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(SPECIAL FUND)

PROJECT FOR THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER SOMALIA

EXECUTING AGENCY
FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

VOLUME III

THE AFGOI - MORDILE CONTROLLED IRRIGATION PROJECT FEASIBILITY STUDY

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SELECTED REFERENCES

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GLOSSARY OF HYDROGEOLOGICAL TECHNICAL TERMS

Coefficient of Transmissibility	-	The rate of flow of water through a cross-sectional area of unit width under a unit hydraulic gradient.
Drawdown	-	The lowering of the aquifer piezometric surface due to the action of a discharging well, measured at any point within the area of influence of that well.
Electrical Conductivity (E. C.)	-	Electrical conductance of a unit volume of an electrolyte (water). Measure of the ease with which electric current passes through the electrolyte, related to the total dissolved solids in water.
Lower Quartile Size	-	25 per cent size.
Recharge	-	The quantity of water reaching an aquifer from all sources.
Specific Capacity	-	Discharge rate of a well per unit drawdown.
Specific Drawdown	-	Drawdown in a discharging well per unit discharge rate.
Upper Quartile Size	-	75 per cent size.
Well String	-	The assembled lengths of well blind pipe and pump casing placed in a tubewell.

Symbols and Units Used

Distance, Area, Volume and Weight

Metric measurements have been used throughout the report.

Monetary Units

The Somali Shilling or Somalo is the local unit of currency and is abbreviated "Shs" throughout the report. At the time of the study the foreign exchange rate was:-

Shs 7.14 = U.S. $ 1.00

Conversion Factors

1 mm	=	0.039	in.
1 m	=	3.28	feet
1 km	=	0.621	mile
1 ha	=	2.47	acres
1 m^3	=	35.3	cuft.
1 kg	=	2.2046	lbs.
1000 kg	=	0.984	ton

GLOSSARY OF LOCAL TERMS

'Azienda'	Farm or concession holding.
'Der'	The rainy season October-November.
'Faf'	The farming or pasture areas inundated by flood flows.
'Far'	A natural channel from the river to lower ground in the flood plain used for inundation watering.
'Gu'	The rainy season April-June.
'Hagai'	The season of coastal showers July-August.
'Jambo'	A short handled hoe used for traditional hand tillage.
'Uebi'	(= Wadi) A non-perennial stream.

FOREWORD

Early in 1966 the Government of the Somali Republic requested United Nations Special Fund assistance in making feasibility studies of a controlled irrigation scheme and a flood irrigation scheme in the Shebelli Valley and in developing a plan for management of the Shebelli River waters. This request resulted from the recommendation of the 1961-66 Special Fund Project - Somalia, Agricultural and Water Surveys - that such feasibility studies be undertaken. In response to the Government's request the United Nations Development Programme (1) authorised in June 1966 a project entitled "Water Control and Management of the Shebelli River, Somalia". The project was assigned to the Food and Agriculture Organisation of the United Nations as the Executing Agency. The Plan of Operation was signed in September 1967 and this Agency contracted with Hunting Technical Services Ltd. of U.K. to carry out the work for the project.

The results of the project investigations are presented in volumes I, II and III of this report. This is Volume III - Afgoi-Mordile Controlled Irrigation Project, Feasibility Report; the others being Volume I - General Report and Volume II - Balad Flood Irrigation Project.

The Food and Agriculture Organisation is in agreement with the Conclusions and Recommendations of Hunting Technical Services as set forth herein.

(1) The United Nations Special Fund and the Expanded Programme of Technical Assistance were merged to form the United Nations Development Programme on 1st January, 1966.

CONCLUSIONS AND RECOMMENDATIONS

Following the feasibility study of the Afgoi-Mordile Controlled Irrigation Project the following conclusions were reached:

Agricultural development is essential in Somalia to raise the national income and improve the living standards of the people.

Providing existing natural flows in the Shebelli River are maintained or not appreciably reduced by upstream abstractions, a sufficiently reliable supply of irrigation water is available for a 3,000 ha. controlled irrigation development. In particular the maintenance of the lower flows at the onset and end of the 'Der' season flood is vital to ensure a sufficiently prolonged season.

The best location for development of a 3,000 ha. controlled irrigation project is in the Afgoi-Mordile area described in this report. The topography of the area and the land classification indicate it as being suitable for irrigation development.

The Afgoi-Mordile Project should be a settlement scheme. On the basis of information obtainable on suitable crops and cultural practices, the Afgoi-Mordile Project, under effective management, could provide increased output amounting to Shs. 6,039,000 annually as against a capital expenditure of Shs. 13,694,000 and an annual operating and maintenance cost of Shs. 1,091,240 excluding loan servicing charges and replacement costs by the twentieth year of operation. This results in an internal rate of return of 8 per cent and a cost benefit ratio of 1:1.08 taking the opportunity cost of capital as being 7 per cent. The foreign exchange portion of the capital cost would be the equivalent of US $1,139,300 while annual foreign exchange savings generated by the project are estimated to be US $462,000. To ensure effective management, steps must be taken to improve extension and research services and it will be necessary to encourage the formation of co-operatives and provide credit facilities.

It is essential that a continually effective hydrological organisation is established in Somalia and that regulations controlling water use are enforced.

Before embarking on full scale development we recommend that a pilot Project of about 100 ha. should be established.

It is further recommended that the results obtained in the Pilot Project should be used in a re-analysis of the economic feasibility of the full 3,000 ha. development before implementation of the Afgoi-Mordile Project.

CHAPTER 1

BASES FOR PROJECT PLANNING

The Project for the Water Control and Management of the Shebelli River of which the Feasibility Study for the Afgoi-Mordile Controlled Irrigation Project forms a part commenced in November 1967. The Project was of 2 years duration and field work in Somalia was completed in July 1969.

The Statement of Work and Specification which was the basis of the study, specified the following surveys and investigations:-

a) Preparation of topographic maps of the area, using ground survey methods and air photo-interpretation.

b) A semi-detailed soil survey of the area and preparation of soils and land class maps.

c) Hydrological studies to determine the quality and availability of river water for irrigation.

d) Hydrogeological studies to ascertain whether groundwater could be used to supplement the irrigation supply at times of low river flows.

e) Agronomic studies leading to proposals for cropping patterns and cultural requirements, together with an assessment of labour and machinery inputs and management and advisory services required.

f) The preparation of irrigation engineering designs in sufficient detail to permit the calculation of quantities and cost estimates required for economic feasibility analysis.

g) Economic studies to include an assessment of potential markets, an economic and financial appraisal of the

The Project for the Water Control and Management of the Shebelli River was a follow up project to the UNDP/SF Agriculture and Water Surveys Somalia completed in 1966 and the information at reconnaissance level contained in that project report was used as the foundation of the present study.

