SOMALI DEMOCRATIC REPUBLIC
MINISTRY OF NATIONAL PLANNING

JOWHAR SUGAR ESTATE

Feasibility Study for Rehabilitation

Final Report

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JOINT VENTURE FOR REHABILITATION OF JOWHAR SUGAR ESTATE

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The Ministry of National Planning,
Mogadishu,
Somali Democratic Republic.

Dear Sirs,

In accordance with Article III, Clause 4 of the Agreement for Consulting Services, we have pleasure in submitting twenty copies of the Final Report.

Two copies of the report are being simultaneously transmitted to Kreditanstalt für Wiederaufbau.

Yours faithfully,

R Schuetz

H.R. Schuetz
for INSTRUPA Consulting GmbH

encls.

PREFACE

This report represents the findings of the Feasibility Study for Rehabilitation of the Jowhar Sugar Estate and Factory. Supporting data and more detailed presentations can be found in the following annexes.

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GLOSSARY

Abbreviations used in the text :

SoSh	Somali Shilling
DM	Deutschmark
$	United States Dollar
JOSR	Jowhar Offstream Storage Reservoir
DOSR	Duduble Offstream Storage Reservoir
FMT	Farm mechanisation and transport
IRR	Internal Rate of Return

Units :

The metric (SI) system of units has been adopted throughout. Some of the units used are explained below.

Mm^3	Million cubic metres
t/d cane	Tonnes of cane per day
t/h cane	Tonnes of cane per hour

Exchange rates used :

SoSh 6.04 = DM 1.0
SoSh 15.227 = US$ 1.0

Farm Numbers :

Until recently the Estate was divided into six farms numbered I to VI. Individual fields were numbered in sequence within the farm area (eg field V6). This numbering system is shown on Figure 2.1.1.

A new numbering system with nine farms was introduced in 1981 (see Figure I.E.1 in Annex I). There is little justification for this new system, especially since it is recommended that only 5 300 ha of the Estate is used for cane in the future.

In this report the old numbering system is used throughout, except where stated otherwise.

SUMMARY

SUMMARY AND CONCLUSIONS

0.1 Background

This Feasibility Study for the Rehabilitation of Jowhar Sugar Estate and Factory was commissioned in early 1983. Fieldwork started at the end of May 1983 and an Interim Report was submitted at the end of August. In subsequent discussions with the Client (Ministry of National Planning) and the Funding Agency for the Study (Kreditanstalt fur Wiederaufbau) it was agreed that further strategies for rehabilitation, in addition to those covered in the Interim Report, should be studied. An extension to the study period of one month was granted for this purpose. The results of the further investigation were presented in a second Interim Report, submitted in November. This second report recommended the adoption of a 'moderate investment strategy' for a cane area of 5 300 ha. Full details of the proposals are contained in this Final Report and the accompanying Annexes.

A separate study for a first phase rehabilitation programme for 3 500 ha was submitted in March 1984.

0.2 Present Situation

0.2.1 Irrigation and Drainage

The gross irrigated area of the Jowhar Estate is some 10 500 ha. with a net cultivable area of 8 230 ha. Whereas the irrigation system has performed reasonably well in the past, the same is not true of the drainage system which has never been properly implemented. Furthermore, the lack of proper maintenance coupled with poor irrigation techniques has resulted in low irrigation efficiency and poor irrigation distribution. The resulting excessive irrigation of some areas, together with no adequate provision for drainage, has lead to waterlogging and salinity problems, and more than 2 000 ha of the cultivable area is presently abandoned. The worst affected areas are generally located in a low-lying part of the Estate which has been irrigated for many years. Some fields have been abandoned for up to 15 years.

Successful drainage trials were carried out in 1977 and 1978 on abandoned land, demonstrating that these areas can be reclaimed. However, this work was not followed up and the decline in productive area has continued to the present day.

The Estate relies solely on the Shabelle river for its supply of irrigation water. River flow is often insufficient in the dry season months of January to April and, when the flow is low, the Estate has the right to abstract only 50% of the available water. In the 1 in 5 dry year (80% exceedance probability), which is normally adopted for the design of irrigation schemes, only 3.3 m^3/s is available in the river during February and March. Half of this would be available to the Estate, which is sufficient for less than 1 000 ha of cane under the present circumstances of low irrigation efficiency. Water quality places further constraints on irrigation on the Estate. Very high sediment loads for much of the year cause severe silting up of canals, and salinity concentrations during the dry season and at the start of the gu wet season are often higher than is acceptable for irrigation water.

0.2.2 Agriculture

The history of cane production at the Jowhar Estate during the last 15 years is one of steady decline. A peak production level of roughly 450 000 t of cane per year was achieved at the end of the 1960s when average cane yields exceeded 80 t/ha. Present production has dropped to only some 100 000 t/year with average yields of 33 t/ha. The decline in sugar content has been less marked falling from 13.5% in 1965 to 11.6% in 1983.

No single factor can be isolated and defined as the major cause of this situation. Contributing factors include: poor operational and managerial quality, water shortages, waterlogging and salinity, a decreasing share of plant cane, lack of production means, and insufficient machinery capacity due to poor maintenance.

0.2.3 Human Resources

In order to fulfill its operational and managerial tasks SNAI should at present employ some 3 200 persons, of which 1 800 are permanent and 1 500 are casual labour. At present the number of permanent employees is sufficient but standards of education and experience are severely lacking especially as far as the skilled workers, technicians and university graduates are concerned. In the case of casual labour a chronic shortage exists which during peak seasons, especially cane cutting, is as high as 50% of the demand. It is caused mainly by the low wages offered. The earning potential in subsistence agriculture is about three times as high and there is no shortage of land for subsistence farming.

SNAI is organised as a public sector enterprise and as such is obliged to follow the rules and regulations of the Somali civil service. Wage levels in the public sector in Somalia are extremely low and, what is worse, their rate of increase is lagging far behind the rate of rise in the cost of living. Wages for an unskilled labourer in the plantation average SoSh 280/month. Since 1977 they have been increased by 40% whereas the index of the cost of living for the same period has increased by more than 300%. Salaries of top grades have shown hardly any movement during this period. The general manager's salary is a mere SoSh 4 000/month. The private sector in the area is offering around SoSh 40/day for casual labour.

In parallel with the abovementioned decline in wage levels, the quantity and quality of social benefits has also steadily declined. Formerly an employee of SNAI could satisfy his needs in basic foods at the company's grocery shop at official government prices. Nowadays he is relying on the parallel market where prices are usually much higher than official prices.

0.2.4 Transport and Mechanisation

SNAI's transport system is based mainly on a narrow gauge railway system totalling some 60 km of rail. It has been slowly supplemented by a road system along with the increased use of heavy machinery such as cane trailers and harvesting machines. The railway system is poorly maintained and partly overaged. Less than 50% of the rolling stock is operational. The design of the road system is extremely rudimentary. Due to the lack of drainage and the complete absence of road surfacing. traffic comes to a standstill after minor rains.

Cane harvesting is done manually after burning, with loading by grab loaders. Hand cut cane is transported to the factory in rail carts or road trailers, the latter from fields close to the factory.

In 1976 SNAI acquired 4 TOFT harvesters as a first step towards mechanised harvesting. Mainly because of the lack of an adequate field layout this attempt must be considered as being premature. This effort was given up after one season and only re-introduced in 1983 due to an acute labour shortage. Furthermore the introduction of chopper-type harvesters should be reconsidered as it would require a complete rearrangement of the existing transport capacities and the cane yard at the factory. On the other hand a trial programme in order to choose the best mechanised harvesting system is vital since, due to the lack of labour, the share of mechanised harvesting will gradually increase.

0.2.5 The Factory

The milling station of the factory has an installed capacity of 100 t of cane per hour. Under conditions of high quality cane and low downtime rates almost 50 000 t of sugar of 'factory white' quality can be produced during the 240 days of the annual campaign.

The factory has reached an extremely low grade of technical efficiency. The extraction rate has dropped to less than 7%. Major shortcomings include the poor operational performance of the milling tandem with consequent low grade juice extraction and the production of wet bagasse; the main boiler station is relying heavily on crude oil as support fuel; control panels, instrumentation and electric wiring need a complete renewal; and the generator station has reached a dangerously low output capacity.

0.2.6 Management and Financial Performance

The level of managerial standards is deplorably low. It is marked by the complete absence of even rudimentary management techniques. The major but not single cause for this is the lack of experience and knowledge of the managerial staff. The situation is aggravated by frequent changes of personnel. The few highly qualified graduates are much too low in number to change the situation.

SNAI's history of its financial performance during the last five years is one of steadily increasing losses. Two major reasons can be noted: low managerial and technical efficiency have inflated the cost price of sugar production. Furthermore up to recently (October 1982) the ex-factory price for sugar had always been fixed at a level below cost price, even under excellent operational conditions.

Past performance has led to an extremely unsound financial situation of the enterprise. Past losses have completely wiped out share capital and equities. The cumulated bank overdrafts at the end of June 1983 amount to SoSh 200 million. Apart from the poor operational and managerial performance mentioned before, ex-factory prices below cost price and inadequate foreign exchange allotments have contributed to this poor financial status.

The provisions of the budget of the Ministry of Industry for 1983 slightly improve the situation. A working capital subsidy of SoSh 62 million has been allocated. Furthermore foreign currency provisions of more than DM 10 million have been made for overhaul operations.

0.3 The Project

0.3.1 Introduction

The recommended project comprises rehabilitation of the Estate to provide a cane area of 5 300 ha on which long-term average cane yields of 91 t/ha can be expected. The quantity of cane produced each year will thus meet the installed capacity of the existing factory.

The selection of a cane area of 5 300 ha has evolved during the course of this study. The main reasons for its selection can be summarised as :

(i) such an area can be expected to produce sufficient cane to meet the design capacity of the factory. Smaller areas will result in underutilisation of the existing installation, and hence lower economic returns;

(ii) the projected average yield of 91 t/ha can be maintained on 5 300 ha without major investment in water storage;

(iii) in order to grow cane on more than 6 000 ha it would be necessary to invest large sums for the installation of field drains in order to reclaim currently abandoned land;

(iv) with a larger area of cane, the frequency of water shortages would be increased with a consequent reduction in cane yields unless a major water storage scheme is implemented. Although expansion of the area without providing water storage would probably result in greater production, even taking into account lower yields, this would be marginal and would result in increased operational complexity.

Thus the so called 'moderate' investment strategy has evolved.

A 'minimum investment strategy' was also examined during the course of the study. This was conceived as a low cost option which would produce enough cane to satisfy the factory's financial break-even capacity. An area of some 2 750 ha of cane would be required. Rehabilitation costs for irrigation and drainage would be minimised by selecting an area of the Estate which suffers least from the current problems of waterlogging, salinity, inadequate drainage and poor irrigation supply. Such an area is to be found in the northern and eastern sectors of the Estate (the newest cane areas). This area has a reasonable irrigation supply and does not need deep drainage.

Strategies between moderate and minimum will not give better economic returns than the moderate strategy because of the heavy investment required in the factory and management assistance which vary little with the extent of cane area. However, an expanded version of the minimum strategy covering an area of 3 500 ha has been defined as a first phase of the full rehabilitation programme. In order to avoid the risk of worsening drainage problems (see Section 0.3.2) this first phase includes the heavy investment in the new field layout which was excluded from the minimum strategy. The overriding factor determining economic viability is the need to utilise the factory at or close to its installed capacity.

0.3.2 Irrigation and Drainage

(a) General

Selection of the geographical location of the 5 300 ha cane area has been largely determined by drainage considerations.

In certain areas of the Estate, mainly the central depressional area where many fields have been abandoned, soil and groundwater conditions are such that rehabilitation can only be achieved by the installation of field drains. This is a very expensive procedure and therefore these areas have been excluded in order to keep costs to an acceptable level.

The remaining areas of the Estate can be divided into two broad categories :

- those which can continue to produce the required cane yields with only a shallow drainage system, and;

- those which require a deep main drainage system which will include some field drains on fields which continue to deteriorate.

In both cases, the projected yield level of 91 t/ha can only be achieved by the proposed improvements to irrigation supply and field layout. These improvements aim to increase the efficiency of irrigation which, of course, reduces the quantity of irrigation water required. The improvements will also reduce the quantity of water which is lost to deep percolation and, consequently, will reduce or eliminate (depending on the area considered) the need for deep drainage.

One of the most important features of the proposals for irrigation rehabilitation is the introduction of night storage so as to avoid night time irrigation. It is irrigation at night which is one of the major factors resulting in poor irrigation efficiency and hence excessive drainage requirements. The introduction of night storage does, however, carry a cost penalty in that it requires more extensive changes to the canal system than would otherwise be necessary. It also increases the area that will require a pumped supply and makes operation of the canal system somewhat more complicated.

The proposed rehabilitation works thus include the following :

- changeover to the new field layout for all cane fields;

- improvements to the existing main drainage channels so that these are able to remove excess surface water (from irrigation and rainfall)

- deepening of the West drain, its branches and collector drains. and a limited programme of field drain installation in this area to arrest further deterioration;

- improvements to the existing irrigation system by introducing night storage and providing better facilities for flow regulation and control;

- providing storage reservoirs on the Estate to ensure water availability for plant cane (see sub-section (b) below).

In addition improvements will be made to the main access roads by embanking these and providing surface drainage.

(b) Water Storage Options

Two levels of water storage have been considered:

- major offstream storage to ensure that the Estate's water requirements for 5 300 ha cane are fully met 4 years in 5.

- small scale storage on the Estate to ensure that there is always irrigation water available for the new cane planted in January and February.

For major storage two alternatives have been considered, namely a new offstream reservoir at Duduble, and increased capacity of the existing reservoir (JOSR) to the south of the Estate. Either alternative can provide the required security of water availability. A new reservoir at Duduble is the more expensive option with a capital cost of SoSh 93 to 110 million, depending on the operating rules adopted. In comparison the increased capacity of JOSR with a pumped supply to the Estate would cost about SoSh 62 million, but this alternative would require an additional recurrent expenditure of SoSh 1.1 million per annum for pumping.

Both these major storage options carry a degree of uncertainty. In the case of Duduble, the lack of data on the soils of the reservoir area makes the prediction of seepage losses and the availability of suitable embankment material uncertain. For JOSR the current sub-optimal operating regime, if maintained, would render any increase in capacity of little value.

Without major storage it is still possible to obtain acceptable yields on 5 300 ha provided that there is water available to guarantee irrigation for dry season plant cane even in the event of a three month total drought. The cost of such storage is small since the existing basins on the Estate can be used. This provision has therefore been allowed for in the proposed project.

It must be stated that there is clearly a need for a more rational approach to the allocation of the Shabelle river water. It is important that the following points in particular are resolved, certainly before any further consideration is given to major water storage schemes:

- the current inefficient operation of the Jowhar offstream storage reservoir;

- the allocation of unregulated flows between the Estate and downstream users;

- the plans for flood relief works at Duduble, part of which might become redundant if a reservoir was to be constructed here.

0.3.3 Agriculture

In the field of cane production the problems to be solved are centered mainly around a seasonal water shortage arising in the months of January to March.

The planting seasons will be changed in such a way that 50% of the annual plant cane will be planted during this dry season since water requirement in the growth cycle are lowest at planting. Inter-seasonal water storage on the Estate will guarantee that a minimum area of 500 ha newly planted cane can be irrigated during a drought.

Monthly water requirement for 5 300 ha cane area vary from 6.04 m^3/s in March to 2.81 m^3/s in October. For the assessment of yield reductions resulting from water shortages a proportionate water supply/yield relation is considered as a fair representation of the crop's production function for most periods in the growth cycle. The exception, of course, being the planting and drying off periods. Lack of irrigation for a period of 10% of the growth cycle will result in a yield reduction amounting to 10% of normal yields. Normal yields being those achieved with full water supply under Jowhar's ecological conditions combined with good agricultural practices. Yields under full water supply will be 100 t/ha. The long term average yield will amount to 91 t/ha as a result of cyclical water shortages. Inter seasonal fluctuations of the production level will be reduced by carrying forward to the next season part of the harvest above the average.

The introduction of a new cropping calendar will also alter the harvesting and crushing seasons. The new ones will be from June 16 to October 15 and from December 16 to April 15.

The use of approximately 2 900 ha of future non-cane area of the Estate has been investigated at pre-feasibility level. Six activities are recommended: paddy, subsistence crops for payment in kind, coconuts, fuel wood combined with pasture, cattle fattening and finally a small-scale settlement scheme.

0.3.4 Factory Rehabilitation

The critical items in the factory are the following :

- speed regulation of the mill turbines;
- steam boilers
- facilities for the make-up of boiler feed water;
- electrical power generation;
- power distribution;
- electrical motors.

Rehabilitation will be implemented in three steps, namely :

- priority measures already contracted by the Ministry of Industry (mill, boiler, instrumentation) programmed for 1983/84;
- a crash programme as part of the project, covering the further improvement of the milling tandem, the water supply system and the power plant; and finally,
- proper rehabilitation will consist of a general overhaul of most items of plant and the procurement of a new 3 600 kVA turbo generator.

The factory's operational performance will steadily improve. The main indicators are summarised below :

	Cane crushed	Operating days	Down time	Recovery	Sugar/ cane ratio
	(t)		%	%	%
1983/1984	45 000	124	50	55	6.1
1991/1992	469 510	230	15	78	10.0

0.3.5 Harvesting and Transport

Mechanised harvesting, compared to manual harvesting, tends to reduce sugar production due to cane losses in the field and due to high foreign matter content in harvested material. Therefore all possible efforts should be made to recruit sufficient labour in order to harvest cane manually.

As recruiting efforts may prove to be ineffective two whole stalk harvesters will be bought for experimental purposes. These will be able to cover, together with the existing TOFT choppers and the currently available labour force, the low production level for the first years of the rehabilitation programme.

Loading will be done mechanically with the existing grab loaders.

The future transport system will combine trailer transport for short hauls and rail transport for long ones. In-field transport will be done by tractors only. The resulting necessity for transloading on rail costs is more economic than the present in-field system of transportable rails. The existing railway system will be overhauled and redesigned to a one-way system.

A total of 23 km of primary and 55 km of secondary roads are programmed for improvement mainly by providing a proper drainage system and embanking low reaches of road.

The main workshop should function in future in two separate more specialised units, one of which would report to the factory department and the other to the agricultural department. The latter would specialise in equipment in the fields of harvesting, transport of cane, and agricultural machinery.

0.4 Organisation and Management

SNAI is a government agency under the supervision of the Ministry of Industry.

Its organisation is based on three main divisions:

- the Factory department (35% of permanent staff)
- the agricultural department (32%)
- administration and finance (33%)

It employs a permanent staff of some 1 850 people. Up to 2 000 additional persons are needed on the farms as casual labourers.

Unfortunately the standard of the existing managerial set-up is deplorably low. There is a complete absence of standard managerial techniques. This deficiency must be considered as the greatest single stumbling block to fast improvement.

The status of a government agency results in a noticeable lack of managerial autonomy especially in the fields of finance and personnel.

Two major structural weaknesses of the organisation are inadequate staff training, and no clear separation between control and operational functions. The existing salary levels are extremely low, and salary increases have lagged far behind that of the cost of living index. In parallel with the decline of the Estate's financial situation the availability of social amenities has come down to practically nil. SNAI has become unattractive as an employment alternative on the very narrow Somali labour market. Under the prevailing labour conditions the Estate cannot even hire sufficient labour to harvest all its mature cane. Most key functions are inadequately staffed. The existing team of enthusiastic young executives is much too small to cope with the problems and the risk is that the resulting low job satisfaction will lead to resignation of these employees.

The proposed reorganisation of SNAI is based on the following principles:

The necessary managerial automony can be achieved only by altering the company status. We have proposed that of a corporation under private law. It will be formed by a board of directors representing government, the banking sector and the sugar industry. Standard managerial instruments such as cost budget and quality control must be introduced.

Investment in human capital - i.e. training, salaries, social amenities - has to be considered as important as technical rehabilitation. SNAI must make every possible effort to regain its previous image of an attractive employee as fast as possible.

Salary levels must be raised considerably. The daily wage-rate for casual labour will have to go up from SoSh 20 to SoSh 50 for cane cutters. This level has been deduced from the earning potential in subsistence farming. Permanent employees will attach more importance to social amenities for themselves and their families.

Training will have to be the backbone of SNAI's future personnel policy.

During an initial phase of the rehabilitation programme the enterprise will rely heavily on an international management assistance team, since the profitable operation of SNAI requires management and technicians of high calibre and with considerable experience which at present in only exceptional cases is available on the Somali labour market. We have identified 39 key posts and formulated the job descriptions for them. Of the 39 key posts identified, it is recommended that 14 are filled with the assistance of an experienced international agency. The remaining posts, mainly at middle management level, should be filled by local contract but with salaries topped up by a foreign exchange component to attract suitably qualified staff. Expatriates will be phased out after periods varying from two to five years, in line with the training of Somali staff.

0.5 Project Cost and Finance

In project's base line costs for a five year period starting from 1 July 1984 amount to DM 75.968 million (equivalent to SoSh 458.847 million) in constant mid-1983 terms. This amount comprises the following elements:

All capital costs for project years 1 to 5, and the recurrent costs (fees) and capital costs for the management unit.

No provisions have been made for an operational fund, estimated at one quarter of the annual operational costs or DM 6 million. Financial losses that are to be expected during project years one and two are not covered either (roughly DM 20 million). Finally it has been postulated that previously cumulated debts (DM 40 million) will be wiped out before the beginning of the project.

The project would start with a crash programme, mainly in 1984/85, necessary to avoid a complete technical breakdown of the enterprise. The crash-programme costs amount to DM 5.009 million, which have not been included in the project cost.

In addition the Somali Government has contracted in 1983 orders for the benefit of the Estate amounting to a total value of DM 10.6 million which have also not been included as they already have an assured source of finance.

Project costs as defined above contain an average foreign exchange component of 88% or DM 66.8 million.

In the financial analysis the following contingencies have been added to baseline costs: physical contingencies of 10% to all cost items and a provision of 7% annually for inflation.

This brings the project cost to

DM 93.674 million (or SoSh 565.791 million)

0.6 Incremental Production, Marketing, Financial Results

Jowhar's sugar production is projected to increase steadily from 1983's near-to-breakdown level of 2 700 tonnes to the medium and long term target level of 46 950 tonnes annually. This is expected to be reached in the 1991/92 campaign (June to May). A net harvestable area of 5 148 ha producing an average 91 t/ha and a sugar-cane ratio of 10% will achieve this result.

Somalia's national sugar production for the same campaign will reach a total of 116 950 tonnes out of which 70 000 tonnes will be produced by the Juba Sugar Factory. The national demand has been projected to be around 149 000 tonnes for the same year. A total of 8.4 million consumers will have reached an annual per capita consumption of 17.7 kg. The present demand is estimated to be 96 000 tonnes exerted by 6.9 million consumers with an average per capita consumption of 14 kg. In fact on the Somali internal sugar market a short supply situation is prevailing. In 1983 the average consumer price was around SoSh 22 000/t which is more than 3 times the long-term import-parity price or close to 2.5 times the present ex-factory price.

The rehabilitation of Jowhar is therefore a clear-cut import-substitution project.

The future financial prospects for the enterprise must be considered as satisfactory. Assuming a future equity-loan ratio of 60 to 40 and furthermore supposing the continuation of the existing producer price level of SoSh 9 018/t the financial analysis shows the following results:

The continuation of operational losses is to be expected for years 1 and 2. Year 5 will produce the first positive cash flow. The latter will increase to a stable medium term level in excess of DM 35 million (year 8 and on).

0.7 Benefits and Justification

The project's economic cash flow has been computed on the following methodological basis. Costs include full labour costs and the cost of international management unit. The official exchange rate has been applied to the project's foreign exchange components in the basic solution. Incremental sugar production has been evaluated at an import parity price of SoSh 6 084/t which is based on a long-term trend price of $ 333 FOB Caribbean ports. Incremental costs and benefits are expressed in constant mid-1983 terms.

Under these conditions the project yields an economic internal rate of return (IRR) of 17.6%. The first positive cash flow appears in year 6.

The cumulative negative cash flow increases to DM 71.6 million in year 5, and is wiped out in year 10. The medium term annual cash flow amounts to DM 14.9 million. A solution where the project's foreign exchange components are shadow priced (SoSh 20 instead of 15.227 per US $) yields an IRR of 18.2%.

The project's effect on Somalia's balance of payments is very positive (approximately DM 20 million per year at full production level). The employment effects are negligible. No major negative environmental effects have been identified.

Two major uncertainties must be noted.

(i) The proposed measures to attract casual labour may prove not to be sufficiently effective. In this case the degree of mechanisation of harvesting will have to increase in step with the progress of the implementation programme for the new field layout. The results will be a very slight increase in the costs of harvesting, a minor reduction of the quantity of cane harvested and a 5% increase of the foreign exchange component of the costs of sugar production, still leaving a comfortable net gain in foreign currency.

(ii) In the medium term it may not be possible to maintain the optimum level of operational and managerial efficiency. The sensitivity test has shown that the project is quite sensitive to a general decline in sugar production. But an economic IRR of 17.6% is a good margin to absorb one of the risks, more so as the financial viability is improved by an ex-factory price being roughly 160% of the import-parity price.

CHAPTER 1

BACKGROUND

CHAPTER 1

BACKGROUND

1.1 Introduction

The Estate is situated 100 km north of Mogadishu on the left bank of the Shabelle River close to the town of Jowhar. The Estate location is shown in Figure 1.1.1.

The Estate was founded in 1920 by the Duke of Abruzzi and was originally operated by a privately owned Italian company, the Societa Agricola Italo Somala (SAIS).

A topographic survey of the area was undertaken by SAIS in 1919. A diversion weir was constructed on the Shabelle in a dry loop of the river and the main flow was diverted through a new channel to the structure. This weir provided the head required to supply the scheme by gravity. Part of the original river channel was retained as an escape during periods of flooding to allow flow to by-pass the weir.

From 1922 and 1926 the scheme grew cotton, but pests destroyed most of the crops and so in 1926 after experimenting with a number of alternatives the scheme concentrated on the cultivation of sugar cane and a sugar factory was built. Early records of SAIS show that an area of 155 ha was under cultivation at this time, and during the 1940s the Estate was gradually expanded to over 1 000 ha.

Following Somali independence in 1960, the government took a controlling interest in the Estate and formed a new company to operate the scheme, Societa Nationale Agricola Industriale (SNAI). This company employed several expatriate staff both in the field and the cane processing divisions.

In 1963 a major sugar production expansion programme was started in both the field and the factory with the object of making Somalia self-sufficient in sugar. The cropped area was increased from 1 400 ha in the 1963/64 campaign to more than 4 000 ha by 1967. A new factory was built in 1965 with a capacity of 40 000 tonnes a year to replace the old factory of 12 000 tonnes capacity. During this period, however, problems arose on some of the land in the older parts of the Estate with the result that 1 000 ha were abandoned as unsuitable for cultivation due to saline soil conditions.

Between 1968 and 1975 the cropped area of sugar cane gradually increased from 4 000 ha to 6 200 ha. During this period more of the older parts of the Estate became unsuitable and were abandoned, and new areas were brought under cultivation to maintain production.

Peak cane production was achieved in the early 1970s. Since then there has been a steady decline. At present more than 2 000 ha of land are abandoned.

1.2 Previous Studies

The problems which the Estate is now experiencing were apparent in the early 1970s. Soon after the Estate was nationalised in May 1970, outside consultancies were invited by the Somali management to identify the reasons for the increasing

deterioration of some parts of the Estate. In 1975/76 Sir M. MacDonald & Partners carried out a study of the irrigation and drainage problems of the Estate including agronomic practices, irrigation methods and disposal of drainage water. Soil and topographic surveys were carried out and a development programme including estimated costs of rehabilitation was submitted (MMP 1976).

The 1976 report recommended that, due to the complex nature of the problem, it would be unwise to proceed immediately with the installation of a full scale drainage system and that a trial should be carried out on a representative field. This was done in 1977/78 with subsurface field drains being installed at different drain spacings (MMP 1978). The trial demonstrated that abandoned fields can be reclaimed and good yields of sugar obtained. However, apart from some other short term inputs from outside consultants, including the work undertaken by Davy Agro (1980), this work was not followed up and the decline in productive area has continued to the present day.

The Feasibility Study for the Rehabilitation of Jowhar Sugar Estate and Factory was commissioned in early 1983. Fieldwork started at the end of May 1983 and an Interim Report was submitted at the end of August. In subsequent discussions with the Client (Ministry of National Planning) and the Funding Agency for the Study (Kreditanstalt fur Wiederaufbau) it was agreed that further strategies for rehabilitation, in addition to those covered in the Interim Report, should be studied. An extension to the study period of one month was granted for this purpose. The results of the further investigation were presented in a second Interim Report, submitted in November. This second report recommended the adoption of a 'moderate investment strategy' for a cane area of 5 300 ha. Full details of the proposals are contained in this Final Report and the accompanying Annexes.

A separate study for a first phase rehabilitation programme for 3 500 ha was submitted in March 1984.

1.3 Recent Trends in the National Economy

It is extremely difficult to paint an accurate picture of the Somali economy. Reliable demographic statistics are difficult to come by. For our future calculations we assume for 1980 a population of 5 million. No exact figures can be obtained about the refugee population in the country, nor about the transmigrating nomad population which seasonally crosses the borders from neighbouring countries when changing grazing grounds. For further calculations we assume each of these groups to be around 700 000 persons. Future population growth rate is estimated at 3.0%. The World Bank has estimated the growth rate of the past at 2.8%.

Table 1.3.1 gives the evolution of the GDP in the 1970s.

Analysis of this table shows that the growth rate during this period has been equivalent to the approximate growth rate of the population. In other words: the economy has been a stagnant one. The growth rates in the productive sectors have been moderate with 0.9% on the average. Agricultural cropping and industrial production have shown a negative growth. Government services, on the contrary, have almost doubled.

Between 1960, when Somalia gained independence, and 1978 the share of agriculture in GDP fell from 68% to 51%, the share of industry remained the same, whereas that of services rose from 19 to 36%.

Figure 1.1.1
Project Location

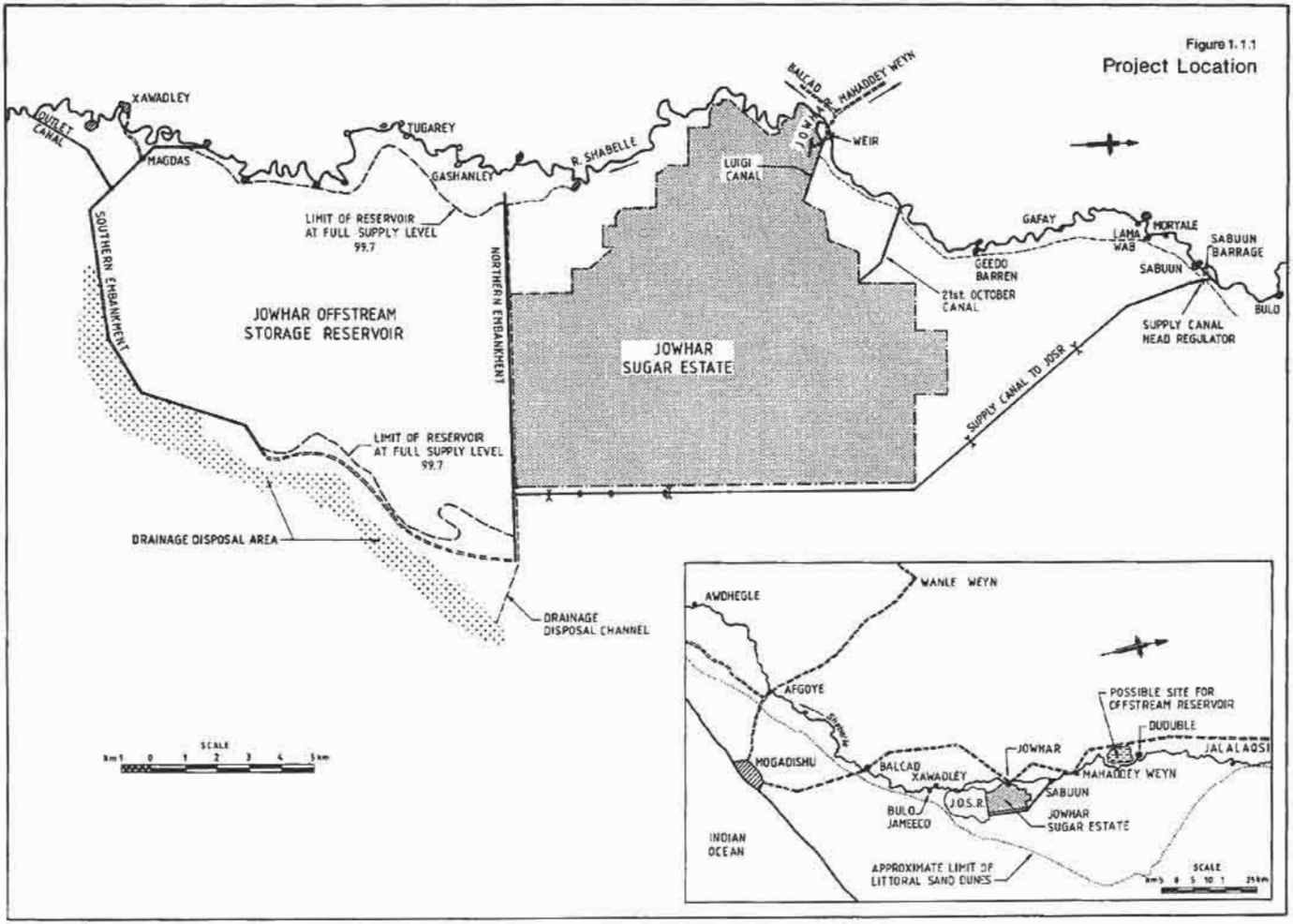


TABLE 1.3.1

Estimates of GDP at Factor Cost, 1972 and 1978

	1972	1978	% of GDP	Average annual growth rate 1972 to 1978
	(SoSh million)		in 1978	(%)
Productive sectors	1 544	1 627	63.7	0.9
Agricultural sector of which:	1 180	1 305	51.1	1.7
Livestock	713	837	32.8	2.7
Crops	294	247	9.7	-3.0
Other	173	221	8.6	4.2
Industrial sector of which:	364	322	12.6	-2.0
Manufacturing	222	212	8.3	-0.8
Construction	106	70	2.7	-6.5
Other	36	40	1.6	1.7
Services sector of which:	626	929	36.3	6.8
Government services	178	297	11.6	8.9
Other services	448	632	24.7	5.9

Source: IBRD Country Report 1982.

Since 1978 the Somali economy has been in a state of financial crisis which can roughly be described in the following words:

- little or no improvement in per capita income during the past two decades;
- continued stagnation in production and exports;
- increased under-utilisation of existing capacity;
- high rate of inflation.

A major causative factor were the overvaluation of the exchange rate, which led to reduced incentives for exports and underpricing of imports, and Government pricing and marketing policies, which resulted in a sharp erosion of producer prices in real terms.

The situation was aggravated by the 1977/78 border conflict. Inflation in this critical period rose to a level of 50% per year. Food imports rose sharply. Exports on the contrary declined. Whereas up to 1978 international transfers had reached a level US $ 550 per capita per year, foreign aid had come down to an extremely low level after the short cut of Russian aid before the uptake of massive new influx of capital out of OECD countries.

Growth of the main sectors in 1979/80 has not been much different from the 1972 to 1978 period. However favourable climatic conditions was the main factor accounting for a substantial increase in value added by the crop sector.

1980 is the beginning of a recovery period. The Government's economic policy is marked by austerity measures. In the same year the IMF and Somalia signed the first three stand-by programmes.

Inflation in the last two years has come down to rates close to 20% per year. Several devaluations of the Somali shilling and marked increases of producer prices in the agricultural sector are major single measures of the economic policy.

As was described above, the industrial sector has, like crop production, suffered a negative growth in the 1970s. Among the more important import-substitution industries are SNAI and Juba Sugar.

Performance of public sector manufacturing/processing industry as a whole has been very poor: a large proportion of the factories are producing far below capacity; most of them are consistently incurring financial losses. As Table 1.3.2 shows, the much smaller private manufacturing sector has performed much better than public sector enterprises.

TABLE I.3.2

Value Added in Industrial Establishments Employing Five or More Persons (constant 1979 prices)

	Value added			Value added per employee		
	Public (millions of SoSh)	Private (thousands of SoSh)	Total	Public (thousand of SoSh per person per year)	Private	Total
Average 1970 to 1972	104	13	118	30	5	19
Average 1977 to 1979	126	26	152	13	9	12
Average annual growth rate (%), 1970 to 1972 - 1977 to 1979	3	10	4	-11	9	-7

Source: IBRD Country Report 1983.

Explanation of low capacity utilisation in industry first of all lies in the poor performance of agriculture. Stagnation or decline (as in the case of SNAI) of agricultural outputs has resulted in scarcity of local raw materials for the factories.

Scarcity of working capital is attributable mainly to the Government's policies, which:

- held down producer prices, thus diminishing the potential profits;
- rationed bank credits mainly to the Government itself and to state trading and marketing agencies and;
- required enterprises to inflate their wage bills by hiring superfluous workers.

The Government's employment guarantee to all secondary school leavers who seek employment in the public sector caused overstaffing in both the Government administration and public enterprises. During a period of 6 to 7 years the number of public service employees doubled and the real, after tax incomes, of these employees fell by as much as 50%, thus having an adverse effect on morale, effort and productivity.

In contrast to the obvious need for a reduction of the labour force, possibly soluble by re-allocation of workers from not so productive Government and parastatal enterprises to more productive employment in agricultural and infra-structural development, there is an overall scarcity of managerial talent and experiences. The gap between the supply and demand of managers, entrepreneurs, skilled workers and technicians widened rather than narrowed.

Management problems further include deficiencies in management systems and fragmented managerial responsibility.

Operation of many enterprises is also constrained by a shortage of imported materials (spare parts, fuel and other inputs).

1.4 The Agricultural Sector

Agriculture occupies a predominant position in the Somali economy. More than 80% of the population depends largely on agriculture for their livelihood.

About 500 000 families are engaged in the livestock subsector, which is the principal generator of income and employment and the major foreign exchange earner covering about 80% of the country's total exports.

Only about 200 000 families, mainly subsistence small scale farmers, are occupied in crop production. These farmers cultivate a total hectarage of some 700 000 ha. Main subsistence crops are maize and sorghum. The major cash crops are bananas, and the second most important export products are cotton and groundnuts.

State farms account only for about 3.5% of the cultivated areas (about 23 600 ha out of 700 000 in 1981).

Crop production accounts for 10% of the GDP only. Its contribution to export earnings had come down to a mere 5% in the beginning of the 1980s. This production sector was characterised by a particularly poor performance in the 1970s. Industrial crop production stagnated between 1972 and 1980 with a severe drop for the two most important single crops, namely bananas and sugar cane, as shown in Table 1.4.1.

TABLE 1.4.1

Production of Selected Agricultural Crops 1972 and 1977 to 1981 (in thousand tonnes)

	1972	1977	1978	1979	1980	1981
Food grains	268	265	261	262	268	372
Bananas	189	65	70	72	60	69
Sugar cane	401	320	312	265	420	378
Other industrial crops(1)	47	47	46	47	45	30

Note: (1) Includes sesame, groundnuts and cotton.

Source: IBRD Country Report 1983.

There has been some recovery in banana production whereas in the sugar cane sector, as we will see later, more long term rehabilitation measures will be needed.

The Government's failure to provide adequate price incentives to producers until recently has to be seen as the critical factor leading to the decline of crop production. Whereas livestock export prices, not being subject to Government control, kept up with inflation, prices of most agricultural crops are kept low for the benefit of urban consumers and therefore in real terms declined significantly over the last six years. Furthermore over-valuation of the exchange rate led to under pricing of food imports, thus serving to dampen local food prices and constituting a disincentive to local production.

The decline of crop production is also due to the farmers' inadequate financial resources and limited access to productive inputs. The crop as well as the livestock and fishery sectors have regularly received only a very low share of the total bank credit relative to the importance of these sectors in the economy.

At the same time fertilisers, improved seeds, tools, farm machinery and equipment and spare parts are less available as the balance of payments has come under increasing strain.

Extension services until recently were rudimentary and still are inefficient. The agencies serving the crop sector are handicapped by limited operating funds and facilitites, a shortage of trained and experienced manpower, frequent staff transfers, absence of work programmes and the lack of management control. (The crop production subsector is served by the Ministry of Agriculture (MOA) through its Departments of Production Extension, Land and Water Resources, Plant Protection and Locust Control, Planning and Statistics, Administration and its Research Institute.)

The traditional marketing system for crops is not as well developed as that for livestock. Roads and other marketing infra-structure are generally poor and post-harvest technology, particularly storage, is wasteful. Moreover Government has not properly maintained existing infrastructure for water, the country's most scarce resource.

In rainfed farming areas, where about 600 000 persons are engaged, yields are extremely low (see Table 1.4.2). Even with the technology now available yields can be doubled or trebled with better extension services, increased input supplies and attractive producer prices.

In the controlled irrigated areas (more than 200 000 persons) the hectarage could considerably be increased by rehabilitation of the irrigation network and improvement of water management.

Technology currently employed on State farms should permit yields two to three times the averages. This will depend largely on better management.

TABLE 1.4.2

Average Crop Yields Compared with Yields Under Good Practice

	Average yield (t/ha)	Yield under good practice (t/ha)
Rainfed:		
Maize	0.3	0.6
Sorghum	0.4	0.8
Controlled irrigated:		
Maize	0.8(1)	2.5
Rice	2.0	3.0
Bananas	15.0	30.0
Sugar cane	45.0	75.0
Sesame	0.3	1.0
Cotton	0.7	2.5

Note: (1) Around 1.2 according to MNP.

Source: IBRD, Agricultural Sector Review, 1981.

1.5 The Somali Sugar Sector

The national sugar demand is around 80 000 t annually. This figure is based on 6.4 million consumers and an annual per capita consumption of roughly 13 kg. A more detailed analysis of the evolution of the national sugar demand is given in Section 5.2.2.

On the production side Somalia has two agro-industrial units:

(i) the older SNAI establishment (Jowhar) - subject of this study - with a design capacity of its factory of 50 000 t of raw sugar per year;

(ii) the recently constructed Juba Sugar Factory with a design capacity of 70 000 t per year.

The actual national production level is far from the design capacity total of 120 000 t. SNAI has produced in 1983 a mere 2 700 t of sugar due to a low production level of cane and more so due to the technical status of the factory being close to breakdown.

The Juba factory is expected to produce some 28 600 t of sugar this year. This factory started production only in 1981. It is expected to reach full design output for the first time in 1987. Both factories are organised as public sector enterprises under the Ministry of Industry. In both cases the cane production basis is an agro-industrial estate covering an irrigated area of slightly above 8 000 ha each. No cane is grown in Somalia by private farmers on a small scale basis (outgrowers).

Under the ecological conditions of Somalia sugar can be grown only under irrigated conditions because of the low rainfall level and the long dry season. Irrigation therefore is the major cost item in cane production. Foreign management is necessary because of the narrowness of the national labour market for highly skilled specialists, and this adds another heavy cost item to the national cost price for sugar.

Therefore even under conditions of high technical and managerial efficiency the local conditions must be considered as only moderately favourable by international standards.

In fact the real cost situation in the recent history of SNAI sugar factory was much worse. A production level far below capacity combined with low degrees of managerial and technical efficiency have led to cost prices far above a level being internationally competitive. Furthermore ex-factory prices were fixed by government at a level that has been hardly sufficient even to cover variable costs. SNAI therefore has not been able to make the necessary replacement investments out of operational profits in recent years.

CHAPTER 2

PRESENT SITUATION

CHAPTER 2

PRESENT SITUATION

2.1 Physical Resources

2.1.1 Climate

The climate at Jowhar is tropical and semi arid and apart from the low rainfall it is well suited to sugar cane production. The mean annual rainfall is 480 mm and falls in two pronounced seasons. The 'gu' rains fall between April and June and the 'der' rains between October and December. There is a great variation in annual rainfall with minimum annual rainfall of around 100 mm. Mean monthly temperatures range between 29° and 36° C, and mean monthly minimum temperatures between 21° and 22° C. Such a regime is ideal for vegetative growth but the temperatures are not sufficiently low at any time of the year to stimulate ripening. It is an area of insolation and 2 800 sunshine hours are recorded annually. The mean relative humidity is 71%. The mean wind speed is 1.4 m/s. Evapotranspiration is rather high and is estimated at 2 300 mm/year.

Mean monthly climate data are presented in Annex II, Table II.1.2.

2.1.2 Topography

The Jowhar Estate lies on the eastern side of the floodplain of the Shabelle river. This comprises a broad, almost flat plain which has a very slight slope towards the south.

The river flows within a natural levee some 2 to 3 m above the surrounding floodplain. The levee is about 1 500 m wide and includes a prominent ridge alongside the river, which slopes gently away from the river to merge with the floodplain.

The slopes in the Estate vary from 0.2% to 0.03%. In the middle of the Estate (parts of Farms Nr II, III, IV and V) the area is almost flat with slightly depressed basins, and this is where most of the abandoned fields are found. Although the general relief is flat, the microtopography is irregular.

Photo maps at 1 : 2 500 scale have been produced for this study. From these a 1 : 25 000 map of the Estate, with 0.5 m contours, has been prepared (Drawing Nr 12700/1).

2.1.3 Soils

A soil survey was conducted during 1975. The alluvial soils generally consist of deep, relatively uniform montmorillonitic clays on the floodplain but there are areas of levee soils (particularly near to the river) where the alluvium has more of a silty texture.

The cane cultivation is almost entirely on floodplain soils. The soils are characterised by deep, imperfect to moderately well drained, dark brown, calcareous clay soils. They are defined as Chromic Vertisols, having a subangular blocky to crumb structure in the upper layers and a prismatic structure, showing slicken sides, in the lower layers. The floodplain soils were

subdvided in the 1976 study into F_1 and F_2 soils; the F_2 soils being characterised by a reddish coloured subsoil present at various depths below the surface. Although classed as Vertisol, the F_2 soil in particular exhibits only a limited expanding soil characteristic and is not considered to be a true Vertisol.

The fertility of the soils is rather good, with very high cation exchange capacity values. Values of exchangeable calcium, magnesium and potassium are high. The soils have a low alkali hazard and can be leached without problems in cases of salt accumulation.

2.1.4 The Shabelle River

All irrigation water for the sugar estate is obtained from the Shabelle river. Water availability is good for much of the year, but shortages occur frequently in the dry season (January to March), at a time when crop water requirements are at their highest. Water quality is variable, particular problems being experienced with salinity and sediment load. Full details are presented in Annex I. The main points are summarised below.

River flow records have been available for the Mahaddey Weyn gauging station since 1951, with some gaps, and more recently from the river barrage at Sabuun. The results of several analyses of these data are presented in Table 2.1.1

At present, the Estate is entitled to take up to 50% of the river flow during the dry season months. This limitation means that water shortages will occur as frequently as one year in two, assuming a cane area of 5 300 ha with reasonably efficient irrigation. With the present poor standards of irrigation management, such shortages will be more severe. The effects of these water shortages on cane yields are discussed in Section 2.3.

The use of saline water for irrigation also results in reduced yields. Electrical conductivity measurements of the river water have been recorded by the Estate for a number of years. These records are summarised as monthly averages, together with some earlier data for Afgoi, in Table 2.1.2.

Salinity levels tend to be high in the dry season months of January to March and become even higher during the first flush of the gu season flood in April or May when values in excess of 3 000 micromhos/cm can occur. For the remainder of the year salinity levels are relatively low, generally less than 1 000 micromhos/cm. During the period December 1977 to May 1983, for which detailed records of salinity values are available, a value of 3 000 micromhos/cm (the recommended upper limit for use as irrigation water) was equalled or exceeded on 124 days - an average of 23 days per annum.

Heavy sediment loads in the river water have presented severe problems in recent years (see Section 2.2.2). Particularly high sediment concentrations were recorded during 1980 and 1981 as part of the Jowhar Offstream Storage Reservoir operation. Unfortunately these records are the most comprehensive of those available - previous records and those covering the past two years are very sparse and do not therefore offer a reasonable basis for comparison. A summary of the available records is presented in Table 2.1.3

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Water Availability (Mm^3) (1)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Period 1951 - 1983 (independent monthly values)													
exceedance probability	50%	31	21*	26*	88	245	125	107	261	332	311	212	86
exceedance probability	75%	21*	9*	11*	33	161	58	48	164	259	242	144	53
exceedance probability	80%	16*	8*	9*	24	159	48	38	119	225	219	132	50
Periods 1954-60, 1961-75, 1981-83 (independent monthly values)													
	50%	33	22*	23*	88	240	114	94	259	334	316	206	80
	75%	17*	8*	23*	22	148	48	38	184	311	257	135	53
	80%	16*	8*	8*	21	136	43	36	171	297	248	132	51
Periods 1954-60, 1961-75, 1981-83 (homogeneous monthly sequence)													
	50%	32	31	23*	95	331	118	102	265	319	293	220	145
	75%	25*	15*	10*	88	176	109	85	147	271	327	172	82
	80%	24*	10*	8*	54	201	99	91	151	308	258	182	62
Estimated requirements(2)		14	13	16	9	8	9	9	11	14	8	8	10

Notes: (1) Based on flow records for Maheddey Weyn (34 km upstream of Jowhar) and Sabuun.
(2) For Jowhar Estate, based on 5 300 ha net cane and using the latest estimates of crop water requirements (see Table 3.6.2).
* Water availability inadequate for requirements assuming the Estate can abstract a maximim of 50% of river discharge.

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Salinity Records for the Shabelle River (micromhos/cm)(1)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1965	580	700	1 310	1 880	1 350	1 060	1 510	1 780	450	610	1 010	1 070
1966	1 100	1 690	1 240	610	1 070	850	470	400	480	480	960	880
1968	828	1 066	1 076	641	780	620	520	454	465	403	742	845
1973	-	-	-	3 350	1 990	850	830	370	360	470	860	930
1974	1 780	2 680	2 870	1 090	1 270	990	420	350	410	440	560	860
1975	1 470	2 390	2 850	2 690	1 170	1 600	900	630	540	420	630	1 180
1976	1 260	1 850	2 330	2 470	1 410	1 440	1 380	400	360	410	730	560
1977	1 170	900	690	1 400	1 480	960	720	620	400	450	570	639
1978	1 230	1 794	1 115	861	880	937	1 013	510	563	477	672	915
1979	1 280	888	633	881	887	1 010	1 038	853	585	603	457	1 106
1980	1 858	2 463	3 163	4 275	1 969	1 593	1 314	615	409	428	362	826
1981	1 656	2 273	-	997	807	837	1 353	663	497	463	569	1 431
1982	2 784	3 599	3 288	1 798	599	507	433	390	374	325	550	611
1983	613	990	960	806	417	-	-	-	-	-	-	-
Average	1 355	1 791	1 794	1 696	1 149	1 020	915	618	438	460	667	911
Average for 1978-1979	1 570	2 001	1 830	1 603	926	977	1 030	606	486	459	522	978

Note: (1) Salinity records for Jowhar except 1965-68 (Afgoi).

TABLE 2.1.3

Records of Suspended Sediment Concentration (ppm)

Month	1968[1]	1976[2]	1980[3]	1981[3]	1983[4]
January	-	-	-	-	-
February	-	-	-	-	-
March	-	-	-	-	-
April	1 016	3 095	-	1 464	-
May	213	5 767	11 255	673	-
June	298	1 450	7 423	2 098	300
July	-	-	-	-	160
August	-	-	4 573	3 646	840
September	345	-	4 556	2 600	<100
October	-	-	2 279	-	<100
November	-	-	2 032	-	-
December	-	-	-	-	-

Notes : (1) Averages of very limited records for Beled Weyn, Bulo Burti, Mahaddey Weyn and Jowhar.

(2) Values based on a total of seven samples taken at Afgoi.

(3) Records for Sabuun barrage.

(4) Samples taken during fieldwork for this study and by the Estate staff after June.

The following conclusions can be drawn from the available flow, salinity and sediment data:

(i) The most significant factor is rainfall in the catchment during the river low flow period (December to April).

(ii) Lower than average rainfall in this period effects the Estate in three ways, causing :

- reduced water availability;
- high salinity of the available water;
- high sediment loads in the flow when the gu season flood arrives.

The data for 1980 clearly illustrate this trend. River flows in January, February, March and April 1980 were well below average (50%, 34%, 16% and 15% of average, respectively). During this period the highest salinity levels on record were measured. In May 1980 the gu season flood arrived, bringing with it enormous quantities of suspended sediment, clearly the result of heavy rain on a drought-stricken catchment.

The converse is true for 1968 and 1983, when dry season flows were above average and hence salinity and sediment problems were much reduced.

2.1.5 Current Land Use

The Estate has a total gross field area of 8 850 ha. According to Estate records this area was used as follows in 1983 :

cultivated	:	6 360 ha gross
storage basins	:	190 ha gross
Burey experimental farm	:	115 ha gross
abandoned	:	2 185 ha gross

The locations of these areas are shown in Figure 2.1.1. Sugar cane is grown on virtually all the cultivated area, though there are small (and negligible) areas of grapefruit and coconuts. With the existing field layout the net area is approximately 93% of the gross area (MMP 1976) so the net cane area currently amounts to some 5 910 ha.

2.2 Irrigation and Drainage

2.2.1 Introduction

The existing irrigation and drainage system is fully described in Annex I and is illustrated on Drawing Nr 12700/1. Figure 2.1.1 shows the principal features of the Estate layout. In this section the existing scheme is described briefly, the main aims being to highlight the problem areas and identify the need for rehabilitation work.

2.2.2 Irrigation Supply and Distribution System

(a) General

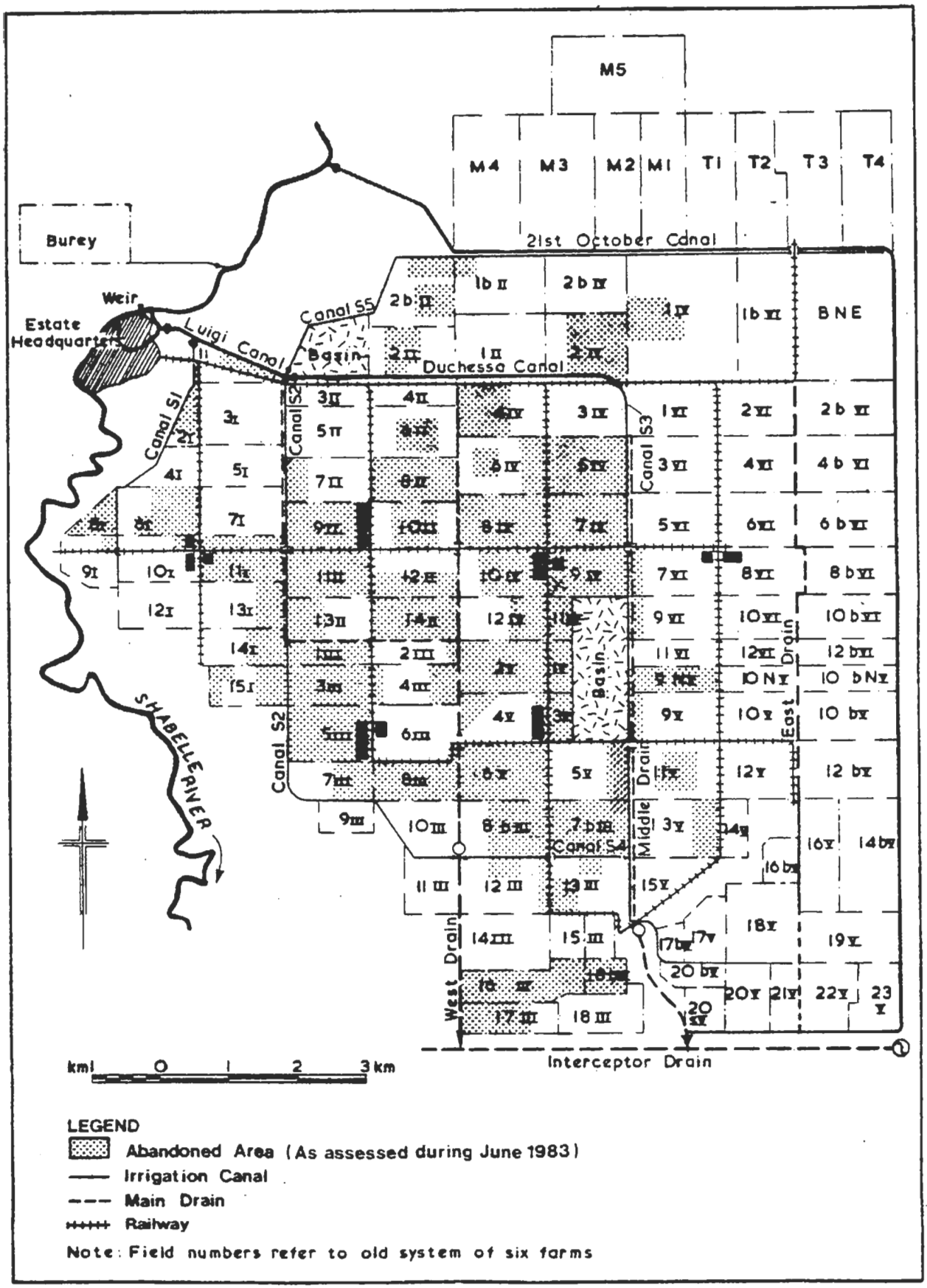
The Estate currently obtains its irrigation water from two offtakes on the left bank of the Shabelle river. The Luigi di Savoia offtake, immediately upstream of the weir across the Shabelle, is the original supply constructed in the 1920s. It presently serves some 60% of the irrigable area through 6.35 km of main canal (Luigi di Savoia and Duchessa d'Aosta canals) and 26 km of secondary canal (S1, S2, S3 and S4 canals).

The 21st October offtake, located approximately 3.5 km up-river from the weir, was constructed in 1969 to 1971 as a flood escape. Subsequently it was provided with cross regulators and offtakes to serve the northern and eastern sectors of the Estate. The 21st October main canal is some 19.2 km long and serves its commanded area (approximately 40% of the total irrigable area) through directly offtaking tertiary canals.

Water levels in the river are controlled by the weir which is 85 m long with an average crest level of about 103.8 m. The condition of the weir is not known since inspection during the study was impossible due to substantial river flows.

Figure 2.1.1

Jowhar Sugar Estate
Existing Layout



The fact that the weir has survived for 60 years is indicative of sound design and construction; however, it is to be expected that the fabric of the structure will have deteriorated somewhat during its life.

(b) The River Intakes

The river intake structures are similar in that they both have three vertical lift sluice gates, those on the Luigi regulator being 2.0 m wide and those on the 21st October structure somewhat wider at 2.3 m. The Luigi regulator is about 60 years old and is of brick arch construction which is generally sound. The 21st October regulator is much more recent, being constructed around 1969, and is of reinforced concrete. Sill level of the Luigi intake structure is about 102.0 m, some 1.8 m below weir crest level. The 21st October intake sill is a little higher at 102.35 m.

Both intakes have short reaches of channel between the river and the head regulator structure. These intake channels trap some of the sediment carried in the river flow, but neither channel is large enough to act as an effective sediment trap and thus the water entering the canal systems is still highly charged with silt. It is reported that the intake for the Luigi canal has to be cleared out by dragline about once a month, and more frequently when the river sediment load is high. This compares with the much less frequent clearing of the 21st October canal intake channel of about three times a year.

The Luigi intake channel is about 270 m long with a design bed width of 12 m. The intake channel is on the inside of a slight bend in the river and, because of the angle of the channel to the river, the flow has to turn through 125°. As a result there is an increase in the sediment load in the water entering the intake channel. The coarser fractions settle out progressively in the intake channel, whilst the finer sediment is carried through into the canal system.

The 21st October canal head regulator is located less than 100 m from the edge of the river. The short intake channel upstream is totally ineffective as a sediment trap, so suspended sediment is carried through into the canal. However, the intake is located on the outside of a bend in the river, and is 3.5 km upstream of the weir, and therefore does not suffer from the same problems as the Luigi intake.

Under the current operating regime both intakes remain open 24 hours/day for most of the year. Generally the gates are only closed when the river salinity is unacceptably high or when there has been substantial rainfall rendering irrigation unnecessary.

(c) The Canals

There are two canal systems, one based on each of the river intakes, although some fields can be served from either system. An inventory of canal structures, as assessed during June 1983, is given in Appendix A to Annex I.

The Luigi di Savoia main canal serves secondary canals S1, S2 and S5, and continues as the Duchessa d'Aosta canal which in turn serves secondary canal S3. Secondary canal S4 links the tails of canals S2 and S3 and connects them to the west drain which is pumped to provide irrigation water to the southern end of the Estate. The Middle drain is also pumped at its southern end, and it is possible to discharge the drainage water into the tail end of canal S3. Canal S5 although connected to the Luigi canal has been abandoned and the fields it used to serve are now served from the 21st October canal. The 21st October canal serves its irrigated area through directly offtaking tertiary canals.

Irrigation water is passed into the secondary and tertiary canals through head regulator structures which generally have manually operated steel lifting gates to control the flow. Secondary canals have similarly gated cross regulators but in the case of these structures most of the gates are missing or broken. Under the present circumstances of silted-up and overgrown canals the cross regulators serve little purpose since the canals have to operate at high water levels just to get the required flow. There are no facilities for flow measurement anywhere in the distribution system.

Many of the canal structures in the Luigi system date from the 1920s and are of brick construction. In spite of their age most are reasonably sound but almost all cross regulators and about half the tertiary head regulators require new control gates. The structures on the 21st October canal are much more recent, dating from the early 1970s, and are generally sound. However, this canal also requires complete rehabilitation of control gates. The major problem which afflicts the steel lifting gates throughout the Estate is corrosion. However, there are also many examples of loose and/or distorted frames and absence of lifting gear. It is clear that the standard of construction of the water control equipment is poor, particularly in that steel sections are too thin to resist corrosion and distortion.

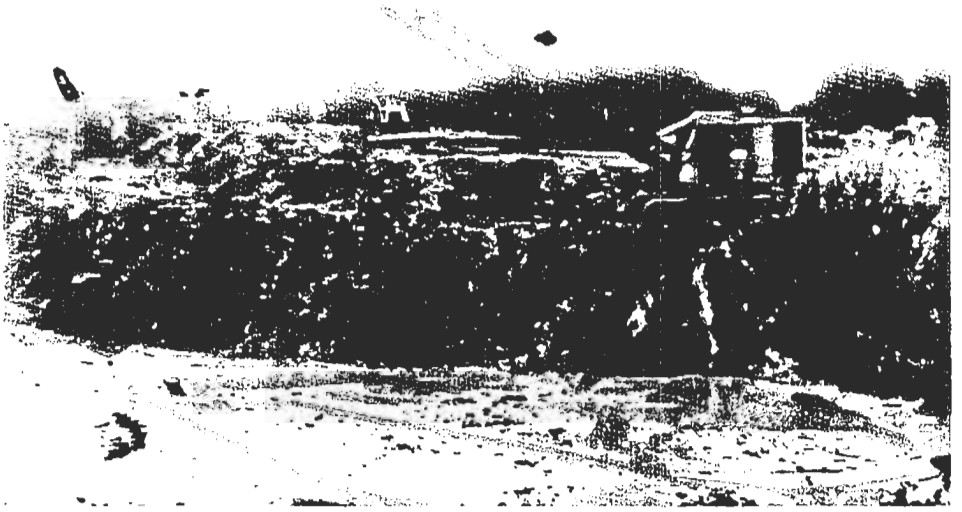
Two serious problems which all the canals suffer from are siltation and weed growth. Siltation results from the totally inadequate provisions for removing sediment from the river water before it is passed into the canals. All canals on the Estate are affected by siltation, but the worst affected are those at the head of the Luigi system. Analyses show that the material deposited in canals is generally very fine, virtually no material being larger than 0.2 mm (find sand). Furthermore the sandy deposits are only found in the upper reaches of the canal systems; elsewhere the sediments are almost exclusively in the silt fractions (0.002 to 0.06 mm). The fact that such fine material settles out is indicative of the very slow flow in the canals (flat slopes) and the extensive weed growth which itself promotes sediment deposition.

