Somali Democratic Republic
Ministry of Agriculture

Mogambo Irrigation Project

Agricultural Operations and Mechanisation Planning Report

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CONTENTS

CONTENTS (cont.)

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (cont.)

SUMMARY

With the construction of the Mogambo Irrigation Project well underway and the Agricultural Management Contract not yet awarded, a detailed planning study of both the agricultural operations and mechanisation required for the project became critical. This report reviews the original proposals contained in the previous studies and makes recommendations on agricultural operations, mechanisation for agriculture and operating and maintenance, transport, workshops, and management and staffing.

Agricultural operations are discussed in Chapter 2. In that section the variety of rice recommended has been changed to varieties IR 24 and IR 22. The quantities of fertiliser and weed control have also been recommended. The application of herbicide has also been altered from the original studies from aerial spraying to the use of tractor-mounted sprayers.

The selection process for each type of machine for both agriculture and operation and maintenance is described in Chapters 3 and 4. The final recommendations in numbers for each item of equipment takes into consideration the common usage of plant between the agricultural and operation and maintenance functions.

The management and staffing requirements are discussed in Chapter 5. For the agricultural organisation it is recommended that the field management is divided into four sections determined by methods of irrigation, independence of irrigation operation and standardising size as far as possible.

Transport and workshop requirements are described in Chapters 6 and 7.

The total budget requirements until the project has reached full development at the end of 1986 are summarised in Chapter 8 with the detailed make-up covered in the appendices.

CHAPTER 1

INTRODUCTION

1.1 Present State of Construction

Construction of the Mogambo Irrigation Project (MIP) is now well underway. The first major construction contract (M1) for project buildings including houses, offices, workshops and stores, etc. is expected to be complete by mid-1984. The contractor for the land development, irrigation and civil works contract (M2) is due to commence work on site early in March 1984. Although this represents a delay of approximately four months from the original planning it is still expected that :

- 459 ha of surface irrigated land will be developed and available for cultivation in the 1985 gu season;
- 1 134 ha of surface irrigated land and 122 ha of sprinkler irrigated land will be available for cultivation in the 1985 der season;
- full development of Phase I (2 052 ha under surface irrigation and 163 ha under sprinkler irrigation) will be completed in time to allow cultivation of the entire area during the 1986 gu season.

Although the planning is based on the above figures it should be recognised that this is totally dependent on the contractor's performance. In the event that water will not be available for the gu season in 1985 the initial 459 ha of surface irrigated land may not be developed.

1.2 Scope of the Planning Report

With less than a year before agricultural operations are due to start, it is essential that detailed planning of these operations is commenced. The purpose of this study therefore is to carry out the detailed planning necessary to facilitate implementation of the agricultural programme; firstly by defining precisely what the programme will involve and secondly by specifying the machinery, agricultural inputs, labour and operating budget necessary to implement the programme successfully. Specifications for machinery and equipment will be in such detail as to allow procurement to proceed immediately.

The rice mill due to be constructed by the beginning of 1986 is a discrete and independent entity not considered within the scope of this report. Similarly, budget costs for the Rice Mill will be provided at a later stage.

The Terms of Reference relating to this Report are included in Appendix I.

1.3 Review of Existing Agricultural Proposals

The agricultural proposals to be implemented are contained in the report on the Mogambo Irrigation Project: Additional Study for an Alternative Development (Sir M. MacDonald & Partners Ltd., March 1980). They are supported by Annex 3 (Agriculture) of the Supplementary Feasibility Study Report (Sir M. MacDonald & Partners Ltd., August 1979). The initial phase of the project is designed primarily for the production of basin irrigated rice

(2 052 ha) with a small adjoining area (163 ha) of sprinkler irrigated cotton. Both production systems are dependent upon intensive mechanisation from land preparation through to harvesting and trash disposal. However, whereas the rice will be mechanically cropped the cotton will be hand picked.

Since the aim of this study is to complete the detailed planning necessary to implement the original concept, there is no question of the basic cropping pattern or production system being altered significantly. Within this study it has been necessary to reconsider the following aspects; the varieties of rice to be grown; the cropping intensity and distribution of cropping between the gu and der seasons and the application of herbicides. The main reason for this is the knowledge gained at the Fanoole and Barro Uen State Farms since the Supplementary Feasibility Study and the Alternative Development Study were completed. Although the area cultivated on either farm has never exceeded 200 ha in a single season, considerable rice growing experience has been accumulated and it is intended that the benefits of this experience are reflected in the detailed planning for MIP.

(a) Rice Varieties

In the 1979/80 studies a short season variety Vista (105 days to maturity) which had been tried successfully at Afgooye and which was equally well suited to basin and upland conditions, was proposed. Its principal advantage lay in its short season characteristic, which would enable a relatively high cropping intensity of 150% to be achieved. Its main disadvantages, however, were susceptibility to bird damage and proneness to shattering. It is no longer grown commercially in Somalia.

At Fanoole and Barro Uen, two varieties IR 24 and IR 22 respectively are grown. Both are potentially higher yielding and less prone to shattering or bird damage. They are long grained translucent varieties and acceptable for consumption by the Somali people. Although both varieties are longer season (120 to 125 days) than Vista, with good management it should still be possible to achieve 150% cropping intensity in one year. As IR 22 is sensitive to photoperiod it should be limited to the der season when less cloud is expected during the growing season. IR 24 is not sensitive to photoperiod and can be used for either season.

(b) Cropping Intensity

In the Alternative Development Study a cropping intensity of 150%, 75% in each season, was proposed. Whilst 150% intensity per annum is considered *attainable, a rigid adherence to 75% intensity in each season may not be* practical in the years when either high rainfall or low river flow is encountered in April.

The implications of this is that each year will have to be taken individually, and whilst a cropping intensity of 150% per annum remains the target, the intensity in each season will vary according to the conditions prevailing at the time. On the basis of the existing data, however, it is quite likely that the April rains may restrict the gu season cropping intensity to less than 75% but the shortfall would be made up in the following der. However, whilst the design capacity of the irrigation system can easily accommodate 100% intensity in the gu season because the crop water requirements are lower at this time, the higher der season requirements for 100% intensity can nearly be met by the system.

(c) Field Operations

The production system is based on intensive mechanisation of almost all field operations. This was proposed in 1979 primarily because of a shortage of labour, and mechanisation represented the best means of achieving a high cropping intensity, timely operations and high yields. Since then labour availability has not improved; if anything, competition for labour in the Lower Juba has increased markedly due to the expansion of the Juba Sugar Company, rehabilitation of banana plantations, and a further planned expansion in the banana hectarage of around 2 000 ha. There is, therefore, no reason to change the production system to one which is more dependent upon labour intensive methods, and consequently the operations planned in the following chapters are largely similar to those outlined in the Supplementary Feasibility Study and Alternative Development Reports.

The only operation which differs from the early proposals is the application of herbicides. Originally when the planning was carried out for the ultimate development of 6 400 ha, it was assumed that aerial application of herbicides on rice, aerial top dressing of nitrogen and aerial spraying of pesticides on cotton represented the cheapest and most effective means of application. With the reduced scale of the Phase I operations, aerial application of rice herbicides can no longer be justified for Mogambo alone. The Phase I rice area would require a total of 4 to 6 days actual spraying time. Since planting and germination extends over a 40 to 45 day period, the diseconomies of bringing an aircraft into the country on a number of occasions, or of maintaining an aircraft in the country for a 40 to 45 day period would be prohibitive. Furthermore, an airstrip would have to be cleared and prepared within the project area. The strip would have to be a minimum of 800 m long and 30 m wide with a central strip 3 m wide surfaced with crushed coral. At present there is no provision for this in Phase I of the project, but there is an existing airstrip at the Juba Sugar Project, 35 km away, which could be considered for use in the spraying operation, especially in association with the Fanoole Project. Taking these facts into consideration aerial spraying of rice herbicides is not considered appropriate and the use of tractor mounted sprayers is now proposed. Tractor mounted sprayers are already being used at Fanoole and Barro Uen State Farms and although there are certain disadvantages this method has proved reasonably successful. The disadvantages are: less timely application in that spraying by tractor would almost certainly mean a delay in spraying of 3 to 5 days compared with aerial application; slightly higher rates of application may have to be used and control of weeds would generally be less effective. Provision for spot spraying of weeds which have survived would have to be made. The spraying operations will be much more susceptible to the incidence of rainfall.

Although aerial spraying is not economic for Mogambo Phase I alone, it should be reconsidered for any further phases and the potential for collaboration with Fanoole should be reviewed as the area of rice develops at both projects.

CHAPTER 2

AGRICULTURAL OPERATIONS

2.1 Cropping Programme

The cropping pattern is not complex and is based on mono-cropping rice on the surface irrigated area at an annual intensity of 150% with some flexibility over the distribution of intensity between the gu and der seasons. Initially, the sprinkler irrigated land will be devoted to mono-cropping cotton grown under a conventional wide row system in the der season. The aim will be to test the feasibility of cotton growing and eventually to investigate the potential for cultivation of a narrow-row system suitable for mechanised stripper picking. Whilst the potential for cotton cultivation will be examined in the first two years, the possibility for a rotation incorporating upland rice and maize in the longer term should not be ruled out.

The cropping programme for the first two years during the construction period to full development is summarised in Table 2.1.

TABLE 2.1

Cropping Programme 1985 to 1986

		1985		1986	
		gu (ha)	der (ha)	gu (ha)	der (ha)
Available land :	Surface irrigation	459	1 134	2 052	2 052
	Sprinkler irrigation	122	122	163	163
Cropping programme :	Paddy rice	459	900	1 539	1 539
	Cotton		122		163

In the 1985 der season it is anticipated that 900 ha of rice is the maximum that can be expected. This will comprise the incremental area of 675 ha to be developed in time for planting during the 1985 der season with approximately half of the area cultivated during the preceding gu season. The final cropping plan of 3 078 ha of rice per annum should be achieved from 1986 onwards. For the cotton crop, 122 ha of sprinkler irrigated land will be available for cultivation in 1985 and 163 ha in 1986. Although this crop will initially be restricted to the der season, ultimately the establishment of a rotation comprising cotton, maize and upland rice should not be ruled out. This possibility should be further considered by the management team to implement at a later stage.

2.2 Field Operations

The cropping programme for basin irrigated rice and sprinkler irrigated cotton is illustrated in Figure 2.1. Husbandry practices and the required levels of inputs to be used are described in the following sections. Detailed discussion of the mechanised operations and machinery selection is contained in Chapter 3.

2.2.1 Basin Irrigation Rice

(a) Land Preparation

Land preparation will involve primary and secondary cultivation to depths of 200 mm and 150 mm respectively, using heavy disc harrows followed by levelling. These operations will be carried out between mid-December and mid-April for the gu season crop and from July to the end of September for the der season crop.

(b) Rice Varieties

Varieties IR 24 and IR 22 are currently grown in Somalia and seed is available from the Fanoole and Barro Uen State Farms. As both have a high yield potential, largely free from major pest and disease problems and are acceptable to the Somali consumer, there is no need to look for alternatives at this stage. IR 24 should be grown in the gu season and IR 24 or IR 22 grown in the der. IR 22 is not recommended for the gu season because of its sensitivity to photoperiod. The greater incidence of cloud cover in the gu would prolong its period to maturity.

(c) Planting

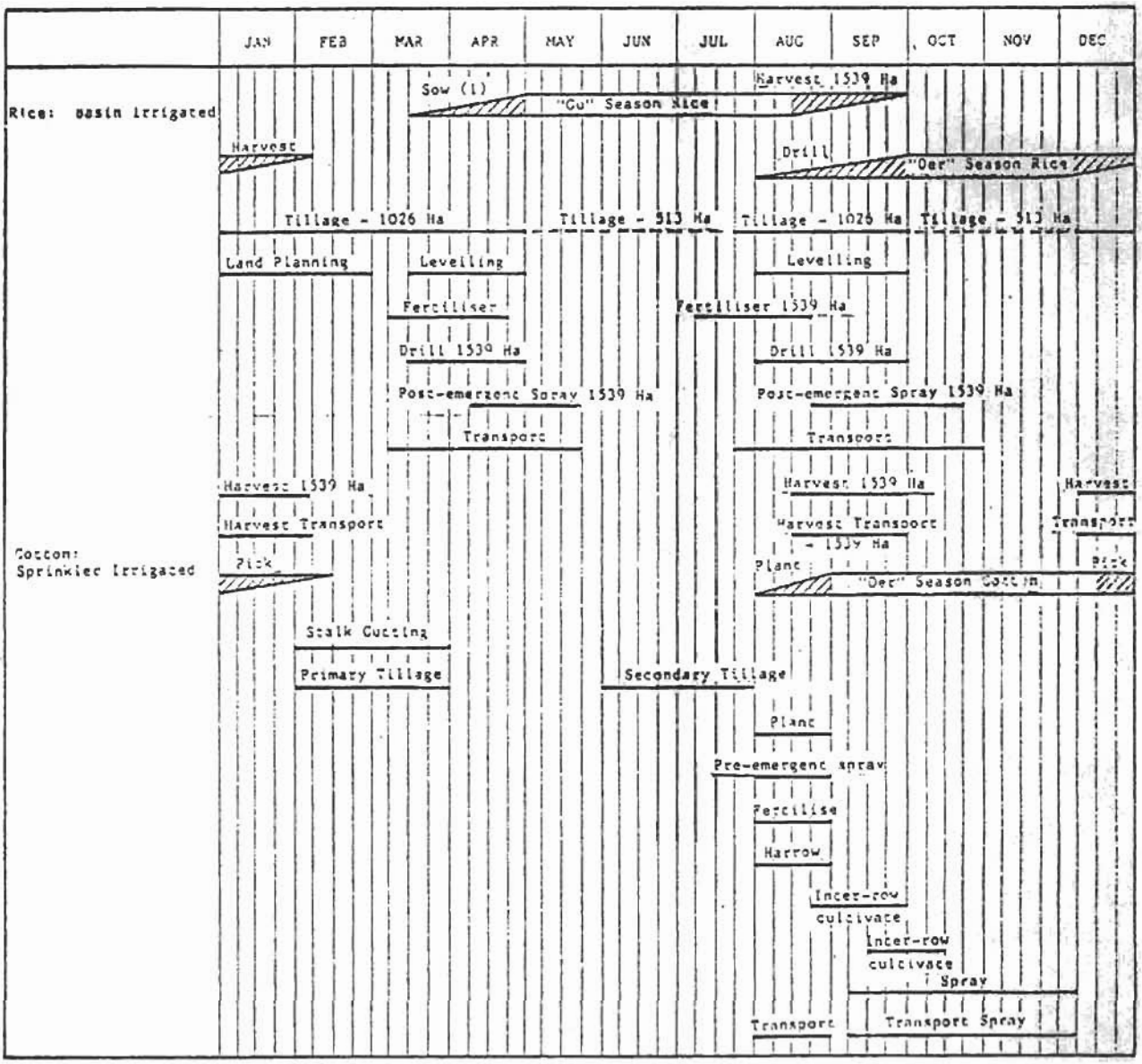
Rice will be drilled into a dry seedbed at a seed rate of 140 kg per ha. This is higher than normal but is considered necessary because of seed losses to birds. At Fanoole the seed rate is 180 kg per ha while at Barro Uen rates of between 150 and 180 kg of seed are used. As the seed will be covered by harrowing immediately after planting, it is expected that losses to birds will be considerably reduced and a seed rate of 140 kg per ha will produce a satisfactory stand.

Planting of the gu crop will take place between the middle of March and the end of April. Planting in March will involve an element of risk in that germination could be initiated by early rains which do not sustain the crop until there is adequate water in the Juba River for irrigation. This risk however, is unavoidable, as the ability to get into the basins later to cultivate and plant could be limited by heavy rains. When conditions are too wet for drilling, broadcasting the seed by spinner may still be possible and would be tried. Ideally a significant proportion of the area could be planted before the rains and a controlled programme of germination by irrigation followed as river water becomes available as each gu season will vary and management planning will have to be flexible to cover any eventuality.

The der crop will be planted during August and September. The low rainfall and the reasonably reliable river flow in these months should allow a planned and controlled programme of planting and germination. Overall the der crop should present considerably fewer difficulties than the gu.

Figure 2.1

Crop Calandars and Timing of Field Operations



(d) Germination

The basins will be irrigated as soon as possible after planting to germinate the crop. If irrigation is completed quickly and the basins are free from standing surface water within 24 hours of commencement of irrigation, this will ensure the best method of even germination and sustained growth of seedlings for the three weeks before the application of herbicides and flooding of the basins is carried out. Pre-irrigation for germination is not recommended because fields would have to be dried out to allow planting. Therefore germination is likely to be uneven and further irrigation following emergence of seedlings would delay application of herbicides due to wet ground conditions in the basins. In the gu season, because of the potential low river flows, pre-irrigation could not be carried out until mid-April, by which time the gu rains are generally at their peak.

With the proposed system of planting into a dry seedbed, the importance of ensuring that basins are free from surface water within 24 hours of irrigation to allow germination, cannot be overemphasised. Rice does not germinate in anaerobic conditions and where pools of water are allowed to remain germination will be poor.

(c) Fertilisers

Since the response of rice to fertiliser levels will be established with experience, the initial levels proposed are based on the consultant's experience taking into consideration the present practices at Fanoole and Barro Uen. Present policy at Fanoole is to apply :

- 150 kg DAP at planting;
- 100 kg urea 15 days after emergence;
- 150 to 225 kg urea at tillering.

At Barro Uen 45 kg DAP and 180 kg urea are applied. This is less than at Fanoole but probably reflects constraints of availability rather than an optimum level.

The following fertiliser policy is proposed for the Mogambo Irrigation Project :

- 150 kg urea per ha broadcast before planting;
- 75 kg DAP per ha combine drilled at planting;
- 100 kg urea per ha hand broadcast at tillering.

Tillering is normally encouraged by reducing the water levels in the basins and this is the most appropriate time for hand broadcasting of the urea top dressing.

(f) Weed Control

A post-emergence application of Stam F34 (Propanil) at a rate of 10 litres per ha will be the main means of weed control. This will be applied by a tractor mounted sprayer approximately 20 days after the initial irrigation to germinate the crop. Ideally the herbicide should be applied when weeds are at the 2-leaf stage, which is normally 16 to 18 days after germination, but 20 days is probably the earliest time when ground conditions will permit access into the basins with the wheeled tractors.

Besides the initial post-emergence spray, spot spraying of weeds will also be necessary. This will be done by hand using knapsack sprayers and for this a requirement of 2 litres per ha of Stam is estimated.

Other herbicides should be tried, either individually or in combination with Stam, at an early stage in the project. These include :

- Avirosan 500 EC (400 Piperophos/100 Dimetha-metryn) as a pre-emergent spray at a rate of 5 litres per ha). This herbicide is currently used extensively in rice cultivation in Tanzania.

- A combination of 0.5 litres 2,4D amine and 10 litres Stam per ha. The addition of 2,4D is reputed to increase the effectiveness of Stam.

Provision has been made in the estimates of inputs required in 1985 and 1986 to enable a trial area of around 100 ha of rice in each season to be treated with Avirosan 500 EC. A much smaller trial of 20 ha to be treated using 2,4D amine and Stam is also recommended.

(g) Pests and Diseases

Both the Fanoole and Barro Uen State Farms report that there are no major disease problems, and apart from birds, mainly (Quelea spp), there are no major pests. The birds however, create a very serious problem, by either causing losses in yield or incurring high labour costs for bird scarers. A national Quelea control project, supported by the German Government, is currently being established and it is hoped that some benefits in terms of protection or control may accrue. Nevertheless this problem should receive the immediate attention of the management team as soon as it is established in the field.

(h) Harvesting

Harvesting will be mechanised using combine harvesters. The gu season crop will be harvested between mid-August and the end of September and the der season crop from early December until the first week in February. Grain handling cleaning, and drying should not present any problem from the 1986 der season onwards when construction of the drying and storage complex will be complete. For the 1986 season's harvest, arrangements will be somewhat makeshift but will probably involve sun drying and speedy disposal to Agricultural Development Corporation.

(i) Straw Disposal

Rice straw will be disposed of in a number of ways. Following the der harvest there will be adequate opportunity for drying off and burning. Following the gu harvest there may be instances when burning is not possible because of rainfall and high humidities. In these cases straw would be chopped up using a rotary slasher and then ploughed in.

2.2.2 Sprinkler Irrigated Cotton

The area of cotton cultivated in Somalia has declined since the Supplementary Feasibility Study was completed. There is no irrigated cotton being grown at present, and although the Government is considering rehabilitating the Jamama ginnery, it is not at present operating. The Mogambo cotton crop will therefore have to be ginned at the Somaltex ginnery at Balad. Somaltex, however, is prepared to transport seed cotton to the Lower Juba.

(a) Land Preparation

This will be similar to that for rice and will comprise primary and secondary cultivations to depths of 200 mm and 150 mm respectively, using heavy disc harrows. Annual landplaning or smoothing operations are not considered necessary. Primary cultivation would be carried out during February and March and the secondary cultivation from June through to August.

(b) Varieties

Acala 4.42 is well suited to Somali conditions and meets the requirements of the Somaltex factory at Balad. Somaltex provides undelinted Acala 4.42 seed to growers free of charge. To allow mechanical planting, the seed will have to be delinted on the project. This should not cause serious problems as various well tried and relatively inexpensive methods of acid delinting of small quantities of cotton seed are available. This is detailed in Appendix 2.