The recommendations which are included in this report are based on the assumption that present natural river flows from the catchment of the Shebelli River in Ethiopia are maintained. In particular the maintenance of the lower flows occurring at the commencement and end of the flood seasons is, in the absence of water storage, vital to ensure a sufficiently extended irrigation season to bring the proposed crops to maturity.

In all fields of investigation, the severe lack of basic data locally resulted in the need to make a number of estimates in the feasibility analysis based upon experience in other countries. The establishment of a Pilot Irrigation Project in the Afgoi-Mordile Project area some 100 hectares in extent is recommended in order that these estimates may be verified before the full project is implemented.

A more detailed examination of the constraints affecting controlled irrigation development, markets and projected prices for produce, detailed recommendations of crop cultivation requirements and details of engineering works and costs are given in the Technical Annex to this report, Volume III A.

CHAPTER 2

THE PROJECT AREA

2.1 Location and Reasons for Selection

The Afgoi-Mordile Controlled Irrigation Project is 3,000 hectares in extent lying on the left bank of the Shebelli River some 19 km downstream of Afgoi.

Irrigation water for the scheme will be abstracted at a site on the river near the village of Mordile and for this reason the Project was called the Afgoi-Mordile Project.

Following a brief soils and engineering reconnaissance during December 1967 and January 1968, this area was selected for the Controlled Irrigation Feasibility Study. The area lies between the Afgoi to Merca main road and the Afgoi to Barire earth road running close to the river. Alternative locations on the right bank of the river downstream of Balad, on the left bank immediately downstream of Afgoi and in the Fornari area downstream of Genale were considered. Soils of the Balad area appeared inferior and the location formed part of the area eventually selected for a flood scheme feasibility study (see Volume II, the Balad Flood Irrigation Project Feasibility Study). The area immediately downstream of Afgoi was already extensively developed for agriculture and the West German assisted dairying enterprise located some 4 km west of Afgoi would have necessitated dividing the irrigation scheme into two halves lying either side of that project. The soils and topography of the Fornari area appeared to offer no advantages over the area selected and as contiguous development in that area was restricted to about 3,000 ha., there was no opportunity for future expansion should hydrological studies indicate sufficient water being available. Furthermore, the Somalia Government had expressed a preference for selection of a site outside the Genale-Bulo Mererta area to avoid possible difficulties over re-

2.2 Climate

The climate of the Shebelli Valley in the vicinity of Afgoi is tropical semi-arid. Rainfall is very variable in both quantity and distribution from year to year and is often very local in occurrence. Table 2.1 shows the mean monthly and annual rainfall and maximum and minimum amounts recorded at Afgoi over 31 years.

TABLE 2.1 Mean, Maximum and Minimum Monthly and Annual Rainfalls at Afgoi in mm

	Months												Total for Year
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	
lean	2.3	0.1	4.4	91.7	81.1	59.0	56.1	24.7	15.1	60.0	83.2	30.0	502.6
ighest	28	5	66	230	283	233	213	124	153	166	245	110	975
owest	0	0	0	0	0	0	0	0	0	0	0	0	192

Sources: 1. 'Contributo alla Climatologia della Somalia' Fantoli A. Ministero degli Affari Esteri, Rome.
2. 'Annual Reports of the Afgoi Research Station.

As shown in the table, rainfall occurs mainly in the two seasons April-June and October-November, locally called the 'Gu' and 'Der' seasons respectively. These seasons are associated with the passage of the intertropical front. Coastal showers locally called 'Hagai' rains occur in July and August, amounts being greatest on the coast but appreciable as far inland as Afgoi. Due to the showery nature of the rainfall and virtual absence of continuous recording gauge records, it is impossible to establish any reliable estimate of short term rainfall intensities. Amounts in excess of 75 mm in 24 hours are, however, unusual.

The fact that rainfall is distributed in two seasons, the relatively small amounts of rain at these seasons and the great variation in rainfall

the two cropping seasons was made and the results are shown in Table 2.2.

TABLE 2.2 Expectation of Accumulated Rainfall in mm at Monthly Intervals Over the 'Gu' and 'Der' Cropping Seasons

Season	Period	Accumulated rainfall normally exceeded	
		5 years in 10	9 years in 10
'Gu'	April	95	0
	April-May	170	40
	April-June	225	85
	April-July	285	135
'Der'	October	35	0
	October-November	125	25
	October-December	155	55

Source: Derived from same sources as Table 2.1.

Temperatures in the Shebelli Valley remain relatively uniform throughout the year, the hottest periods being February to April and October to November. Mean monthly maximum temperatures range from 30 to 35°C and mean monthly minimum temperature from 21 to 24°C. Relative humidity is highest during the April-June and October-November rainy seasons and during the July-August 'Hagai' season, and monthly means range from 65 to 75 per cent.

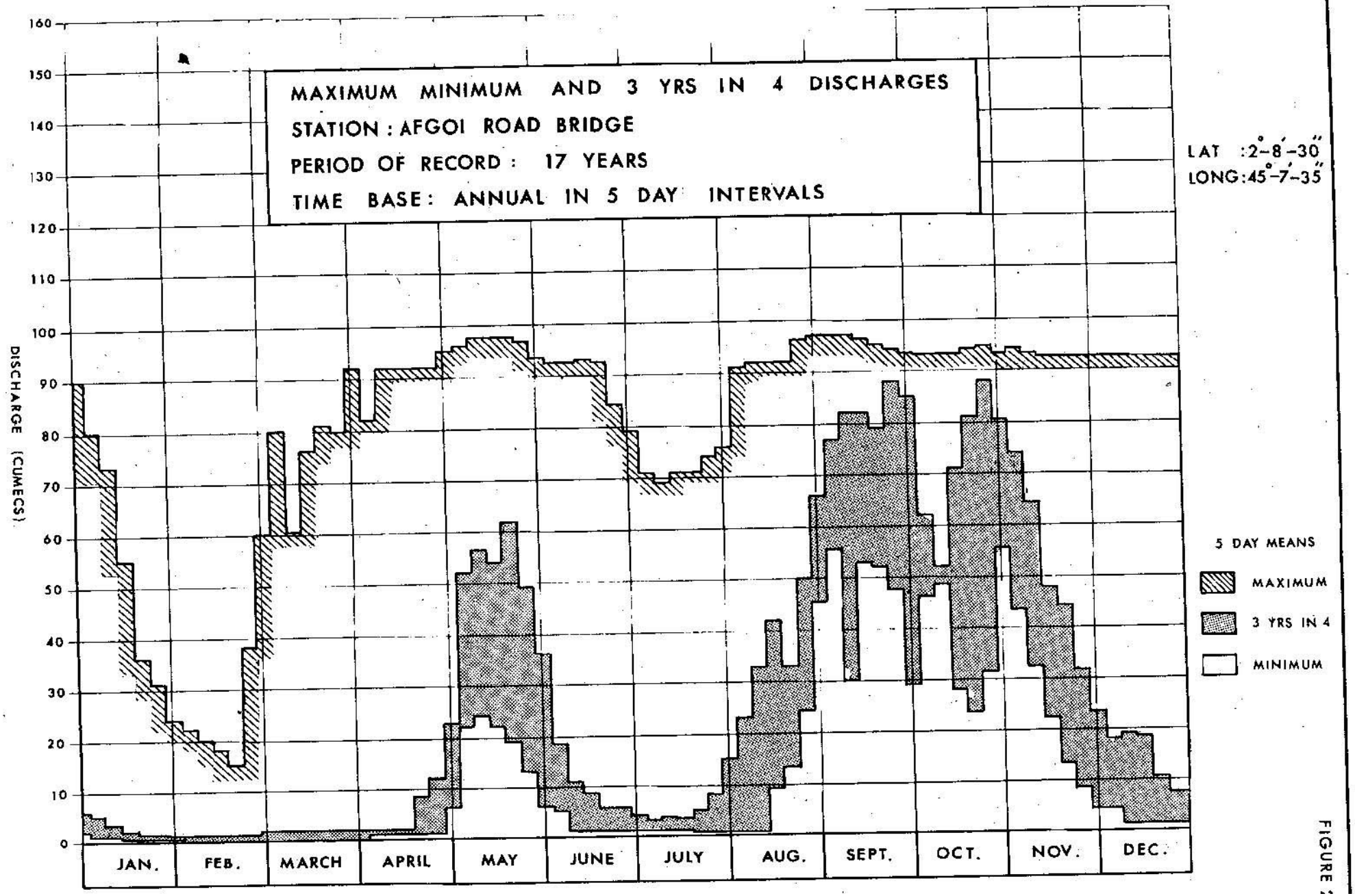
As few reliable records of solar radiation and evaporation were available, the meteorological station at the Afgoi Research Station was resited and equipment installed to provide records of all the climatic parameters necessary for the computation of estimated open water evaporation by the Penman method. An evaporation pan was installed at the Afgoi Research Station during the period over which observations were made and the measurements corrected for advected energy are in agreement with the estimated evaporation. Recorded wind velocities