Weed growth in canals and drains results in reduced channel capacity and makes inspection of the channels very difficult. Furthermore weed seeds deposited in the irrigation water inevitably increase the weed problem in the cane fields. The most severe problems are caused by reeds which grow very densely and at an alarming rate, regrowth being as quick as 2 to 3 weeks after cutting.

(d) The Water Storage Basins

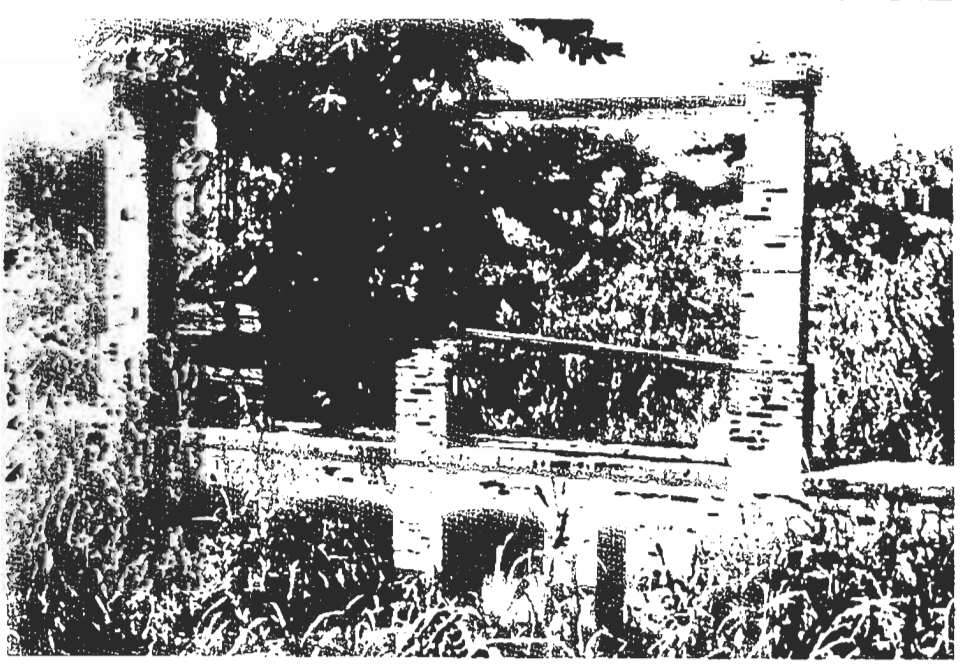
Two storage basins exist within the Estate and their location is shown in Figure 2.1.1. They were constructed in the 1960s, but no records are available of their use. It is understood, however, that they were normally filled by gravity and used for irrigation by pumping from them during drought periods.

Shortly after commissioning them, however, the basins were abandoned as a means of storage as it was thought that peripheral seepage from the basins contributed to the salinity and waterlogging problems on the adjacent fields. The serious water shortage early in 1975 resulted in renewed interest in the basins and both were filled in July and August 1975. In more recent years these basins have had surplus irrigation water discharged into them.



1
Desilting the Luigi canal intake by dragline

2
Extensive silt deposition at the head of Canal S2. Note poor channel formation following mechanical desilting.



3
Canal S3 - typical cross regulator. Note absence of gates, and weed and bush growth in the canal.

Approximate dimensions of the two basins are given below:

Basin Nr	Served by	Plan area (ha)	Average bed level (m)	Average bank top level (m)
1	Luigi canal	70	101.8	104.5
2	Canal S3	160	100.5	103.5

Between them, the two basins can store a gross volume of about 3.5 Mm^3, which could be increased to 4.8 Mm^3 if water is pumped into the reservoirs. The proposals for using these reservoirs in the rehabilitated scheme are discussed in Section 3.4.2.

(e) Evaporation and Percolation Losses

The losses of water in the irrigation system are mostly operational losses resulting from the lack of control structures and poor irrigation management. However, losses also occur as a result of evaporation and seepage.

Evaporation losses are rarely significant in irrigation schemes except where canals are very long and/or very wide. At Jowhar transpiration losses are probably more significant because of the extensive vegetative growth on canal banks. Over the years bushes and trees have been allowed to become established along the canals and no doubt their root systems penetrate deep into the banks where they find a ready supply of water.

Seepage losses from canals in Jowhar are generally not large. The clay soils of the estate are naturally relatively impermeable and canal banks have become well compacted with use. Some problems are experienced with tertiary canals in excessive command. Some of these channels are much higher than necessary and, not having road access down them, have narrow bank tops. As a result seepage flow through the banks is significant and the Estate has, in the past, tried to control this by constructing a parallel drain.

2.2.3 Drainage System

(a) General

The existing drainage system has evolved over many years with the development of the Estate and at present apparently fulfils the following functions which are partially conflicting:

- to remove from the fields surplus surface runoff from field irrigation and rainfall and to convey this to outfalls at the southern boundary of the Estate;
- to act as a supply system to provide irrigation to fields which are not adequately served by the canal systems;
- to provide temporary storage which can be used for escaping surplus canal water (particularly at night) and from which water can be pumped into canals as and when required.

In addition to problems which arise from the conflicts between these objectives, there has been a serious deterioration in the condition of the drainage system, and together these result in very poor performance.

(b) In-field Drainage

Each field has a 1m wide drainage-way down the middle of each fascia, and alternate drainage-ways connect into an open collector drain (about 1 m deep) which runs along the foot of the field (see Figure 2.2.1). The drainage-ways however are frequently blocked by aquiole channels and the system is not particularly effective at preventing waterlogging of fields by excess irrigation or rainfall.

(c) Main Drains and Drainage Disposal System

Each collector drain discharges through a culvert into an open branch or main drain, except for some fields in the north of the Estate which have no connection to a drain disposal system. There are three main drains which run north-south to outfall at the southern boundary of the Estate, and a branch on the West drain. They are wide channels, constructed deep enough to receive excess surface water from the collector drains, but with their cross sections now reduced by heavy weed growth and siltation. The East drain is not a continuous channel and it comprises separate and unconnected northern and southern sections. The northern section appears to have no outlet. In general the main drains flow by gravity to pump stations near the tail which in the past raised the water level to flow to waste in the area now occupied by the Jowhar Offstream Storage Reservoir. New disposal works were designed for the reservoir project but these are incomplete, and at present the West and Middle drains continue to outfall into the reservoir area while the East drain discharges into the new deep Intercepting drain. A temporary pump station raises the water from the Intercepting drain into the reservoir area. These arrangements are inadequate and as a result waterlogging problems have occurred on the southern boundary of the Estate. It is important that the drainage disposal works designed for the reservoir project are completed urgently.

Water is also pumped from the main drains into the irrigation system by fixed pump stations or mobile tractor driven pumps. In addition, near the southern boundary of the Estate and downstream of the drain pumping stations, some fields are irrigated by gravity from the main drains. For some fields this is their only source of irrigation supply as they are not connected to the canal system.

2.2.4 Field Irrigation

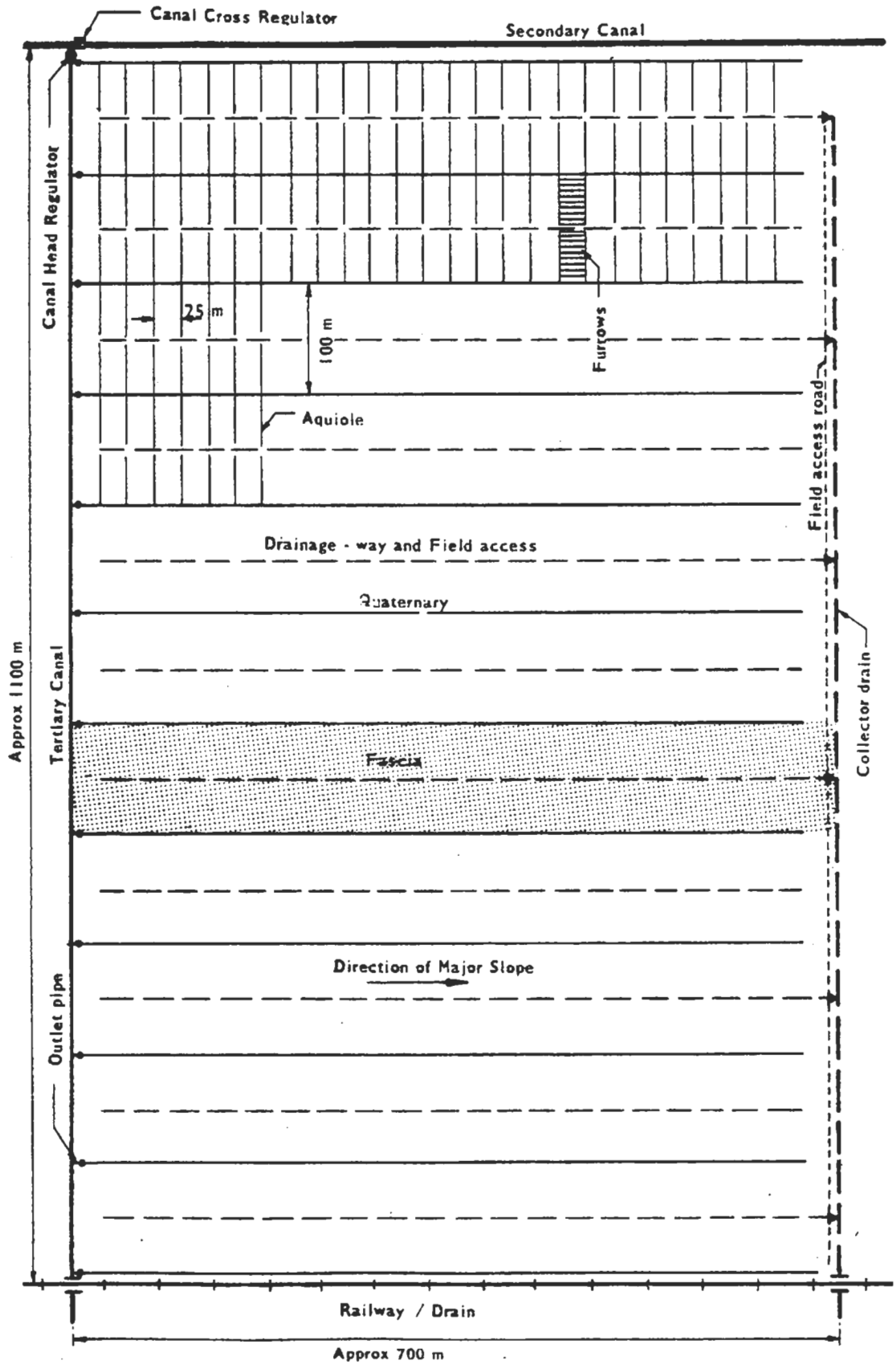
The present irrigation system has basic field units which vary in size considerably from 30 ha to 130 ha, but with 70 ha as an average size. The fields are usually rectangular, typically some 1 000 m wide and up to 700 m long, see Figure 2.2.1.

The field is divided into strips of land 100 m wide called fascias. Water is distributed across the top of the field by a tertiary canal which offtakes from the secondary canal by a gated outlet. Quaternary canals offtake from the tertiary canal by 0.3 m pipe outlets and these supply 'aquiole' channels spaced every 25 m within each fascia. The quaternary channels are permanent canals, but aquioles are reformed regularly because inter-row cultivation destroys their formation.

Each field has a 1 m wide drainageway down the middle of each fascia, and alternate drainageways connect into an open collector drain (about 1 m deep) which runs along the foot of the field. The drainageways, however, are frequently blocked by aquiole channels and the system is not particularly effective at preventing waterlogging of fields by excess irrigation or rainfall.

Figure 2. 2.1

Existing Field Layout



2.2.5 Access

Access into the irrigation scheme is provided by earth roads. These roads are not generally embanked, have no roadside drain, and are often sandwiched between a railway embankment on one side and a canal bank on thé other. The soils of the Estate are unstable when wet and, as a result, roads quickly become impassable after rain. Low reaches of road are particularly bad because water accumulates here and remains for days. Once a tractor or other vehicle has driven along such a reach, the road surface gets churned into deep ruts and cannot be used again until graded.

Road reservations are generally quite wide and, certainly for the main access routes, there is room for a raised embankment with a parallel shallow drain.

Inspection roads along the tops of canal banks are variable. On most canals good access is available down one bank, although bush, tree and weed growth restricts visibility and, in some cases, prevents access. The canal banks are not used for general access and therefore suffer much less from rutting.

Access along the main drains is also reasonable along one bank, although in the case of the Middle drain, access is interrupted at intervals by channels and overgrown or deeply rutted sections of road.

In dry weather, access within the Estate is good and all parts can be reached by road. After rain, even light showers, access is much more difficult and can become impossible. Under such circumstances traffic can stop for days and some routes remain impassable for weeks. Great improvements could be achieved simply by raising low roads and providing for the removal of surface water.

2.2.6 Operation and Maintenance

(a) General

The current operating regime is based on 24-hour flow throughout the year with the system being closed down only because of high river salinity or after substantial rainfall. Throughout the year river water level at the weir varies between 103.8 m at low flows to 105.3 m during high floods. As would be expected, the two main canal systems have been designed for a water level based on the low river level, so that irrigation is possible throughout the year. However, because these design water levels cannot easily command all of the Estate (the elevation of some fields being too high) the operating staff tend to run the canals with water levels higher than design whenever river levels permit. Furthermore the extensive silt deposits in canals require higher water levels to achieve design flows. Thus, when river levels are relatively high, canal water levels are similarly high and, as a result, many of the canal structures have inadequate freeboard or are submerged.

The practice of maintaining flows in canals 24 hours per day would be acceptable if it was matched by 24-hour field irrigation. Unfortunately this is not often the case. Irrigation does take place at night, but not to the same extent as in the daytime, and it is poorly supervised and inefficiently executed. Thus during the night water tends to run to waste, frequently being discharged into abandoned fields and eventually finding its way into the drainage system. Wastage of water during the daytime could also be observed, even though at the time of the study there were many fields in need of irrigation. This is a direct

result of the poor condition of the canals, it being impossible in some areas to pass sufficient water through the silted up and overgrown channel sections. Some of the 'wasted' water is in fact used for irrigation since it passes into the drains and is subsequently pumped back into the canal system lower down.

Most of the cross regulator structures become redundant when excessively high water levels are maintained in the canals. Thus, under the present operating conditions, the fact that many such regulators have no gates is not so important.

(b) System Operation

The operation of the irrigation system has been adapted to suit the prevailing poor condition of the supply and distribution system. This generally means flow in all main and secondary canals whenever there is water available, whether it is needed or not.

Management of the supply and distribution system is the responsibility of the Irrigation Service of the Agricultural Department. It is understaffed and lacks the technical expertise required. Control of flow in tertiary and quaternary canals, and field irrigation therefrom, is the responsibility of the Farm Managers, and is executed reasonably well in view of the constraints imposed by the deterioration of the system.

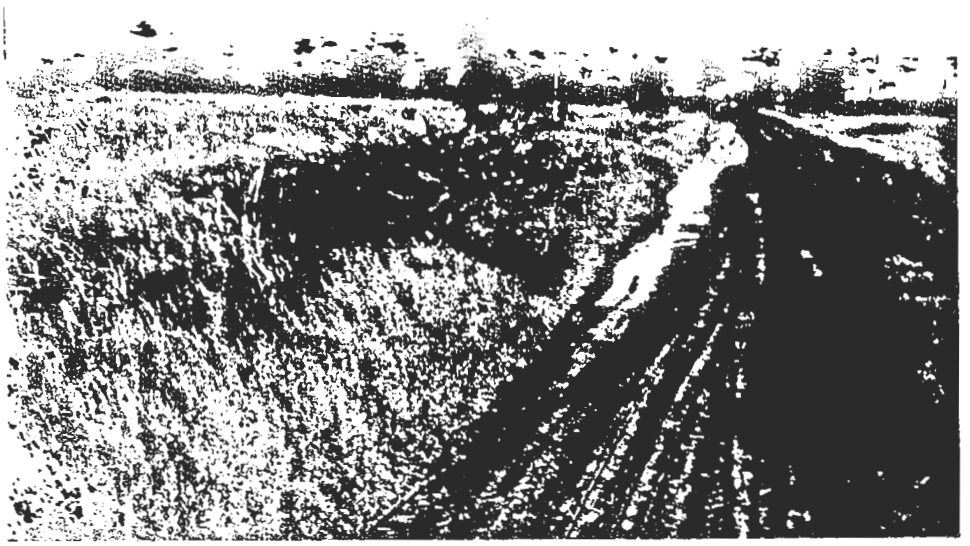
The Irrigation Service is presently divided into two sections - irrigation and land preparation - under the overall control of the Irrigation Manager. In total there are some 80 staff members in the Irrigation Service comprising the manager, one chief of section (irrigation; chief of section post for the land preparation unit is vacant), two assistants, 12 canal guards (gate operators), several gangers, 40 plant operators, and a number of drivers, labourers, etc. Both the Irrigation Manager and the chief of irrigation section have been on the Estate for a substantial number of years. However, their experience in the field of irrigation is limited by what they have learned in-situ. In 1976 both men were surveyors and, indeed, during this present study the chief of the irrigation section was seconded to the team as a surveyor.

The irrigation section is in charge of the operation and maintenance of the canal systems as far as the tertiary canal head regulators, and for the maintenance of main drains. The land preparation section deals with land levelling, uprooting and ploughing.

Because there is no simple means of estimating flows in canals, no records are kept of channel discharges. In fact the only records of irrigation are those kept by each farm on a standard form. As well as records of irrigation applications, the standard forms include details of planting and harvesting dates, variety, mechanical and manual cultivation, fertiliser application, rainfall and cane yields. These records are regularly updated and, as far as can be assessed, provide an accurate history of operations. Unfortunately, the records of irrigation give only the dates of application - there being no way to measure the quantity applied.

The following conclusions can be drawn from an examination of these records :

- irrigation intervals are frequently too long;
- the distribution system in its present condition is not capable of providing irrigation water to all parts of the Estate.



4
Access road made impassable by surplus irrigation water.

5
A large tertiary canal from the 21st October canal. Note good access on banks and clean channel section.

6
Recently irrigated field. Quaternary canal on right. Note division of field by aquiole channels, and accumulation of water at bottom of field.

From observations in the field it is also obvious that, quite often, irrigation applications are too large - this is evidenced by extensive waterlogged areas in some fields. It would therefore seem likely that, by reducing the depth of application and shortening the irrigation interval, a better irrigation regime could be established. The problems of not being able to get water to certain fields are symptomatic of the deficiencies in the distribution system, the principal cause being reduced conveyance of channels resulting from silting up and weed growth.

(c) Maintenance

The major items of maintenance are silt removal and weed clearance. Reinstatement of earth roads after rain is also a significant part of the maintenance programme. On a much smaller scale are such items as gate painting and greasing and minor structural repairs, the latter being carried out by the Building Department.

Although the Estate has a large fleet of mechanical plant much of it is non-operational due to old age or shortage of spare parts. In June 1983 the following items of operational plant were available to the Irrigation Section:

- one dragline (link belt)
- two hydraulic excavators
- two bulldozers (one Fiat, one Caterpillar)
- one grader (Caterpillar 140G)

The dragline is used for desilting work on the Luigi and 21st October canal intake channels, and for similar work on the larger canals. The hydraulic excavators are used for desilting and reforming secondary canals. The bulldozers and grader are most often used for road maintenance.

Generally speaking these items of plant are appropriate for the maintenance work but are insufficient in number and, in the case of the dragline, have insufficient capacity for the large maintenance problems, particularly in view of the present state of canals. The quality of operating staff, as assessed by observation during the fieldwork period, is quite good.

Maintenance work does not follow a routine programme - the shortage of plant and the large backlog of work makes this impossible. Maintenance is generally carried out in response to emergency situations, when canals are in danger of overtopping or where the channel is so silted/overgrown as to prevent sufficient irrigation water passing through.

Material removed from canals during the reforming/cleaning process is generally dumped on the canal banks. This mixture of wet silt and plant growth makes the road on the bank impassable and, even when the deposits dry out, it is necessary to bulldoze or grade the surface to restore access.

On many canal banks the growth of weeds, reeds, bushes and even trees has been allowed to continue unchecked, except for the occasional passage of a bulldozer or hydraulic excavator. The dense growth makes access difficult and channel inspection impossible, as well as increasing water losses from the canals.

Hand cutting of weeds in canals is generally organised by the Farm Managers, but the rapid rate of regrowth makes it hardly worthwhile. Weeds are also cleared during the canal reforming process using excavators or draglines.

2.3 Cane Production - Present Situation

2.3.1 Present Production Areas and Production Levels

The total concession area of the Jowhar Sugar Estate amounts to about 10 500 ha. A gross field area of about 8 850 ha is available for cultivation, equivalent to some 8 230 ha net.

During the survey carried out by Sir M. MacDonald & Partners in 1977 an area of 7 038 ha was under cane, while an area of 1 812 ha was abandoned.

The present situation shows a decline in the area under cane which amounts to 6 472 ha while a total area of 2 378 ha is abandoned, an increase of 566 ha of abandoned land during the last 5 years.

Table 2.3.1 summarises the situation and Figure 2.1.1 indicates the present extent of abandoned land.

TABLE 2.3.1

Farm Areas (ha)

Farm	Field area	Area under cane in 1978	Area under cane in 1983 (%)	Abandoned area in 1978	Recently abandoned area	Total abandoned areas
I	834	567	533 (64)	267	34	301
II	1 136(1)	677	630 (55)	459(1)	47	506(1)
III	1 212	912	719 (59)	300	193	493
IV	1 619(2)	1 218	1 104 (68)	401(2)	114	515(2)
V	1 854(3)	1 541	1 373 (74)	313(3)	168	481(3)
VI	2 079	2 007	1 997 (96)	72	10	82
Burey	116	116	116 (100)	0	0	0
Total	8 850	7 038	6 472 (73)	1 812	566	2 378

Notes:
(1) Figure includes 54 ha for storage basin.
(2) Figure includes 42 ha for storage basin.
(3) Figure includes 94 ha for storage basin.
(4) All areas are field areas. Net area = field area x 0.93.

Most of the abandoned areas are located in the flat basin of the older part of the Estate, especially in Farms I, II and III and to a lesser extent in Farms IV and V.

The present harvestable area for cane can be estimated at 6 200 ha, leaving 200 ha for seed cane. The yearly uprooting and planting programme, based on one plant cane and four ratoon cane, can be estimated at 1 300 ha.

The cane production shows a tremendous decrease during the last 5 years. In 1978/79 a total of 372 757 t of cane was harvested, whereas in 1982/83 the total was only 107 031 t. The yield of cane dropped from 85 t/ha in 1978/79 to 33 t/ha during the 1982/83 campaign when only 3 232 ha were harvested. A total of 1 970 ha under cane could not be harvested during the second period and had to be deferred.

The harvest results of the campaigns in 1963/64 to 1982/83 are presented in Table 2.3.2.

TABLE 2.3.2

Harvest Results of Campaigns 1963/64 to 1982/83

Campaign	Harvested area (ha)	Cane yield (t/ha)	Tonnes cane	Pol % cane	Recovery %	Sugar/ cane %	Tonnes sugar
1963/64	1 418	64	90 595	12.52	78	9.72	8 806
1964/65	1 663	90	149 708	13.56	80	10.79	16 153
1965/66	2 605	92	238 683	13.45	74	10.00	23 868
1966/67	4 129	79	326 882	13.08	76	9.90	32 360
1967/68	4 110	67	276 790	12.97	78	10.15	28 114
1968/69	4 018	98	393 870	12.84	79	10.13	39 917
1969/70	4 480	98	437 964	12.58	80	10.09	44 210
1970/71	5 237	88	463 380	12.89	80	10.25	47 530
1971/72	5 634	76	427 542	12.91	77	9.89	42 266
1972/73	4 720	87	408 822	12.62	72	9.14	37 358
1973/74	5 335	74	392 989	12.11	66	7.99	31 385
1974/75	6 201	62	385 678	12.44	69	8.55	32 983
1975/76	5 716	53	304 761	12.00	74	8.92	27 175
1976/77	5 002	72	361 461	13.13	76	10.01	36 188
1977/78	3 008	88	265 516	12.46	67	8.35	22 180
1978/79	4 386	85	372 757	12.37	59	7.35	27 400
1979/80	4 040	74	297 923	12.49	62	7.72	23 008
1980/81	6 053	39	234 005	11.08	64	7.13	16 693
1981/82	4 943	34	168 676	12.23	61	7.42	12 519
1982/83	3 232	33	107 031	11.61	47	5.46	5 843

2.3.2 Production Constraints

A number of major production constraints have caused the yield decline and abandonment of cane lands. These constraints are, in sequence of importance :

- poor management of the irrigation and drainage system;
- inadequate irrigation and drainage system and poor field layout;

- insufficient irrigation water;
- inadequate crop rotation system;
- poor standard of agricultural practice.

(a) Poor Management of Irrigation and Drainage

The deficiencies in the irrigation and drainage system have been described in Section 2.2. Some fields go without irrigation for months. Others which do have an irrigation supply are often over-irrigated as a result of poor irrigation practice. Irrigation at night is especially difficult to control.

The low efficiency of irrigation has caused problems with drainage. Because of the poor drainage system the watertable has risen in parts of the Estate. High watertables and an increase in salinisation have reduced the cane yields and have gradually led to the abandonment of land. The abandonment of fields as a result of high watertable has led to an increase of the salinisation of the soils.

(b) Inadequate Irrigation and Drainage System and Poor Field Layout

Because there is no means of measuring flows in the canals at present it is impossible to monitor the volume of irrigation applications.

The existing aquiole system with a furrow length of 25 m may have worked in the past when mechanised operations were limited, but an increase in mechanisation is restricted by this field layout. In addition, the present low standard of land levelling reduces the effiency of irrigation.

Trials have been carried out on two fields with long furrows for some years. Very precise levelling is necessary and, according to reports from the Agricultural Department, this has not been achieved. These trials are therefore of limited use and their poor results cannot be considered representative.

(c) Insufficient Irrigation Water

The Shabelle River is the only source of irrigation water for Jowhar Estate. The river has two flood periods, one during April and May and the second during August to December. Periods of low river flow occur in January, February and March and to a lesser extent in June and July. The earlier period is the more serious from an irrigation point of view, when the river sometimes dries up completely. Details of river flow availability are presented in Section 2.1.4.

Periods of low flow during the dry season are often accompanied by high water salinity levels and irrigation has to be stopped until salinity levels fall to an acceptable value. It is estimated that a severe shortage of water for one month (i.e. little or no water available for irrigation) will result in an overall yield reduction of some 10%. This is based on an average of 190 mm/month evapotranspiration out of an annual total of 1 850 mm. A two month shortage would reduce yields by about 20%.

(d) Inadequate Crop Rotation System

The present planting periods are May to June, during and after the gu rainy period, and in September to October, before and during the der rainy period. This results in full canopy being maintained during the driest months when river flow is lowest. Planting during the rainy seasons can also result in poor germination because of adverse conditions and poor in-field drainage. Also mechanical operations are restricted. Another major problem is the lack of good quality seed cane as no nurseries are maintained, and there is no adequate control of diseases.

Because of harvesting and transport problems, cane cannot be harvested at the right time and is deferred to the next campaign. This results in a deterioration of the cane quality, while the planting and uprooting schedules cannot be maintained. The limited quantity of operational equipment curbs the planned schedules of activities and a huge area of the Estate has old ratoon cane of the 5th, 6th, 7th, 8th and 9th cuttings with reduced cane yields.

(e) Poor Standard of Agricultural Practice

Generally the standard of the cane is poor in most of the fields. Gaps are common and the cane is short. In many fields drought symptoms could be observed.

During the visit of the agronomists only a small number of agricultural activities were carried out, because of lack of equipment (mainly tractors). Apart from uprooting no land preparation could be observed.

Planting was done in some fields. The quality of the seed cane was very poor, short internodes, old cane often with dead eyes and with roots at the lower ends. The spacing of the furrows is now 1.45 to 1.50 m. This was recommended by an Australian consultant during his visit in July 1980. Older fields show a furrow spacing of 1.65 m.

After planting, the fields are sprayed with 6 l/ha gesapax combi by knapsack sprayer. An extra 2 l/ha gesapax H is added if Cyperus rotundus occurs. The weed control is reasonably effective.

About 6 weeks after planting an inter-row cultivation is carried out, followed by another 3 to 4 weeks later. The performance is moderate. About 12 weeks after planting hilling-up is executed with discs, however, the furrow shape needs improvement.

In ratoon cane an off-baring and normally 2 inter-row cultivations are applied; the performance of these cultivations is very moderate, showing a poor furrow shape.

Three dressings of urea are applied manually in plant cane totalling 300 kg/ha : 50 kg/ha at planting, 100 kg/ha about 6 to 8 weeks after planting and 150 kg/ha at hilling up. In ratoon cane 300 kg/ha is applied after harvesting in one dressing.

Smut disease is observed in most fields with cane variety NCO 310. The only control measure actually applied is roguing and destruction of diseased stools but this is insufficient. No hot water treatment is applied any more. Other diseases, such as pineapple disease, are of minor importance.

During the visit no ratoon stunting disease (RSD) was found but it may be present. Only slight borer infestation has been observed.

The main variety of cane is NCO 310, which comprises 88% of the total cane supply. The existing variety composition is as follows :

NCO 310	88%
NCO 376	5%
Trojan	4%
Q 68	2%
C 87 - 51)	1%
B 43 - 62)	

2.3.3 Present Organisation of Agricultural Department

An organisation chart is presented in Figure 2.3.1. The agricultural department has two main activities - production and research/development.

Production comprises 6 services : area 1, area 2, area 3, transport, mechanisation and irrigation/land preparation.

Each of the three areas is subdivided into 3 farms, each with a farm manager, 2 supervisors, 9 to 11 capos and an average of 17 permanent workers such as clerks, watchmen, storekeepers, etc.

The activities of the farm are mostly concentrated on planting, manual cultivation, fertilising and weed control, control of pests and diseases, in-field irrigation, cleaning canals, cane cutting and loading.

The transport service is subdivided into 3 units : shift 1, shift 2 and the rail unit, each with a manager and, in total, 11 supervisors, 24 capos, 189 drivers and workers. The activities are concentrated on the laying of rails, cane transport in lorries and road transport.

The mechanisation service provides services to the farms. Before 1982 the farm manager was responsible for all mechanical tillage. Minor repairs are also the responsibility of this service and are done at Farm IV. In total 17 staff members work with the service.

The irrigation/land preparation service is subdivided into 2 units : irrigation and land preparation. In total 80 staff members work with this service comprising 4 supervisors under the manager, several capos, 65 drivers and other workers. The irrigation unit is reponsible for the water supply to the farms and the maintenance of canals and drains using mechanical plant. The land preparation unit deals with the uprooting and ploughing of the fields.

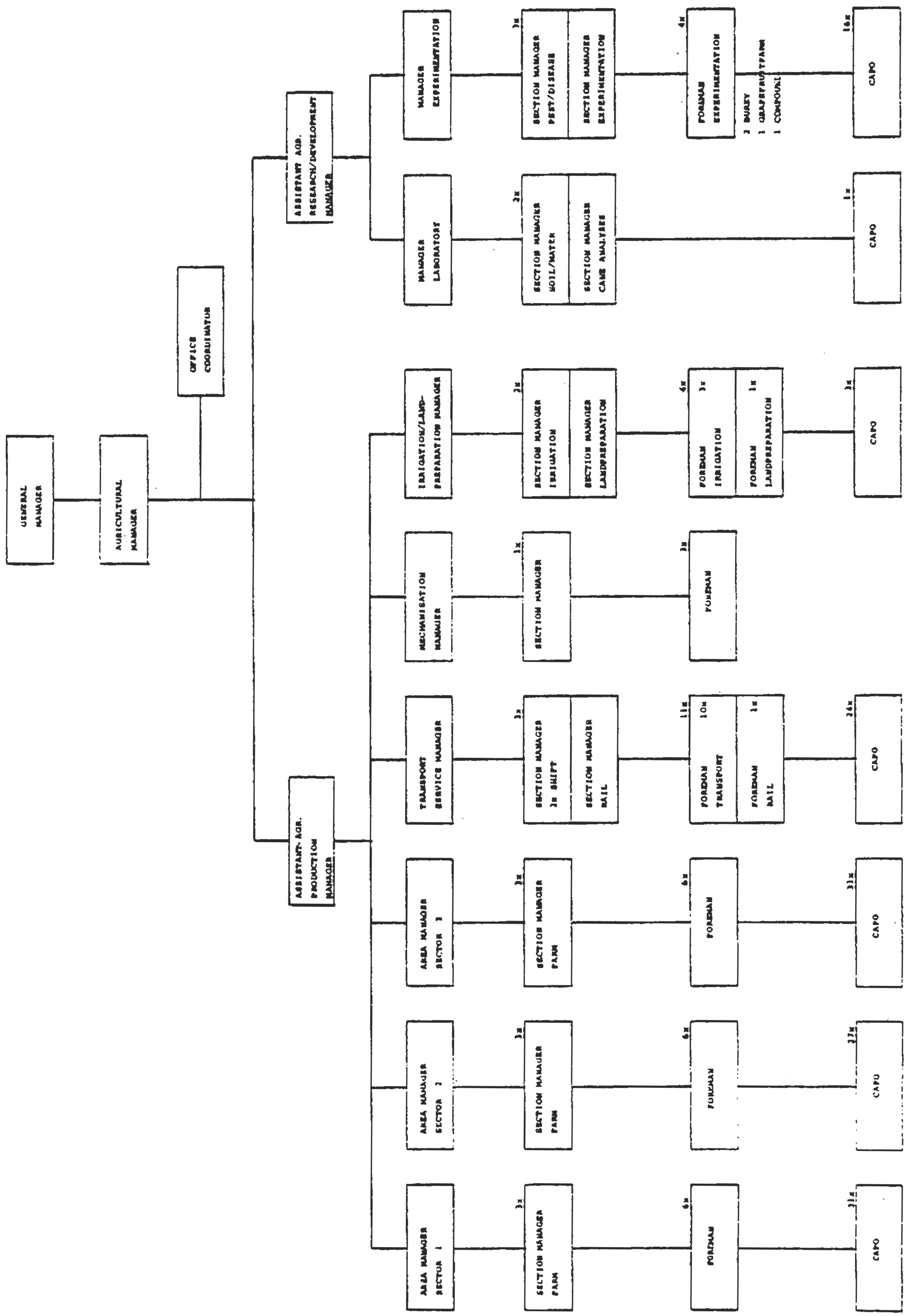
Research/development is divided into two services : a laboratory service for cane maturity analyses and soil and water analyses and an experimentation service, subdivided into two units : pest/disease control and an experimentation unit. A grapefruit farm and the maintenance of the compound are the responsibility of the latter unit. In total 47 staff members work in these sections.

A co-ordination office deals with planning, statistics, personnel and administration of the agricultural department, headed by an office co-ordinator under the agricultural manager.

The total number of staff members in the agricultural department amounts to about 647. The quality of the personnel is inadequate to cope with the problems of the Estate. The planning of activities, partly disrupted by the lack of equipment, is poor.

Figure 2.3.1

Agricultural Department Existing Organisation



2.4 Factory

2.4.1 Condition of Factory Equipment

A small factory was installed on the Estate in 1927. The present plant was installed in 1963 with a capacity of 1 800 tonnes of cane per day. In 1976 the capacity was increased to 2 400 t/day for the production of mill white sugar (pol % sugar 99.5). The factory design is reasonable but, because of inadequate maintenance and poor cane quality, the milling capacity and efficiencies are well below their design levels.

The physical condition of the factory equipment was checked by means of inspection as far as possible. Much equipment had been overhauled during the intermilling season, therefore in some cases fair estimates were made about condition, and lifetime, based on information received from the factory staff and by consultation of records and reports. In general no maintenance records are available with details of repairs, maintenance and renewal of parts. However, major repairs are recorded in the milling season reports.

(a) Cane Unloading Plant

- Weighbridges (2) for rail and road transport are in reasonable condition. The scales are calibrated each year by the local authorities for measures and weights.
- Pneumatic/hydraulic tipper for rail carts is in reasonable condition.
- Cane table for 'Miedema' road trailer is in good condition.
- Cane tables (2) for rail carts are in good condition.
- 3-t gantry cranes for bundled cane from rail carts are in reasonable condition (2 out of 3 cranes are operational).
- Main cane carrier is in good condition.
- Two knife-sets for cane preparation are in an acceptable condition.

The cane unloading plant in total is in a reasonable condition. However, the cane preparation is insufficient and needs to be improved. Expected lifetime (without major renewals) is 10 to 15 years.

(b) Cane Milling Plant

- Six three-roller cane crushing mills.
  Four mills installed in 1963.
  One mill with turbo-generator drive installed in 1974.
  One mill installed in 1977.

  The condition of the prime movers (steam turbines) and reduction gears is good.

  The mills, however, need replacement of worn-out bearings, rollers and pinions.

It is reported that new rollers and other parts for the mills are on order from the USA, together with a cane shredder and tramp iron separators.

- Five intermediate carriers of the mills are in a reasonable condition.

- The cush-cush system of the mills needs to be partly renewed. The DSM-screens are completely worn out.

- Most of the juice and imbibition pumps are in a good condition and are of an outstanding quality (bronze houses and bronze impellers).

After an intensive overhaul under expert guidance, and improved maintenance in the future, it is expected that the mills can be operated for another 20 years.

(c) Steam Boiler Plant and Water Supply Systems

- The bagasse conveyor system is in an acceptable condition.

- The two Ruth boilers with capacities of 7 and 12 t of steam per hour are not considered safe and reliable to generate steam of 25 bar and 380°C. They could still be used to generate steam of 7 bar for the distillery.

- The two Fives-Penhoet boilers, installed in 1964, need reconditioning under expert guidance. Refractory walls need major repairs. Parts of the boiler bank tubes and superheat tubes have to be renewed. Instruments, controls and cabling have to be completely renewed.

- The cross-drum type Foster-Wheeler boiler, manufactured in 1972/73 under licence by Mario Pensotti, is in bad condition and needs a major overhaul under expert guidance. It should be studied where it is possible to change from step grates to suspension firing of the bagasse and to include a grit refiring system to make the boiler more efficient and to overcome the nuisance of soot and fly-ash.

- The boiler feed pumps are in bad condition and need a major overhaul or complete renewal.

- There is no water treatment plant of sufficient capacity for make-up boiler feed water.

- The factory water supply system is in poor condition and no longer reliable, pumps are old, worn out and some need replacing.

  The system needs to be modified to ensure a continuous water supply to the turbo generator and mill drives.

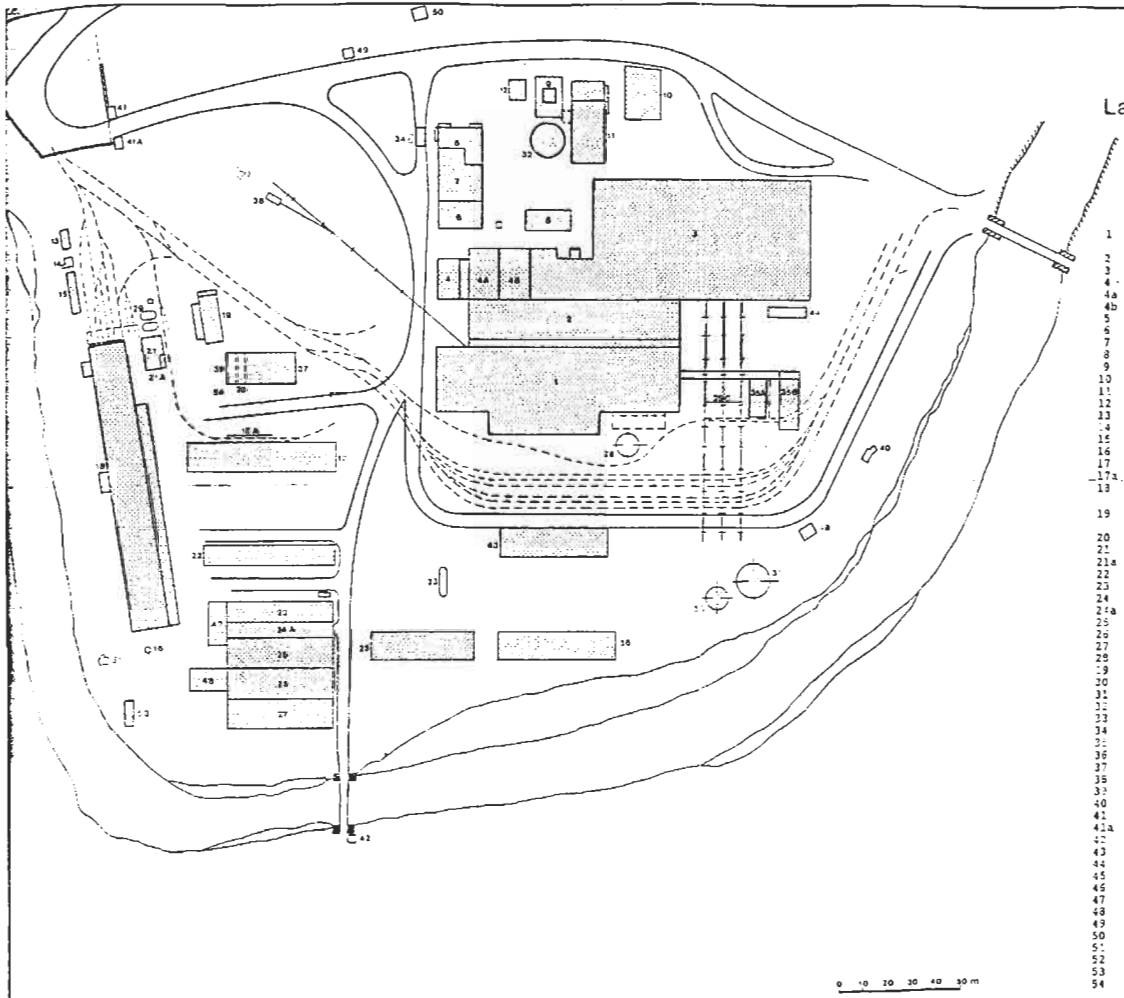
  The cooling water recirculation system, to be used at low flow rates of the river, needs major renewals, the present plant is inadequate and in poor condition.

- The firefighting system is not functioning. A new electric motor is needed.

- One new boiler should be installed within 7 years.

Figure 2.4.1

Jowhar Sugar Factory
Layout of Factory Compound



1 Main factory building (with 25/3 ton crane)
2 Boilerhouse
3 Sugar stores
4 Sugar drying and bagging plant
4a Power plant, Electrical workshop
4b Laboratory
5 Oxygen production plant
6 Alcohol distillery
7 Fermentation
8 Techical offices
9 Cooling pond (not used any more)
10 Cooling pond (not used any more)
11 Diesel power plant
12 Bicycle shed
13 Sanitary building
14 Factory waste water pump station
15 Sand depot for railtracks
16 Washing area for tractors
17 Tractor workshop heavy equipment
17a Bulldozer repair shed
18 Mechanical workshop, locomotive and vehicle workshop
19 Offices for security, firefighting and railtrack maintenance
20 Store for carpenter shop
21 Chemical store
21a Oil store
22 Consumable store
23 Store for bolts, nuts etc.
24 Warehouse for spares
24a Warehouse shed
25 Warehouse for spares
26 Warehouse for automative spares
27 Warehouse for spares
28 Condensate tank
29 Diesel issue station
30 Chocolate tank
31 Condensate tank
32 Final molasses tank
33 Diesel issue station
34 Weighbridge for road transport
35 Cane unloading cables
36 Boilermakers shop
37 Carpenter shop
38 Bagasse feeplain carrier
39 First aid
40 Mosque
41 Guardhouse
41a Time recording office
42 Guardhouse
43 Openstore
44 Boiler fuel tank
45
46 Tyre repair shop
47 Trailer repair area
48 Canteen shop
49 Deepwell pump station
50 Pumpstation spray pond
51 Mosque
52
53 Canteen
54 Petrol issue station

(d) Power Plant and Electrical Distribution

- One 3 000 kVA turbo-generator installed in 1976 needs a complete overhaul under expert guidance. The spare rotor has to be repaired in France. Turbine controls are not reliable, causing voltage drops and frequent black-outs. The cause is carry-over of wet steam, resulting in deposits on stems of the steam regulating values.

  After overhaul it is expected that this generator can reliably serve the factory for another 15 years.

- One turbo-generator, 2 500 kVA, appears to be in a bad condition. It was installed in 1965. With a view to additional loads (cane shredder, installation of drainage pumps) it is advised to install a new set of 3 600 kVA.

- Three diesel generator sets are Deutz BA8M528 diesel engines and 850/1 000 kVA CEM generators. Two sets need urgent supply of spares and a complete 20 000 hours service under expert guidance.

  (Recorded operation hours are 8 000, 36 000 and 37 000 hours repsectively.)

- Auxiliary equipment such as starting air compressor, and fuel piping needs a thorough overhaul.

- The power distribution system is in a very bad condition.

- The main panels in the power plant need partial renewal and all motor control centres in the factory need complete renewal. The most essential controls are not working at all or give unreliable readings.

  Switchgear and relays are poorly maintained and suffer from soot and fly-ash deposition. Additional equipment is connected to existing control circuits and overload relays are improperly set which results in failing safety and burnt-out motors.

- Electric cables need to be renewed or to be relaid. Cable support and gutters need to be renewed or extended.

- The control room for the centrifugal station needs extensive cleaning, repair and removal of obsolete equipment.

(e) Juice Clarification

- Juice weighing : automatic scales with check weigher and weighed juice receiving tank are in good condition. Scales are regularly calibrated.

- The weighed juice pumps are in a poor condition and need a proper overhaul.

- Tanks for milk of lime preparation are in good condition; the milk of lime pumps are in a poor condition and need a proper overhaul or complete renewal.

  Mechanical milk of lime dosing device is in reasonable condition.

Present pH-control is based on pH-measuring on grab samples, which is not adequate.

Automatic pH-recording and controlling equipment should be installed.

- Tank for hot liming is in good condition.

- Equipment for continuous sulphitation of juice and syrup is out of operation. Equipment is in good condition, not required to be in operation again, as sugar produced without sulphitation is of acceptable quality for local consumption.

- Juice heaters are in a reasonable to good condition, except for two heaters in which division plates in headers are partly corroded. A thorough overhaul is needed. Plate thickness of shell, tube plates, etc. is not measured, which should be done each intermilling season.

- The Dorr and the Mirlees Watson Bach clarifiers are in a reasonable to good condition, except for bottoms of compartments of Dorr clarifier. They need to be repaired under expert guidance.

- The FLC clarifier is in a bad condition and taken out of operation. Since capacity of other two clarifiers is ample, it is advised to scrap the FLC clarifier.

- Mud recirculation: tank is in good condition, pumps are in poor condition and need to be overhauled or to be renewed.

- Bagacillo feed mixer is in reasonable condition.

- Bagacillo reclaiming installation is in reasonable condition, except for the blower fan, which needs to be properly overhauled.

- Dorr Oliver vacuum filter and Eimcobelt vacuum filter with filtrate receiving tanks, filtrate pumps and filter cake removal conveyors are in reasonable condition, except for filtrate pumps, which should be overhauled or renewed. To guarantee a crushing rate of 100 t cane/day it is advised to replace the Eimco filter by a filter identical to the Dorr Oliver filter.

- Separan dosing device is in good condition.

- Vacuum system for filters: condensor with Nash type FLC watering vacuum pump is in reasonable condition.

Above specified equipment is in a reasonable to good condition, except for the Dorr clarifier, some juice heaters and pumps.

Lagging on relevant piping and tanks, which is partly present or completely missing, should be redone.

Expected lifetime of the above equipment is 10 to 15 years.

(f) Evaporation

- Two stationary clarified juice screens, provided with bronze gauze, are in poor condition and should be replaced by one DSM type screen.

- Clarified juice receiving tank is in good condition, clarified juice pumps are in poor condition and should be overhauled or renewed.

- Six interchangeable evaporator vessels with a total heating surface of 5 800 m^2 are in a reasonable condition.

  Plate thickness of juice belt, calandria shell, etc. was not measured. This should be done each intermilling season.

- Syrup extraction pumps are in a poor condition and should be overhauled or renewed.

- Soda tanks are in good condition, soda pumps are in poor condition and should be overhauled or renewed.

After an adequate overhaul or renewal of pumps and a subsequent proper maintenance it is expected that the above equipment can be operated for another 15 years.

(g) Sugar Boiling and Curing

- Pan supply tanks are in a reasonable condition.

- Vacuum pans, three for A-, three for B- and two for C-strikes, are in a reasonable to good condition.

  Plate thickness of belts, calandria shell, etc. was not measured. This should be done each intermilling season.

- Crystallisers, four for A-, six for B- and eight for C-massecuite, are in a good condition, except for cooling and reheating elements for C-crystallisers. These elements require an intensive overhaul.

- Pumps for A-, B- and C-massecuite in double execution are in good condition.

- Centrifugals:

  For A-massecuite three FCL semi-automatic batch machines and one Bosco fully automatic are in good condition, except for one semi-automatic machine, which is electrically out of operation.

  For B-massecuite five semi-automatic batch machines, three made by FCL, and two made by Bosco are in good condition, except for one FCL machine.

  For C-massecuite three continuous FC 1000 machines are in good condition, except for one electric motor, which is burnt out. An intensive overhaul, especially of electric controls under expert guidance, is required.

- Grass hopper under A-machines, screw conveyors under B-machines, B-magma mingler, C-screw conveyor under C-machines and C-magma mingler are in reasonable condition.

- Runoff tanks for A-, B- and final molasses are in good condition.

- Pumps in double execution for A-, B-, unweighed and weighed final molasses are in poor to reasonable condition and should be overhauled or renewed.

- Magma receivers on boiler platform, two interconnected for B-magma and two interconnected for C-magma, are in good condition.

- Servo-balance for weighing final molasses out of operation should be overhauled and repaired under expert guidance.

Expected lifetime of above equipment, after proper overhaul, in particular centrifugals, pumps and electric equipment, is about 15 years.

(h) Sugar Drying and Bagging

- Wet sugar bucket elevator, rotary sugar dryer, Sandvik stainless steel belt conveyor, Comessa cascade sugar dryer/cooler, dry sugar bucket elevator, two vibrating sugar screens, sugar silo, automatic weighing/bagging machine and fixed bag sewing slat conveyor with overhead sewing machine are in reasonable to good condition.

  Only air heater of rotary sugar dryer needs to be overhauled and repaired.

- Equipment for bag transport comprises a set of four fixed horizontal rubber belt conveyors of which the third conveyor is provided with a movable device to throw off the bags on to the transportable bag pilers. The last conveyor is provided with a wagon loading machine.

  The above equipment is in a reasonable condition, except for rubber belts and proper adjustment of idle rollers. Expected lifetime after proper overhaul and subsequent regular maintenance is about 20 years.

(i) Condensing Plant

- Barometric condenser for evaporation and central barometric condenser for all pans are in reasonable condition.

- Submerged vertical pump for pumping tail water of condensers to suction pit of spray-pond booster pumps are in reasonable condition.

- Two tail water booster pumps are in poor condition and should be overhauled or renewed.

- FCL reciprocating dry air pump, common for evaporation and pans, is in reasonable condition. Capacity is insufficient. It is reported that one new Nash type watering pump, capacity 5 000 m^3/h, is or will be ordered under the CIP programme.

- Elevated earthen spray pond is in poor condition. Pond is full of weed and main pipe with nozzles is rusted. An intensive overhaul is required. Spray pond should be fully operable at any time.

The above equipment after proper overhaul and subsequent regular maintenance can be kept in operation for another 15 years.

(j) Condensate Collection and Distribution

- Two condensate collecting vessels, one for good condensate, one for poor condensate, are in good condition.

- Condensate removal piping with steam traps, one for each heater, each evaporator vessel and each pan, to two manifolds (one for good, one for poor condensate) connected with above vessels, are in reasonable condition.

- Condensate extraction pumps in double execution for last two evaporator vessels are in poor condition and should be overhauled or renewed.

- Condensate pumps in double execution from good condensate vessel to boiler feed water tanks are in poor condition and should be overhauled or renewed.

- Condensate pumps in double execution from poor condensate vessel to hot process water ring line with branches to relevant process station are in reasonable condition.

- Two interconnected constant head tanks on 16 m level, connected with above ring line, and with overflow to factory effluent canal are in good condition.

- Two interconnected boiler feed water surplus storage tanks, outside factory connected on top with overflow from boiler feed water storage tanks, at bottom with suction of good condensate pumps, are in reasonable condition.

- Lagging of relevant tanks and piping is missing and should be fitted to ensure steam economy.

Expected lifetime of above equipment after intensive overhaul and renewal of pumps, if required, and subsequent regular maintenance is about 15 years.

2.4.2 Factory Performance and Efficiency

The factory performance is far below normal standards. Sugar losses are very high and production costs are inflated by the low efficiency in the mills, boiling house and the low boiler efficiency, resulting in high fuel costs.

(a) Mill Extraction

The mill extraction is very low and has decreased further during recent years.

The moisture content of the final bagasse is very high, up to 55%, reducing the net calorific value of the bagasse and making it very difficult to ignite the bagasse in the boiler furnaces resulting in irregular steam supply.

The reasons for poor extraction are:

The main cane variety at Jowhar, NCO 310, is known for its problems during crushing. The cane is very spongy, with a high pith content and very short fibres. The reabsorption of this cane is very high.

- The cane is not matured before harvesting. Although irrigation is stopped some weeks before harvesting, the cane just continues growing due to the high water tables.

- Cane is very old and has a low purity resulting in reduced mill efficiency.

- Cane supply is irregular resulting in frequent stops of the mills.

- Physical condition of the mills, damaged rollers and a very high content of cush-cush in the juices (partly due to the properties of NCO 310).

- Incorrect mill setting. The mill openings are set for too large a capacity.

- Inadequate cane preparation.

  The installation of a shredder is advisable to increase percentage open cells.

  It is reported that a cane shredder (CAMECO), new mill rollers, thrash plates, coupling boxes and tramp-iron separators are on order from the USA under the Commodity Import Programme (CIP).

The installation of this equipment will certainly improve the milling efficiency, but a normal situation will only be obtained if the other factors are also cured.

It should be noted that all efficiencies as calculated during recent years are partly based on estimates as the imbibition flow meter is not working.

(b) Boiling House Performance

Although the factory was not yet in operation, sufficient records were available to evaluate the factory performance since 1976/77.

Weighed inputs, % pol cane and quantities in the pol balance c.q. % overall pol recovery should be observed with caution. Determination of pol contents by the laboratory is quite reliable, but except for extracted juice, cane is often incorrectly weighed, and imbibition water and final molasses are only estimated. Hence weights of pol in cane, in bagasse and final molasses are approximate, but still sufficient to make a fair evaluation.

The percentage overall sugar recovery decreased from 1976/77 to 1982/83 as follows:

77.20, 67.13, 65.08, 63.73, 65.25, 60.75, 49.34.

In the boiling house this is mainly caused by:

- intermittent crushing due to lack of cane, leading to often unjustified liquidation of clarifiers;

- overflowing of tanks due to negligence of labour force;

- leaking pumps;

- chemical losses due to inversion;

- high pol losses in final molasses due to a high non-sugar content of the low quality stale cane in combination with insufficiently cooled C-massecuite resulting in a too high purity of the final molasses.

In Table 2.4.1 are shown some key figures, derived from the final factory reports from 1976/77 to 1982/83, illustrating the rapid deterioration of the overall performance.

Down hours for operational reasons in the boiling house included in 'various reasons' apart from the poor standard of operation were minor, and were mainly caused by:

- stale cane of low quality, resulting in sticky difficulty curable C-massecuites, often leading to congestion in the back factory.

- mechanical failures, such as:

  Failing pumps

  Insufficiently desuperheated exhaust steam of too low pressure, causing congestion in the boiling house in combination with a too low vacuum on evaporation and pans.

- Electrical failures on centrifuges.

In 1970/71, the best milling season so far, 463 380 t cane were crushed in 240 season days, i.e. 80.4 t per available season hour.

Although no down time percentages were available for this season, it may be assumed that 90 t cane were crushed per actual milling hour, giving a time efficiency of:

$$\frac{80.4}{90} \times 100 = 89.3\%$$

A total down time of 15% to be achieved gradually after 10 years is therefore a realistic target. However, this is dependent on early factory management assistance by a qualified firm combined with training and up-grading on all levels.

(c) Boiler Efficiencies

No records are kept on boiler efficiencies and steam consumption. The installation is not equipped with water meters, steam flow meters, steam quantity recorders. None of the boiler instruments for indication of furnace, air heater and flue gas temperature and drafts is working.

Table Nr 2.4.1

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Factory Statistics 1976-1983

Combined 2 periods of milling season	Available season hours = 100%	Down-hours as percentage of available season hours: Lack of cane	Normal revision	Electrical faults	Mechanical faults	Boiler faults	Various reasons including processing	Total down-time (hours)	% time efficiency	Tonnes cane crushed	Tonnes cane crushed per actual milling hour	Tonnes cane crushed per available season hour
1976/77	5 562.3	10.4	1.4	1.5	4.0	2.5	5.2	25.0	75.0	361 461	86.6	64.9
1977/78	5 588.4	17.2	1.8	2.7	6.9	4.4	6.6	39.6	60.4	262 360	77.7	46.9
1978/79	6 020	10.5	1.5	3.9	5.7	6.2	7.5	35.3	64.7	336 854	86.5	56.0
1979/80	5 358.9	4.7	1.7	4.0	9.9	9.5	10.5	40.3	59.7	283 314	88.6	52.9
1980/81	4 355.3	15.0	1.0	2.2	4.5	6.4	7.6	36.7	63.3	230 346	83.5	52.9
1981/82	3 956	15.0	1.3	3.5	2.5	14.7	6.7	43.7	56.3	165 881	74.4	41.9
1982/83	3 915.6	12.3	1.2	9.5	9.3	14.8	11.7	58.8	41.2	107 031	66.4	27.3

Table Nr 2.4.1

Seeing the very high consumption of boiler fuel oil, the efficiency of the boiler must be low and the steam consumption very high. Another reason for the high fuel consumption is the low NCV of the bagasse due to the high moisture content.

The low boiler efficiency is caused by:

- poor condition of the steam boiler, i.e. damaged baffles, leaking economisers;
- deposits in the water tubes caused by the poor quality of the feed water;
- high blow down factor to avoid high concentration of dissolved solids in the boiler water;
- accumulation of soot in the boilerbanks due to badly maintained soot blowing equipment.

The high steam consumption is caused by:

- irregular operation of the factory; during longer stops water is evaporated in the evaporators;
- inefficient operation of the evaporators;
- fouled steam compartments of heaters, evaporators and vacuum pans;
- high radiation losses due to absence of insulation on steam, water and process piping and vessels;
- low purity of juices and syrups causing a higher re-circulation in the boiling house and consequently a higher steam consumption in this section;
- too low steam temperatures of the live steam resulting in a higher steam consumption of the generator and mill turbines;
- failing controls of the desuperheaters for make-up steam, resulting in less efficiency in the evaporators, heaters and vacuum pans.

(d) Factory Performance of the Current Campaign 1983/84

An additional visit was paid by one of the team members as from the 30th September to 2nd October 1983 to assess the performance of the factory in operation.

In general crushing was very irregular, partly because of technical problems in the factory, but mainly because of insufficient cane supply. From the basic factory performance figures below, it can be seen that the overall performance was extremely poor.

	As from 6th August to 1st October 1983
Total tonnes cane crushed	31 499.6
Total tonnes sugar produced and in process	1 299.4
Pol % cane	10.88
Fibre % cane	13.50
Actual pol extraction	81.98
Reduced pol extraction	83.50
Bagasse % cane	35.79
Pol % bagasse	5.51
Moisture % bagasse	54.37
Final molasses purity	42.58

Down hours % available season hours:

Reasons	(%)
Lack of cane	16.6
Normal revision	1.3
Electrical faults	1.7
Mechanical faults	7.2
Boiler faults	27.9
Various, including processing	8.0
Total	62.7
Time efficiency	37.3
Tonnes cane crushed per actual milling hour	61.6
Tonnes cane crushed per available season hour	23.0
Overal pol recovery	37.77
Sugar % cane	4.11

Cane unloading area:

- Rail tracks need adjustment/alignment. In future all unnecessary transports crossing the railroad system should be avoided. One or two concrete crossings will have to be made.
- Discharge of Miedema trailers went smoothly.
- Discharge of rail carts needs to be improved as positioning of the railcarts onto the dumper was occasionally very time consuming.
- Overhead travelling crane was not used. The cane which was stored loose in the cane yard was loaded into Miedema trailers by means of grabloaders. The trailers were off-loaded onto the special cane table for these trailers.

Milling plant:

- Cane preparation was rather poor.
- Mills were operating without chokes. Imbibition was supplied to the juice tray of the last mill, without any measuring, hence last mill was operating as a dewatering mill.
- Mill adjustments are poor since bagasse had a moisture content of about 54% and reduce extraction was only 83.5%.
- Cush-cush elevator was under repair and all juice and cush-cush was pumped to the DSM screen resulting in a lot of splashing over 1st and 2nd mill area.

Boilers:

- Boiler down time is very high due to the collapse of the brickwork of the Mario Pensotti boiler. Brickwork and sheeting was removed; reconditioning has not yet started, as materials are not available.
- There are still problems with the feedwater pumps.
- Furnace pressures in other boilers are kept at a rather high level. Flames and smoke escape from all openings.
- Factory staff considers the installation of a water treatment plant as a priority item.

Factory lighting:

- This is totally inadequate and needs considerable improvement.
- Most of the factory is completely dark and TL armatures are used in most of the processing area to have at least some illumination.

2.4.3 Distillery

The distillery has been in operation since 1965, with a design capacity of 15 000 l alcohol, 96 vol % per 24 hours. It performs below standard, as can be observed from the final report of period 6th January 1982 to 6th April 1982. Of the 1 632 available operational hours, total down time amounted to 54.7%, of which 42% was due to lack of steam (too low steam pressure) and 12.7% for various reasons, mainly mechanical.

