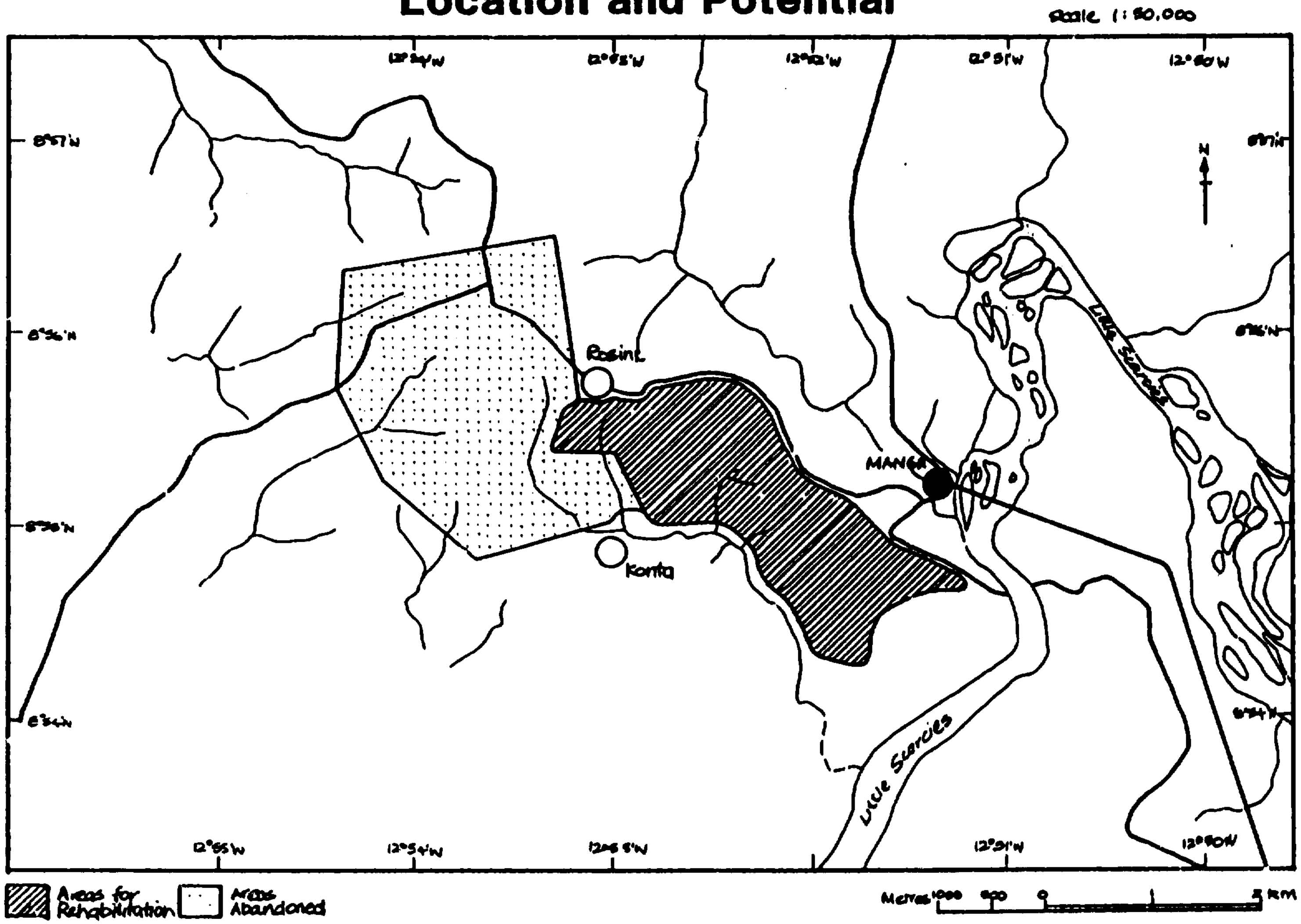

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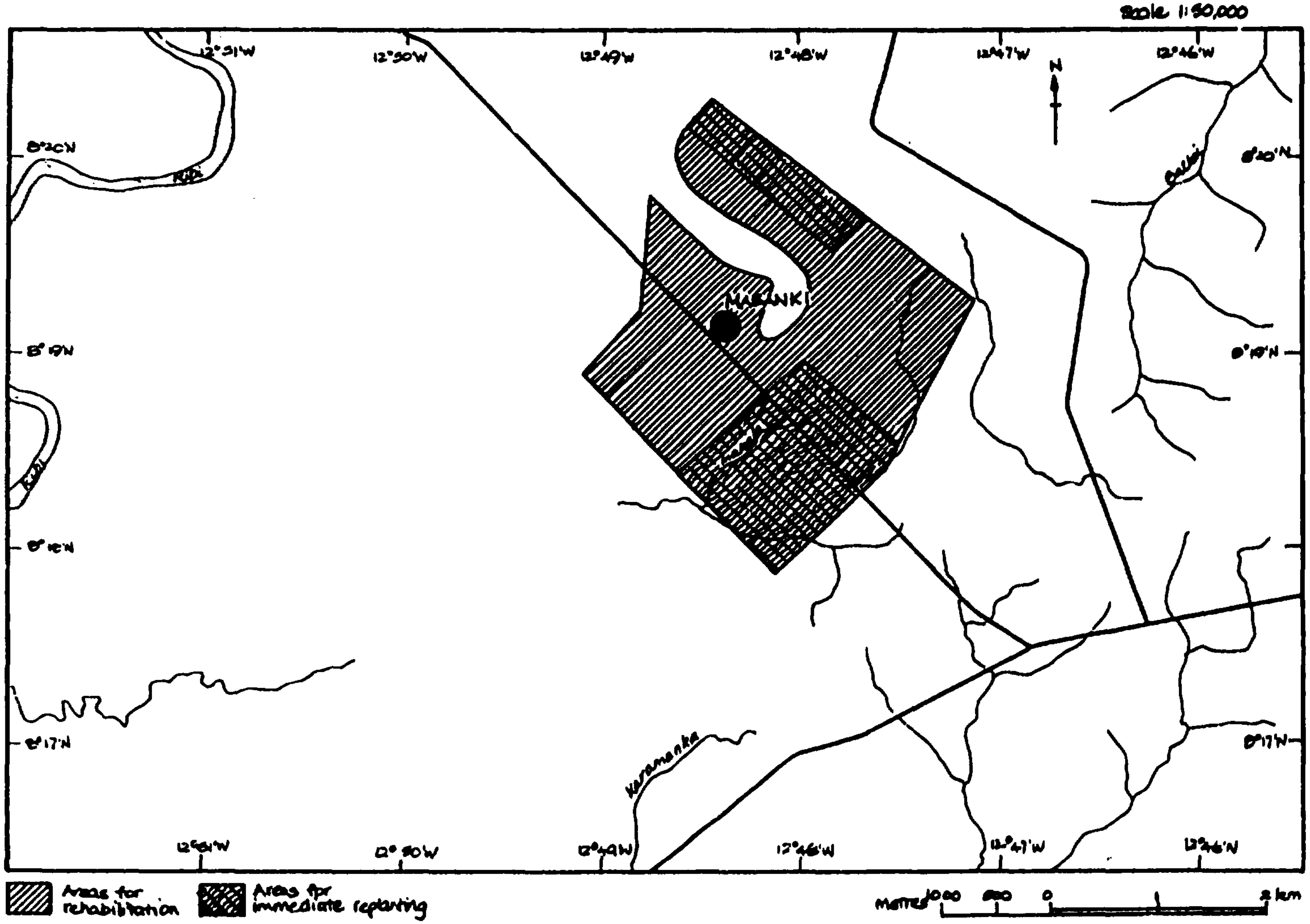

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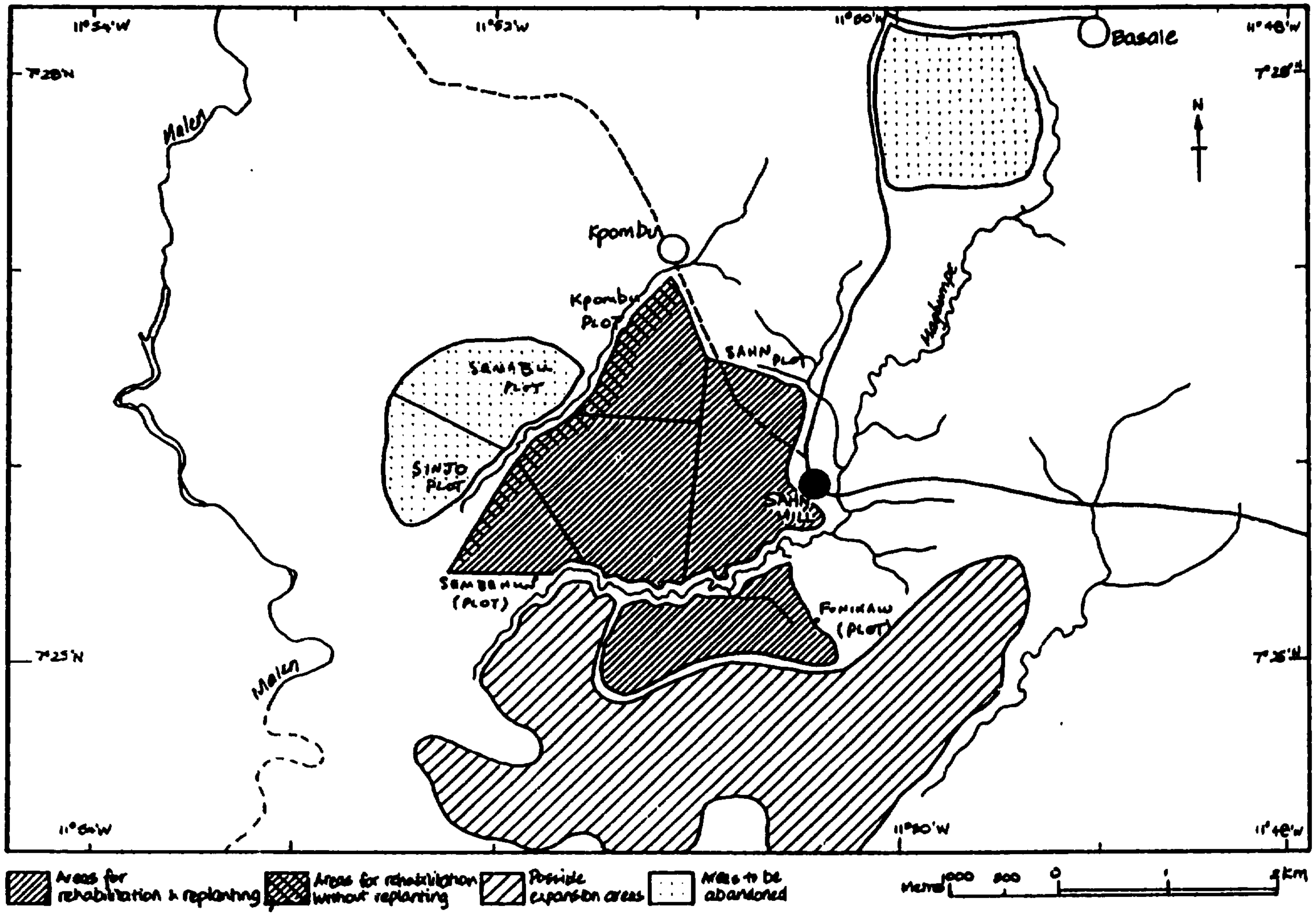

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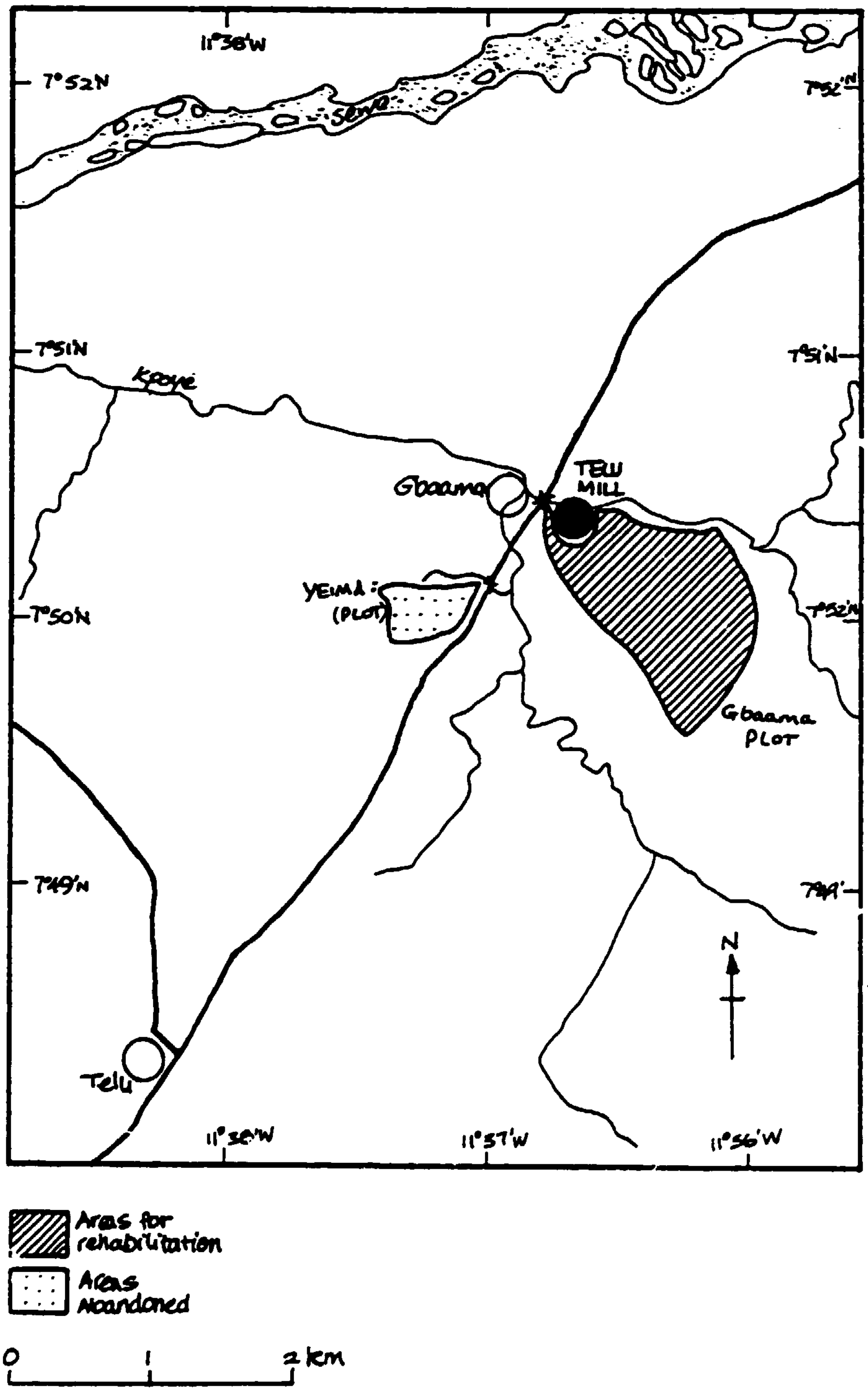

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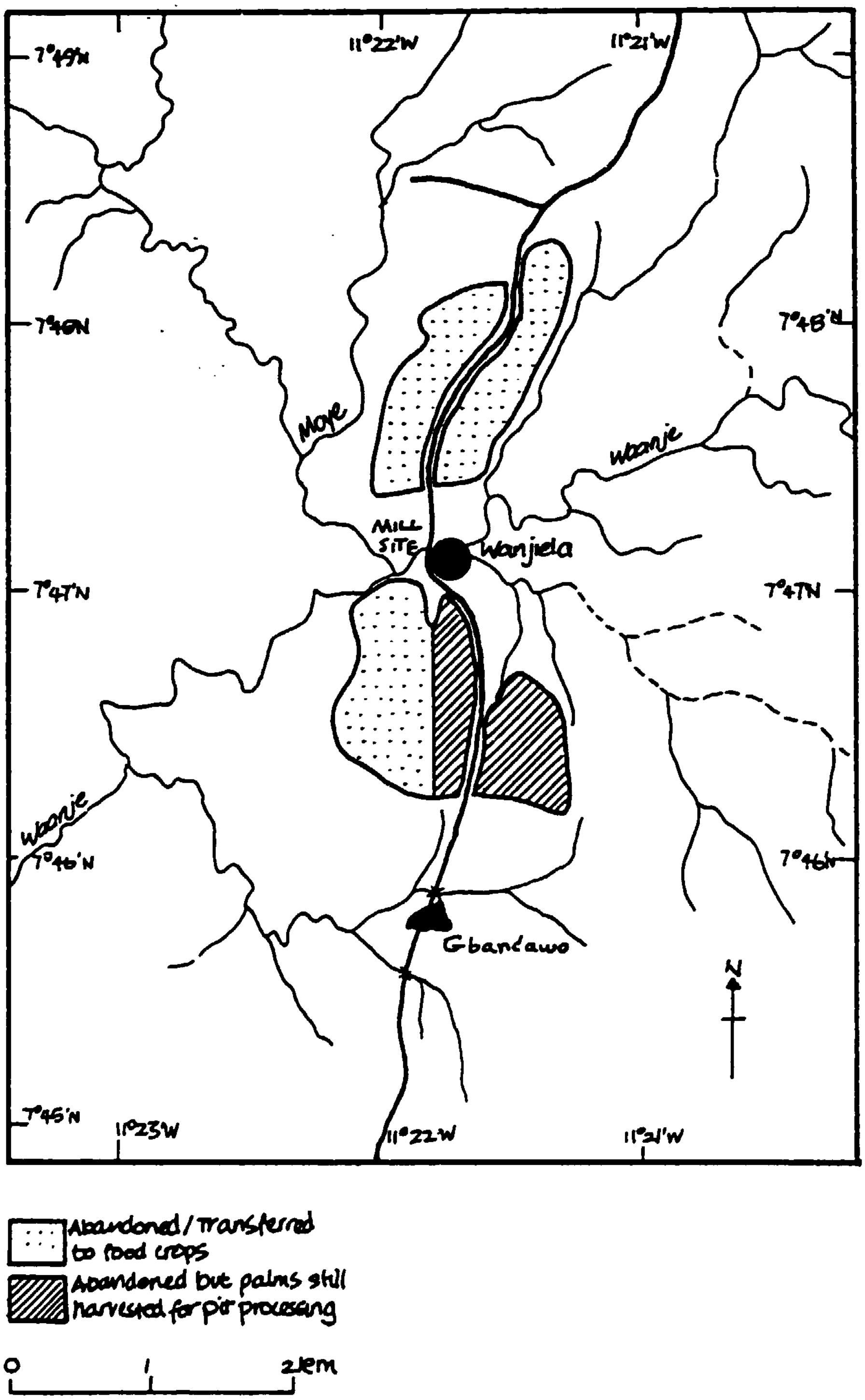

ANNEX 1 DETAILED ACCOUNT OF THE PLANTATIONS

A.1.1. Introduction

A.1.1.1. Background

Soil and crop surveys were conducted at 7 Pioneer mill estates to assess their suitability for oil palm development. Considerable background information is available from the Commonwealth Secretariat report (1986) and is not duplicated here.

Thanks are given to Lands and Water Division of MANR, Freetown, especially Mr. J. J. Abu Bocari, for assistance given during the fieldwork and for the loan of equipment.

The fieldwork on each plantation was limited by the time available (1 to 1.5 days on each) so that only those factors thought critical for selection and that could be collected in the time available were used.

1) The fieldwork aimed to supply an indication of the best, medium and worst locations for rehabilitation.

2) Within each plantation it is only possible to broadly indicate specific areas suitable for rehabilitation, and/or replanting, or to be abandoned completely. The relevant areas are shown on the maps of each plantation.

3) Expansion areas indicated are only based on data collected for rehabilitation and from basic topographical interpretation.

4) Yields estimated for new planting areas assume that soils adjacent to, or in the same land system, (defined by FAO/UNDP, 1980) are similar to the ones identified in the plantations themselves and from which yields are based.

It is clear that some further studies will be required in areas selected for development along the lines indicated below.

1) More specific identification within plantations chosen for rehabilitation of areas most suitable for replanting. This may mean some soil analysis but could be done fairly accurately on the basis of yield information collected during rehabilitation.

2) Depending on the size of any new expansion area, further soil studies would be necessary to identify the most suitable areas and assess their potential for development.

3) Areas for immediate replanting may require more specific demarcation of the most suitable soils than is given in this report but it is noted that large areas of uniformally 'good' soils are rare and in any large planting some marginal areas would be included.

A.1.1.2. Methods of Investigation

An agronomic classification (as devised by Olvin, 1968) is made for the soils on each estate. Soils are classed in a range I-IV and with climatic data are used to assess FFB yields for rehabilitation, replanting and expansion in each area. The basic data collected was:

a) Soils - texture, quantity of gravel in the profile, drainage characteristics and chemical composition.
b) Crop - palm height, planting date and history of maintenance for each area identified (unfortunately no useful record of yield, inputs or man-days has been kept for any estate).

From height and maintenance data the vegetative growth of palms is broadly assessed and, together with soil and climatic data potential palm yields for each area are estimated.

Initially auger bores were taken with a Jarret Auger and broad soil associations were identified in relation to the landform and vegetation (i.e. growth of oil palm) of the area. Soil pits were then located to cover the major associations. These were spaced at about 1 pit per 250 acres and dug to 1 meter. Soil samples were taken at 2 depths, 0-15 or 20cm and at about 75cm. The samples were analysed by Reading Soil Services for:

1) Extractable nutrients - Phosphorus (P), Potassium (K), Magnesium (Mg), and Calcium (Ca)
2) pH (H_2O)
3) Carbon (C) % (estimates organic matter (O.M.) = 58% C)
4) Finger assessment of soil texture

A.1.1.3. Previous Land Suitability Studies

a) Land Resources Survey Project FAO/UNDP (1980). Conducted in 1978, it classified land suitable for several crops based on surveys made at reconnaissance level. Oil palm was not classified at this time. Within this survey a thematic map was drawn up defining land systems by geological formation with basic descriptions of typical soils and vegetation associated with each system.
b) Land suitability for oil palm in Sierra Leone, 1982. Prepared by Cusani-Visconti, a member of the FAO/UNDP team that prepared the above report. Again, a very broad study at reconnaissance level using basically climatic data to define the areas suited to oil palm.
c) Dijkerman J. L. was Senior Lecturer in the Soils Department at Njala University between 1965-67. From Wageningen University, he prepared a soil province map for Sierra Leone and described the major kinds of soil.

A.1.1.4. Land Suitability: Climate

Cusani-Visconti (FAO, 1982) gave a broad outline of the most favourable areas for oil palm. He uses duration of growing period as a criteria and suggests that areas with a growing period of 300 days or more are suitable. A growing day is defined where rainfall exceeds evapotranspiration, making allowance for stored soil moisture. This includes Baoma, Telu, Wanjei, Sahn and Kasse. Mange Bureh, Masanki and Waterloo are outside the range of 250 and 270 growing days respectively. Map 1 shows the most suitable area for oil palm using this criteria.

Although no climatic data are available specific to the Pioneer mill sites, it is clear that because of the marked dry season experienced in the country, palms experience a period of water deficit every year that directly affects potential yield.

Water deficits have also been calculated for various locations in the country. The 'ata appears somewhat uneven but shows water deficits decreasing the further south and east one goes in the country.

At Daru in the east, average water deficit is calculated at 270mm per annum, at Bo 350mm per annum and Gambia Mattru 300mm (Hartley, 1979). Data from the 1970's suggest the figure for Gambia may be higher at 350mm. The following data is presented for the Sahn and Kasse area. Annual rainfall averages 3540mm. (Sumbuya is 10 miles north and Torma Bum 15 miles south of the Sahn/Kasse location).

Mean Monthly Rainfall (mm) for Sumbuya and Torma Bum

J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
17	14	40	114	270	452	578	555	660	429	287	56	3373
17	26	50	127	281	532	713	776	579	361	196	47	3706

Source: Meteorological Dept. Freetown

The following table shows average monthly evapotranspiration typical for the south eastern part of Sierra Leone.

Evapotranspiration (mm/month)

J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
113	118	134	126	119	103	94	93	97	110	105	106	1318

Source: Commonwealth Secretariat (1986).

From this data, the Kasse and Sahn area has an annual water deficit around 300mm. No meteorological data has been prepared specifically for the other Pioneer mill sites but the table below gives water deficits assumed for each location:

Plantation	Water Deficit (mm)
Baoma	285
Wanjei	285
Telu	300
Masanki/Waterloo	350
Mange Bureh	400

The larger the water deficit, the lower the potential yield of oil palm. However, these estimates do not take into consideration the available water capacity (AWC) of the soil. AWC is defined as the volume of water retained between field capacity and permanent wilting point. Some of this water is available to palms over the dry season, the amount varies between soils. No measurements of AWC specific to soils planted to oil palm in Sierra Leone are available, so an amount of 100mm of water in the top 1-1.2 meters has been estimated taking into considerations the soils encountered on the plantations visited.

Factors that affect AWC include:
1) Plant species and its rooting depth,
2) Soil texture, and
3) Stone and gravel content of the soil.

Oil palm are surface feeders and the majority of their roots are normally found at 15-30cm and the top 1 meter of soil is the most important. Roots can penetrate deeper, especially in search of water. Gravel is virtually inert to plant roots and in large quantities reduces the volume of useful soil that roots can exploit. For surface feeders this is especially important. Also, sandy, gravelly soils tend to dry out faster (presence of a water table near the surface alters this) an important factor in the Sierra Leone dry season. Gravel impedes the growth of roots, especially if it is cemented to any degree.

A.1.1.5. Land Suitability - Geology, Topography and Soils

Sahn Malen, Kasse Kangha, Masanki and Waterloo are all located on the tertiary sediments dating from the continental terminal. In Sierra Leone they occupy about a 50 mile wide strip going inland all the way along the coast. The sediments have different names in different countries; in Benin 'terre de barre'; in Ivory Coast 'tertiary sands' and in Nigeria and Cameroon 'acid sands'. Their altitude varies from 50 to 300 feet, topography is flat to gently undulating with few slopes over 10%. The predominant soils formed (with a rainfall of 2000mm or more) in these areas are classified (French) Sols ferrallitiques fortement desature (SFFD) and lower horizons as SFFD Typique appauvri (T/app) (Nguyen Hugo Van et al., 1984). They are generally fairly good for oil palm.

All the above plantations are located on the Newton Land System defined by FAO/UNDP, 1980, as an area of dissected coastal terraces of extremely low relief, on Pleistocene sandy and clayey sediments (see map 1 for locations). The Newton L.S. is one of several land systems within the tertiary sedimentary belt. Soils associated with this land system tend to be deep, yellowish brown to brown sandy clay loams with sandy surface horizons. The nature of the soils and thus suitability for oil palm tends to depend on their position in the toposequence.

2 of

Baoma, Telu, Wanjei and parts of the Mange plantation are located on basement complex rocks, mostly acid gneisses and granite. These rocks rise inland after the tertiary belt, their altitude varying between 50 and 650 feet, topography can be fairly steep. However, all the plantations are located on gently undulating interfluves of about 900 to 1400 meters wide but some more dissected areas are usually included. Interfluves tend to be more dissected, making plantation layout more difficult than on the tertiary sediments.

Soils of the base also tend to be more variable than the sediments. Baoma, Telu and Wenjei are in the Blama L.S. (FAO/UNDP 1980) described as 'dissected plains of extremely low relief with scattered, isolated small hills and common terraces'. Soils tend to be very gravelly, reddish clay loams to clays, the surface horizon is generally more sandy because of the heavy rainfall which washes part of the clay fraction to lower horizons.

I.R.H.O. (Nguyen Hugo Van et al., 1984) distinguish four Land Use Classes (LUC's) on the base. The class depends on the proportions of clay textured particles, lateritic gravel and pieces of rock or indurated laterite in the soil horizons. Most of the soils at Baoma, Telu and Wanjei are in LUC 3 (medium soils) and the proportion of gravel is about 30% in the top meter. LUC 3 is classified as marginally suitable for oil palm. Some planted areas have gravel contents (Baoma) or indurated laterite (Wanjei) or show signs of hydromorphism (Telu) and are in LUC 4 (poor soils). These areas should be abandoned. Some areas may be in LUC 2 (good soils) such as areas at Baoma, Wanjei and at Mange. These areas have little gravel in the top meter of soil and are more suitable for oil palm development, though limited in extent.

From this brief review, suitable areas for oil palm development exist in both land systems where the plantations are located but soils on the base and Blama LS tend to be more variable and the land more dissected than the tertiary sedimentary area. This makes finding uniformally good areas and rational layout of large blocks of oil palm more difficult.

Combining climatic and geological/soils information, as in Map 1, shows Mange and Masanki outside the most suitable climatic area. Baoma, Wanjei and Telu are well within the climatic area but soils may be less favourable. Sahn and Kasse are on the boarder of the best climatic region and are also within the better soils of the tertiary sedimentary belt so are marginally the best located of the Pioneer mill estates.

A.1.2. Fieldwork Results

A.1.2.1. Baoma

Location. The plantation is situated around Baoma village, 11 miles north of Blama junction in Baoma Chiefdom. Longitude 11 20' West and Latitude 8 03' North (map 2).

General Description. The plantation is in 3 plots - Megalahun, Yoni and Deep Water Quay. Total area is 800 acres. Age of palms 20-21 years.

Hydrology. The River Sewa flows along the western border of the plantation but is well contained within steep sided banks. The plantation is drained by a network of minor streams with swampy margins leading to the Sewa.