February-March and July-September. Sunshine averages range from 4.5 hours per day during the rainy seasons to 9 hours per day and open water evaporation was of the order of 5.5 mm per day during the rains increasing to 9 mm per day in the driest months.

2.3 Water Resources

The expectation of seasonal river discharge quantities at the Afgoi gauging station are shown in Figure 2.1 and these apply to the site at which water would be abstracted for the Afgoi-Mordile project. Present use and possible future demands for irrigation water in the Genale area downstream were allowed for when assessing the availability of water for the project. The flows during the September-November period are consistently high with flows in December and January being lower and less reliable. The February-March period is marked by low flows and at this time existing cultivation of perennial crops at Afgoi and Genale already has to rely on groundwater from tubewells or limited quantities of river water stored in ponded areas. The April-May flood season is less reliable than that of September-November and river levels are seldom as high; during June-August flows are usually low. The cultivation of perennial crops requiring year-round irrigation is not possible without provision of expensive storage reservoirs or use of groundwater. The reliable river flows of the 'Der' season would enable the cultivation of annual crops at this time providing the cropping season is so arranged as to keep the requirements for water during the late December-January period as low as possible. Availability of water for the irrigation of annual crops cultivated in the 'Gu' season is less reliable but the greater reliability of rainfall at this time does to some extent offset the risk of irrigation supplies being seriously inadequate for the crops' moisture needs.

From an inspection of the recorded monthly rainfall figures at Afgoi and the recorded monthly river flows it is considered that there will be adequate water supply three years in four with serious deficits rarely occurring and these mainly in the 'Gu' season.


MAXIMUM MINIMUM AND 3 YRS IN 4 DISCHARGES
STATION : AFGOI ROAD BRIDGE
PERIOD OF RECORD : 17 YEARS
TIME BASE : ANNUAL IN 5 DAY INTERVALS
LAT :2°-8'-30"
LONG:45°-7'-35"
DISCHARGE (CUMECS)
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
JAN.
FEB.
MARCH
APRIL
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
5 DAY MEANS
MAXIMUM
3 YRS IN 4
MINIMUM

FIGURE

Groundwater studies in the project area showed that depth to water table increased away from the river, being greater than 40 metres below ground level over most of the area. A test tube-well gave water classified in the high salinity - medium sodium range which would be suitable for irrigation only on soils with unrestricted drainage and for salt tolerant crops. Transmissibility for tubewells in the area would be of the order of 70-110 cubic metres per day per metre. Groundwater recharge is thought to be minimal and operation of a tubewell field for 4 months or more would probably result in serious depletion of groundwater reserves. Groundwater would only be required to supplement irrigation supplies in seasons of low river flow and usually only for a period of 2 months at the end of the 'Der' cropping season. An examination of costs of extracting 1,000 cubic metres of groundwater with a discharge rate of 65 cubic metres per hour showed these to increase rapidly as the period of operation was reduced. Providing satisfactory crops can be obtained using available river water supplies, the increase in yield resulting from an extended cropping season using supplementary supplies of groundwater is unlikely to prove financially attractive except in the case of very high value crops.

2.4 Topography

The topographic map, Figure 2.2 shows a general slope of about 30 centimetres per kilometre parallel to the river. The area is slightly undulating with ridges of higher ground along the Afgoi to Barire road and at the eastern corner of the area near the village of Idamoun.

A sample area of 300 hectares was levelled in greater detail in order to provide information on local variations in level required for engineering design and estimation of quantities.

2.5 Soils and Vegetation

The soils were classified on the basis of the U. S. Department of

analysis results. Two soil orders were identified in the area, namely Entisols and Vertisols (Table 2.3).

Vertisols occur in flat areas and slight depressions, are brown to yellowish brown in colour and of fine texture, ranging from clay loam to silty clay to clay. In some cases they overlie medium or coarse textured horizons or stratified material. The surface consists of a soft mulch or semi-hard to hard crust. These soils have no sodium hazard and no salt hazard in the topsoil, but may have a slight to moderate or occasionally severe salt hazard in the subsoil.

Entisols occur as isolated patches or narrow relatively high ridges corresponding to former river levées, have coarse to moderately fine textures and are generally more saline and alkaline than the vertisols.

Hydraulic conductivity tests carried out on undisturbed core samples indicate that, in general, the soils have no irrigation or drainage problems.

Previous studies of infiltration at the Afgoi Research Farm indicated a steady infiltration rate of approximately 0.4 cm/hour after rapid initial infiltration in dry soil through cracks. Two further tests in the Afgoi Project area confirmed infiltration to be of this order.

Soil moisture retention characteristics were measured on undisturbed core samples from six sites typical of the more important soil series. Available moisture is defined as the difference in moisture content of the soil between Field Capacity and Permanent Wilting Point. A soil suction of 0.3 atmospheres is frequently accepted as representing the field capacity condition and a suction of 15 atmospheres is taken as equivalent to the permanent wilting point. The soils of the Afgoi-Mordile area can retain 10 to 15 per cent v/v available moisture or between 10 and 15 cm of moisture per metre depth of soil.