Intake of molasses was 1 383 t. Total volume of alcohol produced was 474 280 l, of which 329 890 l was potable alcohol and 144 490 l was inferior, i.e. industrial alcohol, a ratio of 69.5 : 30.5. This ratio should be at least 90 : 10 for this type of distillery using molasses with a purity of over 40%.

Gross volume of alcohol per effective working hour of 640 l, i.e. 15 360 l per 24 hours, is the design level. Gross volume of alcohol per t molasses of 343 l is high owing to the high purity of the molasses used. At a downtime of only 13% for various reasons, the distillery could have produced, in the relevant period, twice the amount of alcohol.

The quantities of fusel oil and residue (slops) produced are not determined and are pumped as effluent into the river. At a ratio of about 13 l of this effluent to 1 l alcohol produced, the quantity of effluent per effective working hour will be about 8 m^3 with a BOD content of about 40 00 mg/l.

To avoid river pollution the effluent should be diluted in the river to $\pm$ 50 mg BOD/l, requiring a river flow rate of at least 1.8 m^3/s. A river flow rate lower than 1.8 m^3/s can occur in the months of February and March. During this period it is recommended to transport the effluent to the plantation and spray it on the fields as fertiliser. The container for transport and the spraying device should be corrosion resistant.

Physical condition of equipment:

Fermentation:

- Tanks for buffering molasses, well and river water are in reasonable condition; their expected lifetime is 10 years.

- Tanks for diluting molasses and dosing chemicals are in poor condition; their expected lifetime is 7 years.

- Tanks for yeast propagation and pre-fermentation are in poor condition; their expected lifetime is 7 years.

- Main batch fermentation tanks are in poor condition; their expected lifetime is 7 years.

- Fermented mash transport pump is in poor condition and needs to be overhauled or renewed.

- Sulphuric acid storage tank with transport pump is corroded and beyond repair; it should be scrapped and renewed.

- Sulphuric acid dosing tank has been scrapped due to corrosion. New one to be installed.

- Piping in general is in poor condition; its expected lifetime is 5 years.

Distillery:

- Two mash columns are in poor condition; their expected lifetime is 7 years.

- Column for separating 'heads' is in poor condition; their expected lifetime is 7 years.

- Rectification column is in poor condition; its expected lifetime is 7 years.

- Column for separating methyl alcohol is in reasonable condition; its expected lifetime is 10 years.

- Column for separation of fusel oil is in reasonable condition; its expected lifetime is 10 years.

- Coolers for columns are in reasonable condition; their expected lifetime is 10 years.

- Steam heaters for columns are in reasonable condition; their expected lifetime is 10 years.

- Steam reducers from 6 to 3 bar and 3 to 1.5 bar are in reasonable condition; their expected lifetime is 10 years.

- Piping and relevant pumps are in reasonable condition; their expected lifetime is 10 years.

- Alcohol storage tanks are in reasonable condition; their expected lifetime is 10 years.

After intensive overhaul, including partial renewal of tanks and piping, and subsequent proper maintenance it is expected that the distillery will be operable for another 10 years.

2.4.4 Condition of the Buildings

All buildings in the factory compound have been examined. Details of their present condition are given in Annex IV.

2.4.5 Organisation and Manning

No comprehensive up-to-date organigramme proved to be available. The most likely organigramme of the Factory Department, as shown in Figure 2.4.1, has been derived from a non-complete organigramme and relevant verbal information.

Observations:

- At present responsibility the workload is too heavy for the Factory Manager.

- Training Section should be under the direct responsibility of the General Management. Existing training facilities are very restricted and need to be extended.

- Technical Service/Design Department should be under the direct responsibility of the Technical Manager.

- The same is true for the Technical Manager. Only the mechanical workshop and the diesel power plant of the Workshop Service should be under his direct responsibility.

- Competency of the factory staff is far below standard on most levels.

  Of top and middle management at present only the Factory Manager and the Plant Manager of the distillery are graduates from engineering colleges abroad. The others are either secondary school graduates with little practical experience, or ex-foremen with many years' practical experience but without managerial ability. They have been promoted to higher management levels due to lack of suitable candidates.

- The position of Shift Engineer is vacant.

- The Shift Process Supervisors are at present also acting as Shift Engineers. This is a most serious situation, particularly because these supervisors are ex-foremen with only practical experience in processing operations.

- Cane weighbridges now under the Agricultural Department should be under the control of the Sugar Production Service.

- Total manpower seems to be on the high side, in common with comparable situations elsewhere where lack of quality is compensated by quantity.

2.5 Transport System, Agricultural Machinery and Workshops

2.5.1 Harvesting and Transport System

(a) Systems presently in operation

During a second visit to the Estate harvesting and transport operations were observed, and from these observations and discussions together with the information collected during the first visit the undermentioned conclusions were drawn.

Present practice on the Estate is as follows:

- all cane is burnt prior to harvesting;

- cane is no longer hand loaded;

- cane is either cut by hand and stacked for loading by grab loaders (Cameco) or cut and loaded mechanically by mechanical harvesters (Toft) in one single operation;

- hand cut cane is transported to the factory in both rail-carts and road-trailers;

- mechanically cut cane is either transported directly to the factory by road-trailers (Miedema) or transloaded into rail-carts from in-field trailers (Toft) which work alongside the harvester;

- in-field rail transport, by using portable rail, is used for hand-cut, grab loaded cane only;

- road transport units haul cane from nearby areas, whereas rail transport is used for those areas further away from the factory.

(b) Observations on the present system

Burning prior to harvesting is at present normal practice all over the world. It increases the output of the cane cutters and deterioration rate is very low when cutting and crushing are done within 24 to 30 hours after burning. The required labour force to carry out the burning is relatively high because only small areas are burnt.

Manual Loading

The system of manual loading has not been practised since the introduction of mechanical harvesters (1976) and grab loaders (1977) and should have resulted in a higher output from the cane-cutting labour force.

Manual Cutting of Cane

The labour force for manual cutting consists of women and children only.

The total number of 'labourers' for cutting reaches 600 to 700, with an average capacity of 0.6 to 0.7 t/day. Cutting operations usually start at 6.00 am and are stopped at around 1.00 pm.

Cane is cut in contract and the contract is determined, prior to the start of the actual cutting, on bases of the expected yields and consists of a number of rows, varying between 3.5 and 6, with a length of 25 m being the distance between the aquioles. Total contract value SoSh 8.

This means a total of between 78 and 45 contracts per ha. Reportedly a contract takes about 3 hours to complete and most cutters can do 2 and in exceptional cases even 3 contracts per day.

For supervision one foreman is assigned to 1 ha only. Cane is stacked in different ways depending on road or rail transport in the field.

On the road transport fields cane is stacked irregularly and stack distance varies between 6 and 16 rows in the same field. A satisfactory explanation for this practise was not given.

Observations

- In order to be employed as a cane cutter the worker has to bring his own knife, which can be purchased for about SoSh 250. This is an investment equal to about 30 contracts.

- Knife-sharpening facilities are not provided by the Estate. Private grinding stone proprietors charge SoSh 5 to sharpen each knife.

- Consequently the condition of the knives is far from ideal. Many are not sharpened properly and have inadequate grips, which has a negative impact on the cutter's performance.

It is essential that proper cane knives are issued to the cane cutters. These knives should be sharpened and renewed when required without expense to the cane cutters.

The contract includes cutting, topping and stacking of the cane as well as collection of tops and trash which has to be deposited on stacks for subsequent burning.

When cane is cut too high above ground level a second cutting operation has to be carried out by the cane cutter, to level off the stalks of the cane stools.

The cutting work force is provided with drinking water that is collected from irrigation and drainage canals. This is considered a health hazard.

Food of any kind is not supplied and consequently cane is the only stomach-filling material available during the day.

It is considered essential to provide the cutters with proper drinking water and one properly balanced meal a day. This should be free of charge.

Apart from the actual cutting force considerable numbers of additional personnel are required.

In the field observed it was noticed that 51 cane cutters required:

- 8 labourers to burn an area of about 1 ha prior to cutting;
- 8 labourers for collecting cane that was left behing by the grab loader;
- 3 labourers for closing the aquioles;
- 2 labourers to arrange the water supply;
- 5 foremen to supervise the operations.

It is considered essential to reduce the surplus labour force by the following means:

- burning larger areas in one operation;
- more concentrated cutting operations;
- less supervision;
- more rational water (and food) distribution.

The output of the individual cane cutter can be improved by:

- higher cane yields/ha;
- stacking every 6 to 8 rows, thereby reducing walking distances;
- collection of tops and trash by mechanical means;
- providing proper tools, namely cane knives;
- proper training as to how a stalk should be cut by a single swing of the knife at the proper height.

(c) Mechanical cutting

The mechanical harvesters, in total 4 units (Toft), together with 8 in-field side dumping trailers (Toft) were purchased in 1976. These units have been used for a few months only as their performance was extremely poor. This is mainly the result of a totally unsuitable field layout, resulting in a lot of trash and mud entering the factory, leading to crushing problems. The units had not been used again until recently (1983) when a severe labour shortage forced the Estate to reintroduce mechanical harvesting. The side dumping trailers are used for in-field transport and the chopped cane is transferred into rail carts from these units. The system most practised however is to use the Miedema side-unloading trailers in combination with these harvesters. These trailers are hauled directly to the factory which eliminates the transloading.

The performance of the mechanical harvester observed during operation was very poor and an estimated 40% of the available cane in the field was left behind.

The performance of the harvester is seriously affected by the improper field conditions such as unevenness of the field, lack of an adequate ridge and furrow system, too wide canal stools, uneven stand of the cane, poor condition of harvester, especially base-cutters and crop lifters.

Observations made during the recent campaign showed that the operator was reasonably skilled and handled the equipment properly. Coordination between the harvester operator and the driver of the tractor/trailer unit operating alongside the harvester was good. Field speed reached about 7 km/h but cane stand was poor and reached about 20 t/ha, which means a capacity of about 20 t/h when all cane is cut (no losses). The crossing of the aquiole has hardly any influence on the harvester performance.

The units can only operate during daylight hours.

(d) Grab loading

Grab loading is the most common system when cutting is manual. The performance of loaders is considerably reduced because stacks are not properly made. Reportedly 20 to 25 cane collectors are required to collect the cane left by the grab loaders - which is an unacceptably high number. Loader capacity is also seriously influenced by the field layout and additional labour is required to close and reopen the aquiole channels to allow the loader to pass. The loaders have resulted in a lower labour demand but much of the benefit is reduced by the additional labour required to support these machines. The grab loaders were introduced in 1977/78 when the mechanical harvesters proved to be a complete failure. The grab loaders are also to be used in the future, and it is expected that in combination with tractor/trailer units they will give better overall results than with rail transport units.

(e) Cane transport

Transport of cane by rail was introduced in the early stages of the project and has performed very well in the past, when loading was still carried out by hand. Unfortunately the maintenance of the railroads and the equipment left much to be desired and outputs have fallen drastically. Moreover the system became more labour intensive as, due to the reduction in cane yields, the transfer of transportable rails had to be carried out more frequently. Any future system should aim at doing away with the transportable rails and have the in-field transport carried out by tractor/trailer units. This will improve the output of cane cutters as stacks can be made at every 6 to 8 rows eliminating hand-carrying of cane. Moreover in-field tracks for railways and subsequent losses in cane production can be avoided.

Road transport of cane was also practised in the past, but on a limited scale. The introduction of modern trailers of the weight transfer type, suitable for transport of chopped as well as grab loaded cane, was carried out in 1978, together with the grab loaders. These trailers are used for dried haulage to the factory from nearby fields. In total 12 units of 9 t capacity and 12 units of 12 t capacity are available. Unfortunately the condition of fields and roads in the area is such that outputs are bound to be low, the more so as in actual practice the trailers cannot be loaded to their rated capacity. The system is used to haul cane from nearby fields only.

(f) Cane reception at the factory

Cane is brought to the factory via weighbridges, one for rail-carts and one for road-trailers. In total 3 unloading devices are available. Inclusive of feeder tables, they comprise the following :

(i) hydraulic tipping device for rail-carts suitable for whole stock and chopped cane;

(ii) overhead gantry cranes for unloading bundled cane from rail-carts. Chains for bundling are installed prior to unloading and the chains do not leave the cane unloading area.

The tipping device itself operates properly but minor adjustments to improve the positioning of the railcarts on the platform will be required.

The overhead gantry cranes are adequate and will only be needed in case the tipping device is not operational. It will not be required to arrange for storage of cane. The unloading of the side-dump trailers is operating smoothly.

2.5.2 Infrastructure, Railways, Roads and Camps

(a) Railways

The Estate has always used rail transport for the haulage of sugar cane and the transportation of other materials. The condition of the rails and joints is still at an acceptable level, although severe corrosion was noticed in several places. This corrosion is mainly due to the fact that, contrary to normal practice elsewhere, the sleepers and part of the rails are covered with soil, whereas normally these are laid on top of a ballast bed.

The unballasted bed, usually an earth embankment alongside the roads, must be retained, as the creation of proper ballasting will be far too expensive to be implemented, mainly because the nearest source of suitable stone is more than 100 km away.

Due to the poor alignment, at present the average speed of the rail transport has dropped to less than 40% of what could be achieved, thus reducing the tonnage of cane the system can handle.

Moreover this results in frequent derailments especially of the railcarts; consequently transport operations are seriously hampered, as are the standards of safety and repairs.

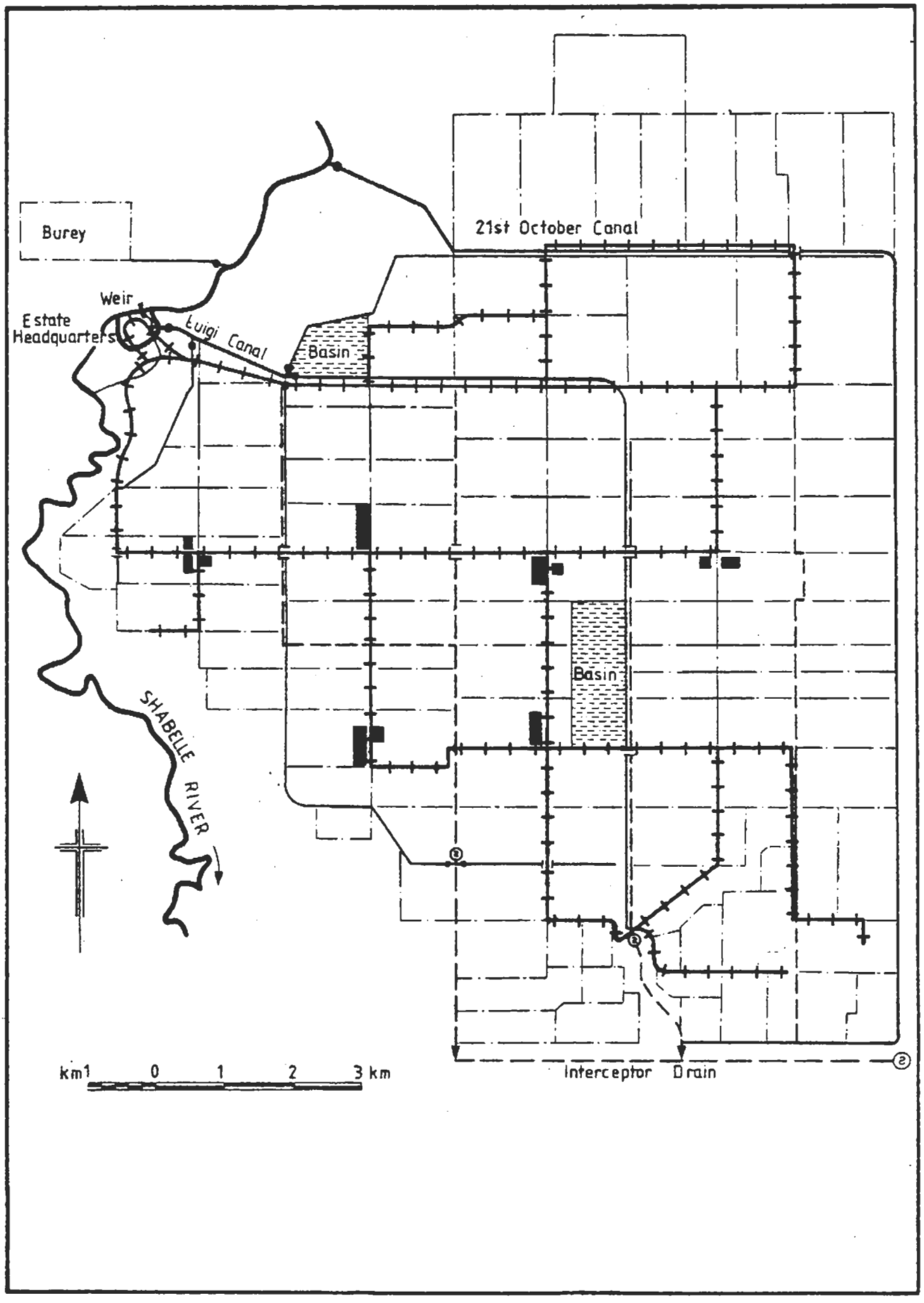
The railroad network as presently available and covering a total distance of some 75 km is presented in Figure 2.5.1 whereas Annex V gives details of the rail condition.

(b) Roads

The condition of the roads and tracks in the plantation is unsatisfactory and they are completely impassable after rains. This is mainly due to the fact that these roads are not free draining as they are bordered on the one side by the railway embankment and on the other side by soil bank resulting from mud removed from drainage and/or irrigation canals.

Figure 2.5.1

Jowhar Sugar Estate
Existing Railroad System



Proper materials for road construction are not available in the area, as was previously described for the railroad ballasting. Consequently only mud roads are available.

(c) Camps

In total 6 plantation camps are situated in the plantation area.

Most of these camps do have a store, office space and living quarters of various standards.

These camps are provided with basic facilities inclusive of electricity.

There is a workshop for agricultural machinery located in Farm IV. It holds a workshop area inclusive of offices, storeroom, toilets, etc. and a large parking area.

2.5.3 Maintenance Facilities

(a) Facilities

Maintenance/repair and manufacturing activities are carried out in a number of workshops supervised by the workshop engineer under the responsibility of the maintenance engineer.

Apart from the boiler makers shop the workshops are located fairly close to each other, facilitating supervision.

The buildings are of good construction and their layout is basically suitable. However, a rearrangement of the various activities done within the buildings will be required to fit a better organisational set-up in future.

Material stores are located close to the workshops, but a rearrangement of parts within the stores is considered necessary to bring the materials closer to the place where they are to be used.

The facilities at the factory compound include :

Machine shop

Carpenter's shop

Tractor shop

Vehicle shop

Locomotive shop

Boiler makers shop

and various other areas for tyre repair, trailer repair, rail cart repair, etc. A rolling equipment workshop is located in Farm IV. The compound layout is illustrated in Figure 2.4.1, and the layout of the main workshop building in Figure 2.5.2.

Mobile facilities to carry out repair and service activities in the field are very limited and consist of a Land Rover for repairs and a fuel tanker.

A radio communication system for contacts between plantation sections and workshops is no longer in existence.

The performance of this part of the maintenance section is below the standard required for an industry of the size and nature of the Jowhar Sugar Estate. This is mainly caused by :

- Lack of trained supervisors and technicians.
- Lack of the required spare parts and tools.
- Inadequate and insufficient facilities.
- Inadequate management information system.
- De-motivated workforce.
- De-moralising effect of the untidy working place and the poor overall performance of the project as a whole.

This has resulted in a chaotic situation. Cannibalised and broken-down equipment, as well as equipment components, most of which cannot be reconditioned/used again, are lying all over the compound and inside the workshop buildings. The latter results in repairs being carried out in the open as room inside the workshops is not available.

It has to be stressed that the level of performance of the workshops has a direct impact on the efficiency of all activities at the Estate in particular on the plantation and factory. The constant lack of reliable equipment has a detrimental effect on drivers and operators as well as on plantation staff.

In the present situation we are of the opinion that the purchase of expensive spares and tools will not basically improve the situation in the long term.

Long-term improvements can only be achieved when :

(i) Experienced and qualified management is made available.

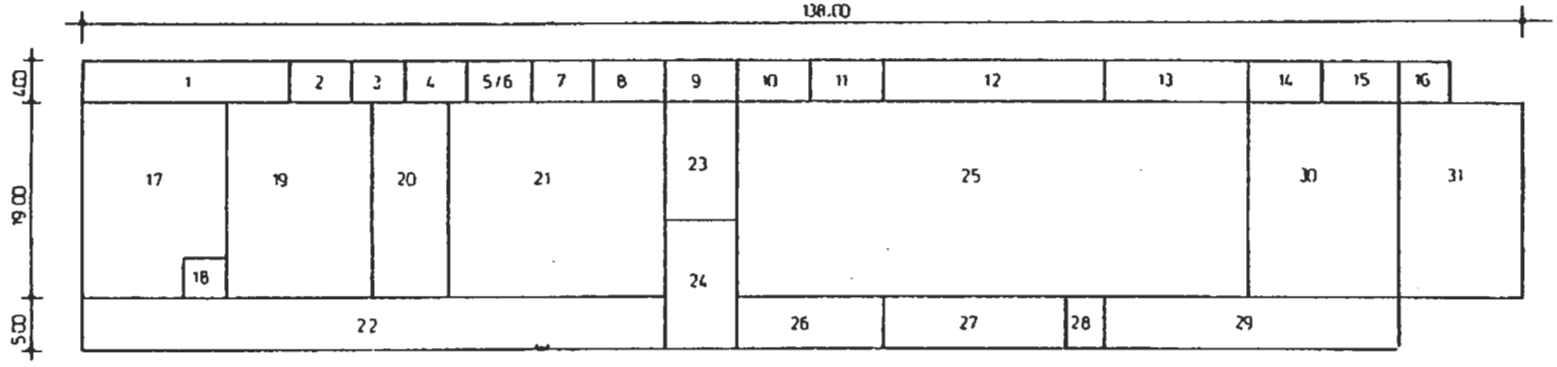
(ii) The available facilities are restored to their original functions.

(iii) Various old machinery in the workshops is replaced and new items introduced.

(iv) Proper mobile facilities are made available together with radio communication.

(v) The stores and purchasing section is reorganised and operates adequately.

(vi) Training of management and technicians is taken in hand.



1 Blacksmith + radiator repair
2 Filled with scrap
3 Entrance
4 Electrical testroom
5 Battery room
6 Filled with scrap
7 Switchboard + battery
8 Fuel pumps repair room
9 Panel beater shop
10 Spares + tool for machine shop
11 Filled with scrap
12 Sawing machine + scrap
13 Pump room repair
14 Tool room
15 Filled with scrap
16 Battery room + electr. workshop
17 Welding shop
18 Filled with scrap
19 Grounded vehicles + scrap
20 Motorcycle repair
21 Grounded vehicle + scrap
22 Various repair + parking
23 Repairs of freezers + airco's
24 Offices
25 Machine shop
26 Filled with parts/materials
27 Filled with scrap
28 Parking
29 Locomotive repair
30 Locomotive repair
31 Locomotive repair

0 5 10 15 20m

Figure 2.5.2
Workshop – Existing Layout

(b) Organisation and manpower

The current organisational structure of the transport and harvesting section is shown in Figure 2.5.3.

At present the workshop manager is directly responsible to the maintenance engineer who in turn is responsible to the factory manager.

The workshop manager is in charge of :

Tractor and vehicle workshops

Locomotive and rail-cart workshop

Machine shop

Boiler shop

Carpenter's shop

The maintenance of the railway network as well as the repair of rails and joints is the responsibility of the agricultural department.

Equipment operators as well as locomotive drivers are also under the direct control of the agricultural department. Drivers for trucks, buses, cars and other general transport are controlled by the workshop manager.

Apart from the drivers/operators a total work force of 186 inclusive of the workshop manager are employed in the workshops, whereas another 24 permanent and 30 seasonal workers are employed for rail/railway repair and maintenance. This total should be considered more than ample to cope with the work load in future and at the same time allow for attendance on training courses.

In the future organisational set-up a distinct difference has to be made between the various workshops and their position in the organisation.

The present organisational set-up is indicated in Annex V, as are the location of the workshops within the factory compound, and the geography of the main workshop building.

(c) Stores

At present too many materials are stocked too far away from the consumer departments. The store buildings are sufficiently large to hold all the spares for the project provided all obsolete materials are removed and the area is cleaned.

The stores are provided with sufficient shelves of good construction to hold the larger spare parts as well as large quantities of consumables.

Provisions for stocking smaller items in small quantities are lacking as well as sufficient racking to store tyres and tubes.

Many cards used with the present cardex system have been used for too long and have become illegible.

The store codification system that was introduced many years ago is basically sound but is not kept up to date.

Stock control activities which should be done at least once in a year have not been carried out for many years now.

The stores hold a lot of obsolete, broken and deteriorated spare parts which have not been removed for years because of the financial consequences for the stock value.

Summarising, it has to be concluded that stores operations and registration is below standard and most of the issues of parts is based on the memory of the store personnel and with the help of samples.

(d) Spare parts

A lot of equipment is idle as it cannot be repaired because the required spare parts are not available or cannot be traced in the stores.

The orders placed for Deutz, Cameco and Caterpillar equipment were screened during the experts' visit and it had to be concluded that although the amounts involved are considerable, very few units can be made operational after arrival of those parts. This is because these orders contained the most expensive items, in large quantities, whereas other essential spare parts of lower values have been 'overlooked'.

Communications between purchasing, stores and consumer departments concerning the position of orders does not exist any more at the Estate nor with the head office in Mogadishu.

The ordering procedures are too complicated and the lack of foreign exchange makes the situation even more complicated.

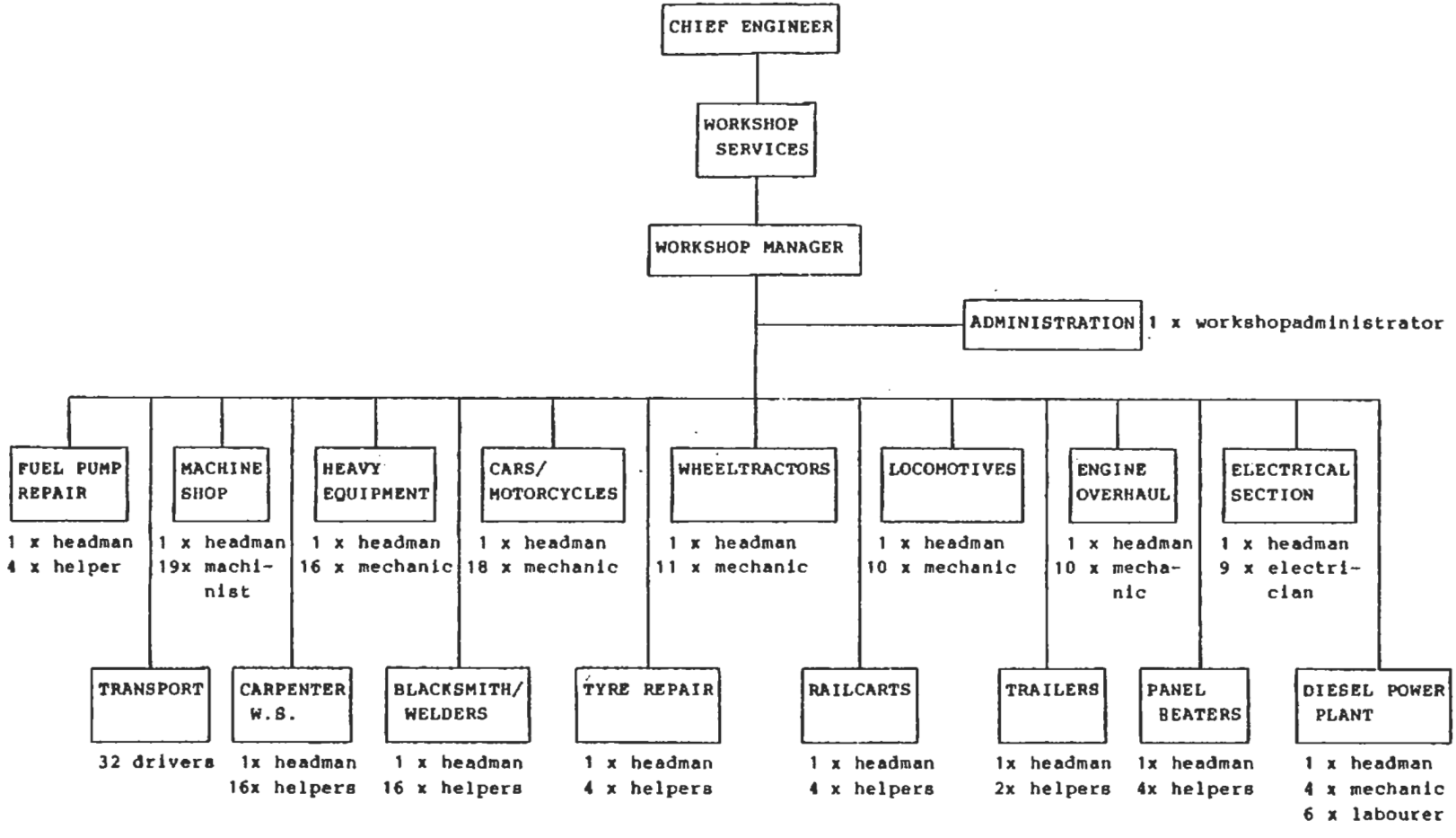
2.5.4 Observations on Rolling Stock

Due to the poor performance of the workshops, the lack of experience of many of the equipment operators, the poor road conditions and the lack of spare parts, much of the equipment is idle and, in some cases, has been so for many years. Many of these idle units have been cannibalised to keep others operational.

Most of these units are parked somewhere in the open either in the factory compound or near the plantation camps, which of course contributes to further deterioration as a result of weather conditions.

Most of the agricultural implements are very old and totally unsuitable for modern agricultural techniques.

The introduction of mechanical harvesters must be considered a complete failure due to the unsuitable field layout for such units. They may be used for future experiments but should not be included in any harvesting system at this stage.



Note: Maintenance and repair of railroads under supervision of agricultural department
Total labour force: 4 x headman
20 x labourer
30 x seasonals

Tractor - locomotive and other machine operators also under supervision of agricultural department

Figure 2.5.3
Workshop
Existing Organisation

The number of crawler tractors that can be economically reconditioned is considered ample to cope with the future demand. It is proposed that all of the Fiat crawlers are disposed of, and a total 8 Nr D4, 7 Nr D6 and 1 Nr D7 Caterpillar crawlers are reconditioned.

The number of wheel tractors that can be made operational again, however, will be far too limited to carry out all the required activities in future and considerable extension of this fleet will be required. This is because part of the mechanical activities in the plantation presently carried out by crawlers will be taken over by wheel tractors and more mechanical tillages are envisaged for the future.

About 55% of the available locomotives are operational, the remainder being idle, mostly waiting for engine overhaul which cannot be carried out as the required parts are not available.

About two-thirds of the rail-carts are operational, the others are awaiting minor repairs to undercarriages. Reconditioning of these units is considered essential as they will be the basis for cane and other transport for many years to come. It is considered possible to recondition part of the railroad equipment in such a way that sufficient units will become available for the cane transport system as envisaged for the future.

The situation with regard to draglines and excavators is similar to that of the other equipment. Most of it is idle. Reconditioning of most of these units is fully justified and will result in sufficient units becoming available to carry out routine maintenance activities of irrigation and drainage canals and even part of the rehabilitation programme.

Both motor graders are out of order at this moment awaiting minor repairs. Their general condition is such that they should operate for many years to come. An eventual extension in number will only be required if the rehabilitation of the roads is not contracted out.

The motor vehicle fleet presently available is rather old and most of it needs immediate replacement. A considerable extension of this fleet with a number of 4-wheel drive vehicles is necessary, mainly for plantation managers and maintenance personnel.

The fleet of motorcycles, although rather old, is still operational. Units are used for supervisors and foremen, most of whom are from the agricultural department.

Of the available Toft harvesters only 3 are operational whereas the 4th unit has been idle for a number of years. Major rehabilitation works to these machines should not be considered.

For details on the equipment status reference should be made to Annex V.

2.6 Social Environment

2.6.1 Employment Situation of Permanent Staff

The SNAI Sugar Estate at Jowhar employs approximately 1 700 persons permanently. This figure has remained constant during recent years. At present some 30% of the total number work for the sugar factory, 30% in the Agricultural Department, and Management and Administration absorb another 30%. The Commercial Department employs about 10% of the total.

The income from permanent employment at SNAI is very low, and salary rises for permanent employees during the last seven years have been different for the various occupational groups (see Table 2.6.1).

The basic salary increase ranges between 3 and 75%. The total expenditures of SNAI for its Jowhar permanent personnel have gone up some 75% in the same time. This indicates that premiums for overtime and other benefits play an important role in determining a fully employed person's total income from his job. For permanent employees 30% overtime (the upper limit according to Government regulations) is a standard.

Senior personnel or employees with a long work record with the Company may take advantage of low cost housing on the Estate.

TABLE 2.6.1

Salary Levels for 1976 and 1982 (SoSh per month)

Occupational group	Average gross monthly earnings 1976	1982	Increase %
1. Unskilled labour (plantation)	200	280	40
2. Unskilled labour (factory)	315	416	32
3. Semi-skilled labour in the factory and the field	600	695	16
4. Skilled artisans			
- electricians	690	820	19
- mechanics	780	882	13
- boiler men	815	920	13
- refiners	510	725	42
5. Technicians			
- engineers	2 350	2 600	10
- agronomists	1 575	2 765	75
6. Administrative and senior clerical staff			
- accounting officers	795	920	15
- middle grade clericals	693	762	10
- low grade clericals	635	655	3
7. Managerial staff			
- heads of service	1 650	1 765	7
- directors of departments	2 657	2 820	5
- general manager	3 900	4 040	4

How low the payments made by SNAI really are is made clear by the cost of living at present. Basic nutrition and the most necessary items of daily use are extremely expensive, some of them up to 2.5 times as high as European standards. A sample of 20 items of daily consumption shows an average inflation of approximately 400% from 1976 up to the present day. One family - and depending whether it is separated into two households if the family head is married to two wives - will at present need between SoSh 3 000 and 4 500 per month in order to assure a decent living (urban dwellers). One person working for SNAI will only cover one-third to one-half of his expenditures with his salary from the Estate.

All persons in whatsoever engagement with SNAI are dependent on supplementary income. Extra part-time jobs, supplementary income from small subsistence farming, 'petit-trade', grey market activities etc. must supplement the job in order to assure a living.

Inevitably this circumstance must affect the productivity of SNAI: the employees spend more and more of their time and energy keeping pace with increasing prices, very high costs of living and a constantly widening gap between their professional income from their employment with SNAI and the actual expenditures of their families and themselves. The working performance must therefore deteriorate.

2.6.2 Casual Labour

As far as casual labour is concerned, about 1 500 unskilled persons are needed throughout the year for activities such as weeding, irrigation, etc. Casual labour is only employed by the Agricultural Department; no casuals are recruited for working in the factory. During the campaign periods an extra demand for casual labour (1 500 to 1 800 more) arises. These people are engaged in cutting and loading the cane.

These figures, as provided by the Personnel Department of SNAI, are extremely high by international standards, if compared with the service concerned and the actual tonnage of output per person employed. This poor ratio can only be explained by the low quality and density of the cane, the poor standard and condition of the technical equipment, low quality of the working tools applied and the very low working performance of the casual labour recruited.

Casual labour is paid according to so-called 'contracts'. For example, an area of 25 x 50 m would be one contract for weeding. In the past cutting the cane and loading was also paid for on the basis of the same area, but is now paid according to weight, approximately 1.0 to 1.2 t being a contract.

The payments for these activities are low:

Weeding	:	SoSh 7/contract
Cutting	:	SoSh 8/contract
Loading	:	SoSh 10/contract

It is common for one worker to complete two contracts in a day; exceptional workers achieve three or even four.

Casual workers in irrigation are paid by hectares irrigated, at the rate of SoSh 4 for 1 ha. During times of good water availability one man can irrigate up to 2 ha/day. In times when water is scarce he may be able to do as little as 0.12 ha.

2.6.3 The Availability of Casual Rural Labour

During the last five years or so the readiness to work for SNAI as casual labour has become very low. At the moment SNAI has difficulties when trying to employ the necessary hands. For the recruitment of casual labour SNAI has established regular contacts and relationships with a large number of villages in the area. These lie within reasonable driving distance for the trucks transporting casual labour. Part of the casual labour force is expected to come from Jowhar town (approximately 20%). Most of the villages lie in the valley of Shabelle river (29 of them) in an area that, from now on, will be called the 'flood irrigated' area. Eight villages lie outside the valley, in the so-called 'rainfall agriculture' area. In practice the urban labour force seems to play a very minor role in the workforce of SNAI.

City dwellers have an even higher reluctance (than members of farming families) to work as very low qualified casual labourers, so the following comments on possible reasons for high casual labour deficiencies can be restricted to the rural population of that area.

This area, determined by the Casual Labour Recruitment Programme issued by SNAI/Agricultural Department on 30th March, 1982, represents some 100 km^2. It has a population of about 16 500 inhabitants, distributed over 3 800 households. The population density thus ranges between 15 and 18 persons per km^2, somewhat higher than the average of all the Middle Shabelle region (12 persons per km^2; it should be underlined that this is very low compared with other areas in developing countries with comparable conditions favouring agriculture). The sizes of farms in the valley area are rather small considering the land availability, with differences between the individual properties by inheritance, labour force potential and traditional family standards. Sizes range from 2 ha per family, considered a small farm, to 7 to 8 ha per family which would be the largest farm that can be operated with traditional means.

An average size, considered to be a good basis to survive on, is 3.5 to 4.0 ha per family. In the valley crop growing is the only activity (maize, beans and sesame); cattle breeding is said to be impossible due to the seasonal appearance of tsetse flies.

The farming in the rainfall agricultural area is fundamentally different. Crop growing is of reduced importance and the size of farms are significantly smaller (2.0 to 2.5 ha). Economically the emphasis is on animal husbandry (mainly cattle, no camels, few sheep and goats), with sales of milk being the most important source of income.

A rough estimate of operational costs and income from farming indicates that both types of farming operate successfully at present. This is mostly due to the high to very high prices the farmers can receive for staple foods and milk. The rural wholesale yearly average price for the four most important items are (1982/1983):

Maize	:	SoSh 700/quintal
Beans	:	Sosh 750/quintal
Sesame	:	SoSh 900/quintal
Milk	:	SoSh 5/litre

In the flood irrigation area the farmer and his family only consume 25 to 35% of their yearly products. On the other hand, in rainfall agricultural areas usually little or no staple food is sold, and an assumed productivity in milk of 1 000 to 1 250 litres per annum per cow guarantees a good to very good income, except when drought reduces grassland availabilities, in which case the cattles' milk output may drop to zero. In an average to good year a farmer in the valley is expected to be left with some SoSh 20 000 to 30 000 net cash, whereas a cattle breeder with favourable marketing conditions for his milk (an urban market nearby) may have a return of even SoSh 50 000 to 100 000 per year.

Since long term observations show that Jowhar and the area surrounding it suffer from reduced rainfall and thus water supply every second year and from droughts every fourth year, we expect that 'rainfall agriculture' farmers will in the long run not be better off than the crop-growing farmers in the valley. Severe droughts may cause losses in cattle, so that the economic basis of a 'rainfall farm' is considered more stable and insecure. Furthermore the above named income only counts for those having easy access to markets.

As far as the operational costs of these two basic types of farms are concerned, land preparation is the most important aspect of expenditure. The production cycle is organised around the two rainfall seasons (gu: March to June, der: September to December) and all jobs have to be done twice a year. First the fields are cleared of grass. The fields actually cultivated may be rotated, and clearing a formerly fallow field would be considered the hardest job. Weed and grass grow quickly on fields cultivated in the previous season and clearing is required at the start of every new planting season. This too is considered hard work. Generally (65 to 80% of all farmers in the area) both jobs are done by hired ploughs, tractors and disc ploughs. After a field is ploughed it is fully cleared, levelled and prepared for seeding. The latter is done by hand, using a simple hoe. For that job all farmers except the poorest will try to find hired labour.

There is therefore a high demand for casual labour within the area. This demand will compete with SNAI's demand for hired hands.

Weeding and irrigating the fields is mostly done by family members of the farmer concerned. Nevertheless it was underlined that, for these jobs as well, labour is likely to be engaged when it is available (generally it is not). Harvesting and marketing the crops is the family members' job. The family head himself will not participate in manual labour unless he is forced to do so by situations of extreme need.

For the rainfall agricultural area the jobs are basically the same with reduced volume in general (smaller sizes of fields) and smaller demand for casual labour.

The fact that nowadays many jobs previously undertaken by casual labour are done mechanically seems to indicate that the indigenous demand for casual labour is no longer met by the availability and/or readiness of the population in the area to work for others as hired hands.

This fact is underlined by the inflation of wages for private rural labour in the area which by far exceed the general rate of inflation:

In 1970, when SNAI paid about SoSh 4 for half a day's contract, casual rural labour elsewhere was paid between SoSh 1.5 and 2.5 for a full day's job (i.e. approximately the equivalent to two contracts). In 1983, during peak seasons,

casual rural labour is hard to find at SoSh 60 for half a day's work, breakfast, lunch and drinks provided. Within 13 years costs of hiring casual workers have gone up, in extreme cases, by 3 000%.

As far as the general readiness to work as hired hands is concerned, (affecting both the SNAI and the private farmers' demand) this has the following implications:

Being obliged to work physically may imply losing face. A farmer with a medium or large farm will avoid it. He will also try to burden his family members with as little as possible. In order to run his farm properly he needs men working for him. As far as land preparation is concerned, labour availability dropped below the demand long ago; mechanical ploughing was adopted into traditional farm-management. A well-off farmer would normally have regular contacts with poorer farmers (helping them with credit, their contacts with authorities, etc.), and would expect them to provide their labour when needed.

With the improved income situation of farmers as a result of inflated market prices for staple food, the dependence of those poorer farmers on income from casual rural labour constantly decreases. In the same way his readiness to work as a hired hand declines, even with a parallel price increase for a given contract. A poorer farmer will still have to work for his old client since this relationship is established by traditional obligation. However, the reluctance to do so will increase. He will find all kinds of excuses why he can't come today or tomorrow, he will demand more money, etc. This will also be true if a person is habitually sent to SNAI. He will try to avoid going there by all means, he will send his wife or one of his children and if that is not possible or accepted and he has to go there himself his working performance will be low.

In general terms we expect the following:

Unless external factors severely interfere with the farmers' returns, e.g. droughts causing the output to drop to a level far below what is considered to be 'self-sufficient' or a dramatic decrease in marketing prices, the patterns described, which must have commenced some 5 to 10 years ago, are likely to continue. The nearby urban market of Mogadishu, good communication by road transport and other external factors have caused extremely favourable marketing conditions for rural production in the Jowhar area. Thus the rural population has become less dependent on labour as an additional source of cash income. The most important source was previously permanent or part-time employment with SNAI and, if that could not be found, casual work for private farmers in the area. (Some 'petit-trade' may also have played a minor role.)

All in all, the casual labour potentials have been reduced dramatically. There is no longer an economic need for an increasing majority of the population in the area to work as hired hands.

Together with that development goes a reduced readiness, due to emotional dislike, to follow moral (or other) obligations in order to provide one's labour-power if requested to do so by traditional employers. If doing somebody a favour by doing physical work means loss of face, particularly if one is not really dependent on the money earned, the all-over readiness to provide casual labour must be considered to be extremely low.

The conclusion is that the all-over demand for casual labour in the area observed is higher than the supply. Unless external factors interfere (for example a reduction of staple food prices) casual labour will become even more scarce than at present. Even if SNAI Jowhar dramatically increases its payments

for casual labour it is anticipated that there will still be a shortage of people willing to work as casual labourers on the Estate.

Unless combined measures are undertaken (including increased payments), aiming at making the work on the plantation attractive in general terms, and development activities in medium terms can create stable working and living conditions for rural labour, SNAI will hardly be able to solve its casual labour problem.

Such developments should also facilitate the better-off farmers' substitution of their demand for hired hands by appropriate means (at low costs) in order to avoid unnecessary competition with SNAI.

Proposals for the solution of the man-power shortage problem are discussed in Chapter 3.

2.7 Financial Performance

2.7.1 Profit and Loss Accounts/Balance Sheets 1979

The profit and loss accounts over the past years show the following results :

	'000 SoSh
1979 loss	26 639
1980 loss	31 368
1981 loss	39 899
1982 loss	63 791

During the period 1979 to 1982 heavy losses were sustained because of declining sugar production, increasing cost of wages, fuel and materials and untimely adjusting of the sugar ex-factory price.

Balance sheets are presented in Table 2.7.1 for the financial years ending 1979, 1980, 1981 and 1982.

The unaudited balances show an increasing deficit of working capital :

	million SoSh
end 1979 deficit	4.8
end 1980 deficit	23.0
end 1981 deficit	59.0
end 1982 deficit	111.0

while the continuous losses also wiped out the equity (capital and reserves) :

	million SoSh
end 1979 negative	2.4
end 1980 negative	34.0
end 1981 negative	74.0
end 1982 negative	137.0

These figures clearly show that the financial position is very unhealthy, and this situation will not improve without drastic measures.

It has to be observed however that the balances do not give a correct picture of the real capital position.

On the one side the replacement value of the fixed assets will be considerably higher than the net book value, on the other hand there is an extensive obsolete stock of spareparts and other materials, which mainly has to be written off.

A revaluation of some assets should be taken into consideration.

TABLE 2.7.1

Balance Sheets as at December 31 (SoSh '000)

Year	1979	1980	1981	1982
Debtors	18 170	24 061	22 920	6 829
Stock finished goods	436	940	782	479
Spares and stores	54 904	50 108	53 161	41 788
Bank	826	842	- 162	19
Cash	1 275	583	1 423	686
	75 611	76 534	78 124	36 143
Ordinary creditors	4 086	- 4 771	3 054	8 878
Bank overdraft	76 284	104 583	134 456	138 010
	80 370	99 812	137 510	146 888
Working capital	- 4 759	-23 278	-59 386	-110 745
Fixed assets	139 540	131 396	130 374	122 707
Work in progress	1 891	1 974	1 974	1 974
Expenditure next crop year	13 725	11 079	11 235	13 374
	150 397	121 171	84 197	27 310
Capital	25 000	25 000	25 000	25 000
Reserves	- 755	-27 395	-58 762	- 98 661
Loss current year	-26 639	-31 368	-39 899	- 63 791
	- 2 394	-33 763	-73 661	-137 452
Depreciation fixed assets	66 409	68 160	75 174	77 549
Long term loans	77 445	77 682	73 891	73 891
Other liabilities	8 937	9 092	8 793	13 322
	150 397	121 171	84 197	27 310

2.7.2 Forecast for 1983

A detailed budget for 1983 has not been made. A clear guideline for the management of the departments and for the enterprise as a whole is missing.

Tuning of actual figures into budget figures for each department is not possible.

Heads of departments are apparently not interested in the financial control of their departments.

To ensure a direct involvement of the responsible officers, the following action should apply with immediate effect:

(a) Budgets should be prepared in close co-operation with the respective heads of departments and basic data agreed. These should be justified and shown in detail on budget forms.

(b) During the budget discussions, the actual figures of the current year are to be scrutinised and agreed upon and expected actual amounts for the year should be defined.

(c) Any changes to the original requirements are to be justified and clearly explained to the appropriate head of department.

According to the forecast for 1983 the estimated profit should be:

SoSh 6.4 million (estimated production : 16 926 t of sugar).

That the accounts for the year 1983 could be closed with as profit at the present ex-factory sugar price of total SoSh 9 000/ton is absolutely out of the question since the sugar production will actually be much lower than the 'break-even' production of about 15 000 t (actual production according to factory-figures during the periods :

7.7.1982 to 21.4.1983 : 5 843 t
4.8.1983 to 15.10.1983 : 1 421 t.

2.7.3 Bank Overdraft/Long Term Loans

In the absence of assistance from the Government to compensate for the continuing losses (other than by increasing the ex-factory price for sugar from time to time) the factory was faced to resort to bank overdrafts. In the period end 1979 to end of September 1983 the bank overdraft has risen from SoSh 76 million to SoSh 200 million excluding interest due.

The continuous increase in bank overdraft has placed tremendous burden on the already strained financial resources.

Since for the bank overdraft an interest rate of 12% per annum is charged, the interest for 1983 is estimated to amount to SoSh 22.5 million compared with SoSh 9.7 million in 1979.

After 1981 neither redemptions nor interest payments have taken place on the outstanding long term loans, amounting to SoSh 74 million.

2.7.4 Financial Department and Accounting System

The performance of the financial department is very weak, mainly caused by :

- too few competent personnel

- absence of any form of organisation and discipline
- regular breakdown of the book keeping machine
- bilingualism of the accounting system
- serious arrears in accounting (at the time of our visit - 9 months).

Moreover the accounts code is insufficiently detailed. Allocation of the expenditure occurs only per cost category and not per cost centre (such as cultivation, harvesting and cane transport, factory, general management). Making a summary of factory cost from the accounts is simply not possible.

The accounting system can therefore not be considered as 'tool of management' and has to be improved by the following measures :

(a) Composing a detailed accounts code.

(b) Monthly cost statements should be prepared and distributed within at least three weeks after the end of each month.

(c) These cost statements should include actual and budget unit costs based on outputs and production, if and when applicable.

(d) The (deputy) manager of the financial department should carefully scrutinise monthly cost figures in close co-operation with the respective heads of departments and all discrpancies and/or queries should be followed-up and adjusted without delay.

It is self-evident that the existing arrears in accounting have to be reduced quickly.

Two new book keeping machines are urgently needed.

The financial year is currently the same as the calendar year. Since the 2 crop seasons generally take place in the period mid-June to mid-April it has been noted that there appear deviations between data from the financial department on the one side and the agricultural department/factory on the other hand. This can be avoided if the financial year is adjusted to the crop seasons, this means from June 1 to May 31.

Fixed assets are depreciated on a straight-line basis of the historical purchase value. The yearly depreciation amounts are not deducted from the remaining book value per item, but are seperately booked on the credit side of the balance. However, a cumulative amount for depreciation per item can not be produced.

It has been observed that a yearly depreciation is allowed on some items which have already been written off. Measures have to be taken that in the future this will be avoided.

2.7.5 Staffing of Finance and Administration Department

It is reported that the senior staff of the financial department at the end of May 1983 consists of 31 persons. It can be observed that this number is on the high side, taking into account that for the budget section no persons have been included.

About 20 senior staff will be enough for an efficient and smooth running of the finance and administration department, provided that the following conditions are met:

- the employees must have sufficient professional capabilities for the function concerned;
- the duties and responsibilities of each employee have to be specified in a job description;
- the accurate execution of finance and accounts procedures has to be maintained;
- the financial manager ought to have organising ability and must entertain a good communication not only within the sections of his department but also with other departments of the enterprise.

The junior staff employees require a more intensive on-the-job training in order to acquire a better understanding and improve the performance of their duties. There is a considerable lack of inter-departmental communication resulting in low job interest.

As a matter of course, actions have to be taken short notice for improving the existing situation on these subjects.

2.7.6 Management Assistance

For the requirement of assistance from a qualified foreign company reference is made to Section 4.2.5.

The following key positions in the finance and administration department may have to be filled by expatriates if competent Somali staff are not available;

Financial manager
Stores manager
Budget/cost accountant

2.7.7 Cost Prices

(a) Period 1979 to 1982

Based on the actual figures for the period 1979 to 1982 the cost prices in SoSh/t of sugar can be summarised as shown in Table 2.7.2.

TABLE 2.7.2

Costs of Sugar Production (1979 to 1982)

	1979		1980		1981		1982	
	SoSh/t	%	SoSh/t	%	SoSh/t	%	SoSh/t	%
Operating cost	2 345	68	2 580	71	4 785	68	7 714	74
Interest	460	13	495	14	1 215	17	1 752	17
Depreciation	645	19	545	15	1 000	15	926	9
Average cost price	3 450	100	3 620	100	7 000	100	10 392	100

Actual production of sugar according to the financial department was as follows:

1979 : 21 406 t
1980 : 21 821 t
1981 : 11 826 t
1982 : 11 878 t

The evaluation of ex-factory sugar prices has been as follows:

Period	SoSh/t
up to November 1980	2 100
up to October 1982	3 400
thereafter	6 018 (+ producers premium of SoSh 3 000/t)

The main conclusions which can be drawn from the above are:

- the contribution of the operating cost to the cost price amounts to about 70 to 75%; interest and depreciation amount to about 25 to 30%;
- during the period 1979 to 1982 the cost price has been tripled due to higher cost and lower production; the operating costs per tonne of sugar only were in these years even higher than the (average) ex-factory sugar price.

(b) Period 1983 to 1991

Reference is made to Annex VII in which a fully detailed specification is given of the production cost of sugar, after completion of the rehabilitation of Jowhar, in the year that the optimum production will be achieved (1991/92). Production cost of sugar for the period 1984/85 to 1991/92 is elaborated in Annex VII.

The total production cost of sugar and the cost per tonne of sugar, both excluding depreciation and cost of finance, are as shown in Table 2.7.3.

TABLE 2.7.3

Projected Costs of Sugar Production (1984 to 1992)

Campaign	Total cost in ('000 SoSh *)	Production (t sugar)	Cost per t sugar in SoSh
1984/85	90 425	9 060	9 981
1985/86	120 466	14 400	8 365
1986/87	137 498	21 120	6 510
1987/88	148 042	28 660	5 165
1988/89	151 559	36 500	4 152
1989/90	153 780	41 920	3 668
1990/91	154 608	44 450	3 478
1991/92	155 408	46 950	3 310
1983/84			estimate 15 000

Note : * Cost of management unit not included.

During the period 1984 to 1992 a decrease of the cost per tonne of sugar of 67%, due to an increase of the production of sugar which is expected to be, in 1991/92, more than 5 times the production for 1984/85.

It has to be noted that the following basic assumptions háve been used for this exercise :

- Cost based on constant mid-1983 prices.
- Implementaton of the proposed increase of salaries/wages during the period 1984 to 1986.
- Gradually raising of the efficiency.
- Production figures presented in Table 5.1.2.

Table 2.7.4 shows the amounts which will become available for depreciation and cost of finance per tonne of sugar during the period 1984 to 1992, assuming a 'break-even' position.

TABLE 2.7.4

Amounts Available for Depreciation and Cost of Finance per Tonne Sugar

Campaign	Cost per t sugar in SoSh * (including 10% physical contingencies)	Amounts available for depreciation and cost of finance per t sugar ex-factory price SoSh 6 018	ex-factory price SoSh 9 018
1984/85	10 979	-	-
1985/86	9 202	-	-
1986/87	7 161	-	1 857
1987/88	5 682	336	3 336
1988/89	4 567	1 451	4 451
1989/90	4 035	1 983	4 983
1990/91	3 826	2 192	5 192
1991/92	3 641	2 377	5 377

Note : * Cost of management unit not included

From this table it is clear that at least for the years up to 1987/88 it is worthwhile to consider an increase of the present ex-factory price of SoSh 9 018 per tonne of sugar.

2.7.8 Ordering Procedure

It has been established that in the long sequence of events in the ordering procedure and, particularly in the procedure of ordering abroad, considerable delays occur (apart from lack of money/foreign currency).

This is mainly attributable to the fact that the subsequent steps in ordering are taken at many (geographical) places and by different people, while the essential information from all these places/people do not reach the central point (purchase department) in time.

In view of the great importance of having a smoothly running ordering procedure, it is recommended to analyse the existing system expeditiously starting from the moment that it has been decided that an article should be (re)ordered until the moment that the (re)ordered article arrives at the estate and is available for use.

The aim of this analysis has to be to investigate the possibility of making the ordering procedure more simple and easier to control.

The possibilities of mechanisation in data handling and control have also to be examined.

CHAPTER 3

PROPOSED REHABILITATION MEASURES

CHAPTER 3

PROPOSED REHABILITATION MEASURES

3.1 Alternative Strategies Considered

3.1.1 Three Major Investment Strategies

During the execution of the study three major investment strategies have been investigated :

- The first phase of the work centered on a HEAVY INVESTMENT STRATEGY. This would aim at sugar production at the factory's full capacity level (close to 50 000 t/year) combined with a high degree of certainty with regard to the annual level of cane output assured mainly by heavy investment in the creation of additional inter-seasonal water storage capacities.

- The MODERATE INVESTMENT STRATEGY was the upper limit of the range of analyses covered more thoroughly during the second work phase. It also aims at a sugar production close to the factory's full capacity, but there would be a higher variance of the annual cane production as a function of the varying degree of water availability.

- The MINIMUM INVESTMENT STRATEGY was defined as the lower limit of the range of investigation in the second phase. This strategy aims at the lowest possible production level which would still assure a medium term positive financial cash flow for the enterprise. This point is reached at a production level of around 18 000 tonnes of sugar annually.

A summary of the major parameters of the three strategies is given in Table 3.1.1. Figures 3.1.1 and 3.5.1 show the cane areas for the minimum and moderate investment strategies, respectively.

During the first phase of our work - mainly the field mission period - the team had aimed its work at the choice of good technical solutions. The resulting project turned out to be unacceptable for the following reasons :

Its costs amounting to roughly DM 140 million in 1983 prices are prohibitively high. The most influential single cost vector is water storage. No previous studies - other than at identification level - have been made for Duduble reservoir. Furthermore the cost of rehabilitation of the abandoned areas, those for the construction of the necessary drainage system and finally those for the necessary technical assistance had been considerably underestimated and/or omitted in previous studies at pre-feasibility level.

Furthermore, this strategy's economic viability is extremely marginal (IRR 1.02%). On the other hand the degree of its technical managerial efficiency is extrememely high (yields of 101 tonnes of cane/ha). The project in this form had to be judged as being extremely risky.

It was agreed therefore that, in a second working phase, possible investment strategies at a lower cost level would be investigated more deeply.

Table Nr 3.1.1

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

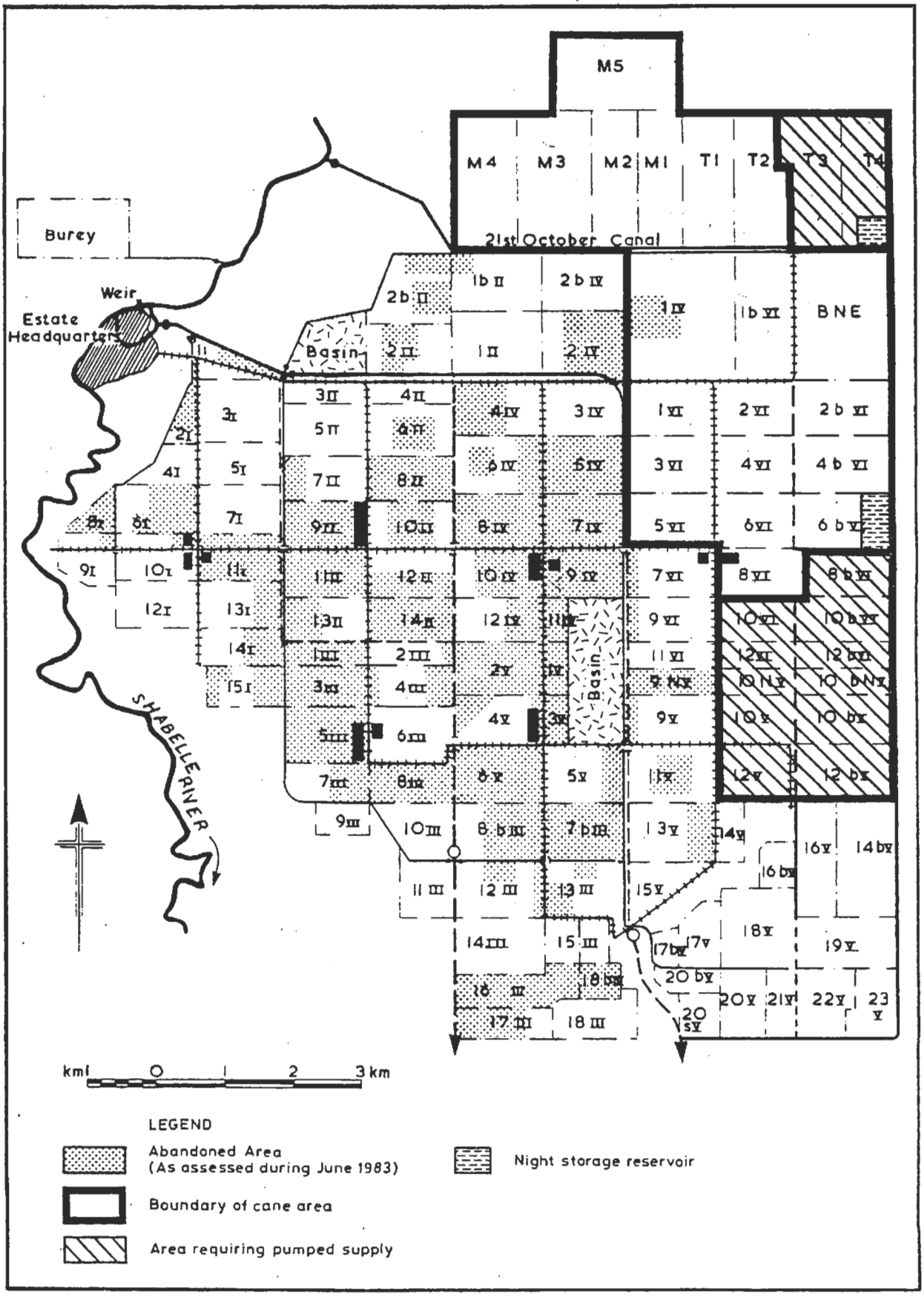
Summary of Strategies Investigated
(Sugar Project only)

Serial Nr	Parameter	Unit	Heavy investment strategy (A)	Moderate investment strategy (B)	Minimum investment strategy (C)
1	Net (harvestable) area under cane	ha	5 300 (5 148) (1)	5 300 (5 148)	2 750 (2 574)
2	Expected yield	t/ha	101	91	76
3	Recovery rate (sugar/cane)	%	10.4	10.0	9.5
4	Sugar production	t/year	48 740	46 960	18 584
5	Rehabilitation measures in the Estate		- offstream storage at Duduble - night storage - deep drainage system - field drains - rehabilitate irrigation distribution system - new field layout	- night storage - storage for plant cane - shallow drainage for East and Middle drains - deep drainage for West drain only - rehabilitate irrigation distribution system - new field layout	- night storage - storage for plant cane - shallow drainage - rehabllitate irrigation distribution system
6	Average cost (irrigation, drainage)	DM/ha	16 400	6 200	3 450
7	Land use, location of cane		Areas closest to factory	See Figure 3.5.1	See Figure 3.1.1
8	Financial cost estimate (6 years)	'000 DM (base line 1983)	139 557	85 982	43 596
	- factory, transport, mechanical (capital expenditure)		19 995 (under-estimated)	31 649	16 067
	- irrigation, drainage (capital expenditure)		86 912	36 300	9 488
	- management unit (all costs)		32 650	18 033	18 041
9	IRR (Economic)	%	1.02	17.6	negative
10	Maximum annual cash flow (Econ)	'000 DM/ year	2 030	16 574	4 061

Note: 1. Out of which 4 640 ha only will be harvested in years of full water supply.