Vegetation and Land Use. Around the plantation the original forest has given way to secondary forest with patches of shifting cultivation (upland rice) and paddy rice in low-lying areas.

Soils. (Blama LS). Three soil associations were identified, two of these were identified by their position in the toposequence. The largest areas for oil palm are the hill crest and gentle slope areas. These are similar but gravel increases in the topsoil on the slopes. On the southern border, the slopes down to the River Maria are steeper (7%) and the area is more dissected. Here, the foot slopes have accumulated a gravel free colluvial layer to depths of 50cm. Soils are better and palms are larger but the area is relatively small in extent. Thirdly, small gravel free alluvial areas exist along the banks of the Sewa, these can be very productive. One near the mill site was used as the estate nursery.

Soil Data

Pit 1

i) General

Location:	750 meters southwest Mangrahun village 9/10/86
Land Form:	dissected interfluve
Elevation:	450 feet
Position:	upper slope
Max. slope:	4% (part down to Sewa > 7% in places)
Parent material:	gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm with 15 years undergrowth
Root Layer:	1st and 2nd horizons but oil palm roots seen in 4th; high gravel content but gravel is well mixed with the soil rather than cemented, means roots are able to penetrate more easily.

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	gr. SCL, 0-10% gravel; friable; some surface laterite
15 - 25	gr. SCL, 10-30% gravel
25 - 55	gr. SCL, 30% gravel
55 - 90	very gr. SCL, 30-50% gravel

Pit 2

i) General

Location:	500 meters west of Yoni village 9/10/86
Land Form:	dissected interfluve
Elevation:	400-45 feet
Position:	crest
Max. slope:	1%
Parent Material:	gravel free colluvium over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm with
Root Layer:	1st and 2nd horizons some medium in 3rd and 4th

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	SL/SCL
15 - 50	gr. SCL, 10% gravel
50 - 65	gr. SCL, 10-30% gravel
65 - 100	gr. SCL, >30% gravel

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH (1:5H_2O)	Organic C (%)	Extractable Nutrients (mg/lit) K	MG	Ca	Bray P (ppm)
0-15	SL/SCL	4.70	2.74	17	6	23	1
65-100	gr.SCL	4.85	-	6	<3	<10	<1

Pit 3

i) General

Location:	300 meters west mill 9/10/86
Land Form:	dissected interfluve
Elevation:	400-450 feet
Position:	crest
Max. slope:	2%
Parent Material:	gravel free colluvium over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm (many missing) herbaceous undergrowth
Root Layer:	1 and 2 some fine and medium in 3 and 4

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	SL/SCL
20 - 40	gr.SCL, 10-20% gravel
40 - 80	gr. SCL, 20-40% gravel some large stones
80 - 90	very gr. SCL, 50% gravel

Crop Data The following data compares palm height with estimated planting date for the three plots at Baoma.

Plot	Palm Ht.(feet)	Planting Date
Mangrahun	11-15	1966
Yoni	18-22	1965
Deep Water Quay	11-20	1965

Plantation maintenance ceased soon after planting and has only been revived recently. Yoni plot and parts of Deep Water Quay were brushed about 3-4 years ago. Although palms are generally small for their age, this is probably partly due to the poor management history.

Map 2 shows the areas recommended for rehabilitation or to be abandoned. Deep Water Quay plot has many missing palms and though some areas are too gravelly and should be abandoned, parts of the plot can be rehabilitated. Mangrahun plot is very gravelly and steep in places - it can be abandoned. Yoni plot is much less gravelly, generally in the top meter of soil, the plot is flatter and the palms were the best seen at Baoma. It is recommended that this area is best for rehabilitation.

A.1.2.2. Kasse Kangha

Location. The plantation is located in southern Sierra Leone, longitude 11 50' west and latitude 7 33' north. The estate is in one block stretching along the road between Kasse in the south and Manibo in the north (see map 2). Bo is 3 hours by road via Sumbuya and Koribundu. The road is poor but motorable all year round.

General Description. The plantation is in Bagbo Chiefdom and the mill is just over the border to the south in Bum Chiefdom. Total area of 1100 acres. A small area is swampy and not planted. Age of palms is 20-23 years, with few missing palms. Estate can be divided into 4 plots named Gorapo (north east), Tengbele (north west), Kasse (south east) and Yesa (south west) after the nearest village to each.

Hydrology. There are no large rivers or streams near the plantation. A small stream, the Tangwi, runs the length of the plantation with associated swampy margin. This area virtually dries up during the dry season and is not planted.

Topography. Flat to gently undulating. The northern half of the plantation is flatter while further south towards Kasse, the land becomes more dissected.

Soils. (Newton LS). The clay content of these soils is low though on flattened hill crests soils tend to have higher clay contents than slopes and can be more productive. However, soils are more sandy than derivatives of basement complex rocks further north.

On the tertiary sands, the nature of the soils depends on their position in the toposequence. Two main areas were identified:

1) Flattened interfluve crests and upper slope areas, and
2) Sloping, more dissected areas with higher gravel contents in the top horizons going down towards the drainage streams.

Valley bottoms are swampy and not planted to oil palm and foot slope areas only cover a very minor area.

Pits 1 and 3 represent the second and pits 2 and 4 represent the first landform. Pit 4 is on the border with both.

Pit 1

i) General

Location:	400 meters north of Kasse village 8/10/86
Land Form:	Flat to undulating interfluve, 75 ft. elevation
Position:	middle slope
Max. slope:	1%
Parent Material:	gravel free colluvium over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm with about 18 months underbush
Root Layer:	1 and 2 horizons, some fine and medium in 3

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	sandy loam, friable
15 - 25	sandy loam, gravel 0-10%
25 - 40	sandy clay loam, gravel 10-30%
40 - 60	sandy clay loam, very gravelly 30%

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH ($1:5H_2O$)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-25	SL/LS	4.95	1.95	18	12	123	1
40-85	gr.SCL	4.7	-	4	<3	23	<1

Pit 2

i) General

Location:	800 meters north west Gorapo village 8/10/86
Land Form:	gently undulating interfluve, elevation 100 ft
Position:	crest
Max. slope:	1%
Parent Material:	gravel free colluvium
Drainage:	well drained
Vegetation:	oil palm and 2 years mixed undergrowth
Root Layer:	2 and 3 horizons

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	sandy clay loam, friable
20 - 35	sandy clay loam
35 - 60	sandy clay loam, patches of transported gravel, few 0-10%
60 - 100	sandy clay loam to clay loam

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH ($1:5H_2O$)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-35	S	4.75	0.73	< 7	< 3	15	< 1
60-100	SCL	4.75	-	< 3	< 3	< 10	< 1

Pit 3

i) General

Location:	500 m south east Lago Village, 8/10/86
Land Form:	interfluve, elevation - 75 ft.
Position:	middle slope
Max. slope:	2%
Parent Material:	gravel free colluvium over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm 12 months undergrowth
Root Layer:	1 and 2 horizons

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	sandy loam, very friable when moist
20 - 30	sandy clay loam, 0-10% gravel
30 - 60	sandy clay loam, very gravelly 30-50%, some large stones
60 - 100	sandy clay loam, very gravelly, 50%, some large stones (cemented laterite)

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH (1:5$H_2$0)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-20	LS/SL	4.80	2.08	23	16	75	2
60-100	vgr.SCL	4.85	-	5	<3	15	<1

Pit 4

i) General

Location:	150m south Manibo village 8/10/86
Land Form:	flat interfluve crest, elevation - 100 feet
Position:	crest/upper slope
Max. slope:	1%
Parent Material:	slightly gr. colluvium over gr. colluvium
Drainage:	well drained
Vegetation:	oil palm, last brushed 18 months ago
Root Layer:	2 and 3 horizons

ii) Soil Profile

Depth (cm)	Field Description
0 - 20	SL, friable
20 - 35	SCL, patches of gravel
35 - 55	SCL, gravel free
55 - 75	gr. SCL, 30% gravel

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH (1:5$H_2$0)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-20	LS	4.85	1.27	13	4	56	1
50-75	vgr.S/LS	4.90	-	5	<3	15	1

Crop Data. The following table compares palm height with planting date for the areas identified.

Plot	Palm Ht. (feet)	Planting Date
Gorapo	30	1966
Kasse	25	1965
Yesa	25	1964
Tengbele	33	1966

Compared to most of the other Pioneer mill plantations, Kasse palms are well grown with an average height of about 28 feet. Most of the plantation has been brushed in the last 18 months and is being harvested.

The fieldwork showed that on the crest areas and upper slopes the gravel free horizon varied from about 75 to 20cm. The more dissected southern half had a much thinner gravel free zone with dense gravel below the surface in places. This is reflected in the palm heights. Majority of the area is crest or upper slope area. Estimated proportions of each area are given in the conclusions (section 1.5 and map 3). The whole area is recommended for rehabilitation though on replanting some of the southern area can be abandoned, estimated at 100 acres.

A.1.2.3. Mange Bureh

Location: The plantation is located in north west Sierra Leone in Mambolo Chiefdom. Longitude 12 51' west and latitude 8 55' north. Freetown is about 2 hours drive. The road is good.

General Description. Total area of the estate is 3167 acres but about 2272 acres were abandoned many years ago and have returned to secondary bush. Parts have been cut down to grown annual crops and some of the palms are still harvested for pit processing. The abandoned palms are 26-31 years old. The rest of the estate, 895 acres and 19-24 years old, are maintained and harvested for the mill. There are many missing palms and effective acres harvested are less.

The estate stretches along south of the road from Mange town to Rosint village (see map 3). For purposes of description, the abandoned area is called Rosint plot and the maintained area, Mange plot.

Hydrology. The Little Scarcies runs close to the eastern border. A stream with several small tributaries drains into the river from the plantation, mainly from Mange plot. It has swampy margins but dries up during the dry season. Mange plot is flatter and less well drained than Rosint and has several swampy areas.

Topography. The area is very gravelly and undulating. Typically, slope and crest areas dry our more quickly than lower-lying areas in the dry season. This was clear from the differences in palm growth between high and low areas. On the eastern side of the plantation, around Mange, land is flatter with wider plantable interfluves.

Soils.(Soil descriptions are based on auger sampling and visual assessment only). The pattern of soils in the Mange area is fairly complex as several land systems meet in the area. Mange plot, in the east, has fairly deep gravel-free soils with a relatively high clay content. From observations, water holding capacity may be better than Rosint (more clay/less gravel) so ameliorating the dry season. Further west the estate becomes more dissected with steeper slope areas. Soils become very gravelly and more sandy in the surface horizons. There are patches of better soils in lower-lying folds of the land but these areas are small.

ANNEX 1

Auger 1

i) General

Location:	1 mile west Mange village 2/10/86
Land Form:	dissected interfluve, 100 feet elevation
Position:	crest
Max. slope:	1%
Parent Material:	gravel free colluvium over gravel colluvium
Drainage:	moderately well drained
Vegetation:	oil palm with elephant grass
Root Layer:	1 and 2 horizons some fine in 3

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	SCL, dark coloured with organic matter
20 - 35	SCL
35 - 60	CL, clay sticky at 40-60
60 - 100	gr. CL (laterite)

Auger 2

i) General

Location:	400 meters west,south west of Rosint 2/10/86
Land Form:	dissected interfluve, elevation 100 feet
Position:	upper slope
Max. slope:	3%
Parent Material:	gravel colluvium
Drainage:	well drained
Vegetation:	oil palm with secondary bush
Root Layer:	1st horizon

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	gr. SL/SCL
20 - >	v gr. SCL

NB. Gravel layer became too dense for the auger below about 20 cm. Soil profiles exposed along the plantation tracks, the gravelly SCL continuing downwards.

Crop Data. Palm height was very variable throughout the plantation with an average height about 15-22 ft. In many areas the palm leaf canopy was very thin. Undergrowth is not shaded, thus increasing maintenance. Many areas are heavily infested with elephant grass (Mange is close to the savanna belt). Grasses compete with the palm for nutrients and also present a fire hazard in the dry season.

Most of the Mange plot is recommended for rehabilitation (see map 4) though the south western end becomes more gravelly. Rosint plot should be left abandoned as it is too gravelly and variable. Most of Mange plot soils are rated as LUC 2 i.e. good soils and although they may reduce the severity of the dry season, the very high water deficit for the area means potential yield would be lower than oil palm on worse soils in the south east.

A.1.2.4. Masanki

Location. Masanki plantation is in the western part of Sierra Leone in Ribbi Chiefdom. Longitude 12 48' west and latitude 8 19' north. It used to be approached from Freetown via a bridge or ferry over the River Ribi. This is not possible now and it is necessary to travel via Magbosi village on the Bo road then Bauya and Masanki. From Freetown this is a 4 hour trip and the road between Magbosi and Masanki is poor.

General Description. Masanki is operated by the Prisons Department. Management by the Prison Wardens is fairly well organised using prisoners for maintenance work and hired labour for the more skilled jobs of harvesting and pruning. Plantation area is 1750 acres with palms from 26-31 years old. About a quarter of the area is abandoned, the rest is still maintained and harvested but at a low level.

Topography. The estate is very flat except in the north east. Depressions are usually swampy and some flat areas are poorly drained.

Soils. Soil decription is based on auger samples and field observations only. The upland areas where the Masanki palms have been planted are basically well to moderately well drained soils, gravel free over more gravelly subsoils with sandy loam and sandy clay loam textures. Soils are similar to Kasse Kangha (Newton LS) though more sandy.

Auger 1
i) General

Location:	2000 meters north of mill 3/10/86
Land Form:	dissected interfluve
Position:	crest
Max. slope:	<1%
Parent Parent Material:	gravel free colluvium over gravelly colluvium
Drainage:	well drained
Vegetation:	smooth stemmed oil palm with 12 months undergrowth
Root Layer:	1 and 2, some fine in 3rd horizon

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	SL
15 - 55	SL/SCL
55 - 80	SCL
80 - 100	gr. SCL, 0-10% gr.

Auger 2

i) General

Location:	600 meters south west of auger 1 3/10/86
Land Form:	dissected interfluve
Position:	foot slope
Max. slope:	1%
Parent Material:	gravel free over gravelly colluvium
Drainage:	imperfect drainage
Vegetation:	oil palm with 12 months undergrowth
Root Layer:	coarse roots in 1st horizon

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	SL
20 - 40	SL/SCL
40 - 65	SCL, some 2mm coarse sand (quartz)
65 - 100	70 cm. coarse sandy fraction (quartz)

Auger 3

i) General

Location:	Half-way between auger 1 and 2 3/10/86
Land Form:	dissected interfluve
Position:	middle slope
Max. slope:	7% but slight depression inslope at this point
Parent Material:	gravel free over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm, 12 months undergrowth

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	SL
15 - 30	SL/SCL
30 - 60	SCL
60 - 80	gr. SCL/CL, 20% gravel

Conclusions: Around the mill, palms are over 50 years old and have been abandoned. Another area of old palms on the northern border is still harvested. They have become smooth stemmed and have reached a height of about 30 feet. There are many missing palms and the leaf canopy seems poorly developed. The area is recommended for replanting immediately.

Map 5 shows the areas potentially suitable for rehabilitation or replanting. Some of the land around the mill is liable to flooding in the wet season and should be abandoned. Crest areas dry out quickly and slopes have higher gravel contents near the surface. Foot slope areas have deeper gravel free soils and 26-30 year old palms are 30-40 feet tall.

A.1.2.5. Waterloo

The plantation is located on the main road leaving the Freetown Peninsular just west of Newton village at approximately longitude 13 02' west and latitude 8 20' North. Total area of about 1000 acres and 25-30 years old. Waterloo was also handed over to the Prisons Department and is still maintained by them. Any FFB produced is sold locally for pit processing as there is no mill to service the plantation.

The geology, topography and soils of Waterloo are basically the same as at Masanki. Soils are sandy and dry out fairly quickly in the dry season. Also, water deficits are high compared to the south east of the country, making yields low. However, yields are reported to be better than at Masanki.

As with Mange, the biggest problem is grass infestation. If the plantation were to be rehabilitated this problem would have to be dealt with using a combination of burning, then heavy applications of herbicide, followed by planting of cover crop. Palms are old but still harvestable as far as their height is concerned.

A.1.2.6. Sahn Malen

Location. The plantation is located around the village of Sahn in southern Sierra Leone in Malen Chiefdom (see map 6). Longitude - 11 50' west and latitude 7 26' north.

General Description. The plantation is in 8 blocks - Basale, Sahn, Kpombu, Masakpa, Semabu, Sinjo, Sembehun and Fonikaw. Total area of 1850 acres, though some dispute exists about the actual acreage. Basale, Sinjo and Semabu have been abandoned and are now virtually secondary bush. Parts of Basale have been cut down and planted to annual crops. Age of the plantation is 23-26 years. Sahn is 8 miles south east in a straight line from Kasse plantation.

Hydrology. No large rivers or streams run through the plantation. The Magbumpe runs south from Basale plot and then cuts across the plantation. Its course is swampy and a bridge used to connect Fonikaw with the rest of the estate. This no longer exists and the only way round is via the road to Pujehun, about 3 miles. Another stream runs along the NW border of Kpombu plot and then divides Semabu and Sinjo from the rest of the plantation. A causeway for tractors is usable if repaired.

Topography. The area is gently undulating interfluve but more hilly than at Kasse, especially Sinjo, Semabu and Basale plots. The majority of the planted area covers the crest formed by the 50 foot contour with slopes not exceeding 1-2%. Fonikaw is more low-lying, being below 50 feet and flat.

Soils Land system classification is Newton. Again, the nature of the soils depends on their position in the toposequence. The soils on the hill crest areas (the largest area planted) are gravel-free, sandy loam (15-20cm) over gravelly, sandy clay loam subsoils. These give way to more gravelly variants as the land falls away to the streams. The valley bottoms, before the swampy stream areas, have deep gravel free soils though often with some mottling usually below 1 meter.

Soil Data

Pit 1

i) General

Location:	300 meters north west Sahn village 7/10/86
Land Form:	dissected interfluve, 50 feet elevation
Position:	crest
Max. slope:	1%
Parent Material:	gravel free colluvium over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm and 18 months underbrush
Root Layer:	2nd horizon

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	SL, friable when moist
20 - 45	SCL
45 - 85	gr. SCL, 10% gravel

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH ($1:5H_2O$)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-10	SL/SCL	5.00	2.96	33	49	385	1
42-80	gr.SCL	4.90	-	15	6	63	<1

Pit 2

i) General

Location:	300 meters south west Kpombu village 7/10/86
Land Form:	dissected interfluve 50 feet elevation
Position:	middle slope
Max. slope:	2%
Parent Material:	gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm with 6 months undergrowth
Root Layer:	1 and 2 horizons, fine roots in 3

ANNEX 1

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 10	gr. SCL 0-10% gravel
10 - 40	gr. SCL 10-30% gravel
40 - 80	gr. SCL >50% gravel

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH (1:5$H_2$0)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-20	SL	4.65	1.20	10	3	15	<1
45-85	gr.SL/SCL	4.80	-	7	<3	30	<1

Pit 3

i) General

Location:	1200 meters east of Sahn mill 7/10/86
Land Form:	gently undulating interfluve 50 feet elevation
Position:	crest
Max. slope:	1%
Parent Material:	gravel free over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm with 18 months undergrowth
Root Layer:	2nd horizon

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	SL
15 - 30	gr. SCL, 0-10% fine gravel
30 - 50	gr. SCL, 10-30% medium gravel
50 - 100	very gr. SCL, 30-50% coarse gravel

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH (1:5$H_2$0)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-15	SL	4.70	1.58	19	11	65	< 1
50-70	gr.SL	4.80	-	6	< 3	<10	< 1

Pit 4

i) General

Location:	500 meters north west Sinjo village 7/10/86
Land Form:	undulating dissected interfluve, 50ft. elevation
Position:	upper slope
Max. slope:	5%
Parent Material:	gr. colluvium
Drainage:	well drained
Vegetation:	oil palm and secondary bush 20 yrs.
Root Layer:	1st horizon decreasing rapidly with depth

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 5	gr. SL, 0-10% gravel
5 - 30	gr. SCL, 10-30% gravel
30 - 70	gr. SCL, 30-50% gravel
70 - 100	very gr. SCL, >50%

Pit 5

i) General

Location:	800 meters west Fonikaw village 7/10/86
Land Form:	gently undulating interfluve
Elevation:	50 feet
Position:	middle slope
Max. slope:	1%
Parent Material:	gravel free over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm with 18 months undergrowth
Root Layer:	coarse in 2, fine and medium in 1 and 3

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	SL, very friable
15 - 25	SCL
25 - 40	gr. SCL, 0-10% gravel
40 - 100	gr. SCL, 10-30% gravel

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH ($1:5H_2O$)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-25	SL	4.95	1.10	9	4	25	<1
40-80	gr.SCL	4.90	-	4	<3	20	<1

Basale Plot

An auger sample was taken only. The area has been abandoned and parts of the plot have been cut down for annual crop cultivation by local landowners. This area is more hilly, with elevations of 100-150 feet and is within a different land system - Bo, which is more gravelly than Newton LS and described by FAO, 1980, as very gravelly, sandy clay loams to clays, brownish to reddish, moderately shallow to deep soils.

Geologically the area is within the granite basement complex rocks area - acid gneiss and schist forming lateritic type soils.

Augering was done on a crest area in a now cultivated part of the original plantation. Crops growing were rice, cassava, sorghum and a few sparsely scattered oil palm.

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 10	SCL, some gravel
10 - 30	gr. SCL, 0-10% gravel
30 - 70	gr. SCL, 10-30% gravel
>70	very gr. SCL 50% gravel

N.B.Clay and gravel increases with depth. Despite the high gravel content most of the profile was augerable. Some evidence of the lateritic gravel being weathered but loose gravel well mixed with sand/clay fraction.

Crop Data. The following table shows height of palms and estimated planting dates for each plot

Plot	Palm Height (feet)	Planting Date
Masakpa	30-35	1960
Fonikaw	30-35	1961
Sahn	30	1961
Kbombu	18-22	1962
Sembehun	25-30	1962
Semabu	10-15	1963
Sinjo	10-15	1963
Basale	10-15	1963

Some of the palms in the valley bottoms reach heights nearer 40 feet, especially in Masakpa plot. The whole area, except Basale, Sinjo and Semabu plots, has been brushed and harvested within the last 2-3 years.

Conclusions Map 6 shows the areas suitable for rehabilitation and abandonment.

Part of Kpombu plot and the area along the stream separating Sinjo and Semabu plot from the rest can be rehabilitated but abandoned on replanting because of the rather high gravel content. Many of the palms are becoming very tall, especially in Masakpa plot. Harvesting can still carry on for several years with the traditional harvesting technique of palm climbing.

A.1.2.7. Telu

Location 3 miles NE of Telu village located near Gbaama village in southern Sierra Leone in Jaiama/Bongor Chiefdom. Longitude 11 37' west and latitude 7 50' north (see map 7).

ANNEX 1

General Description The plantation is in 2 blocks - Gbaama plot immediately adjacent to the mill and Yeima plot on the opposite side of the road. A third plot, west of Hegbema village, was included in the original lease but never planted. Yeima plot has been abandoned and the rest of the plantation has not been maintained for at least 8 years. Total planted acres amount to 170 acres and the total leased is 242 acres. Age of palms is 23-26 years.

Associated with the estate are smallholders. Between them they own about 1,000 acres of planted oil palm. Some areas have been planted in the last 2-5 years. These smallholders have occasionally supplied the mill with FFB. At one stage they pooled resources and tried to take over the mill from SLPMB. This was unsuccessful due to lack of spare parts.

The original lease for the plantation was made between the Chiefdom and Bo District Council. This has expired but the lease between the Chiefdom and SLPMB on the mill site is still valid.

Hydrology. A small river, the Mali, flows along the northern boundary of the plantation. A minor floodplain is associated with the river, of which part is planted to oil palm. The lower elevations of this small area are liable to flooding. Two small swampy areas lie within Gbaama plot cutting the area into 3 parts making access, except on foot, difficult.

Topography. There is a small area of minor floodplain running along the northern boundary with the River Mali but most of the area is flat to gently undulating interfluve country, similar to Baoma, with swampy valley bottoms.

Soils Baoma LS

Soil Data
Pit 1
i) General

Location:	100 meters east of mill 6/10/86
Land Form:	minor floodplain, 50-100 either side of Mali
Elevation:	250 feet
Max. slope:	flat
Parent Material:	alluvium
Drainage:	poorly drained, some flooding, dries out quickly
Vegetation:	oil palm, last brushed 8 years ago

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	SL
20 - 50	SCL
50 - 100	SCL, some mottling starts at 50cm increasing with depth, red/brown

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH (1:5$H_2$0)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-20	LS	4.75	1.22	16	<3	<10	< 1
60-70	SL	4.90	-	8	<3	<10	< 1

Pit 2

i) General

Location:	200 meters east of Yeima village 6/10/86
Land Form:	flat/undulating interfluve, 250-300 ft. elevation
Postion:	middle slope
Max. slope:	1%
Parent Material:	gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm last brushed 10 years ago
Root Layer:	1st and 2nd horizons, some fine in 3rd and 4th

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 10	SL/SCL, <5% gravel, very sandy top 2cm
10 - 25	gr. SCL, 0-10% gravel
25 - 45	very gr. SCL, 30-50% gravel
45 - 90	very gr. SCL/CL, >50% gravel. Some rocks.

Pit 3

i) General

Location:	300 meters south west of mill 6/10/86
Land Form:	gently undulating interfluve, elevation 275 ft.
Position:	crest
Max. slope:	2%
Parent Material:	gravel free over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm, last brushed 1978
Root Layer:	1st and 2nd horizons

ANNEX 1

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 20	SL, reddish-brown, friable
20 - 35	gr. SCL, 0-10% gravel
35 - 55	gr. SCL, 10-30% gravel
55-85	Very gr. SCL, 30-50% gravel

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH (1:5$H_2$0)	Organic C (%)	Extractable Nutrients (mg/lit)			Bray P (ppm)
				K	Mg	Ca	
0-20	SL	4.80	1.5[illegible]	26	8	20	< 1
55-85	gr.SCL	5.10	-	10	<3	18	< 1

Crop Data The following table shows estimates of average height of palms and planting dates for the 3 plots at Telu:

Plot	Palm Ht (Feet)	Planting Date
Gbaama (floodplain)	13-16	1960
Gbaama (interfluve)	25-30	1960
Yeima	17-21	1963

Conclusions The plantation has been poorly maintained for many years and the palms are stunted, especially in Yeima plot.

Map 7 shows areas suitable for rehabilitation and abandonment. Yeima plot is very gravelly with some cemented blocks of laterite in the top meter and is not suitable for further development. Gbaama plot, nearest the mill, is a better area and soils have a thicker gravel free topsoil. The small minor floodplain area that is planted still floods in places and should be abandoned.

The present planted area is too small to support the mill and would have to be replanted and extended if rehabilitation went ahead. However, many landowners in the area grow oil palm and could supply FFB if the mill was working.

Smallholder Oil Palm Plots

Only one of the landowner's farms was inspected. Area of oil palm was about 30 acres, of which 20 acres were 20-23 years and 10 acres 2-3 years old. The older palms had not been brushed for 2 years, though the palms were harvested for pit processing. The younger area had been interplanted with rice, cassava and ochra. The oil palm seedlings were obtained from the Bo-Pujehun Rural Development Project. No fertilizer had been applied to any of the plots for 3 years but before this some fertilizer had been used.

From discussions with other landowners, the above plot is larger than most but state of the palms and history is similar. It is difficult to predict yield from these plots but potential yield would probably be less than the estate (run properly) because of lower input levels, and intercropping practices in early years. However, landowners' plots are still relatively young and have been maintained and harvested fairly regularly compared to the estate. Given adequate help with inputs such as tools, fertilizer and transport and the correct incentives, they have potential to be the main source of FFB for the mill.

A.1.2.8. Wanjei

Location Located around Wanjiela village, longitude 11 22' west and latitude 7 46' north, 10 miles south on the road from Blama Junction.

General Description The plantation is in 2 plots north and south of the Oil Mill Site at Wanjiela. Total leased acreage is about 500 acres but the plantation has been abandoned over most of its history and much of the area has either returned to bush or been reclaimed by landowners and cut down for shifting cultivation. About 100 acres of palms planted on suitable soils 1.5 miles south east of the mill remains intact.

Hydrology The southern plot is flat but still well drained by tributaries of the Waanje. The northern plot is considerably more hilly and dissected and drains south, also into the Waanje.

Topography The Wanjei River occupies a low, relatively flat upland basin area with the Kambui Hill complex to the east and a more dissected hilly area to the west. At least half the original plantation was in a flat area which is much less gravelly though more sandy, than the hillier areas around. Part of the planting is on an isolated hill in the basin.

Vegetation and Land Use Similar to Baoma - most of the original natural forest has been cut down except on the very steep Kambui Hills areas leaving secondary bush, patches of upland cultivation, and paddy rice.

Soils Classified Blama LS. Three landforms were identified:
1) Relatively flat ancient river terrace, well drained.
2) Old river terrace, more dissected and poorly drained and,
3) Isolated hill area, well drained but considerably more gravelly.