(c) Planting

The cotton seed will be planted mechanically in rows 75 cm apart with 20 cm spacing within the row, giving a plant population of around 65 000 plants per ha. The seed rate, using acid delinted seed will be 10 to 12 kg per ha. The seed will be dressed with Fernasan D at a rate of approximately 0.3 kg Fernasan D per kg of seed and the crop will be planted during August.

(d) Fertilisers

As no new data are available on responses to fertilisers in Mogambo the recommendations contained in the Feasibility Study are adhered to. These are 170 kg of urea per ha will be broadcast by spinner prior to final disc harrowing, and 50 kg of DAP will be applied at the planting stage.

(e) Weed Control

Weed control will be maintained primarily by a combination of herbicides and mechanical cultivation supplemented where necessary by hand weeding.

The herbicide application will comprise a pre-emergence application incorporated in the soil prior to planting. The two most suitable herbicides are Treflan (Trifluralin) or Cotoran (Fluometuran). The choice however, depends upon the weed spectrum in that Treflan provides good control of annual grasses while Cotoran will control annual broad leaved weeds. Cotoran is granular, mixes easily with urea and would be applied with urea prior to final discing. On balance annual grasses are expected to present the most serious problem and initially Treflan, applied before final disc harrowing at a rate of 2.8 l/ha, is recommended. Further experiments should be instituted at an early stage. To facilitate this, provision for purchase of Cotoran, applied at a rate of 5 litres per ha, and Codal 400 EC, which provides control over grasses, applied at a rate of 61 litres per ha, has been allowed in the input estimates.

(f) Pest Control

Insect pests, boll worms, leaf eaters, jassids, aphids and cotton stainers are expected to present serious problems. Control measures will be those recommended in the Feasibility Study and will comprise systematic blanket spraying at 8 to 10 day intervals from first bud formation (i.e. about 40 days after planting) through to 130 days after planting. Nine ULV sprays at a rate of 2.5 l/ha of Nuvacron Combi (Monocrotophos/DDT) will be applied.

(g) Harvesting

The crop will be hand picked in either two or three picks from mid-December through to the end of February. Seed cotton will be collected in heaps in the field and eventually transferred to sacks provided by Somaltex. Somaltex will collect the bagged seed cotton in the field and transport it to the ginnery at Balad.

(h) Trash Disposal

Cotton stalks which have not been collected by villagers for fuel will be chopped by flail chopper and raked into heaps for burning. Any remaining residues will be buried during primary cultivation.

2.3 Crop Production Inputs

The estimated requirements for seed, fertilisers, agrochemicals and sacking or packaging materials are summarised by crop season in Table 2.2. ULV sprayers and their requirements for batteries are discussed in Chapter 3 along with mechanisation. Hand tools for farm labourers are discussed in Section 2.5 of this chapter.

2.4 Farm Labour

This section is concerned solely with the unskilled labour necessary to carry out the field operations (i.e. planting, irrigating, bund and in-field channel maintenance, fertilising, spraying, trash disposal and crop handling, between field and storage, etc.) described in the foregoing sections. It does not therefore, include labour associated with general maintenance of Headquarters' buildings and civil irrigation works or unskilled labour in stores or workshops. These are discussed in Chapters 3, 4 and 7.

Tables 2.3 and 2.4 summarise the labour requirements for rice and cotton respectively by field operation on a man days/ha basis. The tables also illustrate the distribution of the labour requirements throughout the year. Table 2.3 includes a labour allowance for bird scaring. This function will be performed by casual labour, probably women and children, and the numbers will be highly variable from year to year.

Similarly the labour requirement for cotton picking will be variable, being dependent upon the annual cotton yield. In Table 2.4 the labour requirement has been specified independently and included as casual labour.

2.5 Hand Tools

The farm field labour force has been estimated on the basis of the crop labour requirements in Tables 2.3 and 2.4. The main hand tools required by this labour force are spades, jambis and pangas. Since a labourer will not require all three tools, the maximum number required for each is assumed to be equivalent to 60% of the labour force. The numbers to be procured are thus :

	1985	1986
Number of each tool required	110	180
Number of each tool to be procured	110	70

2.6 Protective Clothing

Protective clothing will be required by labourers assisting with spraying operations in rice and cotton. This includes the gangs using knapsack sprayers for spot herbicide sprays in rice, ULV sprayers for pesticide application in cotton, and those labourers assisting with handling sprays and filling tractor mounted sprayers. Altogether it is estimated that 50 complete sets of tools, leggings, jackets, hats and goggles will be required over the first two years.

TABLE 2.2

Crop Production Inputs 1985 and 1986

	1985		1986	
	Gu	Der	Gu	Der
Cropping Programme :				
Rice (ha)	459	900	1 539	1 539
Cotton (ha)	-	122		163
Rice Inputs :				
Seed : IR 24 (tonnes)	65	65	220	110
IR 22 (tonnes)	-	65	-	110
Urea (tonnes)	115	225	385	385
DA (tonnes)	35	70	120	120
Stam F 34 (litres)	5 500	10 800	18 500	18 500
Avirosan 500 EC (litres)	500	500	500	500
24D Amine (litres)	10	10	10	10
Sacks (number)	12 800	18 500	36 500	36 500
Cotton Inputs :				
Seed : (undelinted) quintal	-	40	-	50
Sulphuric acid (litres)	-	400	-	500
Fernasan D (kg)	-	450	-	580
Urea (tonnes)	-	21	-	28
DAP (tonnes)	-	6.5	-	8.0
Treflan (litres)	-	350	-	460
Cotoran (litres)	-	25	-	25
Codol (litres)	-	30	-	30
Nuvacron Combi (litres)	-	2 750	-	3 670
Sacking (provided on demand by Somaltex)				

TABLE 2.3

Paddy Rice : Labour Requirement by Field Operation (man days/ha)

Operation	Month														
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Total
Gu season crop :															
Bund and irrigation channel maintenance	0.5	0.5	0.5	1.0	1.0	0.5									4.0
Planting			0.1	0.1											0.2
Spraying (herbicide)				0.2	0.2										0.4
Spot spraying (herbicide)					0.2	0.2									0.4
Top dressing						0.3	0.4	0.3							1.0
Irrigating				2.5	2.5	2.5	2.5	2.0							12.0
Crop handling								0.5	1.5						2.0
Miscellaneous		0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4						3.0
Total base labour	0.5	0.7	1.0	4.2	4.3	3.9	3.3	3.2	1.9						23.0
Estimated labour for bird scaring							5.0	20.0	20.0						45.0
Der season crop :															
Bund irrigation channel maintenance						0.5	0.5	0.5	1.0	1.0	0.5				4.0
Planting								0.1	0.1						0.2
Spraying (herbicide)									0.2	0.2					0.4
Spot spraying (herbicide)										0.2	0.2				0.4
Top dressing											0.3	0.4	0.3		1.0
Irrigating									2.5	2.5	2.5	2.5	2.0		12.0
Crop handling													0.5	1.5	2.0
Miscellaneous							0.2	0.4	0.4	0.4	0.4	0.4	0.4	0.4	3.0
Total base labour						0.5	0.7	1.0	4.2	4.3	3.9	3.3	3.2	1.9	23.0
Estimated labour for bird scaring												5.0	20.0	20.0	45.0

TABLE 2.4

Cotton : Labour Requirement by Field Operation (man days/ha)

Operation	Month										Total
	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	
General field maintenance	0.2	0.2	0.3	0.3							1.0
Planting			0.2								0.2
Fertiliser application			0.2								0.2
Herbicide application			0.3								0.3
Spot weeding					1.0	1.0	1.0				3.0
Irrigating			1.0	2.0	2.0	2.0	2.0	1.0			10.0
Pest control				0.5	1.5	1.5	0.5				4.0
Seed cotton handling & bagging							0.5	1.0	0.5		2.0
Trash burning									1.0	2.0	3.0
Miscellaneous		0.3	0.4	0.4			0.4	0.4	0.4		2.3
Total base labour	0.2	0.5	2.4	3.2	4.5	4.4	2.4	1.9	2.0		26.0
Picking 1985							10	20	10		40.0
1986							12	30	13		55.0
1987							17	40	18		75.0

CHAPTER 3

MECHANISATION

3.1 Selection of Machine Type and Size - Rice

A brief description of the selection process for each type and capacity of machine is given in the following sections.

3.1.1 Tractor Type and Size

From Figures 2.1 and 3.1 it can be observed that there is considerable overlap between tillage operations and other operations such as drilling and harvesting. The selection of tractor type need not, therefore, be made on the basis of a general purpose machine suitable for all operations. Two types of tractor; one suited to tillage and another suited for the transport, spraying and drilling operations have been selected. Restricting the types of tractor to two reduces the problems associated with maintenance and ordering and storage of spare parts.

For tillage a direct drive crawler tractor has been selected. The reasons for this are :

- Crawler tractors are able to work in a greater range of soil conditions than wheeled tractors.
- Operation of a crawler tractor and the setting of discs for tillage does not require such a high level of skill from the operator.
- In the soil conditions on the project area, track life is expected to be very high. At the Juba Sugar Project crawlers have worked for over 6 years without any track component replacement.
- At low tillage speeds, crawler tractors have more usable horsepower at the drawbar than wheeled tractors which rely on relatively high speeds to make full use of their horsepower.
- Crawler tractors will be able to cross channels and bunds more easily and with less damage than wheeled tractors. This is particularly so if soil conditions are wet.
- Crawler tractors can be fitted with bulldozer blades for field and road maintenance work. They are also capable of machine and vehicle recovery work. Two crawler tractors should be equipped with angle blades.
- In the conditions expected at the project area, the economic life of the crawler tractors is expected to be twice that of the wheeled tractors. It is anticipated that although the capital costs will be higher per machine the operating costs per ha will be similar if not lower than a wheeled tractor.

For general purpose duties a 75 hp wheeled tractor has been selected. This size of tractor is capable of efficiently carrying out drilling, spraying and general transport work. In order to facilitate easy entry and exit to fields some of the units should be fitted with front wheel drive assist (unequal wheel 4 wheel drive).

3.1.2 Primary Tillage

The main requirements from the primary tillage implement are :

- Penetrate to a depth of approximately 150 mm.
- Cutting and mixing crop residues (rice straw).
- Minimal disturbance of field levels.
- Ability to penetrate hard dry soil conditions if necessary.
- Easy to set and operate.
- Robust, with a low maintenance requirement of the wearing parts.

The implement that best meets these requirements is the heavy ploughing offset disc harrow. When fitted with 760 to 810 mm diameter cut-away discs and with a weight per disc of 200 kg, this implement is capable of cutting up all surface trash and penetrating even in the driest conditions to at least 150 mm in one pass.

Other primary tillage implements have major drawbacks: disc and mouldboard ploughs are slow, difficult to set and upset field levels; chisel ploughs, although probably best at maintaining levels, are not able to handle large quantities of surface trash. The chisel ploughs also tend to pull dry soil up into large clods which are difficult to break down with subsequent secondary tillage operations.

3.1.3 Secondary Tillage

Offset disc harrows with smaller discs of 660 mm diameter have been selected for secondary tillage. They will further cut and mix the crop residues and produce a level seedbed. Two passes will normally be required.

3.1.4 Levelling

Using disc harrows for tillage the only areas where upsets in bed level are likely to occur are at the headlands where machines turn. For this reason a quick levelling is required after the tillage operations. The simplest and cheapest way of achieving this is to make a rectangular frame from heavy steel rectangular hollow sections which is then dragged behind a tractor. This is illustrated in Figure 3.2. During the initial years there will be considerable settling of the areas of fill in the basins and frequent levelling of the basins will probably have to be carried out. For this, a tractor drawn scraper plane will be required. Any extreme level differences which cannot be adequately handled by the scraper plane will be levelled using the project grader.

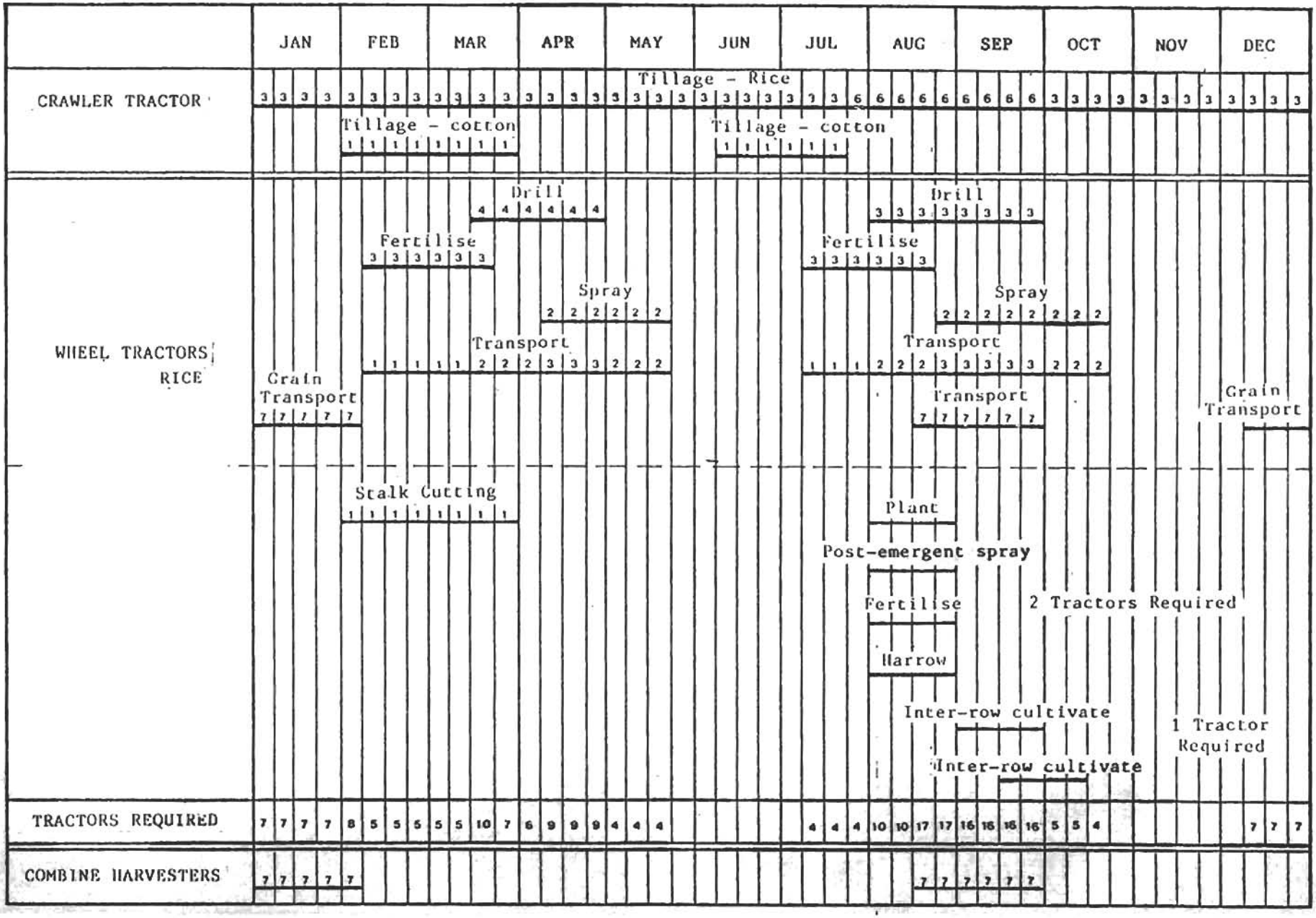
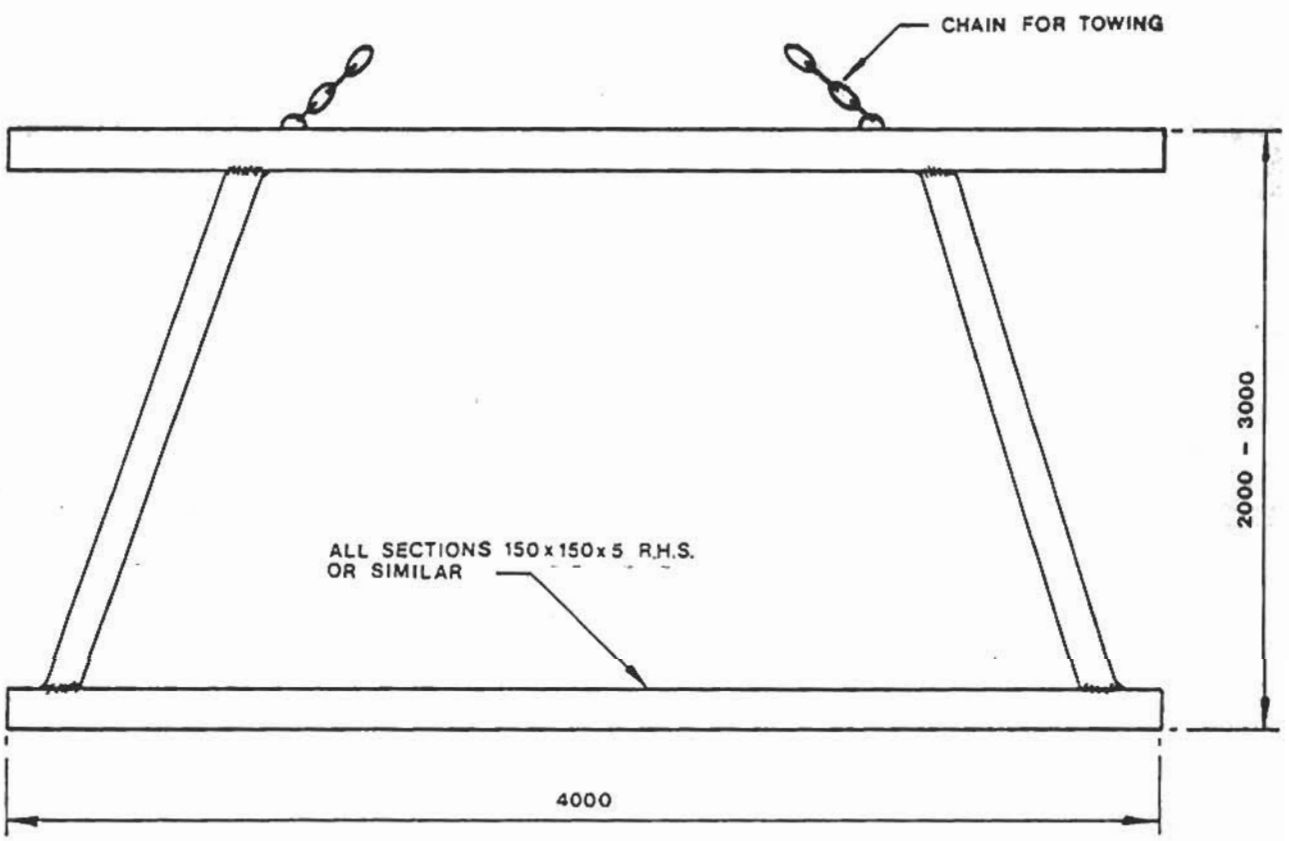


Figure 3.1 Tractor and Combine Harvester Utilisation Chart

Figure 3.2

Tractor Drawn Levelling Frame



ALL DIMENSIONS IN mm

3.1.5 Seed Drilling

A combination seed/fertiliser drill will be used for sowing. The 75 hp tractors will be able to pull a 21 row machine with 175 mm row spacing, which will give an effective working width of 3.6 m. Spike tooth harrows will be attached behind the drill to cover the seed. Double disc openers to cut through residual surface crop residues will be required, as well as special fluted seed metering rollers to cope with the natural abrasiveness of rice seed.

3.1.6 Spraying

Spraying of herbicides with Propanil will take place when the weeds have reached the two leaf stage. This will occur some 10 to 22 days after the beds have received the first irrigated water to induce germination.

The actual timing of post-emergence herbicide application will be dependent upon weather conditions particularly as the incidence and intensity of rainfall. It is anticipated however, that the majority of the area will be sprayed within the optimum dates. The gu season, because of April rainfall, may present some difficulties and consequently it is proposed to include in addition to conventional tractor mounted sprayers, a self-propelled specialist spraying vehicle which is designed to exert extremely low ground pressures of less than 0.1 kg/sq.cm. Whilst this vehicle will be purchased essentially for evaluation purposes it should provide some flexibility in terms of the conditions under which spraying can take place. Pre-emergence spraying is also a possibility and provision has been made for this.

In addition, knapsack sprayers will be required for spot treatment of weeds which have not been controlled by initial post-emergence sprays.

3.1.7 Harvesting

It is proposed to use a 110 to 125 hp rice combine harvester with a 4.2 m width of cut. In a 5 t/ha crop, gross output will be about 5 t/h. The combine will be fitted with a rasp bar threshing cylinder and concave. Each combine will be supplied with track laying undercarriage attachment as well as the wide profile, low ground pressure wheels and rice tyres. All ground conditions can then be tackled by the combine harvesters.

3.1.8 Transport

Two types of trailer will be required for the project: a flat bed 5 t 4 wheel trailer for transporting seeds and fertiliser to the field; and a 7 t weight transfer, tipping grain trailer. Two different types are required because the seed and fertiliser trailer will need to be easily hitched and unhitched at the ends of fields, whereas the weight transfer trailer will allow the maximum use of tractor capacity in transporting grain to the mill.