Figure 3.1.1

Jowhar Sugar Estate
Minimum Investment Strategy
Cane Area



3.1.2 Investigation of Strategies between Minimum and Moderate Investment

Three variables have been isolated for their decisive influence on the future economic and financial viability of the Jowhar Rehabilitation Project. The first and overriding factor is the load factor of the factory's capacity of 2 400 t/d cane or roughly 50 000 t/year of sugar. In the first place this variable is determined by the annual cane production. As the fixed cost of SNAI - mainly the capital assets and permanent staff - are extremely high, production close to capacity is a must for a positive economic result. SNAI's economic break-even point is reached only at a production close to full capacity. Under the actual Somali market conditions however - where producer prices for sugar (SoSh 10 000/t) are roughly 160% of long term import substitution prices - SNAI's financial break-even point is reached at a production level of roughly 25 000 tonnes per annum.

A high cane production level can be regained only at the cost of heavy investment in the improvement and rehabilitation of the irrigation and drainage system. Water supply is a limiting factor due to the low flow of the river in the dry season. Under these water supply conditions a yield potential of 91 t/ha has been calculated for an area of 5 300 ha when investment in water storage is limited to plant cane only. This will satisfy the factory's cane demand.

With the existing low standard of the irrigation and drainage system this yield potential cannot be reached. SNAI comprises roughly 8 200 ha net irrigable area. This area can be rehabilitated to the required yield potential at hectare-costs varying mainly with the degree of deterioration of the irrigation and drainage system and the existing field layout. Rehabilitation costs would be relatively modest in the eastern part of the Estate whereas in the western part close to the factory costly measures (field drainage plus deep open drains) are required for rehabilitation.

The costs of the rehabilitation and improvement of the potential cane area increase in three clearly distinguished steps.

- Areas which require shallow drainage only. These are mainly concentrated in the northern and eastern sectors of the Estate and total some 3 600 ha. The average cost of rehabilitation of these areas is DM 3 000/h, excluding the cost of works for non-cane areas. To this figure must be added DM 2 350/ha for the inclusion of the new field layout.

- Areas which require deep drainage but with only limited installation of field drains to maintain high cane yields. There are some 3 400 ha in this category. The cost of rehabilitation for these areas is about DM 7 500/ha, including the new field layout on cane areas and primary works for non-cane areas. The moderate investment strategy proposed comprises 3 300 ha requiring shallow drainage (the remainder being outside the northern and eastern block) plus the best 2 000 ha in the deep drainage category.

- Areas which can only be reclaimed by installing field drains, amounting to some 1 000 ha.

Future cane areas have thus been selected in such a way that the necessary investment in irrigation and drainage is minimised. The higher transport costs of those areas which are further from the factory, will not offset lower rehabilitation costs.

The third decisive variable - after annual cane production and average cost of rehabilitation - is the cost of management. In the short run the necessary degree of management efficiency can be reached only with the help of a large expatriate management assistance. The national labour market in Somalia cannot supply - even at highly competitive salaries - the necessary staff. Unfortunately the size of the management unit will vary only slightly with different production levels. The project will not be able to support under economic conditions a huge expatriate management unit in the long run. Therefore its presence must be kept to a minimum. Training of local staff has to be a task equivalent in weight to the technical performance.

Other cost vectors show little variation of capital expenditure with alteration of production capacity. The factory has to be run at a minimum capacity of 1 600 t/d cane being set by the existing milling tandem. Consequently cost reductions with decreasing output are modest. They are limited mainly to the installation of reduced capacities of boilers coming up for replacement in year 9.

The existing railway system will remain the backbone of the transport system independent of the cane production level. Within our range of investigation, capital costs for the transport system will show a slight depression only with decreasing output level.

These factors were considered in detail in the Second Interim Report (November 1983) and its Addendum (January 1984) where the relationships between the investment cost, cane area, cane yield and water availability were examined, and the economics of various sizes of development were investigated.

3.1.3 Phase I Development, 3 500 ha

After discussions with the Client (Ministry of National Planning, MNP), the funding agency (Kreditanstalt fur Wiederaufbau, KfW), and representatives of the Estate Management, it was agreed that a phased development would be appropriate. This would reduce the initial level of capital investment, and allow for easier management of the smaller cane area involved.

An additional study was commissioned to examine the proposed Phase I development of 3 500 ha. This was presented as the Study for Phase I Development (3 500 ha) in March 1984, and included a detailed assessment of the economic and technical viability of this first phase.

3.2 Proposals for Priority Measures (Crash Programme)

The main objective of the crash programme is to guarantee the continuation of the Estate's operation. We have described earlier that due to the omission of preventive overhaul and replacement investments, SNAI has reached a situation where a major break-down interrupting the production for several months can be expected any day. In spite of a very important investment programme of DM 10.7 million that has been projected for the fiscal year 1983 (see description below) further priority measures are needed to safeguard the operational continuity of the enterprise.

In fact a major part of the priority measures is already well under way: the Ministry of Industry has placed, for execution in 1983/84, investment orders to a total value of almost SoSh 65 million. This programme is summarised in Table 3.2.1. Two major sources of finance contribute to this budget. The US Commodity Import Programme contributes almost SoSh 48 million. Another SoSh 27 million, covering an order to an Italian joint venture, is being financed out of the national investment budget.

SOMALI DEMOCRATIC REPUBLIC
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Firm Commands Placed by Ministry of Industry for Overhaul of Plant

Serial Nr	Item	Supplier	Reference (pro forma or contract)	Value (CIF) US$	DM	SoSh
A	US-CIP			2 494 421.92	5 612 449.32	37 982 562.58
1	Spares for Deutz D 7206	Ergen SpA	6050/29.03.83	26 600.00	59 850.00	405 038.20
2	Spares for Deutz D 7206	Ergen SpA	6051.29.03.83	130 500.00	293 625.00	1 987 123.50
3	Spares for Deutz D 7206	Ergen SpA	6052/29.03.83	29 951.00	67 389.75	456 063.88
4	Spares for Deutz locomotives	Ergen SpA	6053/29.03.83	3 560.00	8 010.00	54 208.12
5	Engines (6), Deutz locomotives	Ergen SpA	1354/83; 28.03.83	27 976.19	62 946.43	425 993.45
6	Tyres (18.4-15-30; 23.1-18-26; 30-30)	Conti Gummi	083/WG/81; 20.12.81	44 938.16	101 110.86	684 273.36
7	Wire for windings (3.65 t)	Gateway, Washington	PN 1956/11.05.83	24 932.30	56 097.68	379 644.13
8	Caterpillar spares	Gateway, Washington	PN 1880/05.83	335 975.00	755 943.75	5 115 891.33
9	Spares for loaders	Cameco, Louisiana	Q 031300383/22.03.83	60 165.53	135 372.44	916 140.53
10	Spares for loaders	Cameco, Louisiana	Q 031300483/22.03.83	112 565.28	253 271.88	1 714 031.52
11	Spares for loaders	Cameco Louisiana	Q 031300583/22.03.83	97 517.46	219 414.29	1 484 898.36
12	Spares for mill and unigrator	Cameco, Louisiana	6-13212-83/9.03.83	899 890.00	2 024 752.50	13 702 625.03
13	10 km of rail	Rail Construction, Pakistan	Contract dated 16.06.83	699 851.00	1 574 664.75	10 656 631.18
B	CENTRAL BANK			1 755 000.00	3 948 750.00	26 723 385.00
14	Factory overhaul	TEAM Sr. L. Terni (4 months until shipping)	Contract dated 10.07.83			
14.1	Switch panels, instrumentation			FOB 740 000.00	1 665 000.00	11 267 980.00
14.2	Essicatore bagasso alimentazione caldaia			FOB 185 000.00	416 250.00	2 816 995.00
14.3	Overhaul of Pensotti boiler			FOB 620 000.00	1 395 000.00	9 440 740.00
14.4	Spares, CIF, assembly			210 000.00	472 500.00	3 197 670.00
	Total (A + B)			4 249 421.92	9 561 199.32	64 705 947.58

The 1983/84investment programme covers two major sectors: first a major overhaul programme for part of the rolling stock namely locomotives, Deutz tractors, the railway system and heavy earth moving machinery. As far as the factory is concerned the package provides for improvement of the milling tandem together with the installation of a unigrator. The Italian joint venture has been charged, furthermore, with the overhaul of the Pensotti boiler, the installation of a bagasse dryer and lastly with the replacement of the instrumentation system, including wiring and switch pannels.

Finally SNAI put out a limited tender asking for an expatriate factory manager. Offers were received by the end of July. The expert took up his duties in autumn 1983.

The above outlined investment programme for 1983/84 cannot alone ensure the achievement of the above-mentioned target. On the one hand the programme is concentrated on the factory and the rolling stock. Agriculture and civil engineering have not been covered. But even within the programme for the factory, such risk bearing items as electricity generation and pumping systems are not yet included. Finally no capacities have been provided for the necessary detailed planning of the rehabilitation programme. The existing SNAI management can certainly not take on this additional work load.

A complementary crash programme for 1984/85 is therefore proposed, and this is summarised in Table 3.2.2.

In the field of agriculture the provision of nurseries in order to gain time in the multiplication of plant material should be started as soon as possible.

In the field of transport and mechanisation the investment programme for 1983 is not sufficient to assure the overhaul of all the existing machinery. In particular, the number of man-months allowed for mechanics provided by the suppliers of heavy equipment is insufficient. The same applies to the factory itself. It is estimated that the additional need for mechanics during the two years will be another 14 man-months.

After the overhaul of the heavy machinery for the maintenance of the irrigation system the first measures for desilting and cleaning of canals can be started in 1984.

The crash programme also includes for the provision of 2 six-month inputs of expatriate technical assistance, and the 14 man-months of short term inputs by experts for the overhaul of machinery and plant. Details are given in Table 3.2.2.

3.3 Solution of the Man-Power Problem

3.3.1 Introduction

The assessment of the present economic situation in the rural area which SNAI uses to recruit its casual labour, and the estimations concerning preferences of the population, have led us to the conclusion that the solution of SNAI's man-power problems will be rather difficult. Convenient income from agricultural

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CRASH PROGRAMME
PROJECT COST, SUMMARY
(1000 DM 1983)

Ser. Nr		Unit	Unit price	1984/85	1985/86	TOTAL	Foreign exchange component %	DM	1 DM = 5.04 SoSh	SoSh 1000
1	INVESTMENT			3240	225	3465	a 93	3112		21050
1.1	Irrigation and Drainage			200		200	75	190		1288
1.2	Cane Production			80	25	105	90	95		534
1.3	Transport+Mechanization			1663	200	1863	95	1770		11251
1.3.01	iron products as per proforma			375		375	95	356		2244
1.3.02	tyres and tubes as per proforma			11		11	95	10		65
1.3.03	motor cycle spares			100		100	95	101		630
1.3.04	gear box for Deutz engines			50		50	95	48		300
1.3.05	bearing various measurements, estimates			56		56	95	53		336
1.3.06	batteries various measurements			38		38	95	37		119
1.3.07	electrodes various measurements, estimates			20		21	95	37		119
1.3.08	provision for bolts and nuts, general stores			52		52	95	57		330
1.3.09	spares for rolling stock			375	125	500	95	475		3000
1.3.10	F.O.T. workshop equipment			325	75	400	95	385		2415
1.3.11	vehicles			350		350	95	333		2114
1.4	Factory			1057	0	1057	95	941		6344
1.4.01	galvanised sheets - Zingati rough estimates			11		11	95	10		66
1.4.02	process chemicals			260		260	95	247		1570
1.4.03	brass tubes for vacuum pans			80		80	95	76		481
1.4.04	cane milling plant - belt conveyer			65		65	95	62		393
1.4.05	reconditioning distillery			115		115	95	109		695
1.4.06	steamboiler plant									
	- boiler instruments/control			227		227	95	125		1370
	- raw water treatment plant			344		344	95	205		1406
	- new feedwater pump + spares			33		33	95	27		201
1.5	Administration			50	0	50	90	45		302
1.5.01	office equipment			50		50	90	45		302
1.6	Housing			210	0	210	75	158		1269
2	PERSONNEL			539	0	539	a 99	519		3203
2.1	Short Term			309	0	309	100	309		1940
2.1.01	mill turbine expert	MM	22	66		66	100			398
2.1.02	boiler expert	MM	22	66		66	100			398
2.1.03	Deutz expert	MM	22	66		66	100			398
2.1.04	turbo-generator expert	MM	22	44		44	100			262
2.1.05	electrical expert	MM	22	66		66	100			398
2.2	Long Term			222	0	222	95	211		1343
2.2.01	Manager irrigation/drainage	MM	19.33	116		116	95	110		701
2.2.02	Manager fieldmechanisation	MM	17.71	106		106	95	101		642
3	RECURRENT			16	0	16	90	14		97
3.1	vehicles	1000 km	0.80	16		16	90	14		97
4	SUB-TOTAL			3906	225	4031		3852		24350
5	PHYSICAL CONTINGENCIES	10 %		381	23	403				2435
6	INFLATION	7% p.a.		533	42	575				3470
7	GRAND TOTAL	DM		4720	289	5009				30255

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production (both cattle-breeding and crop-growing), a comparatively low density of population per km^2, and a low esteem for working as hired hands in general, results in a significantly higher demand for labour than is actually available.

Furthermore, the jobs with SNAI are poorly paid if compared with the rates for rural labour contracts with private farmers, who on top of the payments provide food and drinks; this is not the case when working for SNAI. The population of the area no longer seems to have a significant interest in jobs that provide cash income. Regardless of SNAI's possibilities of using political influence in order to assure at least a minimum of availability of casual workers, it will have to develop new ways of attracting the work-force to the plantation. A mere increase in payments is not likely to solve the problem.

It is believed that casual labour in the area at present is provided by a rather small group of farmers and their families whose farms, even under favourable marketing conditions for agricultural products, are too small to cover all their needs. In addition to that, traditional links may exist between less well-off families and more influential employers, who may be both official institutions (this includes SNAI) and private farmers. It may well be that casual labour today is also provided on the basis of such traditional obligations by families who, from an economic point of view, no longer have a real need to earn supplementary cash in addition to the revenue from their family enterprise.

The following propositions are made as a proposal of a pilot project for 're-organisation of the casual labour recruitment' within a major project frame aiming at the rehabilitation of SNAI Jowhar Estate in general. The actual identification of appropriate measures must be the separate task of a specialist. In view of the difficulties that can be expected to arise when trying to increase the readiness to work for SNAI, to increase the man/day productivity and the general attractiveness of the jobs that SNAI provides for unqualified rural labourers, the said pilot project should be initiated on a rather reduced scale, organised step by step and have constant socio-econmic monitoring.

3.3.2 General Objectives

(a) Increasing the Man/Day Productivity

According to the information provided by SNAI (Agricultural Department) in June 1983, the overall need for rural casual labourers amounts to approximately 3 000 jobs:

- approximately 1 500 persons needed constantly, throughout the entire year, for activities such as weeding, planting and irrigation;
- approximately 1 500 persons during the campaigns, of which approximately 750 are for cutting and 750 for loading; the campaign lasts about 240 days.

These figures are not realistic; neither justified by the actual production nor by the labour potentials of the area that we can expect to be attracted by SNAI jobs. Firstly, as recently stated by the Agricultural Department, a good cutter is supposed to make 3 to 4 contracts a day. If one contract represents 1.0 to 1.2 tons of cane (a figure stipulated by SNAI), such numbers of labourers would produce (1.0 tons/contract, 3.5 contracts/day, 240 days) 630 000 tons of cane. The highest production ever achieved between 1963/64 and 1982/83 was 463 000 tons (1970/71).

Secondly, using the SNAI casual labour recruitment programme of 30th March 1983 as a basis, the total population of the rural area from which casual labour is recruited is believed to be 16 500 inhabitants. (The urban population of Jowhar is supposed to play a minor or negligible role in SNAI's actual casual employment.) A demand for 3 000 persons, half of them working full time, the rest being at the disposal of SNAI 240 days out of the year, would mean the expectation that 18% of the population in the area (babies and aged people included) would work for SNAI. It is apparent that the readiness to work as a hired hand at present does not exceed 1.0 persons per household, rather that it is 0.7 person/household. In that case the total labour force potential of the area would be 2 660 persons (out of 3 800 households estimated). That group would have to satisfy the total demand for casual labour of the area, not only SNAI's.

Although the group of poorer farmers which are forced to earn supplementary money are not yet identified from a scoio-economic point of view, (i.e., their number and actual dependency on further income as well as their obligations towards other employers), theoretically SNAI should be able to count on some 1 000 to 1 300 persons, about half of which are women and growing children. Despite the fact that these figures are only estimates, the conclusion is evident: in the near future SNAI will have to organise its production with very much less man-power than stipulated.

A prime objective of a pilot project concerned with the improvement of casual labour organisations must therefore be to achieve a significantly higher man/day productivity. The actual man/day productivity is estimated to be 1.2 tonnes (8 h/d, 30 tonnes cane/ha density). This ratio could be improved to 3.0 tonnes/day (8 h/d at 90 tonnes cane/ha density) after rehabilitation of the Estate.

If future production aims at 5 300 ha under cultivation with an annual production of 400 000 to 450 000 tonnes of cane, such projections would result in a demand for approximately 600 cutters and 600 loaders. If, as up to now, the number of labourers needed for weeding, irrigation and planting stays approximately the same as that of the campaign demand, the future need for unqualified labour (if operating the entire plantation with manual cutting and loading) would be around 2 500 persons.

As stated above, it seems quite unrealistic to expect this demand to be met by the population of the area around Jowhar (10 000 km^2, approximately 16 500 inhabitants). To employ all 1 200 persons assumed to be available would need major activity on the part of SNAI in order to regain its attractiveness as an employer and, with that condition fulfilled, this would permit the operation of about half of the area envisaged (2 500 to 2 750 ha) with manual harvesting.

Therefore further options definitely must be considered:

- either attracting poor farmers from more distant areas and applying the improved settlement measures (described below) to them as well;

- or, restricting the employment figures of unqualified labour to approximately 1 200 persons, partly mechanising the production. As an alternative one could also consider fully mechanised work on parts of the area under cultivation.

In general improving the density of cane per ha and improving the productivity per man and day are prime objectives for the reduction of SNAI's demand for labour force.

Furthermore, unless labour force is attracted from areas other than those at present, the objective of cultivating 5 300 ha and producing 450 000 tonnes of cane annually cannot be achieved if the labour recruitment methods as used today are continued. Mechanisation to some degree will be indispensable under such conditions.

(b) Increased Attractiveness of SNAI Jobs

The model of casual labour recruitment as practised up to now (short term employment of certain contingents from different villages in the area, transported back and forth to areas under cultivation) cannot be expected to be successfully operated in the future. Apart from increased payments per contract, SNAI employment must regain its previous high attractiveness. The present form of organising the campaigns with manual labour is unlikely to assure even the regular presence of 1 000 to 1 200 persons assumed to be available or to achieve a man/day productivity of 3.0 tons as an average.

Therefore it is proposed that a package of possible measures is adopted which all together (or in essential parts) could act as catalysts in achieving regular availability of casual labourers and the projected man/day productivity. These proposals are based on some assumptions, which are:

- there is no rural proletariat in the Jowhar area; there is no landless population entirely dependent on employment in the regional agriculture;
- there is a certain, still unidentified group of farmers depending on supplement cash income due to insufficient size of their family property;
- a high demand for rural labour force provides this group with sufficient possibilities to earn what they need;
- this group has a low social standard and is likely to be interested in improving its general living and working conditions.

To attract labour force to the Estate, a model is proposed of 're-thinking the Estate settlement'. In contrast to the older settlements (Kaxarey, Shamento, Iga Dadab, Buulo Nave and Gumarey) which are small villages with small farms generally too small in size to assure a family's living, a new settlement should consist of a larger, connected area available for a larger number of families. Such an area should be placed at a convenient distance to the areas envisaged for manual operation. (For area proposed see Figure 3.3.1).

For new settlers SNAI should offer (under the condition that one person per household works regularly on the plantation):

- provision of (irrigated) land for agricultural exploitation and the housing needed by the family;
- provision of help in soil preparation with SNAI equipment during those periods of the year when equipment is not fully needed in the cane production. This service (mostly ploughing) should be provided at reduced costs as compared with the official market price for one hours tractor rent;

- providing technical assistance in agriculture in order to improve the farmers' production in their traditional cultures, including sales of fertilisers, herbicides, etc. at cost;

- providing increased payments per contract for those working on the plantation;

- further benefits granted to Estate farmers should be provided depending on the degree of activeness (time present) on Estate fields. These could consist of:

  (a) free food and drinks when working on the plantation;

  (b) prophylactic medical treatment;

  (c) allowances to buy sugar (or other food items) in Estate shops at official prices (or at cost);

- good road connection between such settlement and Jowhar;

- help in commercialising the Estate farmers' surplus production (transport, storage, etc.);

- the right to exploit abandoned Estate land both as gazing land and for firewood.

Which of these proposals are practicable should be subject to further social and economic analysis.

The relationship between SNAI and its new settlers must be of high reliability. Services offered should be rendered promptly and according to a publicised schedule, whereas - on the other hand - services connected with active work on the plantation should be strictly related to working performance, and persistent absenteeism should lead to the replacement of that particular family within the settlement scheme.

The settlement programme should be based on leasing the land and housing and the conditions under which such a leasing contract could be terminated should be made clear and eviction enforced if necessary.

As far as the person who works for SNAI is concerned, one should eventually think of abandoning the principle of casual work; it would be preferable always to have the same persons working for SNAI and these persons always to have, if possible, the same job (on rotated fields), working in a team that regularly works together and lives in the neighbourhood of new settlements, enabling them to build up a certain professional standard and specialisation (necessary for the desired man/day productivity) and social attachment to his working team.

Persons working for SNAI should, after a given period, obtain fixed employment with the company (just as was the case previously with unqualified labourers in the sugar factory).

The rest of the family should be able to cultivate their respective fields conveniently (with the said help from the company).

3.3.3 Practical Proposals

(a) Before a definite design of a pilot project 're-organisation of the SNAI man-power' is undertaken, a project pre-phase should be planned. Such a pre-phase should have the following objectives:

- economic analaysis of the different aspects of a new Estate settlement programme;

- identification, via an information compaign in the area concerned, of potential rural labourers willing to settle according to the programme proposed.

  This should include:

  (i) existing Estate settlements;

  (ii) villages that had the highest frequency of sending casuals in the past;

  (iii) other villages in the SNAI casual labour area;

  (iv) poor farmers from other areas, eventually refugee camps, etc.;

- identification of an appropriate area for such a settlement in line with all other aspects concerning the rehabilitation of the Estate;

- determination of the size of an eventual pilot project (both in terms of the size of the cane field to be operated manually and in land plus the number of families to settle).

Such a project pre-phase could be executed in a period of 4 to 6 months, in the hands of an experienced SNAI staff member and a specialist in socio-economy and settlement programmes.

On the basis of all data collected and information obtained during this period, it should be possible:

- to decide whether the proposed settlement program has realistic chances of succeeding;

- if the program is unlikely to succeed, to propose alternative solutions;

- to draft the final project design for 're-organisation of the SNAI man-power'.

(b) The actual pilot project should last at least 3 years.

Year (1):

The farmers selected for a first settlement programme should work one full campaign at new payments per contract. They should preferably be recruited from nearby villages. If this is not possible they should be provided with

provisional lodging as well as food and drinks on the fields. This campaign should be used to establish working teams, identify experienced and respected team-leaders, study the man/day productivity more closely, etc.

At the same time the construction of houses and roads in and to the settlement area should be planned and executed, as well as the rehabilitation of the irrigation system where necessary. The planning and organisational preparation of all details of the settlement programme should be achieved.

From all labourers having performed well during the experimental campaign during year (1) of the pilot project those to receive definite settlement and leasing contracts would be chosen. Between the campaigns of year (1) and year (2) this group would be established in the settlement.

Year (2):

In the second year of the pilot project the programme would start fully, including soil preparation, technical assistance and commercialisation of agricultural products out of the settlement area.

The evaluation of year (2) should permit the analyses of problems met and the successes achieved. If the pilot project was successful in most of its aspects by the end of year (2) the programme could be enlarged and a second settlement programme could be initiated.

Year (3):

Unless being successful to the most important extent, year (3) should be used to improve organisation and administration of the running project and to take up contracts with further settlers.

It would largely depend on how the rehabilitation of the Jowhar Estate is finally organised, but from the view point of 'rural man-power' a settlement programme would at first hardly be able to include a group much larger than 200 to 250 persons (for employment, families not included). It is expected that such a programme would be most attractive for young male farmers desiring to become independent and to get married, and for young, recently married couples with insufficient funds and land. Poor, larger families (including several generations) will be less likely to change their homes and way of living.

Nevertheless 200 to 250 persons to be recruited as workers for SNAI will mean a total population of at least 650 to 750 persons (in 200 to 250 households). In terms of land, in order to assure a decent living from farming, it would need about 3 ha per household, thus a total area of experimental settlement of 600 to 750 ha. To cultivate and irrigate this area, and to organise its population and production efficiently, will be a major task.

On the other hand, if it is assumed that these 250 persons produce 2.0 tonnes of cane per day (half of them working as cutters, the other half as loaders) they would produce only approximately 60 000 tonnes of cane in the first year. With an initial yield of 50 t/ha of cane density, this would correspond to an area of 1 000 to 1 200 ha.

Inevitably the rehabilitation programme must include further appropriate measures to achieve the production objectives. These could include the rehabilitation and repair of existing machinery and the levelling of the area necessary in order to start mechanised production.

Further harvesting could use casual labour recruited in the traditional way. But those labourers coming from the area from which future settlers have been selected would have little inclination to perform well, even if payments per contract were increased, the fact that a group of (even poorer) farmers were going to receive further services and grants would cause resentment.

3.4 Measures to Improve Water Availability

3.4.1 Introduction

The Terms of Reference for this study required an investigation into possible measures to improve dry season water availability to the Estate. In particular prefeasibility studies of an offstream storage reservoir at Duduble, and the alternative of increased storage in the existing Jowhar reservoir, were required.

During the course of this study, and after submission of the Interim Report (August 1983), it was decided that the provision of expensive water storage works could not be justified and indeed was not essential to the succcessful operation of the Estate following rehabilitation. Nevertheless, the two major options for water storage have been examined and the conclusions are described below. In addition the potential for short term, small scale storage on the Estate has been examined. Such storage is considered essential in order to ensure the availability of irrigation water for plant cane in the dry season. The proposals are outlined in the following section (for details see Annex I, Chapter 3).

3.4.2 Storage Reservoirs for Plant Cane

The new cane planted each year in January and February must be irrigated to ensure its survival. River flows are at their lowest during this period and, in extreme years, the river dries up completely. It is therefore necessary to ensure that there is an alternative source of irrigation water for this plant cane.

It is proposed that the two existing storage basins, plus an additional reservoir at the head of the supply system, are used for this purpose. Details of these basins are summarised below:

Basin Nr	Served from	Plan area (ha)	Gross volume (Mm^3)
1 (existing)	Luigi canal	70	1.0
2 (existing)	Canal 53	160	2.7
3 (new)	21st October canal	35	0.7

Basin Nr 1 will also be used for night storage (see Section 3.5) but most of its volume could be reserved for plant cane. A total gross volume of some 4.2 Mm^3 is thus available for plant cane storage.

The reservoirs would be filled during the der season flood (September to November), at a time when irrigation requirements are low. At this time river water salinity levels are at their lowest and sediment load is relatively low. The reservoir would then be kept 'topped up' until such time as there was no water available for this. In the event of a prolonged severe drought in January, February and March, the stored water would then be pumped into the canal system and distributed to the plant cane areas. Any water unused by the start of the gu season flood would be released from the reservoirs so as to reduce any problems of seepage and salinity build-up.

In order to provide irrigation for the dry season plant cane, during three months of drought, it has been estimated (Table 3.6.3 in Chapter 3) that a total volume of 1.4 Mm^3 would be required. This volume includes for normal distribution and application losses. However additional allowance must be included for the much larger distribution losses that will inevitably occur when small quantities of water are passed long distances through the canal system. Losses will also take place in the reservoirs as a result of seepage and evaporation. The total seepage and evaporation loss over a three month period has been estimated at about 1.8 Mm^3, leaving some 2.4 Mm^3 which can be distributed to the plant cane areas. This should be adequate.

The basins would be evacuated in sequence (rather than simultaneously), so as to reduce seepage and evaporation losses, starting with Nr 3 and finishing with Nr 2. The reasoning behind this sequence is that basin Nr 2 is the least well placed reservoir for serving the cane area, whereas basin Nr 3 and, to a lesser extent, basin Nr 1, can readily serve the whole cane area.

The construction works for these reservoirs would include cut-off drains around the boundaries to limit seepage into the cane growing areas.

3.4.3 Duduble Reservoir

(a) Introduction

When the existing Jowhar reservoir (JOSR) was in the planning stage, it was assumed that the maximum flow reaching Sabuun (the reservoir intake) would be 100 m^3/s. This was based on the fact that overbank spillage occurs in the Duduble area for flows in excess of this, effectively reducing downstream flows to a maximum of 100 m^3/s. Furthermore there were proposals to confine this overbank spillage to one or two selected locations by constructing flood relief channels. It is understood that the proposed flood relief channel at Duduble is about to be constructed by a Chinese contractor.

Thus, in the Duduble area, any flow in excess of 100 m^3/s could be diverted into a storage reservoir without adversely affecting the operation of JOSR. This criterion has been adopted in the pre-feasibility study of a reservoir at Duduble, as outlined below.

(b) The Reservoir

The proposed Duduble reservoir is located some 40 km north of Jowhar town on the right bank of the river. It was identified as a possible reservoir site during the Shabelle River Study (MMP, 1969), although it was pointed out then that the reservoir topography did not appear ideal, and that the site was best suited for flood relief works being a natural spillage area.

An aerial survey of the reservoir area was commissioned in early 1983 and, from the 1 : 5 000 air photomaps produced, a 1 : 25 000 contour map has been prepared (Drawing Nr 12700/10). The survey confirms that the topography of the site is not ideal for a reservoir, but there is one fairly large depression which can be incorporated into a substantial reservoir.

Several possible alignments of the embankment have been examined, the aim being to maximise the storage volume whilst keeping the embankment height less than 5.0 m. Embankment heights in excess of 5.0 m will require much more exacting construction techniques and selection of fill material.

The embankment alignment selected makes best use of natural high spots; it is shown on Drawing Nr 12700/10. Within this embankment a reservoir volume of 150 Mm^3 can be achieved with a maximum water level of 114.8 m, which would require a maximum embankment height of 5.0 m, allowing 1.5 m freeboard. The reservoir surface area for this volume would be about 80 km^2, giving a mean storage depth of 1.9 m.

In comparison the JOSR achieved a volume of 200 Mm^3 with a maximum embankment height of 4.3 m and a surface area of 110 km^2 (mean storage depth 1.8 m). To achieve 200 Mm^3 storage volume at Duduble would require a maximum water level of 115.3 m which would necessitate some 2.0 km of embankment higher than 5.0 m (maximum height 5.5 m).

With a maximum storage level of 114.8 m a total length of embankment of 33 km would be required to contain the potential 150 Mm^3 stored volume. Approximately 1 150 000 m^3 of earth would be required to form this embankment.

In addition to the embankment, inlet and outlet structures are required. Outline designs have been prepared for these in order to obtain preliminary cost estimates. The inlet structure has been assumed to have a capacity of 40 m^3/s for a river flow of 140 m^3/s. A similar structure to the JOSR supply canal head regulator would be required, with four 4.0 m wide gated bays. This structure could be combined with the proposed flood relief head regulator if both schemes were to go ahead. In this case floods would be routed through the reservoir, escaping over a spillway in the western embankment, thus saving the cost of the flood channel and also ensuring that maximum use is made of the reservoir.

The outlet structure would be required to discharge water into the river during periods of low flow. Minimum reservoir level would be about 111.5 m, allowing for some dead storage, compared a minimum river level of about 109.0 m. A twin-bayed structure with two 4.0 m wide gates would be required to pass a minimum flow of 10 m^3/s from the reservoir to the river, with the reservoir level at its lowest.

(c) Operational Studies

The computer program developed by Sir M. MacDonald & Partners for JOSR has been modified to test the performance of a reservoir at Duduble. It has been assumed that Duduble reservoir would be operated independently of JOSR, being filled only when river flows exceed 100 m^3/s. Releases from the reservoir would be made at times when the Estates's demand was more than half the natural river flow at Jowhar (the Estate is only allowed to take up to 50% of the flow during the dry season). All water released would be allocated to the Estate.

The performance of a range of reservoir volumes from 68 Mm^3 to 200 Mm^3 has been tested. Evaporation and seepage losses have been estimated as they were for JOSR except that two seepage rates have been used, 2 mm/day and 5 mm/day. The larger rate may be appropriate at Duduble since the soils appear more sandy than those at Jowhar.

The results of one analysis, for a reservoir of 130 Mm^3 capacity, are presented in Table 3.4.1. This shows that a reservoir of this size would satisfy the Estate's needs more than 4 years out of 5.

The results suggest that there is little to be gained by having a reservoir much in excess of 130 Mm^3. The reason for this is that failure occurs simply because insufficient water is available for diversion into the reservoir.

This failure of the reservoir to fill led to re-examination of the operating rules. It is possible, without affecting the operation of the JOSR downstream, to relax the rule on making abstraction for Duduble only at river flow in excess of 100 m^3/s. Reducing this limiting flow to 80 m^3/s results in more frequent filling of the Duduble reservoir with consequent reduced risk of failure to meet the Estate's demands. In fact, with the reduced flow limitation, a reservoir at Duduble with a gross capacity of 95 Mm^3 would satisfy the Estate's demands more often than four years in five.

Significant increases in reliability of meeting the Estate's demands can also be achieved by relaxing the rule that the Estate can only take 50% of the dry season unregulated river flow.

3.4.4 Pumping from JOSR

(a) Introduction

During the design phase for JOSR it was planned to provide a pumping station to supply the southern end of the Estate during periods of water shortage. This plan was dropped during the construction stage and present Ministry of Agriculture policy is that no water in the reservoir is available for the Estate.

However, there is potential for increasing the storage volume of the reservoir by raising the embankments. An increase in embankment height of only 0.5 m would increase the gross capacity by some 55 Mm^3, approximately 25% of the existing capacity. Other minor works would be necessary including raising the wave wall on the outlet regulator and increasing the supply canal bank height to accept a design flow of 60 m^3/s.

(b) Supply Canal to the Estate

In order to make use of the increased storage volume it would be necessary to provide a supply canal to the head of the Estate. For the rehabilitated scheme a command level of about 103.6 m is proposed at the head of the 21st October canal. The JOSR reservoir level would vary between 97.0 and 100.25, depending on the volume stored at the time. A maximum pumped static lift of 6.6 m would therefore be necessary. This would be achieved using two pumping stations to avoid excessively high earthwork volumes for the canal.

Several routes for the canal have been considered. The most appropriate would probably be a straight line parallel and adjacent to the West drain. This is the

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Assessment of Water Availability with Regulation by DOSR (130 Mm^3)

	Exceedence probability	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Independent monthly probabilities	50%	33	24	26	88	228	114	93	238	259	267	198	80
	75%	24	13	21	22	146	48	38	184	259	237	135	53
	80%	22	11*	18	22	136	44	36	166	251	218	132	51
Homgeneous monthly sequence	50%	33	35	26	107	238	115	94	244	226	238	193	139
	75%	26	17	21	57	169	102	77	126	259	251	168	75
	80%	22	15	18	78	156	82	89	116	258	253	170	62
Estate requirements 5 300 ha		14	13	16	9	8	9	9	11	14	8	8	10

Notes: (1) * Indicates that Estate requirements are not met in full.

(2) Assumes seepage loss of 5 mm/day.

shortest route and would make best use of the surplus material available from the remodelling of the West drain. Four underpass structures would be required, carrying the canal under the access road or railway, and 12 drain junction culverts would require extending to pass under the canal into the West drain.

In addition, it would be necessary to excavate a pilot channel in the reservoir bed, connecting the low areas at the southern end to the pump station on the northern bank. This is essential so that, at low reservoir levels, the irrigation pumps would abstract water. The maintenance of this channel might prove troublesome.

(c) Operational Studies

The operational analyses carried out, described in detail in Annex I, show that the Estate's requirements can be met with a reliability of over 90% in all months by increasing the storage capacity of JOSR by 55 Mm^3. This can be achieved without affecting the reliability of supplies to downstream users which are met by making releases from JOSR.

It should be mentioned, however, that the current wasteful operating policy of JOSR would make any increases in storage capacity of little value. At present the volumes of water diverted into storage are restricted in order to maintain high river flows downstream of Sabuun barrage so as to keep water levels high for existing gravity offtakes. This means that, even in good years, the JOSR is never filled. This feature is well illustrated in Figure 3.4.1 which compares actual and theoretical (as recommended in the Operation and Maintenance Manual, 1981) operation of JOSR for 1981/82. Flood flows in the gu season of 1981 and the early part of the subsequent der season were well above average and it should have been possible to fill the reservoir. Figure 3.4.1 shows that, in fact, the reservoir has never filled during this period.

3.4.5 Comparison of Major Storage Options

(a) Performance

In order to reduce the probability of the Estate's demands are not being met to one year in five or better three schemes can be compared.

(i) enlarging JOSR to 260 Mm^3 and pumping supplies to the Estate when necessary;

(ii) constructing a 130 Mm^3 reservoir at Duduble with abstractions for river flows in excess of 100 m^3/s (this option only provides 77% reliability in February and March);

(iii) constructing a 95 Mm^3 reservoir at Duduble with abstractions for river flows in excess of 80 m^3/s.

All the above options assume that the Estate only has the right to abstract 50% of the unregulated flow in the dry season. A change in this rate to, for example, the maintenance of a constant compensation flow of 2 Mm^3/month, would significantly alter dry season reliabilities.

(b) Costs

Cost estimates have been prepared for the three options described above.

The 130 Mm^3 Duduble reservoir would cost some SoSh 110 million. This would be reduced to SoSh 93 million for a gross storage capacity of 95 Mm^3. Increasing the volume of JOSR by 55 Mm^3 and providing a pumped supply to the Estate would cost an estimated SoSh 62 million.

The use of JOSR is thus the option with the lowest capital cost. However there would be the additional recurrent cost of pumping. Average pumping costs have been estimated from an examination of the computer programme output. Pumped volumes and pumping heads for each 5-day period over the 22 year record have been aggregated to give an average annual power demand. From this the recurrent cost of fuel, oil, maintenance and replacement has been estimated at SoSh 1.1 million/year.

(c) Conclusions

The following conclusions can be drawn from the above.

(i) the enlargement of JOSR is the cheapest alternative for improving water supplies to the Estate;

(ii) significant improvements to water availability for the Estate can be achieved simply by changing the "50% rule" (ie. allowing the Estate to take more than half the unregulated river flow);

(iii) before any further offstream storage is considered, it is essential that the present inefficient operation of JOSR is changed to a more optimum operation.

3.5 Irrigation and Drainage

3.5.1 Proposed Land Use

The major objective for the Estate is to produce enough cane to satisfy the factory's requirements of 468 000 t/year.

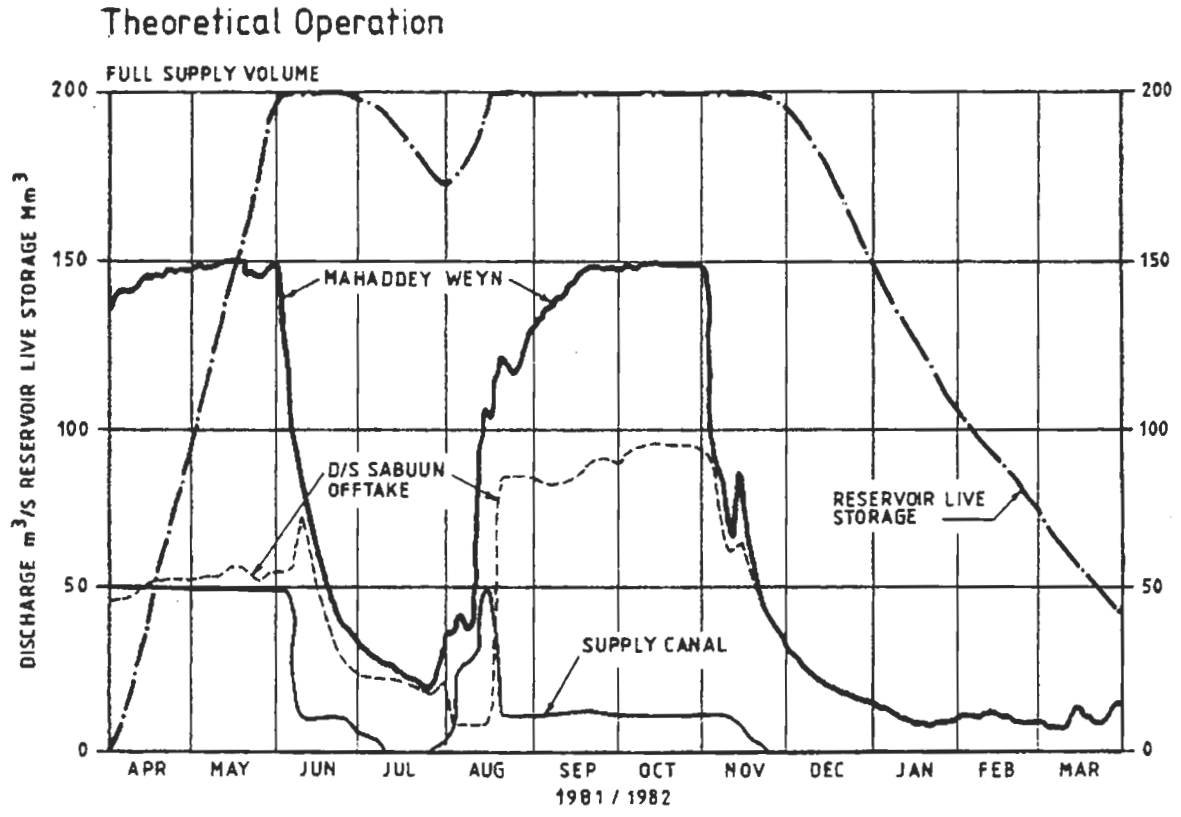
A package of rehabilitation measures has been devised which would be expected to give an estimated average sugar cane yield of 100 t cane/ha if adequate water supplies were available. Water shortage however is a function of the area cultivated, with larger areas requiring larger irrigation volumes and therefore suffering greater stress and yield reductions when water is short.

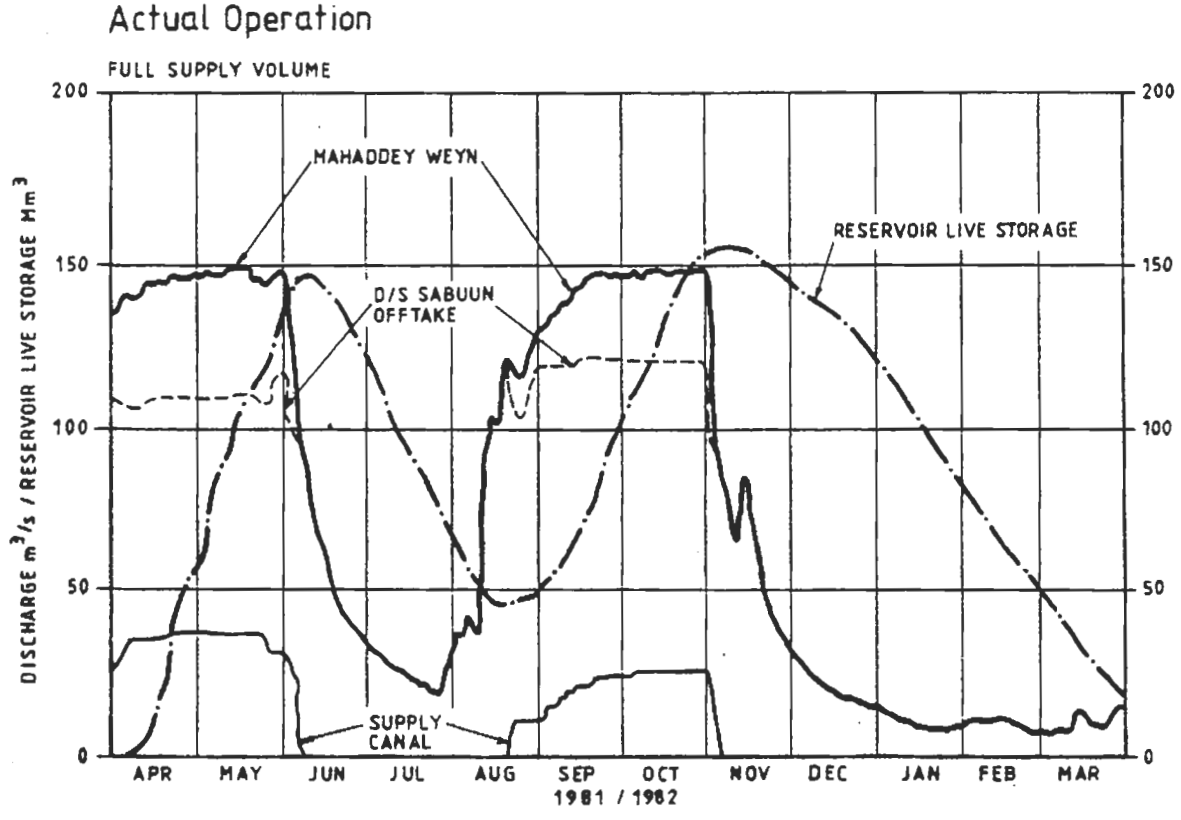
River flow analyses have revealed the frequency and extent of water shortages for a given cane area (Section 2.1.4) and the resulting yield reductions have been estimated (Section 3.6). It has been shown that an area of 5 300 ha net would be appropriate, as the long term average yield for this area (after allowing for water shortages) is estimated at 91 t/ha, which would satisfy the factory requirement and provide the necessary planting stock.

In good years, when water availability is not a constraint, higher yields can be expected. In this case the excess cane over the factory capacity will be deferred to the following year.

Figure 3.4.1

Comparison of Theoretical and Actual Operation of JOSR 1981/82





The selection of particular fields to make up this area was made by comparing the cost of the rehabilitation measures needed to bring the field to the target production potential, and the amortised cost of sugar cane transport from the field to the factory. Field rehabilitation requirements can be broadly grouped into four categories (see Figure 3.5.6):

(i) new field layout and surface drainage;

(ii) new field layout, surface drainage, deep collector drains, and a possible requirement for buried field drains in the medium term;

(iii) new field layout, surface drainage, deep collector drains, buried field drains and reclamation;

(iv) fully abandoned land which cannot readily be rehabilitated to the target production potential.

There are considerable differences between the costs of the various categories and these are generally much greater than the differential transport costs. Therefore those fields which can be rehabilitated most cheaply have been selected for cane production. These consist of all the fields in category (i), covering 3 330 ha net, and a block of fields in category (ii) which are nearest the factory, covering 2 030 ha net served by the West drain (including field 8II from category (iii) which has been included to give a convenient block). These fields include small areas within them on which cane is not currently grown, often because of topographical problems within the field. These uncultivated areas total about 620 ha net and can mostly be brought back into production by the proposed rehabilitation measures. It is assumed however than some 60 ha net, made up of small areas on a number of fields, would be found to have particular problems and have therefore been excluded. The area selected for cane production is thus 5 300 ha net.

These figures do not include the Burey farm (104 ha net) which is used for experimental purposes but presumably makes a small contribution to factory cane supplies. Figure 3.5.1 shows the location of the proposed 5 300 ha net cane area.

The fields not selected for cane production comprise 1 060 ha gross currently growing sugar cane, and 1 530 ha gross abandoned land. These sugar cane areas would be phased out as production builds up under the development programme, and it is assumed that other crops would be introduced both on these fields and on the currently abandoned fields as required (see Section 3.6.3). The precise irrigation and drainage requirements for these will depend on the new crops and production targets. The costs of the main irrigation and drainage system to serve the non-cane areas as well as the cane areas are included in this feasibility study, and similar water requirements and drainage rates to sugar cane have been assumed for these. Rehabilitation of tertiary canals and collector drains, and the introduction of the new field layout have not been included for the non-cane areas.

Details of the cane areas and non-cane areas are given in Table 3.5.1.

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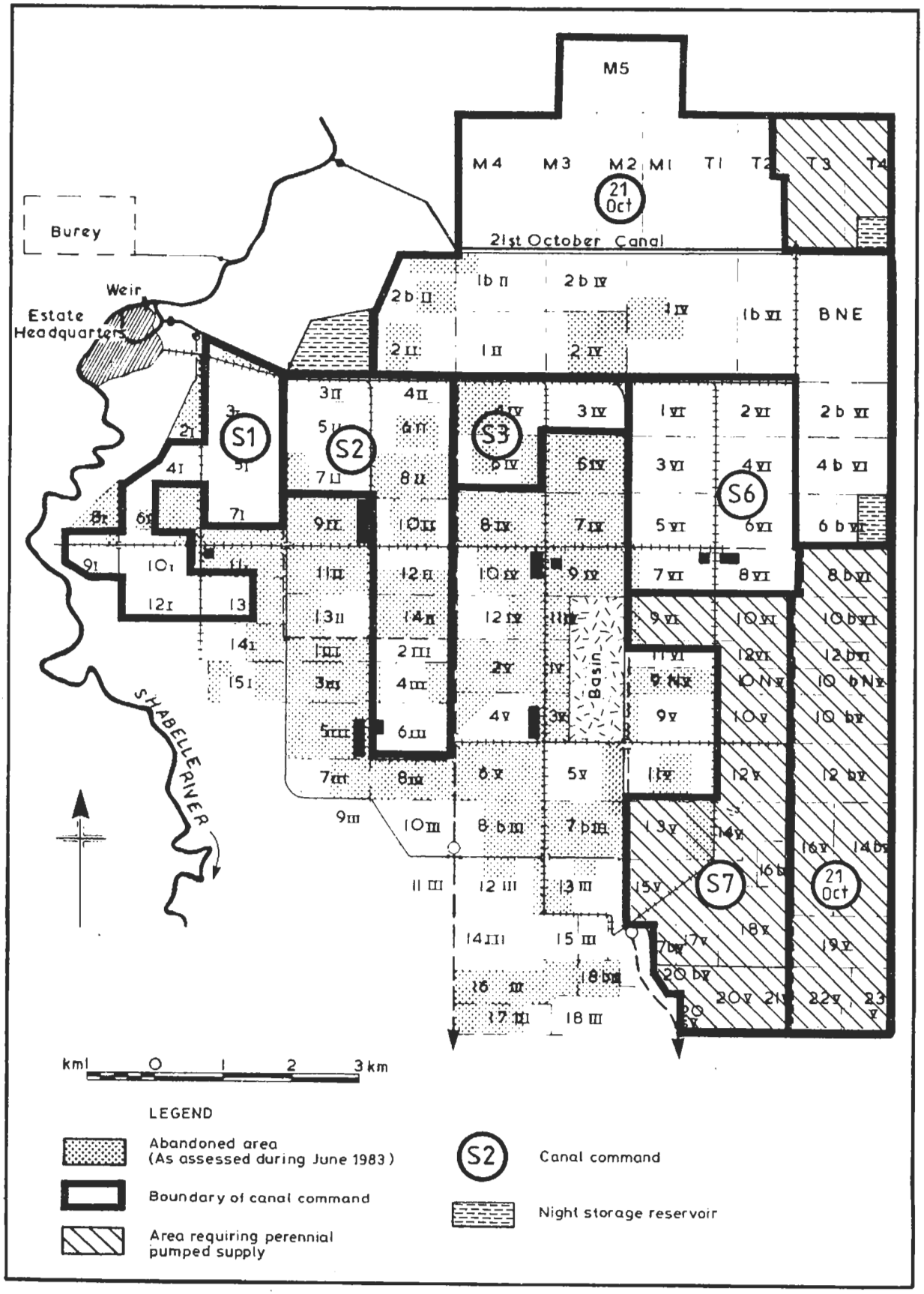
Details of Existing and Proposed Land Use Areas

	Existing land use		Proposed land use	
	Gross field area	Net area(1)	Gross field area	Net area(2)
1. Selected cane area				
1.1 Surface drainage only				
Cultivated	3 527	3 280	3 667	3 300
Not cultivated	170	157	30	27
Total	3 697	3 437	3 697	3 327
1.2 Deep drainage and surface drainage				
Cultivated	1 743	1 621	2 222	2 000
Not cultivated	516	480	37	33
Total	2 259	2 101	2 259	2 033
1.3 Whole of selected cane area				
Cultivated	5 270	4 901	5 889	5 300
Not cultivated	686	637	67	60
Total	5 956	5 538	5 956	5 360
2. Non-Cane Area				
Cultivated	1 055	981	?	?
Not cultivated	1 532	1 425	?	?
Total	2 587	2 406	2 587	2 328
3. Whole Estate				
Cultivated	6 325	5 882	5 889(3)	5 300(3)
Not cultivated	2 218	2 062	2 654	2 388
Total(4)	8 543	7 944	8 543	7 688

Notes : (1) Net area = 0.93 x gross for existing field layout
(2) Net area = 0.90 x gross for new field layout
(3) Assuming the non-cane area is not cultivated
(4) Excluding storage basins and Burey experimental farm

Figure 3.5.1

Jowhar Sugar Estate
Moderate Investment Strategy
Cane Areas



3.5.2 Irrigation Supply and Distribution System

(a) Introduction

A wide range of options has been considered in seeking improvements to the irrigation system. Three basic objectives can be defined as follows:

(i) to reduce the sediment problem to a manageable level;

(ii) to improve regulation and control of canal flows and water levels;

(iii) to introduce a system which avoids the need to irrigate at night.

It has been assumed that the distribution works would be rehabilitated such that all parts of the Estate could be provided with an irrigation supply. Thus a secondary canal would have the capability of serving its entire commanded area, even though only part of the area may be under cane. This philosophy is considered essential in order that the development of non-cane areas is not restricted. However a higher standard of rehabilitation has been aimed at for the proposed 5 300 ha cane area and, in particular, the proposed changes to field layout are only applicable to the cane areas (see Section 3.5.3).

(b) The Command Problem

It is an unfortunate fact that, when river levels are low, some parts of the Estate cannot be irrigated because they are too high (they are thus 'out of command'). At present this problem is overcome by pumping in the dry season and at other times when necessary. The proposed introduction of night storage reservoirs, discussed later in this section, will worsen the command problem and thus increase the area requiring a pumped supply.

The obvious way to eliminate this problem is to raise river levels. Various ways of achieving this have been considered, as summarised below:

(i) Pumping

A new pumping station could be constructed on the river at the 21st October intake. This would pump the Estate's requirements whenever river levels were too low for gravity flow. Even though the pumped static head would be less than 2.0 m, recurrent costs would amount to some SoSh 3.0 million/year and a high capital investment would be required. This option has not therefore been considered further.

(ii) Raising the Existing Weir

No information on the structural design of the weir is available but, in view of the fact that it is some 60 years old, this is unlikely to be a viable option except at high cost. Improved flood embankments would also be required upstream.

(iii) Constructing a New River Barrage and Intake for the Estate

This would be an expensive option which is unlikely to be economically justifiable (estimated cost SoSh 60 million).

(iv) Making Use of the Existing Gated Barrage at Sabuun

This is the most realistic option but it does involve, in addition to a new head regulator on the river, an underpass carrying the irrigation water under the JOSR Supply Canal, and about 10 km of new main canal. With this option it should be possible to maintain a water level at the head of the canal system of about 105.0 m. This would require the Sabuun barrage pond level to be maintained at about 107.0 m. This will undoubtedly lead to increased sediment deposition upstream of the barrage and hence increased risk of flooding. The operation of the barrage at Sabuun is, of course, the responsibility of the Ministry of Agriculture and there may therefore be some conflict between the operational needs of the Estate and the Offstream Storage Reservoir. This would have to be resolved before any works are constructed.

Option (iv) was considered to be the most appropriate means of achieving increased command, and was put forward in the Interim Report (August 1983). It is undoubtedly cheaper than options (ii) and (iii) and does not carry the recurrent cost burden of option (i). However it is not without problems, as mentioned above, and the estimated cost is SoSh 34 million.

Since it was stressed during meetings subsequent to the Interim Report that a high investment strategy for rehabilitation was not appropriate, it was decided to seek an option which would operate with existing river levels. The proposals are described in detail in Annex I and outlined below.

(c) Night Storage Proposals

Night storage is considered to be the only viable means of eliminating night irrigation. The alternative of closing down all canals at night would be very difficult to operate in view of the lengths of canal - so much time would be taken up in filling the canals the next morning.

Night storage in canals would be an appropriate method for Jowhar but it would require complete reconstruction of the canal system at prohibitive cost. Thus it is proposed that night storage reservoirs are introduced.

The design philosophy for siting night storage reservoirs is as follows:

- for those canals serving relatively low areas (principally canal S2) provide gravity-fed reservoirs at the head of the canal;
- for higher areas which can currently be served by minimum river level do not provide night storage;
- for the highest areas which are difficult or impossible to serve from minimum river level provide reservoirs from which water has to be pumped into secondary canals;
- locate the reservoirs as far down the system as practicable.

Locations of the three proposed night storage reservoirs are shown on Figure 3.5.3. Use has been made of the existing storage basin at the end of the Luigi canal. This will provide water for canal S2, and also for canal S1 at times when the latter cannot be served from the Luigi canal. Fields T3 and T4, in the north-eastern corner of the Estate, will have a separate small reservoir off the 21st October canal, from which water will be pumped (field T4 receives a pumped supply at present). The third reservoir will be located about two-thirds of the way down the 21st October canal. Water will be pumped from this into new canal S7 and into the tail reach of the 21st October.

The system will operate with the reservoirs being filled at night and no irrigation taking place during night-time. During the day, those areas which are served by reservoirs will receive their irrigation water solely from the reservoirs; and the day-time flow in the 21st October canal will be diverted to canals which do not have storage.

The principles of the system are illustrated diagrammatically in Figure 3.5.2. It can be seen that there is an imbalance between night and day flow in the main canal. This is because the area served by storage reservoirs is less than the area served direct from the main canal. It will be necessary therefore to adjust the intake regulator twice daily to accommodate this pattern.

It is assumed that canal S1 will continue to be supplied from the Luigi canal. Canal S1 serves some of the highest land in the Estate and cannot command its area when river levels are low; pumping will therefore be necessary for some of the year. It is proposed that when pumping is required this is carried out from the night storage reservoir which supplies canal S2, and which is filled from the 21st October canal. In this way use of the reservoir is maximised and the imbalance between night and day flows in the main canal is reduced. Pumping will be required for between 3 and 6 months a year, depending on river flows. Maintenance of the Luigi intake will continue to be a problem but the idea is to make full use of the high river levels whenever possible. It will not therefore be necessary to keep the intake channel open when river levels fall, and this should reduce the very high desilting requirements which are a feature of the existing operation. If however it proves uneconomic to maintain the Luigi intake, even during high river levels, then the system can be operated with the supply to canal S1 being pumped from the reservoir on a perennial basis.

(d) Canal System

The proposed layout of canals (and drains) is shown on Figure 3.5.3, and in more detail on Drawing Nr 12700/11. Because of the severe problems associated with the Luigi canal intake (discussed in sub-section (e) below), the main supply for the Estate will be moved to the 21st October canal intake. After rehabilitation, all canals will be served from the 21st October intake, except that when river levels are high enough, canal S1 will receive its water from the Luigi intake.

Wherever possible the existing canals have been retained - this is essential if costs are to be kept to an acceptable level. The rehabilitation measures for the existing canals include:

- reforming the channel section to the required capacity by removing silt and weeds and reshaping as necessary;

- removal of obstructive trees, shrubs and other vegetative growth from canal banks to improve access and visibility;

- grading the surfaces of canal banks to a cross fall outwards;

- repairs to brick and concrete structures as necessary (generally relatively minor works to ensure the continued life of the structure, but also some rebuilding work where the present condition is very poor);

- demolishing a few redundant or dilapidated structures;

- providing selected control structures with new gates and lifting gear to improve flow distribution and control (some cross regulators can be left ungated, particularly those in canals serving non-cane areas);

- providing new gates for about half the tertiary head regulator structures.

Generally speaking the existing canal sections and structures are of sufficient capacity to serve their command areas even though in the future flow will be confined to 12 hours/day. The spacing between canal and parallel drain is also sufficient to allow for the provision of access and a reservation for silt dumping.

The proposals also include two entirely new secondary canals (S6 and S7) having a total length of about 10.3 km, and two new reaches of canal connecting S1/S2 and S3 to the 21st October canal. In fact the connecting canal from the 21st October to S2 makes use of existing canal S5 and hence is not really entirely new.

The two new canals S6 and S7 are designed to serve the area between the Middle and East drains. This area is currently served by long tertiary canals supplied at one end by canal S3 and at the other by the 21st October canal. These long tertiaries thus cross both the Middle and East drains. The new secondary canals will ensure that tertiary canals are reduced to about 2 km in length and that there is no need for the tertiaries to cross the main drainage lines.

The new canals would be provided with gated cross regulators and new tertiary head regulator structures (for details see Annex I, Chapter 7). New regulators of the movable weir type would also be constructed at three locations on the 21st October canal and at the heads of canal S6 and the canal serving S1/S2. Movable weir regulators enable accurate flow measurement and can readily be adjusted to take account of varying flow requirements. All other new regulators will be of the vertical lifting gate type.

(e) Sediment Removal Works

The proposed measures to reduce the sediment problem to a manageable level are discussed in detail in Annex I, Chapter 5. The main points are summarised below.

The problem of sediment deposition is probably the single most important cause of poor performance in the past few years. Certainly it is the easiest to identify as a problem. It is only over the last 7 years or so that sediment deposition has become such a serious constraint - the combined effect of a significant increase in river sediment load and a general run-down in the Estate's maintenance plant.