Pit 1
1) General

Location:	1 mile south, south west of mill 11/10/86
Land Form:	dissected terrace; elevation 300 feet
Position:	crest
Max. slope:	1%
Parent Material:	gravel free colluvium over gravelly colluvium
Drainage:	well drained
Vegetation:	oil palm with 5 years undergrowth
Root Layer:	1st and 2nd horizons, mainly fine and medium

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 10	SL
10 - 30	SCL
30 - 70	gr. SCL, 10% gravel
70 - 85	gr. SCL, 20% gravel
85 - 100	very gr. SCL >40% gravel, weakly cemented

iii) Soil Analytical Data

Depth (cm)	Texture (lab)	pH ($1:5H_2O$)	Organic C (%)	Extractable Nutrients (mg/lit) K	Mg	Ca	Bray P (ppm)
0-10	SL/LS	4.90	2.9	18	16	181	1
70-85	gr.SCL	4.70	-	7	<3	<10	<1

Pit 2

i) General

Location:	1 mile south mill, west of road 11/10/86
Land Form:	terrace
Position:	foot slope
Max. slope:	3%
Parent Material:	colluvium over alluvium
Drainage:	imperfectly drained
Vegetation:	oil palm with 7 years undergrowth
Root Layer:	1 and 2 horizon fine, medium and coarse. Some fine roots in 3 and 4.

ii) Soil Profile Description

Depth (cm)	Field Description
0 - 15	SCL
15 - 30	SCL
30 - 75	gr. SCL, 0-10% gravel
75 - 90	gr. SCL/CL, 10-30% gravel

Pit 3

i) General

Location:	800 meter north of mill off road 11/10/86
Land Form:	isolated, dissected hill
Position:	crest
Max. slope:	1%
Parent Material:	gravelly colluvium
Drainage:	well to moderately drained
Vegetation:	oil palm with 10 years undergrowth
Root Layer:	roots abundant in 1 and 2 horizons

ii) Soil Profile Description

Depth (cm)	Characteristics
0 - 3	SL
3 - 10	gr. SL/SCL, 0-10% medium gravel
10 - 30	gr. SCL, 30-50% very coarse gravel,
30 - 70	some boulders (cemented laterite)

Crop Data The following table compares palm height with planting date for Wanjei plantation

Plot	Palm Ht.(Feet)	Planting Date
Pit 1	21-24	1961
Pit 2	15-20	1961
Pit 3	10-15	1961

Conclusions The plantation was not maintained for many years until around 1980 when Eastern Clinic leased the mill and plantation from SLPMB and the landowners. It was operated for 2-3 years but abandoned again because a loss was being made due largely to the small acreage and low yields being obtained. No new planting was possible at that time.

Map 8 shows the areas suitable for rehabilitation and abandonment. Much of the abandoned area has already been transferred to food crops. The area remaining is too small to support the mill if rehabilitated.

A.1.3. Conclusions to Fieldwork

A.1.3.1. Soils Analysis

a) pH is fairly uniform around 4.8. Optimum pH range is 5 - 6 for oil palm but at pH 4.8 oil palm growth is not greatly affected. It is expensive to effect a change in soil pH in relation to the benefits gained, so none is recommended. However, the fertiliser recommended, a 12 12 17 2 (N P K Mg) compound, contains calcium and magnesium and would help to maintain a nutrient balance.

b) Carbon % Organic matter (OM) is 58% C. The figures for C show that all the topsoils tested have a low to medium OM content. Organic matter helps to improve Cation Exchange Capacity which is shown by the figures: a higher OM tending to coincide with higher Ca, Mg, and K levels.

c) Texture All soils tested were sandy throughout their profile and the majority contained gravel (lateritic concretions) at various percentages and levels. The amount of gravel tends to depend on where the soil is in the toposequence. Most of the flattened hill crest areas had developed gravel free soils of about 25-75cm; the convex slopes down to the lower areas usually had gravel at or very close to the surface; the lower concave slopes have the deepest gravel free soils. These lower areas seem to produce the largest palms but this may be due more to the fact that they do not dry out so quickly in the dry season, rather than to better soils.

Sahn and Kasse soils have deeper gravel free surface horizons than Baoma, Telu and Wanjei and on average have less gravel in the top 1 meter of soil.

Mange and Masanki have the lowest gravel contents (not including the abandoned area at Mange which has a very high gravel content).

d) Phosphorus (P). Uniformally very low levels of P were detected in all soils tested. The relationship between level of soil P, yield and fertilizer rates is difficult to assess by comparison with other soils but from the results of the analysis, all plantations would benefit from phosphate applications.

e) Cation Exchange Capacity (CEC) as exhibited by the bases Potassium (K), Magnesium (Mg) and Calcium (Ca). All the soils tested have extremely low nutrient status and even the higher values at Sahn and Kasse appear low compared to many soils growing oil palm in West Africa. The chemical analyses used on the soils shows extractable nutrients rather than exchangeable nutrients and should give a better idea of the total reserves of K, Mg and Ca in the soil. That is, not only ions immediately available to roots on the exchange surfaces but also some of the ions unavailable immediately but that come on to the exchange surfaces slowly by being 'dissolved' from the soil particles. These ions act as a buffer so, as roots remove ions from solution, some of the unavailable ions take their place.

From the results some tentative conclusions can be made:

i) All the soils are almost completely depleted of the nutrients tested, with very little buffering capacity available. A fairly large response to fertiliser would be expected but nutrients added in this way may be easily leached out and lost in the heavy rainfall.

ii) On average, Sahn and Kasse soils have a higher extractable nutrient level than Baoma, Telu and Wanjei soils. The following table compares the sum of extractable nutrients:

Plantation Name	Extractable Nutrients (mg/l)		
	K	Mg	Ca
Kasse	11	7	43
Sahn	12	10	77
Average	11.5	8.5	60
Wanjei	9	7	60
Telu	15	4	15
Baoma	10	5	17
Average	11.3	5.3	31

Based on the number of samples, this is only a tentative conclusion but may illustrate the greater variability of soils formed from the basement complex rocks (Blama LS) compared to the more uniform tertiary sediments (Newton LS). However, it is expected that more fertiliser would be needed for palms on Blama compared to Newton Land Systems.

iii) A response to just applying potassium would be expected but owing to the strong potassium/magnesium antagonism widespread in Africa, Mg deficiency may be exhibited.

f) Slopes. Most are within 7° (10%) but some steeper at 8-9° (15-16%). Sahn has the largest areas of the steeper land but most of the steep areas are recommended for abandoning.

g) Crop Data. The following table compares growth rates of palms in relation to their age. This assumes that upkeep, management and planting material are similar for all plantations. Given that all were owned by SLPMB, this assumption has some validity.

Plantation Name	Age of Palms (yrs)	Estimated[i] Height (ft)	Average Growth Rate (feet/yr)
Baoma	20-21	11-22	0.8
Kasse	20-23	25-32	1.27
Mange	19-24	20-22	0.98
Masanki	26-31	25-35	1.05
Sahn	23-26	22-35	1.16
Telu	23-26	19-30	1.00
Wanjei	24-26	18-24	0.85

Note (i) estimates do not include abandoned areas.

From this table it is apparent that Sahn and Kasse palms have grown better on average than the others. This only confirms the conclusions from comparisons made visually.

A.1.3.2. FFB Yield Potential for New Planting

The following table summarises the results of soil and climatic data collected for each location. Drainage, slope, pH and P are not included as they are fairly uniform for all the areas. The results are used to estimate a class for each soil area and with the water deficit figures, to estimate FFB yields for each.

ANNEX 1

Location	Texture	Est. of gravel % [1]	O.M. %	Soil Class [2]	Water Deficit (mm) [3]	Yield Est. (t/acre)	Est. area covered (acres)
Kangha							
P1	SL-SCL	20	4	III	300	3.8	550
P2	SL	2	3	IIb	300	4.5	275
P3	SL-SCL	30	4	III-IV	300	3.2	130
P4	SL-SCL	10	3	III-IIb	300	4.2	145
Average						4.0	
Sahn							
P1	SCL	10	6	IIb-IIa	300	4.7	300
P2	SL-SCL	30	3	III-IV	300	2.9	200
P3	SL	20	3	III	300	3.9	500
P5	SL-SCL	10	4	III-IIb	300	4.3	200
Average						4.0	
Baoma	SCL	25	5	III-IV	285	3.6	500
Telu	SL-SCL	30	3	III-IV	300	3.5	110
Wanjei	SL-SCL	20	2.5	III-IV	285	3.7	100
Masanki/Waterloo	SL	15	-	III-IIb	350	3.5	600
Mange Bureh	SL-SCL	15	-	IIb	420	3.1	700

Notes: 1/estimates % of gravel in the top 1 meter of soil
2/soil classes I, IIa, IIb, III, IV based on a method developed by Olvin, 1968 to make an agronomic classification of soils. Classes are used as in Hartley, 1979 together with water deficit figures to estimate FFB yield tonnes per acre (7th col.).

3/water deficits do not take into account stored soil moisture, i.e. total moisture held between field capacity and permanent wilting point available to oil palm roots. it is difficult to estimate water holding capacity and it varies between different soils but 100mm in the top 1-1.2 meters can be assumed, based on experience of West African soils planted to oil palm. If an allowance is made for stored soil moisture then the theoretical maximum yields could be some 25% higher (yield estimates assume other inputs are optimum and good management). Expected yields may vary because of the tendency for water deficits in the short term to vary widely from the long term mean.

A.1.3.3. Summary of Conclusions for each Plantation

1) Mange The soils over part of the plantation may ameliorate the high water deficit experienced but even so yields are low. Although oil palm grows in the Mange area it is rather close to the savanna region and generally unsuitable for commercial plantation development compared with the south east of the country.

2) Masanki Also experiences a high water deficit affecting yields. Soils tend to be sandy and dry out quickly especially on higher ground. Again, oil palm will grow in the area but yield potential is lower than in the south east. On the plus side some of the low lying, moister areas may still be productive and soils are relatively gravel free and are some compensation for the high water deficit. Masanki is marginal for further development and in view of the ownership, some replanting may be recommended.

3) Baoma, Wanjei and Telu have the lowest water deficits but soils tend to be gravelly and nutrient status is lower compared to Sahn and Kasse soils. These plantations will need more fertiliser to maintain FFB yields. At Baoma 500 acres is suitable for rehabilitation and further replanting but expansion potential is limited. Telu and Wanjei plantations are too small to rehabilitate. At Wanjei only about 300 acres of the original estate is suitable for replanting, at Telu 200.

4) Sahn and Kanga have potentially the better soils while still being far enough into the south east to be within the FAO 300 day growing limit for oil palm development. Water deficit is still fairly high and is reflected in the potential yields that can be obtained but rehabilitation potential is good based on age of palms, their growth so far, the area available and soils. Large areas of the original plantations can be replanted and there is some potential in the area for expansion.

A.1.4. Potential for Rehabilitation, Replanting and Expansion

In the main body of the report the team's recommendations for development activities are given. These are focussed upon a main project in the Kasse/Sahn Malen area, plus rehabilitation at Baoma and, perhaps, Telu.

In the remaining sections of Annex 1 the agricultural background to these proposals is elaborated. Attention is concentrated on the three locations named above, but basic information is also provided on all seven sites. These sections of Annex 1 also contain the agricultural assumptions for the financial and economic analyses.

In formulating a development plan the general approach has been to use low cost options for both rehabilitation and new planting. Wherever possible, capital items are substituted by labour. This minimises any foreign exchange element, but options are not taken that may affect potential oil production. However, this assumes that sufficient manpower will be available at the right times.

A.1.4.1. Rehabilitation and Replanting Potential

The following table summarises estimated acreages on each estate that are suitable for:

a) Rehabilitation
b) Replanting after rehabilitation
c) Immediate replanting, and
d) Area unsuitable for further developments

Area Summary of Pioneer Mill Plantations
(acres)

Plantation Name	Present total	Age of palms (years)	Rehab	Replant	Abandon
Baoma	800	20-21	500	650	150
Kasse	1100	20-23	1100	1000	100
Mange	3167	19-24	895	700	2467
Masanki	1750	26-31	600	1000	750
Waterloo	1000	25-31	1000	-	1000
Sahn	1850	23-26	1200	1000	850
Telu	242	23-26	110	200	42
Outgrower	1000	3-26	1000	1000	-
W[illegible]jei	500	24-26	100	300	200

The locations are indicated on the plantation maps.

A.1.4.2. Expansion Potential

During the limited time available for fieldwork only an overview of expansion potential was possible. The following notes outline some of the advantages or disadvantages for expansion around the most suitable plantations for rehabilitation.

a) Sahn/Kasse Project Area

This area is likely to be the best for oil palm expansion. After eliminating land which is unsuitable because of bad topography or hydromorphism (poorly drained) the flat topped interfluves tend to be wide and uniform enough to make rational plantation layout possible. However, there is still considerable variability in the nature of the soils, with some areas being more dissected and gravelly than others.

Both plantations are located near the contact zone between the tertiary sedimentary sands and the basement complex rocks which rise just to the north and east. The best areas are likely to be located between and to the south west of a line drawn between Sahn and Kasse to keep within the tertiary sedimentary belt. Other areas may be suitable but tend to be small and dissected. Most of the obvious areas are not ideally placed in relation to the possible new mill site on the River Malen. Some distances estimates from maps are:

ANNEX 1

	Distance (miles)
Sahn mill to new mill	8
Sahn mill to extension area near Sahn Malen	2
Kangha mill to new mill	2.7
Kangha mill to northern tip Kasse estate	3.5
New mill to furthest expansion near Kasse	6.8
New mill to furthest expansion near Sahn	11.0

These distances are based on using existing roads as far as possible with a minimum of new road between the new mill site and a motorable track towards Sahn (see map). Distances may be reduced by building more roads but these travelling distances are still within accepted limits for tractor/trailer FFB haulage in West Africa. Communications between Sahn and Kasse plantations are poor with no continuous motorable roads available. The track between Kangha and the new mill is motorable. The River Malen is a formidable barrier but a new bridge is in the processs of construction near the site of the proposed mill.

b) Baoma

Baoma plantation is located in a valley with the Kambui Hills on the eastern border and the River Sewa forming a barrier on the western side. Expansion is only possible north and south. To the north the valley narrows before widening 6 miles on. To the south the valley broadens considerably with a large pocket of land to the east, though still surrounded by the Kambui Hills. From the topography the northern valley interfluves are narrow, 500-700 meters wide, compared to the south were some interfluves are over 1000 meters, making more rational layout of oil palm blocks possible. The area marked as expansion on map 2 is the nearest most obvious large interfluve area, 2 or 3 other areas exist to the east within 7 miles of the mill but these are more dissected and swampy.

In general the area is more dissected than Sahn/Kasse and suitable land with good gravel free soils is likely tc be of smaller extent, making plantations more cut up.

Communications are relatively good with the north/south public road parallel to the Sewa with motorable tracks leading off.

c) Telu

Telu plantation is located on the same land system as Baoma but the valley around Telu is much broader than at Baoma so offering more land. However, the variability of soils, especially their gravel content, is similar making large areas of good land unlikely.

There are many smallholders in the area growing oil palm whose small plots may cope more easily with the soils but no survey has been conducted to enable us to comment further.

A.1.5. Requirements for Rehabilitation

The standard agricultural requirements for undertaking rehabilitation at each location are described in this section, together with man-day estimates. Broadly, the plan is based on the supply of needed inputs and the implementation of upkeep and harvesting operations on a regular basis. Improvements to management, including the keeping of accurate records for labour employed, inputs used and yields obtained, are essential for success. Specific operations for each plantation are not described in detail.

A.1.5.1. Field Operations (Rehabilitation)

a) Underbrushing - clearing undergrowth under the palms by hand using machettes and slashers. Most of the plantations have areas of fairly dense regrowth with many woody perennials, making the first brushing very labour intensive. It is assumed that cutting is the only operation. Virtually no leguminous cover crop is left but the flora is sufficiently varied to provide adequate protection from raindrop erosion. However, there is minimum recycling of nutrients useful to the palms. Some plantations have specific problems, for example, Mange is infested with elephant grass, which should be chemically controlled, followed by the planting of a suitable cover crop.

b) Pruning - will also be very labour intensive in the first year.

As with harvesting, pruning is done by climbing the palms and cutting the fronds with a machette or axe. Fronds are heaped in the interlines.

c) Ring weeding and toiletting - slashing circles around each palm and removing epiphytes and loose frond butts from palm trunks.

d) Plantation roads - need an initial high labour input to repair adequately. Drains on either side of the road are dug out and the spoil piled to make the road so that flooding cannot occur. Some laterite gravel may need to be transported from adjacent areas to gravel free areas but distances are not great.

e) Bridges and culverts - most of the plantations will not need any major bridge building but suitable land is usually dissected by swamps and to minimise transport distances a bridge or causeway may be necessary. Only one instance of this was recorded during the fieldwork. At Sahn, Fonikaw plot is within a mile of the mill but is cut off by a stream and swamp. The alternative is a 6 mile round trip.

f) Harvesting - the traditional method of climbing the palms to collect FFB are still used on the Pioneer mill estates. Tools used are machette, narrow headed axe, head baskets, climbers (large and small, made of 'local' rope) and chisels (1.5 ins. wide). A team consists of the climber and head carrier and sometimes a loose fruit picker. Harvesting (and pruning) is a skilled job and a higher wage is paid. Harvesting is relatively inefficient in terms of men - estimated at 9 man days to collect 1 tonne of FFB. Climbing can be continued during rehabilitation as conversion to sickle techniques may prove difficult with the height of palms. Sickles, curved knives on the end of long poles, can be used on palms up to 10-12 meters and some saving in labour is achieved. Converting to sickles may be pursued when rehabilitation is underway but knives may have to be imported. If an example is available local blacksmiths can make these as well as other tools. Suitable steel will have to be imported as local supplies of truck springs are limited.

g) Disease and Pests - no problems were encountered on any of the plantations that could be distinguished easily from symptoms of nutrient deficiency and past poor management. No major disease or pest problems have been reported on the plantations.

A.1.5.2. Equipment and Inputs (Rehabilitation)

a) Machinery - a new tractor and trailer is required on each plantation, plus spares and maintenance backup. For cost purposes, new imported MF135s and 5 tonne trailers lasting the whole rehabilitation period are assumed as adequate in view of the small yields obtainable. Spares and repairs are estimated on the basis of 20% of the cost of tractor and trailer per year. Lubricant is 10% of the fuel costs which are estimated on the basis of 6 litres diesel per hour of operation. In addition, a small motorcycle is assumed for the supervisor.

b) Agricultural tools - for upkeep and harvesting are costed on the basis of 50% supplied locally and 50% imported, these include machettes, axes, spades, pickaxes, wheelbarrows, slashers. No knapsack sprayers are included as chemical weeding is not used.

c) Fertiliser - as mentioned earlier, soils are depleted in all the main nutrients. Response of rehabilitated palms to fertiliser was discussed in the Commonwealth Secretariat report (1986) and yield is expected to double as a result of rehabilitation. In most cases FFB production is estimated at less than 2 tonnes/acre based on the state of the palms and ecological constraints, so that no more than 50 kg. per acre per year of a balanced compound fertiliser N P K Mg (12 12 17 2) is recommended.

A.1.5.3. FFB Yield Projections (Rehabilitated Areas)

No yield data was available from the estates. Yields for rehabilitated areas are based on the following assumptions applied to the yields estimated for new plantings.

a) Basis for calculation is to take a quarter of the estimated new planting yield (refer to A.1.3.2.)
b) On implementation of rehabilitation plans, yield increase x 2 by the 2nd year for palms < 25 years old and x1.5 for palms > 25 years old.
c) When palms are 25 years old, yields start to decline by 10%/year.

Given these assumptions, the following table shows crop yield projections for each rehabilitated Pioneer mill plantation.

Plantation (area in acres)	YEARS (tonnes/year) 1	2	3	4	5	6	7	8	9	10
Baoma (500)	450	650	875	875	875	750	650	550	500	450
Kasse (1100)	1100	1540	2090	2090	2090	1870	1650	1540	1320	1100
Mange (895)	525	770	1050	980	840	770	630	560	560	400
Masanki (600)	522	600	600	540	480	480	420	360	300	300
Sahn (1200)	1200	1680	2280	2040	1800	1680	1560	1320	1200	1000
Telu (110)	97	154	210	188	165	150	132	121	99	88
Outg's (1000)	1000	1200	1500	1500	1500	1500	1500	1500	1500	1500
anjei (100)	90	140	150	120	100	90	90	80	80	70

A.1.5.4. Management (Rehabilitated Areas)

A minimum of one supervisor with experience in oil palm and a background in agriculture is needed. With minimum transport of a motorcycle, he could manage up to 1400 acres. Ideally, he should be provided with an assistant. Headmen are employed at 1/20 labourers.

Adequate farm guards are important for patrolling the plantation against thieves 24 hours a day, estimated at 2/200 acres.

A.1.5.5. Telu Smallholders

Management at Telu would need to be increased to cope with the many dispersed plots. At least 1 supervisor and 2 assistants with minimum transport of motorcycles would be needed plus 2 MF135 tractors and trailers for collecting FFB. Also an allowance for transporting and storing inputs. Farmers would be expected to buy inputs at prevailing prices.

A.1.5.6. Man-day Estimates for Field Operations (Rehabilitation)
(man-days per acre)

Operation	Years 1	2	3 - ->
Brushing	5	2	2
Pruning	6	3	3
Heaping	3	1	1
Ring weeding	4	2	2
Toiletting	1	0.5	0.5
Roads	4	0.5	0.5
Bridges	1	0.5	0.5
Fertilising	1	0.5	0.5
	25	10	10 - ->

Notes: --> = Man days constant for following years, though in practice some decrease would be expected.

A.1.5.7. Employee Numbers (Rehabilitation)

Numbers of employees needed for each month for the first 2 years of rehabilitation are estimated as follows:-

Years		J	F	M	A	M	J	J	A	S	O	N	D
Baoma	1	80	80	90	90	90	80	80	80	80	85	85	85
	2	40	40	55	55	55	40	40	40	40	44	44	44
Kasse	1	176	176	190	190	190	176	176	176	176	187	187	187
	2	88	88	121	121	121	88	88	88	88	97	97	97
Mange	1	143	143	160	160	160	143	143	143	143	152	152	152
	2	71	71	98	98	98	71	71	71	71	78	78	78
Masanki	1	90	90	108	108	108	90	90	90	90	102	102	102
	2	48	48	66	66	66	48	48	48	48	52	52	52
Sahn	1	192	192	216	216	216	192	192	192	192	204	204	204
	2	96	96	132	132	132	96	96	96	96	105	105	105
Telu	1	18	18	20	20	20	18	18	18	18	19	19	19
	2	9	9	12	12	12	9	9	9	9	10	10	10
Wanjei	1	16	16	18	18	18	16	16	16	16	17	17	17
	2	8	8	11	11	11	8	8	8	8	9	9	9

Notes:

a) After the 2nd year employee numbers are assumed to be constant.

b) Peak FFB production occurs in March, April, May and a mini-peak occurs in October and November. Under present circumstances, harvesting is concentrated around these peaks and upkeep is timed to prepare the palms just before harvesting begins. With rehabilitation it is assumed that upkeep and harvesting would be carried out more regularly through the year.

The number of harvesting employees is calculated on the basis of 40% of total FFB in March, April and May, 25% in October, November, December and 35% the rest of the year. Employees on upkeep are maintained at a constant number during the year.

A.1.6. Requirements for Replanting and Expansion

Again, a standard plan was applied for consideration of the feasibility of new plantings on each plantation. Differences in the cost between replanting and expansion are accounted for as far as possible.

A.1.6.1. Field Operations (Replanting and Expansion)

The first important consideration is method of clearing; the choice is between hand or mechanical methods. The traditional method used in Sierra Leone is clearing by hand using machettes and axes following the practice in shifting cultivation. Most of the land to be cleared is, at most, light forest (secondary bush) and presents no real physical problems for hand clearing. Also, the cost of clearing by hand is low compared to mechanical methods. Weighed against this is the increased managerial problems of co-ordinating large numbers of labourers, and their availability during the year which may delay the timing of critical operations. Many operations coincide with the peak labour use in other farming activities e.g. clearing land in the dry season and planting at the beginning of the wet season coincides with the same operations in upland rice cultivation. Availability of labour may limit the possible acreage planted in any one year but the larger the area which can be brought into bearing early tends to improve profitability. Mechanical clearing is much easier to manage but the cost of importing a tracked vehicle makes replanting or expansion expensive.

Calculations of man-days are made on the basis of 250 working days per year. Days are lost through public holidays, weekdays, raindays and leave. No allowance is made for sick leave or absenteeism. Saturdays are taken as half days. Total man day requirements are included with the description of each operation.

The Bar Chart of Operations details the sequence of main field operations at Sahn and Kasse for the proposed development plan.

A.1.6.2. Field Diseases and Pests

Certain diseases and pests must be considered as they have a relatively large effect on the costs of development.

a) Vascular Wilt Disease (well known in West Africa). The causal agent is a fungus, *Fusarium oxysporum* which lives in the soil. The disease can be transferred on seed and is associated with light sandy soils and magnesium deficiency; both conditions exist on the Pioneer mill plantations. There is no known cure and although there are no officially recorded instances of the disease, any new planting should use wilt-resistant seed as an insurance. However, the seed is 50% more expensive than the standard.

b) Cane Rats (*Thyronomus swinderianus*) and related species like the porcupine have been recorded as attacking young palms in the field by gnawing at the apical bud tissue and thus destroying the palm. The most effective control is wire collars placed round the base of the palms. The operation, including the wire, is expensive and so should only be performed if rat attacks actually start to occur.

A.1.6.3. Seed Supplies and Nurseries

At Sahn and Kasse, one centralised nursery is proposed to run for 6 years producing seedlings for replant or new planting of 1000 acres per year.

Bar Chart of Operations (Plantation) for the Kasse/Sahn Malen Development Plan

The number of seed ordered is on the basis of a planting density of 58 per acre. Given strict culling of poor performers, and allowing for losses at germination, in the nursery and in the field, 100 seeds per acre has been estimated as necessary. In the large expansion envisaged at Sahn/Kasse, a prenursery stage has been costed for the first year but with experience, a single stage nursery can be used in the following years, so reducing costs. Polybags used are imported and for the main nursery 40 by 40 cm layflat. Local polybags are available but are of low quality and strength. Stringent precautions are necessary in the nursery against certain diseases and pests. Blast diseases and Cercospora leaf spot disease are particularly important and provision is made in the costs for chemical control.

Adequate fertiliser is essential for growing seedlings and the amount should be increased progressively. Actual amount will depend on the situation but as a guide, 290 grams per seedling of a N P K Mg (12 12 17 2) compound fertiliser has been costed.

Watering is also essential during any period where rainfall is inadequate. The system costed in the analysis includes a diesel pump, water bowser, hoses and watering cans. This is a very labour intensive technique but is justified given the cost of importing irrigation equipment in relation to the size of enterprise. Some costs are allocated for agricultural tools used in the nursery.

Scaled down versions of the irrigation system are costed for possible nurseries at Baoma and Telu.

Man-day Requirements for Pre-nursery (1000 acres field planting). Operations include site preparation, shade and bed construction, soil collection, loading and transport, filling bags, planting, sorting and culling, pricking out, spraying and application of chemicals, upkeep, watering, weeding and mulching. Total man-days 2195

Man-days - Main Nursery (1000 acres planting). Operations include site preparation, soil transport (trailer and spades), filling and placing bags, transplanting or planting if single stage nursery, irrigation, chemical spraying, culling, pest control and mulching.

Total man-days 24,000

A.1.6.4. Land Preparation

Clearing bush by hand includes the operations of underbrushing, burning, felling, stumping and heaping where necessary to form planting rows. In replanting it is assumed that palms are felled directionally with axes to form the planting lines.

Construction of plantation roads can also be done by hand. Soils are mostly well drained and gravel is always available in the vicinity to improve road surfaces. Road networks in the Pioneer mill plantations are basically adequate. Carry distances vary but this is sometimes necessary as roads must be adapted to the relief, water courses and swamps. Similar problems will occur in new planting but cost estimates are based on a road network constructed so that the maximum carry distance of cut bunches by harvesters is 125 meters. This makes for about 25 meters of road per acre including boundary roads.

It is assumed that no other land preparation is necessary except for the planting of a cover crop. A seed bed may be prepared by hoeing in selected areas where the cover seed is planted. The legume Pueraria phasiolides is costed here at a rate of 6lbs per acre. Establishing the cover crop is difficult in the dry season and planting should be timed to coincide with the beginning of the rains if possible. Importing Pueraria is expensive and the alternative of obtaining local seed should be considered. Much of the legume was planted around the country in the 1950s and seed has been collected from these sources in the past. For cost purposes, however, imported seed is assumed.

Man-days Requirements for Land Preparation (1000 acres)

Secondary Bush - operations include clearing, culvert and road construction and planting of cover crop

Total man-days 41,000

Replanting - operations include felling palms, some destumping, heaping, some road repairs and cover crop. Considerable man-days are saved in replanting. Total man-days 27,000

A.1.6.5. Field Layout and Planting (1000 acres)

Operations include lining, stacking, holing by hand, cutting harvesting paths, transporting seedlings and loading, carrying and planting, cutting and placing wire collars

Total man-days 10,000

For replanting, orientation of palm lines would follow the old layout and new palms would be planted in the interlines to avoid contact with possible sources of disease from the old stands root boles. Some reduction in labour may be made in lining and cutting harvesting paths. Total man-days 9,000

No major problem with replanting in the interlines is envisaged. The Pioneer mill plantations are planted diagonally with palms 29 feet apart, giving a density per acre of about 60. It is sometimes recommended that a higher density of palms be used. This tends to have the effect of increasing yields in the early years but reducing them later on. No experimental results of changing the planting density are known and for these estimates the normal planting distance of 9m x 9m is used for both replanting and expansion areas.