The Land Classification Map, Figure 2.3, has been prepared, based on the U.S. Bureau of Reclamation Standards Specification, modified to suit prevailing local conditions. In the classification, the following criteria were used:-

TABLE 2.3 Soil Classification

Landform Subdivision Order, Series and Subseries	Mapping Symbol	Texture	EC mmhos/cm
FLOOD PLAIN MEANDER			
VERTISOLS			
CHROMUSTERT (Recent Alluvial)	G1		
Udic Chromustert: hue 10YR.	G1 1a		
	G1 1a11	medium/fine overlying medium/coarse	4
	G1 1a21	)medium/fine overlying	4
	G1 1a22	) fine	4
	G1 1a31	medium/fine overlying stratifications	4
Udic Chromustert: hue 7.5YR.	G1 1b		
	G1 1b11	medium/fine overlying medium/coarse	4
	G1 1b21	medium/fine overlying fine	4
	G1 1b31	medium/fine overlying stratifications	4
Udorthentic Chromustert	G1 1		
	G1 211	medium/fine overlying medium/coarse	4
	G1 221	medium/fine overlying fine	4
PELLUSTERT	G1		
Udorthentic Pellustert	G 13		
	G13 11	medium/fine overlying fine	4
CHROMUSTERT (Old Alluvial)	Sr		
Udic Chromustert	Sr 1		
	Sr 111	)medium/fine overlying	4
	Sr 112	) fine	4
Udorthentic Chromustert	Sr 21		
	Sr 211	)medium/fine overlying	4
	Sr 212	) fine	4
FLOOD PLAIN SLACKWATER			
VERTISOLS			
PELLUSTERT	Sc		
Udorthentic Pellustert	Sc 11		
	Sc 111	medium/fine overlying fine	4
CHANNEL REMNANT (Levee Soils)			
ENTISOLS	C		
Typic Ustorthent	C 11		
	C 111	coarse/medium throughout profile	4
	C 121	coarse/medium overlying	4

TABLE 2.4 Land Classification for Controlled Irrigation Schemes

Class	1	2	3	4	6	Symbol
Minimum soil depth to different exture class(cms)	100	60	60	50	50	d
alinity E. C. in mmhos t fixed depths						
0- 50 cm	4	4	4-8	8-12	unlimited	s
50-100 cm	4	4	8	8-12	"	
00-150 cm	4	4-8	8	unlimited	"	
lkalinity E.S.P. at xed depths						
0- 50 cm	15	15	15	15-25	unlimited	a
50-100 cm	15	15	15	25	"	
00-150 cm	15	15	15	unlimited		
exture	sandy loam to friable clay	loamy sand to permeable clay	loamy sand to moderately permeable clay	loamy sand to clay	unlimited	b= stratifications v= very coarse texture l = moderately coarse texture m=moderately fine texture h= very fine texture
opography	little gilgai formations or no restrictions	moderate gilgai formation or no restrictions	moderate gilgai formation or moderate restrictions	severe gilgai or moderate restrictions	unlimited	g= gilgai t = topography
ofile	no limit to water movement or root development. Well structured.	Water movement and root development a little impeded. Well to moderately structured.	water movement and root development restricted moderately structured.	water movement and root development moderately to severely restricted moderately to poorly structured	unlimited	p

a) Depth of soil to horizons likely to limit root development.

b) Salinity expressed in mmhos/cm electrical conductivity (EC).

c) Exchangeable Sodium Percentage (ESP) a value of 15 being taken as critical.

d) Texture, five textural classes are recognised.

e) Topography, former river channels being excluded from cultivable land.

f) Profile characteristics affecting drainage and root development.

The results indicate that approximately 95 per cent of this area is moderately to well suited for irrigated agriculture, being classified as Class 3 or better. The remaining 5 per cent is classified as Class 3 with some profile limitations and Class 4 and is thus suitable for irrigation but requiring more careful management and is expected to give rather lower yields.

Approximately 75 per cent of the area is bush covered the remainder being either cultivated or has been cleared and cultivated in the recent past. Land previously cultivated but with considerable regeneration of Comiphora spp. with some Acacia nubica, A. nilotica and Dobera glabra and with open grassy areas constitutes 20 per cent of the area whilst 25 per cent of the area has dense cover of these species together with Acacia seyal, A. bussei, Cordia gharaf, Grewia spp., Dichrostachys glomerata, Euphorbia spp. and Salvadoria persica with few open grassy areas. The remainder consists of impenetrable heavy bush with Dichrostachys glomerata being the dominant species.

A total area of 2,790 ha. will require to be cleared of bush and root ploughed before development can proceed.

2.6 Population

In 1966 a census of villages in and adjacent to the Project area gave the number of households as shown in Table 2.5.

TABLE 2.5 Population Statistics of Villages in and around the Project Area from 1966 Census

Village	Administrative District	Number of Households
Beled el Amin	Afgoi	99
Bororo	"	8
Buslow	"	31
Daarta	"	30
Idamoun	"	30
Merere	"	248
Mordile	"	57
Zabed	"	115
Bulo Shan	Audegle	9
Feda Musse, Rahole	Merca	55
	Total	682

As these figures were for taxation purposes, the return may be expected to be low and in fact, the total households for the three villages in Table 2.6 are some 15 per cent higher than for this earlier census. The total number of families in the villages listed in Table 2.5 is therefore assumed to be of the order of 750.

A survey of the Afgoi Municipality made by the Statistical Department of the Ministry of Planning in 1964 indicated a population of 5009 engaged in agriculture of which 2552 were farmers and 2101 agricultural workers.

Two villages, Idamoun and Bulo Shan lie within the proposed Afgoi-Mordile project area. The village of Mordile on the Shebelli River at the proposed site for diversion of irrigation water is very close to the edge of the project as are the villages of Feda Musse and Rahole to the south-west of the project, near the Afgoi-Merca road. Further from the area

are the villages of Booro, Bunslow and Daarta, lying near the Merca road and Merere, Zabed and Beled el Amin on the river.

A population census was carried out in two villages in the project area and at Mordile; the results are shown in Table 2.6.

TABLE 2.6 Population statistics of three villages in or adjacent to the Afgoi-Mordile Project Area from 1969 Survey

Village	Number of Households	Number of Adults[1]			Children	Total	Average number per household
		Male	Female	Total			
Idamoun	39	44	46	90	105	195	5.0
Bulo Shan	9	9	9	18	10	28	3.1
Mordile	63	58	77	135	100	235	3.7

1. Adults were defined as persons judged to be 16 years old or over and able to undertake all types of work on a holding.