Figure 3.5.2
Operation of the
Night Storage System

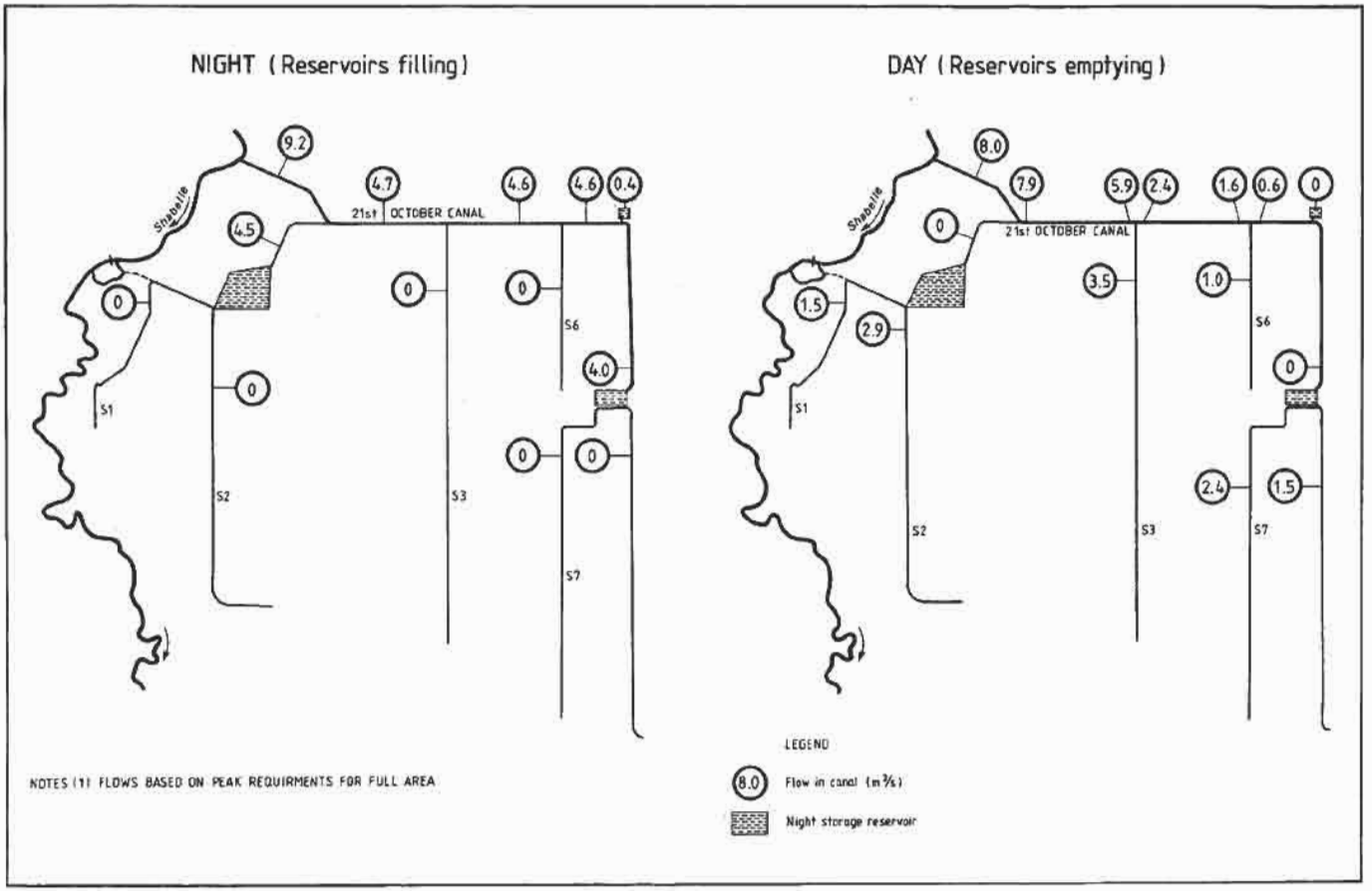
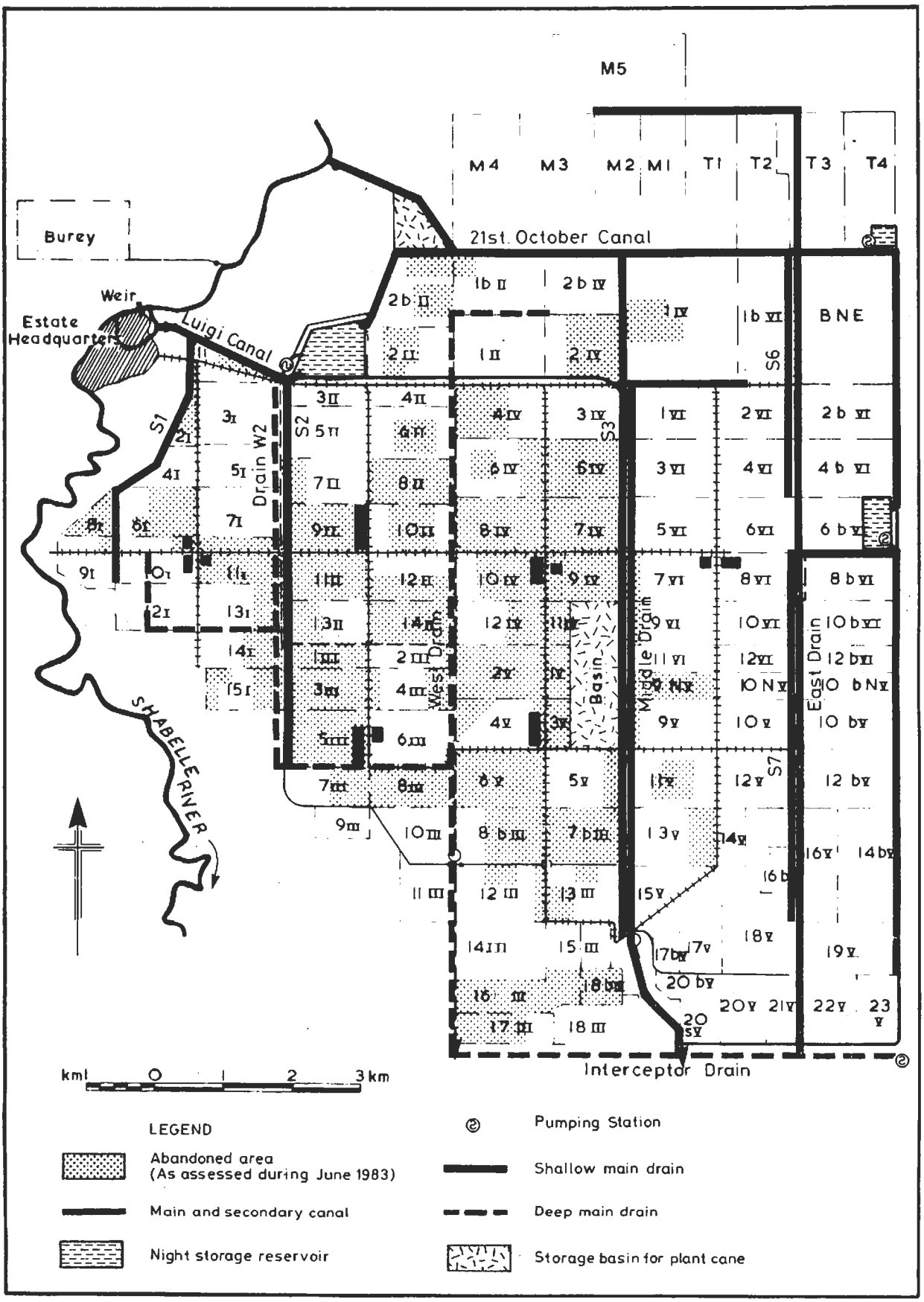


Figure 3.5.3

Jowhar Sugar Estate
Proposed Layout of Canals and Drains



During the fieldwork for the present study a number of bed samples taken from the canal system and near the headworks were analysed for particle size distribution. Using this information, a design grading curve for the river suspended load has been prepared. It is based on the average of the curves for the separate samples. This curve has been used for the preliminary design of sediment removal works. It has been assumed that the grading of suspended sediment entering the remodelled canal system should be finer than the finest sample taken from the existing canal system.

Data on suspended sediment concentrations in the river Shabelle are relatively sparse. It is impossible to predict with confidence average suspended sediment loads through the year. Nevertheless, since the design of sediment exclusion works cannot proceed without this information, we have estimated monthly averages and these are presented in Table 3.5.2.

In order to reduce the concentrations of suspended sediment to a level where the amount and grading of material escaping can be transported by the canal system, a settling basin is required at immediately downstream of the river intake. Apart from discharge and sediment criteria the proportions of a settling basin are influenced by the method adopted for removal and disposal of deposits from the basin.

Since there is insufficient head available for gravity flushing due to high flood levels in the river associated with high sediment loads, the two main alternatives considered are:

(i) removal by land-based mechanical excavators and disposal by spreading with bulldozers;

(ii) removal by floating dredger and pumped disposal by pipeline to a settling lagoon.

Due to generally greater flexibility and lower skill requirements draglines have been adopted as the preferred method.

Of the two existing river intakes, the 21st October offers the best potential for sediment removal. The Luigi intake has an inherent problem in its geometry for which there is no simple solution. The 21st October intake is much more recent, is well sited and, in contrast to the Luigi intake, there is plenty of space in the head reach for a sediment basin of up to 1.5 km long. It is therefore proposed that the sediment basin is located at the head of the 21st October canal.

The settling basin dimensions are determined by:

(i) the loading (discharge/effective basin area) required to achieve a given settling efficiency for a critical particle size;

(ii) the flow-through velocity required to avoid re-suspension of settled particles;

(iii) the volume below the settling zone required to provide adequate storage of deposits to allow for seasonal fluctuation in sediment and discharge inflow.

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Suspended Sediment Concentrations used for Design

Month	Abstraction (m^3/s)(1)	River flow (m^3/s)(2) (50% exceedance)	Design sediment load(3) (ppm)
January	5.09	11.6	1 500
February	5.51	8.7	1 500
March	6.04	9.7	1 500
April	3.29	33.9	1 250
May	3.02	91.4	6 000
June	3.39	48.2	4 500
July	3.23	39.9	4 000
August	3.98	97.4	4 000
September	5.57	128.0	3 500
October	2.81	116.1	2 250
November	3.18	81.8	2 000
December	3.29	32.1	1 500
Average			2 800

Notes : (1) Abstraction rate for 5 300 ha cane (see Annex II).

(2) River flow data presented in Chapter 2 of Annex I.

(3) Based on the high sediment loads recorded in 1980-1981 (see Section 2.1.4).

Preliminary calculations have been carried out to illustrate the relationship between basin loading and the particle size distribution of sediment expected to be deposited and to escape into the canal system downstream. The results of these calculations are plotted in Figure 3.5.4 for a range of basin loading from 1.6×10^{-4} m/s to 1.3×10^{-3} m/s. From these results it is concluded that to achieve a satisfactory grading of escaping sediment the basin loading should not be greater than 3.3×10^{-4} m/s. For flow-through velocity, an upper limit of 0.2 m/s has been adopted with monthly average velocities generally well below this value.

In order to match deposit removal rate with storage volume below the settling zone, the capacities of draglines readily available on the market have been used to provide indicative work rates and corresponding values of bucket reach and settling basin bed width.

To facilitate the selection of the settling basin dimensions with matching dragline capacity a computer program BUNKER has been used. This program assesses the performance of a basin of given dimensions with monthly average input values of discharge and sediment concentration. The particle size grading of the inflowing sediment and average daily removal rates are also input.

The results indicate that, for the design sediment loads presented in Table 3.5.2, a basin with the following proportions would be appropriate:

Length	700	m
Bed width	23.2	m
Maximum depth	4.0	m

The annual volume of material deposited would be some 237 000 m^3, requiring two 30 RB draglines (or equivalent) with 0.96 m^3 bucket.

Since the available sediment data cover such a short period at a time when sediment loads were exceptionally high it is proposed that, initially, only one dragline is purchased and the basin is constructed to half the design capacity. If very high sediment loads persist in the future the basin could be enlarged and an extra dragline purchased.

3.5.3 Field Irrigation

(a) Field Layout

It is recommended that the present furrow/basin method of irrigation used on the Estate is changed to that of furrow irrigation, both to obtain better control over the application of irrigation water and to facilitate mechanical operations on the fields.

It was previously proposed (MMP, 1976) that furrows of 300 m length be used, and in the subsequent drainage trials furrows of this length were used successfully.

For this study an alternative field layout with much shorter (100 m) furrows were also considered. The two layouts have been compared and it has been concluded that the 300 m furrow layout is preferable (see Annex I, Chapter 6). The proposed field layout is shown in Figure 3.5.5. This typical layout would be adjusted to suit individual fields by varying the furrow length between 200 m and 400 m. If the longer furrow lengths prove difficult to manage, the layout can readily be adapted to suit shorter furrow lengths.

The layout shown in Figure 3.5.5 does not include a deep collector drain. Deep collectors would only be provided if it proved necessary to install field drains on a particular field. In this case the deep collectors would be excavated parallel to the surface drains (see Figure I.6.2 and I.6.3 in Annex I).

(b) Water Application

A new header channel will be constructed along the heads of the furrows. Irrigation will be applied by means of siphons into the furrows. The recommended delivery method into the furrow is that of plastic siphon pipes. These are relatively cheap, easy to install, can be used without disturbing the channel bank, and their portability reduces the number required. Several small siphons (50 mm in diameter) should be used to deliver the maximum non-erosive stream into each furrow at the start of irrigation, with siphons being removed as necessary when the water reaches the end of the furrows; thereby adjusting the flow until the desired irrigation amount is applied. The recommended irrigation is for 154 mm field application (which, at 65% application efficiency, amounts to a net field application of 100 mm) and some 90 siphons will be required to irrigate a 70 ha field.

The area immediately downstream of the header channel will be used to turn the tractors before returning for their next run down the field. This length of some 5 m should be repaired after tillage and prior to irrigation.

The speed of advance down the furrow is dependent on the furrow discharge, the slope and roughness. Each furrow will therefore be different and the application efficiency will be dependent on the skill of the irrigator. Actual application practices will be set out under the guidance of the Irrigation and Drainage Manager and his supervisory staff. Excess water should obviously be avoided but any standing water left on the irrigated field should be removed after 24 hours.

(c) Land Levelling

For uniform application of water it is important that an even furrow slope is obtained. Major advances have been made in land levelling techniques during the last decade and it is recommended that these methods using laser control are adopted on the Estate. Minimum and maximum slopes of 0.02% and 0.2% respectively are recommended.

The minimum slope is to ensure that waterlogging does not occur and will enable excess water to be drawn off the end of the furrows into the surface drain. The maximum slope is to ensure a reasonably even water distribution along the furrow.

Sample surveys have been carried out on the Estate and it is estimated that an average of 218 m^3/ha of earthmoving is required to establish the recommended field layout (see Annex I). The laser system of control is recommended for use as opposed to manual control as it has been shown to be both more economical and produces a better result.

The rehabilitation programme allows for 5 300 ha to be land levelled in 5 years, i.e. 1 060 ha per year. Assuming land levelling can be carried out for 265 days per year this will require a work rate of 4 ha per day. The Estate has sufficient land levelling plant for this work, although the units will require the

Figure 3. 5.4

Particle Sizes of Deposited and Escaping Sediment

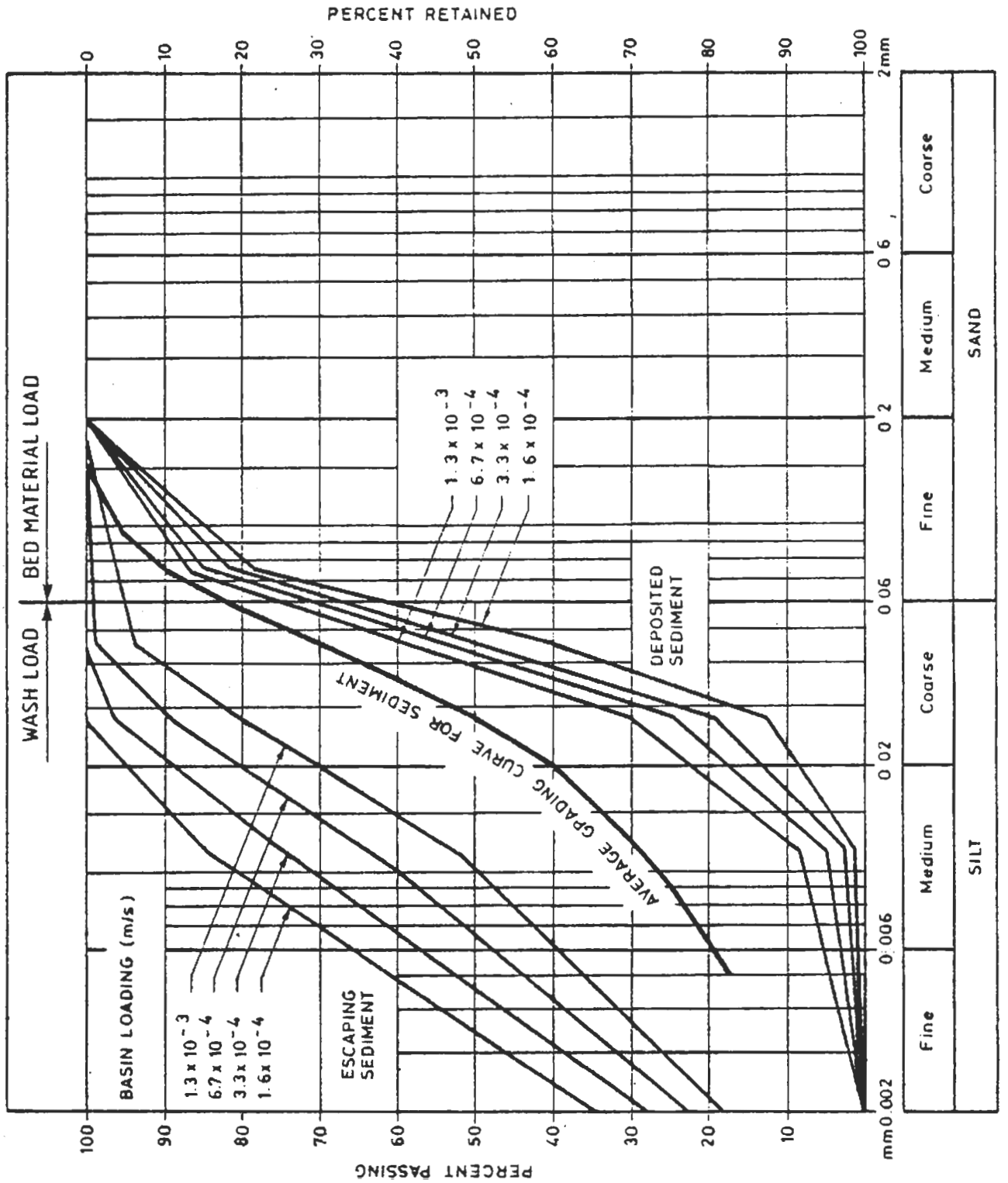


Figure 3.5.5

Proposed Field Layout

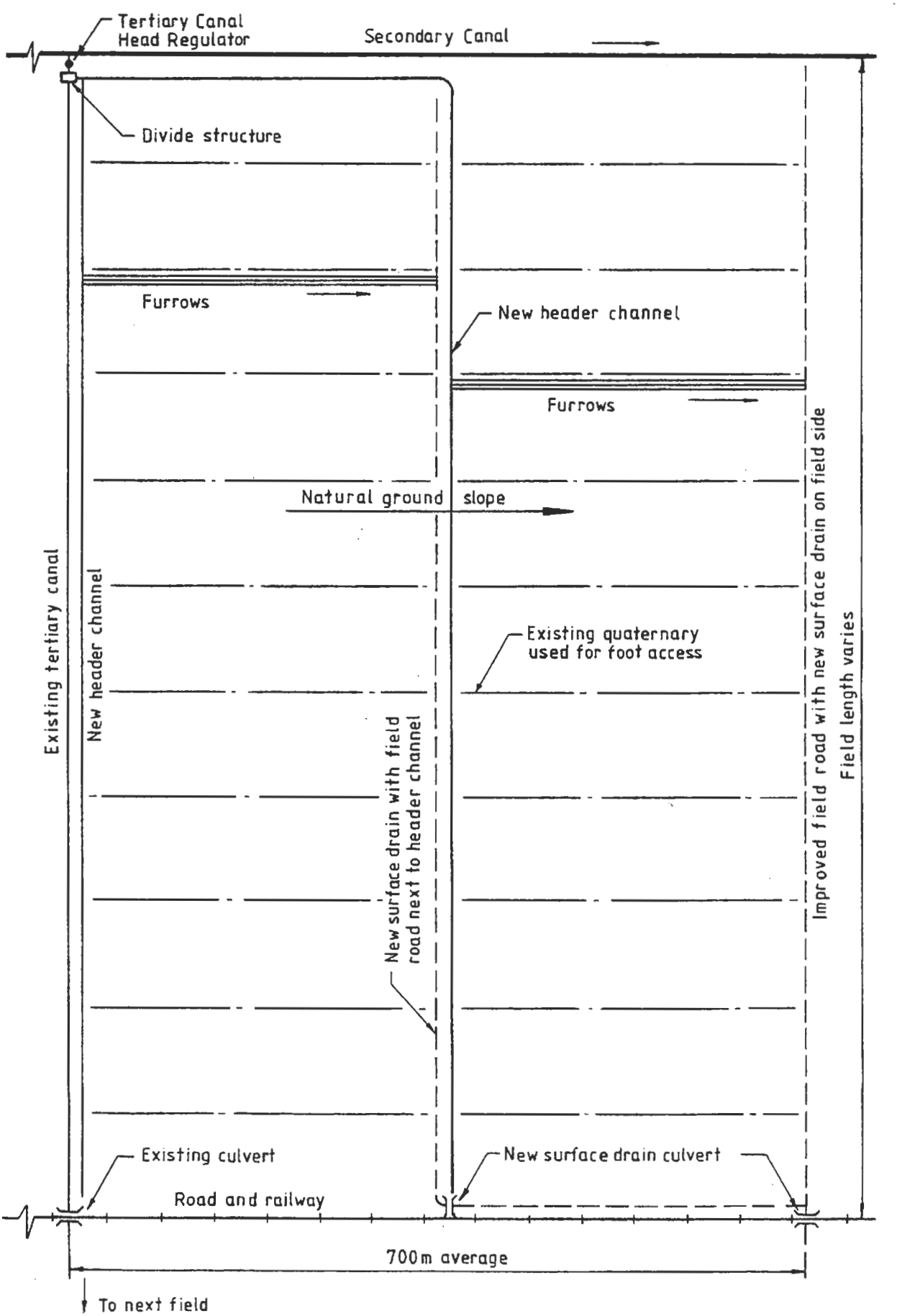
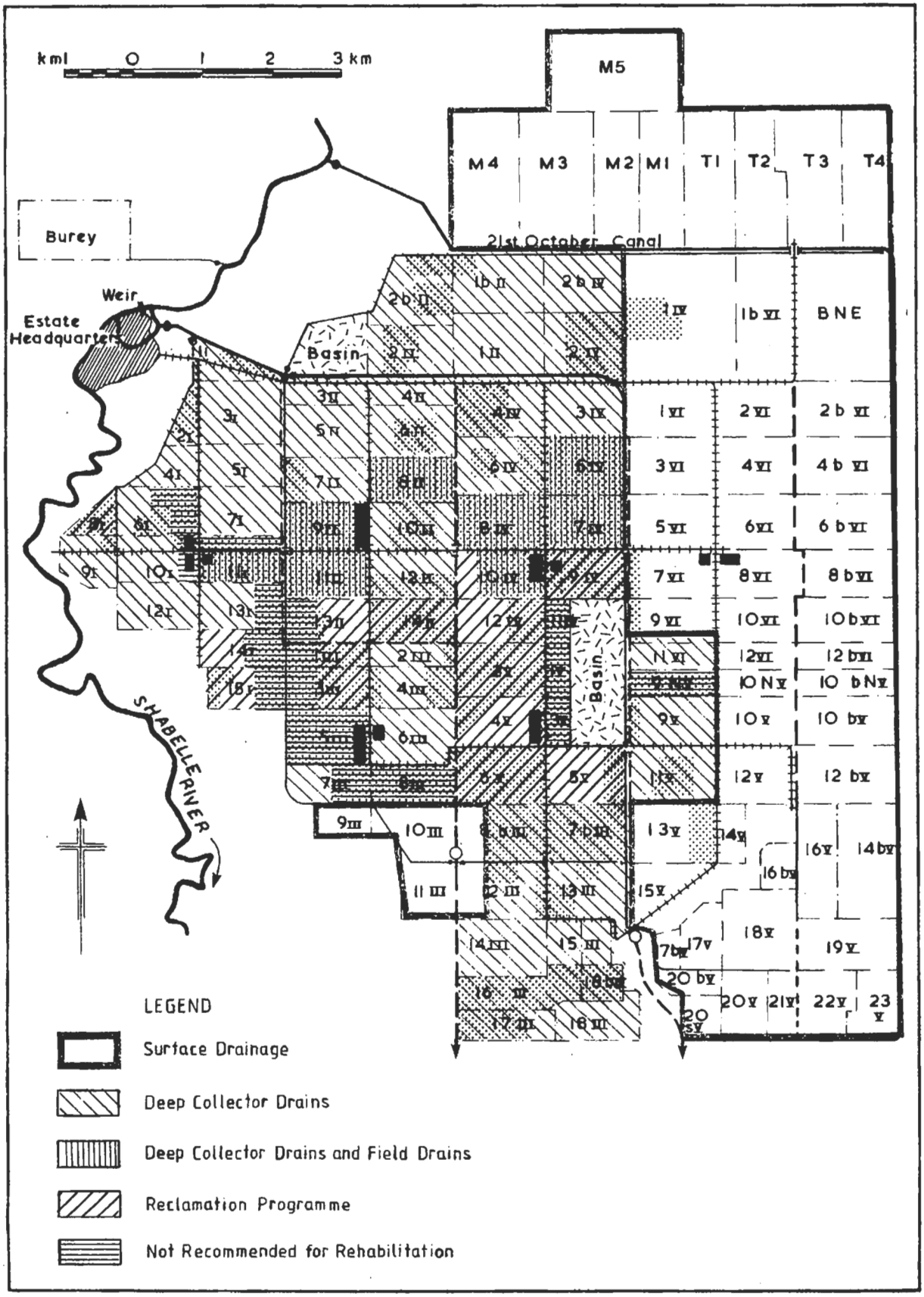


Figure 3.5.6

Jowhar Sugar Estate
Drainage Measures Required



addition of a laser control system. However, it is recommended that the levelling is carried out by a specialist contractor, certainly for the first three years of the programme. Use could be made of the Estate's own plant but, in case this is unacceptable to a contractor, cost estimates have been based on new equipment.

3.5.4 Field Drainage

A study of the existing soil and watertable conditions on the Estate has led to the sub-division of the gross area into various drainage categories. Details are given in Annex I and summarised in Figure 3.5.6. As described in Section 3.5.1, a cane area has been selected which minimises the cost of drainage rehabilitation works. The selected sugar cane area can be divided into two broad categories as far as drainage requirements are concerned (Figure 3.5.7):

(i) an area of 3 300 ha net served by the Middle and East drains which has sufficient natural deep drainage to remove the anticipated recharge to groundwater from irrigation losses, surplus rainfall and canal seepage. It is essential to control irrigations, improve surface drainage and monitor irrigation amounts and watertable heights in this area to prevent excessive losses to groundwater, but subsurface drainage is not necessary on these fields.

(ii) an area of 2 000 ha net served by the West drain which has a low rate of natural deep drainage (estimated at 0.8 mm/d) which is insufficient to remove the anticipated recharge to groundwater (estimated at a mean of 2.3 mm/d after introduction of improved irrigation and surface drainage). Subsurface drainage is required in this area to prevent a further rise in the watertable, and improved irrigation and surface drainage are also needed to minimise the subsurface drainage requirements.

Irrigation improvements are to be made by introducing water measurement and control structures (Section 3.5.2), a well engineered field layout (Section 3.5.3) and professional irrigation management and operation techniques (Section 3.5.10). The new field layout would also provide good surface drainage from the field.

The surface drainage is designed to remove the 1 : 5 year maximum daily rainfall (80 mm) from the furrows within four days, after allowing for losses through infiltration and evaporation. A design drainage rate of 1.0 l/s/ha gross has been adopted.

Subsurface drainage is to be provided to the selected cane fields in the West drain area, initially by deepening the existing collector drain at the foot of each of these fields to a depth of about 2.5 m below ground level and constructing a new collector drain junction culvert into the main drain. This would intercept groundwater and provide some subsurface drainage, which is expected to prove sufficient for some fields to stabilise the watertable. On other fields however it would become clear that additional subsurface drainage provisions are needed. The second stage of subsurface drainage works is to install buried field drains at 2 m depth in those fields which are identified as needing them. It is estimated that this would be implemented gradually to cover about half the West drain cane area (i.e. 1 000 ha net) over the period Year 4 to Year 20.

It will be noted from the above that subsurface field drainage is only to be introduced where and when the need for it has been clearly ascertained. This is a practical strategy for the Estate to follow. The costs of subsurface drainage are such that more widespread installation would be considerably more expensive (Annex I, Chapter 11).

The design subsurface drainage rate has been estimated from a water balance approach at 1.8 mm/d. By using the Hooghoudt steady state drainage equation with a hydraulic conductivity of 0.4 m/d, a required drainage spacing of 50 m has been derived to give a steady state watertable level 1 m below ground level.

Corrugated 80 mm diameter uPVC drainage pipe would be used, with a 75 mm thick graded gravel filter around the pipe and a synthetic pervious membrane laid on top of the gravel. These would be laid by a specialist trenching machine parallel to the furrows, with an average length of 310 m and a maximum length of 400 m.

Field drains in the top half of the field would outfall into an intermediate deep collector drain which would be constructed at the same time. Where drain levels permit, this would also be a buried drain to minimise maintenance requirements and to prevent land being lost to an open drain; in some cases however a buried collector would require excessive deepening of the main drain system downstream, and an open collector would then be used.

Field drains in the lower half of the field would outfall into the deepened existing open collector drain.

Further details of the proposed field drainage works can be found in Annex I, Chapter 12.

3.5.5 Main Drainage

The main drainage system has to receive both surface and subsurface drainage flows and to conduct these by gravity to the Interceptor drain and the drainage disposal system. This requires extending the existing open drains to serve all the fields on the Estate, and remodelling them for the design discharges and levels, as follows:

- to remove the surface drainage flows from all the fields on the Estate, comprising both the selected cane and non-cane fields;

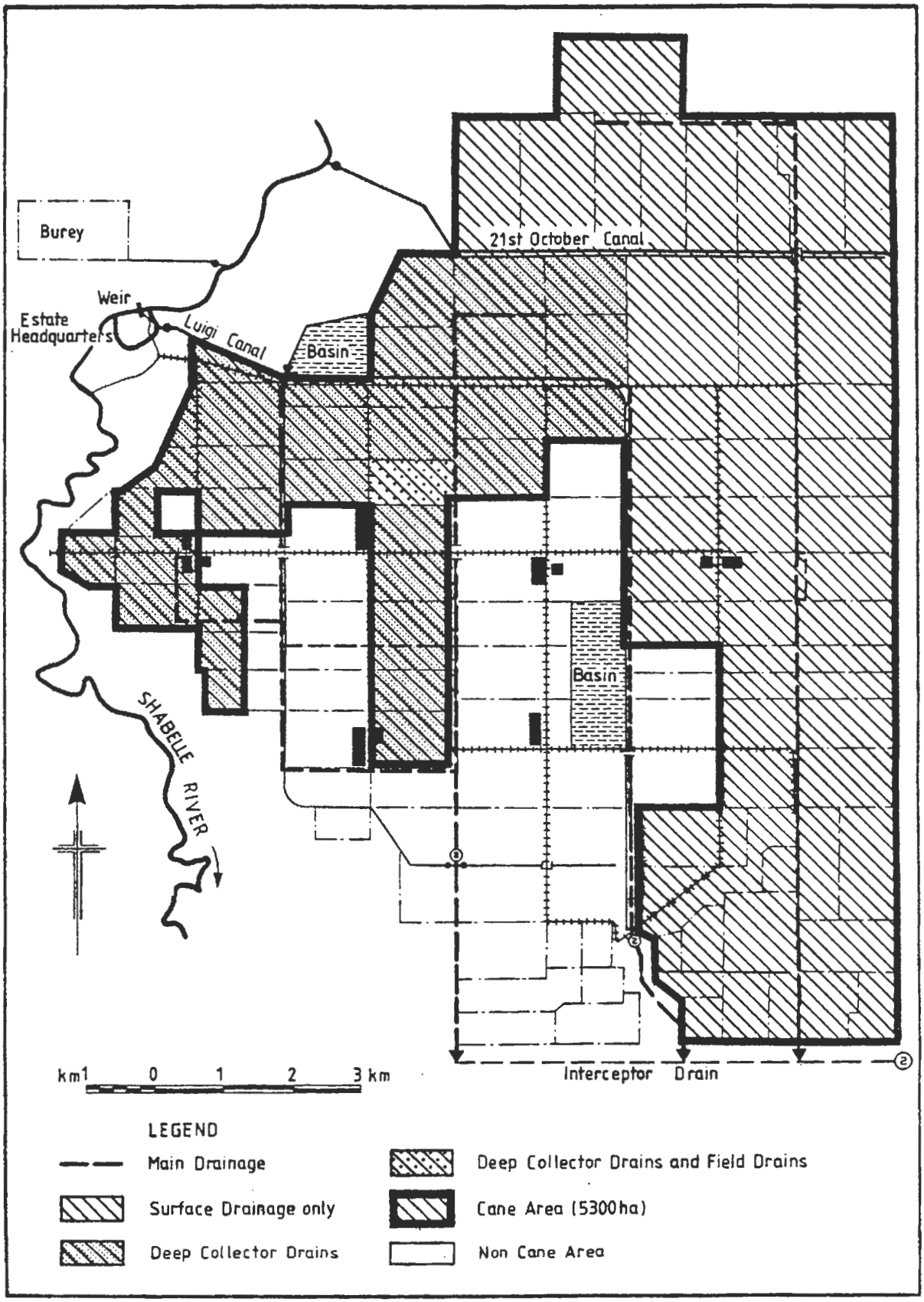
- to remove the design subsurface drainage flows from all the fields to be served by the West drain, both the selected cane and non-cane fields.

An area reduction factor of 0.9 is applied to the design field surface peak drainage rate but no area reduction factor is used for subsurface drainage.

The proposed drainage layout is shown in Figure 3.5.3. In accordance with the above objectives the Middle and East drain are to be designed for a rate of 0.9 l/s/ha at surface drainage water level. This entails cleaning out the existing shallow main drains and structures and connecting up the sections of the East drain. Most of the existing drain underpasses would be demolished as they are not needed with the proposed canal layout. Some new structures will be needed, either additional or to replace existing structures which are too small

Figure 3.5.7

Jowhar Sugar Estate
Proposed Cane Areas and
Drainage Rehabilitation Measures



or in poor condition, and a total of six new culverts and three new drain underpasses would be constructed. The junction culverts from the main drains to the Interceptor drain would be completed.

The West drain and branches W2 and W2/2 are to be designed for two cases:

- for a rate of 0.28 l/s/ha at subsurface drainage water levels, to remove the regular subsurface flows and irrigation runoff, this criterion governs the design of the earthworks and the level of the structures;

- for a rate of 0.9 l/s/ha for peak surface flows at which time higher water levels would be acceptable, this criterion governs the capacity of the structures.

This involves a comprehensive remodelling of the existing shallow main drain to a deep main drain, and replacement of all the structures. The new structures would comprise ten culverts, three underpasses, a footbridge and the junction culverts.

3.5.6 Disposal of Drainage Water

The main drain system of the Estate outfalls into a partially complete drainage disposal system that was scheduled for completion along with the Jowhar Offstream Storage Reservoir (JOSR) in 1979, but is not at present in operation. The scheduled works comprise the Interceptor drain, drainage pump station, pumped drainage outfall culvert, gravity drainage outfall culvert, disposal channel and drainage disposal area. The works are complete except that the pumps have not yet arrived and that both the Interceptor drain and disposal channel require further excavation. After rehabilitation the drainable surplus should be reduced due to the improved irrigation control. Some 34 Mm^3 of drainage water are anticipated as the annual discharge from the 5 300 ha cane area. This is less than half the design discharge for the disposal system provided under the Jowhar Offstream Storage Project, and thus the capacity of the system and the drainage disposal area will be adequate when completed.

At present the Estate has installed temporary pumps to assist the disposal of drainage water from the Interceptor drain into the JOSR, whilst some water continues to flow from the main drains along the old alignment straight over the Interceptor drain and into the reservoir.

The outstanding works comprise:

- completion of the main drain outlets from the West and Middle drains;

- deepening of the Interceptor drain and drainage disposal channel to the JOSR design cross-section (this is also appropriate for the proposed Estate drainage system);

- delivery and installation of pumps in the drainage pump station.

The design of the main drain outlets may need revising to suit the proposed main drain designs, and therefore it is proposed to include these in the Estate rehabilitation project, (the costs of new outlets from the West drain and Middle drain are included in item 3.4.4(c) of Table I.14.6 in Annex I).

The remaining works on the Interceptor drain, drainage disposal channel and drainage pump station should be completed under the JOSR project urgently to the original designs. The earthworks required have been estimated from the 1983 survey (drawing 12700/8) and the estimated costs at mid-1983 prices are detailed in Table 3.5.3. These should be completed urgently to prevent further deterioration of conditions on the Estate and to serve the proposed main drains. It should be noted that the JOSR contractor, the Water Development Agency, has already been paid for this work.

TABLE 3.5.3

Estimated Current Costs of Outstanding Drainage Disposal Works (SoSh '000)

1.	Interceptor drain earthworks (117 000 m^3)	5 850
2.	Disposal channel earthworks (14 500 m^3)	725
3.	Drainage pumps supply	5 700
4.	Drainage pumps installation	200
	TOTAL	12 475

This sum of SoSh 12.5 million has not been included in the estimated costs prepared for this feasibility study. During the fieldwork programme, it was reported that the Water Development Agency was considering returning the sum which they had already received for this unfinished work. This question should be clarified during future loan negotiations since the completion of the unfinished work is a vital part of the proposed rehabilitation progamme.

3.5.7 Reclamation of Abandoned Land

The 5 300 ha cane area recommended for development excludes the worse abandoned areas and the rehabilitation programme concentrates on areas presently under cane. However, there are approximately 600 ha of presently abandoned land included in the proposed cane area. Most of these are presently uncultivated due to local topographic problems, they are either out of command or suffer from regular flooding. These areas are assumed to be re-cultivable with the proposed introduction of the new field layout and the imposition of an improved irrigation regime.

Fields that are identified as having poor soil water characteristics will require full reclamation including the installation of subsurface field drains. Field 8II has been identified for initial reclamation and is scheduled for reclamation in Year 3 of the rehabilitation programme. It is presently abandoned due to a combination of high soil salinity and waterlogging and will be reclaimed by installing the new field layout with subsurface field drains at 50 m spacing and with two deep collector drains. Two or three leaching irrigations should be carried out before sugar cane is planted but it is recommended that the cane is planted one or two months after remodelling of the field. Reclamation of the field will continue as the cane is growing, as once the subsurface drainage is installed the soil water regime of the field will improve under future cultivation. The success of this regime was demonstrated during the drainage trials when cane was planted after only two irrigations.

During and after the rehabilitation of the Estate, it will become apparent that some fields continue to give poor yields. These fields should be examined to establish their soil salinity and watertable levels and, if found to be defective, reclamation, as described for Field 8II above, should be carried out. A 15 year programme of field drain installation has therefore been allowed for in the cost estimates, eventually covering 1 000 ha of the Estate.

3.5.8 Access

The proposals for improving access are mainly concerned with ensuring that rainfall is drained off the road surface and diverted into the main drainage system. The cost of surfacing access roads would be prohibitive, even for relatively modest gravel surfacing. The following measures are therefore recommended:

(i) raising the embankment of all low reaches of main access roads to at least 0.5 m above local ground level (total length assumed 29 km);

(ii) constructing a roadside drain for 60 km of main access road;

(iii) constructing culverts to connect the roadside drains into the main drainage system at intervals (20 Nr assumed);

(iv) grading access roads to a cross fall towards the roadside drain.

The earth fill material required to raise the road embankments will come in part from the roadside drain excavation but mainly from the remodelling works on the main drainage channels and collector drains.

The implementation of these works should help to improve road access but a significant improvement will also be achieved by restricting the movements of traffic on wet roads.

3.5.9 Recommended Rehabilitation Programme

(a) General

The rehabilitation works must be executed with minimal disruption to the cane production activities of the Estate. Programming of the works must therefore fit in with the programme of new planting. Since about 530 ha of new planting will be required each season (twice a year), it will be necessary to adopt a 5 year programme for the introduction of the new field layout over the 5 300 ha cane area. For the main irrigation and drainage works, however, a three year programme is considered more appropriate.

The majority of the rehabilitation works would be carried out by an external contracting agency. The Estate management will be fully occupied in the processes of cane and sugar production and cannot be expected to take on major rehabilitation works, even with the proposed management assistance programme (Chapter 4). However, it is proposed that some of the minor improvement works to channels is carried out by the Estate. This will be possible once the Estate's maintenance plant has been restored to operating condition. Such minor rehabilitation works (cleaning out canals and drains, tree and bush removal, minor repairs to structures, etc.) will be similar to future maintenance tasks, which the Estate will have to undertake. This work will therefore provide the opportunity for building up an effective maintenance section and training staff in the appropriate techniques.

The overall programme for the Estate rehabilitation is shown in Figure 7.1.1. Civil engineering contract(s) would be let at the end of 1984 and work would commence in the dry season of 1985. By the end of 1988 all work on the main irrigation and drainage system would be complete, but conversion to the new field layout would continue for a further two years.

Rehabilitation work carried out by the Estate would start as soon as the required plant is available, and would continue for three years or so, as required.

The Estate's land levelling plant (Cameco scrapers) could be used by the Contractor for the five year programme of conversion to the new field layout. The plant would require the addition of laser control equipment for accurate levelling. After three years, when the main engineering works would be complete, it might be possible for the Estate to take on the task of land levelling for the remaining 2 000 ha. This possibility should be considered when preparing the tender documents for the rehabilitation works.

(b) Programme of Works

In estimating the costs of rehabilitation, works have been allocated to each of the three years for the main rehabilitation programme. The main components are summarised below :

Year 1

- Crash programme.

Year 2

- Rehabilitate 21st October canal to Km 2.5 including the sediment basin.
- Remodel existing canals S1 and S3.
- Construct new canal head reaches for S1/S2 and S3.
- Rehabilitate existing basin off the Luigi canal and construct new reservoir for fields T3 and T4.
- Provide pumping stations for canal S1 and fields T3 and T4.
- Commence West drain earthworks.
- Remodel deep collector drains in West drain area.
- Complete excavation of Interceptor drain to final design section.

Year 3

- Remodel 21st October canal Km 2.5 to Km 7.2, and canal S2 up to Km 4.7.
- Construct new canals S6 and S7.
- Construct new reservoir for canal S7 and 21st October tail reach, and civil works for the pumping station.
- Continue with West drain earthworks and complete branch drains W2 and W2/2.
- East drain earthworks (southern section).
- Continue remodelling deep collector drains and commence remodelling of shallow collectors.

- Purchase field drain trenching machine.

Year 4

- Complete remodelling of 21st October canal (last 12 km) and complete S2 remodelling.

- Rehabilitate existing basin off canal S3, and construct new basin at head of 21st October canal.

- Complete pump station for S7 and 21st October tail.

- Finish West drain earthworks.

- Middle drain earthworks.

- East drain earthworks (northern section).

- Complete collector drain remodelling.

- Install field drains on Field 8II.

The programme of road rehabilitiation would be fitted in to the above programme to make best use of available fill material from the drain earthworks.

Detailed planning of the programme for replanting (and hence introduction of the new field layout) is beyond the scope of this study and will require in-depth consideration before the works commence.

Summaries of the work content of irrigation and drainage rehabilitation are presented in Tables 3.5.4 and 3.5.5.

3.5.10 Operation and Maintenance

(a) Introduction

Many of the problems which the Estate is presently experiencing are the result of inadequate maintenance in the past and a shortage of trained operating staff. If the rehabilitation works proposed in this report are to be successful, it is essential that these problems are avoided in the future. This will be achieved by three measures:

- increasing the numbers and experience of operating staff and providing suitable training programmes;

- providing adequate and appropriate maintenance plant with suitably trained operators;

- incorporating into the rehabilitation works measures which will enable better control over irrigation and which will reduce the maintenance load, as discussed in previous sections.

The proposals for improving operating staff and maintenance plant are discussed in detail in Annex I and summarised below.

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Summary of Irrigation Rehabilitation Works

	Description	Unit	Quantity
1	**Remodel Existing Canal**		
	Canal S1	km	3.5
	Canal S2	km	7.0
	Canal S3	km	6.7
	21 October canal	km	19.2
	Luigi canal	km	1.7
2	**Replace Gates on Existing Structures**	Nr	22
3	**New Canal Earthworks**		
	Sediment basin	m^3	60 000
	Head reach to reservoir for S1/S2	km	1.8
	Head reach for canal S3	km	1.8
	Canal S6	km	4.2
	Canal S7	km	7.4
	Remodel tertiary canals	km	50.0
	Header channel	km	185.0
4	**Canal and Reservoir Structures**		
	Movable weir regulators	Nr	5
	Lifting gate regulators	Nr	12
	Culverts	Nr	1
	Major modifications to existing structures	Nr	3
	Tertiary canal head regulators	Nr	22
5	**Reservoir and Pumping Stations**		
	Rehabilitate existing reservoirs	Nr	2
	Construct new reservoirs	Nr	3
	Pumping stations	Nr	3
6	**Land Preparation**		
	Bush clearance	ha	500
	Land levelling	ha	5 300

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Summary of Drainage Rehabilitation Works

Description	Unit	Quantity
1. Field Drainage		
Surface drain	km	185
Clean existing collector drain	km	53
Deepen existing collector drain	km	36
Buried field drains	km	14(1) (200)(2)
Intermediate deep collector drain	km	1.2(1) (18)(2)
Surface drain culvert, new	Nr	36
Surface drain culvert, rehabilitated	Nr	17
Surface drain junction	Nr	34
Shallow collector drain culvert, new	Nr	9
Shallow collector drain culvert, rehabilitated	Nr	25
Deep collector drain culverts	Nr	7
Deep collector drain junction culvert	Nr	25
2. Main Drains		
West drain, deepen and extend	km	11.6
W2 drain, deepen and extend	km	7.8
W2/2 drain, deepen and extend	km	2.6
Middle drain, rehabilitate	km	10.9
East drain, rehabilitate and extend	km	15.2
Deep main drain culverts	Nr	9
Shallow main drain culverts, new	Nr	6
Shallow main drain culverts, rehabilitated	Nr	5
Main drain underpass	Nr	6
Main drain junction culvert	Nr	4
Footbridge	Nr	1
Demolish existing structures	Nr	29
3. Interceptor Drain and Drainage Disposal System		
Complete Interceptor drain	)	Not included in
Complete drainage pump station	)	project investment
Complete drainage disposal channel	)	see Section 3.5.6

Notes : (1) Initial investment programme.

(2) Total requirements.

(b) Operating Staff

The proposed staffing for the rehabilitated scheme is given in Table 3.5.6 Until such time as there are appropriately trained and qualified Somali staff available, it is proposed that expatriate personnel are engaged to fill the posts of Head of Irrigation Section, Distribution Controller, Maintenance Controller and Surveyor. An expatriate irrigation training specialist will also be provided, otherwise all staff would be recruited locally. Duties and responsibilities of the three key posts are summarised below.

(i) Head of Irrigation Section

The irrigation section head would report directly to the Agricultural Manager and would be responsible for overall control of all irrigation and drainage functions on the Estate, except field irrigation. This latter function would be directed by the individual farm managers.

The irrigation section would be divided into two main sub-sections, distribution and control, each with its own sub-section head.

(ii) Distribution Controller

Under the general direction of the section head, the distribution controller would ensure that the irrigation system is operated to a planned schedule to meet the requirements of each farm. He would be in charge of all gate operators (canal attendants) and pump station attendants (both irrigation and drainage).

He would be responsible for drawing up a new irrigation schedule every two or three weeks and for making adjustments to this in response to water shortages, high water salinity or sediment, and rainfall. He would ensure that full records are kept of river flow, water quality, watertable levels, canal flows, pumping hours and meteorological data.

(iii) Maintenance Controller

The maintenance controller would liaise with the distribution controller and would be responsible for all maintenance operations for the irrigation and drainage system. He would have under his control a team of plant operators whom he would direct through the plant supervisor, and a group of artisans responsible for structure maintenance. He would also have a small survey team.

The maintenance controller would draw up a routine maintenance schedule and would supervise its execution, responding to non-routine maintenance work as it arose. He would make regular inspection tours of canals and drains to keep a check on maintenance requirements.

(c) Operation and Maintenance Plant and Vehicles

The Estate already has a large plant fleet although many items are presently inoperable. However, when the plant has been repaired and serviced (under the proposed Crash Programme), the Estate will have many of the items required to maintain the rehabilitated scheme. Some additional items will be required. A

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Irrigation and Drainage Operation and Maintenance Staff Requirements

Item	Position	Nr
1	Head of Irrigation Section	1
2	Distribution controller	1
3	Canal attendants	(2 x 9 (2 x 2
4	Pump attendants	
	- irrigation	2 x 3
	- drainage	3 x 1
	- mechanic	1
5	Maintenance controller	1
6	Surveyors	1
	Assistant surveyors	1
	Surveyors/labourers	4
7	Plant operators and drivers	25
	Assistant plant operators and drivers	15
8	Artisans	5
	Artisans' labourers	15
9	Plant supervisor	1
10	Maintenance foremen	6
	Maintenance labour	60
11	Field irrigation supervisors	2 x 6
	Irrigators (for 5 300 ha cane)	2 x 150
12	Records clerk	1
	Typist/filing clerk	1

complete list of the key items of plant is given in Table 3.5.7 and the selection is explained below.

(i) Dragline (30 RB or equivalent)

This large dragline is needed at the settling basin to remove the deposited silt. The existing small draglines in the Estate's fleet have insufficient reach and bucket capacity for this task.

(ii) Draglines (LS 78)

The medium sized draglines which the Estate already possesses are ideal for desilting work on the deep drains and main canals. These machines can be rehabilitated to good working condition and there are trained operators capable of making good use of them. There will be some 78 km of large canal and deep drain in the remodelled scheme. Assuming a pessimistic rate of cleaning of 1 km/week, two machines would be capable of carrying out a once-a-year channel maintenance programme with time to spare for other tasks.

(iii) Hydraulic Excavators (LC 90)

The Estate has seven hydraulic excavators of which four can be brought back to operating condition. These machines will be used on shallow main drains and secondary canals for desilting and weed removal. In fact, since the total length of these channels is only about 61 km, two machines will be adequate in the long term. However, it is recommended that the two extra machines are retained until the end of their useful lives to provide additional capability during the first years of rehabilitation.

(iv) Bulldozer (D 6)

One bulldozer will be required permanently at the sediment basin spreading and levelling the material deposited by the dragline. Another bulldozer should be available for emergency repairs to embankments and for road maintenance. Two of the Caterpillar D 6 units which the Estate has should be adequate.

(v) Front-end Loader and Back Hoe

These are very useful items of plant which can be used for minor earthworks across the Estate. They are mobile and versatile, being capable of both loading and ditching work. Two units are recommended and they should be located at Farms II and VI. They would supplement the work of the hydraulic excavators for smaller localised desilting work (for example at structure groups) and would be used for handling materials (sand, stone, etc.) and removal of deposited silt and weed from canal banks where necessary.

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Plant Requirements for Maintenance of Irrigation and Drainage Works

Item	Type/size	Nr	Notes
Dragline	30 RB	1*	Sediment basin
Dragline	LS 78	2	Existing machines
Hydraulic excavator	LC 90	4(2)	Existing machines
Bulldozer	Cat D6	2	Existing machines
Front end loader + back hoe	MF 50	2*	For minor earthworks
Grader	Cat 140G	2(1)	Existing machines
Ditcher	Briscoe	1	For tertiary canals
Tipper lorry	6 m^3	2*	
Tractor + trailer		2	
Low loader	For heaviest plant item	1*	
Boom sprayer attachment		1*	
Field drain jetting machine		1*	
Concrete mixer	$\frac{1}{4}$ m^3	2*	
Compressor with tools		1*	
Mobile pumps		2*	Dewatering structures etc.
FWD station wagon	Land Rover	2*	
Pick up		1*	
Motorcycles		15*	

Notes : * indicates new items required.

Figures in brackets are long-term requirements, the following items of plant need not be replaced when they reach the end of their useful life : 2 hydraulic excavators and 1 grader.

(vi) Grader

A grader will be required for routine maintenance of in-field roads, canal banks and shallow surface drainage channels. One of the existing Caterpillar 140 G units will be sufficient for this purpose.

(vii) Ditcher

A ditcher will be required for annual cleaning of tertiary canals/ header channels. It should be of an appropriate size for this purpose. One unit will be sufficient for the 200 km of tertiary canal/head channel involved.

(viii) Tipper Lorry, Tractor and Trailer, Low Loader

Lorries will be required for the transport of materials within the Estate and for transport of silt, weeds, etc. which have been removed from channels where there is no room for local deposition. Two 6 m^3 units should be adequate. Tractors and trailers will be needed for transporting labourers and materials, tools and equipment; two units should suffice.

The low loader is necessary for moving heavy items of plant and equipment (draglines, pumps, engines, etc.). It should be of sufficient capacity to transport the heaviest item (the 30 RB dragline).

(ix) Boom Sprayer

In view of the very severe problems experienced with reed and weed growth in the channels, and the rapid regrowth which occurs following cutting of these, chemical treatment is considered essential. A tractor mounted boom sprayer will be required for the application of the appropriate herbicide.

(x) Vehicles

A minimum of three vehicles will be required and, in the initial period of rehabilitation, two of these should have four wheel drive. A long wheel-base station wagon should be provided for the head of irrigation section; this vehicle will also be used by the distribution controller. A similar vehicle should be provided for the maintenance controller. The third vehicle should be a pick-up for use by the surveyors, plant supervisor and pump mechanic as required.

The canal attendants will require motorcycles so that they are able to keep a constant check on their canals and make the necessary gate adjustments. Field irrigation supervisors (one per farm) will also require motorcycles.

(d) Scheme Operation

In the rehabilitated scheme, the distribution of irrigation supplies will have to be much more controlled than it is at present. The inclusion of night storage reservoirs will require greater diligence on the part of the gate operators and

pump attendants to ensure that canal flows remain sensibly constant throughout the day. Canal S2 will be the only secondary canal served by gravity from a night storage reservoir. During the day, as the reservoir water level falls, it will be necessary to adjust the canal head regulator gate to compensate. Three or four adjustments during the 12 hour day should be sufficient. With pumped abstraction from a reservoir control of the secondary or tertiary canal flow will be achieved by the number of pumps operating and, to a lesser extent, by varying the engine speed.

At the end of the day all secondary canals will be closed down from the head. The head regulator will be completely closed by the attendant, who will then proceed down the canal closing the offtakes and cross regulators. In this way losses of water will be minimised and the secondary canals will still have water in them when the head regulators are opened the following morning.

During the night all flow will be diverted into the reservoirs. At the same time as secondary canal closure is taking place, the main canal head regulator (river intake) and cross regulators will be adjusted for the night-time flow conditions. Two shifts of two supervisors will be in attendance throughout the night ensuring that the reservoirs are filled in the time available and making adjustments to avoid overfilling.

3.5.11 Costs

Full details of the cost estimates for the rehabilitation works for the irrigation and drainage system are included in Annex I, Chapter 14.

(a) Capital Costs

It has been assumed that the majority of the rehabilitation works would be undertaken by an experienced contracting organisation in a three year programme. However, some remodelling of existing canals and drains and minor repairs to structures can be undertaken by the Estate itself using the plant rehabilitated as part of the Crash Programme. Changeover to the new field layout would be spread over a five year programme.

Cost estimates for the rehabilitation works have been based on the outline designs described in Annex I. Unit rates for the components of the works have been obtained from those for the Mogambo Irrigation Project in Somalia, up-dated to mid 1983.

Allowance has been made for temporary works to maintain flows in existing irrigation and drainage during the contract period since it is vital that the rehabilitation works cause minimal interference to the production of sugar cane.

The total capital cost, excluding contingencies is estimated to be some SoSh 214 million (equivalent to DM 35 million). Table 3.5.8 summarises the rehabilitation costs. It should be noted that the costs include for the provision of an irrigation supply and main drainage for non-cane areas.

(b) Recurrent Costs

Recurrent costs for the irrigation and drainage system have been estimated as follows:

Table Nr 3.5.8

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Summary of Irrigation and Drainage Rehabilitation Costs (SoSh '000)

Item Nr	Item	1985	1986	1987	1988	1989	Total
CANALS AND CANAL STRUCTURES							
1.1	Remodel existing canals	2 995	2 609	3 992	-	-	9 596
1.2	Replace gates on existing structures	753	633	360	-	-	1 746
1.3	Canal and reservoir earthworks	6 463	9 162	2 270	-	-	17 895
1.4	Canal and reservoir structures	12 715	8 235	7 835	-	-	28 785
1.5	Maintain existing supplies	500	500	500	-	-	1 500
TERTIARY CANALS AND IN-FIELD WORKS							
2.1	Canals	1 325	1 325	1 325	1 325	1 325	6 625
2.2	Land preparation	9 563	9 563	9 563	9 563	9 563	47 815
2.3	Drains	1 850	1 850	1 850	1 850	1 850	9 250
2.4	Structures	1 127	1 140	1 137	1 140	1 137	5 681
2.5	Field roads	740	740	740	740	740	3 700
2.6	Miscellaneous	2 375	-	-	-	-	2 375
DRAINS AND DRAIN STRUCTURES							
3.1	West drain earthworks	6 150	14 100	1 850	-	-	22 100
3.2	Collector drain remodelling	4 960	6 001	3 678	-	-	14 639
3.3	Middle and east drain earthworks	-	7 400	3 050	-	-	10 450
3.4	Main drain structures	2 560	9 260	4 705	-	-	16 525
3.5	Deep collector drain structures	1 120	1 310	880	-	-	3 310
3.6	Shallow collector drain structures	-	488	392	-	-	880
3.7	Field drains	-	3 000	2 000	-	-	5 000
ROADS							
4.1	New road embankments	1 240	1 030	1 030	-	-	3 300
4.2	Grade road surface	120	-	-	-	-	120
4.3	Roadside drain	460	575	345	-	-	1 380
4.4	Culverts for roadside drain	270	270	360	-	-	900
TOTAL		57 286	79 191	47 862	14 618	14 615	213 572

Note: (1) Costs do not include contingencies.

Table Nr 3.5.8

(i) Pumping Costs

These have been based on diesel powered pumping for both irrigation and drainage pump stations. From an assessment of pumped volumes and total head, the annual power demand in kWh has been calculated. This has been converted to litres of fuel consumed at the rate of 0.3 l/kWh. The cost of fuel has then been calculated at SoSh 6.7/l and 15% added on to cover the cost of lubricating oil.

Maintenance costs for pumping plant have been based on a rate of 6.5% of the capital cost per annum for both pumps and engines.

(ii) Operation and Maintenance Plant and Vehicles

For each item of plant the average annual hours of use or average annual distance covered have been estimated. Costs have then been estimated using appropriate rates which include fuel, oil, operators, drivers, servicing and maintenance. Details are presented in Annex VII.

(iii) Materials for Operation and Maintenance

This includes such items as cement, sand, gravel, grease, paint, herbicide, etc. An annual cost of SoSh 1.03 million has been allowed for (0.5% of the rehabilitation capital costs). In addition, an annual allowance of SoSh 400 000 has been included to cover the cost of siphon pipes, tools, stationery, etc.

(iv) Staff

The cost of operation and maintenance staff has been based on the proposed staff numbers and recommended salary rates.

(v) Field Drain Installation

It is anticipated that from year 5 onwards a programme of field drain installation will be required as explained in Section. 3.5.4. The capital cost for the drain laying machinery is included in Table I.14.6 but the investment cost estimated at SoSh 2 million per year for field drain installation when required, has not been included as explained in Section 3.9 and Annex VII.6.

Recurrent costs for year 5 onwards are summarised in Table 3.5.9.

TABLE 3.5.9

Summary of Recurrent Costs for Irrigation and Drainage

Item	Annual Costs Year 5 onwards (SoSh)
Irrigation pumping :	
- fuel and oil	810 000
- maintenance	210 000
Drainage pumping :	
- fuel and oil	2 600 000
- maintenance	285 000
O and M Plant and Vehicles	3 903 420
Materials	1 030 000
Siphons, tools, stationery, etc.	400 000
Staff	7 052 268
Total	**16 290 688**

Note : (1) Table excludes replacement costs.

3.6 Agricultural Production

3.6.1 Future Cane Supply and Production Areas

It is proposed that the harvesting season is divided into two periods. The dates of starting and finishing of the period will vary slightly from year to year but will generally approximate to the following dates:

1st period	16th June - 15th October	(121 days)
2nd period	16th December - 15th April	(120 days)

A total of 241 calendar days is available in a year. It is expected that about 6 Feast days and another 5 rainy days will occur during the campaign, leaving 230 milling days. When 15% down time is allowed for technical reasons, a total of 195 net milling days is available.

With a factory capacity of 2 400 tonnes cane per day the yearly cane supply should amount to 468 000 tonnes of cane.

To produce sugar cane at Jowhar, irrigation is necessary. However, the water supply for irrigation depends on the discharges of the Shabelle river, which are irregular, and shortages during 1, 2 and sometimes 3 months occur. Generally

once every two years the water supply is insufficient and a yield reduction is expected. In a year with, for example, two months' water deficit, the yield will be reduced to about 80% of a full cane supply.

The following 3 options for dealing with the shortfall in cane supply have been considered:

Option A :

Accept the shortfall in cane in one out of two years.

Option B :

Store a sufficient quantity of water to compensate for the water shortages (see Sections 3.4.3 and 3.4.4).

Option C :

Increase the cane supply by 10% by increasing the cane area.

Apart from the above mentioned main options, several minor solutions to the water shortage problem are recommended such as : reduce the crop water requirements by changing the planting dates and by more efficient use of the existing water reservoirs at the Estate.

Option A would result in reduced cane supply in years when a significant water shortage occurs (eg 20% reduction for a 2 month deficit). In years with a reduced cane supply the campaign would be shortened. This option is considered inappropriate as the cane supply will be too uncertain.

Option B assumes a 100% cane supply. The feasibility of providing major offstream storage for the Estate is discussed in Section 3.4. It is considered that the high costs of such works cannot be justified.

Option C has been assumed to be a reasonable solution to compensate partly for a reduced cane supply. In years without water shortages, a 10% extra quantity of cane is produced which should be deferred to the following campaign. A slight reduction in cane quality is then expected. Based on a cane supply of 468 000 + 10% = 514 800 t of cane, a total area of 5 300 ha is required of which 152 ha are nurseries.

An area of 5 300 ha net can be found within the existing cultivable lands. However, it is expected that some of the abandoned fields can be reclaimed, especially the marginally suitable soils in Farms I, II and III. Detailed proposals are presented in Section 3.5.

3.6.2 Sugar Cane

(a) Crop Rotation : Planting and Ratooning

It is recommended that the planting programme be changed from the wet seasons to the dry seasons. As there are two equal crushing periods, half of the 'to be planted' area should be planted in the January/February period and the other half in the July/August period.

The advantages of this change in the planting time are far greater than the disadvantages. The advantages are the following:

- the demand on irrigation water during the critical period December to April will be reduced (because of small cane and cover which are less demanding on the water supply);

- while the cane can be planted in the furrows the germination of the cane will be better and thus the final cane yield will be increased. During germination and the initial growing period the cane is very sensitive to adverse drainage conditions. Cane of an age of about 2 months will enter the rainy season and will have maximum profit of it for its growth;

- planting can be mechanised easily during the dry season and mechanisation has been proposed for half of the area initially;

- weed control after planting up to full coverage is improved;

- agricultural mechanised operations will not be disturbed by rainfall.

The disadvantages are the following:

- a shorter period for land preparation of about 1½ month. Immediately after harvesting the last ratoon, the stubble should be uprooted and the soil prepared for planting. Ample time for land preparation is available, when sufficient tractors and implements are available (see tractor scheme of Table II.2.3 of Annex II) and the organisation is improved. Better planning of all field activities will be the task of a qualified management.