A.1.6.6. Agronomic Assumptions (Replanting and Expansion)

a) No chemicals are costed for use in the field and it is assumed that all operations use labour only

b) Ablation, or removal of the male and female inflorescences on very young palms to promote root and foliage development. This operation ceases 9 months before harvesting is planned to begin.

c) Fertiliser requirements should be based on leaf analysis carried out regularly once the palms reach 3 years. Assuming 1 palm per 10 acres is sampled, an indicative cost for the analysis alone is US$ 2000 per 1000 acres. Based on the soil data collected and as would be expected, soils are impoverished on all the plantations. Although on newly cleared bushland fertility may be higher, for our cost projections replanting and extension have been taken as a whole and a compound N P K Mg (12 12 17 2) fertiliser is recommended at the following rates:

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Kg/acre	15	30	60	90	120	120	120	120	150	150	150	150	180	180

N.B. Fertiliser estimates are based on maximum possible yields obtainable under ideal conditions in Sierra Leone. In practice the economic levels may be lower and will vary between areas.

A.1.6.7. Upkeep (Replanting and Expansion)

a) Immature upkeep - operations include circle and interrow weeding, path upkeep, pest inspection and control, infilling, fertiliser applications, leaf analysis and ablation.

Total man-days	Planting year	1	6,500
		2	12,000
		3	10,000
		4	10,000

b) Mature upkeep - operations include weeding circles, slashing interrows, path, road and bridge maintenance, pruning, toiletting, fertiliser application and loading, leaf analysis, pest inspection/control.

Total man-days	Year 5	9,000	Year	9	7,000
	6	9,000		10	7,000
	7	7,000		11	6,000
	8	7,000		12	6,000

A.1.6.8. Yield Projections (Replanting and Expansion)

Potential yields (tonnes of FFB per acre) have been estimated in A.1.3.2. Each area has been rated depending on the climate, mainly annual water deficit expected, and the results of analysing the soils in the areas already planted to oil palm. Projections of the build-up of yields per acre are given below.

Estate	Yields (t FFB/acre) Year				
	5	6	7	8	9
Baoma	0.8	2	2.4	3.1	3.6
Kasse Kangha	1.2	2.4	2.8	3.3	4.0
Mange Bureh	0.5	1.5	1.9	2.4	3.1
Masanki	0.7	1.9	2.3	2.9	3.5
Sahn Malen	1.2	2.4	2.8	3.3	4.0
Telu	1	2.2	2.6	3.2	3.5
Wanjei	1.1	2.3	2.7	3.3	3.7

The above yield figures are those thought attainable taking into account local conditions. The theoretical maxima with optimum inputs could be some 20-25% higher.

A.1.6.9. Harvesting, Collection and Transport of FFB

For new plantings, chisel followed by sickle harvesting techniques are assumed. Chisels on the end of poles are used until the palms become too tall. Harvesting is carried out all the year round; ripeness criterion is 10 loose fruits for 3-5 kg and 20 for 6-15 kg bunches; making harvesting rounds about 10-12 days but this will depend on the season. For harvesting new plantings, 6 man days per tonne FFB have been allowed, including head carriers. As the plantation comes to maturity, harvesting efficiency should improve.

It is assumed that FFB continues to be transported in baskets made locally and that tractors and trailers transport from field to mill. At Sahn and Kasse, where a proposed new mill will be shared by both plantations, travelling distances are assumed to be within tractor capability. The furthest area is the expansion area at Sahn which is 10-11 miles away. Kasse replanting and expansion areas are within 6 miles and Sahn itself is 8 miles from the new mill site. These distances are estimated using existing roads as far as possible with about 4.5 miles of new road built on the Sahn side of the mill. Distances could be reduced if more new roads were built.

For the larger new plantations at Sahn and Kasse, MF290's plus 7 tonne trailers have been used in cost estimates. With 3000 acres at Sahn, 5 tractors will eventually be required by the year 2001 to cover the peak season yield months of March, April and May. Only 3 tractors are needed for Kasse's 3000 acres by 1997 because distances are less. Including breakdowns, a mininum of 9 tractors and 8 trailers are required by 2001. (If yield was unformally spread over the year, only about 6 tractors would be necessary).

For smaller new plantings at Baoma and Telu, MF 135's or equivalent, plus 5 tonne trailer are assumed as adequate.

A.1.6.10. Estimated Requirements for Plantation Employees (at Kasse/Sahn Malen)

The following table estimates the number of employees needed each month for carrying out the work on the Kasse/Sahn Malen project.

Yrs	J	F	M	A	M	J	J	A	S	O	N	D
1	35	35	35	87	87	87	87	87	273	273	273	273
2	273	273	273	229	229	229	139	139	419	419	419	419
3	415	414	415	277	277	277	187	467	467	467	467	467
4	455	455	455	317	317	317	227	227	507	507	507	507
5	495	495	495	357	357	357	267	267	547	547	547	547
6	531	531	491	430	430	430	341	321	527	527	527	527
7	473	473	473	466	466	466	376	376	376	376	376	376
8	467	467	467	500	500	500	500	500	500	500	500	500
9	550	550	550	550	570	570	570	570	570	570	570	570
10	540	540	540	540	540	540	540	540	540	540	540	540
11	500	500	500	500	500	500	500	500	500	500	500	500
12	450	450	450	450	450	450	450	450	450	450	450	450

Notes: No allowance has been made for sickness and absenteeism, so in practice some 20-30% more people would be employed than above.

The view expressed by chiefs and local people was that sufficient labour in the appropriate months would be available for any project suggested but some further investigations are required.

A.1.7. Suggested Further Work for Project Implementation

The following notes outline further work needed before project implementation.

A.1.7.1. Kasse/Sahn Malen

i) Identification of the most suitable land available for expansion within the catchment area of the new mill location.

Bearing in mind the great expense in detailed soil surveys of large areas of land and the amount of work already done on the tertiary sands (on which Sahn and Kasse are located), in other West African countries, actual soil analysis can be kept to a minimum. Broadly unsuitable areas can be eliminated because of hydromorphism (water logging) and bad topography. The rest of the land suitability survey would concentrate on mapping relatively flat areas in the chosen locations, combined with auger sampling to check gravel contents are within limits in the top meter of soil and some soil pits for collection of relevant soil samples.

ii) Exact availability of labour for each month of the year and identification of expected bottlenecks in supply. Important because of the heavy reliance placed on manpower to carry out the project. Survey would include the identification of suitable men for the supervisory posts.

iii) Assuming a new mill is constructed, a survey of building new roads would be needed. The survey would include an assessment of the condition of all roads that would be used and repairs required.

iv) Detailed development plan including proposed plantation layout, timing of all operations (for example seed must be ordered at least 6 months before it is needed), description of necessary agricultural inputs and machinery to be used and training program for local managers.

A.1.7.2. Baoma

i) Expansion areas need to be identified and mapped. Soils derived from the basement complex rocks, on which Baoma is located, can be more complex and variable so greater care in mapping them is required. However, areas can be eliminated due to hydromorphism or bad topography. Areas with a high percentage of gravel in the top meter of soil should be avoided as much as possible. Rational layout of an expansion area may be difficult with several long narrow blocks planted to obtain the required acreage.

ii) As above, labour availability in the area needs to be assessed.

iii) A detailed development plan, with the expansion layout, timing of operations, inputs, etc.

A.1.7.3. Telu

i) Detailed survey of smallholder plots in the catchment area of the mill. The survey would include the agricultural condition of the plots, past maintenance history, labour availability thorugh the year, possible expansion potential, communications between mill and plots, and identification of the specific needs of the farmer for agricultural inputs.

ii) The type of land suitability described above would be used to classify smallholders' plots planted to oil palm and make a better assessment of the yield potential.

ANNEX 2 DETAILED ACCOUNT OF THE PIONEER MILLS

Contents

ANNEX 2 DETAILED ACCOUNT OF THE PIONEER MILLS

A.2.1. The Condition of the Pioneer Mills

Each of the seven Pioneer mills under revue were visited during the period 1st to 10th October 1986. Observations were concentrated on the following factors.

1. The mechanical faults, spare parts shortages and maintenance shortcomings of the mill machinery and equipment already highlighted in the report for UNIDO by Messrs. Cole and Jalloh.

2. The need for building repairs to the mill structure and ancillary buildings, e.g. office, supervisors house, etc.

3. The need to safeguard the water supply to the mills, an essential ingredient of the mill operation and process.

4. The need to improve the security fencing around the mill compounds to deter the theft of FFB and palm oil products.

5. The need to improve the training and management support for successful and sustained mill operation over the next 10 years or longer.

A.2.1.1. Baoma

The Baoma mill building has a number of damaged steel columns and badly corroded galvanised steel roofing sheets which need to be replaced or repaired. The river water supply pump requires an overhaul whilst the old pump house has broken foundations and walls and a leaking roof and needs to be renewed.

The mill machinery and equipment appear clean and relatively well maintained under difficult circumstances. The boiler and steam engine are both reasonably sound although some bearing wear is evident. The process plant requires attention in a number of places such as new fruit elevator buckets and digester blades whilst new drive belts and fasteners are needed for many of the countershafts.

A.2.1.2. Kasse Kangha

The Kangha mill building has a badly corroded roof which needs to be replaced. The well and river water supply pump requires overhaul and some sections of 3" water pipe have to be replaced. During the dry season the river dries up and only the well water, of questionable quality, is available for use. A new water supply will need to be found if full rehabilitation of the mill is required. This is likely to be very costly no matter whether the nearest sizeable river water source (some 3 miles away) or deep water boreholes next to the mill are used.

The mill machinery and equipment appear reasonably sound although several items require urgent attention, e.g. the boiler shell where corrosion holes in some rivets have appeared and where the factory inspector will need to test and clear for operation after welding repairs have been effected. New drive belts and fasteners are required as well as lubricating oils.

A.2.1.3. Mange Bureh

The Mange Bureh mill building is reasonably sound although some roof sheets need replacement. The river water supply pump works reasonably well although river silt makes it necessary to clean out the water storage tanks at least weekly.

The mill machinery and equipment includes a second-hand boiler recently transferred from the derelict Pioneer mill at Gambia which still requires to be tested and cleared for operation by the factory inspector. The steam engine is reasonably sound. New belts and fasteners are required and the building needs a general clean.

A.2.1.4. Masanki

The Masanki mill building has a number of damaged and corroded steel columns and A frames and a badly corroded roof, all of which need repair or replacement. The well water supply has not worked for 10 years and the diesel pump will require a complete overhaul whilst a housing over the well water supply needs to be erected for security purposes.

The mill machinery and equipment at Masanki need considerable overhaul. The boiler fire grate, water feed pumps, sight glass fittings, etc. all need renewal or overhaul whilst the steam engine bearings are all worn. The process plant also needs repair, e.g. steam coils for oil settling tanks, crown wheel and pinion for the fruit digester, etc. whilst new belts and fasteners are required as well as lubricating oils.

A.2.1.5. Sahn Malen

The Sahn Malen mill building roof is badly corroded and needs to be replaced. The present water supply from a deep pond is not satisfactory and occasionally dries up. Apart from reconditioning the water supply pump, the supply can only be improved by running a new 3" pipeline all the way to the nearest sizeable river, some 1500 feet away or by sinking new deep water boreholes next to the mill. Either method will prove expensive.

The mill machinery and equipment at Sahn Malen require considerable attention. Whilst the boiler appears reasonably sound it has not been checked by the factory inspector for 5 years and the steam engine bearings and some countershaft bearings are worn. The process plant needs attention, particularly the steam heating coils in the oil settling tanks and the drive gears to the fruit digester. As before, new belts and fasteners are required as well as lubricating oils.

A.2.1.6. Telu

The mill building at Telu is in reasonably sound condition. The river water supply pump is a 1½" steam operated reciprocating pump which could usefully be standardised to a 3" Lister twin cylinder diesel pump as used in the other Pioneer mills.

The mill machinery and equipment requires some attention although the boiler and steam engine appear reasonably sound. The process plant is mostly in reasonable condition although some new belts and fasteners are required as well as lubricating oils. The clay bath is being wrongly used to wash FFB before processing and should be used to separate cracked shells from palm kernels.

A.2.1.7. Wanjei

The mill building at Wanjei is in reasonably good condition and is the only Pioneer mill which includes a building extension housing a vertical FFB steriliser vessel plus thresher and screw conveyor for transferring fruit to the fruit elevator hopper.

The water supply is obtained from the nearby river via a reciprocating steam pump and there is a district water pumping station nearby equipped with diesel pumps and generators.

The mill machinery and equipment has not been used for a number of years and some essential items, e.g. fire bars for the boiler, shaft and gears for the fruit digester, nut cracker parts and most drive belts are missing. It will be necessary to strip most of the process plant, pumps and drives, including the steam engine, to check on conditions and lubrication before the mill can operate successfully.

At present the mill at Wanjei is deserted.

A.2.2. The Rehabilitation of the Pioneer Mills

In this section the costs of rehabilitating the mills are described beginning with a detailed account of the mill machinery and equipment costs, followed by a summary table, a list of U.K. suppliers, certain other costs and then, in A.2.2.5., tables for each mill giving details of estimated total rehabilitation costs, including fencing and other non-machinery items. Operating costs are also given.

A.2.2.1. Mill Machinery and Equipment Cost Estimates

The cost estimates presented for each mill are based on the figures in the Cole and Jalloh report which have been checked, amended and supplemented by the team. In particular, the team's engineer has checked the estimates with the National Workshop in Freetown and with the relevant U.K. suppliers.

Baoma - Mill Machinery and Equipment Cost Estimates

1. Spare parts manufactured locally

	Unit Cost Le	Total Cost (ex works) Le
24 elevator buckets	120	2,880
1 boiler chimney and damper	21,000	21,000
2 donkey feed pump valves	1,800	3,600
2 engine bearing bushes	4,000	8,000
1 engine gudgeon pin	1,800	1,800
1 layshaft	2,500	2,500
1 mainshaft	7,500	7,500
1 digester pinion	2,400	2,400
1 digester crown wheel	10,000	10,000
6 digester blades	600	3,600
1 centrifuge coupling	2,000	2,000
1 yoke	750	750
1 centrifuge main bearing	4,000	4,000
32 separator beaters	300	9,600
6 separator knives	700	4,200
18 separator blades	600	10,800
1 separator end cover	2,500	2,500
2 autoclave top covers	2,000	4,000
8 nutcracker liners	300	2,400
Repairs to oil separator tanks	2,500	2,500
1 clay bath tank	15,000	15,000
Lubricants	3,000	3,000
		124,030
Spares Contingency		12,970
		Le 137,000

2. Spare parts imported

	Unit cost $	Total costs (ex works) $
3 autoclave top joints	15	45
3 autoclave bottom joints	10	30
3 steam pressure relief valves	70	210
3 steam pressure gauges	30	90
1 oil pump shaft packing	10	10
5 Spirax No. 14 valves	25	125
380 ft. Ballata belting - average width	4	1,520
100 ft. steam pipe lagging 3" x 1½"d	10	1,000
Electric wiring and light fittings	1,000	1,000
		4,030
Spares contingency		470
	Total	$4,500

ANNEX 2

Kasse Kangha - Mill Machinery and Equipment Cost Estimates

1. Spare parts manufactured locally

	Unit Cost Le	Total Cost (ex works) Le
24 elevator buckets	120	2,880
1 steam injector	5,000	5,000
1 boiler chimney and damper	21,000	21,000
1 check valve	4,500	4,500
1 engine governor drive shaft	3,750	3,750
1 engine governor drive bush	1,000	1,000
1 steam valve 1" d	1,500	1,500
1 layshaft	2,500	2,500
1 mainshaft	7,500	7,500
1 digester pinion	2,400	2,400
1 digester crown wheel	10,000	10,000
6 digester blades	600	3,600
1 digester main shaft bush	750	750
1 yoke	750	750
1 centrifuge mainbearing	4,000	4,000
32 separator beaters	300	9,600
6 separator knives	700	4,200
18 separator blades	600	10,800
8 nutcracker liners	300	2,400
1 nutcracker pulley bush	800	800
1 oil separator tank cone	4,000	4,000
1 clay bath perforated container	9,000	9,000
Lubricants	3,000	3,000
		114,930
Spares contingency		12,070
		Le127,000

2. Spare parts imported	Unit Cost $	Total cost (ex works)$
2 donkey feed pump packing	10	20
1 slide valve packing	10	10
1 connecting rod packing	15	15
2 autoclave top joints	15	30
3 autoclave bottom joints	10	30
2 steam pressure relief valves	70	140
2 steam pressure guages	30	60
1 oil pump shaft packing	10	10
5 Spirax No. 14 valves	25	125
380 ft. Ballata belting - average width	4	1,520
100 ft. steam pipe lagging 3" x 1½"d	10	1,000
80 ft. steel wire rope ½"d	10	800
100 ft. galvanised pipe 3" d	5	500
Dynamo test and new wiring	1,000	1,000
		5,260
Spares contingency		540
	Total	$5,800

ANNEX 2

Mange Bureh - Mill Machinery and Equipment Cost Estimates

1. Spare parts manufactured locally

	Unit Cost Le	Total Cost (ex works)Le
30 elevator buckets	120	3,600
1 engine gudgeon pin	1,800	1,800
1 digester pinion	2,400	2,400
1 digester crown wheel	10,000	10,000
1 digester main shaft bush	450	450
6 digester blades	600	3,600
1 yoke	750	750
32 separator beaters	300	9,600
6 separator knives	700	4,200
18 separator blades	600	10,800
8 nutcracker liners	300	2,400
1 nutcracker pulley bush	800	800
1 clay bath tank	15,000	15,000
1 clay bath perforated container	12,000	12,000
Lubricants	3,000	3,000
		80,400
Spare contingency		8,600
		Le 89,000

2. Spare parts imported

	Unit Cost $	Total cost (ex works)
21 boiler mudhole joints	5	105
2 donkey feed pump packing	10	20
1 boiler gauge glass	5	5
1 boiler gauge glass protector	25	25
1 engine slide valve packing	10	10
1 connecting rod packing	15	15
2 autoclave top cover joints	15	30
2 autoclave bottom cover joints	10	20
2 steam pressure relief valves	70	140
2 steam pressure guages	30	60
2 layshaft bearings	40	80
1 oil pump shaft packing	10	10
5 Spirax No. 14 valves	25	125
380 ft. Ballata belting in average width	4	1,520
100 ft. steam pipe lagging 3" x 1½"d	10	1,000
80 ft. steel wire rope ½"d	10	800
Repairs to dynamo, electric controls and light fittings	2,000	2,000
		5,965
Spares contingency		635
	Total	6,600

ANNEX 2

Masanki - Mill Machinery and Equipment Cost Estimates

1. Spare parts manufactured locally

	Unit Cost Le	Total Cost (ex works) Le
24 elevator buckets	120	2,880
1 boiler chimney and damper	21,000	21,000
1 set boiler firebars	22,000	22,000
1 check valve	4,500	4,500
6 galvanised "T" joints	150	900
1 layshaft	2,500	2,500
1 digester pinion	2,400	2,400
1 digester crown wheel	10,000	10,000
1 digester mainshaft bush	450	450
1 yoke	750	750
1 centrifuge main bearing	3,000	3,000
2 centrifuge drive bushes	1,500	3,000
32 separator beaters	300	9,600
6 separator knives	700	4,200
18 separator blades	600	10,800
1 separator top cover	900	900
2 autoclave top covers	2,000	4,000
2 nut cracker pulley bushes	800	1,600
1 clay bath perforated container	9,000	9,000
1 oil pump pulley bush	1,500	1,500
1 oil pump shaft housing	1,500	1,500
2 engine bearing bushes	4,000	8,000
Oil settling tank coil repairs	5,000	5,000
Lubricants	3,000	3,000
		132,480
Spares contingency		13,520
		Le 146,000

2. Spare parts imported

	Unit cost $	Total Cost (ex works)$
21 boiler mudhole joints	5	105
2 donkey feed pump packing	10	20
2 gauge glasses	5	10
2 gauge glass protectors	25	50
2 thermometers	8	16
1 manhole door joint	10	10
1 engine slide valve packing	10	10
3 autoclave top cover joints	15	45
3 autoclave bottom cover joints	10	30
3 steam pressure relief valves	70	210
2 steam pressure gauges	30	60
1 oil pump shaft packing	10	10
5 Spirax No. 14 valves	25	125
1 digester main shaft bearing	60	60
380 ft. Ballata belting in average width	4	1,520
100 ft. steam pipe lagging 3" x 1½"d	10	1,000
80 ft. steel wire rope ½"d	10	800
Dynamo test and new wiring	1,000	1,000
		5,081
Spares contingency		599
	Total	$5,680

Sahn Malen - Mill Machinery and Equipment Cost Estimates

1. Spare parts manufactured locally

	Unit Cost Le	Total Cost (ex works) Le
16 elevator buckets	120	1,920
1 water filter 1½"d	1,200	1,200
1 layshaft	2,500	2,500
1 digester pinion	2,400	2,400
1 digester crown wheel	10,000	10,000
6 digester blades	300	1,800
1 digester mainshaft bush	450	450
18 centrifuge inspection door belts	50	900
1 centrifuge main bearing	3,000	3,000
6 separator knives	700	4,200
15 separator blades	600	9,000
1 separator top cover	900	900
1 separator side cover	1,400	1,400
8 nutcracker liners	300	2,400
1 nutcracker pulley bush	800	800
1 oil separator tank cone	4,000	4,000
5 oil separator tank steam coils	2,400	12,000
2 engine bearing bushes	4,000	8,000
Steam pipe repairs	2,000	2,000
Recondition dynamo	6,000	6,000
Lubricants	3,000	3,000
		77,870
Spares contingency		8,130
		Le 86,000

2. Spare parts imported

Item	Unit Cost $	Total Cost (ex works)$
1 engine slide valve packing	10	10
1 connecting rod packing	15	15
3 autoclave top joints	15	45
3 autoclave bottom joints	10	30
3 steam pressure relief valves	70	210
1 oil pump shaft packing	10	10
5 Spirax No. 14 valves	25	125
380 ft. Ballata belting - average width	4	1,520
100 ft. steam pipe lagging 3" x 1½"d	10	1,000
Electric control panel, wiring and light fittings	2,000	2,000
		4,965
Spares contingency		535
	Total	$5,500

ANNEX 2

Telu - Mill Machinery and Equipment Cost Estimates

1. Spare parts manufactured locally

	Unit Cost Le	Total cost (ex works)Le
20 elevator buckets	120	2,400
1 steam injector	5,000	5,000
1 boiler chimney and damper	21,000	21,000
2 donkey feed pump valves	1,800	3,600
1 layshaft	2,500	2,500
1 mainshaft	7,500	7,500
1 digester pinion	2,400	2,400
1 digester crown wheel	10,000	10,000
6 digester blades	600	600
1 centrifuge coupling	2,000	2,000
1 centrifuge main bearing	4,000	4,000
1 yoke	750	750
32 separator beaters	300	9,600
6 separator knives	700	4,200
18 separator blades	600	10,800
1 separator end cover	2,500	2,500
2 autoclave top covers	2,000	4,000
8 nutcracker liners	300	2,400
Lubricants	3,000	3,000
		98,250
Spares contingency		10,750
		Le 109,000

2. Spare parts imported

	Unit Cost $	Total Cost (ex works)$
21 boiler mudhole joints	5	105
2 donkey feed pump packing	10	20
1 slide valve packing	10	10
1 connecting rod packing	15	15
3 autoclave top cover joints	15	45
3 autoclave bottom cover joints	10	30
1 Spirax 9-200 valve	35	35
3 steam pressure relief valves	70	210
3 steam pressure gauges	30	90
5 Spirax No. 14 valves	25	125
380 ft. Ballata belting - average width	4	1,520
100 ft. steam pipe/lagging	10	1,000
80 ft. steel wire rope ½"d	10	800
1 Dynamo and repairs to electric controls, wiring and light fittings	3,000	3,000
		7,005
Spares contingency		795
	Total	$7,800

Wanjei - Mill Machinery and Equipment Cost Estimates

1. Spare parts manufactured locally

	Unit Cost Le	Total Cost (ex works) Le
24 elevator buckets	120	2,880
2 donkey feed pump valves	1,800	3,600
1 set boiler fire bars	22,000	22,000
1 digester layshaft	2,500	2,500
1 digester pinion	2,400	2,400
1 digester crown wheel	10,000	10,000
6 digester blades	600	3,600
1 yoke	750	750
6 separator knives	700	4,200
18 separator blades	600	10,800
8 nutcracker liners	300	2,400
1 nutcracker input channel	1,500	1,500
Lubricants	3,000	3,000
		69,630
Spares contingency		7,370
		Le 77,000

2. Spare parts imported

	Unit cost $	Total cost (ex works)$
21 boiler mudhole joints	5	105
2 donkey feed pump packing	10	20
1 thermometer	8	8
1 engine slide valve packing	10	10
1 connecting rod packing	15	15
2 autoclave bottom cover joints	10	20
3 steam pressure relief valves	70	210
3 steam pressure gauges	30	90
1 oil pump shaft packing	10	10
5 Spirax No. 14 valves	25	125
380 ft. Ballata belting - average width	4	1,520
100 ft. steam pipe lagging 3" x 1½"d	10	1,000
1 Dynamo and repairs to electrics	3,000	3,000
		6,133
Spares contingency		667
	Total	$6,800

A.2.2.2. Summary of Mill Machinery and Equipment Costs

Mill	Leones Local spares (ex works)	Leones Transport cost to mill	$ Imported spares (ex works)	$ Transport costs to Freetown 20%	$ Total import costs	Leones Transport costs to mill of imports	Leones Install ation costs	Leones total local costs	Leones Total equivalent costs
Baoma	137,000	10,000	4,500	900	5,400	10,000	12,000	169,000	326,000
Kasse Kangha	127,000	10,000	5,800	1,200	7,000	10,000	13,000	160,000	363,000
Mange Bureh	89,000	10,000	6,600	1,400	8,000	10,000	13,000	122,000	354,000
Masanki	146,000	10,000	5,700	1,200	6,900	10,000	14,000	180,000	380,000
Sahn Malen	86,000	10,000	5,500	1,100	6,600	10,000	12,000	118,000	309,000
Telu	109,000	10,000	7,800	1,600	9,400	10,000	14,000	143,000	416,000
Wanjei	77,000	10,000	6,800	1,400	8,200	10,000	13,000	110,000	348,000

A.2.2.3. U.K. Suppliers of Mill Machinery and Equipment Spares

Although some of the original U.K. suppliers of Pioneer mill equipment no longer exist, e.g. Cradley Boilers Ltd., this does not mean that essential spare parts cannot be obtained. Many of the required boiler spares such as joints and packings, valves and fittings, may be obtained from alternative suppliers once detailed and accurate specifications and drawings (already provided in the Cole/Jalloh report) have been provided from careful measurements of the existing worn parts. The following names and addresses are examples of U.K. companies which may be contacted for the supply of various mill equipment spares.

1. Joints and packings

   James Walker Co. Ltd.
   P.O. Box 1,
   Lion Works,
   Woking, Surrey, England

2. Pipework, valves, fittings and insulation:-

   B.T.U. (Supplies) Ltd.
   38, Weyside Road,
   (Off Stoughton Road)
   Guildford,
   Surrey, England

3. Lister diesel generators and pumps:-

   Arise Power Plant,
   Estuary Works,
   Walton Avenue,
   Felixstowe,
   Suffolk, England

4. Ballata belting for machinery drives:-

   Bearing Service Ltd.
   Unit 5,
   Westham Industrial Estate,
   Grafton Way,
   Basingstoke,
   Hants. England

5. Boiler fittings for Cradley boiler:-

   Senior Green (Economisers) Ltd.
   Wakefield, Yorkshire, England.

A.2.2.4. Outline Specifications for Pioneer Mill Workshop Tools and Laboratory Equipment (Required for Full Cost Rehabilitation)

1. Workshop Tools	Estimated Costs Leones	$
½" pillar drill, electric motor and drive		1.500
Electric hand drill		100
Electric hand grinder		100
Oxy-acetylene pressure regulators and torch (coupled with the use of oxy-acetylene bottles)		300
Blacksmith equipment		500
Pipefitting tools		200
Fitters tools and bench vice		400
Electricians tools and soldering equipment		100
Bench	3,000	
Spare drills, grinding wheels,etc.		200
	Le 3,000 +	$3,500

2. Laboratory equipment and consumables

Testing equipment and consumables for testing ffa, moisture and dirt contents in palm oil and moisture and dirt and shell contents in kernels, should include the following items.

(1) Electric oven with thermostat to operate at 105°C
(2) Self-indicating balance scale weighing up to 1 kilogram in steps of 1 gm.
(3) Titration equipment
(4) Glass ware in the form of beakers, flasks, measuring cylinders, funnels, burettes, test tubes, thermometers (0° to 120°C) etc.
(5) Butane bunsen burners and tripods with asbestos plates
(6) Moisture tester and probe for measuring kernels in bags
(7) Consumables such as potassium hydroxide, phenolphithalein, trichlorethylene, etc.

A.2.2.5. Total Rehabilitation Cost Estimates for Each Mill

The requirements for rehabilitating the mill buildings, the mill machinery and equipment and for safeguarding the water supply, as well as erecting a security fence around the mill compound, are specified and costed separately for each mill.

The rehabilitation costs have been presented in two ways. First, as a full cost incorporating not only essential repairs but also desirable additions to mill operations in the form of (a) a simple process control laboratory to allow daily production records on oil and kernel qualities to be kept e.g. oil ffa and water contents, (b) a small diesel generator power supply for the operation of workshop tools and for the provision of lighting within the laboratory and supervisor's house, (c) maintenance workshop tools, (d) additional oil storage drums and in some cases, (e) an improved water supply necessitated by increased mill operation and throughput.

Secondly, a minimum cost option is given which would be sufficient for getting the mill into working order but omits some of the non-essential items described in (a) to (e) above. In both cases a 10% contingency allowance is added.