The proposed Afgoi-Mordile Project will require some 750 settlers. The great majority of the population of the area are presently engaged in raingrown agriculture as are the people in the surrounding district. The people interviewed in the course of the census were generally enthusiastic about the proposed scheme, which would provide a higher income albeit with a more extended and regular work input requirement. Whilst a sufficient number of potential settlers should be found without difficulty, the success attained in their recruitment to the scheme will ultimately depend on the willingness of such settlers to accept the inevitable discipline on which an irrigation scheme depends. The necessary reallocation of the present cultivation rights in the project area may result in problems. Those who cannot be allocated land or do not wish to join the scheme, in particular, older farmers and widows who would be unsuitable as settlers, would require either alternative land outside the scheme or compensation for the land which they presently cultivate within the project area.

2.7 Present Agriculture

Agriculture within the selected project area is restricted to rainland cultivation at present but small areas of irrigated (inundation) agriculture exist near villages along the river.

During the census carried out in the project area and referred to in 2.6 above, an inquiry was made into the farming activities of people resident, particularly in the villages of Idamoun and Bulo Shan. The questionnaire referred specifically to the previous year's activities as it was unlikely that accurate data would be given over a longer period. Many of those interviewed experienced difficulty in giving precise quantitative answers to questions on area cultivated and crop yields. In view of this problem and the natural suspicion of strangers coupled with the reluctance to provide information which might be used for taxation purposes, the results of the enquiry must be looked upon as giving only a general indication of family activities in agriculture and the results should be interpreted with caution.

Land is traditionally held on a tribal basis and each member of a tribe has a right to cultivate land in his sub-tribal area. Members of other tribes are allowed to cultivate within an area if adequate land is available, and providing they conform to the customs of the host tribe.

Cultivation rights assigned to individual plots are in general inherited through the male line but women also hold rights to cultivate. Sale of land is rare but renting is more common, a normal rent being Shs. 5 per ha. per year.

In Idamoun village, the average area cultivated by a farmer was 2.3 ha. and the largest area cultivated as one enterprise was 5.7 ha. These areas are much below the 15 ha. average quoted by the Agriculture and Water Surveys Report for the Inter-River area as a whole.

The customary cropping pattern consists of maize in the 'Gu' season which is interplanted with sesame shortly before harvesting. The sesame crop depends on the amount and distribution of the 'Hagai' rains in July and August. Sorghum is usually grown in the 'Der' season but some maize is also grown. These principal crops may also be interplanted with soya and castor beans. Water melons, tomatoes and papaya are also grown.

Crops over and above the subsistence needs of the family are normally sold to merchants. Yields quoted for the major crops in 1968-69 are shown in Table 2.7, the figures being in 'quintals' which generally represents a weight of 94-96 kg. The table also shows the proportion of crop failures and the price received for crops sold.

TABLE 2.7 Approximate yields and sale prices of major rainland crops grown in 1968-69 in the Afgoi-Mordile Project Area

Crop	Season	Total Area (measured) ha.	Total Quoted Production in Quintals	Average Yield in Quintals/ ha.	Crop failures quoted % (all farms)	Sale Price Shs/quintal
Maize	Gu	122	493	4	34	39
	Der	30	92	3	35	55
Sesame	Hagai	70	52	0.75	36	168
	Der	11	14	1.25	27	-
Sorghum	Der	85	354	4	2	37

2.8 The Need for Development of Agriculture

Somalia's primary resource at present lies in 8 million hectares of cultivable land and a further 12 million hectares, suitable for grazing. Of the cultivable area, approximately 1 million hectares are estimated to be productive at the present time. Agriculture and related activities provide income for at least 90 per cent of the population and virtually all exchange income is dependent on the export of agricultural produce.

A large part of exchange expenditure on the other hand is on agricultural commodities, an appreciable proportion of which it is technically possible to produce in the country.

Although it is hoped that the country's mineral resources will make a substantial contribution to national income in the future, agriculture will remain the primary source of national wealth.

CHAPTER 3

THE AFGOI-MORDILE PROJECT

The Afgoi-Mordile Project is designed as a settlement scheme to provide controlled irrigation for 3,000 ha. of annual field crops and 75 ha. of vegetables. Irrigation water will be abstracted from the Shebelli River by a pumping station sited near the village of Mordile. The layout of the project is shown in Figure 3.1.

The irrigation system has been designed so that the fields are watered only during the daylight hours. Whilst longer watering hours permit larger areas to be irrigated during the watering period from each watercourse and reduce canalisation costs due to a reduction in watercourses and field outlet pipes, night irrigation is extremely difficult even in conntries with long traditions of irrigation. It is normally inefficient and results in overwatering and in a scheme with inexperienced settlers night watering would be almost impossible to institute.

The proposed pump station site is upstream of Mordile on the left bank of the river. The design provides for a maximum irrigation requirement of 4.75 cumecs for a pumping period of 14 hours per day. This would be supplied using four pumping units; three units would then be capable of supplying the same quantity of water in under 19 hours in case one pumping unit were to break down or if it should prove more convenient to pump at this reduced rate over a long period.

The lift of the station, which has a head pool level of 85.0 m A.S.L., can vary from zero to 4.0 metres, the latter when the river discharge is at the minimum permissible for extraction. For short periods the river level may actually exceed the level in the head pool, but this excess appears to be too small and it occurs with insufficient frequency to justify the provision of a free flow channel and water control gate, so that pumping will be necessary whenever water is required.

The principal problem in the design of this station was how best to cater for the wide variation in water level on the suction side of the pumps, which not only affects the working conditions and efficiency of the pumps, but also the rate of discharge from individual pumps. It also has a very pronounced effect on the cost of constructing the pump station. Pumping in two lifts has been seriously considered but the capital cost is high both for the plant and for the structure. The problem could be overcome with single stage pumps working with both variable speed and variable impeller pitch control which would be very expensive, require highly skilled maintenance, and depend on electricity supply from a generator to operate the control system. The alternative is to use Archimedean screw pumps which, although very large for the output required, are virtually indestructible. Their maximum working efficiency is almost as high as that of conventional pumps, though the efficiency will fall off progressively as the screws are drowned by the rising river level. They will, however, be most efficient when operating at the highest lift so that the driving engines will need to be of no greater power than those which would be required to drive conventional pumps. Also the quantity pumped will not depend on the lift and this will permit better control of the quantity of water being pumped into the system. No screens would be necessary on the inlet side of these pumps to avoid damage from river borne trash, however, a shallow bar screen should be provided in the delivery channel downstream of the screws as a safeguard to stop any excessively large item of trash entering the irrigation system.