- extra labour requirements for planting during the harvesting period. Consultant is of the opinion that the number of labour for planting is limited compared to other activities such as maintenance of fields and cane cutting (about 140 labourers per day are required for planting 7 ha) and that this number can be found easily when increasing the salaries, improving the efficiencies of all manual activities and strengthening the degree of organisation and management structure.

Plant cane and four ratoons will be maintained. The growing period for plant cane, under Somali climatic conditions, will be about 14 months, while the period for ratoon cane will be about 11 months. Longer growing periods will result in a slight deterioration of the quality of the cane.

The following harvesting dates are recommended (Table 3.6.1):

TABLE 3.6.1

Recommended Harvesting Dates

First period (Jun/Oct)			Second period (Dec/Apr)		
Cutting	Harvesting	Age (months)	Cutting	Harvesting	Age (months)
I	Sep/Oct	14	I	Mar/Apr	14
II	Aug/Sep	11.5	II	Feb/Mar	11.5
III	Aug	11.5	III	Feb	11.5
IV	Jul	11	IV	Jan	11
V	Jun/Jul	11	V	Dec/Jan	11
Total		59			59

In the 5 years' rotation cycle, about 1 month is available for land preparation after uprooting the last ratoon.

Nurseries

Good quality seed cane is a prerequisite for a good cane crop. Nurseries should therefore be established at the Estate in well-selected fields. Seed cane will be grown in different steps:

- grandmother nurseries supply cane to the
- mother nurseries which supply cane to the
- field nurseries

Cane will be supplied to the commercial fields from the field nurseries. Seed cane for the grandmother nurseries will be hot water treated for the control of ratoon stunting disease and other fungi diseases. The expected propagation rate is 1 : 7. The number of hectares to be planted each year is set out below:

- grandmother nurseries	:	2 ha in January and 2 ha in July
- mother nurseries	:	10 ha in July and 10 ha in January
- field nurseries	:	64 ha in January and 64 ha in July
- commercial fields	:	454 ha in July/August and 454 ha in January/February

A plant and nursery scheme as well as an uprooting scheme is presented in Figure 3.6.1.

(b) Irrigation Water Requirements

The crop water requirements for the Estate are based on the Penman Eo estimates (MMP 1976), crop factors according to the stage of crop development and a standard planting and harvesting scheme.

The crop factors used in Table 3.6.2 are monthly averages of the plantation being factors of 1 plant cane (1/5 of the area) and 4 ratoon cane (4/5 of the area) with different cane ages and so different stages of cane development. The mean monthly crop factors have been worked out in Table 3.6.3 by first calculating the mean monthly crop factors for plant cane and for ratoon cane separately and then taking the weight average of the two crop factors.

The crop factors used in Tables II.1.3 and II.1.4 of Annex II are factors per cutting whereby the factor for plant cane is an average of the January and February planting (or July and August planting).

The net irrigation requirements or monthly water deficit are calculated from the crop water requirements by subtracting the effective rainfall. The effective rainfall is estimated by the evapotranspiration/precipitation ratio method (USDA 1969).

The field irrigation requirements are calculated using a 65% efficiency. The field application efficiency assumes a 10 to 15% leaching requirement. Canal losses are estimated at 10% of the field irrigation requirements and are incorporated in the gross irrigation requirements for the Estate.

In Table 3.6.2 the monthly water requirements for irrigation are presented.

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Table Nr 3.6.2

Irrigation Water Requirements

Unit	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total or average
Evapotranspiration (mm/month)	205	207	236	195	186	161	164	186	201	189	186	189	2 305
Mean monthly crop factor	0.74	0.72	0.85	0.88	0.87	0.74	0.74	0.72	0.85	0.88	0.87	0.74	-
Evapotranspiration x mean crop factor (mm/month)	152	149	201	172	162	119	121	134	171	166	162	140	1 847
Average monthly rainfall (mm/month)	5	2	22	93	88	24	29	17	12	106	85	24	507
Effective rainfall (mm/month)	0	0	20	77	71	21	25	15	11	82	70	22	414
Average deficit/net irrigation requirement (mm/month)	152	149	181	95	91	98	96	119	160	84	92	118	1 435
Field irrigation requirement (mm/month)*	234	229	278	146	140	151	148	183	246	129	142	181	2 207
Gross irrigation requirement (mm/month)**	257	252	306	161	154	166	163	201	271	142	156	199	2 428
Gross irrigation requirement l/s/ha	0.96	1.04	1.14	0.62	0.57	0.64	0.61	0.75	1.05	0.53	0.60	0.74	0.77
Estate requirement (m^3/s) (5 300 ha)	5.09	5.51	6.04	3.29	3.02	3.39	3.23	3.98	5.57	2.81	3.18	3.92	4.08

Note : * 65% in-field efficiency including 10 to 15% leaching requirement.
** 10% canal losses.

Table Nr 3.6.2

	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A
First Period	64 FN 2 GN 454 Planting 10 MN	64 FN 2 GN 454 Planting 10 MN	64 FN 2 GN 454 Planting 10 MN
Second Period	454 Planting 10 MN 64 FN 2 GN	454 Planting 10 MN 64 FN 2 GN	454 Planting 10 MN 64 FN 2 GN
Nurseries	76 76	76 76	76 76
Commercial	454 454	454 454	454 454
Uprooting	530 530	530 530	530 530

Notes (1) Areas in ha.

(2) GN = Grandmother nursery, MN = Mother nursery, FN = Field nursery.

Figure 3.6.1

Planting and Nursery Scheme

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Mean Monthly Crop Factor

		J	F	M	A	M	J	J	A	S	O	N	D
								0.4	0.6	0.8	1.0	1.0	1.0
Crop factors)	(a)												
Jul/Aug)	(b)								0.4	0.6	0.8	1.0	1.0
)	(a)	1.0	1.0	1.0	1.0	0.9	0.7	0.5	Dry				
)	(b)	1.0	1.0	1.0	1.0	1.0	0.9	0.7	0.5	Dry			
Crop factor)													
Jan/Feb)	(c)	0.4	0.6	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.7
planting)	(d)		0.4	0.6	0.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9
)	(c)	0.5	Dry										
)	(d)	0.7	0.5	Dry									
Mean monthly crop factor plant cane		**0.72**	**0.58**	**0.68**	**0.95**	**0.98**	**0.90**	**0.72**	**0.58**	**0.68**	**0.95**	**0.98**	**0.9**
)		1.0	1.0	1.0	1.0	1.0	0.9	0.7	Dry	0.5	0.6	0.8	1.0
Crop factor)		1.0	1.0	1.0	1.0	0.9	0.7	Dry		0.5	0.8	1.0	1.0
Jun/Oct)		1.0	1.0	1.0	0.9	0.7	Dry		0.5	0.8	0.9	1.0	1.0
ratoons)		1.0	1.0	0.9	0.7	0.4	Dry	0.5	0.8	1.0	1.0	1.0	1.0
)		0.7	Dry	0.5	0.6	0.8	1.0	1.0	1.0	1.0	1.0	1.0	0.9
Crop factor)		Dry		0.5	0.8	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.7
Dec/Apr)			0.5	0.8	0.9	1.0	1.0	1.0	1.0	1.0	0.9	0.7	Dry
ratoons)		0.5	0.8	1.0	1.0	1.0	1.0	1.0	1.0	0.9	0.7	0.4	Dry
Mean monthly crop factor ratoon cane		**0.74**	**0.70**	**0.89**	**0.86**	**0.85**	**0.70**	**0.74**	**0.76**	**0.89**	**0.86**	**0.85**	**0.70**
Mean monthly crop factor		**0.74**	**0.72**	**0.85**	**0.88**	**0.87**	**0.74**	**0.74**	**0.72**	**0.85**	**0.88**	**0.87**	**0.74**

The gross irrigation requirements are highest during March, when 1.14 l/s/ha or 6.04 m^3/s for 5 300 ha are required, and lowest during October when 0.53 l/s/ha or 2.81 m^3/s for 5 300 ha are required. These water requirements are compared with water availability in Section 2.1.4.

(c) Water Storage

Because of the problems associated with the control of night-time irrigation it is recommended that, whenever possible, irrigation is restricted to the 12 hours of daylight. The possible ways of achieving this are discussed in Section 3.5. Night storage in reservoirs is the most appropriate solution.

Water storage is also required to ensure the availability of irrigation water for the January/February planting programme. Table 3.6.4 presents the calculations for the quantity of water required for this. It is proposed that the existing water storage basins on the Estate are used for this purpose, together with a further new basin (Section 3.4.2).

(d) Field Layout

Improvement of the present field irrigation efficiencies is necessary for several reasons :

- to reduce the drainage problem and allied salinity problem;
- to economise on water during periods of water shortages;
- to maximise cane yields.

The existing field layout, with short furrows of 25 m, is not well suited to improving irrigation efficiency and mechanisation is hampered.

As discussed in Section 3.5.3, two alternative field layouts have been considered. One is the layout adopted by Sir M. MacDonald & Partners for the trials undertaken in 1977/78, with average furrow lengths of 300 m. The other layout considered would have shorter furrows of about 100 m. It has been decided that the layout with longer furrows is more appropriate. In the unlikely event that this proposal proved unworkable, a subsequent changeover to shorter furrows will be possible without major disruption.

The design criterion for the irrigation system is 2 x 1.04 l/s/ha or 2.08 l/s/ha at the head of a tertiary canal for 12 hours/day. The minimum interval for the design has been set at 17 days, applying 100 mm net per irrigation. Generally intervals for irrigation will be longer as this will depend on the evapotranspiration.

(e) Agricultural Practices

All fields will be land-levelled as part of the introduction of the new field layout described in Section 3.5.3.

The following operations and activities in the plantation are required.

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Water Requirements for January/February Planting

	Units	Jan I	Jan II	Feb I	Feb II	Mar I	Mar II
Evapotranspiration	mm/month	205		207		236	
Mean monthly crop factor		0.4		0.5		0.6	
Evapotranspiration x mean crop factor	mm/month	82		104		142	
Average monthly rainfall	mm/month	5		2		22	
Effective rainfall	mm/month	0		0		0	
Average deficit/net irrigation requirement	mm/month	82		104		120	
Field irrigation requirement	mm/month	126		160		185	
Gross irrigation requirement	mm/month	139		176		203	
Gross irrigation requirement	l/s/ha	0.52		0.73		0.76	
Area to be planted	ha	132	133	132	133		
Gross irrigation requirement, Jan planting	l/s	68.6	137.2	192.8	96.4		
Gross irrigation requirement, Jan planting	Mm^3	0.09	0.18	0.23	0.12		
Gross irrigation requirement, Feb planting	l/s			96.4	192.8	200.6	100.3
Gross irrigation requirement, Feb planting	Mm^3			0.12	0.23	0.27	0.14
Total requirements	Mm^3	0.27		0.70		0.41	

Note : A total of 1.38 Mm^3 water should be stored excluding evaporation and percolation losses.

Table Nr 3.6.4

Mechanical Operations for Uprooting, Planting and Cultivations in Plant Cane

- The cane stools are eradicated with a heavy disc harrow pulled by a crawler tractor D6.

- The soil is subsoiled to a depth of 65 cm to improve aeration and to facilitate ploughing with a subsoiler pulled by a crawler tractor D6.

- After subsoiling the soil is ploughed to a depth of 25 to 30 cm with a 4-disc plough and a heavy wheel tractor 100 hp.

- The ploughing is followed by a harrowing. This operation is executed with a crawler tractor D4 and an offset disc harrow.

- A correction levelling will take place after harrowing with a planer pulled by either a crawler tractor D4 or D6.

- The furrowing prior to planting will be done by a crawler tractor D4 and 3 furrow bodies at a spacing of 1.45 to 1.50 m. Care should be given to make a well-shaped furrow.

- Planting should partly be carried out by hand with good quality seed cane from nurseries. Seed cane should be cut in the nursery at the age of 6 to 7 months and loaded mechanically. Stripping of trash and cutting into 2 to 3 eye pieces is done at the edge of the field to be planted. Dipping in a mercurial solution is proposed prior to planting. Fertilisers can be applied just before planting.

- As labour is becoming scarce at Jowhar it is planned that about 50% of the hectarages to be planted will be planted by mechanical planters, pulled by a wheel tractor 75 hp. Whole stalk cane of good quality should be used. Fertilisers are applied directly by using mounted fertiliser hopper.

- Within 10 to 14 days after planting herbicides are applied by a boom sprayer, mounted on a wheel tractor 75 hp before the second irrigation.

- An inter-row cultivation with chisel tines is planned 6 to 8 weeks after planting to control the weeds. Provision is also made to control weeds manually prior to this cultivation. The operation should be carried out in combination with a second fertiliser application.

- About 2 weeks later the cane is moulded just before the canopy closes by moulding ridger and a wheeltractor 75 hp. Special attention should be paid to the furrow shape. Another chemical weed control is planned after the hilling up. The operation should be carried out with a boomsprayer mounted on a wheel tractor 75 hp.

Mechanical Operation in Ratoons

- After harvesting, trashraking is carried out to improve the effectiveness of the other cultivations. The operation is carried out with a rake on a wheel tractor 75 hp.

- Trashraking is followed by off-baring to reduce the stool width. The operation is carried out with chisels and discs in combination with fertiliser hopper on a wheel tractor 75 hp in order to localise the fertilisers.

- A chiselling is carried out 4 to 6 weeks after harvesting to control the weeds. The operation is carried out with chiselling sets on a wheel tractor 75 hp.

- Before closing in of the cane leaves, a reshaping with a reshaping ridger on a wheel tractor 75 hp is carried out.

- Sometimes the weeds continue their growth after hilling up. Another chemical weed control is planned for about 50% of the ratooned area with a boom sprayer mounted on a wheel tractor 75 hp.

(f) Output of Agricultural Equipment

The output of the agricultural equipment for the different operations is based partly on the experience at Jowhar and partly on experience elsewhere.

In Table 3.6.5 the output of equipment has been presented per 15 day period. It has been assumed that the efficiency during this period is 80% or 12 net days per period. The effective working hours per net day for daylight operations are 8 hours and for day and night operations 17 hours.

(g) Agricultural Equipment Requirements

Tractor schemes are composed for plant cane as well as for ratoon cane in order to calculate the requirements of agricultural equipment (see Annex II).

In Table 3.6.6 a list of agricultural equipment is presented. Tractor hours are presented in Annex II.

(h) Manual Cultivations

The following manual activities in the plantation are required:

- preparation for planting seed cane consists of cutting, cleaning and chopping of cane, dipping in a fungicide, loading at the nurseries and unloading at the fields to be planted, burning of trash at the nurseries and hot water treatment.

  The seed cane for the grandmother nurseries should be hot water treated;

- manual planting of nurseries and plant cane fields require about 10 man-days/ha. Mechanical planting will reduce the amount of labour for planting and preparation of seed cane to about two-thirds of the man-days required for manual planting.

- a provision in man-days is made for interplanting, although it is not always necessary;

- smut control is essential and should be improved. It should become a regular practice in plant and ratoon cane.

  The inspection of fields followed by roguing of smut stools which must be uprooted should be done at an earlier date;

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Output of Land Preparation and Cultivation Equipment per 15 day Period

June 16th to October 15th and December 16th to April 15th

Operation	Tractor	Hours/ ha	Ha/ hours	Net hours/ day	Net days period	Ha/ period
Uprooting and planting						
Stubble ploughing	D6	1.50	0.67	17	12	136
Subsoiling	D6	3.00	0.33	17	12	67
Ploughing	W100	5.00	0.20	17	12	41
Harrowing	D4	2.50	0.40	17	12	82
Planing 2x	D4	5.00	0.20	17	12	41
Furrowing (50% of area)	D4	1.00	1.00	8	12	96
Mechanical planting including fertilising (50% of area)	W75	3.00	0.33	8	12	32
Cultivation plant cane						
Chemical weed control	W75	1.00	1.00	8	12	96
Cultivation and fertilising	W75	2.00	0.50	8	12	48
Moulding	W75	2.20	0.45	8	12	43
Cultivation ratoons						
Trash raking	W75	2.50	0.40	17	12	82
Off-barring and fertilising	W75	2.00	0.50	8	12	48
Chiselling	W75	2.00	0.50	8	12	48
Reshaping	W75	2.20	0.45	8	12	43
Chemical weed control	W75	1.00	1.00	8	12	96

Note : D6, D4 = Crawlers
W100, W75 = Wheel tractors, 2 wheel drive of 100 and 75 hp drawbar

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Agricultural Equipment Required for Mechanical Operations

Tractor/implement	Requirement	Operational units	Total requirements	Remarks
Tractors				
D6	4.0	4	5	
D4	7.0	7	7	
W100	5.7	6	6	
W75	21.2	22	26	
Implements				
Disc harrow	2.5	3	3	Stubble ploughing
Subsoiling sets	4.0	4	4	
Mounted 4 disc plough	5.7	6	7	
Light disc harrow	2.8	3	3	
Trailed planer	5.7	6	6	
Furrower 3 bodies	0.9	1	1	
Mechanical planter	2.7	3	3	
Moulding ridger	3.6)	12	13	Plant cane
Reshaping ridger	8.0)			Ratoon cane
Chisels and fertiliser hopper	3.2)			Plant cane
Off-barring and fertiliser hopper	) 6.3)	10	10	Ratoon cane
Mounted herbicide sprayer	1.6)	4	5	Plant cane
Mounted herbicide sprayer	1.8)			Ratoon cane (50% of area)
Trashrake	4.4	5	5	
Chiseling sets	6.2	7	7	
Auxiliary				
W75		6	6	
Trailer		6	6	Seed cane transport
Grabloader		1	1	
W75		6	6	Fertiliser/water transport
Trailer (flat)		12	12	
Small truck and crane		1	1	Agronomy department
Truck		3	3	General plantation
Bus (50 seat)		1	1	Mechanisation

- to assure an efficient mechanical application of fertilisers some assistance of labour is required to guarantee a regular supply of fertilisers to the fertiliser hopper;

- a provision of 2 times manual weeding is made in addition to chemical and mechanical weed control;

- some assistance of labour is required in filling the reservoirs of chemical spraying;

- growth measurements, flower countings and stalk countings should become a regular practice in the plantation, necessary for future improvements.

In Table 3.6.7 the output of manual cultivations is presented.

(i) Agricultural Chemicals

Fertilisers

The present level of urea application is a result of field experience and observation. The level is too high according to the results of a trial, laid out in 1980. Yields have been reduced drastically and will be so for the near future. It is therefore proposed to reduce the urea application to 150 kg/ha for plant cane, to be applied in two dressings, one at planting and one at hilling up and to 200 kg/ha for ratoon cane, to be applied immediately after harvesting.

Fertiliser experiments should be initiated in order to determine the future fertiliser dressings.

Herbicides

The actual practice of weed control with herbicides can be maintained as it gives reasonable control. Experience elsewhere has shown that the lasting effect of chemical weed control can be improved by adding 2.4 D-amine to the Gesapax combi or equivalent (atrazine-amytrine combi).

The following rates of herbicide application are proposed:

Chemical	Unit	Seed cane	Plant cane	Ratoon cane
Gesapax combi 50%	1 tr	6	6	3
2.4 D-amine 72%	1 tr	2	2	1
Gesapax H	1 tr	2	2	1

An extra 2 l/ha Gesapax H for plant cane and 1 l/ha extra Gesapax H for ratoon cane will be added if Cyperus rotundus occurs (50% of area).

Other Chemicals

A mercurial solution such as benlate will be used at the rate of 1 l/ha for treating the cane sets, and lysol used for disinfecting the cane knives.

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Output of Manual Cultivations

Operations	Seed cane			Plant cane			Ratoons		
	Fre-quency	Man-days ha/ operation	Total man-days/ ha	Fre-quency	Man-day ha/ operation	Total man-days/ ha	Fre-quency	Man-days ha/ operation	Total man-days/ ha
Planting	1	10	10	1	10	10			
Interplanting	1	2	2	1	2	2			
Smut control	5	2	10	5	2	10	5	3	15
Fertilising (manual, mechanical)	1	2	2	1	2	2	1	1	1
Weeding	2	20	40	2	20	40	2	25	50
Ditches	1	20	20	1	20	20	1	20	20
Pushing cane	1	1.2	1	1	1.2	1	1	1.2	1
Growth measurements	3	0.5	2	3	0.5	2	3	0.5	2
Flower counting	3	0.5	2	3	0.5	2	3	0.5	2
Stalk counting	4	0.5	2	4	0.5	2	4	0.5	2
Chemical weed control	1.5	2	3	1.5	2	3	1	2	2
Cutting, cleaning chopping (manual)	1	72	72						
Cutting, cleaning chopping (mechanical)	1	36	36						
Dipping	1	8	8						
Loading/unloading (manual)	1	16	16						
Loading/unloading (mechanical)	1	8	8						
Burning trash	1	1	1						
Hot water treatment	1	28	28				1	0.5	1

(j) Agronomy Department

In broad outlines the task of the Agronomy Department can be defined as follows:

To provide the Estate management with information, aimed at supporting the Estate in achieving optimum execution of all plantation operations - from field preparation to delivery of cane to the factory - related to the production of sugar cane in desired quantity and quality.

In order to be able to provide such information, the agronomy department has to undertake investigations and research, geared to the requirements of the Estate and guided by own orientation and by communication with third parties, such as the research department of Juba Sugar Estate.

Programmes of research and investigation should be drafted annually after due consultation of the field department and general management.

The results of the investigations and research activities should be communicated to the Estate's management and to the field department.

The annual test field programme may include approximately 1 test field per 100 ha and may be divided over the categories and cuttings as follows:

TABLE 3.6.8

Annual Test Field Programme

Category	Plant cane	1st rate	2nd rate	3rd rate	4th rate
Introduction varieties	3	3	3	-	-
Main varieties	3	3	3	-	-
Fertiliser	5	5	5	5	5
Irrigation	3	3	-	-	-
Herbicides	3	3	-	-	-
Total 55 testfields	17	17	11	5	5

New varieties to be tested in introvariety trials should be introduced at the Estate and tested with the standard variety NCO 310. The variety distribution is such that the cane supply is heavily dependent upon one variety. The tests with 2 replications will further include observations on germination, growth, tillering, length, growth, erectness, shedding of old leaves, flowering, pests, diseases, number of millable stalks, brix and pol % cane, ratooning vigour.

Before introducing new varieties, screening should be done in a quarantine station outside Jowhar. The test fields for commercial, semi-commercial and most promising varieties will be carried out with a maximum of 6 varieties in 8 replications. Planning of such testfields should be done well in advance. Nurseries should be prepared for it to guarantee good quality seed cane, while the soil conditions within the test fields should be as homogeneous as possible.

Fertiliser test fields should be carried out in a sufficient number in all cuttings. It is preferred to lay out single nitrogen, potassium and phosphate trials. The same number of treatments and replications are aimed to investigate the quantity of water to be applied and the optimum irrigation interval. Normally the trials are executed in 3 treatments with 4 replications.

Variety, fertiliser and irrigation trials will be harvested. Herbicide trials are only observation trials in which different herbicides are tested for their effectiveness to weed control. In addition to this programme regular observations should be carried out. Flower and stalk countings and growth measurements carried out by the field department will be computed and analysed by the agronomy department.

Regular cane analyses and soil moisture determinations should be carried out.

For mechanisation trials, strips of a whole field in replication are taken into account.

The agronomist should visit the Juba Sugar Estate regularly so that the research activities will be tuned to each other. However, Jowhar has its own characteristics of climate, soils and type of irrigation which differ considerably from that of Juba. Results from trials at one Estate can never be applied at the other.

Provisions for such a programme have been included in the budget.

The meteorological station should be rehabilitated and will be controlled by the agronomy department.

(k) Organisation Agricultural and Agronomy Departments

The proposed organisation as presented in Figure 3.6.2 distinguishes two different departments, an agricultural department under the responsibility of an agricultural manager and an agronomy department under the responsibility of an agronomist. Both departments are directly responsible to the General Manager.

The agricultural department is responsible for the production of cane and the supply of cane to the factory. The number of farms should be reduced to the original 6. Each farm covers about 900 ha. Their main activities are infield irrigation and manual cultivations. The section manager of a farm is responsible to the farm manager. He will live in one of the 6 farm houses, while materials and fertilisers will be stored in the existing stores in the field. Two small offices, one in the north and one in the south are desirable.

Cane cutting should be the responsibility of the harvesting/transport service. The land preparation activities should be the responsibility of the mechanisation service. A special manager diversification should be appointed, who should be responsible for the citrus area, compound and cultures, other than sugar cane. It depends on the total area under other cultures if a section manager is required. The section manager irrigation/ drainage should also be responsible for civil works in the plantation such as irrigation/drainage structures and assist the transport service in roads and railway constructions.

The agronomy department is responsible for the supply of technical and scientific information in order to optimise the plantation operations to produce cane at its desired quantity and quality. Field laboratory experiments should be conducted and problems investigated. The results of the applied research at the estate should be the basis for management decisions and should become available without interference of the agricultural production department. Therefore the agronomy department is directly responsible to the general manager.

Required Manning Cultivation/Agronomy

1 Agricultural manager	25% manual cultivation 25% mechanised cultivations 25% irrigation 25% harvesting/transport

Manager Tillages

1 Manager farm
6 Section managers
6 Field foremen (man. cultivations)
6 Senior headmen
56 Headmen
12 Clerks
6 Office messengers
6 Storekeepers
6 Store labourers/24 labourers plantation villages

Seasonals	219	mandays/ha seed cane
	94	mandays/ha plant cane
	95	mandays/ha ratoon cane

Mechanical Tillages

1 Manager mechanisation
4 Field foremen (mech. cultivations)
4 Senior headmen
4 Clerks

Agronomy Department

1 Agronomist
1 Ass. Agronomist
1 Section manager (experimentation)
2 Foremen (experimentation/laboratory)
5 Headmen (4 experimentation/1 laboratory)
3 Clerks
1 Office messenger
1 Typist
30 Labourers/lab. assistants

3.6.3 Other Crops

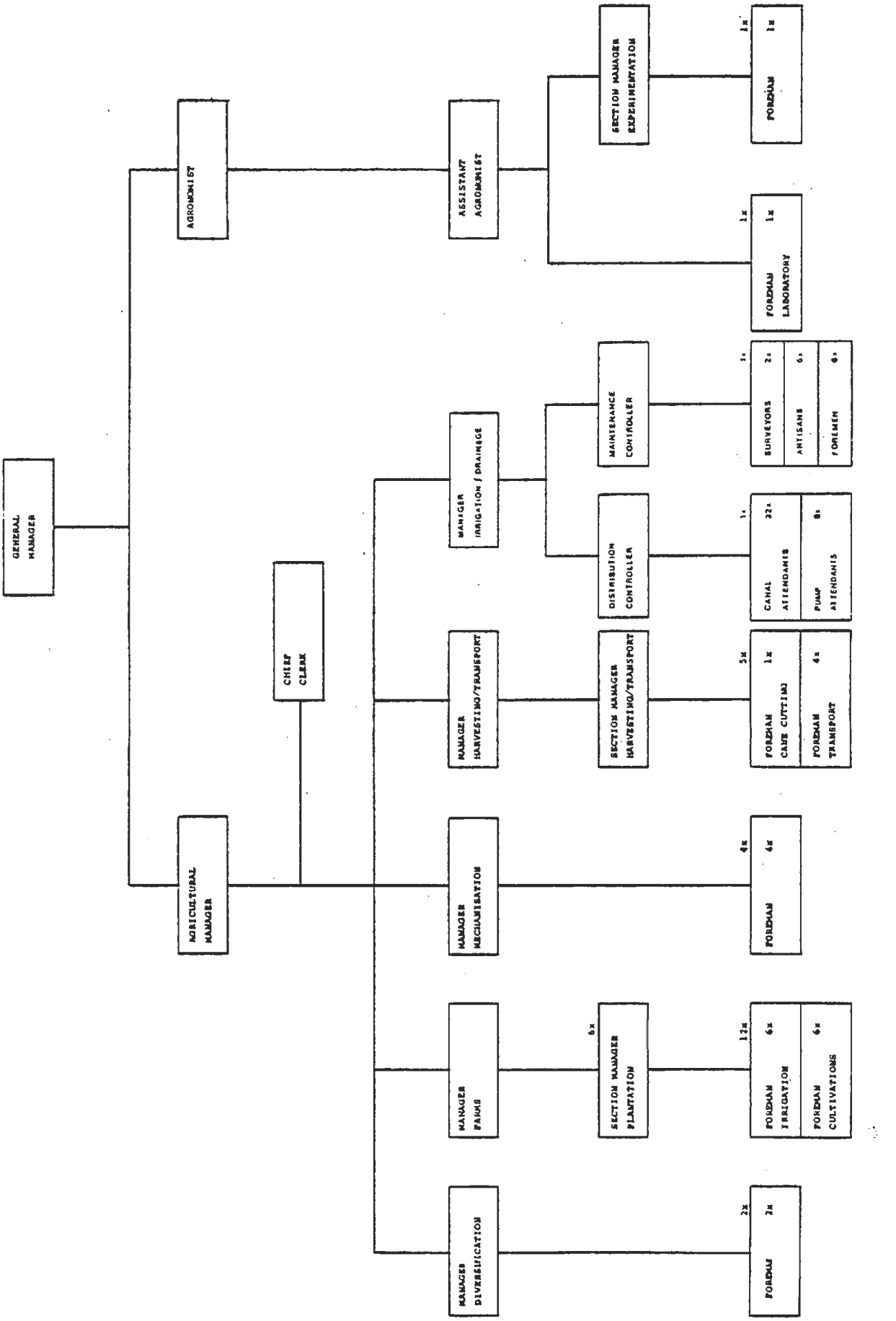
(a) Introduction

This section covers at prefeasibility level land use options for non-cane areas. The area under investigation represents some 2 900 ha in the south-western part of the Estate. The following conceptional criteria have been adopted to limit our selections:

- labour extensiveness in order to avoid an aggravation of the labour shortage in cane production;
- chosen crops should not compete with sugar cane for water during shortage period;

Figure 3.6.2

Agricultural Department
Proposed Organisation



- the activity should be extensive in management in order to limit the further burden to SNAI management;

- preference would be given to subsistence crops in order to attract labour to the Estate.

The assessment of soil suitabilities is based on the soil map elaborated in 1976 (Sir M. MacDonald & Partners). These data have been supplemented by investigations and the analysis of soil samples taken during this mission.

In general the non-cane areas of the Estate show good to excellent yield potential for a broad spectrum of crops. They are flat, with alluvial heavy soils rich in N and K elements. The climate is tropical and humid with sunshine intensity above the average for this latitude. The distance to Mogadishu, the potential market, is around 100 km only on an all-weather road. The major deficiencies are the following: about one third of the area is suffering from poor drainage; salinity in this area is normally high; at the beginning of the annual flood period the river water used for irrigation also shows a dangerously high salt content; the construction of a drainage system has never been completed.

Poor drainage must be considered to be the gravest handicap. The presence of a well functioning deep drainage system is the precondition for a successful leaching out of the salt. Cane specialists consider all the abandoned areas suitable for rehabilitation but either at very high cost, or by supplying time consuming extensive measures. An intermediate land use with crops less sensitive to salt and/or waterlogging will be an important consideration.

The activities preselected on the basis of ecological criteria and for reasons of labour economics have been submitted to economic analysis. We have conceived pilot schemes of 100 ha each for six of them. The technical details and the cash flow analysis are presented in Annex III.

(b) Alternative Land Use Proposals

The following land use proposals have been formulated: fully mechanised paddy, fuel wood production combined with pasture, coconut plantations, cattle fattening, the growing of subsistence crops (also fully mechanised), and finally a pilot resettlement scheme for casual labour (cane cutters).

A summary table of the proposed location of the activities and ecological reasons for this choice are given in Table 3.6.9. The individual activities are discussed below.

(i) Paddy cultivation

By mere ecological criteria paddy seems to be the best alternative for depressed areas suffering from salinity and/or waterlogging. Rice tolerates salinity up to approximately 4 mmhos/cm. Poor permeability reduces percolation and thus water requirement but does not depress yields. Paddy cultivation can be fully mechanised. If the need arises paddy fields can be restored to cane cultivation after a few years without major changes in the irrigation system. Four years of permanent paddy cultivation will have brought down salinity in the fields to a level tolerated by cane.

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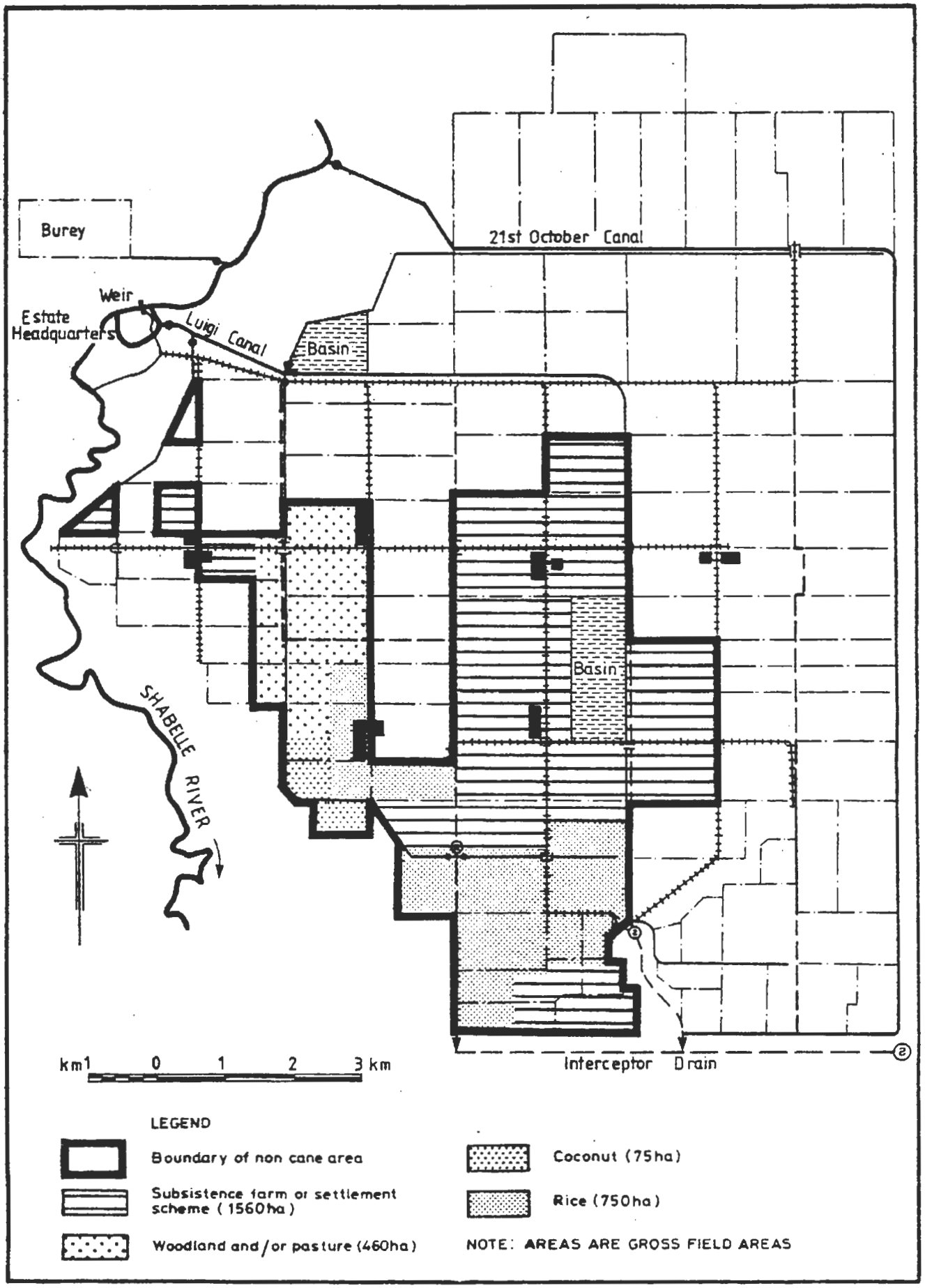
Summary of Alternative Land Use Proposals
(See also Figure 3.6.3)

Activity	Site chosen	Discussions and reasons for choice (mapping of alternatives)
Rice for paddy	Middle of southern triangle (around fields III 12 + III 13)	In this part are two depressions within contour line 99.5 m, supposed to have poorly drained soils, suitable for rice. But this site has not much salt and 'paddy leaching' would not be necessary. Deepest hole (within contour line 98.5 m) is in fields III 13 and III 15, drainage would be difficult.
Subsistence farm or settlement scheme (maize, sesame, green gram) probably most suitable soil for coconut (L1)	South of above site, extreme SE. part of triangle (around field III 18)	South of above described soil is a smooth hilltop with mainly L1 soil, fertile, well drained and probably with no or little salt. It's an ideal soil for all crops, but small; and positive influence of groundwater is doubtful (good for trees) and observation will have to continue.
Subsistence farm or settlement scheme; (in depression eventually paddy)	North of above described site, from paddy fields up to height of field V 6 (near basin)	Also good soils (F1) with poor salt, three farm buildings could eventually serve. But fields III 8 and III 7 have higher salt levels and are situated in a depression (within contour line 99.5 m) rising up to field 3.
Coconut and woodland pasture (trees with fodder)	Row of fields, south to north from field III 1 to field II 9	Main reason is the existence of trees which seem to grow well and will furnish fuel wood, charcoal, rubber and timber. By thinning this natural grownwood we may obtain space for fodder parcels or large fodder rows. But fodder plants must be (highly) salt tolerant (Atriplex ssp.) or site must be leached. Soils north of III 1 are F2 soils (moderately well drained). This row must have suitable groundwater level influenced by irrigated neighbouring row (cane) from fields III 6 to II 8.
Coconut, paddy	South-western depression	In depression (within contour line 99.5 m) heavy, poorly drained soils must be expected. Depression has high salt content (3.5 mmho, 0-2 m) so paddy cultivation is indicated for above-mentioned reasons. In SW of the depression, on slight slope coconuts may be grown, but clearing will be necessary.
Settlement scheme or subsistence crop if salt problem can be resolver; if not good for woodland pasture.	Remaining north-western parts near Shabelle river	These parts have F2 soils in direction to centre, field I 6 has F1 and triangle I 8 even L1 soils. All these fields have salt and need clearing.
Subsistence crops as far as possible; northern part rice	Eastern row on side of water basin up to field 5 V	Fields north of water storage basin have F2 soils, height is 100 m or more fields IV - 5,7,8,10,11 and field V 2 have high salt levels (over 3.5 - mmhos; 0-2 m). If not needed for subsistence crops, rice could be grown.

Figure 3.6.3

Jowhar Sugar Estate
Land Suitability for Other Crops



Cash flow analysis for a 25 year project shows an internal rate of return of 8.7%. Costs of this project cover the cost of an agronomist as technical adviser to the project for eight years. Economic analysis is based on import-substitution prices for rice. Two harvests (one ratoon) are obtained per year. Yields are expected to be 4 to 5 t/ha per harvest after the two years of leaching, relative to a theoretical yield potential of up to 10 tonnes.

(ii) Fuel Wood and Pastures

Mono-cropping of fuel wood for charcoal production must be considered as an economically marginal activity. The basic solution in Annex III shows an IRR around zero. This activity can become profitable under two conditions. Establishment costs can be brought down and yields are very high due to favourable groundwater conditions. The latter is likely to occur on sites benefiting from percolating irrigation water of cane areas. The observed natural regrowth in areas abandoned for ten years or more seems to confirm this theory.

The economics of this activity can be improved further if combined with secondary products such as fodder and/or arabic gum. Even subsistence crops might be grown in between the relatively widely spaced watered regrowth. Certain areas could be leased out to labourer-settlers for this purpose. The necessary technical assistance for such a sub-project might be possibly obtained from the FAO/IDA missions working within the national range agency.

(iii) Coconut Plantations

The production of fresh coconuts will be a profitable activity if two limiting factors are observed: good yields can be achieved only on well drained soils. These are rather limited in the area under consideration (category L1, silty loams). Secondly the absorbtion capacity of the Somali market for fresh fruit is rather limited and over-production may provoke a rapid price decline. Within these limits the coconut project shows an IRR of 10%. The big advantage of such a project is its labour extensiveness. Copra production is non-competitive.

(iv) Feed Lot

Cattle fattening at Jowhar is an extremely complex activity. Advantages of the site are the availability of molasses and extremely high yield potential for irrigated fodder grasses. Climatic conditions on the other hand are extremely unfavourable for any high yielding breed and even for the national cattle stock. Trypanosomiasis is a further complication. Economically viable live weight gains can be achieved only with a well balanced, concentrated daily ration difficult to obtain on an all year basis.

Under the prevailing price conditions intensive beef production is only marginally profitable.

Cattle breeding could be a viable activity if it is integrated into the local subsistence farm for the combined production of milk, meat and manure on an extensive basis (green grams as a catch crop for fodder, molasses, straw). But its success is conditioned by the introduction of a trypano-tolerant cattle breed (cross-bred with N'Dama for instance).

(v) Subsistence Crops

The two remaining activities that have been analysed namely production of basic food and a settlement scheme must be understood as a measure contributing to the objective of alleviating in the medium term the bottle-neck of non-availability of casual labour for the cane harvest.

The fully mechanised production of maize, sesame and green gram on an area of some 1 500 ha would release a male labour force of some 3 000 formerly occupied in traditional subsistence farming. Basic food can be produced at cost prices far below the prevailing consumer price and even below the official farm gate price (SoSh 2.5/kg of maize). Mechanised harvesting of sesame will require the introduction of a variety with non-bursting pods.

(vi) Settlement Scheme

This scheme would offer homesteads on irrigated land to young rural couples with limited access to alternative land.

The size of each farm would be such that one adult family member would be permanently available as Estate labourer.

SNAI would offer services such as ploughing and irrigation that traditionally are men's roles as a central service on a credit basis. The scheme would be started as a pilot project on a small scale. A more detailed presentation is given in Annex VI.

3.7 Improvement of the Factory

The most important yardsticks for any sugar factory are its capacity and the overall recovery. From the factory records since 1963/64 it was learned that the factory started in 1963 at a reduced capacity of 600 t/d cane and an overall recovery of 77.6%. Gradually the capacity increased to 1 930 t/d cane in 1970/71 with an overall recovery of 79.5%.

In 1971/72 the capacity was slightly less but the overall recovery went down to 76.9%. After 1971/72 both capacity and overall recovery gradually went down and the result in 1982/83 was 660 t/d cane with an overall recovery of 49.3%, which is extremely poor.

The Jowhar factory is basically a well designed factory, the efficiencies were until 1971/72 at an acceptable level, but the mill extraction was always rather low. However, this must be attributed mainly to the properties of the cane milled (NCO 310).

However, the factory equipment is now in poor condition and the maintenance is inadequate. It is feared that a further deterioration of the equipment or a calamity in the factory will result in a complete shut down of the factory. The situation is at present most critical for:

- the speed regulation of the mill turbines;
- the steamboilers;
- facilities for the make-up of boiler feedwater;
- the electrical power generation;

- the power distribution;

- the electrical motors.

Whatever strategy for improvement is envisaged, it has to start with a crash programme to guarantee continuation of its operation.

This crash programme to be implemented during 1984/85, succeeded by a proper rehabilitation programme, covering a period as from 1985/86 through 1990/91.

3.7.1 Proposed Measures for the Crash Programme

(a) Cane Milling Plant

- Installation of a cane shredder, already ordered under the CIP programme, including modification of the relevant cane carriers.

- Installation of two magnetic tramp iron separators, already ordered under the CIP programme.

- Procurement of essential mill's spares, already ordered under the CIP programme.

- Procurement of 3 Woodward Governors, type UG-8 for the speed control of the mills.

- Thorough overhaul of the mill turbines by an expert employed by the manufacturer.

(b) Steam Boiler Plant and Water Supply Systems

- Procurement of refractory cement for the boiler refractory repair.

- Procurement of spares for the KSB boiler feedwater pump.

- Procurement of a complete new waterpump with electrical motor.

- Repair of the Mario Pensotti boiler for which a contract has already been concluded with an italian firm.

- Installation of a bagasse dryer in front of the boiler, reportedly included in the above mentioned contract.

- Procurement of instruments/controls for the two Fives-Penthoet boilers.

- Installation of a new water treatment plant for make up of boiler feedwater, capacity 25 m^3/h.

(c) Power Plant and Electrical Distribution

- Procurement for the existing 3 000 kVA turbo-generator of a new Woodward Governor, type UG-40 and a new stem and guide bush for its steam regulating valve.

- Repair in France of the damaged rotor of the existing 3 000 kVA turbo-generator.

- Complete overhaul of the 3 000 kVA turbo-generator under expert guidance.

- Procurement of spares for a 20 000 hours maintenance service for two of the three Deutz diesel generator sets, including a new rotor and overhaul kit for the BBC turbo blower.

- Overhaul of the two Deutz diesel generator by a Deutz service engineer.

- Complete renewal of panels, motor control centres and part of the cables of the electrical distribution system.

- Procurement of 250 kg winding wire of different diameters and insulating varnish (20 l) for electrical motor repair.

- Repair of the electrical distribution system for which a contract has already been concluded with an Italian firm.

(d) Boiling House

- Installation of a new vacuum pump, capacity 5 000 m^3/h, to ensure optimum vacuum on vacuum filters, evaporation plant and vacuum pans, already ordered under the CIP programme.

- Procurement of lagging material for vessels and piping, including tools for lagging.

- Execution of lagging under supervision of an insulation expert.

(e) Distillery

- Installation of new equipment for storing and dosing concentrated sulphuric acid, comprising a storage tank, dosing tank and transport pump.

(f) Investment Costs for Crash Programme

Estimated investment costs for aforementioned measures are given in Annex IV, Table IV.1.1.

3.7.2 Proposed Measures for Proper Rehabilitation

(a) Cane Unloading Plant

- Installation of a hydraulic system for the Miedema trailers.

- Since cane transport operations will continue for 24 h/d and the required buffer capacity (approximately 3/4 h) will be arranged for inside railcarts, there is no need to arrange for storage facilities in the cane unloading area. Apart from realignment of the rail system near the factory, major investments will not be required.

(b) Cane Milling Plant

- Installation of an automatic cane carrier control.
- Intensive overhaul of the mills under expert guidance.
- Installation of a new DSM type mill juice screen.
- Apart from spare rollers, trash plates and couplers, already ordered from the USA, new pinions and some additional bearings need procurement.

(c) Steam Boiler Plant and Water Supply Systems

- Reconditioning of the two Fives-Penthoet boilers under expert guidance.
- Installation of new steam desuperheating equipment for the make-up system of exhaust and 7 bar steam, including two desuperheating water pumps.
- Installation of one new 40 t/h steam boiler within 7 years.
- After rehabilitation the Mario Pensotti boiler wil be capable of providing sufficient steam for a crushing rate of 1 600 t/d cane. Both Fives Penthoet boilers will act as stand-by units and will require normal upkeep and maintenance only. When the capacity is increased to over 1 600 t/d cane (in year 4) one of the Penthoet boilers needs to be in operation to cope with the steam demand.
- The condition of the Fives Penthoet boilers is such that it is expected that these boilers will not be considered reliable and safe after 25 years of operation. It is common practice that after this lifetime, extensive boiler inspections complete with material tests, are required by official authorities (government, insurance companies, etc.).
- It is expected that most boiler components like drums, headers, pipes, etc. will not pass such tests as these have seriously been affected by corrosion due to the bad quality of boiler and feedwater.
- From experience it is known that an extensive rehabilitation of boilers may cost between 60 and 70% of a new boiler.
- Since it concerns the rehabilitation of 2 boilers it is best to install one new modern type of boiler with a capacity of 40 t/h at the same total cost and with a higher efficiency and consequently lower fuel consumption.
- Installation of new pumps for factory water supply.

(d) Power Plant and Electrical Distribution

- The available diesel generator units are considered more than ample (after rehabilitation) to cope with the power demand during the off-season and start-up of the factory. During failure of the TA-set in the crushing season sufficient power can be generated for emergency operations. Replacement of diesel generator sets is now considered

necessary during the project period as the units are well within the economical lifetime of stationary units. Besides, the rehabilitation of all diesel generators can be arranged for the same amount as would be required for the installation of one complete new unit. A single new unit however would still necessitate the overhaul of 2 other units to arrange for the required spare capacity.

- Installation of one new turbo-generator capacity 3 600 kVA, maximum steam consumption 9 kg/kWh, preferably lower (see Annex IV).

- This set should be installed as soon as possible, but since it takes considerable time between the decision to install the unit and the actual operation of the set it is not expected to be operational before the 1987/88 crushing season.

- Procurement of about 120 new electric motors for replacing the obsolete ones, driving pumps, conveyors, etc.

- Procurement of new electric motors for the centrifugals.

(e) Boiling House

- Installation of instrumentation, comprising automatic pH-control for final hot liming, temperature recording of first and final heated limed juice, clear juice before evaporation, brix recording of syrup ex evaporation, water consumption meters for vacuum pan and centrifugal plant, conductivity meters for controlling grain formation.

- Installation of one rotary vacuum filter with ancillary equipment, including filtrate pumps. Filter to be identical to existing Dorr Oliver filter.

- Overhaul of existing Dorr clarifier under expert guidance.

- Installation of one new DSM type stationary screen for straining clear juice to improve sugar quality.

- Installation of an additional air heater and blower fan for sugar drying.

- Installation of new process pumps, each with a stand-by pump of adequate capacity at a throughput of 2 400 t/d cane to replace the obsolete pumps and pumps of too low capacity.

- Installation of new process piping to replace obsolete piping and piping of underrated size.

- Installation of new panels for centrifugals to replace the panels, which are beyond repair.

- Overhaul of centrifugal plant under expert guidance from suppliers FCB and Bosco.

- Repair of Servobalance for final molasses and installation of available Servobalance for imbibition weighing under expert guidance.

(f) Laboratory

Procurement of the following equipment:

- one air conditioner for chief chemist's office;
- two analytical balances;
- one moisture teller for moisture bagasse determination;
- one Jeffco wet disintegrator for pol bagasse determination;
- one water distilling apparatus;
- one laboratory centrifugal for checking massecuite exhaustion;
- one laboratory microscope;
- three electronic table model calculating machines.

(g) Distillery

- Intensive overhaul under expert guidance.

(h) Buildings

- Procurement of paint.
- Replacing obsolete raingutters and roofsheets by new ones.
- Installation of new shed for tailwater boosterpumps near to spray-pond.

(i) Investment Costs for Proper Rehabilitation

Estimated investment costs for aforementioned measures are given in Table IV.1.2.

3.7.3 Proposed Measures for Improvement of Organisation and Manning

- The organisation and manning numerically, as shown in Figure 2.4.2, to be maintained, except for the following modifications:

  (a) The workshop service to be under the direct responsibility of the General Manager, except for the factory workshop and the diesel power plant as for its operation, which should remain under the direct responsibility of the Technical Manager. Maintenance of the diesel power plant to remain under the workshop service.

  (b) Cane weighbridges to be under direct responsibility of the Chief Chemist.

  (c) Technical Service/Design Department to be under direct responsibility of the Technical Manager.

(d) Training section to be under direct responsibility of the General Manager.

- Unqualified personnel in top and middle management positions, i.e. mechanical, electrical, instrumentation engineers, shift engineers and shift process supervisors, to be gradually replaced by local personnel of college graduate level.

  These personnel to be employed in time and to be appointed to the actual execution of their function after having obtained adequate practical expertise under the guidance and coaching of expatriate staff.

- To achieve the targets of a moderate investment strategy, aforementioned expatriate staff should be engaged on short notice at least for the followng positions:

  - one Factory Manager;
  - one Technical Manager (Chief Engineer);
  - three Shift Engineers;
  - one Senior Electrical/Instrument Engineer;
  - one Mill Engineer
  - one Boiler Engineer
  - one Electrical Engineer
  - one Instrument Engineer
  - three Repair Engineers
  - one Design Engineer
  - one Production Manager
  - three Shift Process Supervisors
  - one Laboratory Chemist
  - one Training Coordinator

Job descriptions for these positions are given in Annex IX. Years of employment are given in Table 3.7.1.

- To start on short notice a crash training programme, for which the restricted available training facilities have to be extended with the emphasis on upgrading of maintenance, operational skill and on-the-job training. Theoretical and practical training of all levels as much as possible to be executed in own management in concert with a training coordinator, full time, assisted by at least two training experts, one for cane sugar engineering, the other for cane sugar processing and part time assisted by aforementioned expatriates for classroom and for on-the-job training.

The training coordinator and training experts including relevant training materials, i.e. manuals, audio-visual instruction equipment, etc., preferably to be contracted from a qualified firm for a period till at least 1988, whereafter the training facilities have to be managed completely by local qualified staff.

In addition in a later stage maximum use should be made from the Vocational Trade School in Mogadishu, which will start in the middle of 1984.

TABLE 3.7.1

Proposed Expatriate Staffing

Nr	Position	1984	1985	1986	1987	1988	1989	1990
1	Factory Manager	+	+	+	+	+	-	-
1	Technical Manager	+	+	+	+	+	-	-
3	Shift Engineers	+	+	+	+	-	-	-
1	Senior Electrical/ Instrument Engineer	+	+	+	+	-	-	-
1	Mill Engineer	-	+	+	+	-	-	-
1	Boiler Engineer	-	+	+	+	-	-	-
1	Electrical Engineer	-	+	+	+	-	-	-
1	Instrument Engineer	-	+	+	+	-	-	-
3	Repair Engineers	-	+	+	-	-	-	-
1	Design Engineer	-	+	+	+	+	-	-
1	Production Manager	-	+	+	+	+	-	-
3	Shift Process Supervisors	-	+	+	+	-	-	-
1	Laboratory Chemist	-	+	+	+	-	-	-
1	Training Coordinator	-	+	+	+	+	-	-
2	Training Experts	-	+	+	+	-	-	-

3.7.4 Time Efficiency and Factory Capacity

- In Table 3.7.2 is shown, as a result of the moderate investment strategy, the expected improvement of the time efficiency in relation to the gradually increasing cane supply and the crushing rate derived therefrom (cane crushed per actual milling day), reaching the design rate of 2 400 t/d cane in 1991/91.

- Since a crushing rate below 1 600 t/d cane is impractical, the number of operation days for 1983/84; 1984/85 and 1985/86 should be less than 230. Hence the first milling period of 1984/85 and 1985/86 will only be about one month and three months respectively with the advantage that more leeway becomes available for the implementation of the crash programme and subsequent rehabilitation.

3.7.5 Steam Balance and Energy Requirements

Considerations on and assessment of the energy requirements during the milling season and off-season are elaborated in Annex IV, including the steam balance during normal operation at 100 t/h cane, as well as diagram (Figure IV.1) of the steam production and steam consumption at 100 t/h cane.

3.7.6 Recoverable Commercial Sugar from Cane

In Annex IV.2 is elaborated the assessment of recoverable commercial sugar from cane after rehabilitation at a moderate investment strategy, including the Brix and Pol balance showing the sugar losses in bagasse, filtermud, molasses and unknown losses.

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Factory Output

First milling period as from 16.6 to 15.10		:	121 days
Second milling period as from 16.12 to 15.4		:	120 days
Total available calendar days		:	241
Downtime for non-factory reasons:			
- public holidays	: 6 days		
- out of cane due to rain	: 5 days	:	11
Total available operation days		:	230

Year	Cane crushed (t)	Operation days	Downtime %	Time efficiency %	Actual milling days	Cane milling day (t)	Pol % cane	Recovery %	Sugar % cane	Sugar (t)
84/85	99 000	124	50	50	62	1 600	11.0	55	6.1	6 040
85/86	148 500	155	40	60	93	1 600	11.0	55	6.1	9 060
86/87	214 910	206	35	65	134	1 600	11.2	60	6.7	14 400
87/88	285 470	230	30	70	161	1 780	11.4	65	7.4	21 120
88/89	349 510	230	25	75	172.5	2 030	11.7	70	8.2	28 660
89/90	405 550	230	20	80	184	2 200	12.0	75	9.0	36 500
90/91	436 650	230	15	85	195.5	2 230	12.3	78	9.6	41 920
91/92	453 610	230	15	85	195.5	2 320	12.6	78	9.8	44 450
92/93	469 510	230	15	85	195.5	2 400	12.8	78	10.0	46 950
93/94	469 510	230	15	85	195.5	2 400	12.8	78	10.0	46 950

3.7.7 Individual Capacity of Installed Equipment

Updated detailed data on equipment appeared to be scantily available.

Data currently available made it possible to assess at least whether the capacity of main equipment is sufficient for a throughput of 100 t/h cane.

This has been elaborated in Annex IV.3. As for minor equipment a substantial number of process pumps and electric drives as well as pipelines are reportedly under-rated for 100 t/h cane apart from being in a poor to bad condition.

Therefore, provisions for capital expenditure during the rehabilitation stage have been made for gradual replacements, rated for 100 t/h cane.

3.7.8 Raw Factory Water, Boiler Feedwater and Process Water

In Annex IV is elaborated the assessment of required raw factory water, boiler feedwater and process water for processing 100 t/h cane including a detailed review of the present condition of these utilities with recommendations for improvement.

3.7.9 Effluent Treatment

Filtermud

The filtermud will be collected in specially designed trailers that will transport the mud to the fields, where it is to be spread out. In this way additional fertiliser is obtained.

Factory Waste Water

This concerns only very limited quantities for cleaning purposes with very low BOD levels and direct drainage into the river is fully acceptable.

Distillery Waste Water

The total quantity will reach some 160 m^3 per day (less than 2 l/s) with a high BOD level. It is suggested to drain this into the river, when the river flow rate is over 2.0 m^3/s. When the river flow rate is lower, this slop will be spread over the fields.

Molasses

As long as the factory operates at reduced capacity all molasses can be handled by the present distillery. It is also envisaged that in future adequate measures will be taken to have the required distillery capacity available to process all molasses produced by the sugar factory.

The required transport units have been included in the rolling stock requirements.

3.8 Future Harvesting and Transport System

3.8.1 Future Transport System

(a) General

To devise a proper system requires careful evaluation of the various parameters such as:

(i) methods applied at present;

(ii) topography of the area under cane;

(iii) soil conditions in the field;

(iv) climatic conditions during the crushing period;

(v) available manpower and skills;

(vi) field and road layout;

(vii) costs of the various systems that are physically possible;

(viii) managerial capabilities of the project staff;

(ix) rehabilitation programme of the plantation;

(x) unloading facilities at the factory.

The harvesting and transport systems presently used have been introduced without proper evaluation of the various advantages and disadvantages of these systems.

(b) Harvesting System

Harvesting and transport of sugar cane is carried out in many different ways all over the world. A major part of the cane handling system is the cutting and loading in the fields. With regard to this operation 3 systems may be considered most popular:

(i) Handcutting followed by mechanical loading.

(ii) Mechanised cutting followed by mechanical loading.

(iii) Mechanical harvesting by machines that cut and load in one single operation.

When a decision as to the application of a system has to be made the following major aspects have to be taken into consideration:

- availability of labour and skills;
- impact on overall cane and sugar recovery and the financial consequence thereof;
- cost of cutting and loading with the various systems, taking into account the foreign exchange components.

(c) Labour Availability

Jowhar Estate is not the only enterprise in Africa that faces difficulties in recruiting sufficient labour for the cutting of sugar cane under the severe and dirty conditions inherent to that activity.

This problem has been solved quite successfully in a number of enterprises by mechanising all other plantation activities like planting, fertilising, weeding, etc., to save on manual labour in order to attract more people for cutting.

Moreover cane cutters were provided with better salaries, housing, tools and transport, whereas they received a high energy diet (free of charge) once per day and received basic training and advice.

Together with a more efficient system this made the work more attractive and consequently more workers applied for the job while less were needed as a result of the higher outputs per manday.

It is considered possible to obtain an output of 3 tons per man day in the final stage of the rehabilitation programme, which including absenteeism, results in a total labour force of some 800 to 900 cutters.

Over and above this labour additional personnel will be required for supervision, burning, grab loading, cane collection and field preparation.

(d) Mechanised Operations

When harvesting operations are mechanised labour requirements drop to about 10%, but it is obvious that managerial, technical and operational skills need to be of a far higher standard.

It is generally accepted that provided skilled cane cutters are employed the amount of cane left in the field is 4 to 5%, compared with 10 to 12% for mechanical harvesting.

The amount of foreign matter brought in by chopper harvesters reaches 12%, by whole stalk harvesters 10% and by hand cutting 4.5% as general averages.

It is because of this foreign matter that considerable investments had to be made in the factories dealing with mechanised harvesting to clean and wash the cane prior to entering the milling plant. Nevertheless the overall sugar recovery in the factory is reduced, whereby the results of chopper harvesters are less favourable than with whole stalk harvesters.

It is generally accepted that sugar production per hectare harvested by machines is reduced by about 10% for chopper harvesters and about 9% for whole stalk harvesters when compared with manual cutting.

When comparing both mechanical systems it has to be observed that the machines can only be used during daylight hours which are generally limited to 12 h/d.

When chopper harvesters are used this implies that storage facilities (usually inside containers) need to be available for about 13 hours, which requires a considerable capital outlay, whereas all transport equipment can operate for 12 h/d only.

When whole stalk harvesters are used the loading by grab loaders and transport operation can be continued throughout 24 h/d. This in principle reduces the transport fleet to about 50% of that for choppers and eliminates major investments in storage facilities, as the limited storage capacity required can be arranged for in the transport units themselves, or at the cane yard.

(e) Loading

In future all loading will be carried out by means of grab loaders. The number of units presently available and of the proper design will be more than ample to cope with the requirements and apart from normal replacements investments need not to be made.

The loaders will operate 24 h/d in a 3 shift system.

(f) Recommended Harvesting Systems

In the future system all effort should be concentrated on recruiting sufficient labour to manually harvest the cane. In case this proves to be impossible, the purchase of whole stalk harvesters should be considered.

The chopper harvesters presently available at the Estate should be used until their economic lifetime is passed (they are estimated to last until 1986).

They should, especially in the beginning, contribute to the highest possible cane supply to the factory, regardless of the high losses in the field and factory. The units should be used in nearby fields and work together with part of the available trailers.

The purchase of 2 whole stalk harvesters is considered necessary for experimental purposes, in order to obtain the necessary experience with such units and facilitate a possible changeover, in case labour recruitment for cutting also fails in future.

Moreover these units, as well as the chopper harvesters, will be required to assist in the cane supply during the first years of the rehabilitation programme, when labour availability and outputs per day are expected to be low.

It should be kept in mind that the performance of the whole stalk harvesters will not be optimal as long as the fields have not been rehabilitated and consequently the ordering of additional units will be dependent on the progress in these fields.

Although the direct costs for harvesting by these machines are about the same as for manual cutting (SoSh 19.3 and SoSh 20.0 respectively), most of the harvester expenses (over 90%) are in foreign exchange, and overall sugar recovery per hectare may be reduced by 8 to 10% as compared with manual cutting.

Considerable investments will have to be made to install a cane washing plant at the factory.

It is because of these losses and additional investment in factory equipment, that manual labour is favoured and all our financial calculations are based on the manual system at the final stage of the project.