3.1.9 Miscellaneous Machines and Implements

The following machines will also be required :

- Rotary Grass Slasher for maintenance of road sides and drainage channels.
- Grain, bag and bale elevator for stacking bags, loading grain, etc.
- Baler for baling rice straw for sale to cattle owners.
- Straw and cotton stalk chopper for pulverising straw or cotton stalk in the field if burning is unsuccessful, in order to facilitate cultivations.
- Elevated grain hopper with bagging-off spouts.
- Front-end loaders for four of the wheel tractors. These should be supplied with a materials bucket and fork lift attachments.
- Grain augers for transferring heaped grain into the grain hopper or into trailers.
- Mounted spinner-type fertiliser spreader.

3.2 Selection of Machine Type and Size - Irrigated Cotton

3.2.1 Tractors

The tractors used for the rice will also be used for the cotton. The crawler tractors will be used for the tillage and the wheeled tractors for fertiliser spreading, spraying, planting and inter-row work such as weeding.

3.2.2 Primary and Secondary Tilling

This will be carried out using the disc harrows as for rice. The stalks will be pulverised first using the straw chopper, as many as possible burnt and the remainder incorporated in the soil.

3.2.3 Planting

A four row unit planter with fertiliser attachments will be used for planting the cotton. In case maize is to be planted at a later date the planter will also be capable of planting maize. The row spacing will also need to be adjustable from 75 cm for cotton to 90 cm for maize. Seed will be acid delinted on site.

3.2.4 Fertilising

Fertiliser will be applied to the cotton area by spinner-broadcaster before planting and during the planting operation.

3.2.5 Inter-row Cultivation

There will be two types of inter-row cultivators; a tined type fitted with a combination of ducks feet and straight points and a rolling cultivator. The tined cultivator will handle heavy established weed infestations and the rolling cultivator will be a quick operation to handle small weeds and to break any soil cap that forms after irrigation.

3.2.6 Spraying

A normal tractor mounted sprayer will handle all spraying until plant height precludes the use of tractors. Final application of insecticides at the boll formation stage will be done manually using ultra low volume sprayers.

3.2.7 Picking and Bagging

Cotton picking and loose bagging will be carried out manually.

3.3 Machine Quantification

3.3.1 General

As discussed in Chapter 1, a maximum rice cropping intensity of 150% of the total surface irrigated area has been taken as the basis for the project. However, within this 150% total intensity there may well be variations from year to year in the hectarages grown in the gu and der seasons.

Several options were examined to calculate machine requirements. An extreme case was taken of 50% intensity in the gu and 100% intensity in the der and the effect on machine numbers compared with a 75% : 75% division. The only effect this extreme would have would be to increase the number of combine harvesters by two. The same effect also occurs if 100% intensity in the gu season and 50% in the der season are considered.

Since these extremes would require only minor adjustments to the machine numbers the 75% : 75% intensity is the most appropriate intensity on which machine requirements should be based.

3.3.2 Number of Days Available for Each Operation

A six day working week has been assumed for the purpose of calculating machine numbers, except in the peak periods covering March to May and July to September, when a seven day week has been taken.

(a) Der Season Rice Crop

The target area to be sown to rice for the der season crop is 1 539 ha (75% of the gross area). Of this, 513 ha will have been fallow during the preceding gu season, leaving 1 026 ha of the gu season rice crop to be cultivated. A summary of days available for each operation is shown in Table 3.1.

TABLE 3.1

Days Available for Mechanised Operations - Der Season

Operation	Area (ha)	Dates	Days available
Tillage (including levelling)	513	May 1st to Jul 20th	81 days gross 69 days net
	1 026	Jul 20th to Sep 30th	72 days gross 62 days net
Fertiliser spreading	1 539	Jul 8th to Aug 20th	44 days net 38 days gross
Drilling	1 539	Aug 1st to Sep 30th	61 days gross 61 days net
Post-emergent spraying	1 539	Aug 20th to Oct 20th	61 days gross 52 days net
Transport - seed fertiliser, spray materials		Jul 21st to Oct 31st	102 days gross
Combine harvesting	1 539	Dec 8th to Feb 7th	62 days gross 50 days net
Transport grain		Dec 8th to Feb 7th	62 days gross 50 days net

During the two tillage periods which have to be completed in 69 days and 62 days respectively, four operations have to be carried out by the crawler tractors. These consist of primary tillage, two passes of secondary tillage, and levelling. In order to estimate the minimum number of tractors required, the total net time available has to be split into individual periods for each operation. The allocation of the total time available between each operation is determined by the ratio of the work outputs for each operation. The output of each piece of equipment based on a 50 minute working hour is illustrated in Table 3.2.

TABLE 3.2

Output of Machinery (based on 50 minute working hour)

Machine	Field efficiency (%)	Working width (m)	Working speed (kph)	Theoretical output (ha/h)	Actual output (ha/h) (1)
90 hp Crawler					
Ploughing offset disc harrowing	85.00	2.30	5.00	1.15	0.81
Offset disc harrowing	85.00	3.65	6.50	2.37	1.68
Landplaning	85.00	3.00	8.00	2.40	1.70
Levelling	85.00	4.00	8.00	3.20	2.27
75 hp Tractor					
Combination seed drill	60.00	36.0	6.00	2.16	1.08
Spraying	60.00	6.00	8.00	4.80	2.40
Stalk cutting	85.00	1.80	5.00	0.90	0.64
Fertilising	60.00	6.00	8.00	4.80	2.40
Spike tooth harrowing	85.00	4.00	6.00	2.40	1.70
Planting	75.00	3.00	5.00	1.50	0.94
Inter-row cultivation	75.00	6.00	8.00	4.80	3.00
Post-emergence spraying	60.00	6.00	8.00	4.80	2.40
Combine harvester	60.00	4.00	3.00	1.20	0.60

Note : (1) Actual output is the theoretical output taken on a 50 minute hour basis, with a further reduction based on the field efficiency.

The days available for each operation for the two areas are summarised in Table 3.3.

TABLE 3.3

Days Available for Individual Land Preparation Operations - Der Season

	Primary tillage	Secondary tillage	Secondary tillage 2nd	Land-planing	Totals
Output (ha/h)	0.81	1.68	1.68	1.70	
Time per ha (h)	1.23	0.60	0.60	0.60	2.87
Days per operation :					
1. 513 ha	30	14	14	11	69
2. 1 026 ha	27	13	13	10	63

(b) Gu Season Rice Crop

The target area to be sown to rice for the gu season crop is also 1 539 ha. Again, 513 ha will have been fallow during the der season, leaving 1 026 ha of the der season area to be cultivated. The days available for each operation in the gu season are shown in Table 3.4.

TABLE 3.4

Days Available for Mechanised Operations - Gu Season

Operation	Area (ha)	Dates	Days available
Tillage (including levelling)	513	Oct 1st to Jan 7th	98 days gross 80 days net
	1 026	Dec 8th to Apr 30th	144 days gross 121 days net
Landplaning	684 (1/3 gross area)	Jan 1st to Feb 28th	59 days gross 51 days net
Fertiliser spreading	1 539	Mar 8th to Apr 20th	44 days gross 38 days net
Drilling	1 539	Mar 16th to Apr 30th	46 days gross 46 days net
Post-emergent spraying	1 539	Apr 8th to May 20th	43 days gross 43 days net
Transport - seed fertiliser, spray materials		Mar 8th to May 20th	74 days gross
Combine harvesting	1 539	Aug 16th to Sep 30th	46 days gross 46 days net
Transport grain		Jul 21st to Sep 7th	49 days gross 49 days net

Since the tillage of the 1 026 ha will effectively follow the tillage of the 513 ha of fallow they can be taken together and treated as an area of 1 539 ha. Using the same methodology as for the der season tillage operations, the days available for each tillage operation are summarised in Table 3.5.

TABLE 3.5

Days Available for Individual Land Preparation Operations - Gu Season

	Primary tillage	Secondary tillage	Secondary tillage (2nd)	Level-ling	Land-planing	Totals
Output (ha/h)	0.81	1.68	1.68	2.27	1.70	
Time per ha (h)	1.23	0.60	0.60	0.44	0.59	3.46
Days per operation for 1 539 ha	72	35	35	25	34	201

(c) Cotton

TABLE 3.6

Days Available for Mechanised Operations of the Cotton Crop

Operation	Area (ha)	Dates	Days available
Stalk cutting	163	Feb 1st to Mar 31st	60 days gross 51 days net
Primary tillage	163	Feb 1st to Mar 31st	59 days gross 51 days net
Secondary tillage	163	Jun 1st to Jul 31st	61 days gross 51 days net
Pre-emergence spraying	163	Aug 1st to Aug 31st	31 days gross 31 days net
Planting	163	Aug 1st to Aug 31st	31 days gross 31 days net
Fertilising	163	Aug 1st to Aug 31st	31 days gross 31 days net
Harrowing	163	Aug 1st to Aug 31st	31 days gross 31 days net
Inter-row cultivation	163	Aug 21st to Oct 15th	56 days gross 48 days net
ULV spraying	163		2 days gross

3.3.3 Numbers of Machines Required

The output of each machine is calculated in Table 3.2. The number of machines required for the rice and cotton operations is shown in Tables 3.7 and 3.8 respectively. A 10 hour working day has been used on the basis that the machine operator will have an assistant operator to take over as and when required. A 20% service factor to make allowances for downtime for service repair is also included. The final columns in the tables establish the actual machine hours worked in order to calculate the operating costs of the machines.

Because many operations overlap, the number of tractors required is higher than that shown by the calculation of individual operations. The extent of this overlap is demonstrated in Figure 3.1 which shows the timing of the individual operations. From this it can be seen that the peak requirement for crawler tractors is during August and September when 6 machines will be required. The figure also indicates that the peak requirement for wheeled tractors occurs in the last half of August, when 17 tractors will be required.

The output of ULV sprayers is about 1 ha per hour. If 163 ha of cotton has to be covered in 2 days, then on the basis of an 8 hour working day, 11 sprayers will be required. Hand held battery powered ULV sprayers are sold in export packs of 45 and are very cheap (SoSh 575 each) when purchased in bulk. It is therefore recommended that one export pack of 45 be purchased.

It is impossible to estimate accurately the requirement for knapsack sprayers because the exact area for spot spraying each season is not known. It is proposed that 20 sprayers be purchased initially.

The total number of machines required, divided into 1985 and 1986 purchasing schedules, is given in Table 3.9.

3.3.4 Machine Utilisation

The actual machine time for the tractors, implements and combine harvesters are shown in Tables 3.7 and 3.8. The total number of machine hours are summarised in Table 3.10.

3.4 Training

The success of the project will rest very heavily on the ability of the workshops and the field staff to have machines ready at the right time and in the right quantities. Because of financial inducements offered to skilled personnel by the oil producing states in the Gulf there is a critical shortage of mechanical skills in Somalia. The training and retention of a skilled workforce on the project will therefore be of paramount importance.

Examination of Figure 2.1 illustrates the complex nature of the management of the mechanised operations. At one point in the der season there are ten operations occurring at once. Some of these operations require a high level of skill and supervision, e.g. combine harvesting, rice drilling, spraying and fertilising. It is therefore essential that key personnel be trained as quickly as possible. It cannot be expected that the Field Manager will be able to effectively carry out all of this training by himself. Similar problems of training will also arise in the maintenance and repair of the farm machinery.

It is therefore proposed that the project take advantage of the training facilities available from and often provided at a very reasonable cost by the manufacturers of the farm machinery. Initially, the manufacturers will supply instructors for the durations noted in the particular specifications. The cost of this training will be written into the contract.

TABLE 3.7

Number of Machines Required

Rice - 75% Gu Season and 75% Der Season

Operation	Area (ha)	Days available	Hours worked per day	Working rate ha/ hour	ha/ day	ha/ machine	Theoretical number of machines	Service factor percentage downtime	Actual number of machines	Machine days (actual working time)	Machine hours (actual working time)
Gu season (75% of area cropped)											
Ploughing	1 539.00	72.00	10.00	0.81	8.10	583.20	2.64	20	4	190	1 900
Disc harrowing (first pass)	1 539.00	35.00	10.00	1.68	16.80	588.00	2.62	20	4	92	916
Disc harrowing (second pass)	1 539.00	35.00	10.00	1.68	16.80	588.00	2.62	20	4	92	916
Land planning	684.00	34.00	10.00	1.70	17.00	578.00	1.18	20	2	40	402
Levelling	1 539.00	25.00	10.00	2.27	22.70	567.50	2.71	20	4	68	678
Fertiliser spreading	1 539.00	38.00	10.00	2.40	24.00	912.00	1.69	20	3	64	641
Seed drilling	1 539.00	46.00	10.00	1.08	10.80	496.80	3.10	20	4	143	1 425
Spraying	1 539.00	43.00	10.00	2.40	24.00	1 032.00	1.49	20	2	64	641
Combine harvesting	1 539.00	46.00	10.00	0.60	6.00	276.00	5.58	20	7	257	2 565
Der season (75% of area cropped)											
Ploughing	1 026.00	27.00	10.00	0.81	8.10	218.70	4.69	20	6	127	1 267
Disc harrowing (first pass)	1 026.00	13.00	10.00	1.68	16.80	218.40	4.70	20	6	61	611
Disc harrowing (second pass)	1 026.00	13.00	10.00	1.68	16.80	218.40	4.70	20	6	61	611
Levelling	1 026.00	10.00	10.00	2.27	22.70	227.00	4.52	20	6	45	452
Ploughing (fallow)	513.00	30.00	10.00	0.81	8.10	243.00	2.11	20	3	63	633
Disc harrowing (fallow) (first pass)	513.00	14.00	10.00	1.68	16.80	235.20	2.18	20	3	31	305
Disc harrowing (fallow) (second pass)	513.00	14.00	10.00	1.68	16.80	235.20	2.18	20	3	31	305
Levelling (fallow)	513.00	11.00	10.00	2.27	22.70	249.70	2.05	20	3	23	226
Fertiliser spreading	1 539.00	38.00	10.00	2.40	24.00	912.00	1.69	20	3	64	641
Seed drilling	1 539.00	61.00	10.00	1.08	10.80	658.80	2.34	20	3	143	1 425
Spraying	1 539.00	52.00	10.00	2.40	24.00	1 248.00	1.23	20	2	64	641
Combine harvesting	1 539.00	50.00	10.00	0.60	6.00	300.00	5.13	20	7	257	2 565

TABLE 3.8

Number of Machines Required
Cotton

Operation	Area (ha)	Days avail-able	Hours worked per day	Working rate ha/h	Working rate ha/day	Working rate ha/ machine	Theo-retical number of machines	Service factor percentage downtime	Actual number of machines	Machine days (actual working time)	Machine hours (actual working time)
Stalk slashing	163.00	51.00	10.00	0.64	6.40	326.40	0.50	20	1	25	255
Ploughing	163.00	51.00	10.00	0.81	8.10	413.10	0.39	20	1	20	201
Disc harrowing (first pass)	163.00	26.00	10.00	1.68	16.80	436.80	0.37	20	1	10	97
Disc harrowing (second pass)	163.00	26.00	10.00	1.68	16.80	436.80	0.37	20	1	10	97
Pre-emergent spraying	163.00	31.00	10.00	2.40	24.00	744.00	0.22	20	1	7	68
Fertilising	163.00	31.00	10.00	2.40	24.00	744.00	0.22	20	1	7	68
Spike tooth harrowing	163.00	31.00	10.00	1.70	17.00	527.00	0.31	20	1	10	96
Planting	163.00	31.00	10.00	0.94	9.40	291.40	0.56	20	1	17	173
Inter-row cultivating	163.00	24.00	10.00	3.00	30.00	720.00	0.23	20	1	5	54
Inter-row cultivating	163.00	24.00	10.00	3.00	30.00	720.00	0.23	20	1	5	54

TABLE 3.9

Machinery Requirement : 1985 and 1986

Machine	1985	1986	Total Nr	
90 hp crawler tractor	4	2	6	
75 hp 2WD tractor	7	3	10	
75 hp 4WD tractor	4	3	7	
Combine harvester	5	2	7	
Ploughing offset disc harrow	3	1	4	(1)
Offset disc harrow	4	2	6	
Land plane	2	0	2	
Seed drills	3	1	4	
Sprayers - tractor	2	1	3	(2)
Sprayers - LGP	1	1	2	(2)
Spike tooth harrow	1	0	1	
Cotton planter	1	0	1	
Fertiliser spreader	3	1	4	
Inter-row cultivator	1	0	1	
Rolling cultivator	1	0	1	
Grass slasher	1	0	1	
Cotton stalker & straw slasher	1	0	1	
Rectangular baler	1	0	1	
Front end loaders	4	0	4	
Grain augers	2	0	2	
Grain, bag & bale elevator	2	1	3	
Tine cultivator	2	0	2	
4 wheel 5 t trailer	6	2	8	
7 t grain trailer	5	2	7	
Knapsack sprayer	14	6	20	
ULV sprayer	45	0	45	(3)
Elevated grain hopper	1	0	1	

Notes :

(1) In Table 3.7 the maximum number of ploughing disc harrows calculated is 6. These calculations are based on sequential operations, i.e. all the tractors carrying out primary tillage at the same time and then all going on to do secondary tillage. This assumption has been made to ease calculation of tractor numbers. In actual practice different tillage operations will be occurring at the same time as secondary tillage. Four ploughing offset disc harrows are therefore considered sufficient to carry out all primary tillage operations.

(2) Final quantities of each type to be decided in 2nd year.

(3) One export pack of 45.

TABLE 3.10

Total Number of Machine Hours

Machine	Gu season	Der season	Cotton	Total	Percent non-productive	Total hours	Number of machines	Hours per machine
90 hp crawler tractor	4 812	4 410	395	9 617	10	10 579	6	1 763
75 hp wheeled tractor	2 707	2 707	768	6 182	30	8 036	17	473
Ploughing disc harrow	1 900	1 900	201	4 001	-	4 001	4	1 000
Offset disc harrow	1 832	1 832	194	3 858	-	3 858	6	643
Land plane	402	-	-	402	-	402	2	201
Land leveller	678	678	-	1 356	-	1 356	4	339
Seed drill	1 425	1 425	-	1 425	-	1 425	4	356
Sprayer	641	641	68	1 350	-	1 350	3	450
Fertiliser spreader	641	641	68	1 350	-	1 350	4	338
Spike tooth harrow	-	-	96	96	-	96	1	96
Planter	-	-	173	173	-	173	1	173
Inter-row cultivator	-	-	108	108	-	108	1	108
Stalk slasher	-	-	255	255	-	255	1	255
Combine harvester	2 565	2 565	-	5 130	-	5 130	7	733

The above figures do not include tractor and trailer transport operations. These are calculated as follows:

Grain transport	Gu season	-	Approx. 46 days at 10 hours per day for 6 tractors and trailers = 2 760 hours.
	Der season	-	Approx. 50 days at 10 hours per day for tractors and trailers = 1 800 hours.
Drilling	Gu season	-	Approx. 30 days for 1 tractor = 300 hours. Approx. 42 days for 2 tractors = 840 hours. Approx. 21 days for 3 tractors = 630 hours.
	Der season	-	Approx. 20 days for 1 tractor = 200 hours. Approx. 42 days for 2 tractors = 840 hours. Approx. 35 days for 3 tractors = 1 050 hours.
Cotton		-	Approx. 10 days for 1 tractor = 100 hours.

Total tractor and trailer hours = 8 520 hours.

Total 75 hp tractor hours including transport is then 6 182 + 8 520 = 14 702 plus 30% for non-productive running around = 19 113 hours. With a total of 17 tractors each tractor does 1 124 hours per annum. With a total of 15 trailers each trailer does on average 1 274 hours.

CHAPTER 4

OPERATION AND MAINTENANCE

4.1 Mechanical Plant for Operations and Maintenance

The required procurement programme not only makes provision for vehicles and equipment for agricultural purposes, but is also required for the operation and maintenance of the civil and building works of the project.

There will be an overlap in the vehicles and equipment required for agricultural purposes and for operation and maintenance, particularly in the provision of workshop equipment and tools. The proposals have taken this into consideration.

The workshops have been designed to accommodate the repair of the vehicles, plant and equipment which will be necessary for agriculture at full development and for operation and maintenance for civil and building works.

The equipment required for the Mogambo Irrigation Project for operation and maintenance is, essentially, as follows :

- Bicycles, motorcycles, personnel and load carrying vehicles.
- Agricultural tractors, associated equipment and trailers.
- Excavators, grader and wheeled loader.
- Low load trailer.
- Water pump and concrete mixer.
- Workshop and maintenance equipment.

The levels for the provision of spare parts have been defined and the costs of these spare parts have been included in the Engineer's estimates.

4.1.1 Selection

A proportion of the fleet of vehicles and plant proposed for agriculture can be used for operation and maintenance but, in addition, the vehicles and plant required for operation and maintenance are listed in Table 4.1. Dredgers are not included as these are scheduled to be provided in Year 15. (See Additional Study for an Alternative Development, March 1980.)

No provision has been made for a mobile workshop or a compressor with tools. The mobile workshop is not considered necessary as work can be carried out on site using hand tools and portable equipment, which will be carried on the flat bed truck provided with a 12 t hydraulic arm crane, together with a welding set. The need for a compressor and tools could be infrequent, perhaps once a year when compressed air is really necessary and then a compressor and tools could be obtained for short periods from elsewhere, possibly from the Juba Sugar Project.