Preliminary prices were obtained both for conventional pumps and for screw pumps and the capital cost of a screw pump installation is unlikely to be very different from that for a conventional pumping installation with mechanically raked screens. The use of screw pumps is recommended in preference to conventional pumps protected by mechanical screens for this station, mainly on the grounds of improved

The recommended pump station is shown in Figure 3.2. Twin intake culverts, 2.0 m wide by 1.6 m in depth, discharge into the screw bays. The screws are mounted at an angle of 30 degrees to the horizontal and the flow for each screw is isolated by dividing walls until it reaches the stilling basin downstream of the pump house. Each flow section is fitted with a flap gate at the entrance of the stilling basin to prevent reverse flow through a screw which is not in operation. There are four screws of 1.9 m diameter and each is driven by a 89KVA diesel engine and the screw speed is approximately 33 r.p.m. The two intakes are fitted with vertical lifting gates so that the screw bays can be drained.

It is recommended that there should be sufficient capacity in the fuel tanks on the site to supply the pumps for 3 months. Also there should be at least two fuel tanks so that in the event of one being inoperative, then there is still 6 weeks supply and the estimates include two 115,000 litre tanks which will be sited in bunded pits, so that the fuel is confined in the event of leakage.

It is recommended that a separate building is provided for the use of the operating staff, containing a small office, a workshop for maintenance work, a mess and kitchen, a store and a toilet. There should also be an access road to the pump house, the fuel tanks and the office building. The site plan of the pumping station and the canal headreach and pool is shown in Figure 3.3.

The water leaves the pump station at Mordile and flows along a short length of pump channel to the head-pool. At this point, four minor canals off-take through movable weirs. These weirs have the advantage that provided the minimum head condition is fulfilled, then the discharge is independent of the downstream level; thus, once the weir has been set to a particular flow it need not be adjusted provided the upstream level is constant. The series I weirs vary in width from 0.45 m to 1.30 m and can pass discharges up to 1.0 cumec with a

3.00 m in width and can pass discharges up to 5.0 cumecs with a minimum head of 0.30 m. Movable weirs are also placed at the division of minor canals, where accurate measurement of flow is required.

The intermediate regulators on the minor canals are of the pipe regulator type. The regulators consist of steel pipes with a plate valve on the upstream end five sizes of pipe varying from 0.50 m to 1.24 m diameter being required. The smaller pipes will operate on a head of 0.05 m and the larger ones on a head of 0.10 m. The flow from the minor canals into the watercourses is by means of field outlet pipes; these are concrete pipes 0.35 m in diameter and 12 m long which pass the water under the canal banks and adjacent roads. Each pipe is fitted with a flap valve at its upstream end to control the flow. There are four settings on these valves and for various field requirements the opening time can be varied as well as the opening size.

The flow in the watercourses is controlled by 'Bombas'; these are short pipes laid in the watercourse and their position may be arranged to suit the field requirements The standard size of field is 36 hectares and the field is divided into nine 4 hectare plots each plot being served by a lateral which is fed through a pipe buried in the banks of the watercourse and the water is then conveyed to the plots by means of short plastic pipe syphons, which pass over the banks of the laterals and are moved along the lateral as watering proceeds.

The minor canals have been aligned along the ridges where possible and arranged so that the maximum number of standard 36 ha. fields can be accommodated. The standard distances have been arranged so that the watercourses can be aligned either parallel or normal to the minors with a minimum wastage of land.

The usual arrangement is for the watercourses to be normal to the minor canals but on steeper slopes this may not be suitable. In these circumstances it may be better to align the watercourses parallel to the

It is considered that the maximum drainage requirement is of the order of 18 m^3/ha/day. Most storm rainfall is absorbed within 24 hours and there is little run-off. No field drains will be provided as the small amount of run-off from one field will run along the side of the access road adjacent to the watercourse without causing serious damage. If it is later decided to drain some fields, ditches may be dug by tractor drawn ploughs along the edge of the field roads. However it is essential that a system of relatively dry roads adjacent to minor canals is maintained so that supervision and movement of plant from place to place within the project during wet weather is not seriously interrupted. Therefore all the minor drains will be dug and the spoil used to raise the level of the adjacent roads above the natural ground level.

The water collected from the project in the minor drains must be removed from the scheme area and therefore allowance has been made in the estimates for 3 kilometres of outfall drains. Additional survey work will be required to define these but most of the area drains naturally to a depression on the west side of the project and a short channel to the lower parts of this depression will be sufficient. The southern part of the project can be drained to the other side of the Afgoi-Merca road and into an excavated pool if necessary. However this should not be provided unless it is shown to be necessary after implementation of the project.

The net canalised area is 3, 250 hectares, 500 hectares being used by canals, roads and drains or being undeveloped. It is estimated that a total of 175 hectares of the canalised area will be out of command after levelling and thus the net irrigable area is 3, 075 hectares.

3.2 Crops and Cropping Pattern

The object of the Afgoi-Mordile Scheme is to resettle Somali farmers, most of whom are at present engaged in dryland subsistence farming. The scheme will be divided into small holdings, managed in

with the management providing the services necessary for organised irrigated agriculture. To date, no attempt has been made in Somalia to settle indigenous farmers on such an organised scheme, recent Government policy having been directed towards the establishment of State farms. In the selection of suitable crops and cropping patterns, the requirements of such a highly organised and strictly controlled system of farming has been taken into account.

The cultivation of perennial crops would require the provision of supplementary irrigation supplies from groundwater or storage reservoirs both of which are costly and marketing difficulties are anticipated with high value banana and grapefruit crops which might otherwise have been considered. The selection of a suitable rotation has thus been limited to those annual crops which can be produced during the seasons when rainfall or irrigation supplies from the Shebelli River are reasonably assured.

The recently completed textile factory at Balad has resulted in an increased local demand for cotton. Whilst the rainfed and flood irrigation sectors will be developed to help satisfy this demand, the higher yields and lower yield fluctuation from year to year make the cultivation of cotton under controlled irrigation, attractive, in assuring that a portion of the factory's total cotton requirements will be regularly met. As the factory will be producing a cheap, relatively low quality cloth, medium staple varieties will be most suitable for cultivation. Recently introduced Acala 4-42 and Carolina Queen varieties have performed reasonably well in trials at the Afgoi Research Station, where it was possible to provide adequate pest control. Yields of over 2,500 kg per ha. seed cotton have been obtained under irrigation. Unfortunately no information on lint quality and ginning out-turn of these varieties under local conditions is available.

Groundnuts have given yields of up to 4,500 kg per ha. in shell in one exceptional trial at the Afgoi Research Station and yields well in

concessions in the Genale area are described as producing yields in excess of 1, 500 kg per ha. during the 1950's. This crop appears particularly well suited to cultivation in the 'Gu' season and providing a variety with a short growing season is selected, it can be harvested in sufficient time to permit cultivations for the succeeding 'Der' season crop to be completed. The increasing local demand for vegetable oils will ensure a satisfactory market.