(g) Recommended Transport System

It is envisaged that in-field transport by rail will be eliminated as soon as possible and will be carried out by means of tractor and trailer units.

These tractor/trailer units either transport the cane directly to the factory from nearby areas or to transloaders that transfer the cane into railcarts for areas further away from the factory. In Annex V is indicated the nature of transport for sugar cane at the Estate.

The available Miedema and Toft trailers are considered adequate to transport the cane directly to the factory as their hydraulic tipping device allows for unloading at the factory without additional provisions regardless as to whether they have to transport chopped or whole stalk cane.

New trailers will have to be purchased to implement the transport system whereby transloading is required. It should be noted that the availability of these trailers determines the termination of the in-field rail transport.

Although the available trailers are considered capable of carrying 8 to 12 t of chopped cane it is estimated that due to the tyre size the load should be limited to 8 t only to reduce soil compaction.

These trailers of the weight transfer type will be hauled to the factory as single trailer lunits by the available Deutz tractors.

The new trailers will have a capacity of 4.5 t of cane each. The leading trailer will be of the weight transfer type whereas the other trailer will be of the single axle type. The unit, consisting of 2 trailers, can be hauled by the available Deutz tractors.

This 2 trailer unit is preferred above a single trailer of the same capacity to reduce soil compaction and to safeguard a minimum cane supply to the factory in case of wet fields as the unit will then operate with 1 trailer only.

Rail transport will be used for about 2/3 of the cane area in combination with the transloaders and the in-field units.

The available rail track, locomotives and rail carts are considered ample to cover the needs and apart from replacements in future additional investments need not to be made.

The entire transport system will operate in a 3 shift system for 24 h/d as from the beginning of the rehabilitation programme.

(h) Light Units

Apart from a proper lighting system on tractors, loaders and locomotives it is considered necessary to arrange for additional allumination near the fields where loading is being carried out as well as near the transloading stations.

This is to be arranged by small mobile diesel driven generators of 5 to 6 kW capacity.

(i) Required Equipment

The equipment requirements for the harvesting and transport section, inclusive of costs, have been calculated in detail and are presented in Annex V.

(j) Organisation of Harvesting and Transport Section

The manager of this section is directly responsible to the agricultural manager and should arrange for all activities related to harvesting, loading and transport of cane up to the factory weighbridges, where the cane is taken over by the factory staff.

Harvesting will only be carried out in daytime in 3 fields simultaneously and consequently 3 crews will be required for supervision.

Loading and transport will continue for 24 h/d as from 3 locations and this implies that a 3 shift system is necessary, each shift having 3 crews.

Prior to the actual harvesting the fields need to be burnt which is usually done during the night before. This burning requires various special precautions and preparations for which a well-trained crew should be available.

The preparation of field entrances/exits prior to the transport operations should be arranged for by the farm managers in consultation with the road maintenance section of the Estate.

An organogram of the harvesting section is presented in Annex V, Figure V.2 when harvesting is done manually. Annex V also includes the requirements for whole stalk harvesting.

In this harvesting section, which covers the entire area, adequate transport means for supervisory staff is an absolute must whereby motorcycles should not be considered suitable for night operations.

All head men and the harvesting foremen can be transported together with the cane cutters or equipment operators. The transport foremen need to share a pick-up, whereas the supervisors and the department manager need to be provided with their own transport means.

The wheel tractor and locomotive drivers transporting cane to the factory can be relieved at the factory compound.

Grab loader, transloader and wheel tractor operators for in-field operation should change shifts in the field for which purpose a small truck will be required.

This unit is also to be used for the provision of means to the cane cutters.

Water should be provided by means of a tank trailer pulled by a wheel tractor that also supplies water to fields where other manual activities are carried out or to any other places where drinking water is not readily available.

Cane knives which are to be supplied free of charge need to be collected at the end of the day by the foremen of the section.

Those knives that need repairs or to be sharpened have to be sent to the machine shop.

When harvesting is carried out by whole stalk harvesters the total number of especially unskilled labour will be reduced considerably, but the number of operators and maintenance personnel need to be increased.

3.8.2 Infrastructure, Railways, Roads and Camps (Future)

(a) Railway Network

As already observed under harvesting it is envisaged that a fixed network of railways will be maintained whereas there will be no need to use transportable rails in future.

The main purpose of the railway network is the transport of sugar cane but it may also be used for all other kinds of transports, like personnel (e.g. cane cutters), fertiliser, etc.

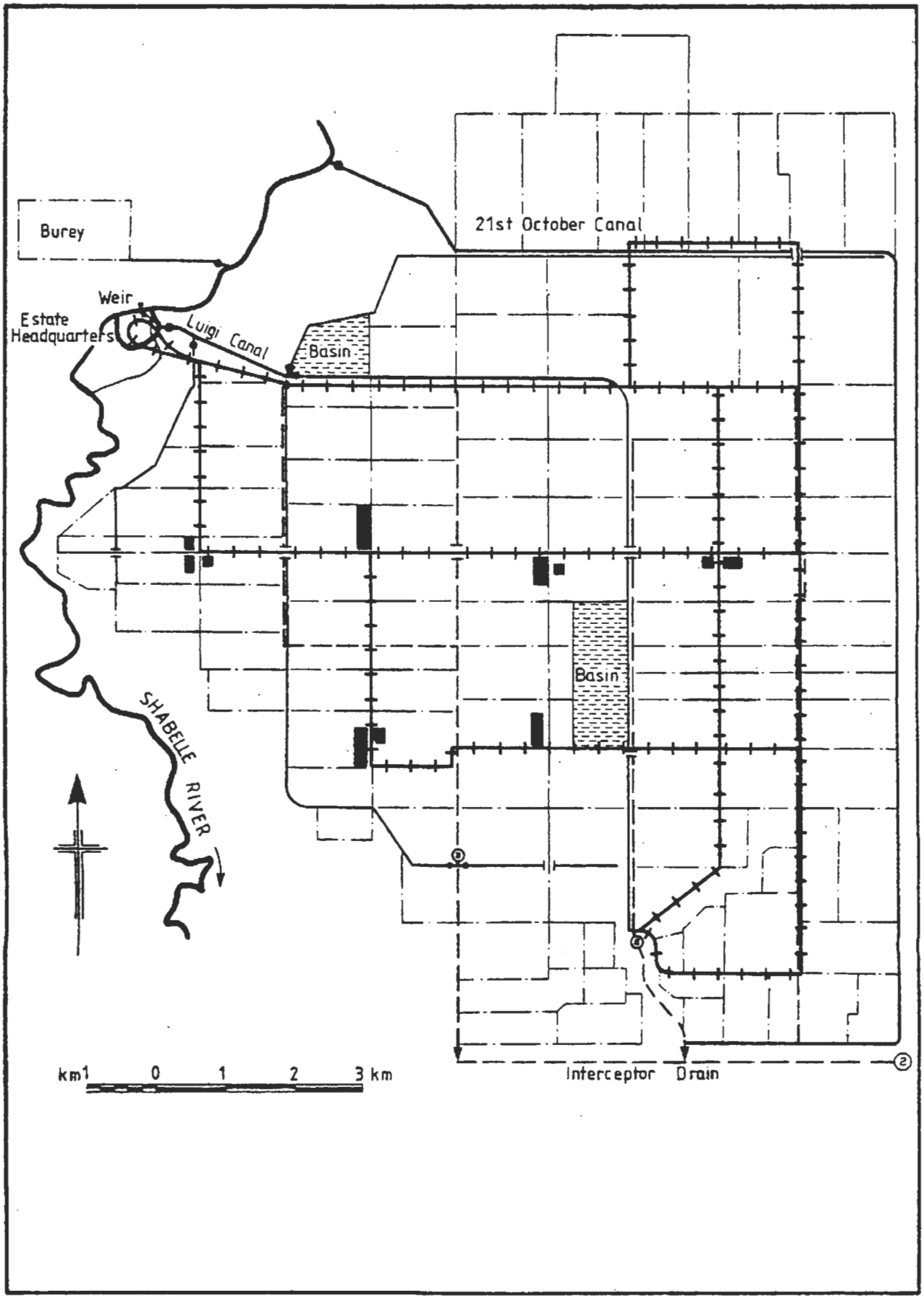
In order to create a safe and smoothly operating system the network should allow for one direction of transport only, whereby in the case of transport in both directions either a double track or adequate passings should be arranged for.

The proposed railway network is shown in Figure 3.8.1. It allows for one-way traffic for the cane transport for the major part of the area, whereas all the available camps in the area can be reached as well.

When comparing the new layout with the presently available network, including the portable rail presently available, it is concluded that the available rail will be sufficient to arrange for the new network and major investments for extension need not be made.

Figure 3.8.1

Jowhar Sugar Estate
Future Railway Network



(b) Roads

In designing the road layout consideration has to be given to the nature and frequency of the transport in the area and to arrange for adequate and shortest possible connections between the various plantation areas.

Figure 3.8.2 presents the proposed layout for primary and secondary roads, whereby it is observed that the major part of these roads is already in existence, be it that they require considerable upgrading, which is mainly a matter of arranging proper road drainage.

The total area will require about 23 kilometres of primary and about 55 m of secondary roads.

All other requirements to reach individual fields can be of tertiary standards as traffic on these "tracks" is very limited. To reduce on maintenance of these communications attention has to be paid to surface drainage.

Although the soils of the Estate are far from ideal for constructing road embankments, it is anticipated that with proper drainage and limited transport movements during and immediately after rains, road maintenance can be kept within reasonable limits. The upgrading of the road system should be an integral part of the entire rehabilitation work on the irrigation and drainage systems.

(c) Camps

It is envisaged to upgrade the standards of these camps especially those of the former Farms I, II, IV and VI and to also create more living quarters for plantation and harvesting personnel.

3.8.3 Maintenance Facilities in Future

(a) General

It is envisaged to divide the present workshop into a complete separate section, for farm machinery and transport equipment, responsible to either the General Manager or the Agricultural Manager and another section consisting of machine shop, boiler shop and carpenters' shop responsible to the factory manager, as the factory is more dependent on these workshops.

This division is considered necessary as the experience and skill required to manage and supervise the totally different workshops, in the future, is unlikely to be available and would make future training programmes too extensive. In this way more specialised courses can be worked out.

As already indicated, the available manpower is considered adequate in quantity, but is definitely insufficient in quality.

Extensive training programmes have to be worked out, whereby the utmost attention should be given to the exploration of possibilities in Mogadishu and other African countries.

As to the maintenance of the railway network, it is observed that this needs to be carried out by a civil engineering department also in charge of maintenance of roads, irrigation and drainage systems. This department should then be within the control of the agricultural manager.

The repair of rails and joints should be dealt with by the FMT workshop.

(b) Required Manning of Workshops

The prevailing conditions at the project and in the workshops in particular require the employment of a management team for a prolonged period of time. As for the workshops each team should consist of:

(i) farm machinery and transport workshop manager;

(ii) assistant farm machinery and transport workshop manager;

(iii) workshop manager for carpenter, boilermakers, and machine shop.

All the above personnel should be highly qualified expatriates.

Furthermore there should be a total of 4 highly qualified third country nationals for the following functions:

For farm machinery and transport workshops:

(i) heavy plant and wheel tractor engineer;

(ii) motor vehicle engineer;

(iii) general engineer.

For other workshops:

(i) machine shop supervisor.

It is noted that the expatriate team is required for a period of at least 5 years, whereas the average period for the other experts is estimated at 2 to 3 years.

The future organisational set-up, including the required manning for the FMT workshop, and that for the other workshops is presented in Annex V.

(c) Required Workshops

The present buildings are considered adequate provided all scrap materials and equipment that is beyond repair are removed from within the various buildings.

The future layouts of the workshop buildings are presented in Annex V. Ample room will be available to carry out the activities as envisaged.

(d) Required Workshop Equipment

Most of the equipment presently available in the workshops is pretty old and needs rehabilitation or immediate replacement.

The available hand tools, measuring equipment, hoisting facilities, washing equipment and the like are far too limited to achieve an acceptable efficiency in those workshops.

Figure 3.8.2

Jowhar Sugar Estate
Future Road Network

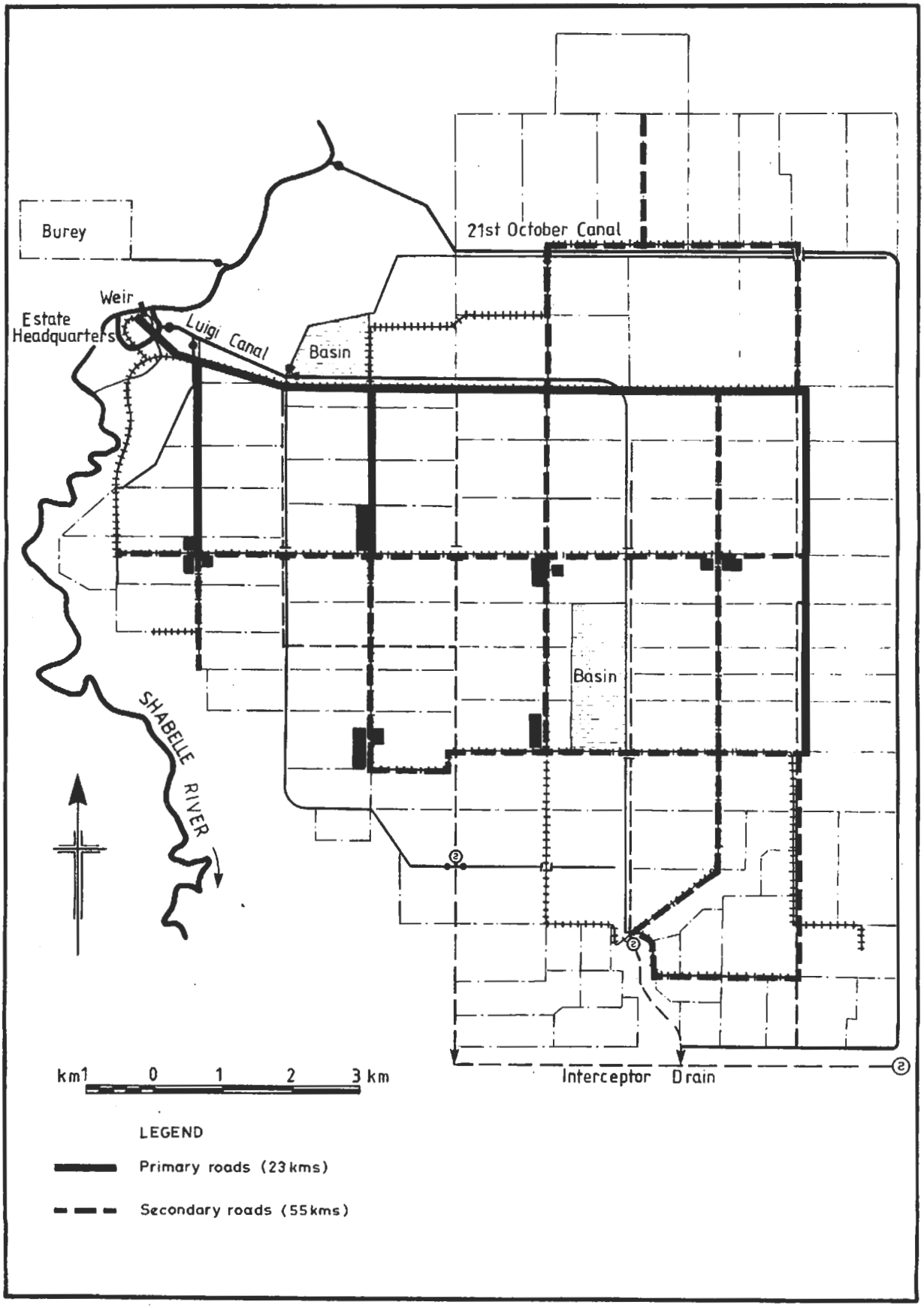
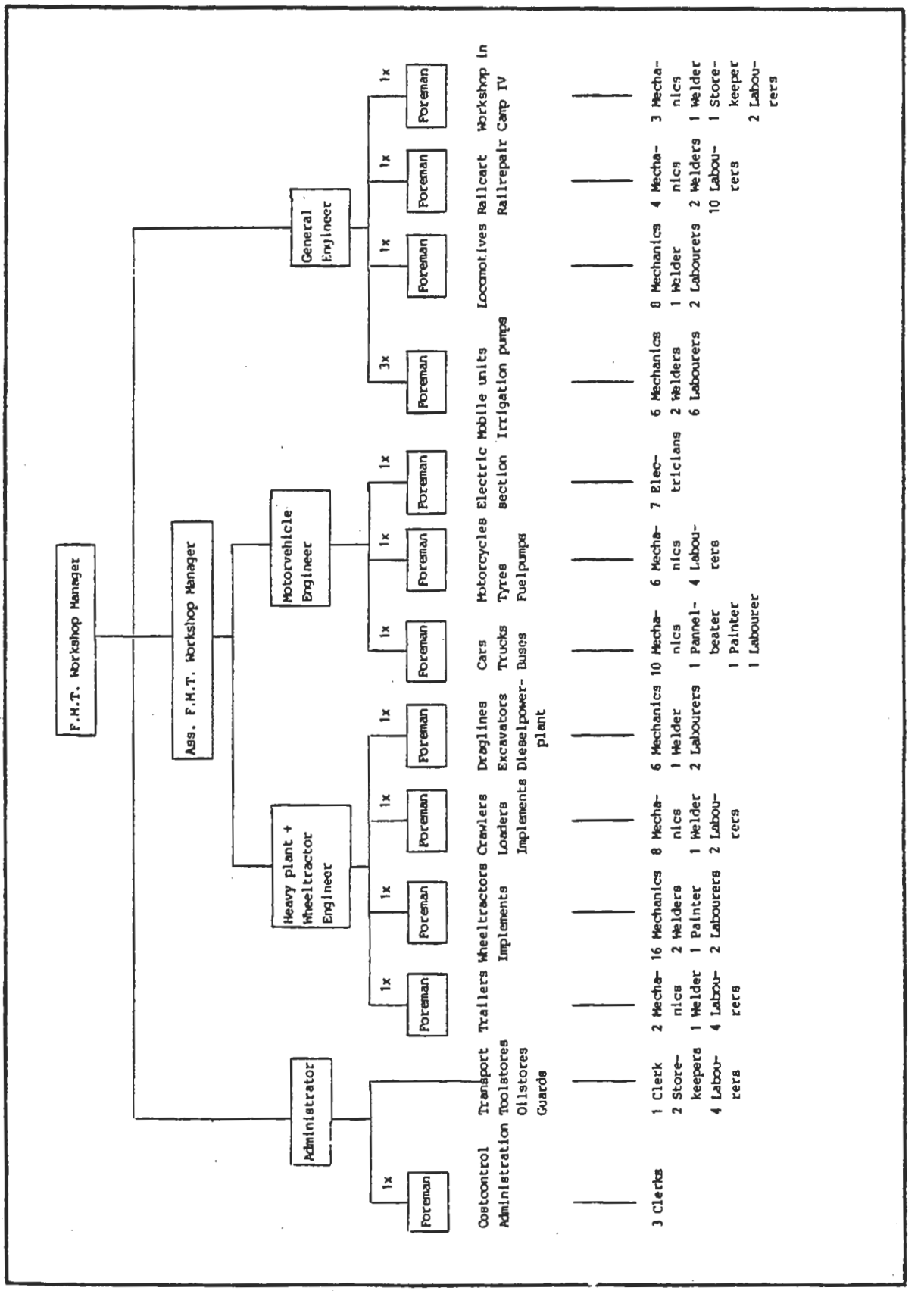
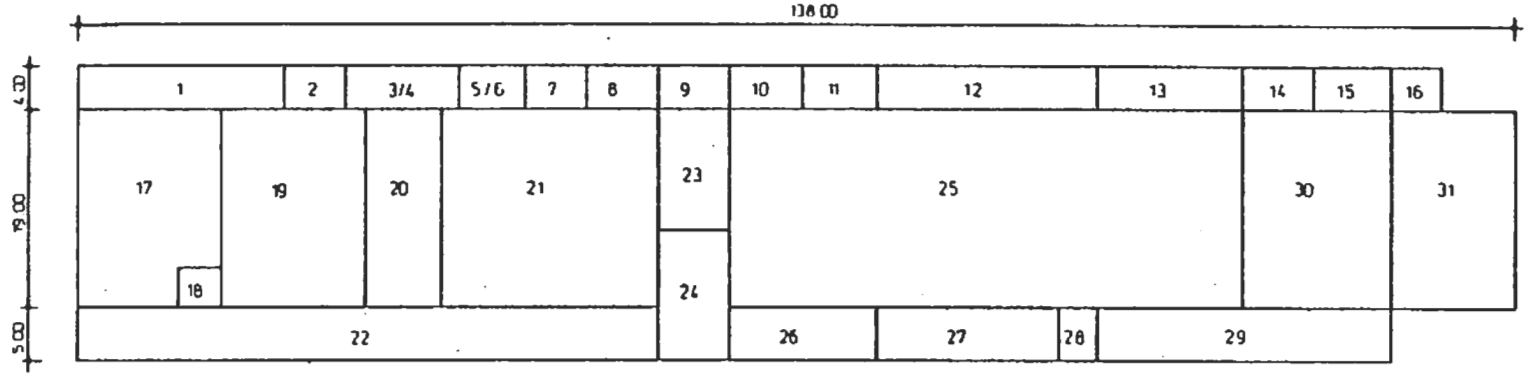


Figure 3.8.3

Mechanisation and Transport
Proposed Organisation





1 Body + radiator repair
2 Battery room
3, 4 Electrical workshop
5, 6 Battery room
7 Switchboard
8 Fuel pumps repair room
9 Repair freezers + airco's
10 Toilets
11 Office
12 Welding + blacksmith
13 Pump repair room
14 Tool store
15 Office
16 Electrical workshop
17 Welding area
18 Office
19 Motorcycle repair
20 Service/greasing area
21 Vehicle repair
22 Parking area
23 Tool + oilstore
24 Offices
25 Machine shop
26 Parking
27 Parking
28 Parking
29 Rail repair
30 Locomotive/railcart repair
31 Locomotive/railcart repair

0 5 10 15 20m

Figure 3.8.4
Main Workshop
Proposed Layout

In Annex V the available workshop equipment is listed and additional requirements indicated.

Over and above an improvement of the facilities within the building it is considered essential to have a well equipped mobile workshop available (equipped with the necessary tools and machinery to carry out repairs in the field). At the same time a mobile fuel/oil/grease unit is to be available to service those machines that either work on a 24 h/d basis, or that are parked in the fields at night time and do not come to the workshops for fuelling and greasing.

Over and above the mobile workshop it will be necessary to have a tractor/trailer unit available, to replace flat tyres in the field. The actual repair of the tyres will be carried out in the workshop itself.

To coordinate the activities in the field and to arrange for an optimal communication between and amongst maintenance and plantation sections the availability of a radio communication network is considered to be top priority.

This will reduce travelling time and consequently the mileage driven and increase the outputs to a great extent, which all mean lower costs and higher efficiencies.

(e) Workshop in Farm IV Camp

The workshop located in Farm IV camp is situated in the centre of the Estate area and as such the location is ideal for a FMT workshop.

A transfer of the heavy plant and harvesting equipment to this workshop has been seriously considered. In view however, of the fact that a subsistence crop section within the Estate will possibly need a separate workshop, for which purpose this workshop is ideal, this was rejected partly because some additional investment would be required to arrange for the necessary facilities, which would also be required or are already available at the main workshop.

Moreover, separate spare part stores, supervision, skills, etc. will increase costs, as well as the additional housing facilities which need to be created for technicians and operators who most probably are not willing to leave the township.

In our opinion this workshop should be used to park the equipment after working hours unless they can be parked in the field.

This workshop should then carry out the general services, such as fuelling, greasing, checking and minor repairs.

To arrange for this a limited crew with limited facilities, including a store carrying some of the most frequently needed items, will be adequate.

All of this can be arranged, as apart from some upgrading the required buildings and other facilities are available.

(f) Training

As already observed earlier the lack of trained supervisors and technicians had a detremental effect on the performance of the maintenance sections.

It is therefore considered a must to include extensive programmes in the rehabilitation schedule, moreover counterpart employees, if possible with the required educational background, should be made available at the earliest stage of the project to work together with the expatriates and TCN employees.

Although difficult to assess correctly, a brief evaluation of the available skills of the supervisory staff indicates that the counterparts already available at the project, apart from on-the-job training, do require additional in-class training. This training has to be focused on particular aspects of management of the project including administrative, personnel, organisational, ordering, stock policy and technical matters.

Most of these aspects can be covered in general courses for all counterparts regardless of their specific job, others however, need to be focused on the required specific knowledge.

For those general courses training facilities need to be created at the project itself, whereas for the specific requirements assistance will have to be arranged from within the country or from abroad, preferably within Africa.

Training of all other technical personnel in the workshops, from helpers to foremen, should be arranged at the enterprise itself. Apart from shop floor training it is expected that in-class training for a period of about 6 months will be required for these personnel.

In order to obtain the highest efficiency in the training programme proper guidance during the shop floor training is of crucial importance, as this usually is the weakest part of the whole exercise.

Training of drivers and equipment operators should not be overlooked. This is because a well trained driver will handle the machine properly, thus increasing outputs and reducing repair bills.

The training should consist of a course on how to operate the equipment, which can be by the plantation staff. The technical aspects of the equipment and the maintenance it requires should be dealt with by the FMT workshop staff.

All of this training can be arranged during the out of crop season, when most of the equipment is idle and units can be made available for training purposes in the field. Some of the drivers and operators can be assigned to the workshop to assist with service and maintenance activities and in this way learn the technical aspects of the latter.

(g) Stores (Future)

It will take a long time to arrange for a proper functioning store.

Apart from the efforts required by the store personnel substantial assistance will be required fom the consumer departments to identify parts when the information is no longer available, or to decide on whether or not a particular part is obsolete.

It is considered best to start with ordering the necessary store racks for the smaller items as soon as possible and to work out a plan as to where the various racks for particular consumer departments should be located.

The relocation of spare parts should at the same time be used to:

- make out a new cardex card;
- make a stock inventory control;
- determine the correct codification number;
- decide on obsolescence.

The cardex and codification system presently in use should be maintained, as it is basically sound and computerisation of the stores need not to be considered for many years to come.

Together with accounts and consumer departments the entire administrative system for requisitions, issues, returns, receipts, etc. need to be reviewed and implemented.

(h) Spare Part Position

Although the parts position will improve after the arrival of the orders placed under the various schemes, a major improvement cannot be expected. This is because these orders only hold a small variety of spare parts for specific equipment and consequently will be much too limited to cope with the requirements.

Since rehabilitation of the equipment cannot be accomplished without the necessary spare parts top priority should be given to arrange for this.

Unfortunately it will be impossible to obtain reliable information from the stores with regard to the availability of parts.

The inventory list as presented in Annex V provides basic information as to the condition of most of the equipment and with the help of the manufacturers it is considered possible to work out requirements to at least start with the overhaul.

Any new equipment that is bought for the project should be supplied with a variety of spares and tyres equivalent to 10 to 15% of the purchase value in order to keep it operational for about 18 months.

Upon arrival of these parts stores procedures should be adequate and store racks should be available.

3.8.4 Short and Long Term Objectives

(a) General

Whenever considerable investments have to be made on farm machinery and transport equipment, it should be at the disposal of a competent management at the right time. Such equipment should be supplied complete with the required spare parts for 18 months of normal operation.

The maintenance facilities should be available, together with the required organisation and manpower to ensure both an optimal operation efficiency and high standards of (especially) routine maintenance to prevent extensive and costly repairs.

New agricultural techniques require equipment which is not in operation at the Estate at this moment and hence should not be made available yet to prevent abuse during operation.

The rehabilitation of the whole project is so complex that it is not advisable to improve on particular aspects, when other related ones cannot be tackled at the same time.

Therefore the short term objectives should be:

(a) Fulfilment of the immediate requirements to ensure the highest possible sugar production in providing the required transport means.

(b) To prevent any further deterioration and silting up of the irrigation and drainage system to ensure an optimal cane production under the prevailing conditions.

(c) To create the possibility for an optimal start of the rehabilitation programme by working out detailed requirements on spare parts, workshop equipment, storage facilities for parts, etc.

The long term objectives will aim at providing the necessary equipment, with a mechanical availability of not less than 75%, to carry out all required field and transport activities of the project. To achieve this, highly qualified management and supervisory staff is a prerequisite and such levels are not considered available to the project from within the country.

The employment of expatriates will enable local staff to attend training courses and receive extensive on-the-job training over a number of years for the benefit of the project in future.

The high availability rate as envisaged can only be achieved when other parameters like purchasing, stores, workshop facilities, field layout, railway and road conditions, overall management, etc., are simultaneously improved.

(b) Crash programme

In the light of the observations made earlier it is obvious that any crash programme, unless foreign management is involved at the same time, will have but limited results.

In order to prevent further deterioration of the maintenance activities and to guide and supervise the rehabilitation of the available equipment it is advisable to arrange for a farm machinery and transport maintenance manager as soon as possible.

This is to ensure that the operational availability of the existing as well as any new equipment is kept at the highest possible level to carry out the crash programme.

The rehabilitation of the existing equipment should be carried out by highly skilled technicians employed by the manufacturers.

It is anticipated that in total 3 experts will be required for two periods of 3 months to recondition the most crucial agricultural equipment:

- A heavy equipment expert for Caterpillar crawlers and motor graders as well as for Poclain excavators and Sink Belt draglines.
- A wheel tractor expert, preferably from Deutz, the manufacturer of the wheel tractors, who should also be familiar with the locomotives, all of which have similar engines to the wheel tractors.
- An expert from Cameco, the manufacturer of the grab loaders and heavy 4-wheel drive tractors.

Prior to sending these experts the required spare parts and tools should be available at site to enable them to start repairs immediately.

Sufficient information is available to implement these orders in consultation with the equipment manufacturers to make a start.

Furthermore, the experts should be allowed to order additional parts for immediate requirements by air. The importance of proper tools for the experts and their assistants at site should not be underestimated and these must be available upon arrival at site.

The presence of the experts should also create the opportunity to evaluate the available equipment in more detail during the repair period and they should prepare lists of spare parts required to keep the equipment operational for another year.

These lists need to be checked by the stores on eventual availability of the parts needed. This will result in extensive lists indicating future requirements that can be ordered immediately when the overall rehabilitation programme starts.

Special aspects to be taken into consideration when the experts are made available :

- Required accommodation.
- Required local manpower.
- Position in the organisation.
- Area of responsibility, which should be limited to the actual repair only.
- Should be able to speak Italian.

In order to have the required maintenance facilities available the ordering of additional workshop equipment especially the mobile units is considered top priority. Details can be worked out on the basis of the final requirements as indicated in Annex V.

Apart from the rehabilitation of the existing equipment it will be necessary to arrange for a limited number of new equipment to cover the immediate needs. This will basically be limited to a number of transport units for the supervisory staff and for the transportation of personnel.

Major investments on new agricultural equipment should not be effected until a complete management team is available for the project. The preparation of tender documents, etc. for this new equipment could be worked out by a professional consultant, who eventually can also assist in the evaluation of the offers in order to arrange for immediate ordering once a management contract of whatever nature is agreed upon.

In the meantime the project could start with an extensive cleaning operation around and inside the workshops. Since moreover cane transport in future will also mainly depend on rail transport a start should be made wherever possible to repair the railroad network. Those rail lines not required in future can be removed, repaired and stored near the area where the rails will be required in future.

3.8.5 Future Requirements on Rolling Stock

These requirements are presented in Annex V and hold all units of the entire project.

The units presently available at site and earmarked for rehabilitation have been included as well except for the 5 Cameco 4 WD tractors and the 10 Reynolds scrapers. The latter are particularly suitable for levelling activities in the field and it is anticipated that these units can be hired out to the contractor given the task to level the fields.

In the event that this does not materialise the tractor can be used to carry out part of the D6, D4 and 100 hp wheeltractor activities.

The immediate needs to carry out a crash programme are very limited and can be covered by the units suitable to be rehabilitated.

In order, however, to improve on supervision in the fields, to allow for better transport of plantation personnel, to have better field repair services, etc. it is suggested to order in total 4 x 4 WD terrain vehicle, 5 x pick-up and 3 trucks without delay.

3.9 Projects Costs

Estimates for capital cost are presented in Table 3.9.1. The following methodology has been adopted in the preparation of all tables.

- prices are given in mid-1983 constant terms, free estate;
- the estimates for rehabilitation of mechanical equipment are based on quotations obtained in Europe;
- the cost of civil engineering works has been based on current construction costs for similar works in Somalia;
- unit costs for technical assistance (management unit) are all inclusive;

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SUMMARY, FINANCIAL PROJECT COSTS

FIN COSTSUM

		UNIT	UNIT COS	0 1983/84		1 1984/85		2 1985/86		3 1986/87		4 1987/88		5 1988/89		SUM cols.(1) to (5)		FOREIGN EXCHANGE %	amount
				quantity	amount	quantity	amount	quantity	amount	quantity	amount	quantity	amount	quantity	amount	quantity	amount		
1	CAPITAL COSTS	DM	1	-	-	14027	14027	9783	9783	16169	16169	13223	13223	5989	5989	59191	59191	86	50904
2	MANAGEMENT UNIT	DM	1	-	-	2444	2444	4464	4464	4305	4305	3743	3743	1821	1821	16777	16777	95	15938
3	SUBTOTAL (Baseline cost)	DM	1		0	16471	16471	14247	14247	20474	20474	16966	16966	7810	7810	75968	75968	88	66842
4	CONTINGENCIES			0	0	1647	1647	2422	2422	4914	4914	5515	5515	3208	3208	17706	17706	88	15550
4.1	Physical	DM	10%	0	0	1647	1647	1425	1425	2047	2047	1697	1697	781	781	7597	7597	88	6684
4.2	Inflation	DM	1	0	0	0	0	997	997	2866	2866	3818	3818	2427	2427	10109	10109	58	5866
5	TOTAL	DM	1		0	18118	18118	16669	16669	25388	25388	22481	22481	11018	11018	93674	93674	88	82423

RSCH 24.04.84

10% physical contingencies have been included, and also a provision of 7% annually for inflation.

Moreover it has to be noted that:

- an allowance has been made for a working capital fund of DM 5.0 million (for financing spare parts for rolling stock and factory);
- costs for the priority measures, initiated by the Ministry of Industry in 1983 and those of the crash programme (Annex X) are excluded;
- no provision has been made for cash shortages before or after 1984;
- certain investment programmes continue after year 5 but project costs have not been included because of the satisfactory self-financing capacity of the Estate.

Based on these assumptions, the costs (including technical assistance) amount to:

Million SoSh	Million DM	
458.847	75.068	base line cost (without contingencies)
565.791	93.674	in current prices, taking into account 7% inflation per annum and 10% contingencies
504.733	83.565	in constant mid-1983 prices (including 10% physical contingencies).

The average foreign exchange component has been established at 88% of total project cost.

Detailed cost calculations are presented in Annex VII.6.

CHAPTER 4

ORGANISATION AND MANAGEMENT

CHAPTER 4

ORGANISATION AND MANAGEMENT

4.1 Analysis of the Actual Organisational Structure

4.1.1 General Presentation

SNAI is an autonomous government agency under the overall supervision of the Ministry of Industry. It is 100% government owned. Its nominal share capital is SoSh 25 million (DM 4.14 million). Its potential annual sales turnover based on an annual output of 50 000 t of factory white sugar evaluated at import parity prices is slightly above DM 50 million. Evaluated at the actual ex-factory price of SoSh 6 018/t plus a producer premium of SoSh 3 000/t the potential annual sales turnover amounts to SoSh 451 million or DM 74.7 million.

The number of its permanent staff amounted to 1 828 employees in 1982. Out of these 35% were employed in the factory, 32% in the agricultural department. The relatively high remainder of another 33% came under administrative and managerial tasks. Details of employment figures for 1969 to 1982 inclusive are given in Table 4.1.1.

To this staff must be added a group of up to 2 000 casual labourers occupied in the fields of cane production and harvesting.

The cost of establishing a similar agro-industrial sugar complex under Somali conditions at 1983 prices can be estimated at roughly DM 350 million.

4.1.2 Actual Management Standards

The level of managerial standards is extremely low. It is marked by the complete absence of even rudimentary management techniques. The major single cause for this is the lack of experience and knowledge of the managerial staff. The situation is aggravated by frequent changes in personnel. The few highly qualified graduates are much too low in number to change the situation. This deficiency must be considered as the greatest single stumbling block to fast improvement.

In 1982 a team of UNIDO advisers to the Ministry of Industry qualified the managerial standards prevailing at Jowhar by giving a list of missing managerial standard instruments. These are the following:

(i) the company policy and objectives are neither generally understood, nor agreed upon nor do they exist in writing;

(ii) the managerial objectives are not set, the appropriate responsibility of centre managers is not defined;

(iii) regularly scheduled working management meetings are not held;

(iv) factory and field management is not sufficiently involved with the development of budgets;

(v) production planning meetings are not held;

(vi) an effective cost control system is neither in place nor in use;

INSTRUPA - MACDONALD - HVA Table Nr 4.1.1

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Employment Figures and Percentages 1969 to 1982 According to Departments

Year	Factory		Agricultural department		Commercial department		Management and administration		Totals	
	total	%	total	%	total	%	total	%	total	%
1969	809	49	451	28	99	6	286	17	1 645	100
1970	578	41	511	36	82	6	249	17	1 420	100
1971	714	42	481	28	79	5	423	25	1 697	100
1972	674	40	564	33	96	6	367	21	1 701	100
1973	676	39	564	32	77	4	434	25	1 771	100
1974	688	40	507	30	77	4	449	26	1 721	100
1975	674	38	582	33	78	4	454	25	1 788	100
1976	673	39	533	30	82	5	460	26	1 748	100
1977	651	34	540	28	96	5	623	33	1 913	100
1978	667	36	586	31	165	9	450	24	1 868	100
1979	669	35	577	31	142	8	493	26	1 881	100
1980	655	34	579	30	144	8	526	28	1 904	100
1981	586	33	581	33	125	7	476	27	1 768	100
1982	642	35	581	32	125	7	480	26	1 828	100

Source : Department SNAI

(vii) technical and job training for personnel is inadequate;

(viii) standards for control purposes are not used;

(ix) production results are inadequately distributed among management and technical personnel;

(x) future personnel needs are not properly identified. A detailed recruitment and promotion plan does not exist.

Some efforts have been undertaken since the formulation of the above mentioned report, but as has been said earlier the number of sufficiently qualified key personnel is much too low to cope effectively with a problem of this size.

4.1.3 Salary Levels and Other Employment Conditions

As far as salaries and staff policy decisions for its permanent staff are concerned, SNAI submits to the rules and regulations of the Somali civil service. These rules can hardly be considered as adequate for an industrial enterprise of this size. For instance, decisions on the employment and promotion of personnel apart from unskilled labour are made by the Ministry of Labour or, in the case of university graduates, even by a presidential commission. The actual salary levels are given in Table 4.1.2. They have been related to their social environment in a detailed way in Annex VI-1. The situation can be summarised as follows:

(i) Monthly salaries for permanent employees vary from SoSh 416 for an unskilled labourer in the factory up to SoSh 4 040 for the General Manager. Skilled artisans and middle grade clerical staff earn close to SoSh 1 000, a junior university graduate close to SoSh 3 000. These salaries are unrealistically low, especially for the lower income groups. The cost of living for the respective groups amounts to 2 to 3 times their salary. Therefore SNAI employees - as most of the public servants - are forced to look for a second source of income. This is normally a secondary employment, farming or petty trade by family members.

(ii) Formerly SNAI employees were profiting from a broad programme of fringe benefits and social amenities. They included low-cost housing, medical services, low priced shops, canteen services for bachelors, a bakery and so on. Along with the deterioration of the financial situation of the Estate all these amenities had ceased to exist by mid-1983. Since then the first efforts have been made to reinstall a small part of the former benefits. For instance employees are now allowed to buy a monthly sugar quota at the official consumer price which is less than two thirds of the practised retail price with private traders.

(iii) In general employment conditions must be qualified as unsatisfactory and non-competitive. The disadvantage of the small town of Jowhar relative to Mogadishu is not compensated for by social amenities. The generally low level of the nominal pay with public services is hardly attractive for highly qualified staff.

4.1.4 Actual Organisation

A detailed description of the organisational set-up of the individual departments has already been given in Chapter 2 in the relative sub-chapters. A synoptic view of the organisational set-up as per mid 1983 is given in Figure 4.1.1. Since then some streamlining has been taking place on the administrative side of the organisation chart. So, by the end of 1983, SNAI management is based on three main columns, namely the factory department, the agricultural department and administration and finance. The remaining structural weaknesses of this are as follows:

(i) there is no clear separation between planning and controlling on the one hand and operations on the other;

(ii) the now unified finance and administration sector still has a too high weight relative to the productive departments. This is reflected by a 33% share in total personnel;

(iii) the existing training capacities are close to nil.

4.2 Proposed Organisational and Managerial Concept

4.2.1 Management Principles

Objective Nr 1 will be the alteration of the company status in such a way that the necessary managerial autonomy is guaranteed to the management. We propose to transform SNAI into a corporation under private law. In the long run government must not even be the only shareholder of the company. In future the shareholders' influence on company matters would be limited to the definition of policy matters, objectives and performance control. Within this set framework the general management would dispose of financial and administrative autonomy.

Objective Nr 2 would be to develop for application by the general management adequate techniques to assure the exchange of information between all levels. In the pursuance of this target the general manager will have to have at his disposal the necessary staff in the fields of planning, agricultural research, internal audit and sugar production control. An effective communication system will have to be set up in order to assure a fast flow of information between the departments and general management. Standards of operational and financial performance have to be defined for the control unit of the functional departments.

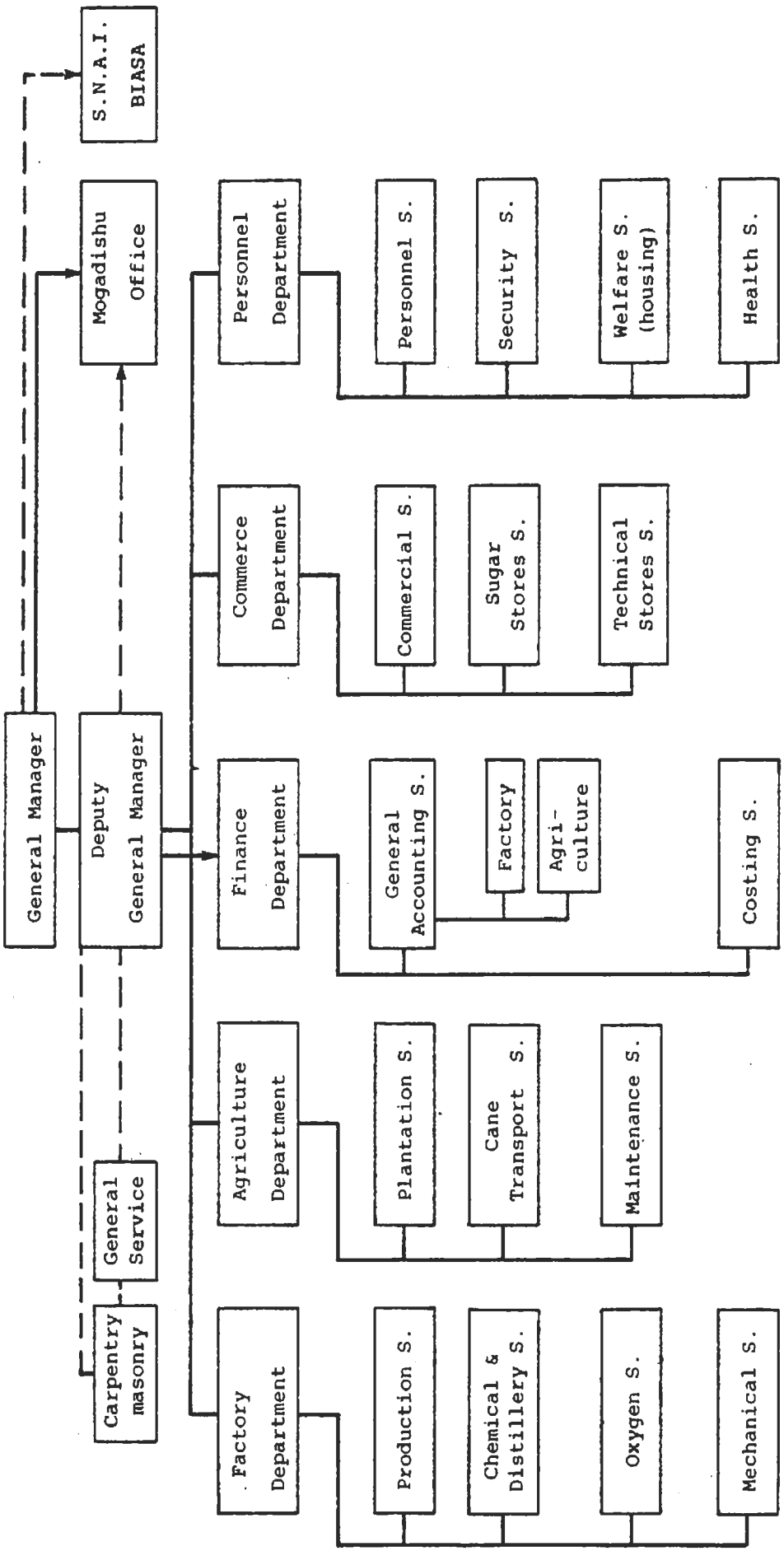
Objective Nr 3 has to be the development of highly qualified staff that will be able to produce the managerial and operational efficiency that is necessary to achieve the technically possible profitable results. For this purpose the only short-term solution is to contract an important foreign management consultancy team. In the medium run training has to receive an adequate weight in the Estate's activities.

4.2.2 Salaries and Social Amenities

SNAI will only be able to develop an effective permanent staff if it can create employment conditions that are attractive and competitive in the Somali labour market.

Figure 4.1.1

Jowhar Sugar Estate
Organisational Structure



Casual labour is the most important short term bottleneck on the production side. In order to again attract sufficient rural labour SNAI must offer earning and social conditions that are equal or superior to its competitors'. In Annex VI.1 we have presented a detailed analysis of the social structure of the areas surrounding the Estate. This investigation allows us to define the minimum level of employment conditions that will initiate a transfer of rural labour from the agricultural subsistance sector to the sugar sector. As a first step in order to propose a new salary level we have analysed the earning potential for non-skilled labour in competing sectors. The most relevant one is private small-scale farming. In rainfed agriculture there is no shortage of land. Access to land is reasonably free. In the crop budgets presented in Annex III, Tables III.7.1 and III.7.2, we have calculated the monetary remuneration per man-day for traditional agriculture at the prevailing technical level. It varies between SoSh 40 and 45 per man-day for intercropped maize and beans under irrigated condition and reaches even SoSh 89 in the case of rainfed sesame. Yields in rainfed agriculture, of course, are subject to a high degree of uncertainty due to the high variance of annual rainfalls.

The second important employer competing with SNAI for casual labour is private large scale farming that is dependent on seasonal external labour. During peak seasons these farmers have to pay as much as SoSh 60 per day plus food.

Based on these findings we have come to the conclusion that a remuneration level below SoSh 50/man-day as the basic salary for a male cane cutter must be considered as non-competitive and unattractive. We are quite aware of the fact that this increase amounts to 150% on top of the actual wage level. The financial analysis will show that this increase can be borne without major difficulties. Even at these wage levels manual harvesting will remain competitive compared with mechanised harvesting. In Table 4.1.2 we are presenting our proposals for SNAI's future wage and salary scales. The following principles have made us arrive at these proposals :

The cane cutters' daily wage rate of SoSh 50 has been taken as the cornerstone of the pay system. In the bracket of unskilled labour we have maintained the formerly existing ratio between cane cutters, loaders and weeders thus arriving at daily rates of SoSh 50, 62.5 and 43.75 respectively.

Salaries for permanent employees should be fixed at a level that safeguards against emigration to other potential employers such as the Juba Sugar Factory or industrial enterprises at Mogadishu. SNAI's wages are actually much lower generally then those of the aforementioned competitors. On the other hand, the formerly existing distance between different grades has to be maintained to some extent. But we are of the opinion that in the bracket of unskilled labour and semi-skilled labour the increase should be relatively higher than in the top grades for social reasons. Therefore the proposed increases for unskilled labour amount to 140%. His monthly salary would rise from SoSh 416 per month nowadays to SoSh 1 000. On the other end of the scale the proposed increase for a director of department amounts to only 50%. His salary would rise from SoSh 2 820 per month to SoSh 4 230.

The social and cultural activities actually offered to SNAI's employees on the Estate and in Jowhar town must be considered as being modest.

Schooling and training facilities are as follows :

The area possesses five elementary and four intermediate schools.

The only existing secondary school teaches up to Form 12.

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Proposed Salary Increases
(SoSh/man/month)

Serial Nr	Occupational group	Actual Contract	Actual Man-day	Actual Man-month	Future(1) Contract	Future(1) Man-day	Future(1) Man-month
1	Unskilled labour in plantation						
	- Weeding (women)	7	17.5	437.5	17.5	43.75	1 093.75
	- Cane cutting	8	20	500	20	50	1 250
	- Loading	10	25	625	25	62.5	1 562.5
2	Unskilled labour in factory			416			1 000
3	Semi-skilled labour in the factory and the field			695			1 700
4	Skilled artisans						
	- Electrician			820			1 900
	- Mechanic			882			2 000
	- Boilerman			920			2 050
	- Refiner			725			1 800
5	Technicians						
	- Engineer			2 600			3 900
	- Agronomist			2 765			4 150
6	Administrative and senior clerical staff						
	- Accounting officer			920			2 050
	- Middle grade clerical			762			1 600
	- Low grade clerical			655			1 250
7	Managerial staff						
	- Head of service			1 765			2 647
	- Director of department			2 820			4 230
	- General manager			4 040			6 060

Note : (1) Add 20% for fringe benefits for labour cost to employer.

(2) One man-day = 2.5 contracts, 1 man-month = 25 man-days.

An agricultural training school offers a 4-year's course starting after intermediate school.

The Estate itself offers a 2 year vocational training course for only 20 students every two years. This vocational school is run by part-time teachers either from Jowhar Secondary School or from the engineering staff of SNAI.

Medical infrastructures are as follows :

Jowhar town has a hospital with 60 beds. Its three doctors are relatively inexperienced young university graduates.

The Estate's own health post, that was formerly operating, has been closed down.

Cultural activities are limited to two cinemas and the Estate's social club that is accessible for grades equal or superior to head of unit.

The Estate's housing facilities are sufficient in number for senior grades. It has even been possible to rent out some of the houses to 'outsiders'; but also in this sector the disastrous financial situation has led to a deplorable situation due to lack of maintenance. The rents charged to employees are so low that they must be considered as symbolic only. Subsidised housing must be seen as part of the employee's income.

It must be concluded that social and cultural amenities are insufficient. Their standard has gone down considerably in recent years due to the fact that SNAI has cancelled most of its formerly offered fringe benefits due to lack of finance. The re-introduction of the previous programme will play an important role in re-establishing SNAI's attractiveness as an employer.

We have therefore included a cost element of 20% of the basic salary for unskilled labour in order to cover a programme of fringe benefits. One meal daily should be offered to cane cutters. The same target group should benefit from a programme of preventive medicine (i.e. daily malaria prophylaxis).

4.2.3 Organisational Set-up

Proposals for the organisation of individual departments have been given in Chapter 3. A synoptic view of the new organisational structure is given on the following page in Figure 4.1.2. The underlying concept of the proposed organisation is one which forms an integrated operation of all agricultural processing and administrative activities under centralised management.

(a) Board of Directors

The governing body of the enterprise will be a board of directors with responsibility for the formulation and execution of company policies. The board has to formulate the broad guidelines of operational activities and supervise their execution by its General Manager. The latter is represented on the board and will be selected in consultation with the board.

Apart from representatives of the owners, namely, the Ministry of Industry, its members will be agents of the banking sector, other financing agencies and the Somali sugar industry. During the period of the presence of a consultancy management units at Jowhar a representative of this company should have at least the status of an observer in the board.

The number of board members should not exceed eight in order to maintain the possibility to convene meetings at a short notice if necessary. It should meet at least once in three months.

(b) Management Department

The General Manager would have responsibility for meeting production volume and quality targets; maintaining financial liquidity and solvency; developing required manpower; safeguarding and properly maintaining company property; developing and maintaining harmonious relations with other Government authorities and with the communities surrounding the Estate area. He would be assisted in his functions on the one hand by his personal monitoring and control specialists (Management department) and on the other hand by four functional departments, namely agriculture, finance and administration, factory and finally personnel and industrial relations.

The proposed management department will unite functionally positions that physically may be attached to other departments. This proposition shall safeguard that holders of key functions in the field of planning and control do report directly to the General Manager. We have recommended therefore that the functions of monitoring and planning, agricultural research, training coordination, internal audit and sugar production control are united in this body. In practice the internal auditor and the chief chemist will be working in the departments of factory and finance and administration respectively.

4.2.4 Staff Training

Training will have to be the backbone of SNAI's future personnel policy. The country's vocational training capacities are far too low to supply the national labour market with a sufficient number of skilled and well-trained staff even in the field of general technical matters or administrative subjects. This is even more true for subjects especially related to the sugar industry.

In the organisational set-up the importance of the field of training is underlined by the fact that the training coordinator will report directly to the General Manager. He will be seconded by two training officers related to the factory department from which the highest share of training requirements will accrue. The formulation of career development programmes for company personnel - perhaps in coordination with the training officer of Juba Sugar Factory - would set the framework for the training activities.

The training programmes would be based on an inventory of individual staff in each department and identification and quantification of training needs of each. Training schedules would be prepared at the beginning of each year specifying the objectives and nature of each programme, the participants, frequency and length of programmes, structures and facilities required and estimated costs of the programme for review by company management. Approved programmes would be funded by sufficient budgetary provisions.

Proposed Organisational Structure

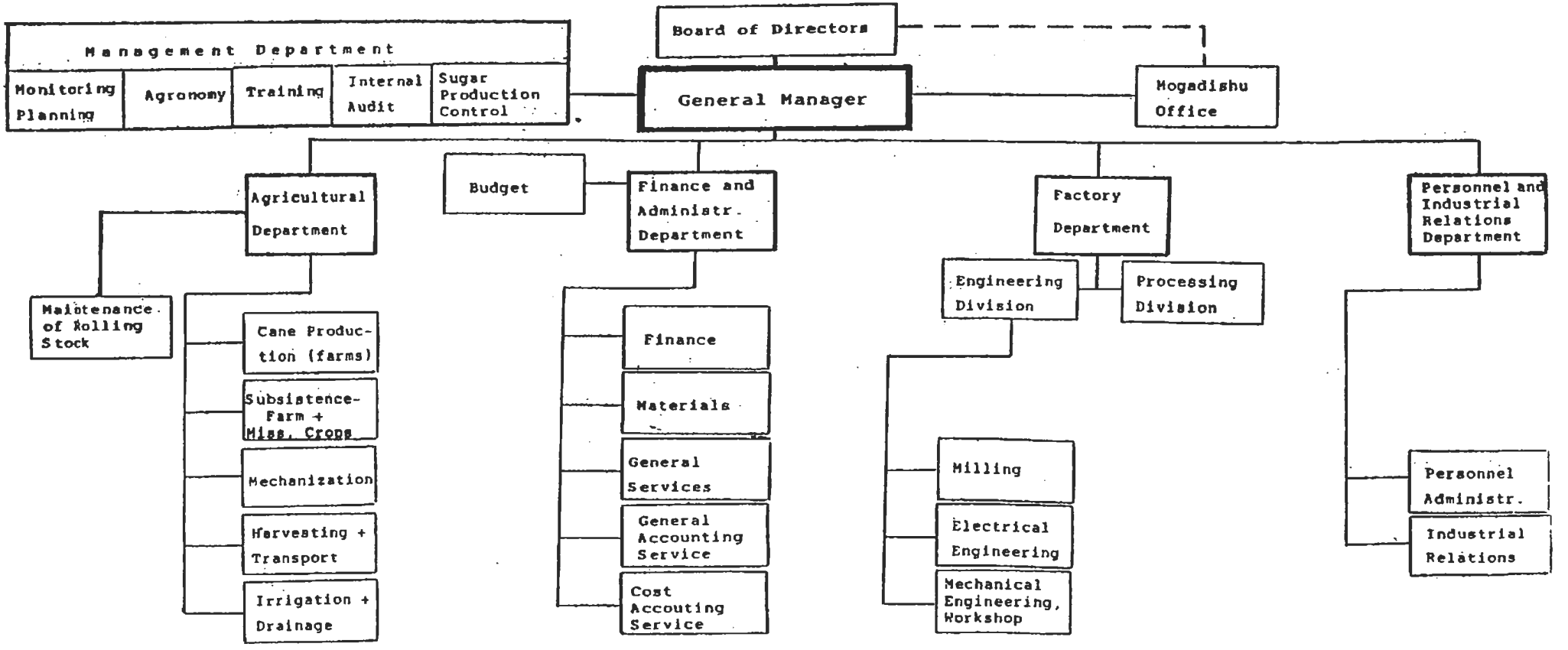

Figure 4.1.2

4.2.5 Management Staffing

A strong capable management is considered the basis for good results in field and factory. Therefore the Consultants propose a team of 15 highly qualified expatriates for the various key positions and a middle management with 27 qualified persons, who should meet the qualifications as stipulated in Annex IX.

It is considered very difficult to find at short notice qualified Somalis for the relevant posts. Therefore some of the management and technicians have to be recruited from overseas.

The 27 qualified persons have to be employed by Jowhar Sugar Estate. In order to make the job more attractive they should be given a bonus of DM 2 000 to DM 2 500 per month in foreign exchange, over and above a cost of living allowance in local currency to be provided for by the project itself. When transport costs are estimated at DM 10 000 per man and an overall recruitment fee of 5% is added, the foreign component of expenses for qualified staff and technicians amounts to DM 42 000 and DM 35 700 per year, respectively.

These estimated figures have been used to calculate the recurrent expenditure for the management unit in foreign exchange, details of which are listed in Table 4.1.3. The total recurrent foreign expenditure of the management unit will reach DM 15 570 820 over the total period, including the costs for the crash programme.

The local component for the middle management has been based on SoSh 36 000 per year and per qualified person and will amount to SoSh 2 772 000 for the project period.

Expenses for housing will amount to DM 45 000 per unit for highly qualified staff, DM 12 500 per unit for middle management. Total amount will reach DM 1 012 500.

Expenses for transport will be limited to DM 100 000 as motorcycles, vehicles and buses are incorporated in the total project costs.

During discussions with KfW and a Somali delegation on 28 and 29 February 1984, KfW proposed to reduce the team of highly qualified staff with the following positions :

- technical manager
- electrical/instrumentation manger
- production manager
- financial manager
- assistant farm mechanisation and transport manager

The Consultants have strong objections to reducing the team with these positions. It will influence the factory results as 3 out of 4 positions in the factory will be eliminated. A reduction of the overall recovery from 78% to 75% may be expected, while downtime of the factory increases from 15% to 17.5%.

About 1 284 tonnes of sugar per year will be produced less, having a value of SoSh 11 556 000, while the costs of the three factory experts per year is SoSh 3 852 312. Furthermore, a higher downtime of the factory will reduce the total quantity of cane which can be crushed during the season and so reduce the sugar production.

A financial manager is considered essential for the cost control and the control of the investments during the rehabilitation period. A delayed implementation of the investment programme will certainly reduce the profitability of the project.

The farm and machinery workshop requires a tremendous upkeep during the first ? years of the rehabilitation period. A second man is therefore considered essential in order to safeguard the implementation programme in the field, requiring a great number of agricultural equipment and the programme for cane transport.

Proposed phasing and cost of management staffing are presented in Table 4.1.3.

4.2.6 Co-ordination of National Sugar Policy

The Somali sugar industry is continually faced with numerous problems, the remedial measures for which require action at the national level. The necessary assistance involve a number of agencies with, so it seems, little co-ordination. We therefore submit for consideration the idea of the creation of a Somali sugar authority.

Members of this body would be the following :

- the Ministry of Industry (Chairman)
- the Ministry of Agriculture
- the Ministry of National Planning
- the national sugar factories
- the banking industry

The authority could be run by a chief executive attached to the Ministry of Industry.

Main field of co-ordination would be manpower development, marketing and agronomy, research in the field of cane production and finally formulate recommendations on sugar policy to Government.