Some amendments to the Alternative Study for an Alternative Development requirements have been made as follows :

(a) Previously proposed were three agricultural tractors plus three general purpose trailers, one water tank trailer and one flail.

TABLE 4.1

Vehicles and Plant for Operation and Maintenance

Item	Utilisation	Number
Bicycles	General use General maintenance	30 1
Flat truck with cargo crane	General transport	1
Tipper truck	General maintenance and for the disposal of silt	2
Concrete mixer	General repairs	1
Water tank trailer	Domestic supply	1
Fuel tank trailer	For pumps and plant	1
Flail unit	For cutting vegetation on canal banks down to water level	1
Dragline excavator	Desilting intake channel and settling basin	1
Hydraulic backhoe excavator	Desilting main drain	1
Hydraulic backhoe excavator	Cleaning distributaries	1
Grader	General use	1
Low load trailer	General use	1
Loader	General use and for loading lorries, particularly any accumulation of dried out silt which has been dredged out by excavators	1
Water pump	General use	1
Workshop and field maintenance equipment	General use and for the maintenance of housing	1 lot

Note : The determination of the numbers of vehicles and plant and equipment items for agriculture takes into account the requirements for operation and maintenance. Those items of common use are not listed in this table but are as follows :

Motor cycles
Estate car/Station wagon
Pick-up
Flat trucks as cargo carriers
Agricultural tractors (wheeled and tracked)
Agricultural trailers
Front end loaders (for agricultural tractors)
5 000 litres parked fuel bowser (field operations)

An allowance has now been made in the selected numbers of agricultural tractors and trailers proposed for agriculture to cater for operation and maintenance with, as before, one water tank trailer of 2 000 to 2 500 litre capacity and one flail unit.

In addition it is now proposed that a fuel tank trailer of 2 000 to 2 500 litres be provided in addition to the 5 000 litre fuel tank trailer to be parked adjacent to field operations.

(b) Front loader equipment to be fitted to wheeled tractors is now proposed for agricultural operations and for operation and maintenance.

(c) The number of crawler tractors, with bulldozer equipment, selected for agriculture, takes into account the requirements for operation and maintenance. The need for a larger bulldozer cannot be justified and the standardisation of a common type of crawler tractor for both agriculture and for operation and maintenance has obvious advantages.

(d) Two hydraulic backhoe excavators have been added and also a wheeled loader.

(e) The numbers of motorcycles, estate cars/station wagons and pick-ups neded for personnel transport takes into consideration both agricultural operations and operation and maintenance. The provision of bicycles is linked primarily to operation and maintenance.

Explanatory comment on each item selected for operation and maintenance is contained in the following sections.

(i) Bicycles

These should be of a basic type with a wheel size of 26 in. for general use.

(ii) Motorcycles

Motorcycles to be provided for the use of block supervisors, ditch riders and irrigation supervisors can all be of the same type, usually known as trial machines for off-the-road use, and of 125 cc capacity.

(iii) Personnel vehicles

The requirements for operation and maintenance are one station wagon plus two pick-ups for the dual role of personnel/goods carrying.

All these vehicles should be four wheel drive, long wheelbase and fitted with diesel engines as diesel fuel will be more readily available for general use.

(iv) Flat bed truck

This vehicle can be made much more work effective by being fitted with a cargo crane mounted behind the cab. With a capacity of 10 to 12 t the hydraulic arm will have a lifting capability to load, to the bed of the lorry, both irrigation pumps and engines from ground level. This vehicle can also serve as a travelling crane, suitable for most of the lifting duties envisaged.

The vehicle loads are expected to be approximately as follows :

Gross vehicle weight			160 000 kg
less	weight of chassis cab	4 500 kg	
	hydraulic crane arm	2 000 kg	
	flat body	1 500 kg	
		8 000 kg	8 000 kg
	pay load		8 000 kg

A length of flat body of about 5 m would be appropriate for the payload and would be suitable for the requirements of the project in operation and maintenance. A bolster over the cab would be useful for carrying extra long loads.

(v) Tipping Trucks

The tipping trucks could be of the same type as the flat deck truck above. Excluding the weight of the cargo crane and with a shorter body of about 4 m the payload would be in the order of 10 000 kg.

(vi) Low bed trailer

This trailer has been specified to have an adequate load carrying capacity to transport the crawler tractors. The only other machine of greater weight to be carried is the larger of the backhoe machines where the operating weight could be in the order of 17 tonnes.

If the low bed trailer can be restricted to a payload of 10 tonnes then the trailer can be towed on a good surface by an agricultural tractor or on a poor surface by a crawler tractor. To contemplate the purchase of a tractor and trailer combination to handle the larger backhoe would require expenditure at a level of about £45 000 which could not be justified. If the larger backhoe machine has be to transported to the workshops then the low loader unit at the Juba Sugar Project, or elesewhere, could possibly be utilised.

(vii) Agricultural tractors

Of the agricultural tractors to be purchased it is proposed that four should be rigged with front loaders and one other with a flail unit.

This combination of agricultural tractors, trailers and attached equipment should satisfy the needs of the project in operation and maintenance. The duties will vary according to the season as some of the equipment is only required at certain times of the year.

(viii) Agricultural trailers

These general purpose trailers are not tipping trailers. Although they are required to operate in support of labour intensive operations the trailer is intended to be sufficiently robust to be loaded by the loading shovel and also to carry the smaller items of plant.

(ix) Front loader

This front loading shovel equipment for the agricultural tractor is intended to have the capability of loading loose material on to the tipper truck.

(x) Flail

The tractor mounted flail has a two piece boom as the longer reach of the three piece boom is not necessary. When the flail is dismounted from the tractor the counterweight could remain fitted, thereby improving grip for other operations. However, the haphazard removal of the flail unit from this tractor to enable the tractor to be used for other operations, should be discouraged as there should be enough work to keep the flail reasonably well employed.

(xi) Water and fuel tank trailers

These are similar, with variations to suit the liquids which are being carried. Coupling is to the agricultural tractor, where the trailer parking wheel and jacklegs keep the connection at the correct level for re-coupling to the agricultural tractor.

For the supply of domestic water (when this is required) a tank capacity of up to 2 500 litres is considered to be adequate.

Fuel is normally delivered by the project's tanker truck but when ground conditions become difficult, in the wet season for instance, fuel could be delivered by this fuel tank trailer towed by an agricultural tractor or by crawler tractor where necessary, the fuel being discharged either by gravity or by the semi rotary pump provided.

(xii) Dragline

The duties at the dragline were examined in relation to the reach required for desilting the intake channel and settling basin. The intake channel with a bed width of 10 m and a channel depth of 6 m, with bank slopes of 1 to 2 (vertical to horizontal) indicates that a machine with a reach of 21 m would be adequate working from both banks. A dragline with the capability of the NCK 605 could meet these requirements with the standard bucket size of 2 cubic yards (1.5 cu.m).

If the jib was lowered to say 28 degrees then the reach could be extended to 31 m by throwing the bucket. This would be necessary to reach the centre of the widest section of the settling basin where, with a bed width of 36 m and a depth of 3.4 m, a reach of 28 m is

required to excavate at the centre. To make this a practical proposition a jib length of not less than 24.5 m would be required, rigged at a flat angle down to 28 degrees and a 1 cubic yard (0.75 cu.m) Hendrix type dredging bucket would be utilised. This would normally keep clear the whole of the settling basin.

To complete the study the reach of the hydraulic excavator with the maximum outreach of 15 m was considered for the requirement of desilting the intake channel. With a requirement of 21 m to reach the centre line of the channel, from both banks, the 15 m reach of the best hydraulic backhoe thought to be currently available was not adequate.

The dragline machine is therefore the only machine capable of desilting the intake channel and settling basin.

For the desilting operations in the intake channel and desilting basin the choice is as follows :

For settling basin	Flat jib at say 28 degrees Probably not less than 24.5 m jib 0.75 cu.m Hendrix type bucket.
For the intake channel :	Normal jib elevation of say 42 degrees 18.3 to 21.3 m jib length 1.5 cu.m Hendrix type bucket.

It is also envisaged that the dragline will become engaged in some desilting operations for the flood relief channel where the bed width is in the order of 55 m which is well in excess of the reach of the dragline specified.

There are, at present, two NCK 605 dragline machines already working at the Juba Sugar Project on maintenance of inlet channels. The possibility of being able to utilise a NCK 605 long jib dragline excavator from the Juba Sugar Project at Mogambo should be considered in order to reduce the capital expenditure for operation of maintenance work.

(xiii) Hydraulic backhoe excavators

It is recommended that the use of the dragline machine be confined to the intake channel and settling basin in order to conserve the life of this machine.

To move this dragline to work down the main canal would be wasteful and unnecessary and it is therefore proposed that two further hydraulic backhoe excavators be purchased, one for the maintenance of the main canal and a smaller machine for the maintenance of the drains and distributary channels. This type of hydraulic backacter machine has proved to be ideal in these applications where the shape of the channel is important and where overcutting is to be avoided. This type of excavator can also carry out the weeding as well as silt removal.

The main canal, with a bed width of 8 m and a depth of 2 m, could be maintained with an excavator working from one bank only, if a reach of about 19 m is obtainable, but an excavator with such a

reach may not yet be readily available. To reach only to the centre of the bed of the main canal calls for a reach in the order of 11 to 12 m, which is within the reach capability of the more common range of long reach hydraulic backhoe machines.

The distributary channels, with bed widths varying from 1.5 m to 4 m and channel depths varying from 0.8 m to 1.5 m, respectively, are within the range of many makes of hydraulic backhoe excavators. Using the advantage of working from one bank only precludes the use of backhoe machines in the mini-excavator sizes. The use of long reah backhoe machines for smaller distributaries is also not suitable as the machine would have to stand well back from the channel in order to be able to work effectively.

(xiv) Grader

The size of the grader which has been specified is in keeping with the operational conditions experienced in projects in Somalia.

(xv) Bulldozer

The size of the bulldozer for operation and maintenance can be the same as for agriculture and the specification is based upon this consideration.

The operational life of this bulldozer can be conserved by the use of the grader. To run the tracks off the bulldozer in minor work is wasteful and should be avoided.

(xvi) Wheeled loader

The wheeled loader will be in great demand within the project having many applications in operation and maintenance.

It is expected that silt removed from the irrigation channels will be dumped on the bank. In certain areas this silt will have to be loaded on to a lorry, by the loader, for dumping elsewhere. To meet this maintenance two tipper trucks will be required to ensure a reasonable balance with the output of the wheeled loader.

(xvii) Water pump

A diaphragm type water pump has been chosen in preference to a centrifugal pump, largely because of the relatively small water flows which can be expected and because the diaphragm type pump can handle a large proportion of solids and can run even when sucking air and water, for long periods, without detriment.

(xviii) Concrete mixer

This has been chosen at an adequate size to be robust, portable and with a tilting drum.

(xix) Workshop and field maintenance equipment

Equipment would normally be held at the base workshop but it is expected that it would also be utilised in field maintenance and repairs. This workshop and field maintenance equipment is considered under the following main headings :

(a) Machine tools for the main workshop, comprising :

- centre lathe;
- benchgrinder with green silicon wheels for tungsten carbide tipped tools;
- radial drilling machine;
- twist drill regrinding machine;
- valve refacing grinding machine;
- heavy duty pedestal grinder;
- lighter bench mounted grinding machine;
- powered hacksaw;
- garage type compressor;
- battery charger;
- medium size shaper.

(b) General tools and equipment and measuring instruments.

(c) Equipment for the inspection and reconditioning of fuel injectors for diesel engines.

(d) Socket sets and spanners.

(e) Files and drills.

(f) Hand operated travelling lifting frame.

(g) Lifting slings.

(h) Sawbench for carpenter.

(i) Lighting set.

(j) Tractor mounted welding set.

4.2 Operation and Maintenance for Housing, Administration Buildings and Services

The requirements for operation and maintenance of housing, adminstration buildings and services were covered in the Supplementary Feasibility Study. The costs were assessed on a percentage basis of the capital cost and these have been updated together with the increased cost of fuel where appropriate.

It is now estimated that the housing contract will be complete in September 1984 and with a year's maintenance period very little input apart from running fuel costs will be needed before September 1985.

Costs allied to labour and staff are allocated in another section of this report. The following summaries show the make-up of the other costs involved.

4.2.1 Materials and Spares Costs

Total capital cost of buildings	=	SoSh 50 857 455
Therefore annual costs of materials and spares at 1.5%	=	SoSh 762 862
Total capital cost of roads	=	SoSh 1 289 300
Therefore annual costs of materials at 2%	=	SoSh 25 786
Total capital costs of sewerage, potable water and electrical supply	=	SoSh 98 291 130
Therefore annual cost of materials and spare parts at 1%	=	SoSh 98 291
Therefore total annual cost of spare parts and materials at 1984 prices	=	SoSh 886 939
Allowing 5% inflation.		
Total cost for 1985	=	SoSh 931 286
Maintenance by the contractor is complete by September 1985 therefore allowance for 1985	=	SoSh 232 820
Total cost for 1986	=	SoSh 977 850.

4.2.2 Operating Costs

The main cost involved is the fuel costs for the generators. For the generators on site it is assumed that 600 litres per day of diesel will be required. For 1984 assume 5 months in the year will be required.

Cost of diesel for 1984 assumed at SoSh 5/litre

Therefore cost for 1984	=	SoSh 5 x 600 x 30 x 5
Lubrication costs are assumed at 10% of fuel cost	=	SoSh 450 000
Therefore lubrication costs	=	SoSh 45 000
Assuming 10% inflation per annum for diesel		
Cost for 1985	=	SoSh 600 x 365 x 5.5
Lubrication costs	=	SoSh 1 204 500
Cost for 1986	=	SoSh 1 204 500 x 1.1
	=	SoSh 1 324 950
Lubrication costs	=	SoSh 132 495.

4.3 Operation and Maintenance for the Irrigation and Drainage System

Once again these costs are based on the Supplementary Feasibility Study.

It is estimated that the Irrigation and Drainage Contract will be completed in March 1986 and thereafter the Contractor has to complete one year's maintenance.

The costs of staff, labour and maintenance of equipment for operation and maintenenance are covered elsewhere.

4.3.1 Materials and Spares Costs

As the Contractor's maintenance period is not complete until March 1987 no materials or spares will be required during 1985 and 1986. The costs of running the mechanical equipment for maintenance of channels, etc. is allowed in another section.

4.3.2 Operating Costs

The fuel and oil costs are based on quantities shown in the Additional Study for an Alternative Development with the costs of diesel updated to the current duty free cost of SoSh 5/litre.

From the Additional Study the following costs are noted at full development of 1 539 ha of surface irrigated rice and 163 ha of sprinkler irrigated cotton :

	Costs/annum in SoSh
Main irrigation pump station	530 000
Sprinkler pump station	162 000
Drainage pump station	19 000

Recalculating these to 1984 costs, allowing SoSh 5/litre for diesel, adjusts these figures to :

	SoSh/annum
Main irrigation pump station	2 284 480
Sprinkler pump station	698 275
Drainage pump station	81 900

To suit the proposed programme of :

	1985		1986	
	Gu	Der	Gu	Der
Rice crop (ha)	459	900	1 539	1 539
Cotton crop (ha)	-	122	-	163

and allowing for 10% inflation per annum for fuel costs, the total fuel costs are as follows :

	1985 SoSh	1986 SoSh
Main irrigation pump station	1 109 508	2 764 220
Sprinkler pump station	574 898	844 913
Drainage pump station	39 169	99 099
Totals	1 723 602	3 708 232

CHAPTER 5

MANAGEMENT AND STAFFING

5.1 Present Status

The primary aim of this chapter is to establish the staff needed to implement both the agricultural programme successfully and thereafter to operate and maintain the project. From this a recruitment schedule upon which a staff recurrent cost budget can be based is also established. This chapter therefore reviews the present status of the project in terms of organisation and staffing and thereafter produces an estimate of staff required to operate the project for the first two years.

5.1.1 Existing Staff

A project headquarters has been established in Mogadishu, and over the years since the project was initiated, a cadre of Somali managerial and support staff have been recruited. As of February 1984, headquarters staff numbered around 46 persons, made up of the following :

- General Manager
- Irrigation Engineer
- Head of Administration
- Chief Accountant
- Two Agronomists/Agricultural Managers
- Two Senior Accountants
- Personnel Manager
- Procurement Officer
- Junior staff comprising clerks, typists and drivers, etc. making up the balance of the 46.

Of the senior staff, an agronomist is stationed on site. His principal task is to manage the small banana farm which was purchased by the project, and to act as site agent for the client. The agronomist is supported by a radio operator, driver, foreman and a labour force varying between 10 and 30, which is needed to maintain the banana farm.

5.1.2 Management Organisation

A management study aimed at defining an appropriate management organisation for the project was carried out during the early part of 1983. This report did not clarify in any further detail the management which was shown in the 1980 Alternative Development Report.

The Alternative Development Report proposed an organisation comprising three major departments; Operations, Accounts and Administration, to be presided over by a Board, General Manager and Deputy Manager. Of these departments, Operations was particularly diverse incorporating Farm Management, Agronomy and Irrigation Engineering sections. On a scheme of this size there is little scope for an alternative organisational structure and the only issue which is worth considering at this stage, is whether Engineering and Agriculture, the major elements central to the successful operation of the scheme, should be established as separate departments.

The Engineering component is particularly diverse, involving :

- operation and maintenance of irrigation and drainage works;
- operation and maintenance of civil and building works;
- operation and maintenance of a wide range of heavy plant (stationary and mobile).

Agriculture is also diverse, incorporating field management, agronomy and agricultural engineering and would probably be more easily managed if established as a separate department.

The comprehensive mechanical workshop would be complementary to both the Engineering and Agricultural departments.

Although the organisation of existing staff into discrete departments is not yet formalised, they could clearly be organised into four main departments: Accounts, Administration, Agriculture and Engineering. In terms of existing staff numbers, the Accounts and Administration departments are already well established.

5.2 Proposed Organisation and Staffing

5.2.1 Headquarters

The proposed organisational structure for the project headquarters staff at Mogambo, including the factory organisation is shown in Figure 5.1. The agricultural operation comprises four main departments: Accounts, Administration, Engineering and Agriculture. The proposed complement of staff, excluding the factory requirements, at Mogambo headquarters is given in Table 5.1. This table indicates the timing of recruitment of headquarters staff and the incorporation of existing professional staff into the management structure.

5.2.2 Field Management and Agricultural Labour

(a) Field Management

It is proposed that the scheme is divided into smaller management units to be known as sections. To avoid excessive distances between the labourers' villages and their place of work each section would have its own permanent labour force. Whilst it is desirable that labour will ultimately identify with a particular section, it may be necessary in the early years for labour from one section to help out from time to time in another.

Four sections are proposed. They have been determined primarily on the basis of :

- size, with the aim of standardising size as far as possible;
- methods of irrigation; surface or sprinkler;
- independence of irrigation operation.

The four sections (three surface irrigation and one sprinkler) are defined in Table 5.2. The surface irrigation sections are 702, 675 and 675 ha in area, and as each is in the command of a specific night storage reservoir (Section 1 is served by two reservoirs), they have maximum independence in terms of irrigation operation.