At the Afgoi Research Station, upland rice, safflower, soya beans, sunflower, sesame, castor and various leguminous food crops have also been grown under irrigation in trial plots, but so far no attempt has been made to assess these crops on a commercial field scale. Although some of these crops have proved promising in trials, there was insufficient evidence to support their recommendation for inclusion in the cropping pattern with the exception of upland rice which has been shown to have good prospects. Upland rice variety trials at Afgoi Research Station produced two American varieties, Dawn and Saturn, giving yields of between 2, 000 and 3, 000 kg per ha. Rice is at present the largest single import into Somalia and consumption is expected to increase. Upland rice rather than paddy rice has been chosen for inclusion in the rotation because of its lower requirement for irrigation water.

Consideration was given to a number of other possible crops including lemons, limes, pineapples, papaya, avocado pear, coconuts, soya beans, kenaf, sisal, maize and tobacco, none of which can be recommended due to marketing problems, lack of information on local production potential and ability to meet the required quality standards, slow maturity, and poor economic return in relation to the level of investment required.

Based on available yield data and an assessment of economic potential, upland rice, cotton and groundnuts proved to be the most profitable crops for which an appreciable market could be forecast.

The Afgoi Scheme offers only a limited quantity of crop residues suitable for stock feeding and little grazing potential within the scheme. The utilisation of these resources for beef production is unlikely to provide an attractive economic return at currently prevailing prices. Although a milk factory exists at Mogadiscio and is presently operating very much below capacity indications are that present retail marketing is weak, although the reasons are not clear. Possibly, the public are not yet ready to consume processed milk in any considerable quantity and even with a reduction in price, a fairly intensive promotion campaign would be required to increase sales appreciably. In these circumstances, the integration of milk production into the Afgoi-Mordile scheme cannot be recommended.

The selected rotation over a 2 year cycle is as follows:

Year 1 'Gu' season	Groundnuts planted in April
Year 1 'Der' season	Cotton planted in September
Year 2 'Gu' season	Fallow
Year 2 'Der' season	Upland rice planted in late August to early September

The fallow has been included to allow time for land preparation necessary for the rice crop and also to permit weed control operations to be carried out, particularly spraying of herbicides for grass control, if this proves necessary before the rice crop is planted. Germination of weeds would be assured by the 'Gu' season rains which occur during the fallow period.

Although soil differences do occur over the scheme area, these differences are not sufficiently great to warrant any modification to the standard cropping pattern.

In order that the settlers on the scheme may have the opportunity to cultivate vegetables to meet the needs of their family, separate areas will be set aside, for this purpose, each settler being allocated 0.1 hectare.

This is preferable to having such 'free cropping' included in the arable rotation. Although the local market for vegetables is unable to absorb any appreciable increase in production, without resulting in a marked fall in prices, certain crops, especially onions do offer a limited potential for expansion of production and their cultivation could prove very rewarding to the grower, providing current price levels are maintained. It has been assumed that 10 per cent of the area allocated for vegetable production will be utilised by more progressive farmers in intensive cultivation for the local market. Production will, however, be limited by the seasonal water supplies available.

Estimates of crop yields have been prepared based on limited local research information and upon experience in other countries. The yields assume that a sound management organisation for the project is set up and that good crop husbandry is practised by the tenants. As the tenants will have had no previous experience of the proposed crops and cultivation techniques a running in period of 5 years has been allowed for during which yields will gradually increase to the maturity level.

Forecasts of future farm gate prices of produce have been made, based upon current and projected prices, of hulled rice, lint cotton and vegetable oils, allowance being made for transport, handling, storage and processing where applicable. Table 3.1 shows yield and price projections for the selected crops.

TABLE 3.1 Anticipated Crop Yields and Prices

Crop	Yield in kg/ha.		Projected Price So. Shs/ton
	Year 1	Year 5	
Upland Rice	1,000	2,500	600
Cotton (Seed cotton)	700	1,500	1,000
Groundnuts (Shelled)	1,000	1,500	700

The market situation for project crops, crop cultural requirements, and projected prices are discussed fully in the Technical Annex to this report.

3.3 Irrigation Requirements

In the absence of reliable information on crop water use under local conditions, the irrigation requirements have been calculated from estimates of evaporation. Meteorological data recorded at the Afgoi Research Station during 1968-69 was used to estimate potential evapotranspiration. The mathematical model used to derive an estimate of daily water balance throughout the crop season takes account of the growth phase and surface characteristics of the crop, the depth of soil exploited by the root system and the effect of increasing soil moisture stress in reducing evapotranspiration. It assumes that irrigation takes place when a predetermined level of moisture stress occurs, this critical level being dependent on the crop growth phase.

The amount of water required at each irrigation is that needed to return the soil within the crop root zone to field capacity, plus amounts to successively wet deeper soil layers within the ultimate zone of root exploitation. Before this zone is fully wetted, an irrigation field efficiency factor of 85 per cent has been applied to allow for losses during irrigation, Subsequently, a factor of 66 per cent has been used to allow for such losses and also for deep percolation beyond the root zone.

Because of the unreliability of the 'Der' season rains, these have been ignored in assessing the irrigation needs of cotton and upland rice during this season. Rainfall during the 'Gu' season is more reliable and as river flows will in some years be inadequate, especially during the early part of the season, rainfall has been taken into account in assessing the irrigation needs of the groundnut crop. This will require 8 irrigations in a dry season but 3 irrigations

The estimated irrigation requirements of the recommended crops are shown in Table 3.2.

TABLE 3.2 Crop Field Irrigation Requirements

Crop	No. of Irrigations*	Total Irrigation Requirement	Maximum Irrigation Application
Groundnuts	8	59.0 cm	900 m^3/ha
Cotton	8	72.0 cm	1,000 m^3/ha
Rice	11	68.5 cm	750 m^3/ha

* Excludes the preplanting irrigation.

The applications of irrigated water should be spaced as uniformly as possible to facilitate simple operation of the irrigation system and as far as possible, applications should be reasonably uniform to avoid undue peaks in irrigation demand, which would result in unnecessarily large canals and pumping capacity. Small adjustments to the figures initially calculated have been made to achieve such uniformity.

Due to the short season during which irrigation water is available in many years, no pre-planting irrigation has been allowed for in the estimates. Although not essential, a pre-planting irrigation would be beneficial both in improving the tilth of the seedbed and in ensuring rapid germination after planting. It is recommended that a pre-planting irrigation be applied in those years when water is available. In the event of a pre-planting irrigation being possible, the early post-planting irrigations will be reduced in volume. The amount applied prior to planting should not exceed the maximum post-planting irrigation on which canal design is based.

Irrigation water for the proposed vegetable plots will be available during the irrigation seasons for the field crops. Uniform applications of 5.0 cm equivalent to 500 m^3 per ha. at 10 day intervals has been assumed to allow for the requirements for these plots.