Baoma - Total Rehabilitation Cost Estimates for Mill

	Full Cost		Minimum Cost	
	Le +	$	Le +	$
Building				
Repairs to bent steel columns near FFB reception area.	4,000		4,000	
Wire brush and repaint steelwork	2,000		2,000	
10% new roofing sheets 26 swg galvanised: roof area 90 ft. x 60 ft. approx.	18,000		18,000	
Minor repairs to mill floor, kernel drier floor and to end concrete column and to boiler foundation	6,000		6,000	
Painting building walls	1,000		1,000	
Water Supply				
Overhaul of Lister twin cylinder 3" diesel pump.	2,000	500	2,000	500
New pump house	12,000		12,000	
Wire brush and repaint water storage tank and supporting steelwork	1,000		1,000	
Security Fence				
New galvanised steel wire security fence (8 ft. x 300 ft. x 300 ft.) and concrete posts, complete with entrance gates and small gatehouse	16,000	15,000	16,000	15,000
Kernel Store				
Minor repairs and repaint	1,000		1,000	
Workshop and Store				
Minor repairs and repaint	1,000		1,000	
Office				
Minor repairs and repaint	3,000		3,000	
Supervisor's House				
Minor repairs and repaint	4,000		4,000	

ANNEX 2

	Full Cost Le +	$	Minimum Cost Le +	$
<u>Mill Machinery & Equipment</u>	167,000	5,400	167,000	5,400
Add: Laboratory for process control	54,000	2,000	-	-
3 kw diesel generator for workshop/office/ laboratory/house power supply plus generator hut and diesel storage tank	25,000	4,000	-	-
Workshop tools	3,000	3,500	-	-
Oil storage drums - 45 x 90 galls.	8,000			
Totals	328,000	30,400	238,000	20,900
10% contingencies	33,000	3,100	24,000	2,100
GRAND TOTALS	361,000	33,500	262,000	23,000
Total equivalent Leones	1,332,000		929,000	

Kasse Kangha - Total Rehabilitation Cost Estimates for Mill

	Full Cost Le +	$	Minimum Cost Le +	$
Building				
Wire brush and repaint steelwork			2,000	
100% new roofing sheets 26 swg galvanised: roof area 90 ft x 60 ft approx.			150,000	
Minor repairs to mill floor and kernel drier floor			2,000	
Painting of building walls			1,000	
Water Supply				
Repairs to 3" water supply line and reconditioning of Lister twin cylinder diesel pump			6,000	1,000
Minor repairs to pumphouse			1,000	
Security Fence				
New galvanised steel wire security fence (8ft x 400 ft x 300 ft) and concrete posts complete with entrance gates and small gatehouse			17,000	16,000
Kernel Store				
Minor repairs and repaint			1,000	
Workshop and Store				
Minor repairs and repaint			1,000	
Office				
5% new roofing sheets 26 swg galvanised				
Minor repairs to doors and windows				
Wire brush and repaint building			5,000	

ANNEX 2

	Full Cost Le	+ $	Minimum Cost Le	+ $
<u>Supervisor's House</u>				
Minor repairs to building structure and windows				
Wire brush and repaint			4,000	
<u>Mill Machinery and Equipment</u>			160,000	7,000
Totals			350,000	24,000
10% contingencies			35,000	2,400
GRAND TOTALS			385,000	26,400
Total equivalent Leones			1,150,000	

Note: Because a "full cost" rehabilitation of the Kangha mill depends on the provision of an expensive new water supply no "full cost" estimate has been given.

ANNEX 2

Mange Bureh - Total Rehabilitation Cost Estimates for Mill

	Full Cost Le	+ $	Minimum Cost Le	+ $
Building				
Wire brush and repaint steelwork	2,000		2,000	
10% new roofing sheets 26 swg galvanised: roof area 90 ft x 60 ft approx.	18,000		18,000	
Minor repairs to mill floor and kernel drier floor	1,000		1,000	
Painting of building walls	1,000		1,000	
Water Supply				
Minor repairs to pump house	1,000		1,000	
Wire brush and repaint water storage tank and supporting steelwork	1,000		1,000	
Security Fence				
New galvanised steel wire security fence (8 ft x 300 ft x 300 ft) and concrete posts complete with entrance gates and small gatehouse	16,000	15,000	16,000	15,000
Kernel Store				
Minor repairs and repaint	1,000		1,000	
Workshop/Store				
Minor repairs and repaint	1,000		1,000	
FFB Store				
Minor repairs to wooden framework	1,000		1,000	
Office				
Repairs to windows: wire brush and repaint building including roof	4,000		4,000	

ANNEX 2

	Full Cost Le +	$	Minimum Cost Le +	$
Supervisor's House				
Minor repairs: wire brush and repaint	4,000		4,000	
Rest House				
Refurbishment and repaint	10,000		10,000	
Mill Machinery and Equipment	120,000	8,000	120,000	8,000
Add:				
Laboratory for process control	54,000	2,000		
3 kw diesel generator for workshop/office/laboratory/ house power supply plus generator hut and diesel storage tank	25,000	4,000		
Workshop tools	3,000	3,500	-	-
Oil storage drums - 45 g and 90 g	8,000		-	-
Totals	271,000	32,500	181,000	23,000
10% contingencies	27,000	3,300	18,000	2,300
GRAND TOTALS	298,000	35,800	199,000	25,300
Total equivalent Leones	1,336,000		933,000	

Masanki - Total Rehabilitation Cost Estimates for Mill

	Full Cost Le	+ $	Minimum Cost Le	+ $
Buildings				
Repairs to 2 steel columns and A frames holding main countershaft	4,000		4,000	
Wire brush and repaint steelwork	2,000		2,000	
100% new roofing sheets 26 swg galvanised: roof area 90 ft x 60 ft approx.	150,000		150,000	
Minor repairs to mill floor and kernel drier floor	2,000		2,000	
Repairs to walls of FFB storehouse 50 ft x 25 ft.	2,000		2,000	
Painting building walls	1,000		1,000	
Water Supply				
Overhaul of 3" Lister twin cylinder diesel pump	2,000	500	2,000	500
Repairs to pumphouse	2,000		2,000	
Housing for well water supply	3,000		3,000	
Security Fence				
New galvanised steel wire security fence (8 ft x 400 ft x 300 ft) and concrete posts complete with entrance gates and small gatehouse	17,000	16,000	17,000	16,000
Kernel Store				
Minor repairs and repaint	1,000		1,000	

ANNEX 2

	Full Cost Le	+ $	Minimum Cost Le	+ $
Office				
Minor repairs and repaint	2,000		2,000	
Supervisor's House				
Minor repairs and repaint	4,000		4,000	
Mill Machinery and Equipment	180,000	6,900	180,000	6,900
Add:				
Laboratory for process control	54,000	2,000	-	-
3 kw diesel generator for workshop/office/laboratory/house power supply plus generator hut and diesel storage tank	25,000	4,000	-	-
Workshop/store building	50,000		-	-
Workshop tools	3,000	3,500	-	-
Oil storage drums - 45 g and 90 g	8,000		-	-
Totals	512,000	32,900	372,000	23,400
10% contingencies	51,000	3,300	37,000	2,400
GRAND TOTALS	563,000	36,200	409,000	25,800
Total equivalent Leones	1,613,000		1,157,000	

ANNEX 2

Sahn Malen - Total Rehabilitation Cost Estimates for Mill

	Full Cost Le +	$	Minimum Cost Le +	$
Building				
Wire brush and repaint steelwork	2,000		2,000	
100% new roofing sheets 26 swg galvanised: roof area 90 ft by 60 ft. approx.	150,000		150,000	
Minor repairs to mill floor and kernel drier floor	1,000		1,000	
Painting of building walls	1,000		1,000	
Water Supply				
New water supply line from river source 1500 ft. away aprox. including new diesel pump and pumphouse	20,000	35,000	-	-
Repairs to existing 3" water line including reconditioning of Lister twin cylinder diesel pump and pumphouse	-	-	8,000	1,000
Wire brush and repaint water storage tank and supporting steelwork	1,000		1,000	
Security Fence				
New galvanised steel wire security fence (8 ft x 400 ft x 400 ft) and concrete posts complete with entrance gates and small gatehouse	18,000	16,000	18,000	16,000
Kernel Store				
Repairs to door and windows				
Wire brush and repaint building	1,000		1,000	

ANNEX 2

	Full Cost Le	+ $	Minimum Cost Le	+ $
Workshop/Store				
100% new roofing sheets 26 swg galvanised				
Wire brush and repaint building	5,000		5,000	
Office				
100% new roofing sheets, 26 swg galvanised				
Repairs to windows				
Wire brush and repaint	20,000		20,000	
Supervisor's House				
Repairs to windows and rehabilitation of toilet and kitchen				
Wire brush and repaint	9,000		9,000	
Mill Machinery and Equipment	118,000	6,600	118,000	6,600
Add:				
Laboratory for process control	54,000	2,000		
3 kw diesel generator for workshop/office/laboratory/ house power supply plus generator hut and diesel storage tank	25,000	4,000	-	-
Workshop tools	3,000	3,500	-	-
Oil storage drums - 45 g and 90 g	8,000			
Totals	436,000	67,100	334,000	23,600
10% contingencies	44,000	6,700	33,000	2,400
GRAND TOTALS	480,000	73,800	367,000	26,000
Total equivalent Leones	2,620,000		1,121,000	

ANNEX 2

Telu - Total Rehabilitation Cost Estimates for Mill

	Full Cost Le	+ $	Minimum Cost Le	+ $
Building				
Wire brush and repaint steelwork	2,000		2,000	
10% new roofing sheets 26 swg galvanised: roof area 90 ft x 60 ft approx.	18,000		18,000	
Minor repairs tc mill floor and kernel drier floor	1,000		1,000	
Painting of building walls	1,000		1,000	
Water Supply				
New 3" water supply line from river source some 150 ft. away approx. including new Lister twin cylinder diesel pump	10,000	7,000	-	
Repairs to existing pumphouse including new door	1,000		1,000	
Wire brush and repaint water storage tank and supporting steelwork	1,000		1,000	
Security Fence				
New galvanised steel wire security fence (8 ft x 400 ft x 300 ft) and concrete posts, complete with entrance gates and small gatehouse	17,000	16,000	17,000	16,000
Kernel Store				
Repairs to door and windows				
Wire brush and repaint building	1,000		1,000	
Workshop and Store				
Repairs to door				
Wire brush and repaint building	1,000		1,000	

ANNEX 2

	Full Cost Le +	$	Minimum Cost Le +	$
Office				
5% new roofing sheets 26 swg galvanised				
Repairs to door and windows				
Wire brush and repaint building	5,000		5,000	
Supervisor's House				
Repairs to windows and minor building repairs				
Wire brush and repaint	6,000		6,000	
Mill Machinery and Equipment	143,000	9,400	143,000	9,400
Add:				
Laboratory for process control	54,000	2,000	-	-
3 kw diesel generator for workshop/office/laboratory/house power supply plus generator hut and diesel storage tank	25,000	4,000		
Workshop tools	3,000	3,500		
Oil storage drums - 45 g and 90 g	8,000			
Totals	297,000	41,900	197,000	25,400
10% contingencies	30,000	4,200	20,000	2,600
GRAND TOTALS	327,000	46,100	217,000	28,000
Total equivalent Leones	1,664,000		1,029,000	

ANNEX 2

Wanjei - Total Rehabilitation Cost Estimates for Mill

	Full Cost Le +	$	Minimum Cost Le +	$
Building				
Wire brush and repaint steelwork	2,000		2,000	
5% new roofing sheets 26 swg galvanised: roof area 90 ft x 60 ft approx.	12,000		12,000	
Minor repairs to mill floor and kernel drier floor	1,000		1,000	
Painting building walls	1,000		1,000	
Water Supply				
New Lister twin cylinder diesel pump and repairs to pumphouse	1,000	6,000		
Overhaul of existing donkey steam pump and repairs to pumphouse			2,000	
Wire brush and repaint water storage tank and supporting steelwork	1,000		1,000	
Security Fence				
New galvanised steel wire security fence (8 ft x 250 ft x 250 ft) and concrete posts complete with entrance gates and small gatehouse	15,000	14,000	15,000	14,000
Kernel Store				
Minor repairs and repaint	1,000		1,000	
Workshop/Store				
Minor repairs and repaint	1,000		1,000	
Office				
Minor repairs and repaint	3,000		3,000	

ANNEX 2

	Full Cost Le	+ $	Minimum Cost Le	+ $
Supervisor's House				
Minor repairs and repaint	5,000		5,000	
Mill Machinery and Equipment	110,000	8,200	110,000	8,200
Add:				
Laboratory for process control	54,000	2,000	-	-
3 kw diesel generator for workshop/office/laboratory/ house power supply plus generator house and diesel storage tank	25,000	4,000		
Workshop tools	3,000	3,500		
Oil storage drums - 45 g and 90 g	8,000			
Totals	243,000	37,700	154,000	22,200
10% contingencies	24,000	3,800	15,000	2,300
GRAND TOTALS	267,000	41,500	169,000	24,500
Total equivalent Leones	1,470,000		879,000	

A.2.2.6. Rehabilitated Pioneer Mill Operating Costs (Minimum Cost Basis)

Operating costs may be expected to vary according to the monthly tonnage of FFB to be processed and hence the number of working hours necessary per month. The costs below are based on a maximum 24 working days per month.

Labour Costs Single Shift

			Unit Cost Le/month	Monthly Total
Labour	1	Supervisor	750/month	750
	1	Clerk	450/month	450
	1	Mechanic	450/month	450
	1	Boiler/Engine man	400/month	400
	12	Process workers	10/day	2,880
	3	Watchmen	10/day	720
				5,650

Material Costs

To include the following:
Lubricating oil for main engine and all other moving parts
Ballata belting and clips
Replacement bearings and bushes
Replacement gear wheels and pinions
Replacement joints

Allow Le2,350/month
(50% local
(50% foreign)

Occasional welding repairs, etc.
Replacement boiler fire grates and chimney
Replacement digester/blades and separator beaters and knives
Replacement tools, welding rods, etc.

TOTAL OPERATING COST SINGLE SHIFT — Le 8,000/Month

For 2 shift working assume — Le 12,000/month

Note: For a full cost basis the above operating costs should be increased to Le 12,000/month for single shift and Le18,000 for 2 shift working: this allows for the additional cost of a laboratory technician (Le450/month) and of diesel fuel for the diesel power generator.

A.2.2.7. Operation of the Rehabilitated Pioneer Mills

1. If the plantations were rehabilitated the maximum FFB crop projections and yields of palm oil and kernels for each Pioneer mill plantation would be approximately as follows:-

Mill	Maximum production (t.p.a.)		
	FFB	Palm Oil	Kernels
Baoma	875	153	70
Kasse Kangha	1,900	332	152
Mange Bureh	1,050	184	84
Masanki	600	105	48
Sahn Malen	2,340	409	187
Telu	1,900	332	152
Wanjei	150	26	12

In each case the maximum crop is expected to occur during Project Year 3 and yields of oil and kernels are based on 17.5% and 8% respectively.

2. Since the processing capacity of each Pioneer mill after full rehabilitation is expected to be 1½ t.p.h. or 2,500 t.p.a. (see Section 4.3) no problems should arise in processing any of the above FFB annual production tonnages into palm oil and kernels. On the basis of 24 working days or 336 hours per peak month, assumed to be 20% of annual production, the maximum number of hours to be worked each day equates to 14 or two 7 hour shifts. Only in the case of Sahn Malen where FFB production is expected to be around 2,340 t.p.a. is such two shift working likely to be necessary - in all other cases one long shift should prove sufficient throughout the year.

3. The estimated rehabilitation costs for each mill are given in Section 4.3. Operating costs are expected to vary according to the anticipated FFB throughputs (see above) as follows:

Mill	Working Hr. Necessary in Peak Months	"Minimum cost" basis Operating Costs Le per Year	
Baoma	117	12 x 6,000	72,000
Kasse Kangha	255	12 x 8,000	96,000
Mange Bureh	141	12 x 6,000	72,000
Masanki	80	12 x 4,000	48,000
Sahn Malen	315	3 x 12,000 plus 9 x 8,000	108,000
Telu	255	12 x 8,000	96,000
Wanjei	20	12 x 4,000	48,000

4. The factory manning for each Pioneer mill will normally be 20 on single shifts including the factory supervisor, mechanic, clerk and laboratory technician.

The training of the factory supervisor, mechanic and clerk will all need to be improved so that a proper understanding of their duties and how best to perform them may readily be understood. It is suggested that this can best be done by "on the job" training with the assistance of palm oil factory consultants over an initial period of say 2 months followed by yearly monitoring of progress and factory performance: the new laboratory technician should also be trained in this way.

5. The palm oil produced at each Pioneer mill will need to be packaged and stored before being collected by buyers or transported by lorry to the main market centres such as Bo and Freetown. Initially when oil production is still very modest, standard 45 gallon and 90 gallon drums may continue to be used as at present. Later, say after 2 years from starting the rehabilitation of the plantations when FFB and oil production may have doubled, it may become necessary to install a storage tank at certain mills capable of holding about 2 weeks average oil production. Sahn Malen, for instance, would require a 20 ton storage tank. In each case the tank would need to be equipped with a steam heated coil to prevent the oil from solidifying: the oil is subsequently delivered by gravity into drums as before and collected by lorry for market.

Kernels can continue to be bagged but care should be taken to ensure that the bags are stored in dry conditions to help maintain the low moisture content and keeping qualities of the product.

6. There are two very desirable requirements for improving the efficient operation of each Pioneer mill.

(i) The provision of a number of workshop tools at each mill for essential daily maintenance purposes so that mill processing facilities are always available.

(ii) The provision of a small laboratory room equipped with water and work bench where the free fatty acid (ffa) content of the oil produced in the mill and the moisture and dirt contents of the oil and kernels may be tested daily. This will help to ensure that the oil and kernels sold to the markets will be of consistent and desirable qualities. In this respect ffa content would be expected to be between 3% and 5%, water in oil under 0.2% and dirt in oil under 0.01% whilst kernel moisture content should be under 8% with dirt and shell content under 6%.

Outline specifications of the workshop tools and laboratory equipment were given in A.2.2.4.

7. In implementing the rehabilitation of each Pioneer mill two essential matters will have to be attended to.

(i) All the pressure vessels, and the boiler in particular, must be fully inspected and tested by the Chief Factories Officer in order to conform to the Factories Act and the necessary test certificates issued before the factory machinery and equipment can be considered safe to operate.

(ii) All the Pioneer mill spares at present held in the central stores of SLPMB at Bo, of which an up-to-date inventory dated April 1986 exists, must be thoroughly checked and made use of wherever possible before ordering new spares from abroad or from sources within Sierra Leone such as the National Workshop. From the evidence of the latest inventory it would appear that considerable savings may be effected in the cost of spares required for each mill if full account and use of existing stock is properly taken into account.

A.2.3. Costs of New Palm Oil Mills

1. The main palm oil mill suppliers are to be found in Luxembourg (Usine-de-Wecker), Holland (Stork), France (Speichim) and in Malaysia (Kampulan-Emas, Hip Hing, etc.). In general the most competitive prices are likely to come from Malaysia. However, the quality of some of the equipment will not always be as good as that from Western Europe and this could affect long-term operating costs as items wear out more quickly. The estimated costs (including 10% contingency) of the palm oil mills listed below are based on Malaysian turnkey prices.

Mill Capacity	Item	F.X. Costs $	Local Costs Leones	Total Costs Equivalent Leones
2 t/hr FFB	Equipment	400,000		11,600,000
	Services	35,000		1,000,000
	Civils & Bldgs		5,400,000	5,400,000
				18,000,000
3 t/hr FFB	Equipment	660,000		19,100,000
	Services	40,000		1,200,000
	Civils & Bldgs		6,700,000	6,700,000
				27,000,000
5 t/hr FFB	Equipment	980,000		28,400,000
	Services	60,000		1,700,000
	Civils & Bldgs		10,900,000	10,900,000
				41,500.000
10 t/hr FFB	Equipment	1,740,000		50,500,000
	Services	100,000		2,900,000
	Civils & Bldgs		18,600,000	18,600,000
				72,000,000

2. In the case of palm oil mills installed in 2 stages or housing 2 process lines, which are sometimes necessary in order to accommodate a slow phased build-up in FFB production, costs are estimated as follows:

Mill Capacity	Item	F.X. Costs $	Local Costs Leones	Total Costs Equivalent Leones
3 t/hr.+ 5 t/hr	Equipment	1,400,000		40,600,000
FFB	Services	80,000		2,300,000
	Civils & Bldgs.		14,100,000	14,100,000
				57,000,000

Of the Le 57m total it may be assumed that Le 33m would be required for the initial 3 t/hr. stage and Le 24m for the second 5 t/hr stage.

Mill Capacity	Item	F.X. Costs $	Local Costs Leones	Total Costs Equivalent Leones
5 t/hr.+ 10 t/hr	Equipment	2,180,000		63,200,000
FFB	Services	130,000		3,800,000
	Civils & Bldgs		23,000,000	23,000,000
				90,000,000

Of the Le 90m total it may be assumed that Le 50m would be required for the initial 5 t/hr stage and Le 40m for the second 10 t/hr stage. Further details of the cost estimates for the 15 t/hr. FFB capacity mill, which is the preferred option for the proposed project at Kasse/Sahn Malen, are given in the table below.

ANNEX 2

Cost Estimates for 15 t/hr. Capacity Palm Oil Factory

Item	Installed Costs $	Installed Costs Leones	Total Equivalent Leones
Mill machinery and equipment:			
FFB reception station	200,000		
Sterilisation station	90,000		
Threshing and pressing station	350,000		
Clarification station	310,000		
Kernel recovery station	175,000		
Steam and power plant	1,000,000		
Services including pipework and electrics	185,000		
	2,310,000		67,000,000
Civil works and foundations		12,000,000	
Building structures		10,000,000	
Effluent treatment ponds		1,000,000	
		23,000,000	23,000,000
			90,000,000

3. Estimated operating costs for the new mills are as follows.

Mill Capacity	Operating Costs, Leones/Month		
	Labour	Materials	Total
2 t/hr FFB	432 man-days at Le 15/day average = 6,480	7,000	13,480
3 "	480 man-days at Le 15/day average = 7,200	10,000	17,200
5 "	576 man-days at Le 15/day average = 8,640	15,000	23,640
10 "	672 man-days at Le 15/day average = 10,080	25,000	35,080
3 t + 5 t/hr FFB	1,056 man-days at Le 15/day average = 15,840	20,000	35,840
5 t + 10 t/hr FFB	1,248 man-days at Le 15/day average = 18,720	30,000	48,720

1 single day shift, nominally of 8 hrs. but varying between 6 and 10 hrs. according to need, has been assumed 24 days a month for 9 months a year. The remaining 3 peak months will mostly require 2 shift working when total costs may be assumed to be increased by a factor of 1.5. e.g. Le73,000/month for the 5t + 10t/hr. mill.

The build-up of operating costs for such a mill, which is the preferred option for the proposed project at Kasse/Sahn Malen, are given in the table overleaf.

Build-up in Operating Costs for 15 T/Hr FFB Capacity Mill

Assuming the first stage of factory capacity is commissioned during year 7 and the second stage during year 9, opeating costs are expected to approximate to those listed below, based on an average pay rate of Le15/day per man and 24 working days per month.

Year	Manning	Man/days per month	Labour cost/month	Maintenance materials cost/month	Total Costs per month Le
Year 7	40 on single shift for 12 months	960	14,400	10,000	24,400
Year 8	40 on single shift for 12 months	960	14,400	20,000	34,400
Year 9	40 on single shift for 9 months	960	14,400	20,000	34,400 for 9 months
	60 on two shifts for 3 months	1,440	21,600	30,000	51,600 for 3 months
Year 10 at seq.	52 on single shift for 9 months	1,248	18,720	30,000	48,720 for 9 months
	78 on two shifts for 3 months	1,872	28,080	45,000	73,080 for 3 months

Note: 90% of the maintenance materials costs will be incurred as foreign exchange.

A.2.4. Factory Requirements for the Kasse/Sahn Malen Development Plan

1. On the basis of the FFB projections the following yields of palm oil and kernels may be expected.

Year	FFB	Maximum Production tpa	
		Palm Oil	Kernels
6	500	110	20
7	2,400	528	96
8	4,800	1,056	192
9	8,000	1,760	320
10	12,000	2,640	480
11	16,000	3,520	640
12	19,200	4,224	768
13	21,600	4,752	864
14	23,200	5,104	928
15	24,000 et seq.	5,280	960

It has been assumed that with the use of improved palm tree stock and oil extraction efficiency expected from the use of modern commercial palm oil factories, that yields of palm oil and kernels should reach a maximum of 22% and 4% respectively.

2. Assuming, as before, a maximum monthly peak production figure of 20% of annual, the final factory capacity has to be capable of processing 4,800 tons of FFB per month. On the basis of 24 working days and 14 press hours per day (two 8 hr shifts) the required capacity needs to be around 15 tons/hr.

Since the build-up of FFB extends over a long period of some 9 years, it is advisable to consider installing new factory capacity in two stages. The first stage could take up to, say, 5 tons/hr. equivalent to 8,500 t.p.a. (project year 9) and the second stage of

10 tons/hr equivalent to 17,000 t.p.a. would take the combined factory capacity to 25,500 t.p.a. This would leave a small margin in capacity should FFB additional to the projected 24,000 t.p.a. prove possible either from smallholders or increased yields.

An alternative would be to install the factory capacity in two 7½ t/hr stages.

3. The estimated total capital costs of the 15 t/hr palm oil factory is expected to amount to $2,310,000 plus Leones 23 million which is equal to a total cost of Leones 90 million.

5. Factory manning can normally be expected to total 52 on single shifts, made up of the factory manager, factory engineer and 50 supporting staff. During the short 3 month peak season two shift working may prove to be necessary as an alternative to long single shifts and factory manning could rise to 78. Both the factory manager and engineer would need to be experienced in the operation of modern palm oil mills and assistance and advice on factory performance from an outside palm oil factory consultant for, say, 2 weeks every year would prove beneficial.

6. The palm oil and kernels produced within the new factory will have to be stored at the mill until road transport to the markets can be arranged.

Bulk storage tanks, fitted with steam heated coils, will be required for the oil with a storage capacity of at least 4 weeks average oil production. Thus ultimate oil storage capacity will probably be around 500 tons. Road tankers, holding 7 tons of oil, will be required to transport the oil to the markets.

The kernels, after bagging and storage at the mill, will be transported in covered lorries to Freetown. The kernels have to be stored under dry conditions to maintain their low moisture content and quality.

7. An important aspect of the factory design will be the measures taken to treat and dispose of the factory effluent which is an essential part of the factory process. For the proposed factory development a system of effluent treatment ponds is proposed with the final discharge of the effluent liquids into the river itself. This commercially acceptable form of treatment should ensure that no ecological damage to the river environments will occur.

8. The siting of the new mill remains to be finalised at appraisal stage but an apparently suitable site, next to a sizeable river and about 3 miles from Kangha Pioneer mill, was shown to the team's engineer.

ANNEX 3 MISCELLANEOUS

Contents

A.3.1. **Terms of reference**

for

The preparation of the documentation for the rehabilitation of seven palm oil (pioneer) mills in Sierra Leone

1. Description of the project

The United Nations Industrial Development Organization is to carry out a techno-economic assessment and evaluation of the public sector palm oil (pioneer) mills predominantly operating in rural areas. The evaluation is to result either in the definition of economically justified technical and managerial improvement action or in the specification of the most suitable palm oil factory(ies) to be established for the production of palm oil for domestic markets in replacement of the existing pioneer mills.

2. Background information

Sierra Leone is a traditional palmoil producing country and palm oil is an essential food item for the local population. The total consumption of palm oil is estimated at 55.000 tons per year. The accessible wild palm trees are estimated to cover an area of 60.000 acres. In addition there are more than 40.000 acres of cultivated oil palm plantations producing palm fruits for industrial exploitation.

In the public palm oil production sector ten oil mills exist with a capacity of 20.000 tons of red (crude) palm oil and 3.500 tons of palm kernel per annum. In the traditional household production sector additional 18.000 tons of crude red palm oil are annually produced and the rest in the private industries sector.

Despite this large palm oil potential, the country has been facing a crisis in its palm oil production sector, namely due to the fact that the existing palm oil mills only operate at fractions of their installed capacity. A UNIDO expert estimated the capacity utilization at 25 per cent only. The situation resulted in the need for palm oil imports of 8000 tons per annum to fill at least part of the shortfall in the domestic production involving Le 10 million of foreign exchange.

The main reason for the very low capacity utilization appear to be inefficient management, unsatisfactory plant maintenance, high production losses, technically out-dated eqipment and others. In order to improve this situation, a UNIDO expert (SI/SIL/82/801) had recommended the setting up of a Common Facility Centre for the Palmoil Industry to act as a co-ordinator and to provide the individual oil mills with the necessary as well as technical and financial assistance. The recommendation was favourably received by the authorities but turned down later primarily because of the policy decision taken by the Government to privatize the entire public palm oil production sector.

In the meantime the privatization process has started. With regard to the privatization of two larger scale oil mills negotiations have already reached the final stage. However, the remaining seven smaller scale palm oil mills which are 30 to 50 years old and not any more technically up to date have not so far attracted the interest of private investors. These seven mills may still reach a higher level of productivity if suitably repaired and modernized and if appropriate management methods be applied combined with structural changes.

In case the rehabilitation of these seven palm oil mills could necessarily be carried out, their total production could be increased from the present 1,600 tons of palm oil per annum to 6,300 tons which is equal to their previously installed production capacity. Such an increase in the production of the seven factories would nearly cover the production shortfall and palm oil imports could be reduced.