Figure 5.1

Proposed Organisational Structure

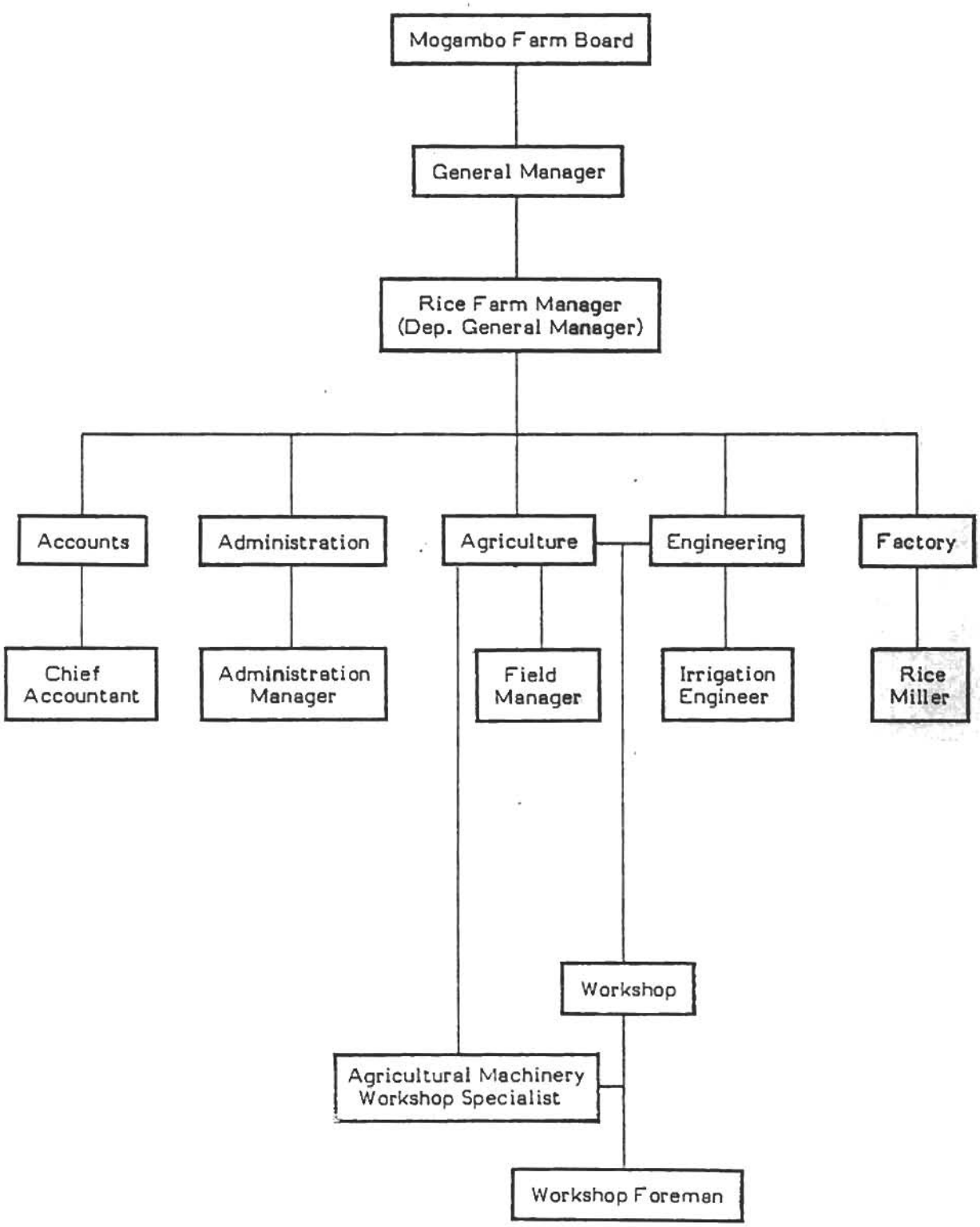


TABLE 5.1

Mogambo Irrigation Project - Project Staff Requirements: Project Headquarters

Position	Expatriate or local staff	Total Nr	Existing staff Feb 1984	Recruitment of staff Aug to Dec 1984 Nr	Jan to Jun 1985 Nr	Jul to Dec 1985 Nr	1986 Nr
Management							
General Manager	S	1	1	1	1	1	1
Secretary	S	1	1	1	1	1	1
Rice Farm Manager/Deputy General Manager	E	1		1	1	1	1
Secretary	S	1		1	1	1	1
Drivers	S	1		1	1	1	1
Watchmen	S	2		1	2	2	2
Labourers	S	2		1	2	2	2
Gardeners	S	1		1	1	1	1
Messengers	S	2		1	2	2	2
Accounts Department							
Chief Accountant	E	1		1	1	1	1
Chief Accountant (Designate)	S	1	1	1	1	1	1
Senior Accountant	S	2	2	2	2	2	2
Procurement Officer	S	1	1	1	1	1	1
Clerks	S	3		2	3	3	3
Typists	S	2		1	2	2	2
Drivers	S	1	1	1	1	1	1
Chief Storeman	S	1		1	1	1	1
Storeman	S	1		1	1	1	1
Assistant Storeman	S	1		1	1	1	1
Stores Clerk	S	1		1	1	1	1
Typist	S	1		1	1	1	1
Labourers	S	2		2	2	2	2
Fuel Distribution Clerks	S	2		2	2	2	2
Fuel Bowser Drivers	S	1		1	1	1	1
Administration Department							
Senior Administrator	S	1	1	1	1	1	1
Personnel Officer	S	1	1	1	1	1	1
Training Officer	S	1	1	1	1	1	1
Clerks	S	2		1	2	2	2
Typists	S	2		1	2	2	2
Drivers	S	1		1	1	1	1
Engineering Department							
Irrigation Engineer	E	1			1	1	1
Irrigation Engineer (Designate)	S	1	1	1	1	1	1
Building Foreman	S	1		1	1	1	1
Draughtsman	S	1		1	1	1	1
Labourers	S	4			4	4	4
Drivers	S	1			1	1	1
Agricultural Department							
Field Manager	E	1			1	1	1
Deputy Field Manager	S	1	1	1	1	1	1
Agricultural Machinery/Workshop Specialist	E	1			1	1	1
Agronomists	S	1	1	1	1	1	1
Technicians	S	4			4	4	4
Typists	S	1		1	1	1	1
Labourers	S	4			4	4	4

TABLE 5.2

Definition of Management Units

Section number	Irrigation command	Number of units	Area (ha)	Comments
1	M1C1	17	459	M2C1 will be completed for gu 1986
	M2C1	9	243	
		Total	702	
2	M1C4	17	459	both commands completed for der 1985
	M1C6	8	216	
		Total	675	
3	M2C2	13	351	both commands completed for gu 1986
	M2C4	12	324	
		Total	675	
4	Sprinkler irrigated area	4	163	122 ha available der 1985, 163 ha for der 1986

Day-to-day operations in each section will be supervised by a Section Manager, who will be responsible to the Field Manager. Other supervisory support at the section level will include timekeepers, wages clerks and foremen. Foremen will be recruited at a ratio of one foreman to 20 labourers. Table 5.3 shows the number of field supervisory staff required between 1984 and full development in 1986.

(b) Machinery Operators

Machinery operators fall into three main groups :

- wheeled tractor operators;
- crawler tractor operators;
- combine harvester operators.

An operator and an assistant (trainee operator) will be assigned to each machine and a senior operator appointed for each group. The requirement for machinery operators is shown in Table 5.3. Overall management of machinery may have to remain the responsibility of the Field Manager although the case for appointment of a Mechanisation Manager is discussed in a later section of this report.

TABLE 5.3

Mogambo Irrigation Project - Project Staff Requirements: Field Management

Position	Total Nr	Existing staff Feb 1984	Recruitment of staff Aug to Dec 1984 Nr	Jan to Jun 1985 Nr	Jul to Dec 1985 Nr	1986 Nr
Field Management						
Section Managers	4	-		2	3	4
Time and Wages Clerks	7	-		4	6	7
Foremen	15	-		5	10	15
Machinery Management						
Tractors:						
Senior Operators	1	-	1	1	1	1
Operators	16	-	11	16	16	16
Operators' Assistants	17	-	12	17	17	17
Crawlers:						
Senior Operators	1	-	1	1	1	1
Operators	5	-	3	5	5	5
Operators' Assistants	6	-	4	6	6	6
Combine harvesters:						
Senior Operators	1	-		1	1	1
Operators	6	-		6	6	6
Operators' Assistants	7	-		7	7	7

(c) Agricultural Labour Force

Table 5.4 shows the build up in labour force for each section. At full development in April 1986, the total unskilled labour force required for field operations would be around 290 persons. There would also be a requirement for casual labour for general field operations of just under 4 000 man days per year from 1986 onwards. This does not include cotton pickers who would add a further 200 casuals to the labour force of Section 4 for approximately 2 weeks in December, all of January and two weeks during the following February.

The need for bird scarers is unpredictable and the economics of comparing wages for bird scarers and potential losses due to bird damage will have to be assessed. Assuming a requirement of 1.5 persons per ha for a period of 30 days for each ha the requirement at full development would rise to 1 280 persons during August and September and January and February. During initial development, 380 persons would be required in August/September 1985 with 740 persons needed in January/February 1986. It is unlikely that bird scarers will be available in these numbers, particularly between December and February when bird scaring will coincide with cotton picking.

Protection from bird damage represents the most serious problem which project management will have to face and should be one of the immediate priorities of the Agricultural department.

5.2.3 Workshop

Under the proposed organisational structure the workshops will be complementary to both the Engineering and Agricultural departments. The workshop itself will be managed by the Workshop Foreman who will be supported by a complement of staff incorporating the range of skills, mechanical, electrical, carpentry, machining, etc., required to repair and maintain all project vehicles, plant and machinery. The staff required are shown in Table 5.5.

5.2.4 Irrigation Department

The staff for the operation and maintenance of the irrigation and drainage is based on figures for the Additional Study for Alternative Development, 1980, with the exception that the labour for the infield works now come under the supervision of field management.

Labour is retained, however, for the maintenance works involved in the main canals and drains which will be required in conjunction with the plant maintenance work. Table 5.6 shows the required build up and total numbers required.

5.2.5 Project Housing

Whereas the management staff will be based in the project headquarters village already constructed, the housing for other staff has still to be constructed. This will inevitably create problems, especially during the early stages of construction when staff are required to settle in and commence training. It should also be noted that the nearby Juba Sugar Project provides block built houses for their Somali staff for staff Grades 1 to 8. This will be an important factor to take into consideration in trying to bring staff to the Mogambo Irrigation Project.

Farm Labour Requirements 1985/86

Section	1985 J	F	M	A	M	J	J	A	S	O	N	D	1986 J	F	M	A	M	J	J	A	S	O	N	D	1987 J	F
1. Surface Irrigation																										
Section 1																										
Estimated man months(1)	10	13	19	80	82	79	69	70	75	40	36	31	41	33	22	92	94	96	83	92	134	94	85	72	70	42
Proposed labour force	20	20	40	70	70	70	70	70	70	70	70	70	70	70	70	90	90	90	90	90	90	90	90	90	90	90
Nr of Foremen	1	1	2	4	4	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5
Casual labour(2)					600 man days												1 200 man days									
Bird Scarers							95	380	380			45	180	180					110	440	440			110	440	440
Section 2																										
Estimated man months(1)						14	20	28	118	121	110	93	100	68	21	88	91	93	84	88	128	90	82	69	68	40
Proposed labour force						20	20	40	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90	90		
Nr of Foremen						1	1	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4		
Casual labour(3)					720 man days												1 200 man days									
Bird scaring												140	560	560					105	420	420			105	420	420
Section 3																										
Estimated man months(1)													10	15	22	88	90	93	84	88	128	90	82	69		
Proposed labour force													20	20	40	90	90	90	90	90	90	90	90	90		
Nr of Foremen													1	1	2	4	4	4	4	4	4	4	4	4		
Casual labour(2)																	1 200 man days									
Bird scaring																			105	420	420			105	420	420
Total Surface Irrigation:																										
Labour force	20	20	40	70	70	90	90	110	160	160	160	160	180	180	200	270	270	270	270	270	270	270	270	270		
Foremen	1	1	2	4	4	5	5	6	8	8	8	8	9	9	10	13	13	13	13	13	13	13	13	13		
Casual labour(2)					2 600 man days												3 600 man days									
Bird Scarers							95	380	380			185	740	740					320	1 280	1 280			320	1 280	1 280
2. Sprinkler Irrigation																										
Section 4																										
Estimate man months (4)						1	3	12	16	23	23	22	12	9	10	-	-	2	3	16	22	30	30	30	16	14
Proposed labour force						5	5	10	20	20	20	20	20	20	20	20	20	20	20	20	25	25	25	25	25	
Foremen						1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Cotton Pickers												90(6)	90	90(6)									200(6)	200	200(6)	
Casual labour(5)					190 man days												260 man days									

Notes:
(1) Based on Table 2.3.
(2) Does not include Bird Scarers.
(3) Assumes that surplus labour on Section 1 in October and November 1985 could be used on Section 2.
(4) Based on Table 2.4.
(5) Does not include cotton picking.
(6) Half month only.

TABLE 5.5

Mogambo Irrigation Project - Project Staff Requirements: Workshop and Stores

Position	Expatriate or local staff	Total Nr	Existing staff Feb 1984	Recruitment of staff Aug to Dec 1984 Nr	Jan to Jun 1985 Nr	Jul to Dec 1985 Nr	1986 Nr
Workshop Staff							
Workshop Foreman	E	1		1	1	1	1
Foreman	S	7		7	7	7	7
Mechanics I	S	8		8	8	8	8
Mechanics II	S	10			10	10	10
Vehicle Electrician	S	1			1	1	1
Labourers (semi-skilled)	S	14			10	14	14
Apprentices	S	9			5	9	9
Welder	S	1			1	1	1
Welder's Assistant	S	1			1	1	1
Turner	S	1			1	1	1
Turner's Assistant	S	1			1	1	1
Plumber	S	1			1	1	1
Plumber's Assistant	S	1			1	1	1
Electrician	S	1			1	1	1
Electrician's Assistant	S	1			1	1	1
Carpenter	S	1			1	1	1
Carpenter's Assistant	S	1			1	1	1
Truck drivers	S	4			4	4	4
Drivers' Assistants	S	4			4	4	4
Watchmen	S	4			4	4	4
Labourers	S	4			4	4	4
Spare Parts Store							
Chief Storeman	S	1		1	1	1	1
Spare Parts Clerk	S	1		1	1	1	1
Typist	S	1		1	1	1	1
Labourers	S	1		1	1	1	1

TABLE 5.6

Mogambo Irrigation Project - Project Staff Requirements: Irrigation Department

Position	Expatriate or local staff	Total Nr	Existing staff Feb 1984	Recruitment of staff Aug to Dec 1984 Nr	Jan to Jun 1985 Nr	Jul to Dec 1985 Nr	1986 Nr
Operation and Maintenance Staff							
Irrigation Engineer	E	1	1		1	1	1
Irrigation Supervisor (Designate)	S	1	1		1	1	1
Surveyor	S	1			1	1	1
Survey Assistants	S	2			1	2	2
Operators	S	8			4	6	8
Ditch Riders	S	14			6	10	14
Labourers	S	20			10	14	20

5.3 Management Organisation

The project management organisation is to be supported in the early years by an expatriate Agricultural Management Team comprising seven specialists, most of whom will be provided by a single firm currently engaged in agricultural management. Of this management team one member is a Rice Miller and as the organisation of the rice mill is outside the scope of this study, no comments are made on this position. Of the other six posts, one is an irrigation engineer who will be provided by the Mogambo Irrigation Project. The remaining specialists, who will be involved in the crop production operations have proposed inputs as follows :

		Duration of assignment (years)
1.	Rice Farm Manager (Deputy General Manager)	3
2.	Field Manager	3
3.	Chief Accountant	2
4.	Agricultural Machinery/Workshop Specialist	2
5.	Workshop foreman/mechanic	3

It is planned that a minimum of 10% of the Farm will be farmed by small holders. The management team in liaison with the General Manager will formulate a policy to provide settlement and extension services for the small holders. Should it be proved necessary an agronomist may be added to the team, at a later stage, to assist in these settlement and extension services.

5.4 Implementation Schedule

Figure 5.2 illustrates the timing of the various activities which have to be carried out to enable the target cropping programme for 1985 and 1986 to be achieved. It assumes that land development and construction of irrigation and drainage works have been completed and they do not impede or restrict agricultural operations. The timing of field operations has been shown in detail in Figure 2.1, Figure 5.2 therefore is concerned primarily with :

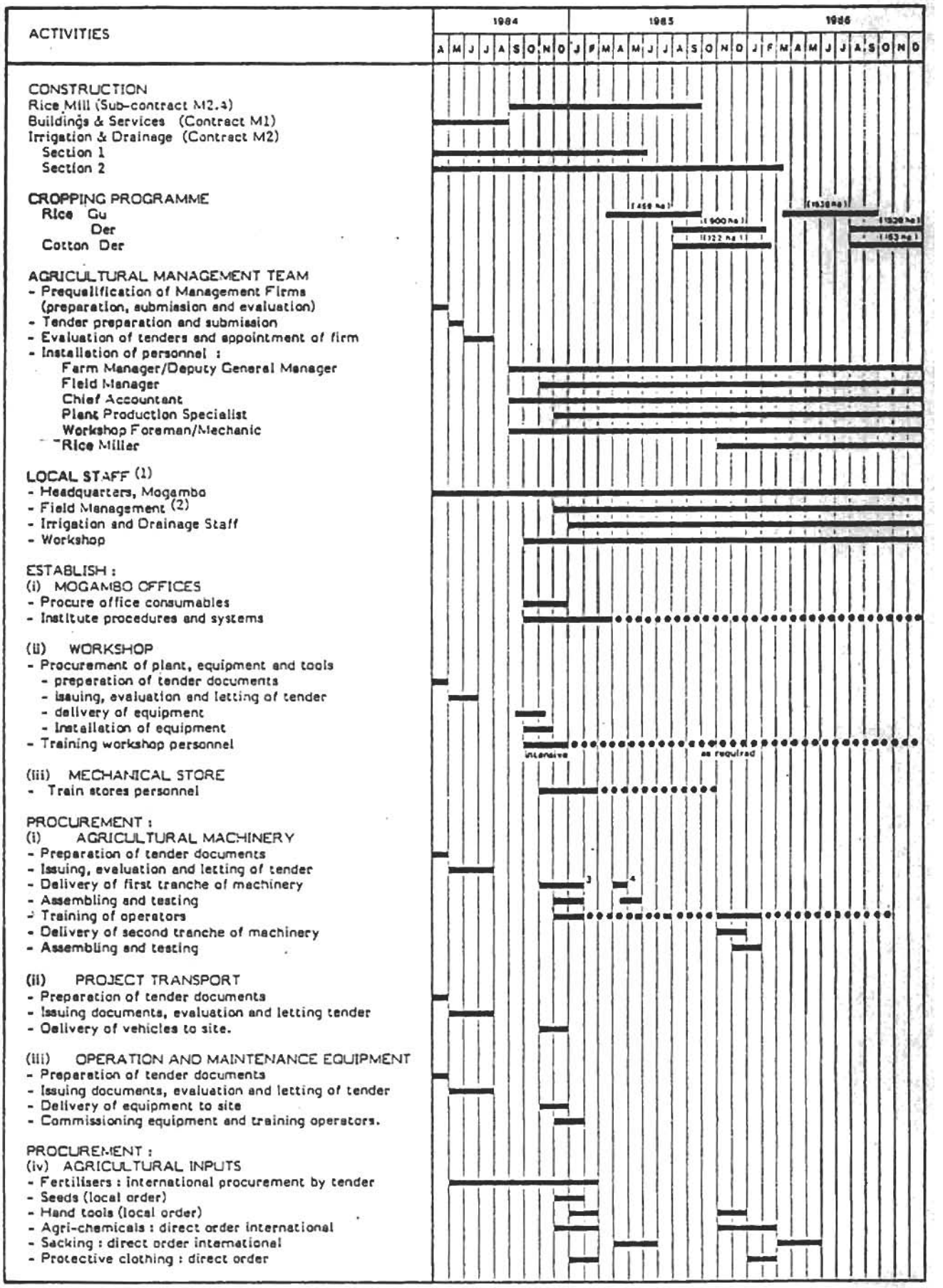
- the recruitment and installation of management staff;
- the establishment of workshops and mechanical stores;
- the establishment of management, accounting, administration and stores procedures;
- the procurement of machinery vehicles and plant;
- staff training;
- procurement of agricultural inputs.

If the target area of 459 ha of basin irrigated rice in the 1985 gu season is to be achieved it is clear from Figure 5.2 that the first batch of agricultural machinery will have to arrive on site during November and December 1984 at the latest, if it is to be ready to commence operations in January 1985. Prior to this however, the workshop will have to be properly established, equipment installed, staff recruited and training underway. The Workshop foreman should therefore be in post early in September 1984.

A workshop equipped and operating effectively is essential if the initial servicing and assembly of agricultural machinery is to be achieved by the beginning of 1985.

Figure 5.2

Mogambo Irrigation Project
Implementation Schedule



Notes : (1) Details given in Chapter 5
(2) Including the agricultural labour force
(3) Tractors, cultivating, planting and spraying equipment
(4) Harvesting and grain handling equipment

CHAPTER 6

TRANSPORT

6.1 Types of Vehicles

The project will be orientated towards diesel powered machines. There is provision for bulk storage of diesel fuel and the workshops will be mainly concerned with the maintenance and repair of diesel engine powered machines. For vehicles, diesel engines also have the advantages of economy and price over equivalent petrol engined vehicles. It is therefore recommended that all vehicles to be purchased should be diesel engine powered. The motor cycles only will be petrol engined.

6.2 Number of Vehicles

The total requirement for transport vehicles is summarised in Table 6.1. Of these one Range Rover and three Land Rover pick-ups have already been provided by the funding agents. The balance, i.e. two estate cars, three 4 wheel drive station wagons, three 4 wheel drive pick-ups, one 3 tonne van, twelve motor cycles and four 10 tonne trucks will be purchased in 1985.

TABLE 6.1

Estimate of Requirement for Transport

Designated position	Type of vehicle	Number required	Estimated life (km)
General Manager Chief Accountant Administration Manager	Estate car	3	120 000
Deputy General Manager Agric.Mach/Workshop Specialist Irrigation Engineer Field Manager	4 wheel drive station wagon or estate car	4	150 000
Workshop Foreman Workshops (general including Maintenance and Stores)	4 wheel drive pick-up	6	150 000
Stores	3 tonne van	1	150 000
Deputy Field Manager (1) Section Manager (4) Maintenance and Stores	Trail-type motor cycle 125 cc	12	50 000
General transport	10 tonne capacity truck (one fitted with cargo crane)	4	300 000

Note : No vehicles have been allowed for the Rice Mill requirements.