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DETAILS, MANAGEMENT UNIT

		UNIT COST	0 1983/84		1 1984/85		2 1985/86		3 1986/87		4 1987/88		5 1988/89		Sum (1) to(5)		6 1989/90		TOTAL		Foreign Exchange		TOTAL 1000 So 1 DM = 6.04 So
			quantity	amount	quantity	amount	quantity	amount	quantity	amount	quantity	amount	quantity	amount	quantity	amount	quantity	amount			%	amount	
1	SUBTOTAL	230.35	n.a.	0	8	1838.25	14	3231.86	14	3231.86	13.5	3100.56	7	1674.221	56.5	13076.76	0	0.00	13076.76		95	12422.92	73983.4
1.01	Factory manager	262.60	n.a.	0	.5	131.30	1	262.60	1	262.60	.5	131.30	0	0.00	3	787.80	0	0.00	787.80		95	748.41	4758.1
1.02	Technical manager	212.60	n.a.	0	.5	106.30	1	212.60	1	212.60	1	212.60	0	0.00	3.5	744.10	0	0.00	744.10		95	706.90	4494.1
1.03	Electrical/Instrum. Engineer	212.60	n.a.	0	.5	106.30	1	212.60	1	212.60	1	212.60	0	0.00	3.5	744.10	0	0.00	744.10		95	706.90	4494.1
1.04	Production Manager	212.60	n.a.	0	.5	106.30	1	212.60	1	212.60	1	212.60	.5	106.30	4	850.40	0	0.00	850.40		95	807.88	5136.4
1.05	Agricultural Manager	262.60	n.a.	0	.5	131.30	1	262.60	1	262.60	1	262.60	1	262.60	4.5	1181.70	0	0.00	1181.70		95	1122.62	7137.4
1.06	Agronomist	212.62	n.a.	0	.5	106.31	1	212.62	1	212.62	1	212.62	1	212.62	4.5	956.80	0	0.00	956.80		95	908.96	5779.0
1.07	Manager mech. agr. operations	212.60	n.a.	0	1	212.60	1	212.60	1	212.60	1	212.60	0	0.00	4	850.40	0	0.00	850.40		95	807.88	5135.4
1.08	Manager irrigation/drainage	232.06	n.a.	0	1	232.06	1	232.06	1	232.06	1	232.06	0	0.00	4	928.16	0	0.00	928.16		95	881.75	5604.0
1.09	Advisor to General Manager and to Personnel Manager	298.60	n.a.	0	.5	149.30	1	298.60	1	298.60	1	298.60	1	298.60	4.5	1343.70	0	0.00	1343.70		95	1276.52	8115.9
1.10	Financial Manager	212.60	n.a.	0	.5	106.30	1	212.60	1	212.60	1	212.60	1	212.60	4.5	956.70	0	0.00	956.70		95	908.87	5778.4
1.11	Training coordinator	212.60	n.a.	0	.5	106.30	1	212.60	1	212.60	1	212.60	0	0.00	3.5	744.10	0	0.00	744.10		95	706.90	4494.1
1.12	F.M.I. Workshop Manager	262.60	n.a.	0	.5	131.30	1	262.60	1	262.60	1	262.60	1	262.60	4.5	1181.70	0	0.00	1181.70		95	1122.62	7137.4
1.13	Ass. F.M.I. Manager	212.60	n.a.	0	.5	106.30	1	212.60	1	212.60	1	212.60	.5	106.30	4	850.40	0	0.00	850.40		95	807.88	5135.4
1.14	Factory Workshop Manager	212.60	n.a.	0	.5	106.30	1	212.60	1	212.60	1	212.60	1	212.60	4.5	956.70	0	0.00	956.70		95	908.87	5778.4
2	SUBTOTAL	46.90	n.a.	0	13	605.50	26.5	1232.35	23	1073.45	13.5	642.60	3	147.00	79	3700.90	0	0.00	3700.90		85	3147.90	22353.4
2.01	Shift engineers	49.00 1)	n.a.	0	1.5	73.50	3	147.00	3	147.00	3	147.00	1.5	73.50	12	588.00	0	0.00	588.00		86	504.00	3551.5
2.02	Mill engineer	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	.5	24.50	0	0.00	3	147.00	0	0.00	147.00		86	126.00	887.3
2.03	Boiler engineer	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	.5	24.50	0	0.00	3	147.00	0	0.00	147.00		86	126.00	887.3
2.04	Electrical engineer	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	.5	24.50	0	0.00	3	147.00	0	0.00	147.00		86	126.00	887.3
2.05	Instrument engineer	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	.5	24.50	0	0.00	3	147.00	0	0.00	147.00		86	126.00	887.3
2.06	Repair engineers	42.70	n.a.	0	1.5	64.05	3	128.10	1.5	64.05	0	0.00	0	0.00	6	256.20	0	0.00	256.20		84	214.20	1547.4
2.07	Design technician	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	.5	24.50	0	0.00	4	196.00	0	0.00	196.00		86	165.00	1183.1
2.08	Shift process supervisors	42.70	n.a.	0	1.5	64.05	3	128.10	3	128.10	1.5	64.05	0	0.00	9	384.30	0	0.00	384.30		84	321.30	2321.1
2.09	Laboratory chemist	49.00	n.a.	0	.5	24.50	1	49.00	.5	24.50	0	0.00	0	0.00	2	98.00	0	0.00	98.00		86	84.00	591.9
2.10	Manager harvest/transport	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	0	0.00	0	0.00	3.5	171.50	0	0.00	171.50		86	147.00	1035.5
2.11	Manager farms	49.00	n.a.	0	.5	24.50	1	49.00	.5	24.50	0	0.00	0	0.00	2	98.00	0	0.00	98.00		86	84.00	591.9
2.12	Assistant Agronomist	49.00	n.a.	0	.5	24.50	1	49.00	.5	24.50	0	0.00	0	0.00	2	98.00	0	0.00	98.00		86	84.00	591.9
2.13	Distribution Controller (irr.)	42.70	n.a.	0	0	0.00	.5	21.35	1	42.70	.5	21.35	0	0.00	2	85.40	0	0.00	85.40		84	71.40	515.2
2.14	Maintenance Technician (irr.)	42.70	n.a.	0	.5	21.35	1	42.70	.5	21.35	0	0.00	0	0.00	2	85.40	0	0.00	85.40		84	71.40	515.2
2.15	Surveyor	42.70	n.a.	0	.5	21.35	1	42.70	.5	21.35	0	0.00	0	0.00	2	85.40	0	0.00	85.40		84	71.40	515.2
2.16	Heavy plant/wheeltractor eng.	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	.5	24.50	0	0.00	3	147.00	0	0.00	147.00		86	126.00	887.3
2.17	Motorvehicle engineer	42.70	n.a.	0	.5	21.35	1	42.70	1	42.70	.5	21.35	0	0.00	3	128.10	0	0.00	128.10		84	107.10	773.7
2.18	General engineer	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	1	49.00	.5	24.50	4	196.00	0	0.00	196.00		86	168.00	1183.1
2.19	Machineshop supervisor	42.70	n.a.	0	.5	21.35	1	42.70	1	42.70	.5	21.35	0	0.00	3	128.10	0	0.00	128.10		84	107.10	773.7
2.20	Stores manager	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	1	49.00	.5	24.50	4	196.00	0	0.00	196.00		86	168.00	1183.1
2.21	Budget/cost accountant	49.00	n.a.	0	.5	24.50	1	49.00	1	49.00	1	49.00	0	0.00	3.5	171.50	0	0.00	171.50		86	147.00	1035.5
3	GRAND TOTAL		138.87	0.00	21	2443.75	40.5	4464.21	37	4305.31	27.00	3743.16	10.00	1821.22	135.50	16777.66	0.00	0.00	16777.66			15570.82	10133

CHAPTER 5

PRODUCTION, MARKETING AND FINANCIAL RESULTS

CHAPTER 5

PRODUCTION MARKETING AND FINANCIAL RESULTS

5.1 Future Sugar Production at Jowhar

5.1.1 Sugar

(a) Yield Estimates

The productivity of sugar cane land is a complex function of several interacting management and ecological factors. With a high standard of management, yields correlate closely with annual evapotranspiration. In the absence of limiting factors, the ratio of sugar cane yield to the amount of water lost by evapotranspiration tends to be constant. This constant varies with cuttings because soil conditions, especially those affecting the root system, vary and deteriorate with every cutting. When these constraints are minimal (plant cane), cane yields of 0.9 t/ha/cm water transpired are recorded. For subsequent cuttings the cane yields are 0.85, 0.8, 0.75, 0.7 t/ha/cm water transpired for, respectively, cuttings II, III, IV and V. The average consumptive use in mm has been calculated over the lifetime of the crop (11 to 14 months), taking into account the stage of the development of the crop (crop factor).

The figures are presented in Annex II and are worked out per cutting. Potential cane yields can only be reached if no other constraints of agricultural practices and management occur. For Jowhar an efficiency factor of 70% is estimated when no constraints of water supply occur.

In Table 5.1.1 the expected cane yields for the different cuttings have been calculated.

TABLE 5.1.1

Expected Average Cane Yield from each Cutting

Cutting	Average consumptive use (mm)*	Yield factor	Potential cane yields (tonnes cane/ha)	Efficiency factor	Expected cane yields (tonnes cane/ha)
I	2 090	0.090	188	0.7	132
II	1 844	0.085	156	0.7	109
III	1 706	0.080	136	0.7	95
IV	1 729	0.075	130	0.7	90
V	1 735	0.070	121	0.7	85
Average	1 820	0.080	145	0.7	101

Note: * In years when a water shortage occurs, lower yields will be obtained.

(b) Relationship between Cane Yield and Water Availability

Table 5.1.1 shows the average consumptive water use over 5 cuttings of 1 820 mm, required to produce an average cane yield of 101 tonnes per hectare. To calculate the yield reduction when insufficient water is available, a linear relationship has been assumed between tonne cane produced and water consumed. An exception is made for the germination period of the cane and the early stage of cane development. Shortage of water during these stages affects the cane yield considerably.

The expected yields in the period 1955 to 1983 have been calculated in Annex II, based on an average cane yield of 101 t/ha cane when there is no constraint on water availability, and yield reduction of e.g. 10.1 t/ha cane for every 182 mm water shortage.

The average cane yield over 26 years was 91 t/ha cane. It is expected that this can be reached after rehabilitation of the irrigation and drainage system, after improvement of the agricultural practices and after levelling the fields. It is anticipated that cane yields will vary from as high as 101 t/ha to as low as about 60 t/ha.

(c) Field Layout, Levelling and Agricultural Practices

The present low standard of land levelling reduces the efficiency of irrigation and creates surface drainage problems. An improvement in land levelling and field lay-out will have a beneficial effect on cane yields. The expected yield increase due to these improvements is about 15 to 20%. Particular improvements can be expected in germination and tillering.

Improvement of land preparation and cultivations will increase the cane yields. It is, however, difficult to estimate the effect of individual measures on the yield increase. Bad quality seed cane can have a very detrimental effect on cane yields. Also a bad control of weeds can result in a yield reduction of sometimes more than 50%.

(d) Total Cane and Sugar Production Estimates

The following cane yields per cutting are now expected :

Cutting	Expected cane yields (tonnes cane/ha)
I	119
II	98
III	86
IV	81
V	76
Average	91

The total cane supply is about 468 000 tonnes. With an average cane yield of 91 t/ha a total harvestable area of 5 148 ha is required.

For planning the future cane and sugar production it has been assumed that rehabilitation will start in 1985 and that the first increase in production may be anticipated in the campaign of 1986/87. If the start of the rehabilitation is postponed after January 1986 the production targets set in this report will be delayed one year.

Cane production estimates up to the 1993/94 campaign are summarised in Table 5.1.2. These estimates are based on the assumption that the Estate will be rehabilitated and will be managed by an expatriate team.

TABLE 5.1.2

Cane and Sugar Production Estimates

Campaign	Harvestable area (ha)	Cane yield (t/ha)	Cane (t)	Pol cane %	Recovery %	Sugar/ cane %	Sugar (t)
1984/85	3 000	33	99 000	11.0	55	6.1	6 040
1985/86	4 500	33	148 500	11.0	55	6.1	9 060
1986/87	4 984	43	214 910	11.2	60	6.7	14 400
1987/88	5 148	55	285 470	11.4	65	7.4	21 120
1988/89	5 148	68	349 510	11.7	70	8.2	28 660
1989/90	5 148	79	405 550	12.0	75	9.0	36 500
1990/91	5 148	85	436 650	12.3	78	9.6	41 920
1991/92	5 148	88	453 610	12.6	78	9.8	44 450
1992/93	5 148	91	469 510	12.8	78	10.0	46 950
1993/94	5 148	91	469 510	12.8	78	10.0	46 950

In years with sufficient water the cane production will be about 10% higher than the factory capacity. Part of the cane should be deferred to the following season accepting a slightly lower cane quality.

Detailed cane production estimates are presented in Annex II. It has been assumed that the current low yield levels will be maintained until rehabilitation starts, and 20% yield reductions have been allowed for during the rehabilitation period.

5.1.2 Secondary Products

(a) Molasses/alcohol

After a proper rehabilitation under expert guidance it may be expected that the distillery at a design capacity of 15 000 l of alcohol per day will produce at a downtime of 5% in 230 operation days:

$$230 \times 0.95 \times 15\,00 = 3\,277\,500 \text{ l of alcohol}$$

At about 320 l/t of molasses

$$\frac{3\,277\,500}{320} = 10\,242 \text{ t of molasses}$$

will be required for 230 operation days

At molasses % cane of ± 3.30.

10 242 t of molasses correspond with $\frac{10\ 242}{0.033}$ =

310 360 t of cane, being nearly available in 1986/87.

From 1987/88 onwards there will be a surplus of molasses.

In 1987/88 it will be:

(349 510 - 310 360) x 0.033 = 1 291 t of molasses, gradually increasing to
(469 510 - 310 360) x 0.033 = 5 252 t in 1991/92.

At 230 operation days the surplus will be per operation day in 1987/88

$\frac{1\ 291}{230}$ = 5.6 t, equivalent to about 3.7 m^3;

in 1991/92

$\frac{5\ 252}{230}$ = 22.8 t, equivalent to about 15 m^3.

Above quantities are too small economically to process it further into other by-products than alcohol, e.g. fodder yeast or citric acid.

The most prudent approach to cope with molasses surplus is to replace after about 10 years' time the existing distillery by a distillery based on continuous fermentation with a daily capacity of:

$$\frac{469\ 510 \times 0.033 \times 320}{230 \times 0.95} = 22\ 691,$$

say, 23 000 l of alcohol/day.

Till that time the following ways of utilising the molasses surplus can be applied:

- mixing it with slops from the distillery to be used as fertiliser.
- mixing it with filtercake to be used as fertiliser.
- spraying it over the roads after dilution 1 : 10 with water to reduce dust, caused by wind or traffic.

(b) Bagasse/electricity

As elaborated in Anned IV there will be a surplus of about 6 t of bagasse per actual milling hour, which will be used during factory stops and for starting up the boilers at the beginning of the milling season and at the end of the milling season for finishing off.

It is calculated that until 1988/89 heavy fuel oil in gadually decreasing quantity needs to be supplied to the boilers to cover the total energy requirements during the milling season.

After 1988/89 there will be some surplus of bagasse, gradually increasing to about 3 t per operation hour in 1991/92.

This quantity will be too small economically to process it further into, for example, particle board. The most prudent way to utilise it is to pile it after baling in the open near to the factory and to supply it during the milling season to the boilers in case of a very low fibre content of the cane, or, in case of stagnation, in fuel oil supply.

Referring to Jowhar's suggestion to install a turbo-generator (see Annex IV), it could be considered to install an extraction/condensation turbo-generator (partly backpressure, partly condensation) in about the year 1990, if it appears that a steady bagasse surplus is available.

The surplus could then be used instead of fuel oil to generate steam for the turbo-generator by one of the smaller existing boilers.

Its backpressure steam could then be used for the distillery and the generated electric energy for covering the electric energy demand during off-season.

An additional advantage is that any surplus of molasses can be processed into alcohol during off-season.

At a steady surplus of 3 t of bagasse per operation hour, there will be 3 x 24 x 230 = 16 560 t of bagasse available for 135 off-season days, of which 16 560 x 2 = 33 120 t of steam can be generated, i.e. per off-season hour:

$$\frac{33\ 120}{135 \times 24} = 10.2 \text{ t offsteam}$$

At a steam consumption of about 8 kg/kWh to be generated per hour:

$$\frac{10\ 200}{8} = 1\ 275 \text{ kWh}$$

This corresponds at a power factor of 0.8 with a turbo-generator capacity of:

$$\frac{1\ 275}{0.8} = 1\ 600 \text{ kVa}$$

5.2 SNAI's Position in the Somali Sugar Market

5.2.1 International Trends and Perspectives

The world produced around 190 million tonnes of sugar in the late 1970s. The per capita consumption amounted to roughly 21 kg. About 25 million tonnes of sugar entered international trade in this period. Sugar is the most important earner of foreign exchange for developing countries after petroleum and coffee.

About 70% of all the sugar traded in the world is now sold through the free market. The balance is made up of trade under bilateral agreement such as the Lome Agreement, the Commonwealth Sugar Agreement (up to 1975) and trading arrangements between Cuba and the USSR. Since 1953 several international sugar agreements have tried to regulate the supply of sugar.

Overall performance in the international sugar market in the last two decades has been characterised by cyclical imbalances between supply and demand. The free market has gone through short spells of supply deficits and sharp price

advances despite the overall tendency of production to exceed consumption for extended periods. These sharp prices increases have tended to induce overexpansion of the output.

The actual world market situation is marked by a price depression and oversupply. Average International Sugar Agreement (ISA) prices for the first semester 1983 for raw sugar. FOB Caribbean ports, have been around 18 cents per kg. The most competitive international producers can reach a cost price of around 30 cents per kg.

TABLE 5.2.1

Import Parity Prices for Sugar (raw)
(constant 1983 prices)

Serial Nr		Unit	Economic prices(1)		Financial prices(2)	
			Trend price 1983	Project-ion 1995	Trend price 1983	Project-ion 1995
1	FOB Carribean port	US $/t	333	372	333	372
	plus ocean freight	US $/t	60	60	60	60
2.1	CIF Mogadishu	US $/t	393	432	393	432
2.2	FOB Mogadishu	SoSh/t	7 860	8 604	5 984	6 575
3	Plus handling and transport(3)	SoSh/t	100	100	100	100
4	Free ENC-godown	SoSh/t	7 960	8 740	6 084	6 575

Notes : (1) At the shadow exchange rate of 1 $ = SoSh 20.

(2) At the official exchange rate of 1 $ = SoSh 15.22.

(3) Mission estimate.

World Bank's commodity price forecast of July 1983 predicts a substantial recovery of the sugar market only for the later 1980s. For the 1990s a price of US $ 372 per tonne (1983 constant $) is projected.

In order to resolve the erratic changes in sugar price for the purpose of economic analysis within this study we have calculated a long term trend price for 1983 amounting to US $ 333/t - FOB Caribbean ports. From this we have deducted an import parity price for Somalia of SoSh 6 084.21 at the official exchange rate of US $ 1 equal to SoSh 15.22 or of Sh 7 960 per tonne free Mogadishu godown basis of a shadow exchange rate where US $ 1 equals SoSh 20.

5.2.2 National Production and Demand

(a) Review of previous production figures in the Jowhar and Juba Sugar Factories

Up to 1981 Jowhar was the only sugar factory in Somalia. Its actual capacity of 50 000 tonnes per annum was installed in the early 1960s. During a take-off period starting from 1964 the factory's production developed from 8 800 t/year to its all time high of 47 500 t reached in 1971.

The Estate's performance during the early 1970s was quite satisfactory. Cane production had reached an average level of 90 t/ha. The sugar/cane ratio was stable around 10%. The amount of cane harvested annually was oscillating around 450 000 tonnes.

The subsequent years can be described as a period of steady decline ending in a situation of close to total breakdown in 1983. The annual cane production has come to less than 100 000 t. The extraction rate has fallen back to less than 5%. The cane production level is hardly higher than 30 t/ha/year. The annual sugar production in 1983 was a mere 2 700 t.

The very complex set of reasons for the actual situation has been described earlier in the relevant chapters. It can be summarised as follows:

- The lack of an appropriate drainage system combined with poor irrigation techniques has resulted in waterlogging and salinisation of a major share of the cane fields thus bringing down the yield potential of the area and leading to the abandonment of more than 2 000 ha of the cane area.

- Shortage of labour has initially led to lengthening of the ratoon cycle. The standard of agricultural techniques has steadily declined and today the labour shortage has reached a level where SNAI is not even able to harvest all its mature cane. An economically sound mechanisation of harvesting will require a completely new field layout allowing for sufficiently long runs of the heavy equipment.

- On the mechanical side, the lack of funds due to heavy losses in general and the lack of foreign exchange in particular, a nationwide problem, has led to the omission of replacement of worn out parts and to a general decline of the maintenance standards in the factory and for the rolling stock.

The Juba factory started production in 1981 with an output of 14 900 t. It had reached 26 400 t in the following year and it is expected to produce 28 600 t in the current year. These figures reflect a one year delay relative to implementation schedule. In the case of Juba the recent national shortage of foreign exchange has led to insufficient allotment of gas oil. This has resulted in a slowing down of the area development and has reduced the irrigation applications (the Juba Estate relies on pumped sprinkler irrigation).

(b) Projection of National Production

The mid-term production projection for Juba has been estimated by its management in April 1983 as given in Table 5.2.2:

TABLE 5.2.2

Four Year Production Plan 1983 to 1986 - Juba

	1983	1984	1985	1986
Area (ha)	4 283	5 129	6 419	7 564
Yield (t/ha)	80	86	88	94
Cane (t'000)	343	449	565	711
% Sugar	12.0	11.4	11.0	10.9
Sugar (t'000)	28.6	39.4	51.4	65.2
Molasses (t'000)	15.4	20.2	22.6	28.4

It forecasts a steady increase of all performance figures in order to reach full production capacity of 70 000 t/year the first time in 1987.

The evolution of SNAI's production figures have been described in detail in Section 5.1. Assuming a successful implementation of the on-going 'relief operations' up to the beginning of the new campaign in March and furthermore assuming a beginning of the crash programme in early 1984 a production level of 9 000 t can be expected for the coming year. The long term production level of 46 846 t/year will be reached the first time in 1991.

The national production level (see also Table 5.2.3) thus will part from the cumulated production of the two factories of 31 300 t in 1983. It will steadily increase to close to design level of 120 000 t which will be reached the first time in 1991 with an estimated total output of 116 846 t. Thereafter production can be markedly increased only after the installation of additional capacities.

(c) Future Demand

In order to estimate Somalia's future sugar demand we have compiled the following projection model:

The model's departure year is 1980. Official demographic figures fix Somalia's population at 5 million inhabitants at this time. Its medium term growth rate is estimated at 3.1% annually. In addition to this basic figure Somalia's sugar market has to satisfy the demand of a considerable refugee population estimated at 700 000 and supposed to remain constant during the projection period up to the year 2000. A further 700 000 of seasonally migrating nomadic population of the border areas have been assumed to also rely on this market. This vector has also been kept constant during the period under review. Thus the number of consumers will develop from a basis of 6.4 million in 1980 to 10.6 million in the year 2000.

The annual per capita consumption has been derived from historic import and production figures (see Annex VIII-1). The departure level arrived at is an annual consumption per head of 12.8 kg. This figure compares reasonably well with the consumption of countries in Africa in similar economic conditions. The growth rate of the per capita consumption has been fixed at 3% per annum

allowing for a moderate income increase and a moderately high income elasticity of sugar demand. Under these assumptions the annual per capita consumption will reach 23 kg per annum in the year 2000 which is close to today's average world consumption.

The national demand derived from this model amounts to roughly 80 000 t for the departure year 1980. It will reach a level close to the actually installed production capacity in 1988.

This model includes two vectors of the future evolution of which is hardly predictable, namely the future refugee population and the border population. Furthermore the long term evolution of the growth rate of Somalia's population is likely to decline.

Because of these uncertainties we recommend to deduct from the model especially for the period after 1990 only the following trends.

National production and national demand will be roughly balanced around 1990. After that the need for imports is most probable. A surplus production is most improbable during any period without a reasonably early installment of additional capacities.

(d) Examination of Sugar Export Possibilities

The prospects for sugar exports from Somalia under free market conditions are quite moderate. The actually installed capacity will allow only for a production permanently level below the national demand.

We have shown earlier that Somalia's cost structure, by international standards, is above the average due to high irrigation cost. A considerable increase of the existing cane production capacity can be achieved only at even higher cost as an improved water supply situation can be obtained only at the cost of heavy investment and water storage.

5.2.3 The National Sugar Marketing System

Sugar marketing was a monopoly of the national trading co-operation (ENC) up to autumn 1982. Since then the distribution of locally produced sugar is done directly by the factories on instructions received from the Ministry of Commerce.

The supply situation must be described as one of permanent shortage and further of regional imbalances. The country does not systematically build up buffer stocks in order to bridge supply gaps due to overestimations of national production.

Prices are fixed centrally by the Government. The actual producer price paid to the factory is SoSh 6 018.8/t. On top of that a production premium of SoSh 3 000/t is paid. A consumer tax of SoSh 7 201/t is levied. Costs of distribution and traders' profits are estimated to be SoSh 1 000/t. The officially fixed consumer price is SoSh 14 200/t equivalent to US $ 943 or DM 2 375.

Government price policy is of significance mainly to the producer. He is not allowed to adopt his price policy to altering market or cost situations. On the consumer side the official price is hardly of significance at all. The public

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Table Nr 5.2.1

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Development of Self Sufficiency in Supply

		1980 -4	1981 -3	1982 -2	1983 -1	1984 1	1985 2	1986 3	1987 4	1988 5	1989 6	1990 7	1991 8	1992 9	1993 10	1994 11	1995 12	1996 13	1997 14	1998 15	1999 16	2000 17
1	Number of sugar consumers	6400000	6555000	6714805	6879564	7049430	7224563	7405124	7591283	7783213	7981092	8185106	8395445	8612303	8835885	9066379	9304056	9549081	9801703	10062156	10330682	10607534
1.1	Somalia's population(1)	5000000	5155000	5314805	5479564	5649430	5824563	6005124	6191283	6383213	6581092	6785106	6995445	7212303	7435885	7666397	7904056	8149081	8401703	8662156	8930682	9207534
1.2	Border areas economically dependent	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000
1.3	Refugees	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000	700000
2.	Per capita consumption (t/year)(2)	.0128	.0131	.0135	.0139	.0144	.0148	.0152	.0157	.0162	.0167	.0172	.0177	.0182	.0187	.0193	.0199	.0205	.0211	.0217	.0224	.0231
3.	Demand (t)	81920	86421	91184	96224	101558	107203	113179	119505	126202	133293	140801	148752	157172	166090	175536	185541	196140	207369	219266	231871	245227
4.	National production (t)	23000	31400	34700	31300	48459	65759	86152	98705	106602	112007	114396	116846	116846	116846	116846	116846	116846	116846	116846	116846	116846
4.1	Jowhar	23000	16600	12500	2700	9059	14359	20952	28705	36602	42007	44396	46846	46846	46846	46846	46846	46846	46846	46846	46846	46846
4.2	Juba	0	14800	22200	28600	39400	51400	65200	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000	70000
5.	Import (-t)/ Export (+t)	-58920	-55021	-56484	-64924	-53099	-41444	-27027	-20800	-19600	-21286	-26405	-31906	-40326	-49244	-58690	-68695	-79294	-90523	-102420	-115025	-128381

Notes: (1) Growth rate of population 3.1%.

(2) Growth rate demand 3%.

Table Nr 5.2.

trading sector does not dispose of any retain outlets and thus cannot effectively control retail prices. Consumer prices with private retailers are heavily fluctuating as a function of the changing supply situation. As supply shortages are predominant the actual consumer price in Mogadishu in 1983 has hardly ever fallen below SoSh 25/kg.

Even if we allow for higher costs of distribution and higher profit margins for the wholesaler, than the total cost of SoSh 1 000 officially estimated, the cost price for the retailer will hardly ever exceed SoSh 16 000/t thus allowing for an average gross margin of SoSh 9 000/t. This is a most unusual situation for a non-perishable basic food commodity. This hints at the fact that considerable 'premiums' are paid for the allotment of sugar quotas and/or for import licences. On the background of heavy losses of the state owned sugar sector the situation must be considered as being extremely unsatisfactory.

Political decision makers may have to reconsider their sugar marketing and price policy. A policy of low consumer prices combined with short supply can be maintained only if government assumes the role of retail distributor. If, on the other hand, the extremely high consumer price level is acceptable to the authorities it should be assured that the financial returns are directed to the loss making sugar producers or to government who as its owner has to subsidise them.

5.3 Cash-flow Forecast and Financial Viability

5.3.1 General

The results of the cash flow forecast and the financial viability of the rehabilitation project are mainly dependent on:

- the measures which will be taken by the Government regarding SNAI's existing debts;
- the factory sugar price.

(a) SNAI's debts accumulated in the past, will be well above SoSh 250 million (DM 41 million) by the end of 1983.

Consideration must be given to the treatment of these debts. The only reasonable approach in our opinion is cleaning the slate. The debts should be written off as losses to be borne by the government as sole shareholder.

(b) The self financing capacity of SNAI is extremely low at present and will remain so for some time for the following seasons:

- equity and share capital have been wiped out due to heavy losses in the past;
- during a part of the rehabilitation period further losses will be unavoidable due to weak cane production base.

Therefore it is worthwhile that the government considers an increase of the ex-factory sugar price, at least for the first years of the rehabilitation period, in order to enable Jowhar to finance at least the operating costs, replacement and interest.

A reduction of the consumer tax on sugar and/or increase of the official consumer price to finance the higher producer price is suggested.

5.3.2 Cash-flow Forecast

For a cash-flow forecast for the period 1984/85 to 2004/5 reference is made to Table 5.3.1 (Cost Summary), Annex VII (Details of Costs) and Table 5.3.2 (Liquidity Analysis).

The following assumptions have been made for this exercise:

(i) the financial year will be adjusted to the crop season (July 1 to June 30);

(ii) benefits of marginal importance such as sale of electricity and/or molasses have been excluded;

(iii) Debts per end June 1984 will be written off as losses to be borne by the Government;

(iv) the firm command for rehabilitation of equipment placed by the Ministry of Industry in 1983 will be financed by the Government without charging Jowhar;

(v) estimates for capital costs, operating cost and replacements have been based on mid 1983 prices;

(vi) for short term financing of salaries, wages and consumables an allowance has been made amounting to DM 5 million in year 1, and DM 2 million in year 2;

(vii) an equity/loan ratio of 60/40 has been adopted for that part of the capital cost that cannot be financed from self generated funds;

(viii) an interest percentage of 12% for new long term loans has been calculated;

(ix) taxes on profits have not been taken into account, no provision has been made for dividend payments;

(x) the ex-factory sugar price is maintained at SoSh 10 000/t (DM 1 656) during the analysed cash-flow period of 30 years.

The cash-flow forecast indicates that:

Assuming that the rehabilitation programme will be financed 100% by foreign capital, the Estate will regain a self-financing capacity from project year 5 onward. The positive gross cash-flow of the 1988/89 campaign has been calculated to be DM 14.5 million. At full production level annual standard surplus will amount to roughly DM 40 million per year. Maximum cumulated negative cash flow will amount to DM 58.1 million at the end of year 4.

Under the financing mode of 60% equity to be put up for capital costs and the cost, of the management unit and only 40% of the same costs will be financed on long term loans, the liquidity of the Estate would be tight during the first

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SUMMARY, FINANCIAL PROJECT COSTS

CTN COSTSUM

		UNIT	UNIT COS	0 1983/84 quantity	amount	1 1984/85 quantity	amount	2 1985/86 quantity	amount	3 1986/87 quantity	amount	4 1987/88 quantity	amount	5 1988/89 quantity	amount	SUM cols.(1) to (5) quantity	amount	FOREIGN %	EXCHANGE amount
1	CAPITAL COSTS	DM	1	-	-	14027	14027	9783	9783	16169	16169	13223	13223	5989	5989	59191	59191	86	50904
2	MANAGEMENT UNIT	DM	1	-	-	2444	2444	4464	4464	4305	4305	3743	3743	1821	1821	16777	16777	95	15935
3	SUBTOTAL (Baseline cost)	DM	1		0	16471	16471	14247	14247	20474	20474	16966	16966	7810	7810	75968	75968	88	66842
4	CONTINGENCIES			0	0	1647	1647	2422	2422	4914	4914	5515	5515	3208	3208	17706	17706	88	15558
4.1	Physical	DM	103	0	0	1647	1647	1425	1425	2047	2047	1697	1697	781	781	7597	7597	88	6684
4.2	Inflation	DM	1	0	0	0	0	997	997	2866	2866	3818	3818	2427	2427	10109	10109	88	8894
5	TOTAL	DM	1		0	18118	18118	16669	16669	25388	25388	22481	22481	11018	11018	93674	93674	88	82423

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Table Nr 5.3.2

Liquidity Analysis
(in DM 1000, 1983 constant terms)

Year	1983/84 0	1984/85 1	1985/86 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
Costs		32025	29506	40519	40368	33238	32529	29177	30114	38947	34047	35279	41779	35279	35279	36179	36179	41929	36179	36179	36179	36179	48679	36179	36179	36179	36179	42179	36179	36179	36179
Investments, replacements		17287	10008	16169	13223	5989	6519	2800	3600	12300	7400	8632	15132	8632	8632	9532	9532	15282	9532	9532	9532	9532	22032	9532	9532	9532	9532	15532	9532	9532	9532
Management unit	0	2444	4464	4305	3743	1821	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operational costs	9454	12294	15034	20045	23402	25428	26010	26377	26514	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647
Sales	4031	10060	15090	23985	35177	47736	60794	69822	74053	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200
Annual production (t)	2700	6040	9060	14400	21120	28660	36500	41920	44460	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950
Ex-factory price	1.493	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656	1.6656
Liquidation Value	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42000
Annual cash flow	-	-21965	-14416	-16534	-5191	14498	28265	40645	43939	39353	44153	42921	36421	42921	42921	42021	42021	36271	42021	42021	42021	42021	29521	42021	42021	42021	42021	36021	42021	42021	84021
Cumulated cash flow		-21965	-36380	-52915	-58105	-43607	-15342	25303	69242	108495	152648	195569	231990	274911	317832	359853	401874	438145	480166	522187	564208	606229	635750	677750	719792	761813	803824	839855	881876	923897	1007918
Liquidity Analysis																															
Interest on loans		0	1547	2482	3104	3319	1294	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Repayment of loans				3000	5000	20000	10781	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equity		11839	8683	12284	10180	4686	3911	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-term loans		12892	7789	8190	6786	3124	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Outstanding loans end year		12892	20681	25871	27657	10781	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net Cash Flow, Annual		2766	509	-1542	3671	-1011	20102	40645	43939	39253	44153	42921	36421	42921	42921	42021	42021	36271	42021	42021	42021	42021	29521	42021	42021	42021	42021	36021	42021	42021	84021
Cumulated		2766	32575	1733	5404	4394	24496	65141	109080	148333	192486	235407	271828	314749	357670	399691	441712	477983	520004	562065	604046	646067	675588	717609	759630	801651	843672	879693	921714	963735	1047756

Table Nr 5.3.2

two years. To overcome this shortage, long term loans have been increased by DM 5 million in year 1 and DM 2 million in year 2 to cover working capital needs. Loan repayment can be started with progressive annual instalments from year 3 onwards. Loans will be paid back at the end of year 6.

Total equity to be put up during the six years rehabilitation phase amounts to DM 51.6 million, maximum outstanding loans will be DM 27.7 million.

5.3.3 Financial Viability

Based on:

(a) the figures of the cash-flow forecast for:

- sugar production (including the period 1/1/84 to 31/5/84),
- operating costs,
- capital cost.

(b) the following assumptions:

- sugar production before rehabilitation (1983/84) will be 2 700 t,
- the operating cost for 2 700 t sugar has been estimated to be DM 9.454 million,
- the remaining value of the Estate after 30 years equals DM 42.0 million,
- the financial internal rate of return amounts to 45% (see Table 5.3.3).

The long term average cost price for one tonne of sugar can be estimated as follows:

	DM 1 000/year
Operational costs	26 647
Depreciation on assets acquired within rehabilitation programme	5 570
Depreciation on formerly acquired assets (7% of DM 232 million, see Table VII.6.5)	16 240
Total annual production costs	48 457
Annual production	46 050
Cost per tonne of sugar	1.052

This cost price is roughly equal to the import parity price of DM 1 007.28/t and equal to 60.5% of the actual ex factory price of DM 1 665.6/t.

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FINANCIAL CASH FLOW AND INTERNAL RATE OF RETURN

Ser. Nr.		0 83/84	1 84/85	2 85/86	3	4	5	6	7	8	9	10	11	12	13	14
1	COSTS		32825	29506	40519	49368	33238	32529	26377	26514	26647	26647	26647	26647	26647	26647
1.1	Investments,replacements		17287	10000	14169	13323	5989	6519	0	0	0	0	0	0	0	0
1.2	Management unit	0	3444	4464	4305	3743	1421	0	0	0	0	0	0	0	0	0
1.3	Operational costs	9454	12094	15034	20045	23402	25428	26010	26377	26514	26647	26647	26647	26647	26647	26647
2	SALES	4031	18060	15098	23995	35177	47736	60794	69822	74053	78200	78200	78200	78200	78200	78200
2.1	Annual production (t)	2700	9950	9960	14400	21120	28640	36500	41930	44460	46950	46950	46950	46950	46950	46950
2.2	Ex-factory price	1.493	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656
3	LIQUIDATION VALUE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4	ANNUAL CASHFLOW	-	-31945	-14416	-16524	-5193	14498	28245	43445	47539	51553	51553	51553	51553	51553	51553
5	CUMULATED CASHFLOW		-31945	-46360	-62915	-68108	-53607	-25362	18083	65622	117175	168728	220280	271833	323386	374939
6	LIQUIDITY ANALYSIS															
6.1	Interest on loans		0	1547	2482	3184	3318	1276	0	0	0	0	0	0	0	0
6.2	Repayment of loans				3000	5000	20000	18221	0	0	0	0	0	0	0	0
6.3	Equity		19159	8583	12334	10156	4388	1911	0	0	0	0	0	0	0	0
6.4	Longterm loans		12892	7720	8198	6726	3124	0	0	0	0	0	0	0	0	0
6.5	Outstanding loans end year		12892	20681	25871	27657	10791	0	0	0	0	0				
7	NET CASHFLOW, ANNUAL		2766	589	-1542	3471	-1911	20102	43445	47539	51553	51553	51553	51553	51553	51553
8	CUMULATED		2766	3275	1733	5404	4394	24496	67941	115479	167032	218585	270138	321691	373244	424797

Ser. Nr.		15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	IRR
1	COSTS	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	
1.1	Investments,replacements	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.2	Management unit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
1.3	Operational costs	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	26647	45
2	SALES	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	78200	
2.1	Annual production (t)	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	46950	
2.2	Ex-factory price	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	1.8656	
3	LIQUIDATION VALUE	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42000	
4	ANNUAL CASHFLOW	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	
5	CUMULATED CASHFLOW	476350	528002	579555	631005	682358	733611	784867	837228	888773	940326	991879	1043432	1094985	1146537	1198090	1249643	
6	LIQUIDITY ANALYSIS																	
6.1	Interest on loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6.2	Repayment of loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6.3	Equity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6.4	Longterm loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6.5	Outstanding loans end year																	
7	NET CASHFLOW, ANNUAL	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	51553	
8	CUMULATED	476350	528002	579555	631005	682358	733611	784867	837228	888773	940326	991879	1043432	1094985	1146537	1198090	1249643	

CHAPTER 6

ECONOMIC BENEFITS AND JUSTIFICATION

CHAPTER 6

ECONOMIC BENEFITS AND JUSTIFICATION

6.1 Analysis of Economic Viability

Project costs for the years one to six are given in Table 3.9.1. The project's economic cash flow for 30 years is presented in Table 6.1.1. Details of the economic cost calculations and detailed cash flow compilation are given in Annex VII.6, and the methodology of converting financial to economic cost is presented in Annex VIII.2.

The following methodology has been applied for calculating the incremental costs and benefits of the project. Prices are given in 1983 constant terms throughout the lifetime of the project. No major deviation from the general trend is expected for either costs or benefits.

Prices for labour are fully accounted for. The proposed salary increases for the 1985/86 campaign are fully included in project costs. As the proposed daily wage for rural casual labour is deduced from and roughly equal to the earning potential in the subsistence farming sector no shadow price has been applied to casual labour.

The foreign exchange component of the project has not been shadow priced, but the effect of shadow pricing has been investigated in the sensitivity test (see last block of Table VIII.3.1).

Incremental sugar production has been evaluated at economic import parity prices of DM 1 007/t for 1983. This is a considerably higher price than the prices prevailing in 1983 on international competitive markets. The latter were marked in 1983 by an over supply situation resulting in strong price depression. In order to eliminate in our analysis the influences of erratic short term price fluctuations we have deduced from the time series of international sugar prices of the last 30 years a long term trend. The price determined by the intersection of the trend line with the mid-1983 axis has been taken as the sugar price to calculate the import parity price used within this analysis (see Figure 6.1.1).

Project costs include all financial costs. The latter have been calculated free of taxes in the financial analysis. Full costs of the management unit are included in spite of its high training component. Any costs relevant to areas other than cane are not included.

Incremental benefits only include the incremental sugar production. Molasses, the most important by-product, is being transformed to alcohol within the project. In the recent past it had been sold at prices not even covering cost. For the future it is assumed that this by-product will be sold at cost-price. As the costs of alcohol production, apart from minor capital costs for the rehabilitation of the alcohol plant, are excluded from project costs this omission will have no effect on the results.

The determination of the enterprise's production level 'without project' is somewhat of a problem. Due to a close to breakdown situation only 2 700 t of sugar have been produced in 1983. On the other hand important investments concentrated in the factory and on the rolling stock amounting to a value of DM 10.4 million have been started outside this project in 1983. In our basic cashflow calculation we have excluded these investment costs. As production level 'without project' we have taken the extremely poor 1983 result.

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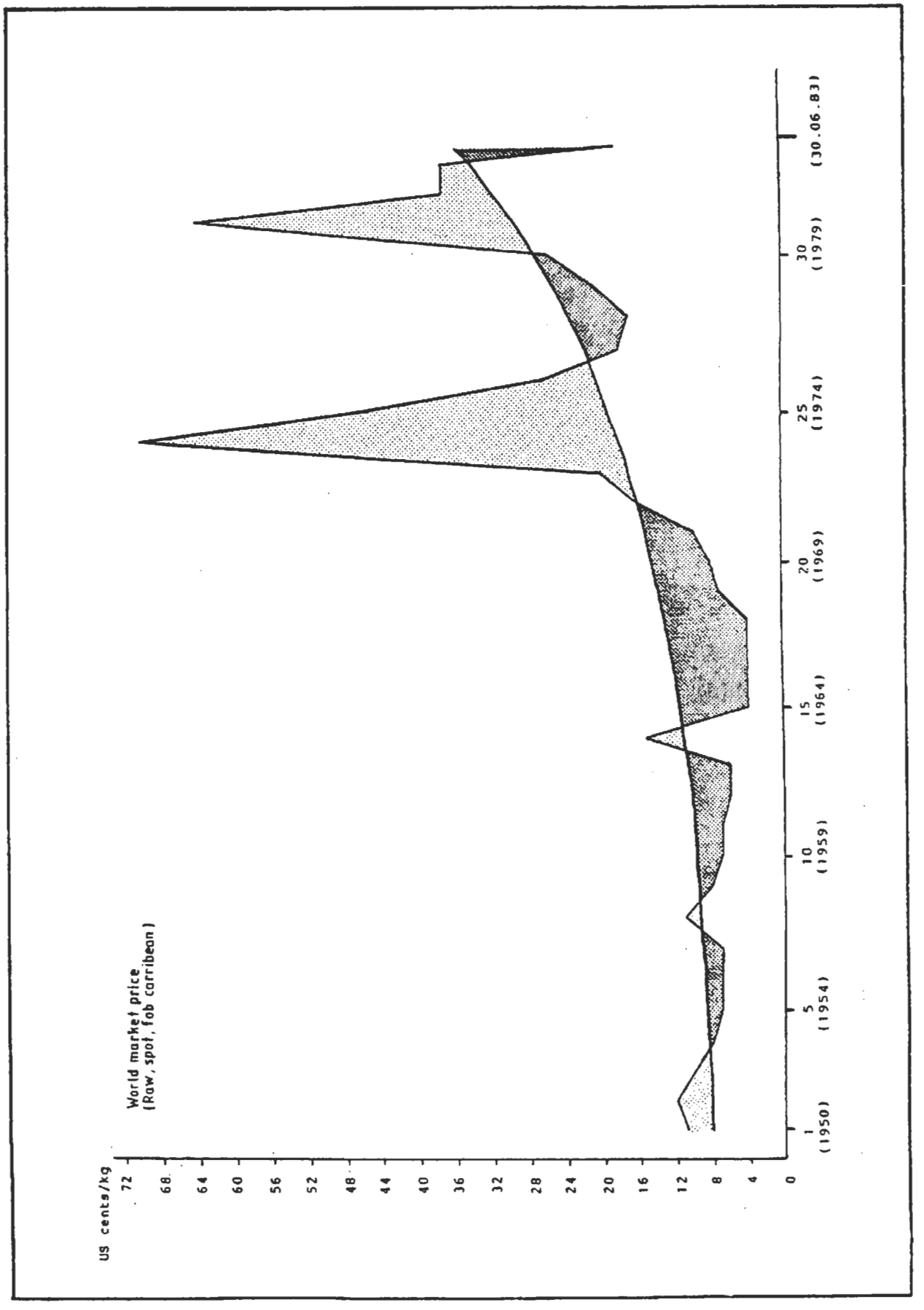
CASHFLOW AND SENSITIVITY TEST (DM '000)

	Ser.Nr.		UNIT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	1	CAPITAL EXPENDITURE	TDM/a	14016	9333	16328	14556	6528	7171	3080	3960	13530	8140	9495	16645	9495	9495	10485
	2	INCREMENTAL RECURRENT EXP.	TDM/a	6758	11994	17331	30406	30520	19157	19561	19712	19658	19658	19858	19858	19858	19658	19858
	3	INCREMENTAL SUGAR PRODUCTION	TDM/a	3364	6406	11735	18554	26149	34048	39506	42064	44572	44572	44572	44572	44572	44572	44572
5300 ha	4	CASHFLOW. ANNUAL	TDM/a	-17410	-14921	-21874	-16408	-959	7718	16865	18392	11184	16574	15219	8069	15219	15219	14229
	5	CUMULATED	TDM	-17410	-32331	-54205	-70613	-71572	-63854	-46989	-28597	-17413	-839	14380	22449	37668	52887	67116

	Ser.Nr.		UNIT	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	IRR
	1	CAPITAL EXPENDITURE	TDM/a	10485	16810	10485	10485	10485	10485	24235	10485	10485	10485	10485	17085	10485	10485	10485	
	2	INCREMENTAL RECURRENT EXP.	TDM/a	19858	19858	19858	19858	19858	19858	19858	19858	19858	19858	19858	19858	19858	19858	19858	
5300 ha	3	INCREMENTAL SUGAR PRODUCTION	TDM/a	44572	44572	44572	44572	44572	44572	44572	44572	44572	44572	44572	44572	44572	44572	240652	17.
	4	CASHFLOW. ANNUAL	TDM/a	14229	7904	14229	14229	14229	14229	479	14229	14229	14229	14229	7629	14229	14229	210309	
	5	CUMULATED	TDM	81345	89249	103477	117706	131935	146164	146643	160872	175101	189330	203559	211188	225417	239646	449955	

Figure 6.1.1

Sugar Price Trends



The project's replacement investments for years 7 to 30 have been determined in detail in Table VIII.3.3. A description of the methodolgy is presented in Annex VII, Section 6.

The basic cash-flow solution produces a very satisfactory internal rate of return of 17.6%. The first positive cash flow occurs in project year 6. The average long term cash flow at full production level is close to DM 12 million per year. The cumulated negative cash flow reached its maximum in year 5 amounting to DM 71.6 million. This is wiped out by the end of year 10.

Our basic solution has been submitted to a sensitivity test. In a first approach we have altered the two vectors of incremental cost and benefits in 20% steps and submitted the resulting new cash flows to a new IRR calculation. The results are summarised in Table 6.1.2.

This is quite sensitive to alteration of the cost benefit ratio. Cost increase by 20% and a benefit reduction of the same rate results in a negative IRR. The inverse alteration (cost 80%/benefits 120%) produces 32.9%.

In a second step we have analysed the special solution of applying shadow prices to the project's foreign exchange components. We have chosen a shadow exchange rate of SoSh 20 to US$ 1 instead of the official exchange rate of SoSh 15.227 to US$ 1.

This rate reflects the shortage of foreign exchange of the Somali economy which is also expressed by the black market rate for the dollar amounting to SoSh 30 in summer 1983. The higher price (x 1.3) has been applied to the foreign exchange component (89%) of incremental cost and to 100% of incremental benefits as Somalia is and will remain for the foreseeable future a sugar importing country. This version (see Block 4 of Table VIII.3.1) gives an IRR of 18.2%.

Finally a word must be said about the project's major risks that may influence its economic performance. We have already seen that the project's viability is very sensitive to a long term decline in sugar output. The decrease of the actual 1983 production level of sugar relative to former production forecasts explains partly the higher IRR of this final report compared to the interim report which was based on optimistic forecasts. The predicted fast increase of cane yields and the factory's sugar/cane ratio can only be maintained if :

- the project's tight time schedule can be adhered to strictly, especially as far as an immediate beginning of the crash programme is concerned;

- the required operational and managerial efficiency can be maintained in the long run. To achieve this target SNAI will have to avoid, at almost any cost, a future 'exodus' of its staff formed during the rehabilitation period.

6.2 Socio-Economic Considerations

6.2.1 Employment

In the sector of permanent employees the rehabilitation programme will have hardly any quantitative effect. In spite of the very considerable decline of production in recent years no real reduction of staff volume has been effected.

SOMALI DEMOCRATIC REPUBLIC
REHABILITATION OF JOWHAR SUGAR ESTATE

Final Report

Results Cost-Benefit Analysis
('000 DM, economic, 1983 constant terms)

Serial Nr		IRR (%)	Maximum negative cash flow	First year of positive cash flow	'Standard' cash flow at full production
1	Basic solution	17.6	71 572	6	11 855
2	Cost 120%/Benefits 80%	neg.	159 580	7	-2 600
3	Cost 80%/Benefits 120%	32.9	46 447	5	26 375
4	Foreign exchange components shadow priced (1 US$ = 20 SoSh instead of 15) Cost: 0.89 x 1.33 Benefit: 1.00 x 1.33	18.2	77 717	5	20 210

Table 6.1.2

Therefore the enterprise must be considered to be markedly overstaffed at the actual production level. By and large the actual staff will be sufficient in number to regain full production level. In certain departments, especially of administrative nature, the tendency will even be towards a staff reduction.

Things are rather different when analysing quality aspects: the proposed training programme combined with the recommended employment campaign are aiming at a considerable rise of the average level of qualification of SNAI's employees. Due to the relatively high weight of SNAI as an enterprise in the Somali industrial sector its influence on the national labour market is important. The proposed increases of the wage scale might set an example for other public sector enterprises and even for the civil service.

SNAI's high demand for skilled labour and qualified technicians will not only have negative effect on the rest of the industry if the existing gaps are being filled either from abroad or as a result of additional training efforts.

The assessment of future employment effects is much more complex in the case of seasonal agricultural labour. Under actual conditions, as claimed by the Estate's agricultural department, more than 6 000 ha under cane would require a work force of more than 2 000 labourers for manual harvesting and mechanical loading in spite of the extremely low yields. With improved labour productivity, as is shown in Section 3.3.8, a labour force of around 1 600 would be required for harvesting of some 460 000 tonnes of cane annually from an area of 5 300 ha. In 1983 the Estate could recruit only a very small fraction of the labour force needed for the harvesting of mature cane. A working day with more than 1 000 present in the field was an exception. Most of the would-be cane cutters were women and children.

The analysis in Annex VI shows that there is no rural unemployment in the surroundings of the Estate. Labour can be recruited only at the cost of employment reduction in a competing sector, namely subsistance agriculture. Our study does not show definitely whether the proposed measures to increase the attractiveness and competitiveness of SNAI as an employer to casual labour are sufficiently effective to provoke the transfer of labour from subsistance agriculture to the sugar sector. The same degree of uncertainty applies for the speed of effectiveness.

The envisaged new field layout created the technical precondition of the introduction of mechanised harvesting. But the proposed levelling programme can be implemented only at a rate of slightly more than 1 000 ha per year starting from 1985 onwards. This fact blocks the possibility of a fast introduction of mechanised harvesting. On the other hand this fact implies a 'grace period' of two to three years during which the effectiveness of the new employment conditions and other proposed pilot measures (settlement scheme, payment partly in kind) can be tested.

6.2.2 Income

The proposed salary changes (see Chapter 4) will increase the average annual cost of personnel for SNAI by a rate of some 80%. The annual wage bill will rise from roughly SoSh 33 million to SoSh 59 million. These figures do include casual rural labour and they are based on the assumption that harvesting is done manually. This increase may sound impressive at first sight but when compared with the recent escalation of cost of living in Somalia it must be said that this substantial increase is still insufficient to catch up with the former buying power of the salary of SNAI's employees. Since 1976 the Mogadishu cost of living index has increased fourfold. The average increase of the salary scale on the other hand has remained below 50% during the same period.

6.2.3 Balance of Payment

As a first step to assess the project's foreign exchange effects we will compare the foreign exchange component of sugar production at full capacity with the cost of the same amount of imported sugar. All prices are expressed in 1983 constant terms. The applied exchange rates are the official rates of mid 1983. Maximum production of 46 950 tonnes of sugar annually will be reached the first time in the 1990/91 campaign. Production cost will be SoSh 4 274/t. This amount includes cost of depreciation, but does not contain those of financing nor any provision for expatriate management. The latter is expected to have been phased out by this time.

During the first six years of our project the average foreign exchange component of all costs has been calculated to be 71%. This is expected to be reduced to 65% in the medium term as the two important foreign exchange vectors, namely rehabilitation investment and management unit, are no longer part of the cost structure. Under this assumption the foreign exchange component in the production cost of one tonne of sugar amounts to SoSh 2 778. The Estate's annual foreign exchange requirement amounts to SoSh 130 million.

The import parity price for sugar based on the long term international trend price (see Annex VIII-1) amounts to SoSh 5 375/t. Relative to sugar import under commercial conditions the net surplus in foreign exchange in the case of the local production would be SoSh 2 597/t, equivalent to SoSh 121 million/year (DM 20 million).

A further sophistication can be applied to this model when replacing the long term price trend of sugar by the international price fluctuations that can be foreseen for the coming years. Actual international sugar prices are about one third below the long term trend price and tend to reach the trend again only in the late 1980s. The short run low price condition of international markets combined with the existing extremely high cost price per tonne of sugar leads to a net loss in foreign exchange, as the foreign currency share of fixed costs of the Estate is definitely higher than the actual production value of sugar.

Another aspect to be borne in mind when analysing foreign exchange effects of this sugar project is the long term tendency to increase the share of mechanical cane harvesting. Fully mechanised harvesting will increase the foreign exchange component of sugar production cost by approximately 5% and thus, under 'normal' international market conditons, still result in a comfortable net earning of foreign currency.

The foreign exchange net earnings from local sugar production substituting sugar importation will have to serve also to reimburse the likely foreign exchange loan to finance project cost. The latter amounts, as mentioned before, to roughly DM 120 million in current prices for a 6 year period. The repayment of this loan will require the foreign exchange net earnings of the project for a period ranging from 6 to 10 years according to loan conditions.

6.3 Assessment of Environmental Effects

The operation of an irrigated area under tropical conditions always involves health risks for operational staff. The rehabilitation of Jowhar Estate will certainly not create new irrigated area but the considerable improvement of the water supply situation combined with the construction of night storage reservoirs and the rehabilitation of storage reservoirs for plant cane will improve the living conditions for waterborne diseases. The eventual cultivation of paddy in non-cane areas will also aggravate the problem.

Three major diseases are to be mentioned in the context of the ecological environment of Jowhar Estate: schistosomiasis and malaria are the two diseases affecting the human population. In both cases the disease transmitting vectors, snails and mosquitoes respectively, are likely to increase with improved water supply conditions. Nowadays medical knowledge offers relatively low priced and simple solutions in order to combat this threat. Theoretically any interruption of the propagation cycle will effectively stop a further spread of the diseases. Formerly huge sums were spent trying to eradicate the disease-bearing snails and Anopheles larvae. These measures proved to be relatively ineffective in the medium and long run. More recent techniques try to interrupt the transmission cycle with curative and preventive programmes among the infected population (malaria prophylaxis and hygienic education). This can be done nowadays with relatively moderate costs. The implementation of such a public health programme is also recommended for the Jowhar area.

The tsetse fly transmitting trypanosomiasis affecting the regional cattle population makes effective cattle breeding in the surroundings of the Estate literally uneconomic. Tsetse flies rely for their reproduction on a dense shrubbery fauna which, under Somali conditions, normally can be found only in the immediate neighbourhood of permanent water sources. An eventual reforestation of part of the Estate area that is not being used for cane production in the immediate future will create almost ideal living conditions for the tsetse fly. The Somali government will implement in 1984 a tsetse eradication programme in the middle Shabelle area. Nevertheless we are of the opinion that reasonably successful cattle breeding in the river valley will be possible only after the cross breeding of local cattle with imported tsetse-resistant varieties. Details of the proposed measures are given in Annex III.

The actual operation of the sugar factory involves two pollution problems, namely air pollution due to technically ineffective boilers, especially soot removing systems, and also river pollution due to disposal of surplus molassses directly into the river. The latter habit is especially problematic during periods of low river flow in spring. The air pollution problem will be considerably suppressed after the rehabilitation of the Pensotti boiler and after the installation of a bagasse dryer. These measures are included in the crash programme. The respective contracts have already been signed.

River pollution will also be brought down to a negligible minimum after the overhaul of the alcohol plant. No surplus molasses beyond the storage capacity of the existing tanks will occur. The remaining process waste (yeasts and others) can be effectively used as manure.

Drainage water from the fields is disposed of separately from the river in the drainage disposal area as envisaged in the design of the Jowhar Offstream Storage Reservoir, and should not have any pollution or salinity effect on the river.

6.4 Conclusions and Recommendations

The analysed project is economically fully viable.

The high IRR of 17.5% reflects the fact that enterprise's remaining capital assets of considerable value can be rehabilitated within a relatively short period, and a production level close to the factory's design capacity can be achieved within five years. Financially this argument is valid only if either the company's cumulated debts are taken over by government or if sufficient capital is injected into the enterprise as huge losses in recent history have wiped out equities.

As Somalia will remain a sugar importing country unless it considerably increases its sugar production capacity and, furthermore, as the foreign exchange component of sugar production in the case of Jowhar is considerably inferior to the long term trend value of sugar CIF-Mogadishu, the project will also produce a comfortable net earning in foreign exchange.

The major remaining uncertainty of the project study is the answer to the question whether SNAI will be able to attract a sufficiently high number of casual labourers in order to maintain manual harvesting. A definite answer can be given only after two or three years when the proposed package of general measures (salary increases and improvement of social amenities) together with the pilot settlement scheme have been tried out.

A much higher degree of mechanisation of harvesting may become necessary. Full mechanisation will certainly burden the foreign exchange balance of the project but still leave a comfortable net earning.

The employment effects of mechanised harvesting must be considered as neutral as the social group from which cane cutters are being recruited is mainly that of small subsistence farmers. In this sector a considerable labour shortage exists.

Of course the level of operational and managerial skill necessary to achieve the projected production targets is high. On the other hand it corresponds only to the standard efficiency level of an internationally competitive sugar complex of this size. The proposed international management unit may seem voluminous, but we think it necessary during the heavy investment phase in addition to the complementary heavy investment in the training of Somali staff.

The financial viability of the project is good and this margin may serve to absorb one or the other risk. But this fact must not lead to the conclusion that less ambitious efficiency levels should be aimed at. The opportunity costs of a production level considerably below optimum are too high even if they do not appear in the cash flow analysis.

A final word should be said about the future use of non-cane areas. Today's cost of constructing an irrigated area of 2 900 ha under Somali conditions would be US $ 20 to 30 million. The rehabilitation of the currently abandoned area is technically feasible. The major share of the area can be used immediately for short cycle crops during at least 8 months of the year. In order to avoid additional heavy managerial burdens the board of directors of SNAI should perhaps consider leasing out to a separate project part of or all of the non-cane area.

CHAPTER 7

IMPLEMENTATION

CHAPTER 7

IMPLEMENTATION PROGRAMME

As an introduction we would like to stress once again the urgency of an immediate start of the rehabilitation programme. Any further delay risks a complete operational breakdown. Furthermore the fact that Jowhar at present produces at a level not even representing 10% of its design capacity leaves idle an important source of income. The expected positive cash flow at full production amounts to DM 14 million per year. Finally, Somalia's need to import sugar which could be produced on the Estate has a very detrimental effect on the balance of payments in a country with a severe foreign exchange shortage.

In Figure 7.1.1 we have subdivided the implementation programme into three phases and its components have been broken up into seven contracts.

The project would start in mid-1984. Training of staff, mechanical plant and equipment rehabilitation, and civil engineering works would be implemented during project years 1 to 6. Full production level would be reached in project year 9 (1992/93).

The crash programme, the first phase of implementation, would take place mainly in 1984/85. In 1985/86 it would overlap with the beginning with the following phase namely the period of heavy investment that we have labelled 'push phase'.

The major target of the crash programme is to stop the steep decline of Jowhar's operational performance.

The push phase would last for four years (1985/86 to 1988/89). This period is needed to achieve the staff training targets aimed at and furthermore for the execution of the major civil works contracts. The majority of the mechanical engineering components of the rehabilitation programme can be executed during the first two years of this phase.

The third phase has been named "phasing out of external support". It will last for two years (1989/90 and 1990/91) and will cover the period up to the achievement of target production. It would reset the Estate on a sound financial footing.

Implementation Programme

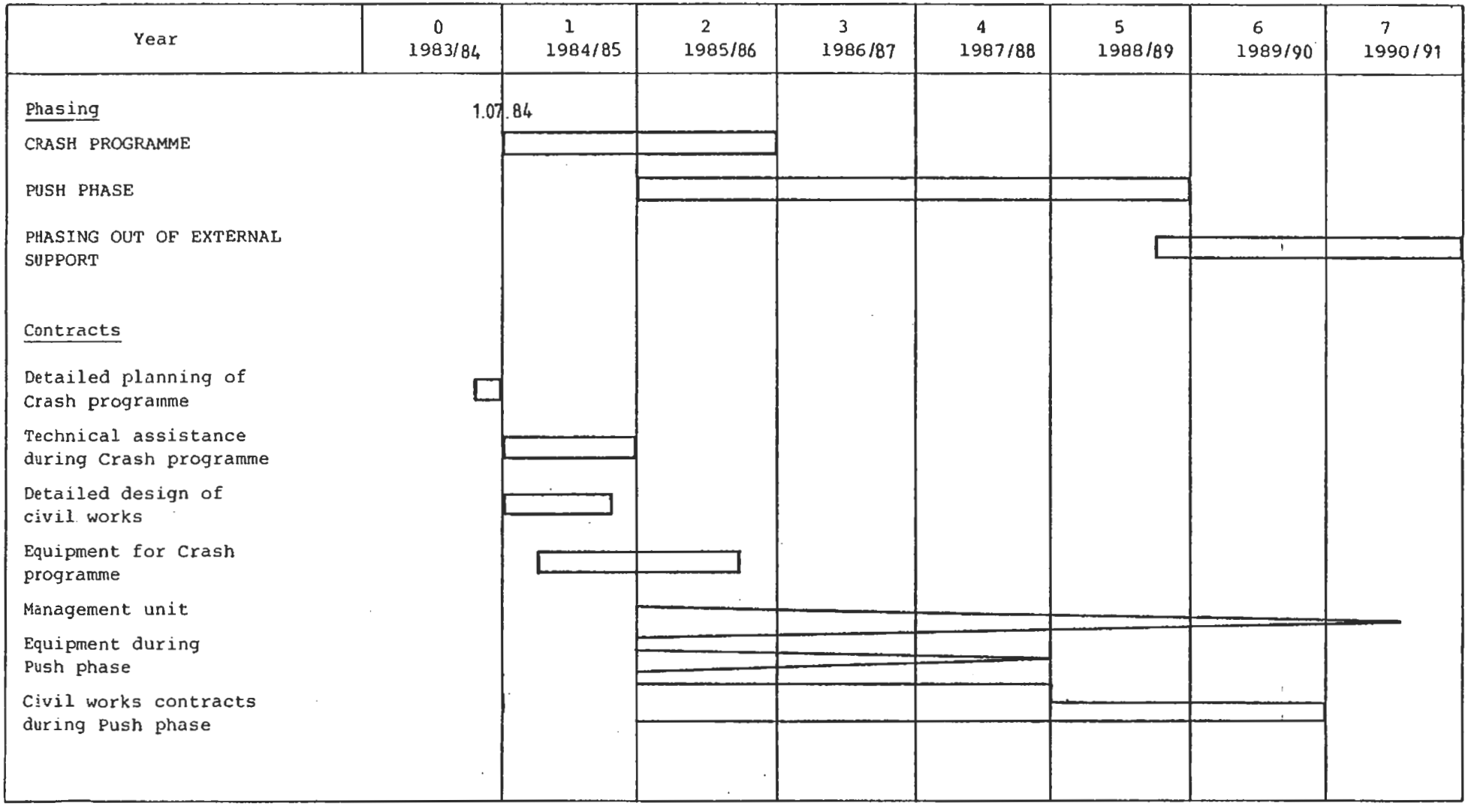


Figure 7.1.1

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