The Government of Sierra Leone, therefore, wishes to make use of UNIDO assistance to result in a complete and detailed assessment of the situation along with specific recommendations for rehabilitation action based on relevant economic and financial calculations.

3. <u>Responsibilities and duties of the contractor</u>

a) An assessment is to be made of the (natural) palm fruit production sector resulting in recommendations for the improvement of yields, harvesting methods, FFA quality controls, transport to the factories, management controls and other relevant requirements.

b) An assessment is to be made of the seven pioneer mills presently in operation followed by an evaluation of the technology applied, the equipment used, repair and maintenance services, quality controls, management structure, qualification of labour and staff, product packaging and marketing and other relevant issues.

c) Based on the results obtained from the assessment mentioned under 5 b) above, conclusions have to be drawn with regard to the most appropriate action to be taken for the rehabilitation of seven pioneer mills - or their most suitable replacement in line with the palm oil requirements of the domestic market.

d) The rehabilitation/replacement action has to be specified in its details for either the rehabilitation of each pioneer mill or the replacement of all or part of them as individual factories or combined processing units.

e) A detailed cost estimate has to be prepared divided into items to be imported and items to be locally manufactured.

f) A work programme and time schedule has to be elaborated based on priority action itemizing the work to be carried out combined with cost structures in local currency and foreign exchange.

g) The rehabilitation/replacement action as outlined under 5 d, e and f above has to be economically justified from the factories' production efficiency view point and from the country's national economy view point.

h) A comprehensive rehabilitation document has to be prepared for financing purposes and forming the basis for practical rehabilitation/replacement action to follow. The document in principle is to contain the following:

- equipment specification
- technology revisions (flow diagrams)
- repair and maintenance facilities and spare parts
- quality control arrangements
- management structure
- labour and staff requirements and training
- product packaging and marketing
- raw material controls and supplies
- detailed cost calculations
- economic evaluation.

Important

a) The components of the assessment and evaluation work as listed above are not necessarily exhaustiveof those required for their appropriate execution. The contractor is, therefore, required to collect, evaluate and present any additional information and carry out any additional work which he considers essential for the preparation of the rehabilitation document

b) The rehabilitation document shall contain all data and sources of information which have been used as the basis for the conclusions arrived at.

4. Language qualification: English

5. General programme schedule

a) The contractor's team leader is required to visit UNIDO Headquarters for detailed briefing discussions with UNIDO's substantive staff within two weeks from the date of signing the contract.

b) The contractor will submit to UNIDO three copies of his field study report upon completion of the field study work but not later than two months from the date of signing the contract.

c) The contractor will submit to UNIDO three copies of his final draft of the rehabilitation/replacement document latest within fifteen weeks from the date of signing the contract.

d) UNIDO will prepare its comments on the final draft of the rehabilitation/replacement document within ten days of receipt.

e) The contractor will take into consideration the comments made by UNIDO in preparing the final rehabilitation/replacement document, five copies of which are to be submitted to UNIDO within two weeks after receipt of UNIDO comments.

f) The contractor's personnel shall be available at UNIDO Headquarters for detailed evaluation/debriefing discussions with UNIDO's substantive staff according to the requirements at a date to be mutually agreed upon.

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ANNEX 4 BACKGROUND TO THE FINANCIAL AND ECONOMIC ANALYSES

Contents

ANNEX 4 BACKGROUND TO THE FINANCIAL AND ECONOMIC ANALYSES

A.4.1. Introduction

The notes in this annex give further information to that already supplied in the main text and in Annexes 1 and 2 on the financial and economic models, and on the assumptions made within each.

Copies of the relevant computer tables (Annex 5) are available in a separate volume (limited distribution only).

A.4.2. The Rehabilitation Model

As described in Section 5 of the main text a standard set of rehabilitation assumptions were applied to the seven sites with minor modifications for particular estates.

The assumptions for the rehabilitation model, based on constant prices, are set out in the table.

Rehabilitation Assumptions

Palm oil price	(Le/drum)	1300	Exchange rate	(Le/$)	29
	(Le/ton)	7280			
Palm kernel price	(cents/lb)	60	Fertilizer price	(US$/ton)	200
	(Le/ton)	1344			
			Fertiliser application		
Diesel fuel price	(Le/gal)	30	rate	(kg/acre)	50
Land Lease	(Le/acre)	50			
			Salaries	(Le/month)	
			Manager		1500
Extraction rate[1]	oil	0.175	Supervisor		1000
	kernels	0.08	Asst. Supervisor		600
(small) Tractor/			Wage/skilled	(Le/day)	12
trailer	(US$)	1500	Wage/unskilled	(Le/day)	9

Note [1] The proportion of oil and kernels extracted from FFB

A.4.3. Kasse-Sahn Malen Financial Model

Revenues and costs deriving from three separate plantation areas and two mills were accounted over a thirty year period to provide net present value (NPV) and internal rate of return (IRR) figures for the project as a whole. The three plantation areas are the existing plantations at Kasse and Sahn Malen and a proposed expansion area which could be at either location (or more likely divided between them). For convenience the expansion area is accounted as part of the Kasse (sub) model, but this should not be taken to imply that the expansion would take place entirely at Kasse. Almost certainly expansion would take place in both chiefdoms. The precise geographical location does not affect the accounting procedure.

The base values,based on constant prices, used in the analysis are given below.

Financial Analysis
Kasse and Sahn Malen - Base Values

	IRR (%)	10.0	
	NPV (MLe)	-33.0	
Expansion area (acres)	4000	Discount rate (%)	15
Number of ex-patriates	1	Fuel price (Le/gal)	30
Kasse existing area (ac)	1100	Thousand polybags (small) $	[illegible].46
Sahn existing area (ac)	1150	Thousand polybags (large) $	[illegible]4
Expansion areas 1..4	1000	Fertiliser ($/t)compound	[illegible]
Nursery to supply (pa)	1000	Fert. app. (kg/acre)	50
Replanting unit	1000	(rehab. only)	
Palm oil price (Le/t)	7280		
Palm oil price (Le/drum)	1300	Salaries (Le/month)	
Seed price ($US each)	0.57	Manager	1500
Palm kernel price (Le/t)	1344	Supervisory	1000
Extraction rate 1	0.175	Assistants	600
Extraction rate 2	0.195		
Extraction rate 3	0.22	Wages (Le/day)	
Kernels (old)	0.08	Labour 1	12
Kernels (new)	0.04	Labour 2	9
Kernels (old/new)	0.1		
Lease (per acre)	50	Tractors	
Exchange rate $1 =	29	Small tractor/trailer($)	15000
Yield factor (new)	1.00	Large tractor/trailer($)	20800
Yield factor (rehab)	1.00		
Oil price factor	1.30		
Cost factor	1.0		
Fertiliser app. factor (not rehab)	1		

3 of

The price level for palm oil was set at 1,300 Le/drum on the basis that the current equivalent price at Daru is 1,400 Le/drum. This allowed for the more difficult transportation problems from Kasse and the possibility of a slight price reduction as supply increases. The palm kernel price (1,344 Le/t) is equivalent to the current level of 60 cents/lb paid by SLPMB. Prices given in US$ reflect estimates of current international FOB prices to which 15 per cent is added in the cost calculations to cover the cost of delivery to Sierra Leone. The three extraction rates for palm oil from FFB correspond to use of a Pioneer mill on fruit from a rehabilitated plantation, a new mill on a rehabilitated plantation and a new mill on a replanted or expansion area, respectively. Similarly, the percentage of FFB available as kernels is assumed to be eight for the original mill and four for the new mill. An old mill processing fruit from replanted or new trees might yield as much as ten per cent kernels but this situation does not arise.

The various 'factors' are set at unity with the exception of the oil price, set at 21.35 (this corresponds to 1,300 Le/drum). These factors facilitate sensitivity analysis by permitting yields, fertiliser application rates and the palm oil price to be varied by a fixed proportion. For example, entering a yield factor of 1.1 permits the calculation of the NPV and IRR which would result from a (general) ten per cent increase in yields. Wage levels, set at 12 Le/day for semi-skilled and 9 Le/day for unskilled workers approximate to levels reported from several different locations during the team's visit.

The final proposed version of the project envisages immediate replanting of the existing Kasse plantation, rehabilitation of the Sahn Malen plantation with the associated Pioneer mill, 4,000 acres of expansion and eventual replanting of Sahn Malen in year seven. The new mill at Kasse is installed in year 6 and expanded in year 10. For convenience the model includes rows for rehabilitation, replanting and expansion (revenues and costs) for both plantations, but these are accounted as zero values where appropriate. For example, although there are figures for the rehabilitation of the Kasse plantation, the totals for both revenue and costs are set at zero. This construction facilitated the exploration of a range of alternative project proposals which resulted in that now put forward.

The central management costs are assumed to be common to the two plantations. One expatriate is assumed to cost $US 70,000 per year which is accounted as 2.0 million Leones at the assumed exchange rate of 29 Le=$US 1. A breakdown of the Sierra Leonean staff and vehicle costs (excluding tractors) is provided.

Kasse-Sahn Malen: Vehicle Costs (Excluding Tractors)

Manager's car $12,000	348,000
Pick-ups (2 @ $12,000)	696,000
Lorries (2 @ $25,000)	1,450,000
	2,494,000
Vehicle maintenance 15% pa.	374,000
Fuel (per year):	
Lorries 2 x 1,000 gal.@ Le 30/gal	60,000
Other vehicles (3) 20,000 gals.	60,000
	120,000

Note: All vehicles are assumed to be replaced every seven years.

Kasse-Sahn Malen: Central Management Staff Costs (Excluding Expatriates)

Manager	35,000
Mill Manager/Engineer	20,000
Accountant	20,000
Wages Officer	10,000
Secretary	12,000
Storeman	10,000
Assistant	6,000
Drivers 3 @ 6,000	18,000
Security 4 @ 3,500	14,000
Total	145,000

The office equipment cost was estimated at $20,000 initially with maintenance set at ten per cent per year and replacement in year 15. The construction of new buildings envisaged an office building of 1,800 sq. ft. costing Le585,000, a store of 326 sq. ft. costing Le653,000, three houses for the manager ($20,000) and two others ($15,000 each). In addition a workshop was included at an estimated cost of $20,000 including equipment. Maintenance and repair costs were estimated at ten per cent (per year) of the total construction cost. Compensation to SLPMB for the take-over of existing buildings was set at one million Leones as was compensation to landholders for the destruction of existing stands of perennial crops. Both these figures were necessarily somewhat arbitrary since the former would depend on negotiations with SLPMB and the latter on the locations chosen for expansion.

The printout for the financial model includes all the identified costs and revenues for the different aspects of the project for the thirty year period (in Leones or million Leones as appropriate). A summary of the basic costs, revenues and the net cash flow is presented overleaf.

Summary of Costs and Revenues for Kasse-Saha Malen (Million Leones)

Year:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Saha Rehabilitation															
Cost	2.3	1.2	1.3	1.2	1.1	1.0									
Revenue	1.6	2.4	3.2	2.5	2.1	1.6									
Saha Cost[1] after replant							1.7	0.4	0.6	0.7	0.9	0.9	0.9	0.9	1.1
Kasse Cost[2] (inc. expansion & new mill)	12.6	7.5	10.3	9.5	10.2	61.4	9.3	10.2	8.9	47.5	8.7	8.2	11.6	10.7	9.6
Kasse Mill Revenue						1.3	4.0	7.9	13.2	19.9	26.5	31.8	35.8	38.4	39.7
Cash Flow[3]	-14.8	-6.4	-8.4	-8.2	-9.2	-59.6	-7.0	-2.7	3.8	-28.4	16.9	22.7	25.2	26.8	29.1
Cumulative Cash Flow	-14.8	-21.2	-29.6	-37.7	-46.9	-106.5	-113.5	-116.2	-112.4	-140.9	-124.0	-101.3	-78.1	-51.3	-22.2

Year:	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Saha Rehabilitation															
Cost															
Revenue															
Saha Cost[1] after replant	1.1	1.1	1.1	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2
Kasse Cost[2] (inc. expansion & new mill)	9.3	10.5	10.1	13.1	12.0	10.0	9.7	10.5	9.8	12.8	11.8	9.7	8.6	8.3	6.4
Kasse Mill Revenue	39.7	39.7	39.7	39.7	39.7	39.7	39.7	39.7	39.7	39.7	39.7	38.9	38.1	35.6	33.9
Cash Flow[3]	29.3	28.1	28.5	25.4	26.4	28.5	28.7	27.9	28.6	25.7	26.7	28.0	28.3	26.1	27.8
Cumulative Cash Flow	7.1	35.2	63.7	89.0	115.4	143.9	172.7	200.6	229.2	254.9	281.6	309.5	337.8	363.9	391.7

Does not include central costs (tractors, fuel and (new) mill) or central management costs.

Includes central management costs and central costs (new mill, tractors and fuel).

1.5 million Leones working capital is included in the costs for year 1 and returned for year 30.

A.4.4. Kasse-Sahn Malen Economic Model

The base values used in the economic analysis are given below.

Economic Analysis
Kasse and Sahn Malen - Base Values

IRR (%) 8.7
NPV (MLe) -54.5

Expansion area (acres)	4000	Shadow revenue (Le/acre)	1800
Number of ex-patriates	1	Shadow wage (family)	9
Sahn Malen area	1150	SLPMB oil price (Le/t)	11200
Kasse area	1100	SLPMB oil price (Le/drum)	2000
Expansion areas 1..4	1000	Discount rate	15
Nursery to supply (pa)	1000	Fuel price (Le/gal)	30
Replanting unit	1000	Thousand polybags (small) $	28.46
Palm oil price (Le/t)	11200	Thousand polybags (large) $	125.24
Palm oil price (Le/drum)	2000	Fertiliser ($/t) compound	200
Seed price ($US each)	0.57	Fert. App. (kg/acre)	50
Palm kernel price (Le/t)	1344	(rehab. only)	
Extraction rate 1	0.175		
Extraction rate 2	0.195	Salaries (Le/month)	
Extraction rate 3	0.22	Manager	1500
Kernels (old)	0.08	Supervisory	1000
Kernels (new)	0.04	Assistants	600
Kernels (old/new)	0.1		
Lease (per acre)	0	Wages (Le/day)	
Exchange rate $1 =	29	Labour 1	12
Yield factor (new)	1.00	Labour 2	9
Yield factor (rehab)	1.00		
Oil price factor	2.00	Tractors	
Cost inflator	1.0	Small tractor/trailer ($)	15000
Fertiliser App. factor (not rehab)	1	Large tractor/trailer ($)	20800

In structure the economic model is very similar to the financial model. The essential differences relate to those transfers not appropriate in evaluating the economic worth of the project, namely the lease and the compensation payments to landholders and compensation to SLPMB, the opportunity costs attributed to the land used for expansion and the value of existing production.

For the purposes of economic analysis, the lease and compensation payments are set to zero. The calculation of opportunity costs for land involves assumptions regarding the shadow revenue ascribed to the land and the shadow wage rate for family labour. These are set at 1,800 Le/acre/year and 9 Le/day in the printed version of the model enclosed with this annex. This version also assumes a palm oil price of 2,000 Le/drum (11,200 Le/tonne) for both the oil currently produced by SLPMB and that which would be produced by the project. The value of current production for both palm oil and kernels amounted to some 2.4 million Leones based on a high estimate of annual production (200t oil + kernels). The estimated profit, after allowance for operating costs of 1.7 million and adminstration costs (at Bo) of 0.25 million, is 0.5 million Leones. These figures and those summarising the expected benefits from the new project can be found in the model printout following the Kasse sub-model.

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Report prepared
for
UNIDO
and the
Government of Sierra Leone

(Project No. SI/SIL/85/802
UNIDO Contract Number 86/52)

PSL 5203/SFJ
November 1986

VOLUME 3

ANNEX 5 Copies of Computer Tables of the Financial and Economic Analyses

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General Note: each set of tables are preceded by a layout guide.

A.5.1. KASSE / SAHN MALEN FINANCIAL ANALYSIS

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FINANCIAL ANALYSIS
Kasse and Sahn Malen - Base Values

IRR (%)	10.0
NPV (MLe)	-33.0

Expansion Area (acres)	4000	Discount Rate (%)	15
Number of Ex-patriates	1	Fuel Price (Le/gal)	30
Kasse Existing Area (acres)	1100	Thousand Polybags (small) $	28.46
Sahn " "	1150	Thousand Polybags (large) $	125.24
Expansion Areas 1..4	1000	Fertiliser ($/t) Compound	200
Nursery to supply (pa)	1000	Fert App.(kg/acre)	50
Replanting Unit	1000	(rehab. only)	
Palm oil price (Le/t)	7280		
Palm oil price (Le/drum)	1300	Salaries (Le/month)	
Seed Price ($US each)	0.57	Manager	1500
Palm Kernel Price (Le/t)	1344	Supervisory	1000
Extaction Rate 1	0.175	Assistants	600
Extraction Rate 2	0.195		
Extraction Rate 3	0.22	Wages(Le/day)	
Kernels (old)	0.08	Labour1	12
Kernels (new)	0.04	Labour2	9
Kernels (old/new)	0.1		
Lease(per acre)	50	Tractors	
Exchange Rate $1 =	29	Small Tractor/trailer($)	15000
Yield Factor(new)	1.00	Large Tractor/trailer($)	20800
Yield Factor (rehab)	1.00		
Oil Price Factor	1.30		
Cost Factor	1.0		
Fertiliser App. Factor (not rehab)	1		

TOTAL
COSTS AND REVENUES**

Sahn Revenue	1.6	2.4	3.2	2.5	2.1	1.6
Sahn Cost	2.3	1.2	1.3	1.2	1.1	1.0

Sahn Replant Cost	0.0	0.0	0.0	0.0	0.0	0.0
Sahn net cost	0.8	-1.2	-1.9	-1.4	-1.0	-0.5
Kasse etc costs	12.6	7.5	10.3	9.5	10.2	61.4
Kasse Mill Revenue	0.0	0.0	0.0	0.0	0.0	1.3
Working Cap (MLe)	1.5					
NET CASH FLOW	-14.8	-6.4	-8.4	-8.2	-9.2	-59.6
Cumulative Net Cash Flow	-14.8	-21.2	-29.6	-37.7	-46.9	-106.5

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CENTAL MANAGEMENT COSTS

Year		1	2	3	4	5	6
Ex-pats	1	2.0	2.0	2.0	2.0	2.0	2.0
SL staff		0.145	0.145	0.145	0.145	0.145	0.145
Vehicles		2.5	0.4	0.4	0.4	0.4	0.4
Fuel		0.12	0.12	0.12	0.12	0.12	0.12
Office eqpt		0.58	0.006	0.006	0.006	0.006	0.006
Landholder Comp		1.0					
ROAD				1.1	0.11	0.11	0.11
BUILDINGS		3.5	0.04	0.04	0.04	0.04	0.04
SLPMB Comp (SM)		1.0					
Total		10.9	2.7	3.8	2.8	2.8	2.8

PRODUCTION
ORIGINAL PLANTATION
Rehabilitated

Year	1	2	3	4	5	6
Yield(t FFB/acre)	1.5	1.6	2.3	2.4	2.4	2.4
Total FFB	0	0	0	0	0	0
Total oil	0	0	0	0	0	0
Total Kernels	0	0	0	0	0	0
Oil Revenue (M Le)	0.00	0.00	0.00	0.00	0.00	0.00
Kernel Revenue "	0.00	0.00	0.00	0.00	0.00	0.00
Total Revenue(MLe)	0.00	0.00	0.00	0.00	0.00	0.00

Replanted

Year	1	2	3	4	5	6
Yieldl(t FFB/acre)						0.8
Total FFB		0	0	0	0	800
Total oil						176
Total Kernels						32
Oil Revenue (M Le)						1281280
Kernel Revenue "						43008
Replanted Revenue(MLe)		0.0	0.0	0.0	0.0	1.3
Year	1	2	3	4	5	6

EXPANSION
Production (tFFB)
Areal

Area2
Area3
Area4

Total FFB(Exp area)
Oil (t)
Kernels(t)
Oil Revenue
Kernels Revenue
Expansion Revenue (MLe)

A3

Year	1	2	3	4	5	6
Kasse FFB (old)	0	0	0	0	0	0
Kasse FFB (new)	0	0	0	0	0	800
S Malen FFB (old)	0	0	0	0	0	0
S Malen FFB (new)	0	0	0	0	0	0
GRAND TOTAL FFB (for Kasse Mill)	0	C	0	0	0	800
REVENUE						
Kasse Mill						
oil(t)	0	0	0	0	0	176
kernels(t)	0	0	0	0	0	32
oil revenue	0	0	0	0	0	1281280
kernel revenue	0	0	0	0	0	43008
Kasse total(M Le)	0.0	0.0	0.0	0.0	0.0	1.3

Year	1	2	3	4	5	6
CENTRAL COSTS						
Mill etc.						50.25
Tractor etc	1664832	277472	277472	277472	277472	277472
Harvest F & L	0	0	0	0	0	17143
Total	1.66	0.28	0.28	0.28	0.28	50.55

REHABILITATION COSTS

Manager	27000	27000	27000	27000	27000	27000
Superviscry Staff	38400	38400	38400	38400	38400	38400
Maintenance	295350	186450	140250	140250	135300	125400
Harvesting	303660	319500	430380	446220	446220	446220
Machinery	647280	87000	87000	87000	87000	87000
Tools	6900	6900	6900	6900	6900	6900
Fuel/Lube	62106	69300	69300	69300	69300	69300
Fertiliser	319000	319000	319000	319000	319000	319000
Lease	55000	55000	55000	55000	55000	55000
Contingency (10%) (ex. machinery)	110742	102155	108623	110207	109712	108722
Rehab Costs (MLe)	0.0	0.0	0.0	0.0	0.0	0.0
Revenue "	0.0	0.0	0.0	0.0	0.0	0.0
Surplus "	0.0	0.0	0.0	0.0	0.0	0.0

REPLANTING COSTS

Year	1	2	3	4	5	6
Supervisors		38400	38400	38400	38400	38400
clearing & land preparation		235000				
planting		130000				
Upkeepl		59000	140000	113000	113000	68000
Roads etc		18000	18000	18000	18000	18000
Cover Crop		200100				
Wire Collars		900450				
Fertiliserl		87000	174000	348000	522000	696000
Harvesting						112560
fuel&lube (Ex. Harvesting)		49500	16500	3300	3300	3300
lease		100000	100000	100000	100000	100000
Replant Costs (MLe)		1.8	0.5	0.6	0.8	1.0
Replant Revenue "		0.0	0.0	0.0	0.0	1.3
Surplus "		-1.82	-0.49	-0.62	-0.79	0.29

EXPANSION

Year	1	2	3	4	5	6
COSTS						
Manager	27000	27000	27000	27000	27000	27000
Supervisors	24000	24000	24000	24000	24000	24000
Assistants			7200	7200	72000	72000
Farm Guards						131400
New Lease			250000	250000	250000	250000
Total	51000	51000	308200	308200	373000	504400

Nursery Establishment	
Pre-nursery	3879
Site Prep	6255
Pump House	10000
Germination Shed	6000
Total	26134

ASSUMES 5 X 200 ACRE EXPANSION UNITS

Nursery	1	2	3	4	5	6
Labour	35433	36423	36423	36423	36423	36423
Supervision (1 hea	4500	4500	4500	4500	4500	4500
Seed	330600	330600	330600	330600	330600	330600
Small Polybags	14857	0	0	0	0	0
Large "	59925	59925	59925	59925	59925	59925
Fertiliser	29000	29000	29000	29000	29000	29000
Temik	42204	42204	42204	42204	42204	42204
Glyphosate	16328	16328	16328	16328	16328	16328
Sprayers	4802	0	0	0	0	0
Tools	4000	1600	1600	1600	1600	1600
Pump	29000	5800	5800	5800	5800	5800
Fuel	7391	7391	7391	7391	7391	7391
Total Nursery	2890204	2668855	2668855	2668855	2668855	2668855

Year	1	2	3	4	5	6
Labour			504000	504000	504000	504000
Headmen			67500	67500	67500	67500
Tools (imported)						
Matchettes			187594	75038	75038	75038
Axes			108750	43500	43500	43500
Tools (local)			48250	48250	48250	48250
Cover Crop			756900	756900	756900	756900
Fuel&Lube			145895	145895	I45895	145895
Wire Collars			783000	783000	783000	783000
Total			2601888	2424082	2424082	2424082

Expansion Area

Immature Upkeep

Year	1	2	3	4	5	6
Labour						
First 200 acres			54000	117000	108000	108000
Second 200 acres				54000	117000	108000
Third 200 acres					54000	117000
Fourth 200 acres						54000
Total	0	0	54000	171000	279000	387000

Mature Upkeep

Labour						
First 200 acres						
Second 200 acres						
Third 200 acres						
Fourth 200 acres						
Total	0	0	0	0	0	0

Year	1	2	3	4	5	6
Fertiliser						
First 200 acres			87000	174000	261000	522000
Second 200 acres				87000	174000	261000
Third 200 acres					87000	174000
Fourth 200 acres						87000
Hand Tools			750	900	1200	1800
Total	0	0	87750	261900	523200	1045800
Harvesting						
Labour(200 acres)	0	0	0	0	0	0
Tools						
Total	0	0	0	0	0	0

Expansion Costs (MLe)		2.7	5.7	5.8	6.3	7.0
Expansion Revenue (MLe)		0.0	0.0	0.0	0.0	0.0
Surplus (MLe)		-2.7	-5.7	-5.8	-6.3	-7.0

A6

Sierra Leone Oil Palm Project 28/10/86
Sahn Malen using Kasse Mill
Base Values

(inc expansion)			
Area (acres) =	1150		
Expansion Areas 1..5	0		
Replanting Unit	1000		
Palm oil price (Le/t)	7280	Discount Rate	15
Palm oil price (Le/drum)	1300	Fuel Price (Le/gal)	30
Seed Price ($US each)	0.57	Thousand Polybags (small) $	28.46
Palm Kernel Price (Le/t)	1344	Thousand Polybags (large) $	125.24
Extaction Rate 1	0.175	Fertiliser ($/t) Compound	200
Extraction Rate 2	0.195	Fert App.(kg/acre)	50
Extraction Rate 3	0.22	(rehab. only)	
Kernels (old)	0.08		
Kernels (new)	0.04	Salaries (Le/month)	
Kernels (old/new)	0.1	Manager	1500
Lease(per acre)	50	Supervisory	1000
Exchange Rate $1 =	29	Assistants	600
Yield Factor(new)	1		
Yield Factor (rehab)	1	Wages(Le/day)	
Oil Price Factor	1.3	Labour1	12
Cost Inflator	1	Labour2	9
Fertiliser App. Factor (not rehab)	1		
Small Tractor/trailer ($)	15000		
Large Tractor/trailer($)	20800		

PRODUCTION
ORIGINAL PLANTATION
Rehabilitated

Year	1	2	3	4	5	6
Yield(t FFB/acre)	1	1.5	2	1.6	1.3	1
Total FFB	1150	1725	2300	1840	1495	1150
Surplus FFB	0	0	0	0	0	0
SMalen oil	201	302	403	322	262	201
SMalen Kernels	92	138	184	147	120	92
Oil Revenue (M Le)	1.47	2.20	2.93	2.34	1.90	1.47
Kernel Revenue "	0.12	0.19	0.25	0.20	0.16	0.12
Total Revenue(MLe)	1.59	2.38	3.18	2.54	2.07	1.59

Replanted (to Kasse Mill) A7

Year	1	2	3	4	5	6
Yieldl(t FFB/acre)						
Total FFB						
EXPANSION						
Production (tFFB)						
Area1						
Area2						
Area3						
Area4						
Area5						
Total FFB(Exp area)						
SURPLUS FFB (old)	0	0	0	0	0	0
SURPLUS FFB (new)	0	0	0	0	0	0

Year	1	2	3	4	5	6
REHABILITATION COSTS						
Mill Costs (min)	1217000	96000	96000	96000	96000	96000
Manager	27000	27000	27000	27000	27000	27000
Supervisory Staff	38400	38400	38400	38400	38400	38400
Maintenance	308775	194925	146625	146625	141450	131100
Harvesting	231660	314460	397260	331020	281340	231660
Fuel&Lube	24643	36964	49286	39429	32036	24643
Tools	6900	6900	6900	6900	6900	6900
Fertiliser	333500	333500	333500	333500	333500	333500
Lease	57500	57500	57500	57500	57500	57500
Contingency (10%) (ex. machinery)	100374	108309	111759	105135	99649	93646
Rehab Costs (MLe)	2.3	1.2	1.3	1.2	1.1	1.0
Revenue "	1.6	2.4	3.2	2.5	2.1	1.6
Surplus "	-0.8	1.2	1.9	1.4	1.0	0.5

REPLANTING COSTS						
Year	1	2	3	4	5	6
Supervisors						
clearing & land preparation						
planting						
Upkeepl						
Roads etc						
Cover Crop						
Wire Collars						
Fertiliserl						
Harvesting						
fuel&lube						
" (Harvesting)						
lease						
Replant Costs (MLe)						

EXPANSION

Year	1	2	3	4	5	6
COSTS						
Manager						
Supervisors						
Assistants						
Driver+Loader						
Farm Guards						
Tractor/Trailer						
New Lease						
Total						

Clearing,Preparation and Planting

Year	1	2	3	4	5	6
Labour			0	0	0	0
Headmen			0	0	0	0
Tools (imported)						
Matchettes			0	0	0	0
Axes			0	0	0	0
Tools (local)			0	0	0	0
Cover Crop			0	0	0	0
Fuel&Lube			0	0	0	0
Wire Collars			0	0	0	0
Total			0	0	0	0

Expansion Area
Immature Upkeep

Year	1	2	3	4	5	6
Labour						
First 200 acres			0	0	0	0
Second 200 acres				0	0	0
Third 200 acres					0	0
Fourth 200 acres						0
Fifth 200 acres						
Total	0	0	0	0	0	0

Mature Upkeep

Labour						
First 200 acres						
Second 200 acres						
Third 200 acres						
Fourth 200 acres						
Fifth 200 acres						
Total	0	0	0	0	0	0

A9

Year	1	2	3	4	5	6
Fertiliser						
First 200 acres			0	0	0	0
Second 200 acres				0	0	0
Third 200 acres					0	0
Fourth 200 acres						0
Fifth 200 acres						
Hand Tools			0	0	0	0
Total	0	0	0	0	0	0
Harvesting						
Labour(200 acres)	0	0	0	0	0	0
Tools						
Total	0	0	0	0	0	0
Total Fuel	0	0	0	0	0	0
Expansion Costs (MLe)		0.0	0.0	0.0	0.0	0.0
NET COSTS	0.8	-1.2	-1.9	-1.4	-1.0	-0.5

****

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.7	0.4	0.6	0.7	0.9	0.9	0.9	0.9
1.7	0.4	0.6	0.7	0.9	0.9	0.9	0.9
9.3	10.2	8.9	47.5	8.7	8.2	11.6	10.7
4.0	7.9	13.2	19.9	26.5	31.8	35.8	38.4
-7.0	-2.7	3.8	-28.4	16.9	22.7	23.2	26.8
-113.5	-116.2	-112.4	-140.9	-124.0	-101.3	-78.1	-51.3

....