6.3 Running Costs

For the purposes of estimating running costs the following annual use for the vehicles has been taken :

	(km)
Estate cars	25 000
4 wheel drive station wagons	25 000
4 wheel drive pick-ups	30 000
3 tonne van	30 000
Motor cycles	10 000
10 tonne trucks	50 000

CHAPTER 7

MECHANICAL WORKSHOPS AND STORES

7.1 General

The workshops will have to perform the following maintenance and repair functions :

(1) Agricultural machinery
(2) Project maintenance equipment (O & M)
(3) Irrigation pumps and equipment
(4) Estate maintenance
(5) Vehicles

The stores will have to organise the ordering, handling, collection and storage of all project inputs for :

(1) Agricultural machinery spare parts
(2) Operations and maintenance equipment spare parts
(3) Irrigation pump and equipment parts and materials
(4) Vehicle spare parts
(5) Tools
(6) Fuel and oil.

There are several factors which determine the type of facilities required in the workshop. These are :

(a) A shortage in Somalia of any effective representation and distribution of major agricultural machinery manufacturers. Consequently, the project will have to be almost entirely self-sufficient in ordering and storing parts.

(b) There are no known facilities for the overhaul of injectors and injector pumps in Somalia;

(c) There are no high quality facilities for crankshaft regrinding, cylinder reboring or other machinery facilities.

7.2 - Equipment and Tools

The workshops have to fulfil the functions of maintenance and repair of a wide range of agricultural, construction, irrigation and other equipment. As this should be achieved by replacement of worn parts rather than fabrication of new items, the recommended list of tools and equipment reflects this requirement with a low emphasis on machine tools and a high emphasis on hand and special tools.

Despite the absence of crankshaft regrinding facilities and injection pump overhaul equipment there are not sufficient machines on the project to warrant the purchase of those pieces of overhaul equipment. It is recommended that the project should make use of the available facilities in Kenya, for :

(a) Crankshaft regrinding;

(b) Recalibration of fuel metering pumps;

(c) Repair of operators and starters.

In addition advantage should be taken of service exchange facilities, where available, for engines and hydraulic pumps. This requirement, however, should rarely be necessary within the first two years of the project and no budget costs have been allowed for that within the first two years.

The provision of additional standby units for tractors up to the level of complete engines will be part of the procurement programme.

The project will have to obtain the manufacturer's recommended tool kit required, where applicable, from the level of servicing to major repairs.

Within the project a distinction must always be made between the work to be carried out in the field and work which should be carried out in the workshop. As a general rule, if a machine needs to be dismantled for major repairs, then it should be brought back to the workshop. Field repairs are thus restricted to puncture repair, oil changes, machine adjustments and minor repairs. A small service truck is well capable of carrying out these tasks and there is no need for a fully equipped mobile workshop. The service truck should be fitted with a good mechanic's tool set, hand greasing equipment, lubricating oil, filters, etc. A 4 wheel drive pick-up has been selected for these tasks.

For fuel distribution two fuel bowsers will be required; one a 7 500 litre tanker truck for carrying fuel from the bulk storage tanks sited with the project and the other, a 5 000 litre fuel tank trailer, double axle type with drawbar, to be located adjacent to the field operations where crawler tractors are in use. The crawler tractors will run to the bowser for refuelling and the siting of the stationary bowser should keep these distances to a minimum.

The increased flexibility with wheeled machines makes possible a choice for refuelling and 40 gallon fuel drums can also be employed as a means of short term storage for isolated machines. The tanker truck would therefore be the means of distribution, either direct to machines on a daily basis or to the tractor tank or drum storage and will be kept fully occupied.

7.3 Spare Parts

As stated in Section 7.1 the project will not be able to rely upon the procurement of spare parts through a local distribution system. A high percentage of parts will have to be retained as spare parts from overseas will have a 6 to 12 month delay time between ordering and delivery.

A spares holding of 15 to 20% of the whole goods value will need to be established at project start-up. As spares are drawn down from this inventory an annual 'topping up' will be required. This will range from 3 to 5% per annum for implements and up to 10% per annum for some of the machines with fast wearing parts. This re-ordering of parts will need to commence in the second year after project start-up and will require an annual foreign exchange component of approximately US$ 110 000 at full development from 1986 onwards. It must be emphasised that the 15 to 20% holding is not sufficient to cover operational needs for several years. As soon as parts are drawn down replacements will need to be ordered when stocks fall to specified minimum levels. The holding levels will have to be set to take procurement times into consideration.

From the proposed workshop layout it is noted that parts storage is restricted to 28 sq.m. This is very limited and it is recommended that parts and other project inputs be shipped in non-returnable containers which in turn can provide further storage space. These can be easily purchased for about US$ 750 and these have been budgeted for in the capital costs.

CHAPTER 8

BUDGET ESTIMATES 1984 to 1986

8.1 Basis for the Estimate

The budget estimate is based on the cropping programme and farming system described in Chapter 2 and the inputs (including machinery, labour and materials) necessary to implement it successfully are specified in the succeeding chapters. The starting point for all costs is the 1984 current level. Purchases have been inflated between 1984 and 1986, at rates of between 5% and 10% per annum according to the anticipated inflation rate advised by the suppliers.

(a) Vehicles, Machinery and Equipment

The capital cost estimates are based on European and American manufacturers' prices for equipment which fits the specifications provided. Operating costs are estimated on the basis of fuel, lubricant and spare part use for an expected number of hours of operation, or in the case of transport, kilometres travelled, in each year.

(b) Irrigation

The irrigation costs refer primarily to the use of consumables, oil, lubricants and spare parts, expected to be used in producing the irrigation water requirement. Maintenance of the system (canals, drains and reservoirs) is covered under the capital and operating costs of heavy plant and equipment.

(c) Housing, Administration Buildings and Services Operation and Management

These costs include the materials necessary to maintain the buildings and Headquarters compound and the fuel, lubricants and spare parts necessary to keep the electricity generating plant operating.

(d) Salaries and Wages

These include both expatriate Technical Assistance staff and local staff (managerial, administrative, technical, skilled, semi-skilled and unskilled labour). Current Juba Sugar Company salary scales have been used as the basis for determining wage and salary levels. The levels used are essentially estimates for budgetary purposes only and are not necessarily recommended levels. It is pointed out however, that if labour is to be recruited in the Lower Juba area, the rates of pay offered will have to be competitive with the Juba Sugar Company, local banana estates and contractors. It is also suggested that the introduction of salary incentives to encourage senior executives and skilled technician staff, to commit themselves to the project, should be considered.

(e) Agricultural Inputs

The majority of these, apart from hand tools, will be imported. Fertilisers are the major cost and prices appear significantly higher than the 1983 fertiliser prices quoted by Somali Fruit, which is the major importer, whose 1983 supplies were shipped from Italy and were probably subsidised by the Italian Government. The company has indicated that it expects a considerable increase in prices this year. The prices used are based on manufacturers' current quotes and are in line with current world fertiliser prices.

(f) House and Office Furnishings

These are included in the M1 Contract and thus have already been provided for.

8.2 The Budget Estimates

Table 8.1 summarises the budget estimates for 1984 to 1986. The detailed estimates upon which the summary is based are included in Tables IV.1 to IV.16 in Appendix IV.

TABLE 8.1

Cost Estimates 1984 to 1986

TABLE 8.1

Cost Estimates 1984 to 1986

Description	1984 FE component (US$ '000)	1984 Local component (SoSh '000)	1984 Total SoSh ('000)	1985 FE component (US$ '000)	1985 Local component (SoSh '000)	1985 Total SoSh ('000)	1986 FE component (US$ '000)	1986 Local component (SoSh '000)	1986 Total SoSh ('000)
1. Capital costs:									
Project transport	344.38	175.63	6 030.08	-	-	-	-	-	-
O&M plant and equipment	915.82	467.07	16 036.03	-	-	-	-	-	-
Agricultural machinery	1 304.49	665.29	22 841.58	620.29	316.35	10 861.29	-	-	-
Workshop & mechanical stores plant and equipment	110.29	56.25	1 931.09	-	-	-	-	-	-
Total capital costs	2 674.98	1 364.24	46 838.78	620.29	316.35	10 861.29	-	-	-
10% contingency	267.50	136.42	4 683.88	62.03	31.64	1 086.13	-	-	-
2. Operating costs:									
Mogambo HQ: Salaries and wages	75.0	433.5	1 708.5	472.5	1 365.21	9 397.71	496.13	1 433.47	9 867.68
Workshop and mechanical stores: salaries and wages	37.5	268.25	905.75	94.5	1 477.34	3 083.84	99.23	1 593.55	3 280.46
Irrigation operation: salaries and wages	-	-	-	-	404.21	404.21	-	634.84	634.84
Field management: salaries and wages	-	155.10	155.0	-	1 031.94	1 031.94	-	1 301.83	1 301.83
Project transport: fuels, lubricants and spare parts	-	-	-	23.64	1 377.39	1 779.27	26.0	1 515.13	1 957.10
Heavy plant: fuels, lubricants and spare parts	-	-	-	36.51	1 174.52	1 795.19	40.16	1 291.98	1 974.70
Agricultural machinery; fuels, lubricants and spare parts	-	-	-	100.13	1 528.83	3 231.04	128.35	2 282.84	4 464.79
Irrigation and drainage: fuels, lubricants and spare parts	-	-	-	-	1 895.96	1 895.96	-	4 079.05	4 079.05
Agricultural labour force: wages	-	-	-	-	1 248.4	1 248.4	-	4 602.40	4 602.40
Housing, administration buildings and services O&M	-	495.0	495.0	13.70	1 324.95	1 557.85	57.52	1 457.45	2 435.29
Agricultural inputs: annual costs	-	-	-	206.9	1 619.2	5 136.3	586.7	650.5	10 624.4
Total operating costs	112.5	1 351.75	3 264.25	947.88	16 172.94	30 561.71	1 434.09	20 843.04	45 222.54
10% contingency	11.25	135.18	326.43	94.79	1 617.29	3 056.17	143.41	2 084.30	4 522.25
Total costs and contingency	3 066.23	2 987.59	55 113.34	1 724.99	18 138.22	45 565.30	1 577.50	22 927.34	49 744.79

Notes : Based on Appendix IV Tables IV.1 to IV.16. Fuel and lubricants taken as local cost.

APPENDIX I

TERMS OF REFERENCE

The Consultant will carry out the work in the stages described below :

A Planning Stage (in Somali Democratic Republic and UK)

Agricultural Aspects

(1) Review the project construction schedule and confirm the timing of land becoming available for cultivation.

(2) Finalise the cropping calendar and prepare a detailed schedule of field operations (timing and areas) including land preparation, planting, initial irrigation, fertilising, weed/pest control, harvesting, etc.

(3) Design a mechanisation system and machine operation schedule on the basis of (1) and (2) above.

(4) Identify and draw up preliminary specifications for the agricultural machinery by type and quantity taking into account the rainfall, soil conditions, field sizes, field access, and other factors to be identified during the field visit.

(5) Examine the requirements for aerial operations such as spraying (weed and pest control) and if necessary identify the cost and source of such services.

(6) Identify and draw up preliminary specifications for project vehicles including personnel vehicles and general transport vehicles.

(7) Identify the support facilities (workshop, spare part stores, and fuel storage and distribution) required to maintain the fleet of agricultural machinery and project vehicles.

(8) Determine the requirements for seed, fertiliser agrochemicals, sacking and other inputs necessary to implement the cropping programme.

(9) Determine, skilled, semi-skilled and unskilled personnel requirements necessary to carry out all field operations, and operate, maintain and repair agricultural machinery. Prepare a detailed schedule for recruitment of personnel.

(10) Prepare annual budgets covering capital, (machinery and transport) maintenance, repair and operation costs, personnel and agricultural input costs in detail for the first year's operation and in outline for each year to the full development of Phase 1.

Operation and Maintenance Plant and Equipment

(11) Identify and draw up preliminary specifications for the plant for the proper operation and maintenance (O/M) of the project works, including canals and roads.

(12) Identify the support facilities (workshop bays, spare part stores and fuel storage and distribution) required to maintain the O/M plant and the irrigation pumps.

(13) Specify workshop equipment required for the repair and maintenance of the O/M plant and the irrigation pumps.

(14) Prepare annual budgets covering capital plant maintenance, repair and operational costs, personnel, fuel and lubricants costs in detail for the first year's operation and in outline for each year to the full development of Phase 1.

Report

(15) Prepare Report.

APPENDIX II

DELINTING OF COTTON SEED

Where delinted cotton seed suitable for machine planting is not available, small quantities of seed, up to 3 tonnnes, can be delinted using the following method.

The equipment and materials required include :

- an old concrete mixer (driven by electric motor or internal combustion engine);
- three halves of 44 gallon drums;
- 95% pure commercial grade concentrated sulphuric acid;
- a supply of caustic soda;
- protective clothing;
- adequate supply of water.

Cotton seed and concentrated sulphuric acid in a ratio of 9 kg of cotton seed to 0.6 litre of sulphuric acid (up to 0.9 litre of sulphuric acid depending on the extent of delinting in the ginning process) are mixed for 4 to 5 minutes in the drum of the concrete mixer during which time the lint will have been burnt off and the contents of the drum form a 'sticky porridge'.

Cold water is then sprayed into the drum until the seeds are separated and the acid solution in the drum weakened. The contents of the drum are then tipped in small quantities into baskets made of mosquito netting or similar filter material. The seed is then put into the first half drum containing clean water and stirred thoroughly adding water at the same time to further dilute any remaining acid.

The seed is then removed and placed in a second drum containing 5 lb of caustic soda in solution and thoroughly mixed to neutralise any remaining acid. The seed is then removed and thoroughly washed in the third drum which is half-filled with cold water. Any floating seed is scooped off and thrown away. The remaining seed is removed and laid out in the sun to dry before bagging and storing until use.

APPENDIX III

LIST OF AGRICULTURAL EQUIPMENT AND OPERATIONS AND MAINTENANCE EQUIPMENT

The following lists show all the equipment in their proposed lots for procurement, together with the proposed phased supply.

Phase A - Nov/Dec 1984

Phase B - Nov/Dec 1985

Lot 1 - Vehicles and motor cycles

Item number	Description	Phased supply A	Phased supply B
1	Estate car	3	0
2	Four wheel drive station wagon	2	0
3	Four wheel drive pick-up	3	0
4	3 - 5 tonne closed van	1	0
5	10 tonne flat truck for general cargo	4	0
6	10 tonne flat truck with cargo crane	1	0
7	10 tonne tipper truck	2	0
8	7 500 l fuel tanker truck	1	0
9	Spare assemblies	1 lot	0
10	Motor cycles	12	0

Lot 2 - Agricultural tractors, implements and trailers

Item number	Description	Phased supply A	B
1	Two wheel drive wheeled tractor	7	3
2	Four wheel drive wheeled tractor	4	3
3	Spare assemblies	1 lot	0
4	Combination grain and fertiliser seed drill	3	1
5	Spiked tooth harrow	1	0
6	Cotton/maize	1	0
7	Fertiliser spreader	3	1
8	Inter-row cultivator	1	0
9	Rotary grass slasher	1	0
10	Cotton stalk and straw slasher	1	0
11	Front end loader equipment	4	0
12	Tine cultivator	2	0
13	5 tonne, two axle trailer	6	2
14	7 tonne grain tipping trailer	5	2
15	Water tank trailer	1	0
16	Fuel tank trailer (2 000/2 500 l)	1	0
17	Low loader trailer	1	0
18	Tractor-mounted flail unit	1	0
19	Two axle, 5 000 l fuel trailer	1	0

Lot 3 - Crawler tractors and implements

Item number	Description	Phased supply A	Phased supply B
1	Crawler tractor	4	2
2	Bulldozer equipment	2	0
3	Land plane	2	0
4	Ploughing offset disc harrow	3	1
5	Offset disc harrow	4	2

Lot 4 - Combine harvesters

Item number	Description	Phased supply A	Phased supply B
1	Combine harvester	5	2

Lot 5 - Dragline excavator

Item number	Description	Phased supply A	Phased supply B
1	Dragline excavator	1	0

Lot 6 - Workshop equipment

Item number	Description	Phased supply A	B
1	Machine tools	1 lot	0
2	Lifting frame	1	
3	Lifting slings	1 lot	0
4	Welding equipment	1 lot	0
5	General tools and equipment	1 lot	0
6	Socket sets and spanners	1 lot	0
7	Files and drills	1 lot	0
8	Nozzle reconditioning equipment	1 lot	0
9	Sawbench	1	0
10	Carpenter's tool kit	1	0
11	Plumber and pipefitter's tool kit	1	0
12	Electrician's tool kit	1	0
13	Consumables - provisional	1 lot	0
14	Handling equipment	1 lot	0
15	Store racking	1 lot	0

Lot 7 - Small items

Item number	Description	Phased supply A	Phased supply B
1	Sprayer - tractor	2	1
2	Sprayer - low ground pressure	1	1
3	Knapsack sprayer	14	6
4	Ultra low volume sprayer	45	0
5	Rolling cultivator	1	0
6	Rectangular baler	1	0
7	Grain auger	2	0
8	Bag and bale elevator	1	1
9	Elevated grain hopper	1	0
10	Concrete mixer	1	0
11	Water pump	1	0
12	Bicycle	30	0
13	Portable generator	1	0
14	Portable tyre inflation compressor	1	0

Lot 8 - Motor grader and wheeled loader

Item number	Description	Phased supply A	Phased supply B
1	Motor grader	1	0
2	Wheeled loader	1	0

Lot 9 - Hydraulic backhoe excavators

Item number	Description	Phased supply A	Phased supply B
1	Hydraulic backhoe excavator	1	0
2	Hydraulic backhoe excavator	1	0

APPENDIX IV

DETAILED COST ESTIMATES

List of Tables :

1. Capital Costs : 1984 to 1985

2. Operating Costs : 1984 to 1986

TABLE IV.1

Capital Costs - Project Transport

Description	FOB unit cost US$	CIF unit cost US$	Total number	1984 Number	1984 US$ cost	1984 SoSh cost (1)	1984 Total SoSh cost	1985 Number	1985 US$ cost	1985 SoSh cost	1985 Total SoSh cost	Total cost SoSh
Estate car	12 000	13 800	3	3	41 400	21 114	724 914	0	0	0	0	724 914
4WD station wagon	12 000	13 800	2	2	27 600	14 076	483 276	0	0	0	0	483 276
4WD pick up	8 000	9 200	3	3	27 600	14 076	483 276	0	0	0	0	483 276
3 ton van	12 000	13 800	1	1	13 800	7 038	241 638	0	0	0	0	241 638
10 ton truck	30 000	34 500	4	4	138 000	70 380	2 416 380	0	0	0	0	2 416 380
7500 litre fuel bowser	30 000	34 500	1	1	34 500	17 595	604 095	0	0	0	0	604 095
Motor cycle	1 200	1 380	12	12	16 560	8 446	289 966	0	0	0	0	289 966
Spares at 15% of capital cost					43 884	22 381	768 409	0	0	0	0	768 409
Total					344 379	175 633	6 030 076		0	0	0	6 030 076

Note : (1) 3% of CIF cost covers port charges, clearance charges and transport to site.

TABLE IV.2

Capital Costs - Operation and Maintenance Plant and Equipment

Description	FOB unit cost US$	CIF unit cost US$	Total number	1984 Number	1984 US$ cost	1984 SoSh cost (1)	1984 Total SoSh cost	1985 Number	1985 US$ cost	1985 SoSh cost	1985 Total SoSh cost	Total cost SoSh
Dragline excavator	263 350	271 803	1	1	271 803	138 620	4 759 271	0	0	0	0	4 759 271
Hydraulic excavator (main drain)	79 750	91 713	1	1	91 713	46 774	1 605 895	0	0	0	0	1 605 895
Hydraulic excavator (distributaries)	46 400	53 360	1	1	53 360	27 214	934 334	0	0	0	0	934 334
Wheeled loader	43 500	50 025	1	1	50 025	25 513	875 938	0	0	0	0	875 938
Grader	123 250	141 738	1	1	141 738	72 286	2 481 832	0	0	0	0	2 481 832
Low load trailer	14 500	16 675	1	1	16 675	8 504	291 979	0	0	0	0	291 979
Flat truck with cargo crane	44 950	51 693	1	1	51 693	26 363	905 144	0	0	0	0	905 144
Tipper truck	42 050	48 358	2	2	96 716	49 325	1 693 497	0	0	0	0	1 693 497
Water tank trailer (2 000/2 500 l)	2 175	2 501	1	1	2 501	1 276	43 793	0	0	0	0	43 793
Fuel tank trailer (2 000/2 500 l)	2 175	2 501	1	1	2 501	1 276	43 793	0	0	0	0	43 793
Flail (for tractor mounting)	7 395	8 504	1	1	8 504	4 337	148 905	0	0	0	0	148 905
Concrete mixer	1 813	2 085	1	1	2 085	1 063	36 508	0	0	0	0	36 508
Water pump (diaphragm type)	2 610	3 002	1	1	3 002	1 531	52 565	0	0	0	0	52 565
Bicycles	116	135	30	30	4 050	2 066	70 916	0	0	0	0	70 916
Spare parts at 15% of capital cost					119 455	60 922	2 091 657					2 091 657
Total					915 821	467 070	16 036 027		0	0	0	16 036 027

Note: (1) 3% of CIF cost covers port charges, clearance charges and transport to site.