B2

7	8	9	10	11	12	13	14
2.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0
0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145
2.5	0.4	0.4	0.4	0.4	0.4	2.5	0.4
0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
4.9	2.8	2.8	0.8	0.8	0.8	2.9	0.8
7	8	9	10	11	12	13	14
2.4	2.4	2.4	2				
0	0	0	0				
0	0	0	0				
0	0	0	0				
0.00	0.00	0.00	0.00				
0.00	0.00	0.00	0.00				
0.00	0.00	0.00	0.00				
7	8	9	10	11	12	13	14
1.6	2.4	3.2	4	4	4	4	4
1600	2400	3200	4000	4000	4000	4000	4000
352	528	704	880	880	880	880	880
64	96	128	160	160	160	160	160
2562560	3843840	5125120	6406400	6406400	6406400	6406400	6406400
86016	129024	172032	215040	215040	215040	215040	215040
2.6	4.0	5.3	6.6	6.6	6.6	6.6	6.6
7	8	9	10	11	12	13	14
800	1600	2400	3200	4000	4000	4000	4000
	800	1600	2400	3200	4000	4000	4000
		800	1600	2400	3200	4000	4000
			800	1600	2400	3200	4000
800	2400	4800	8000	11200	13600	15200	16000
156	468	936	1560	2464	2992	3344	3520
32	96	192	320	448	544	608	640
1135680	3407040	6814080	11356800	17937920	21781760	24344320	25625600
43008	129024	258048	430080	602112	731136	817152	860160
1.2	3.5	7.1	11.8	18.5	22.5	25.2	26.5

B3

7	8	9	10	11	12	13	14
0	0	0	0	0	0	0	0
2400	4800	8000	12000	15200	17600	19200	20000
0	0	0	0	0	0	0	0
0	0	0	0	800	1600	2400	3200

2400	4800	8000	12000	16000	19200	21600	23200

528	1056	1760	2640	3520	4224	4752	5104
96	192	320	480	640	768	864	928
3843840	7687680	12812800	19219200	25625600	30750720	34594560	37157120
129024	258048	430080	645120	860160	1032192	1161216	1247232
4.0	7.9	13.2	19.9	26.5	31.8	35.8	38.4

7	8	9	10	11	12	13	14
0.26	0.38	0.43	40.60	0.61	0.61	0.61	0.61
277472	2497248	416208	416208	1248624	554944	1387360	2497248
51429	102857	171429	257143	342857	411429	462857	497143
0.59	2.98	1.01	41.28	2.20	1.57	2.46	3.60

27000	27000	27000	27000
38400	38400	38400	38400
115500	115500	105600	105600
446220	446220	446220	382860
87000			
6900	6900	6900	6900
69300	69300	69300	69300
319000	319000	319000	319000
55000	55000	55000	55000
107732	107732	106742	100406
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0

7	8	9	10	11	12	13	14
38400	38400	38400	38400	38400	38400	38400	38400
68000	68000	68000	68000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000
696000	696000	696000	696000	696000	696000	1044000	1044000
172560	232560	292560	352560	352560	352560	352560	352560
3300	3300	3300	3300	3300	3300	3300	3300
100000	100000	100000	100000	100000	100000	100000	100000
1.1	1.2	1.2	1.3	1.3	1.3	1.6	1.6
2.6	4.0	5.3	6.6	6.6	6.6	6.6	6.6
1.55	2.82	4.08	5.35	5.35	5.35	5.00	5.00

7	8	9	10	11	12	13	14
27000	27000	27000	27000	27000	27000	27000	27000
24000	24000	24000	24000	24000	24000	24000	24000
72000	72000	72000	72000	72000	72000	72000	72000
131400	131400	131400	131400	131400	131400	131400	131400
250000	250000	250000	250000	250000	250000	250000	250000
504400	504400	504400	504400	504400	504400	504400	504400

B5

7	8	9	10	11	12	13	14
108000							
108000	108000						
108000	108000	108000					
117000	108000	108000	108000				
441000	324000	216000	108000	0	0	0	0
	90000	72000	72000	63000	63000	63000	63000
		90000	72000	72000	63000	63000	63000
			90000	72000	72000	63000	63000
				90000	72000	72000	63000
0	90000	162000	234000	297000	270000	261000	252000

7	8	9	10	11	12	13	14
696000	696000	696000	696000	696000	696000	696000	696000
522000	696000	696000	696000	696000	696000	696000	696000
261000	522000	696000	696000	696000	696000	696000	696000
174000	261000	522000	696000	696000	696000	696000	696000
2400	960	960	960	960	960	960	960
1655400	2175960	2610960	2784960	2784960	2784960	2784960	2784960
57600	172800	345600	576000	806400	979200	1094400	1152000
1000	1000	1000	1000	1000	1000	1000	1000
58600	173800	346600	577000	807400	980200	1095400	1153000
2.7	3.3	3.8	4.2	4.4	4.5	4.6	4.7
0.0	1.2	3.5	7.1	11.8	18.5	22.5	25.2
-2.7	-2.1	-0.3	2.9	7.4	14.0	17.9	20.5

B6

7	8	9	10	11	12	13	14
0	0	0	0				
0	0	0	0				
0	0	0	0				
0	0	0	0				
0	0	0	0				
0.00	0.00	0.00	0.00				
0.00	0.00	0.00	0.00				
0.00	0.00	0.00	0.00				

7	8	9	10	11	12	13	14
				0.8	1.6	2.4	3.2
				800	1600	2400	3200
0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
		0	0	0	0	0	0
			0	0	0	0	0
				0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	800	1600	2400	3200

7	8	9	10	11	12	13	14
96000	96000	96000	96000				
27000	27000	27000	27000				
38400	38400	38400	38400				
120750	120750	110400	110400				
66060	66060	66060	66060				
0	0	0	0				
6900	6900	6900	6900				
333500	333500	333500	333500				
57500	57500	57500	57500				
76051	65011	63976	63976				
0.0	0.0	0.0	0.0				
0.0	0.0	0.0	0.0				
0.0	0.0	0.0	0.0				

7	8	9	10	11	12	13	14
38400	38400	38400	38400	38400	38400	38400	38400
235000							
130000							
59000	140000	113000	113000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000
200100							
900450							
87000	174000	348000	522000	696000	696000	696000	696000
				52560	52560	52560	52560

50000	50000	50000	50000	50000	50000	50000	50000
1.7	0.4	0.6	0.7	0.9	0.9	0.9	0.9

B8

7	8	9	10	11	12	13	14

7	8	9	10	11	12	13	14
0							
0							
0							
0							
0							
0							
0							
0							
0							

7	8	9	10	11	12	13	14
0							
0	0						
0	0	0					
0	0	0	0				
0	0	0	0	0			
0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0
		0	0	0	0	0	0
			0	0	0	0	0
				0	0	0	0
					0	0	0
0	0	0	0	0	0	0	0

7	8	9	10	11	12	13	14
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.7	0.4	0.6	0.7	0.9	0.9	0.9	0.9

C1

****

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3
1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3
9.6	9.3	10.5	10.1	13.1	12.0	10.0	9.7
39.7	39.7	39.7	39.7	39.7	39.7	39.7	39.7
29.1	29.3	28.1	28.5	25.4	26.4	28.5	28.7
-22.2	7.1	35.2	63.7	89.0	115.4	143.9	172.7

****

C2

15	16	17	18	19	20	21	22
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145

0.4	0.4	0.4	0.4	2.5	0.4	0.4	0.4
0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.58	0.006	0.006	0.006	0.006	0.006	0.006	0.006
0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
1.4	0.8	0.8	0.8	2.9	0.8	0.8	0.8

15	16	17	18	19	20	21	22

15	16	17	18	19	20	21	22
4	4	4	4	4	4	4	4
4000	4000	4000	4000	4000	4000	4000	4000
880	880	880	880	880	880	880	880
160	160	160	160	160	160	160	160
6406400	6406400	6406400	6406400	6406400	6406400	6406400	6406400
215040	215040	215040	215040	215040	215040	215040	215040
6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
15	16	17	18	19	20	21	22
4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000
16000	16000	16000	16000	16000	16000	16000	16000
3520	3520	3520	3520	3520	3520	3520	3520
640	640	640	640	640	640	640	640
25625600	25625600	25625600	25625600	25625600	25625600	25625600	25625600
860160	860160	860160	860160	860160	860160	860160	860160
26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5

C3

15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0
20000	20000	20000	20000	20000	20000	20000	20000
0	0	0	0	0	0	0	0
4000	4000	4000	4000	4000	4000	4000	4000
24000	24000	24000	24000	24000	24000	24000	24000
5280	5280	5280	5280	5280	5280	5280	5280
960	960	960	960	960	960	960	960
38438400	38438400	38438400	38438400	38438400	38438400	38438400	38438400
1290240	1290240	1290240	1290240	1290240	1290240	1290240	1290240
39.7	39.7	39.7	39.7	39.7	39.7	39.7	39.7
15	16	17	18	19	20	21	22
0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
416208	416208	1248624	554944	1387360	2497248	416208	416208
514286	514286	514286	514286	514286	514286	514286	514286
1.54	1.54	2.37	1.68	2.51	3.62	1.54	1.54

C4

15	16	17	18	19	20	21	22
38400	38400	38400	38400	38400	38400	38400	38400
68000	68000	68000	68000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
352560	352560	352560	315060	315060	277560	277560	52560
3300	3300	3300	3300	3300	3300	3300	3300
100000	100000	100000	100000	100000	100000	100000	100000
1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.3
6.6	6.6	6.6	6.6	6.6	6.6	6.6	6.6
5.00	5.00	5.00	5.03	5.03	5.07	5.07	5.30

15	16	17	18	19	20	21	22
27000	27000	27000	27000	27000	27000	27000	27000
24000	24000	24000	24000	24000	24000	24000	24000
72000	72000	72000	72000	72000	72000	72000	72000
131400	131400	131400	131400	131400	131400	131400	131400
250000	250000	250000	250000	250000	250000	250000	250000
504400	504400	504400	504400	504400	504400	504400	504400

15	16	17	18 CS	19	20	21	22
15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
252000	252000	252000	252000	252000	252000	252000	252000
15	16	17	18	19	20	21	22
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
696000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
696000	696000	1044000	1044000	1044000	1044000	1044000	1044000
696000	696000	696000	1044000	1044000	1044000	1044000	1044000
960	960	960	960	960	960	960	960
3132960	3480960	3828960	4176960	4176960	4176960	4176960	4176960
1152000	1152000	1152000	1152000	1152000	1152000	1152000	1152000
1000	1000	1000	1000	1000	1000	1000	1000
1153000	1153000	1153000	1153000	1153000	1153000	1153000	1153000
5.0	5.4	5.7	6.1	6.1	6.1	6.1	6.1
26.5	26.5	26.5	26.5	26.5	26.5	26.5	26.5
21.4	21.1	20.7	20.4	20.4	20.4	20.4	20.4

C6

15 16 17 18 19 20 21 22

C1

15	16	17	18	19	20	21	22
4	4	4	4	4	4	4	4
4000	4000	4000	4000	4000	4000	4000	4000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
4000	4000	4000	4000	4000	4000	4000	4000
15	16	17	18	19	20	21	22
15	16	17	18	19	20	21	22
38400	38400	38400	38400	38400	38400	38400	38400
68000	68000	68000	68000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000
870000	870000	870000	870000	1044000	1044000	1044000	1044000
52560	52560	52560	52560	52560	52560	52560	52560
50000	50000	50000	50000	50000	50000	50000	50000
1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3

C8

15	16	17	18	19	20	21	22

15	16	17	18	19	20	21	22

15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

c9

15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.1	1.1	1.1	1.1	1.3	1.3	1.3	1.3

DI

****

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2
1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2
10.5	9.8	12.8	11.8	9.7	8.6	8.3	6.4
39.7	39.7	39.7	39.7	38.9	38.1	35.6	33.9
							-1.5
27.9	28.6	25.7	26.7	28.0	28.3	26.1	27.8
200.6	229.2	254.9	281.6	309.5	337.8	363.9	391.7

****

D2

23	24	25	26	27	28	29	30
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145

0.4	0.4	2.5	0.4	0.4	0.4	0.4	0.4
0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
0.8	0.8	2.9	0.8	0.8	0.8	0.8	0.8

23	24	25

23	24	25	26	27	28	29	30
4	4	4	4	3.5	3.5	3	3
4000	4000	4000	4000	3500	3500	3000	3000
880	880	880	880	770	770	660	660
160	160	160	160	140	140	120	120
6406400	6406400	6406400	6406400	5605600	5605600	4804800	4804800
215040	215040	215040	215040	188160	188160	161280	161280
6.6	6.6	6.6	6.6	5.8	5.8	5.0	5.0
23	24	25	26	27	28	29	30
4000	4000	4000	4000	4000	3500	3000	3000
4000	4000	4000	4000	4000	4000	3500	3000
4000	4000	4000	4000	4000	4000	4000	3500
4000	4000	4000	4000	4000	4000	4000	4000
16000	16000	16000	16000	16000	15500	14500	13500
3520	3520	3520	3520	3520	3410	3190	2970
640	640	640	640	640	620	580	540
25625600	25625600	25625600	25625600	25625600	24824800	23223200	21621600
860160	860160	860160	860160	860160	833280	779520	725760
26.5	26.5	26.5	26.5	26.5	25.7	24.0	22.3

D3

23	24	25	26	27	28	29	30
0	0	0					
20000	20000	20000	20000	19500	19000	17500	16500
0	0	0	0	0	0	0	0
4000	4000	4000	4000	4000	4000	4000	4000

24000	24000	24000	24000	23500	23000	21500	20500

5280	5280	5280	5280	5170	5060	4730	4510
960	960	960	960	940	920	860	820
38438400	38438400	38438400	38438400	37637600	36836800	34434400	32832800
1290240	1290240	1290240	1290240	1263360	1236480	1155840	1102080
39.7	39.7	39.7	39.7	38.9	38.1	35.6	33.9

23	24	25	26	27	28	29	30
0.61	0.61	0.61	0.61	0.61	0.61	0.61	0.61
1248624	554944	1387360	2497248	416208	416208	1248624	554944
514286	514286	514286	514286	503571	492857	460714	439286
2.37	1.68	2.51	3.62	1.53	1.52	2.32	1.60

D4

23	24	25	26	27	28	29	30
38400	38400	38400	38400	38400	38400	38400	38400
38400	38400	38400	38400	38400	38400	38400	38400
1044000	1044000	1044000	1044000	1044000	0	0	0
52560	52560	52560	52560	52560	52560	52560	52560
3300	3300	3300	3300	3300	3300	3300	3300
100000	100000	100000	100000	100000	100000	100000	100000
1.3	1.3	1.3	1.3	1.3	0.2	0.2	0.2
6.6	6.6	6.6	6.6	5.8	5.8	5.0	5.0
5.34	5.34	5.34					4.73

23	24	25	26	27	28	29	30
27000	27000	27000	27000	27000	27000	27000	27000
24000	24000	24000	24000	24000	24000	24000	24000
72000	72000	72000	72000	72000	72000	72000	72000
131400	131400	131400	131400	131400	131400	131400	131400
250000	250000	250000	250000	250000	250000	250000	250000
504400	504400	504400	504400	504400	504400	504400	504400

DS

23	24	25					
23	24	25					
0	0	0					
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
252000	252000	252000	252000	252000	252000	252000	252000
23	24	25	26	27	28	29	30
1044000	1044000	1044000	1044000	1044000	1044000	0	0
1044000	1044000	1044000	1044000	1044000	1044000	1044000	0
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
960	960	960	960	960	960	960	960
4176960	4176960	4176960	4176960	4176960	4176960	3132960	2088960
1152000	1152000	1152000	1152000	1152000	1116000	1044000	972000
1000	1000	1000	1000	1000	1000	1000	1000
1153000	1153000	1153000	1153000	1153000	1117000	1045000	973000
6.1	6.1	6.1	6.1	6.1	6.1	4.9	3.8
26.5	26.5	26.5	26.5	26.5	26.5	25.7	24.0
20.4	20.4	20.4	20.4	20.4	20.4	20.7	20.2

D6

23 24 25

D7

23	24	25	26	27	28	29	30
4	4	4	4	4	4	4	4
4000	4000	4000	4000	4000	4000	4000	4000
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
4000	4000	4000					
23	24	25	26	27	28	29	30
23	24	25	26	27	28	29	30
38400	38400	38400	38400	38400	38400	38400	38400
68000	68000	68000	68000	68000	38400	38400	38400
18000	18000	18000	18000	18000			
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
52560	52560	52560	52560	52560	52560	52560	52560
50000	50000	50000	50000	50000	50000	50000	50000
1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2

23	24	25
23	24	25
23	24	25
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0

D9

23	24	25					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0.0	0.0	0.0					
1.3	1.3	1.3	1.3	1.3	1.2	1.2	1.2

Years 1-6	7-14	15-22	23-30
A_1	B_1	C_1	D_1
A_2	B_2	C_2	D_2
A_3	B_3	C_3	D_3
A_4	B_4	C_4	D_4
A_5	B_5	C_5	D_5
A_6	B_6	C_6	D_6
A_7	B_7	C_7	D_7
A_8	B_8	C_8	D_8
A_9	B_9	C_9	D_9

ECONOMIC ANALYSIS
Kasse and Sahn Malen - Base Values

IRR (%)	8.7
NPV (MLe)	-54.5

Expansion Area (acres)	4000	Shadow Revenue (Le/acre)	1800
Number of Ex-pats	1	Shadow Wage (Family)	9
Sahn Malen area	1150	SLPMB oil price(Le/t)	11200
Kasse Area	1100	SLPMB oil price(Le/drum)	2000
Expansion Areas 1..4	1000	Discount Rate	15
Nursery to supply (pa)	1000	Fuel Price (Le/gal)	30
Replanting Unit	1000	Thousand Polybags (small) $	28.46
Palm oil price (Le/t)	11200	Thousand Polybags (large) $	125.24
Palm oil price (Le/drum)	2000	Fertiliser ($/t) Compound	200
Seed Price ($US each)	0.57	Fert App.(kg/acre)	50
Palm Kernel Price (Le/t)	1344	(rehab. only)	
Extraction Rate 1	0.175		
Extraction Rate 2	0.195	Salaries (Le/month)	
Extraction Rate 3	0.22	Manager	1500
Kernels (old)	0.08	Supervisory	1000
Kernels (new)	0.04	Assistants	600
Kernels (old/new)	0.1		
Lease(per acre)	0	Wages(Le/day)	
Exchange Rate $1 =	29	Labour1	12
Yield Factor(new)	1.00	Labour2	9
Yield Factor (rehab)	1.00		
Oil Price Factor	2.00	Tractors	
Cost Inflator	1.0	Small Tractor/trailer($)	15000
Fertiliser App. Factor (not rehab)	1	Large Tractor/trailer($)	20800

CENTAL MANAGEMENT COSTS

Year		1	2	3	4	5	6
Ex-pats	1	2.0	2.0	2.0	2.0	2.0	2.0
SL staff		0.145	0.145	0.145	0.145	0.145	0.145
Vehicles		2.5	0.4	0.4	0.4	0.4	0.4
Fuel		0.12	0.12	0.12	0.12	0.12	0.12
Office eqpt		0.58	0.006	0.006	0.006	0.006	0.006
Landholder Comp		0.0					
ROAD				1.1	0.11	0.11	0.11
BUILDINGS		3.5	0.04	0.04	0.04	0.04	0.04
SLPMB Comp (SM)							
Total		8.9	2.7	3.8	2.8	2.8	2.8

PRODUCTION
ORIGINAL PLANTATION
Rehabilitated

Year	1	2	3	4	5	6

Yield(t FFB/acre)	0.95	1.4	1.9	1.9	1.9	1.5
Total FFB	0	0	0	0	0	0
Total oil	0	0	0	0	0	0
Total Kernels	0	0	0	0	0	0
Oil Revenue (M Le)	0.00	0.00	0.00	0.00	0.00	0.00
Kernel Revenue "	0.00	0.00	0.00	0.00	0.00	0.00
Total Revenue(MLe)	0.00	0.00	0.00	0.00	0.00	0.00
Replanted						
Year	1	2	3	4	5	6
Yieldl(t FFB/acre)						0.8
Total FFB		0	0	0	0	800
Total oil						176
Total Kernels						32
Oil Revenue (M Le)						1971200
Kernel Revenue "						43008
Replanted Revenue(MLe)		0.0	0.0	0.0	0.0	2.0
Year	1	2	3	4	5	6
EXPANSION						
Production (tFFB)						
Area1						
Area2						
Area3						
Area4						
Total FFB(Exp area)						
Oil (t)						
Kernels(t)						
Oil Revenue						
Kernels Revenue						
Expansion Revenue (MLe)						
Year	1	2	3	4	5	6
Kasse FFB (old)	0	0	0	0	0	0
Kasse FFB (new)	0	0	0	0	0	800
S Malen FFB (old)	0	0	0	0	0	0
S Malen FFB (new)	0	0	0	0	0	0
GRAND TOTAL FFB	0	0	0	0	0	800
(for Kasse Mill)						
REVENUE						
Kasse Mill						
oil(t)	0	0	0	0	0	176
kernels(t)	0	0	0	0	0	32
oil revenue	0	0	0	0	0	1971200
kernel revenue	0	0	0	0	0	43008
Kasse total(M Le)	0.0	0.0	0.0	0.0	0.0	2.0
Year	1	2	3	4	5	6
CENTRAL COSTS						
Mill etc.						50.24

Tractor etc	1664832	277472	277472	277472	277472	277472
Harvest F&L	0	0	0	0	0	17143
Total	1.66	0.28	0.28	0.28	0.28	50.54

REHABILITATION COSTS

Manager	27000	27000	27000	27000	27000	27000
Supervisory Staff	38400	38400	38400	38400	38400	38400
Maintenance	295350	186450	140250	140250	135300	125400
Harvesting	216540	287820	367020	367020	367020	303660
Machinery	647280	87000	87000	87000	87000	87000
Tools	6900	6900	6900	6900	6900	6900
Fuel/Lube	62106	69300	69300	69300	69300	69300
Fertiliser	319000	319000	319000	319000	319000	319000
Lease	0	0	0	0	0	0
Contingency (10%) (ex. machinery)	96530	93487	96787	96787	96292	88966
Rehab Costs (MLe)	0.0	0.0	0.0	0.0	0.0	0.0
Revenue "	0.0	0.0	0.0	0.0	0.0	0.0
Surplus "	0.0	0.0	0.0	0.0	0.0	0.0

REPLANTING COSTS

Year	1	2	3	4	5	6
Supervisors		38400	38400	38400	38400	38400
clearing & land preparation		235000				
planting		130000				
Upkeepl		59000	140000	113000	113000	68000
Roads etc		18000	18000	18000	18000	18000
Cover Crop		200100				
Wire Collars		900450				
Fertiliserl		87000	174000	348000	522000	696000
Harvesting						112560
fuel&lube (Ex. Harvest)		49500	16500	3300	3300	3300
lease		0	0	0	0	0
Replant Costs (MLe)		1.7	0.4	0.5	0.7	0.9
Replant Revenue "		0.0	0.0	0.0	0.0	2.0
Surplus "		-1.72	-0.39	-0.52	-0.69	1.08

EXPANSION

Year	1	2	3	4	5	6
COSTS						
Manager	27000	27000	27000	27000	27000	27000
Supervisors	24000	24000	24000	24000	24000	24000
Assistants			7200	7200	72000	72000
Farm Guards						131400
New Lease						
Total	51000	51000	58200	58200	123000	254400

Nursery Establishment	
Pre-nursery	3879
Site Prep	6255
Pump House	10000

Germination Shed	6000					
Total	26134					
ASSUMES 5 X 200 ACRE EXPANSION UNITS						
Nursery						
Labour	35433	36423	36423	36423	36423	36423
Supervision (1 hea	4500	4500	4500	4500	4500	4500
Seed	330600	330600	330600	330600	330600	330600
Small Polybags	14857	0	0	0	0	0
Large "	59925	59925	59925	59925	59925	59925
Fertiliser	29000	29000	29000	29000	29000	29000
Temik	42204	42204	42204	42204	42204	42204
Glyphosate	16328	16328	16328	16328	16328	16328
Sprayers	4802	0	0	0	0	0
Tools	4000	1600	1600	1600	1600	1600
Pump	29000	5800	5800	5800	5800	5800
Fuel	7391	7391	7391	7391	7391	7391
Total Nursery	2890204	2668855	2668855	2668855	2668855	2668855
Clearing,Preparation and Planting						
Year	1	2	3	4	5	6
Labour			504000	504000	504000	504000
Headmen			67500	67500	67500	67500
Tools (imported)						
Matchettes			187594	75038	75038	75038
Axes			108750	43500	43500	43500
Tools (local)			48250	48250	48250	48250
Cover Crop			756900	756900	756900	756900
Fuel&Lube			145895	145895	145895	145895
Wire Collars			783000	783000	783000	783000
Total			2601888	2424082	2424082	2424082
Expansion Area						
Immature Upkeep						
Year	1	2	3	4	5	6
Labour						
First 200 acres			54000	117000	108000	108000
Second 200 acres				54000	117000	108000
Third 200 acres					54000	117000
Fourth 200 acres						54000
Total	0	0	54000	171000	279000	387000
Mature Upkeep						
Labour						
First 200 acres						
Second 200 acres						
Third 200 acres						
Fourth 200 acres						
Total	0	0	0	0	0	0
Year	1	2	3	4	5	6

Fertiliser						
First 200 acres			87000	174000	348000	522000
Second 200 acres				87000	174000	348000
Third 200 acres					87000	174000
Fourth 200 acres						87000
Hand Tools			750	900	1200	1800
Total	0	0	87750	261900	610200	1132800
Harvesting						
Labour(200 acres)	0	0	0	0	0	0
Tools						
Total	0	0	0	0	0	0
Expansion Costs (MLe)		2.7	5.5	5.6	6.1	6.9
Expansion Revenue (MLe)		0.0	0.0	0.0	0.0	0.0
Surplus (MLe)		-2.7	-5.5	-5.6	-6.1	-6.9
Year	1	2	3	4	5	6
Sahn net cost	.0	-0.7	-3.2	-3.0	-2.0	-1.2
Kasse etc costs	10.6	7.4	9.9	9.2	9.9	61.2
Kasse Mill Revenue	0.0	0.0	0.0	0.0	0.0	2.0
Working Cap (MLe)	1.5					
Gross Benefit (MLe	-12.0	-6.7	-6.8	-6.2	-7.9	-58.0
less						
Existing Plantations:						
Benefit (oil + kernels)	2.4	2.4	2.4	2.4	2.4	2.4
Operating Cost	1.7	1.7	1.7	1.7	1.7	1.7
Bo Cost	0.25	0.25	0.25	0.25	0.25	0.25
	0.5	0.5	0.5	0.5	0.5	0.5
Expansion Area:						
Opportunity Cost of Land:						
Revenue	17.6	17.6	17.6	17.6	17.6	17.6
Input Costs (purchased)	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9
Family Labour	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
Net Cost	10.2	10.2	10.2	10.2	10.2	10.2
Total Net Benefit	-22.7	-17.3	-17.4	-16.8	-18.5	-68.6

Sierra Leone Oil Palm Project 28/10/86
Sahn Malen using Kasse Mill
Base Values

(inc expansion)			
Area (acres) =	1150		
Expansion Areas 1..5	0		
Replanting Unit	1000		
Palm oil price (Le/t)	11200	Discount Rate	15
Palm oil price (Le/drum)	2000	Fuel Price (Le/gal)	30
Seed Price ($US each)	0.57	Thousand Polybags (small) $	28.46
Palm Kernel Price (Le/t)	1344	Thousand Polybags (large) $	125.24
Extaction Rate 1	0.175	Fertiliser ($/t) Compound	200
Extraction Rate 2	0.195	Fert App.(kg/acre)	50
Extraction Rate 3	0.22	(rehab. only)	
Kernels (old)	0.08		
Kernels (new)	0.04	Salaries (Le/month)	
Kernels (old/new)	0.1	Manager	1500
Lease(per acre)	0	Superviso	1000
Exchange Rate $1 =	29	Assistants	600
Yield Factor(new)	1		
Yield Factor (rehab)	1	Wages(Le/day)	
Oil Price Factor	2	Labour1	12
Cost Inflator	1	Labour2	9
Fertiliser App. Factor (not rehab)	1		
Small Tractor/trailer ($)	15000		
Large Tractor/trailer($)	20800		