TABLE IV.3

Capital Costs - Agricultural Machinery

Description	FOB unit cost US$	CIF unit cost US$	Total number	1984 Number	1984 US$ cost	1984 SoSh cost (2)	1984 Total SoSh cost	1985(1) Number	1985(1) US$ cost	1985(1) SoSh cost (2)	1985(1) Total SoSh cost	Total cost SoSh
90 hp crawler tractor	35 000	40 250	6	4	161 000	82 110	2 819 110	2	88 550	45 171	1 550 511	4 369 621
75 hp 2W/D tractor	17 500	20 125	10	7	140 875	71 846	2 466 721	3	66 413	33 870	1 162 883	3 629 604
75 hp 4W/D tractor	19 500	22 425	7	4	89 700	45 747	1 570 647	3	74 003	37 741	1 295 784	2 866 431
Combine harvester	64 000	73 600	7	5	368 000	187 680	6 443 680	2	161 920	82 579	2 835 219	9 278 899
Ploughing offset disc harrow	12 250	14 088	4	3	42 263	21 554	740 016	1	15 496	7 903	271 339	1 011 356
Offset disc harrow	13 000	14 950	6	4	59 800	30 498	1 047 098	2	32 890	16 774	575 904	1 623 002
Land plane	15 000	17 250	2	2	34 500	17 595	604 095	0	0	0	0	604 095
Seed drills	11 500	13 225	4	3	39 675	20 234	694 709	1	14 548	7 419	254 727	949 436
Sprayers - tractor	8 700	10 005	3	2	20 010	10 205	350 375	1	11 006	5 613	192 706	543 081
Sprayer - LGP	21 750	25 013	2	1	25 013	12 756	437 969	1	27 514	14 032	481 766	919 735
Spike tooth harrow	870	1 001	1	1	1 001	510	17 519	0	0	0	0	17 519
Cotton planter	2 600	2 990	1	1	2 990	1 525	52 355	0	0	0	0	52 355
Fertiliser spreader	3 500	4 025	4	1	12 075	6 158	211 433	1	4 428	2 258	77 526	288 959
Inter-row cultivator	3 500	4 025	1	1	4 025	2 053	70 478	0	0	0	0	70 478
Rolling cultivator	3 100	3 565	1	1	3 565	1 818	62 423	0	0	0	0	62 423
Grass slasher	1 300	1 495	1	1	1 495	762	26 177	0	0	0	0	26 177
Cotton stalk and straw slasher	1 300	1 495	1	1	1 495	762	26 177	0	0	0	0	26 177
Rectangular baler	7 500	8 625	1	1	8 625	4 399	151 024	0	0	0	0	151 024
Front end loaders	2 250	2 588	4	4	10 350	5 279	181 229	0	0	0	0	181 229
Grain augers	2 175	2 501	2	2	5 003	2 551	87 594	0	0	0	0	87 594
Bag and bale elevator	3 500	4 025	2	1	4 025	2 053	70 478	1	4 428	2 258	77 526	148 003
Tine cultivator	3 900	4 485	2	2	8 970	4 575	157 065	0	0	0	0	157 065
4 wheel 5 ton trailer	4 350	5 003	8	6	30 015	15 308	525 563	2	11 006	5 613	192 706	718 269
7 ton grain trailer	6 100	7 015	7	5	35 075	17 888	614 163	2	15 433	7 871	270 232	884 395
Trailed fuel bowser (5 000 l)	7 200	8 280	1	1	8 280	4 223	144 983	0	0	0	0	144 983
Knapsack sprayer	90	104	20	14	1 449	739	25 372	6	683	348	11 961	37 333
ULV sprayer	30	35	45	45	1 553	792	27 184	0	0	0	0	27 184
Elevated grain hopper	3 000	3 450	1	1	3 450	1 760	60 410	0	0	0	0	60 410
Miscellaneous implements	17 500	20 125	1	0.5	10 063	5 132	176 194	0.5	11 069	5 645	193 814	370 008
Spares at 15% of capital cost					170 151	86 777	2 979 336	0	80 908	41 263	1 416 690	4 396 026
Total					1 304 488	665 289	22 841 577		620 291	316 348	10 861 293	33 702 870

Notes : (1) 10% price inflation

(2) 3% CIF cost covers port charges, clearance charges and transport to site

TABLE IV.4

Capital Costs - Workshop and Mechanical Stores, Plant and Equipment

Description	FOB unit cost US$	CIF unit cost US$	Total number	1984 Number	1984 US$ cost	1984 SoSh cost (1)	1984 Total SoSh cost	1985 Number	1985 US$ cost	1985 SoSh cost	1985 Total SoSh cost	Total cost SoSh
Used containers	650	748	6	6	4 485	2 287	78 532	0	0	0	0	78 532
Workshop equipment(2)	90 000	103 500		1	103 500	52 785	1 812 285	0	0	0	0	1 812 285
Spare parts rack & equipment	2 000	2 300	1	1	2 300	1 173	40 273	0	0	0	0	40 273
Total					110 285	56 245	1 931 090		0	0	0	1 931 090

Notes : (1) 3% of CIF cost covers port charges, clearance charges and transport to site.

(2) Estimated at US$ 90 000.

TABLE IV.5

Mogambo Headquarters - Staff Salaries and Wages

Position	Total Nr	Existing staff Feb 1984	Monthly gross salary	Aug 1984 to Dec 1984 Number	Cost SoSh	Cost US$	Jan 1985 to Jun 1985 Number	Cost SoSh	Cost US$	Jul 1985 to Dec 1985 Number	Cost SoSh	Cost US$	1986 Number	Cost SoSh	Cost US$
General Manager	1	1	7 000	1	35 000		1	44 100		1	44 100		1	92 610	
Secretary	1	1	1 800	1	9 000		1	11 340		1	11 340		1	23 814	
Rice Farm Manager/Deputy Farm Manager	1		US$7 500	1		37 500	1		47 250	1		47 250	1		99 225
Secretary	1		1 800	1	9 000		1	11 340		1	11 340		1	23 814	
Drivers	1		1 100	1	5 500		1	6 930		1	6 930		1	14 553	
Watchmen	2		650	1	3 250		2	8 190		2	8 190		2	17 199	
Labourers	2		650	1	3 250		2	8 190		2	8 190		2	17 199	
Gardeners	1		650	1	3 250		1	4 095		1	4 095		1	8 600	
Messengers	2		650	1	3 250		2	8 190		2	8 190		2	17 199	
Accounts Department															
Chief Accountant	1		US$7 500	1		37 500	1		47 250	1		47 250	1		99 225
Chief Accountant (Designate)	1	1	5 000	1	25 000		1	31 500		1	31 500		1	66 150	
Senior Accountant	2	2	3 500	2	35 000		2	44 100		2	44 100		2	92 610	
Procurement Officer	1	1	3 500	1	17 500		1	22 050		1	22 050		1	46 305	
Clerks	3		1 200	2	12 000		3	22 680		3	22 680		3	47 628	
Typists	3		1 500	2	15 000		3	28 350		3	28 350		3	59 535	
Drivers	1	1	1 100	1	5 500		1	6 930		1	6 930		1	14 553	
Chief Storeman	1		4 500	1	22 500		1	28 350		1	28 350		1	59 535	
Storeman	1		3 500	1	17 500		1	22 050		1	22 050		1	46 305	
Assistant Storeman	1		1 500	1	7 500		1	9 450		1	9 450		1	19 845	
Stores Clerk	1		1 100	1	5 500		1	6 930		1	6 930		1	14 553	
Labourers	2		650	2	6 500		2	8 190		2	8 190		2	17 199	
Fuel Distribution Clerks	2		1 100	2	11 000		2	13 860		2	13 860		2	29 106	
Fuel Bowser Drivers	1		1 100	1	5 500		1	6 930		1	6 930		1	14 553	
Administration Department															
Senior Administrator	1	1	5 000	1	25 000		1	31 500		1	31 500		1	66 150	
Personnel Officer	1	1	4 500	1	22 500		1	28 350		1	28 350		1	59 535	
Training Officer	1	1	3 500	1	17 500		1	22 050		1	22 050		1	46 305	
Clerks	2		1 200	1	6 000		2	15 120		2	15 120		2	31 752	
Typists	2		1 500	1	7 500		2	18 900		2	18 900		2	39 690	
Drivers	1		1 000	1	5 000		1	6 300		1	6 300		1	13 230	
Engineering Department															
Irrigation Engineer	1		US$7 500			0	1		47 250	1		47 250	1		99 225
Irrigation Engineer (Designate)	1	1	5 000	1	25 000		1	31 500		1	31 500		1	66 150	
Building Foreman	1		2 500	1	12 500		1	15 750		1	15 750		1	33 075	
Draughtsman	1		2 500	1	12 500		1	15 750		1	15 750		1	33 075	
Labourers	4		650		0		4	16 380		4	16 380		4	34 398	
Drivers	1		1 100		0		1	6 930		1	6 930		1	14 553	
Agricultural Department															
Field Manager	1		US$7 500			0	1		47 250	1		47 250	1		99 225
Deputy Field Manager	1	1	3 500	1	17 500		1	22 050		1	22 050		1	46 305	
Agric. Mech./Workshop Specialist	1		US$7 500			0	1		47 250	1		47 250	1		99 225
Agronomists	1	1	3 500	1	17 500		1	22 050		1	22 050		1	46 305	
Technicians	4		2 000		0		4	50 400		4	50 400		4	105 840	
Typists	1		1 500	1	7 500		1	9 450		1	9 450		1	19 845	
Labourers	4		650		0		4	16 380		4	16 380		4	34 398	
Total				40	433 500	75 000	63	682 605	236 250	63	682 605	236 250	63	1 433 471	496 125

Notes: (1) Expatriate employment costs taken as an average of US$ 7 500 per month. In practice there will be a differential between individual salaries according to seniority and experience.
(2) 5% inflation allowed on all salaries per annum.
(3) Monthly gross salaries in SoSh unless quoted otherwise.

TABLE IV.6

Workshop and Mechanical Stores - Staff Salaries and Wages

Position	Total Nr	Existing staff Feb 1984	Monthly gross salary	Aug 1984 to Dec 1984 Number	Cost SoSh	Cost US$	Jan 1985 to Jun 1985 Number	Cost SoSh	Cost US$	Jul 1985 to Dec 1985 Number	Cost SoSh	Cost US$	1986 Number	Cost SoSh	Cost US$
Workshop staff							1		47 250	1		47 250	1		99 225
Workshop Foreman	1		US$7 500	1		37 500	7	154 350		7	154 350		7	324 135	
Foreman	7		3 500	7	122 500		8	126 000		8	126 000		8	264 600	
Mechanics I	8		2 500	8	100 000		10	94 500		10	94 500		10	198 450	
Mechanics II	10		1 500		0		1	15 750		1	15 750		1	33 075	
Vehicle Electrician	1		2 500		0		10	50 400		14	70 560		14	148 176	
Labourers (semi-skilled)	14		800		0		5	25 200		9	45 360		9	95 256	
Apprentices	9		800		0		1	15 750		1	15 750		1	33 075	
Welder	1		2 500		0		1	5 040		1	5 040		1	10 584	
Welder's Assistant	1		800		0		1	15 750		1	15 750		1	33 075	
Turner	1		2 500		0		1	5 040		1	5 040		1	10 584	
Turner's Assistant	1		800		0		1	15 750		1	15 750		1	33 075	
Plumber	1		2 500		0		1	5 040		1	5 040		1	10 584	
Plumber's Assistant	1		800		0		1	15 750		1	15 750		1	33 075	
Electrician	1		2 500		0		1	5 040		1	5 040		1	10 584	
Electrician's Assistant	1		800		0		1	15 750		1	15 750		1	33 075	
Carpenter	1		2 500		0		1	5 040		1	5 040		1	10 584	
Carpenter's Assistant	1		800		0		4	37 800		4	37 800		4	79 380	
Truck Drivers	4		1 500		0		4	20 160		4	20 160		4	42 336	
Driver's Assistant	4		800		0		4	16 380		4	16 380		4	34 398	
Watchmen	4		650		0		4	16 380		4	16 380		4	34 398	
Labourers	4		650		0										
Spare Parts Store							1	28 350		1	28 350		1	59 535	
Senior Storeman	1		4 500	1	22 500		1	15 750		1	15 750		1	33 075	
Spare Parts Clerk	1		2 500	1	12 500		1	9 450		1	9 450		1	19 845	
Typists	1		1 500	1	7 500		1	4 095		1	4 095		1	8 600	
Labourers	1		650	1	3 250										
Total	80			20	268 250	37 500	72	718 503	47 250	80	758 835	47 250	80	1 593 554	99 225

Notes: (1) Expatriate employment costs taken as an average of US$ 7 500 per month. In practice there will be a differential between individual salaries according to seniority and experience.
(2) 5% inflation allowed on all salaries per annum.
(3) Monthly gross salries in SoSh unless quoted otherwise.

TABLE IV.7

Irrigation Operation – Staff Salaries and Wages

Position	Total Nr	Existing staff Feb 1984	Monthly gross salary	Aug 1984 to Dec 1984 Number	Cost SoSh	Cost US$	Jan 1985 to Jun 1985 Number	Cost SoSh	Cost US$	Jul 1985 to Dec 1985 Number	Cost SoSh	Cost US$	1986 Number	Cost SoSh	Cost US$
Operation and Maintenance Staff															
Surveyor	1		3 500	-		-	1	22 050	-	1	23 152.5	-	1	48 620	-
Survey Assistants	2		2 500	-		-	1	15 750	-	2	33 075	-	2	69 457	-
Operators	8		1 100	-		-	4	27 720	-	6	43 659	-	8	122 245	-
Ditch Riders	14		1 100	-		-	6	41 580	-	10	72 765	-	14	213 929	-
Labourers	20		650	-		-	10	40 950	-	14	60 196.5	-	20	180 589	-
Total								129 780			274 428			634 840	

Note : (1) 5% inflation allowed on all salaries per annum.

TABLE IV.8

Field Management - Staff Salaries and Wages

Position	Total Nr	Existing staff Feb 1984	Monthly gross salary	Aug 1984 to Dec 1984 Number	Cost SoSh	Cost US$	Jan 1985 to Jun 1985 Number	Cost SoSh	Cost US$	Jul 1985 to Dec 1985 Number	Cost SoSh	Cost US$	1986 Number	Cost SoSh	Cost US$
Field Management															
Section Managers	4		3 000		0		2	37 800		3	56 700		4	158 760	
Time and Wages Clerks	7		1 500		0		4	37 800		6	56 700		7	138 915	
Foreman	15		1 200		0		5	37 800		10	75 600		15	238 140	
Machinery Management															
Tractors:															
Senior Operators	1		1 400	1	7 000		1	8 820		1	8 820		1	18 522	
Operators	16		1 100	11	60 500		16	110 880		16	110 880		16	232 848	
Operator's Assistants	17		800	12	48 000		17	85 680		17	85 680		17	179 928	
Crawlers:															
Senior Operators	1		1 400	1	7 000		1	8 820		1	8 820		1	18 522	
Operators	5		1 100	3	16 500		5	34 650		5	34 650		5	72 765	
Operator's Assistants	6		800	4	16 000		6	30 240		6	30 240		6	63 504	
Combine Harvesters:															
Senior Operators	1		1 400		0		1	8 820		1	8 820		1	18 522	
Operators	6		1 100		0		6	41 580		6	41 580		6	87 318	
Operator's Assistants	7		800		0		7	35 280		7	35 280		7	74 088	
Total	86			32	155 000		71	478 170		79	553 770		86	1 301 832	

Note: (1) 5% inflation allowed on all salaries per annum.

TABLE IV.9

Project Transport : Fuel, Lubricants and Spare Parts

(a) Year 1985

Description	Capital cost (FOB) US$	Fuel cost per litre	Number of vehicles	Vehicle life (km)	Annual use (km)	Vehicle life (yrs)	Maintenance % cap.cost	Annual maintenance %	Maintenance cost/vehicle US$/year	Total FOB cost US$ spare parts	US$ CIF cost spare parts (2)	Local SoSh cost	Fuel use km/litre	Fuel use/year/ machine	Total fuel use per year	Total fuel cost per year	Tax & Insurance (1) SoSh
Estate car	12 000	5.50	3	120 000	25 000	5	40	8	1 000	3 000	3 450	1 760	7.00	3 571	10 714	58 929	61 200
4 wheel drive station wagon	12 000	5.50	3	150 000	25 000	6	40	7	800	2 400	2 760	1 408	5.00	5 000	15 000	82 500	61 200
4 wheel drive pick-up	8 000	5.50	6	150 000	30 000	5	40	8	640	3 840	4 416	2 252	7.00	4 286	25 714	141 429	81 600
3 ton van	12 000	5.50	1	150 000	30 000	5	40	8	960	960	1 104	563	5.00	6 000	6 000	33 000	20 400
10 ton truck	30 000	5.50	4	300 000	50 000	6	40	7	2 000	8 000	9 200	4 692	2.50	20 000	80 000	440 000	204 000
7 500 litre fuel bowser	30 000	5.50	1	300 000	30 000	10	40	4	1 200	1 200	1 380	704	2.50	12 000	12 000	66 000	51 000
Motor cycle	1 200	8.25	12	50 000	10 000	5	40	8	96	1 152	1 325	676	25.00	400	4 800	39 600	24 480
Totals										20 552	23 635	12 054			154 229	861 457	503 880

(b) Year 1986

Description	Capital cost (FOB) US$	Fuel cost per litre	Number of vehicles	Vehicle life (km)	Annual use (km)	Vehicle life (yrs)	Maintenance % cap.cost	Annual maintenance %	Maintenance cost/vehicle US$/year	Total FOB cost US$ spare parts	US$ CIF cost spare parts	Local SoSh cost	Fuel use km/litre	Fuel use/year/ machine	Total fuel use per year	Total fuel cost per year	Tax & Insurance (1) SoSh
Estate car	12 000	6.05	3	120 000	25 000	5	40	8	1 100	3 300	3 795	1 935	7.00	3 571	10 714	64 821	67 320
4 wheel drive station wagon	12 000	6.05	3	150 000	25 000	6	40	7	880	2 640	3 036	1 548	5.00	5 000	15 000	90 750	67 320
4 wheel drive pick-up	8 000	6.05	6	150 000	30 000	5	40	8	704	4 224	4 858	2 477	7.00	4 286	25 714	155 571	89 760
3 ton van	12 000	6.05	1	150 000	30 000	5	40	8	1 056	1 056	1 214	619	5.00	6 000	6 000	36 300	22 440
10 ton truck	30 000	6.05	4	300 000	50 000	6	40	7	2 200	8 800	10 120	5 161	2.50	20 000	80 000	484 000	224 400
7 500 litre fuel bowser	30 000	6.05	1	300 000	30 000	10	40	4	1 320	1 320	1 518	774	2.50	12 000	12 000	72 600	56 100
Motor cycle	1 200	9.08	12	50 000	10 000	5	40	8	106	1 267	1 457	743	25.00	400	4 800	43 560	26 928
Totals										22 607	25 998	13 259			154 229	947 603	554 268

Notes : (1) 10% of capital cost per vehicle per year.

(2) Rate of exchange used 1 US$ = 17.0 SoSh.

(3) 10% inflation per annum allowed for fuel costs.

TABLE IV.10(a)

Heavy Plant : Fuel, Lubricants and Spare Parts

Description	Capital cost (FOB) US$	Fuel cost SoSh/litre	Number of machines	Engine hp	Machine life (h)	Annual use (h)	Machine life (yrs) (1)	Spare parts % cap.cost	Spare parts annual use %	Spare parts cost/ machine per year	Total FOB cost US$ spare parts	Total CIF cost US$ spare parts (2)	Local SoSh cost (3)	Fuel use/hour (litres)	Fuel use/year/ machine (litres)	Total fuel use litres/year	Total fuel cost SoSh/year	Total lubrication cost SoSh/year (4)
1985									3	7 091	7 091	8 155	4 159	18	27 000	27 000	148 500	14 850
Dragline	236 350	5.5	1	150	15 000	1 500	10	30	4	3 190	3 190	3 669	1 871	11	16 500	16 500	90 750	9 075
Hydraulic excavator	79 750	5.5	1	95	15 000	1 500	10	40	5	2 320	2 320	2 668	1 361	8	12 000	12 000	66 000	6 600
Hydraulic excavator	46 400	5.5	1	70	12 000	1 500	8	40	8	3 480	3 480	4 002	2 041	10	20 000	20 000	110 000	11 000
Wheeled loader	43 500	5.5	1	80	10 000	2 000	5	40	4	4 930	4 930	5 670	2 892	16	19 200	19 200	105 600	10 560
Grader	123 250	5.5	1	135	12 000	1 200	10	40	10	740	740	581	434	n/a	n/a	n/a	n/a	n/a
Flail	7 395	n/a	1	n/a	5 000	1 000	5	50	10	181	181	208	106	0.25	125	125	688	69
Concrete mixer	1 815	5.5	1	2	3 000	500	6	60	5	131	131	151	77	0.25	125	125	688	69
Water pump	2 610	5.5	1	2	5 000	500	10	50										
Totals											22 063	25 374	12 941			94 950	5 222 226	52 223
1986									3	7 800	7 800	8 970	4 575	18	27 000	27 000	163 350	16 335
Dragline	236 350	6.05	1	150	15 000	1 500	10	30	4	3 509	3 509	4 035	2 058	11	16 500	16 500	99 825	9 982
Hydraulic excavator	79 750	6.05	1	95	15 000	1 500	10	40	5	2 552	2 552	2 935	1 497	8	12 000	12 000	72 600	7 260
Hydraulic excavator	46 400	6.05	1	70	12 000	1 500	8	40	8	3 828	3 828	4 402	2 245	10	20 000	20 000	121 000	12 100
Wheeled loader	43 500	6.05	1	80	10 000	2 000	5	40	4	5 423	5 423	6 236	3 180	16	19 200	19 200	116 160	11 616
Grader	123 250	6.05	1	135	12 000	1 200	10	40	10	814	814	936	477	n/a	n/a	n/a	n/a	n/a
Flail	7 395	n/a	1	n/a	5 000	1 000	5	50	10	199	199	229	117	0.25	125	125	756	76
Concrete mixer	1 815	6.05	1	2	3 000	500	6	60	5	144	144	166	85	0.25	125	125	756	76
Water pump	2 610	6.05	1	2	5 000	500	10	50										
Totals											24 269	27 909	14 234			94 950	574 447	57 445

Notes : (1) Maximum life of any machine, regardless of hours completed, has been taken as 10 years.

(2) FOB cost increased by 15% to obtain CIF.

(3) Local costs on assumed 3% of CIF cost in SoSh.

(4) Lubrication cost assumed 10% of fuel cost.

(5) Rate of exchange US$ 1 = SoSh 17.0

TABLE IV.10(b)

Heavy Plant : Fuel, Lubricants and Spare Parts

(a) Year 1985

	Capital cost (FOB) US$	Fuel cost per litre	Number of vehicles	Vehicle life (km)	Annual use (km)	Vehicle life (yrs) (1)	Maintenance % cap.cost	Annual maintenance %	Maintenance cost/vehicle US$/year	Total FOB cost US$ spare parts	US$ CIF cost spare parts (2)	Local SoSh cost (3)	Fuel use km/litre	Fuel use/year/ machine	Total fuel use per year	Total fuel cost per year (4)	Tax & insurance (5) SoSh
Low load trailer	14 500	n/a	1	300 000	-	10	-	2	290	290	334	170	n/a	n/a	n/a	n/a	24 650
Flat truck (cargo crane)	44 950	5.5	1	300 000	50 000	6	40	7	3 147	3 147	3 619	1 896	2.5	20 000	20 000	110 000	76 415
Tipper truck	42 050	5.5	2	300 000	50 000	6	40	7	2 944	5 888	6 771	3 453	2.5	20 000	40 000	220 000	142 970
Water tank trailer (2 500 l)	2 175	n/a	1	-	-	6	-	4	87	87	100	51	n/a	n/a	n/a	n/a	3 706
Fuel tank trailer (2 500 l)	2 175	n/a	1	-	-	6	-	4	87	87	100	51	n/a	n/a	n/a	n/a	3 706
Bicycles	116	n/a	30	-	-	6	-	5	6	180	207	106	n/a	n/a	n/a	n/a	n/a
Totals										9 679	11 131	5 677			60 000	330 000	251 457

(b) Year 1986

	Capital cost (FOB) US$	Fuel cost per litre	Number of vehicles	Vehicle life (km)	Annual use (km)	Vehicle life (yrs)	Maintenance % cap.cost	Annual maintenance %	Maintenance cost/vehicle US$/year	Total FOB cost US$ spare parts	US$ CIF cost spare parts (2)	Local SoSh cost (3)	Fuel use km/litre	Fuel use/year/ machine	Total fuel use per year	Total fuel cost per year (4)	Tax & insurance (1) SoSh
Low load trailer	16 500	n/a	1	300 000	-	10	-	2	319	319	367	187	n/a	n/a	n/a	n/a	27 115
Flat truck (cargo crane)	44 950	6.05	1	300 000	50 000	6	40	7	3 462	3 462	3 981	2 051	2.5	20 000	20 000	121 000	84 065
Tipper truck	42 050	6.05	2	300 000	50 000	6	40	7	3 238	6 476	7 448	3 798	2.5	20 000	40 000	242 000	157 267
Water tank trailer (2 500 l)	2 175	n/a	1	-	-	6	-	4	96	96	110	56	n/a	n/a	n/a	n/a	4 080
Fuel tank trailer (2 500 l)	2 175	n/a	1	-	-	6	-	4	96	96	110	56	n/a	n/a	n/a	n/a	4 080
Bicycles	116	n/a	30	-	-	6	-	5	7	210	231	118	n/a	n/a	n/a	n/a	n/a
Totals										10 659	12 247	6 246			60 000	363 000	276 607

Notes : (1) Maximum life of any machine, regardless of hours completed, has been taken as 10 years.

(2) FOB cost increased by 1% to obtain CIF.

(3) Local costs on assumed 3% of CIF cost in SoSh.

(4) Lubrication cost assumed 10% of fuel cost.

(5) Assumed 10% of capital cost (FOB) per vehicle per year expressed in SoSh.

Rate of exchange US$ 1 = SoSh 17.0.

TABLE IV.11(a)

Agricultural Machinery : Fuel, Lubricants and Spare Parts - Year 1985

Description	Capital cost (FOB) US$	Fuel cost SoSh/litre	Number of machines	Engine hp	Machine life (h)	Annual use (h)	Machine life (yrs) (1)	Spare parts % cap.cost	Spare parts annual use %	Spare parts cost/ machine per year	Total FOB cost US$ spare parts	Total CIF cost US$ spare parts	Local SoSh cost	Fuel use/hour (litres)	Fuel use/year/ machine (litres)	Total fuel use litres/year	Total fuel cost SoSh/year	Total lubrication cost SoSh/year
90 hp crawler tractor	34 000	5.5	4	90	12 000	1 763	7	50	7	2 571	10 284	11 827	6 032	10.80	19 040	76 162	418 888.8	41 889
75 hp 2 wheel drive tractor	17 500	5.5	7	75	8 000	1 124	7	50	7	1 229	8 606	9 896	5 087	9.00	10 116	70 812	389 466.0	38 947
75 hp 4 wheel drive tractor	19 500	5.5	4	75	8 000	1 124	7	50	7	1 370	5 480	6 301	3 214	9.00	10 116	40 464	222 552.0	22 255
Combine harvester	64 000	5.5	5	125	3 000	733	4	25	6	3 909	19 547	22 479	11 464	15.00	10 995	54 975	302 362.5	30 236
Ploughing offset disc harrow	12 250	n/a	3	n/a	10 000	1 000	10	50	5	613	1 838	2 113	1 078	0	0	0	0	0
Offset disc harrow	13 000	n/a	4	n/a	8 000	643	10	50	5	650	2 600	2 990	1 525	0	0	0	0	0
Land plane	15 000	n/a	2	n/a	4 000	201	10	30	3	450	900	1 035	528	0	0	0	0	0
Seed drills	11 500	n/a	3	n/a	3 500	356	10	30	3	351	1 053	1 211	617	0	0	0	0	0
Sprayers - tractor	8 700	n/a	2	n/a	2 000	225	9	30	3	294	587	675	344	0	0	0	0	0
Sprayer - LGP	21 750	5.5	1	55	3 500	225	10	30	3	653	653	750	383	6.60	1 485	1 485	8 167.5	817
Spike tooth harrow	870	n/a	1	n/a	2 500	96	10	10	1	9	9	10	5	0	0	0	0	0
Cotton planter	2 600	n/a	1	n/a	2 000	173	10	30	3	78	78	90	46	0	0	0	0	0
Fertiliser spreader	3 500	n/a	3	n/a	2 000	338	6	30	5	177	532	612	312	0	0	0	0	0
Inter-row cultivator	3 500	n/a	1	n/a	2 000	56	10	30	3	105	105	121	62	0	0	0	0	0
Rolling cultivator	3 100	n/a	1	n/a	2 000	56	10	30	3	93	93	107	55	0	0	0	0	0
Grass slasher	1 300	n/a	1	n/a	2 000	400	5	50	10	130	130	150	76	0	0	0	0	0
Cotton stalk & straw slasher	1 300	n/a	1	n/a	2 000	255	8	50	6	83	83	95	49	0	0	0	0	0
Rectangular baler	7 500	n/a	1	n/a	3 000	400	8	30	4	300	300	345	176	0	0	0	0	0
Front end loaders	2 250	n/a	4	n/a	8 000	400	10	10	1	23	90	104	53	0	0	0	0	0
Grain augers	2 175	n/a	2	n/a	2 000	300	7	30	5	98	196	225	115	0	0	0	0	0
Grain, bag & bale elevator	3 500	5.5	1	10	2 000	300	7	30	5	158	158	181	92	1.20	360	360	1 980	198
Tine cultivator	3 900	n/a	2	n/a	2 000	300	7	20	3	117	234	269	137	0	0	0	0	0
4 wheel 5 ton trailer	4 350	n/a	6	n/a	8 000	1 274	6	10	2	69	416	478	244	0	0	0	0	0
7 ton grain trailer	6 100	n/a	5	n/a	8 000	1 274	6	10	2	97	486	559	285	0	0	0	0	0
Trailed fuel bowser	7 200	n/a	1	n/a	10 000	1 000	10	10	1	72	72	83	42	0	0	0	0	0
Knapsack sprayer	90	n/a	14	n/a	500	200	3	30	12	11	151	174	89	0	0	0	0	0
ULV sprayer (2)	30	n/a	45	n/a	500	200	3	30	12	4	27 162	31 236	15 931	0	0	0	0	0
Elevated grain hopper	3 000	n/a	1	n/a	2 000	400	5	10	2	60	60	69	35	0	0	0	0	0
Miscellaneous implements	17 500	n/a	1	n/a	2 000	255	8	30	4	669	669	770	393	0	0	0	0	0
Workshop consumables	90 000	n/a	1	n/a	n/a	n/a	-	-	5	4 500	4 500	5 175	2 639	0	0	0	0	0
Totals											87 069	100 129	51 066			244 258	1 343 417	134 342

Notes : (1) Maximum life of any machine, regardless of hours completed, has been taken as 10 years.

(2) Includes the cost of batteries in the spare parts cost.

TABLE IV.11(b)

Agricultural Machinery : Fuel, Lubricants and Spare Parts - Year 1986

Description	Capital cost (FOB) US$	Fuel cost SoSh/litre	Number of machines	Engine hp	Machine life (h)	Annual use (h)	Machine life (yrs) (1)	Spare parts % cap.cost	Spare parts annual use %	Spare parts cost/ machine per year	Total FOB cost US$ spare parts	Total CIF cost US$ spare parts	Local SoSh cost	Fuel use/hour (litres)	Fuel use/year/ machine (litres)	Total fuel use litres/year	Total fuel cost SoSh/year	Total lubrication cost SoSh/year
90 hp crawler tractor	35 000	5.5	6	90	12 000	1 763	7	50	7	2 571	15 426	17 740	9 047	10.80	19 040	114 242	628 333.2	62 833
75 hp 2 wheel drive tractor	17 500	5.5	10	75	8 000	1 124	7	50	7	1 229	12 294	14 138	7 218	9.00	10 116	101 160	556 380.0	55 638
75 hp 4 wheel drive tractor	19 500	5.5	7	75	8 000	1 124	7	50	7	1 320	9 589	11 027	5 624	9.00	10 116	70 812	389 466.0	38 947
Combine harvester	64 000	5.5	7	125	3 000	733	4	25	6	3 909	27 363	31 470	16 050	15.00	10 995	76 965	423 307.5	42 331
Ploughing offset disc harrow	12 250	n/a	4	n/a	10 000	1 000	10	50	5	613	2 450	2 818	1 437	0	0	0	0	0
Offset disc harrow	13 000	n/a	6	n/a	8 000	643	10	50	5	650	3 900	4 485	2 287	0	0	0	0	0
Land plane	15 000	n/a	2	n/a	4 000	201	10	30	3	450	900	1 035	528	0	0	0	0	0
Seed drills	11 500	n/a	4	n/a	3 500	356	10	30	3	351	1 404	1 614	823	0	0	0	0	0
Sprayers - tractor	8 700	n/a	3	n/a	2 000	225	9	30	3	294	881	1 013	517	0	0	0	0	0
Sprayer - LGP	21 750	5.5	2	55	3 500	225	10	30	3	653	1 305	1 501	765	6.60	1 485	2 970	16 335	1 634
Spike tooth harrow	870	n/a	1	n/a	2 500	96	10	10	1	9	9	10	5	0	0	0	0	0
Cotton planter	2 600	n/a	1	n/a	2 000	173	10	30	3	78	78	90	46	0	0	0	0	0
Fertiliser spreader	3 500	n/a	4	n/a	2 000	338	6	30	5	177	710	816	416	0	0	0	0	0
Inter-row cultivator	3 500	n/a	1	n/a	2 000	56	10	30	3	105	105	121	62	0	0	0	0	0
Rolling cultivator	3 100	n/a	1	n/a	2 000	56	10	30	3	93	93	107	55	0	0	0	0	0
Grass slasher	1 300	n/a	1	n/a	2 000	400	5	50	10	130	130	150	76	0	0	0	0	0
Cotton stalk & straw slasher	1 300	n/a	1	n/a	2 000	255	8	50	6	83	83	95	49	0	0	0	0	0
Rectangular baler	7 500	n/a	1	n/a	3 000	400	8	30	4	300	300	345	176	0	0	0	0	0
Front end loaders	2 250	n/a	4	n/a	8 000	400	10	10	1	23	90	104	53	0	0	0	0	0
Grain augers	2 175	n/a	2	n/a	2 000	300	7	30	5	98	196	225	115	0	0	0	0	0
Grain, bag & bale elevator	3 500	5.5	1	10	2 000	300	7	30	5	158	158	181	92	1.20	360	360	1 980	198
Tine cultivator	3 900	n/a	2	n/a	2 000	300	7	20	3	117	234	269	137	0	0	0	0	0
4 wheel 5 ton trailer	4 350	n/a	8	n/a	8 000	1 274	6	10	2	69	554	637	325	0	0	0	0	0
7 ton grain trailer	6 100	n/a	7	n/a	8 000	1 274	6	10	2	97	680	782	399	0	0	0	0	0
Trailed fuel bowser	7 200	n/a	1	n/a	10 000	1 000	10	10	1	72	72	83	42	0	0	0	0	0
Knapsack sprayer	90	n/a	20	n/a	500	200	3	30	12	11	216	248	127	0	0	0	0	0
ULV sprayer (2)	30	n/a	45	n/a	500	200	3	30	12	4	27 162	31 236	15 931	0	0	0	0	0
Elevated grain hopper	3 000	n/a	1	n/a	2 000	400	5	10	2	60	60	69	35	0	0	0	0	0
Miscellaneous implements	17 500	n/a	1	n/a	2 000	255	8	30	4	669	669	770	393	0	0	0	0	0
Workshop consumables	90 000	n/a	1	n/a	n/a	n/a	-	-	5	4 500	4 500	5 175	2 639	0	0	0	0	0
Totals											111 612	128 354	65 461			366 509	2 015 802	201 581

Notes (1) Maximum life of any machine, regardless of hours completed, has been taken as 10 years.

(2) Includes the cost of batteries in the spare parts cost.

TABLE IV.12

Irrigation and Drainage System

Fuel, Lubricants and Spares

Description	1985 Total fuel cost SoSh/year	1985 Fuel use/year litres	1985 Total lubrication cost SoSh/year	1986 Total fuel cost SoSh/year	1986 Fuel use/year litres	1986 Total lubrication cost SoSh/year
Main irrigation pump station	1 109 508	201 729	110 951	2 764 220	456 895	276 422
Sprinkler pump station	574 898	104 526	57 490	844 913	139 655	84 491
Drainage pump station	39 196	7 126	3 919	99 099	16 380	9 910
Totals	**1 723 602**	313 381	172 360	3 708 231	612 930	370 823

Notes : (1) Figures taken from Chapter 4 of the Report.

(2) Lubricants assumed at 10% of fuel costs.

(3) Spares costs nil in 1985 and 1986.

TABLE IV.13

Farm Unskilled Labour : Wages Cost(1)

(SoSh '000)

	1985(2)	1986(3)
Regular labour :		
Surface irrigation area	782.0	1 687.4
Sprinkler irrigation area	68.0	174.0
Sub-total	850.0	2 711.4
Casual labour :		
Surface irrigation area	52.0	79.2
Sprinkler irrigation area	3.8	5.7
Sub-total	55.8	84.9
Cotton pickers	30.6	168.1
Bird scarers(4)	312.0	1 638.0
Total	1 248.4	4 602.4

Notes : (1) Based on estimate of labour requirements. Table 5.1 (Chapter 5).

(2) 1985 wage notes : regular labour and cotton pickers SoSh 680 per month; casual labour SoSh 20 per day; bird scarers SoSh 300 per month.

(3) 1986 wage rates : regular labour and cotton pickers SoSh 680 per month; casual labour SoSh 22 per day; bird scarers SoSh 350 per month.

(4) The number of bird scarers required will be slightly variable from year to year but some budget provision must be made to cover costs if they are required.

TABLE IV.14

Housing, Administration Buildings and Services

Operation and Maintenance

Description	1984		1985		1986	
	FE component (US$)	Local component (SoSh)	FE component (US$)	Local component (SoSh)	FE component (US$)	Local component (SoSh)
Materials and spares	-	-	13 695	-	57 520	
Fuel costs	-	450 000	-	1 204 500	-	1 324 950
Lubrication costs	-	45 000	-	120 450	-	132 495
Total	-	495 000	13 695	1 324 950	57 520	1 457 445

Note : (1) Figures taken from Chapter 4 of the Report.

TABLE IV.15

Agricultural Inputs : Unit Costs 1985/86

	1985			1986		
	FE component US$	Local component SoSh	Total(1) SoSh	FE component US$	Local component SoSh	Total SoSh
Seed:						
Rice(per kg)	-	7.0	7.0	-	7.5	7.5
Cotton	Supplied free of charge by Somaltex					
Fertiliser:(2)						
Urea (per tonne)	245	250	4 415	260	300	4 720
DAP (per tonne)	355	250	6 785	380	300	6 760
Agri-chemicals:(3)						
Stam F34 (per litre)	3.5	3.0	62.5	3.9	4.0	70.0
Avirosan (per litre)	12.3	10.0	220.0	13.6	12.0	245.0
2,4D amine (per litre)	3.0	10.0	60.0	3.3	12.0	70.0
Treflan (per litre)	6.5	6.0	115.0	7.2	7.0	130.0
Cotoran (per litre)	7.4	10.0	135.0	8.0	12.0	148.0
Codol (per litre)	8.4	10.0	155.0	9.2	12.0	170.0
Nuvacron (per litre)	6.4	10.0	120.0	7.0	12.0	132.0
Fernasan D (per kg)	3.5	6.0	65.0	3.8	7.0	70.0
Protective clothing	30	-	510	35	-	595
Sacks (per 100)	85	75	1 520	95	80	1 695
Hand tools:						
Spades (each)	-	-	210	-	-	230
Jambis (each)	-	-	120	-	-	130
Pangas (each)	-	-	250	-	-	275
Sulphuric acid (litre)	1.0	10.0	27	1.1	12	30.
Infield works:						
Siphon tubing	17.25	8.87	302.0	18.11	9.24	317
Portable canvas unit						
Channel checks	595	303.5	10 418	624.7	319	10 940

Notes : (1) Exchange rate US$ 1 = SoSh 17.0

(2) Urea bagged in Europe - shipped to Mogadishu; DAP ex-Gulf bagged in Europe and shipped to Mogadishu. Prices are considerably higher than current prices quoted by Somali Fruit. Somali Fruit however (personal communication) anticipate considerable increases in fertiliser prices in 1984 and 1985.

(3) Prices ex-Europe but based on current quotations C and F Mogadishu increased by 10% per annum price inflation.

TABLE IV.16

Agricultural Inputs : Annual Cost Estimate 1985/86

	1985			1986		
	FE component (US$ '000)	Local component (SoSh '000)	Total SoSh ('000)	FE component (US$ '000)	Local component (SoSh '000)	Total (SoSh) ('000)
Seed:						
Rice	-	1 365.0	1 365.0	-	-	
Fertiliser urea	37.0	37.8	6 66.7	207.5	239.4	3 766.6
DAP	39.6	27.9	700.8	94.2	74.4	1 676.5
Agri-chemicals:						
Stam F34	57.1	48.9	1 018.8	144.3	148.0	2 590.0
Avirosan	12.3	10.0	220.0	13.6	12.0	245.0
2,4D amine	0.06	0.2	1.2	0.07	0.24	1.4
Treflan	2.3	2.1	40.3	3.3	3.2	59.8
Cotoran	0.2	0.3	3.4	0.2	3.0	3.7
Codol	0.3	0.3	4.7	0.3	0.4	5.1
Nuvacron	17.6	27.5	330.0	25.7	44.0	484.4
Fernasan D	1.6	2.7	29.3	2.2	4.1	40.6
Protective clothing	1.5	-	25.5	-	-	-
Sacks	26.6	2.5	475.8	69.4	58.4	1 237.4
Hand tools:						
Spades	-	23.1	23.1	-	16.1	16.1
Jambis	-	13.2	13.2	-	9.1	9.1
Pangas	-	27.5	27.5	-	19.3	19.3
Sulphuric acid	0.4	4.0	10.8	0.6	6.0	15.0
Infield works:						
Siphon tubing	7.9	4.0	138.7	19.5	10.0	342.6
Portable canvas unit						
Channel checks	2.4	1.2	41.5	5.7	2.9	100.3
Total	206.9	1 619.2	5 136.3	586.7	650.5	10 612.9