PRODUCTION
ORIGINAL PLANTATION
Rehabilitated

Year	1	2	3	4	5	6
Yield(t FFB/acre)	1	1.5	2	2	1.6	1.3
Total FFB	1150	1725	2300	2300	1840	1495
Surplus FFB	0	0	0	0	0	0
SMalen oil	201	302	403	403	322	262
SMalen Kernels	92	138	184	184	147	120
Oil Revenue (M Le)	2.25	3.38	4.51	4.51	3.61	2.93
Kernel Revenue "	0.12	0.19	0.25	0.25	0.20	0.16

Total Revenue(MLe)	2.38	3.57	4.76	4.76	3.80	3.09
Replanted (to Kasse Mill)						
Year	1	2	3	4	5	6
Yieldl(t FFB/acre)						
Total FFB						
EXPANSION						
Production (tFFB)						
Area1						
Area2						
Area3						
Area4						
Area5						
Total FFB(Exp area)						
SURPLUS FFB (old)	0	0	0	0	0	0
SURPLUS FFB (new)	0	0	0	0	0	0
Year	1	2	3	4	5	6
REHABILITATION COSTS						
Mill Costs (min)	1312700	96000	96000	96000	96000	96000
Mill Costs (max)	4058100	110400	110400	110400	110400	110400
Manager	27000	27000	27000	27000	27000	27000
Supervisory Staff	38400	38400	38400	38400	38400	38400
Maintenance	308775	194925	146625	146625	141450	131100
Harvesting	231660	314460	397260	397260	331020	281340
Fuel&Lube	24643	36964	49286	49286	39429	32036
Tools	6900	6900	6900	6900	6900	6900
Fertiliser	333500	333500	333500	333500	333500	333500
Lease	0	0	0	0	0	0
Contingency (10%) (ex. machinery)	94624	102559	106009	106009	98867	92864
Rehab Costs (MLe)	2.4	1.2	1.2	1.2	1.1	1.0
Revenue "	2.4	3.6	4.8	4.8	3.8	3.1
Surplus "	.0	2.4	3.6	3.6	2.7	2.1
REPLANTING COSTS						
Year	1	2	3	4	5	6
Supervisors						
clearing & land preparation						
planting						
Upkeepl						
Roads etc						
Cover Crop						
Wire Collars						
Fertiliserl						
Harvesting						
fuel&lube						

" (Harvesting)						
lease						
Replant Costs (MLe)						
EXPANSION						
Year	1	2	3	4	5	6
COSTS						
Manager						
Supervisors						
Assistants						
Driver+Loader						
Farm Guards						
Tractor/Trailer						
New Lease						
Total						
Clearing,Preparation and Planting						
Year	1	2	3	4	5	6
Labour			0	0	0	0
Headmen			0	0	0	0
Tools (imported)						
Matchettes			0	0	0	0
Axes			0	0	0	0
Tools (local)			0	0	0	0
Cover Crop			0	0	0	0
Fuel&Lube			0	0	0	0
Wire Collars			0	0	0	0
Total			0	0	0	0
Expansion Area						
Immature Upkeep						
Year	1	2	3	4	5	6
Labour						
First 200 acres			0	0	0	0
Second 200 acres				0	0	0
Third 200 acres					0	0
Fourth 200 acres						0
Fifth 200 acres						
Total	0	0	0	0	0	0
Mature Upkeep						
Labour						
First 200 acres						
Second 200 acres						
Third 200 acres						
Fourth 200 acres						
Fifth 200 acres						
Total	0	0	0	0	0	0
Year	1	2	3	4	5	6
Fertiliser						
First 200 acres			0	0	0	0

Second 200 acres				0	0	0
Third 200 acres					0	0
Fourth 200 acres						0
Fifth 200 acres						
Hand Tools			0	0	0	0
Total	0	0	0	0	0	0
Harvesting						
Labour(200 acres)	0	0	0	0	0	0
Tools						
Total	0	0	0	0	0	0
Total Fuel	0	0	0	0	0	0
Expansion Costs (MLe)		0.0	0.0	0.0	0.0	0.0
NET COSTS	.0	-0.7	-3.2	-3.0	-2.0	-1.2

7	8	9	10	11	12	13	14
2.0	2.0	2.0					
0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145
2.5	0.4	0.4	0.4	0.4	0.4	2.5	0.4
0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
4.9	2.8	2.8	0.8	0.8	0.8	2.9	0.8
7	8	9	10	11	12	13	14

1.2	1.1	1	1
0	0	0	0
0	0	0	0
0	0	0	0
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00

7	8	9	10	11	12	13	14
1.6	2.4	3.2	4	4	4	4	4
1600	2400	3200	4000	4000	4000	4000	4000
352	528	704	880	880	880	880	880
64	96	128	160	160	160	160	160
3942400	5913600	7884800	9856000	9856000	9856000	9856000	9856000
86016	129024	172032	215040	215040	215040	215040	215040
4.0	6.0	8.1	10.1	10.1	10.1	10.1	10.1
7	8	9	10	11	12	13	14

800	1600	2400	3200	4000	4000	4000	4000
	800	1600	2400	3200	4000	4000	4000
		800	1600	2400	3200	4000	4000
			800	1600	2400	3200	4000
800	2400	4800	8000	11200	13600	15200	16000
156	468	936	1560	2464	2992	3344	3520
32	96	192	320	448	544	608	640
1747200	5241600	10483200	17472000	27596800	33510400	37452800	39424000
43008	129024	258048	430080	602112	731136	817152	860160
1.8	5.4	10.7	17.9	28.2	34.2	38.3	40.3

7	8	9	10	11	12	13	14
0	0	0	0	0	0	0	0
2400	4800	8000	12000	15200	17600	19200	20000
0	0	0	0	0	0	0	0
0	0	0	0	800	1600	2400	3200
2400	4800	8000	12000	16000	19200	21600	23200

528	1056	1760	2640	3520	4224	4752	5104
96	192	320	480	640	768	864	928
5913600	11827200	19712000	29568000	39424000	47308800	53222400	57164800
129024	258048	430080	645120	860160	1032192	1161216	1247232
6.0	12.1	20.1	30.2	40.3	48.3	54.4	58.4

7	8	9	10	11	12	13	14
0.25	0.26	0.63	40.63	0.63	0.65	0.65	0.65

277472	2497248	416208	416208	1248624	554944	1387360	2497248
51429	102857	171429	257143	342857	411429	462857	497143
0.58	2.86	1.22	41.30	2.22	1.62	2.50	3.65

27000	27000	27000	27000
38400	38400	38400	38400
115500	115500	105600	105600
256140	240300	224460	224460
87000			
6900	6900	6900	6900
69300	69300	69300	69300
319000	319000	319000	319000
0	0	0	0
83224	81640	79066	79066
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0

7	8	9	10	11	12	13	14
38400	38400	38400	38400	38400	38400	38400	38400

68000	68000	68000	68000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000

696000	696000	870000	870000	870000	870000	1044000	1044000
172560	232560	292560	352560	352560	352560	352560	352560

3300	3300	3300	3300	3300	3300	3300	3300

0	0	0	0	0	0	0	0

1.0	1.1	1.3	1.4	1.4	1.4	1.5	1.5
4.0	6.0	8.1	10.1	10.1	10.1	10.1	10.1
3.03	4.99	6.77	8.72	8.72	8.72	8.55	8.55

7	8	9	10	11	12	13	14
27000	27000	27000	27000	27000	27000	27000	27000
24000	24000	24000	24000	24000	24000	24000	24000
72000	72000	72000	72000	72000	72000	72000	72000
131400	131400	131400	131400	131400	131400	131400	131400
254400	254400	254400	254400	254400	254400	254400	254400

B4

7	8	9	10	11	12	13	1

7	8	9	10	11	12	13	14
108000							
108000	108000						
108000	108000	108000					
117000	108000	108000	108000				
441000	324000	216000	108000	0	0	0	0

	90000	72000	72000	63000	63000	63000	63000
		90000	72000	72000	63000	63000	63000
			90000	72000	72000	63000	63000
				90000	72000	72000	63000
0	90000	162000	234000	297000	270000	261000	252000
7	8	9	10	11	12	13	14

696000	696000	696000	696000	870000	870000	870000	870000
522000	696000	696000	696000	696000	870000	870000	870000
348000	522000	696000	696000	696000	696000	870000	870000
174000	348000	522000	696000	696000	696000	695000	870000
2400	960	960	960	960	960	960	960
1742400	2262960	2610960	2784960	2958960	3132960	3306960	3480960
57600	172800	345600	576000	806400	979200	1094400	1152000
1000	1000	1000	1000	1000	1000	1000	1000
58600	173800	346600	577000	807400	980200	1095400	1153000
2.5	3.1	3.6	4.0	4.3	4.6	4.9	5.1
0.0	1.8	5.4	10.7	17.9	28.2	34.2	38.3
-2.5	-1.3	1.8	6.8	13.6	23.6	29.3	33.1
7	8	9	10	11	12	13	14
0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.2
9.0	9.8	8.9	47.4	8.7	8.4	11.9	11.1
6.0	12.1	20.1	30.2	40.3	48.3	54.4	58.4
-3.8	1.4	10.4	-18.2	30.6	38.9	41.5	46.1
2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9
-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
-14.5	-9.3	-0.3	-28.9	19.9	28.3	30.8	35.5

B6

7	8	9	10	11	12	13	14
0	0	0	0				
0	0	0	0				
0	0	0	0				
0	0	0	0				
0	0	0	0				
0.00	0.00	0.00	0.00				
0.00	0.00	0.00	0.00				

B7

0.00	0.00	0.00	0.00				
7	8	9	10	11	12	13	14
				0.8	1.6	2.4	3.2
				800	1600	2400	3200
0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0
		0	0	0	0	0	0
			0	0	0	0	0
				0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	800	1600	2400	3200
7	8	9	10	11	12	13	14
96000	96000	96000	96000				
110400							
27000	27000	27000	27000				
38400	38400	38400	38400				
120750	120750	110400	110400				
66060	66060	66060	66060				
0	0	0	0				
6900	6900	6900	6900				
333500	333500	333500	333500				
0	0	0	0				
70301	59261	58226	58226				
0.0	0.0	0.0	0.0				
0.0	0.0	0.0	0.0				
0.0	0.0	0.0	0.0				
7	8	9	10	11	12	13	14
38400	38400	38400	38400	38400	38400	38400	38400
235000							
130000							
59000	140000	113000	113000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000
200100							
900450							
87000	174000	348000	522000	696000	696000	696000	696000
				52560	52560	52560	52560

B8

0	0	0	0	0	0	0	0
1.7	0.4	0.5	0.7	0.9	0.9	0.9	0.9
7	8	9	10	11	12	13	14

7	8	9	10	11	12	13	14
0							
0							
0							
0							
0							
0							
0							
0							
0							

7	8	9	10	11	12	13	14
0							
0	0						
0	0	0					
0	0	0	0				
0	0	0	0	0			
0	0	0	0	0	0	0	0

	0	0	0	0	0	0	0
		0	0	0	0	0	0
			0	0	0	0	0
				0	0	0	0
					0	0	0
0	0	0	0	0	0	0	0
7	8	9	10	11	12	13	14
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.2

C1

15	16	17	18	19	20	21	22
0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145
0.4	0.4	0.4	0.4	2.5	0.4	0.4	0.4
0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.58	0.006	0.006	0.006	0.006	0.006	0.006	0.006
0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
1.4	0.8	0.8	0.8	2.9	0.8	0.8	0.8
15	16	17	18	19	20	21	22

C2

15	16	17	18	19	20	21	22
4	4	4	4	4	4	4	4
4000	4000	4000	4000	4000	4000	4000	4000
880	880	880	880	880	880	880	880
160	160	160	160	160	160	160	160
9856000	9856000	9856000	9856000	9856000	9856000	9856000	9856000
215040	215040	215040	215040	215040	215040	215040	215040
10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
15	16	17	18	19	20	21	22
4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000
4000	4000	4000	4000	4000	4000	4000	4000
16000	16000	16000	16000	16000	16000	16000	16000
3520	3520	3520	3520	3520	3520	3520	3520
640	640	640	640	640	640	640	640
39424000	39424000	39424000	39424000	39424000	39424000	39424000	39424000
860160	860160	860160	860160	860160	860160	860160	860160
40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3
15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0
20000	20000	20000	20000	20000	20000	20000	20000
0	0	0	0	0	0	0	0
4000	4000	4000	4000	4000	4000	4000	4000
24000	24000	24000	24000	24000	24000	24000	24000
5280	5280	5280	5280	5280	5280	5280	5280
960	960	960	960	960	960	960	960
59136000	59136000	59136000	59136000	59136000	59136000	59136000	59136000
1290240	1290240	1290240	1290240	1290240	1290240	1290240	1290240
60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4
15	16	17	18	19	20	21	22
0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65

C3

416208	416208	1248624	554944	1387360	2497248	416208	416208
514286	514286	514286	514286	514286	514286	514286	514286
1.58	1.58	2.42	1.72	2.55	3.66	1.58	1.58

15	16	17	18	19	20	21	22
38400	38400	38400	38400	38400	38400	38400	38400
68000	68000	68000	68000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
352560	352560	337560	322560	315060	277560	277560	52560
3300	3300	3300	3300	3300	3300	3300	3300
0	0	0	0	0	0	0	0
1.5	1.5	1.5	1.5	1.5	1.4	1.4	1.2
10.1	10.1	10.1	10.1	10.1	10.1	10.1	10.1
8.55	8.55	8.56	8.58	8.58	8.62	8.62	8.85
15	16	17	18	19	20	21	22
27000	27000	27000	27000	27000	27000	27000	27000
24000	24000	24000	24000	24000	24000	24000	24000
72000	72000	72000	72000	72000	72000	72000	72000
131400	131400	131400	131400	131400	131400	131400	131400
254400	254400	254400	254400	254400	254400	254400	254400

15	16	17	18	19	20	21	22
15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
252000	252000	252000	252000	252000	252000	252000	252000
15	16	17	18	19	20	21	22

C5

1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
870000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
870000	870000	1044000	1044000	1044000	1044000	1044000	1044000
870000	870000	870000	1044000	1044000	1044000	1044000	1044000
960	960	960	960	960	960	960	960
3654960	3828960	4002960	4176960	4176960	4176960	4176960	4176960
1152000	1152000	1152000	1152000	1152000	1152000	1152000	1152000
1000	1000	1000	1000	1000	1000	1000	1000
1153000	1153000	1153000	1153000	1153000	1153000	1153000	1153000
5.3	5.5	5.7	5.8	5.8	5.8	5.8	5.8
40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3
35.0	34.8	34.6	34.4	34.4	34.4	34.4	34.4
15	16	17	18	19	20	21	22
1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
9.8	9.4	10.4	9.8	12.8	11.7	9.7	9.4
60.4	60.4	60.4	60.4	60.4	60.4	60.4	60.4
49.4	49.8	48.8	49.4	46.4	47.5	49.5	49.8
2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9
-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
38.8	39.2	38.2	38.7	35.8	36.8	38.9	39.1

C6

15 16 17 18 19 20 21 22

15	16	17	18	19	20	21	22
4	4	4	4	4	4	4	4
4000	4000	4000	4000	4000	4000	4000	4000
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
4000	4000	4000	4000	4000	4000	4000	4000
15	16	17	18	19	20	21	22
15	16	17	18	19	20	21	22
38400	38400	38400	38400	38400	38400	38400	38400
68000	68000	68000	68000	68000	68000	68000	68000
18000	18000	18000	18000	18000	18000	18000	18000
870000	870000	870000	870000	1044000	1044000	1044000	1044000
52560	52560	52560	52560	52560	52560	52560	52560

0	0	0	0	0	0	0	0
1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2
15	16	17	18	19	20	21	22
15	16	17	18	19	20	21	22
15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
15	16	17	18	19	20	21	22
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2

Di

23	24	25	26	27	28	29	30
0.145	0.145	0.145	0.145	0.145	0.145	0.145	0.145
0.4	0.4	2.5	0.4	0.4	0.4	0.4	0.4
0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
0.8	0.8	2.9	0.8	0.8	0.8	0.8	0.8

23 24 25

23	24	25	26	27	28	29	30
4	4	4	3.8	3.6	3.5	3	3
4000	4000	4000	3800	3600	3500	3000	3000
880	880	880	836	792	770	660	660
160	160	160	152	144	140	120	120
9856000	9856000	9856000	9363200	8870400	8624000	7392000	7392000
215040	215040	215040	204288	193536	188160	161280	161280
10.1	10.1	10.1	9.6	9.1	8.8	7.6	7.6
23	24	25	26	27	28	29	30
4000	4000	4000	4000	4000	3500	3000	3000
4000	4000	4000	4000	4000	4000	3500	3000
4000	4000	4000	4000	4000	4000	4000	3500
4000	4000	4000	4000	4000	4000	4000	4000
16000	16000	16000	16000	16000	15500	14500	13500
3520	3520	3520	3520	3520	3410	3190	2970
640	640	640	640	640	620	580	540
39424000	39424000	39424000	39424000	39424000	38192000	35728000	33264000
860160	860160	860160	860160	860160	8332[illegible]0	779520	725760
40.3	40.3	40.3	40.3	40.3	39.0	36.5	34.0

23	24	25	26	27	28	29	30
0	0	0					
20000	20000	20000	19800	19600	19000	17500	16500
0	0	0	0	0	0	0	0
4000	4000	4000	4000	4000	4000	4000	4000
24000	24000	24000	23800	23600	23000	21500	20500
5280	5280	5280	5236	5192	5060	4730	4510
960	960	960	952	944	920	860	820
59136000	59136000	59136000	58643200	58150400	56672000	52976000	50512000
1290240	1290240	1290240	1279488	1268736	1236480	1155840	1102080
60.4	60.4	60.4	59.9	59.4	57.9	54.1	51.6

23	24	25	26	27	28	29	30
0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65

D3

1248624	554944	1387360	2497248	416208	416208	1248624	554944
514286	514286	514286	510000	505714	492857	460714	439286
2.42	1.72	2.55	3.66	1.57	1.56	2.36	1.65
23	24	25	26	27	28	29	30
38400	38400	38400	38400	38400	38400	38400	38400
38400	38400	38400	38400	38400	38400	38400	38400
1044000	1044000	1044000	1044000	1044000	0	0	0
52560	52560	52560	52560	52560	52560	52560	52560
3300	3300	3300	3300	3300	3300	3300	3300
0	0	0	0	0	0	0	0
1.2	1.2	1.2	1.2	1.2	0.1	0.1	0.1
10.1	10.1	10.1	9.6	9.1	8.8	7.6	7.6
8.89	8.89	8.89					7.42
23	24	25	26	27	28	29	30
27000	27000	27000	27000	27000	27000	27000	27000
24000	24000	24000	24000	24000	24000	24000	24000
72000	72000	72000	72000	72000	72000	72000	72000
131400	131400	131400	131400	131400	131400	131400	131400
254400	254400	254400	254400	254400	254400	254400	254400

D4

23	24	25

23	24	25

0	0	0

63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
63000	63000	63000	63000	63000	63000	63000	63000
252000	252000	252000	252000	252000	252000	252000	252000
23	24	25	26	27	28	29	30

DS

1044000	1044000	1044000	1044000	1044000	1044000	0	0
1044000	1044000	1044000	1044000	1044000	1044000	1044000	0
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
960	960	960	960	960	960	960	960
4176960	4176960	4176960	4176960	4176960	4176960	3132960	2088960
1152000	1152000	1152000	1152000	1152000	1116000	1044000	972000
1000	1000	1000	1000	1000	1000	1000	1000
1153000	1153000	1153000	1153000	1153000	1117000	1045000	973000
5.8	5.8	5.8	5.8	5.8	5.8	4.7	3.6
40.3	40.3	40.3	40.3	40.3	40.3	39.0	36.5
34.4	34.4	34.4	34.4	34.4	34.5	34.3	32.9
23	24	25	26	27	28	29	30
1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0
10.2	9.5	12.5	11.5	9.4	8.3	8.0	6.1
60.4	60.4	60.4	59.9	59.4	57.9	54.1	51.6
							-1.5
49.0	49.7	46.8	48.5	50.0	49.6	46.2	45.5
2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4
1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
-------	-------	-------	-------	-------	-------	-------	-------
0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
17.6	17.6	17.6	17.6	17.6	17.6	17.6	17.6
-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9	-5.9
-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6	-1.6
-------	-------	-------	-------	-------	-------	-------	-------
10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
38.4	39.1	36.1	37.8	39.4	39.0	35.5	34.8

D6

23 24 25

D7

23	24	25	26	27	28	29	30
4	4	4	4	4	4	4	4
4000	4000	4000	4000	4000	4000	4000	4000
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
4000	4000	4000					
23	24	25	26	27	28	29	30
23	24	25	26	27	28	29	30
38400	38400	38400	38400	38400	38400	38400	38400
68000	68000	68000	68000	68000	38400	38400	38400
18000	18000	18000	18000	18000			
1044000	1044000	1044000	1044000	1044000	1044000	1044000	1044000
52560	52560	52560	52560	52560	52560	52560	52560

Dg

0	0	0	0	0	0	0	0
1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
23	24	25					

23	24	25

23	24	25

0	0	0

0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
0	0	0
23	24	25
0	0	0

D9

0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0	0	0					
0.0	0.0	0.0					
1.2	1.2	1.2	0.0	0.0	0.0	0.0	0.0

A.5.3. BAOMA FINANCIAL ANALYSIS

YEARS 1-6	7-10
A_1	B_1
A_2	B_2

BAOMA OIL PALM MILL AND PLANTATION

REHABILITATION VERSION
(financial)

Area (acres) =	500	IRR (Rehab only)	24.3
		NPV	0.5
Palm oil price (Le/t)	7280	Discount Rate	15
Palm oil price (Le/drum)	1300	Fuel Price (Le/gal)	30
Seed Price ($US each)	0.57	Thousand Polybags (small) $	28.46
Palm Kernel Price (Le/t)	1344	Thousand Polybags (large) $	125.24
Extaction Rate 1	0.175	Fertiliser ($/t) Compound	200
Extraction Rate 2	0.195	Fert App.(kg/acre)	50
Extraction Rate 3	0.22	(rehab. only)	
Kernels (old)	0.08		
Kernels (new)	0.04	Salaries (Le/month)	
Kernels (old/new)	0.1	Manager	1500
Lease(per acre)	50	Supervisory	1000
Exchange Rate $1 =	29	Assistants	600
Yield Factor(new)	1.00		
Yield Factor (rehab)	1.00	Wages(Le/day)	
Oil Price Factor	1.30	Labour1	12
Cost Inflator	1.0	Labour2	9
Fertiliser App. Factor (not rehab)	1		

PRODUCTION
ORIGINAL PLANTATION
Rehabilitated

Year	1	2	3	4	5	6
Yield(t FFB/acre)	0.9	1.3	1.75	1.75	1.75	1.75
Total FFB	450	650	875	875	875	875
Total oil	79	114	153	153	153	153
Total Kernels	36	52	70	70	70	70
Oil Revenue (M Le)	0.57	0.83	1.11	1.11	1.11	1.11
Kernel Revenue "	0.05	0.07	0.09	0.09	0.09	0.09

Total Revenue(MLe)	0.62	0.90	1.21	1.21	1.21	1.21
Grand Total FFB	450	650	875	875	875	875
REHABILITATION COSTS						
Mill Costs (min)	1025000	96000	96000	96000	96000	96000
Mill Costs (max)	1476500	144000	144000	144000	144000	144000
Office	50000	50000	50000	50000	50000	50000
Building	600000					
Manager						
Supervisory Staff	19200	19200	19200	19200	19200	19200
Maintenance	134250	84750	63750	63750	61500	57000
Harvesting	58920	73320	89520	89520	89520	89520
Machinery	605955	78300	78300	78300	78300	78300
Tools	6900	6900	6900	6900	6900	6900
Fuel/Lube	10607	15321	20625	20625	20625	20625
Fertiliser	145000	145000	145000	145000	145000	145000
Lease	25000	25000	25000	25000	25000	25000
Contingency (10%) (ex. machinery)	39988	56349	56400	56400	56175	55725
Working Capital	200000					
Rehab Costs (MLe)	2.3	0.6	0.6	0.6	0.6	0.6
Revenue "	0.6	0.9	1.2	1.2	1.2	1.2
Surplus "	-1.6	0.3	0.6	0.6	0.6	0.6

7	8	9	10
1.4	0.9	0.8	0.7
700	450	400	350
123	79	70	61
56	36	32	28
0.89	0.57	0.51	0.45
0.08	0.05	0.04	0.04
0.97	0.62	0.55	0.48
700	450	400	350
96000	96000	96000	96000
144000	144000	144000	144000
50000	50000	50000	50000
19200	19200	19200	19200
52500	52500	48000	48000
76920	58920	55320	51720
78300	78300	78300	78300
6900	6900	6900	6900

B2

16500	10607	9429	8250
145000	0	0	0
25000	25000	25000	25000
53602	36713	35785	35307
			-200000
0.6	0.4	0.4	0.2
1.0	0.6	0.6	0.5
0.4	0.2	0.2	0.3

A.5.4. TELU FINANCIAL ANALYSIS

YEARS 1-6	7-10
A_1	B_1
A_2	B_2

A1

TELU PALM OIL MILL AND PLANTATION

REHAB AND OUTGROWERS ONLY

		IRR	35.
		NPV	2.0
Area (acres) =	110		
Outgrower Area	1000		
FFB price (Le/t)	600		
Palm oil price (Le/t)	7280	Discount Rate	15
Palm oil price (Le/drum)	1300	Fuel Price (Le/gal)	36
Seed Price ($US each)	0.57	Thousand Polybags (small) $	28.46
Palm Kernel Price (Le/t)	1344	Thousand Polybags (large) $	125.24
Extaction Rate 1	0.175	Fertiliser ($/t) Compound	200
Extraction Rate 2	0.195	Fert App.(kg/acre)	50
Extraction Rate 3	0.22	(rehab. only)	
Kernels (old)	0.08		
Kernels (new)	0.04	Salaries (Le/month)	
Kernels (old/new)	0.1	Manager	1500
Lease(per acre)	50	Supervisory	1000
Exchange Rate $1 =	29	Assistants	600
Yield Factor(new)	1.00		
Yield Factor (rehab)	1.00	Wages(Le/day)	
Oil Price Factor	1.30	Labour1	12
Cost Inflator	1.0	Labour2	9
Fertiliser App. Factor (not rehab)	1		

PRODUCTION

ORIGINAL PLANTATION

Rehabilitated

Year	1	2	3	4	5	6
Yield(t FFB/acre)	0.9	1.4	1.9	1.5	1.2	1.1
Total FFB	99	154	209	165	132	121
Total oil	17	27	37	29	23	21
Total Kernels	8	12	17	13	11	10
Oil Revenue (M Le)	0.13	0.20	0.27	0.21	0.17	0.15
Kernel Revenue "	0.01	0.02	0.02	0.02	0.01	0.01
Total Revenue(MLe)	0.14	0.21	0.29	0.23	0.18	0.17

A2

Plantation FFB	99	154	209	165	132	121
Outgrower FFB	1000	1200	1500	2000	2000	2000
Grand TOTAL FFB	1099	1354	1709	2165	2132	2121

REHABILITATION COSTS						
Mill Costs (min)	1029000	96000	96000	96000	96000	96000
Mill Costs (max)	1807900	144000	144000	144000	144000	144000
Building	600000					
Office etc.	50000	50000	50000	50000	50000	50000
Manager	27000	27000	27000	27000	27000	27000
Supervisory Staff	38400	38400	38400	38400	38400	38400
Maintenance	29535	18645	14025	14025	13530	12540
Harvesting	24888	28848	32808	29640	27264	26472
Machinery	605955	78300	78300	78300	78300	605955
Tools	6900	6900	6900	6900	6900	6900
Fuel/Lube	2121	3300	4479	3536	2829	2593
Fertiliser	31900	31900	31900	31900	31900	31900
Lease	5500	5500	5500	5500	5500	5500
Contingency (10%)	16624	35449	35501	35090	34732	34530
(ex. machinery)						
Working Capital	200000					
Rehab Costs (MLe)	3.4	0.5	0.5	0.5	0.5	1.0
Revenue "	0.1	0.2	0.3	0.2	0.2	0.2
Surplus "	-3.3	-0.3	-0.2	-0.2	-0.3	-0.8

B1

7	8	9	10
1	0.8	0.8	0.8
110	88	88	88
19	15	15	15
9	7	7	7
0.14	0.11	0.11	0.11
0.01	0.01	0.01	0.01
0.15	0.12	0.12	0.12

B2

1610	3788	6538	10038
2000	2000	2000	2000
3610	5788	8538	12038
96000	96000	96000	96000
144000	144000	144000	144000
50000	50000	50000	50000
27000	27000	27000	27000
38400	38400	38400	38400
11550	11550	10560	10560
25680	24096	24096	24096
78300	78300	78300	78300
6900	6900	6900	6900
2357	1886	1886	1886
31900	31900	31900	31900
5500	5500	5500	5500
34329	34123	34024	34024
			-200000
0.5	0.5	0.5	0.3
0.2	0.1	0.1	0.1
-0.3	-0.3	-0.3	-0.1

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