For the cotton crop the irrigations are required at 15 day intervals

the daily discharge for a 36 ha. field of cotton is 4, 800 m^3 which can be supplied from a standard watercourse in 11½ hours. For rice, irrigation is necessary at 10 day intervals giving a peak requirement of 75 m^3 per hectare per day over a short period but for design purposes this was reduced to 72. 5 m^3 per ha. per day from 31st October to 19th November. The maximum daily discharge for a 36 ha. field of rice is 5, 400 m^3. This can be delivered by a standard watercourse in 13 hours. This is longer than recommended but each field is only affected for one 5 day irrigation period.

The 75 ha. of vegetables are irrigated at a uniform rate of 50 mm every 10 days. Their requirement applies mainly to one minor canal and has not been included for the calculation of the peak gross watering rate for all 'Der' season crops which would otherwise have been reduced for the canals not serving the vegetable cultivation area.

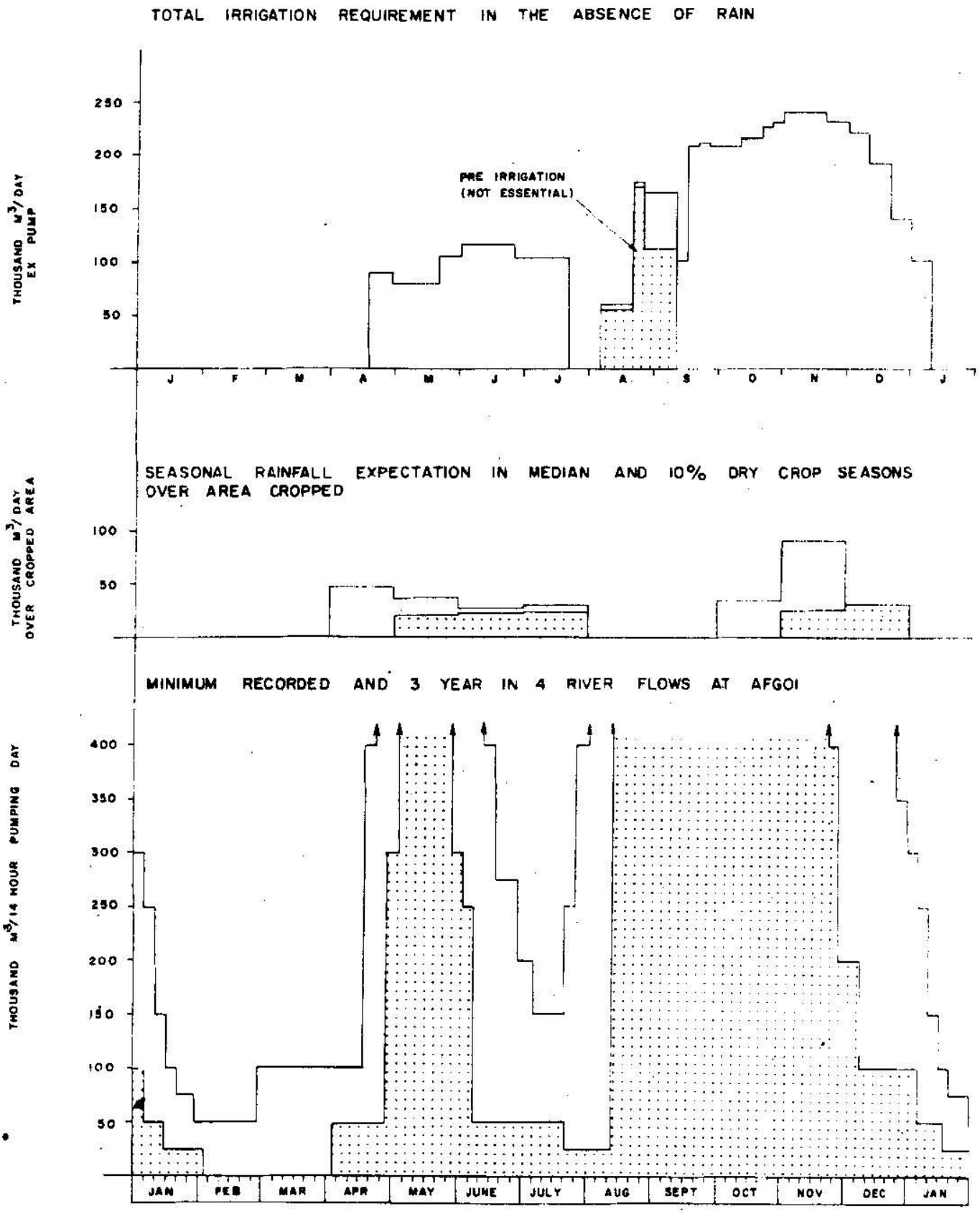
The peak water requirement for the groundnut crop occurs during June when irrigations in a dry year are needed at 12 day intervals giving a requirement of 75 m^3 per hectare, per day, similar to that for rice in the 'Der' season. In a median rainfall season the peak requirement is reduced to 66. 7 m^3 per ha. per day similar to that for 'Der' season cotton.

The peak gross factor is 69. 6 m^3 per hectare per day at farm outlets and 78. 0 m^3 per hectare per day at the minor canal headpool when an allowance of 12 per cent is made for total transmission losses. These values occur during the first 20 days in November. The recommended gross factors for design assuming that the canals will be operated for 14 hours per day and allowing a 15 per cent overload in the factor for structures to permit an increase in the water requirements in the future are as follows:-

Canal excavation in dry and pump station - 134 m^3/ha/day
Canal structures - 154 m^3/ha/day

Figure 3. 4 shows the total irrigation requirement ex-pump, anticipated rainfall and river flows at Afgoi during the two cropping seasons.

FIGURE 3·4


TOTAL IRRIGATION REQUIREMENT IN THE ABSENCE OF RAIN
THOUSAND M³/DAY EX PUMP
250
200
150
100
50
PRE IRRIGATION (NOT ESSENTIAL)
J F M A M J J A S O N D J
SEASONAL RAINFALL EXPECTATION IN MEDIAN AND 10% DRY CROP SEASONS OVER AREA CROPPED
THOUSAND M³/DAY OVER CROPPED AREA
100
50
MINIMUM RECORDED AND 3 YEAR IN 4 RIVER FLOWS AT AFGOI
THOUSAND M³/14 HOUR PUMPING DAY
400
350
300
250
200
150
100
50
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC JAN

3.4 Mechanisation and Labour Requirements

The proposed field layout has been designed to facilitate the uniform application of irrigation water and the operation of mechanical cultivation equipment. The scheme will be divided into fields, which will, as far as possible, be of a standard size measuring 1285 metres by 310 metres quivalent to 39.84 ha. of which 36 ha. will be the cropped area. Each field will at any one time be uniformly planted to one crop, two adjacent fields being planted in turn to the recommended crops in the rotation over a period of 2 years.

Each field will be served by a watercourse from which field lateral channels will deliver water for irrigation. Where ground slopes do not exceed 6 cm in 150 m, these laterals will be spaced at 138 m intervals dividing the field into 9 uniform 4 ha. plots. Where slopes greater than 6 cm in 150 m occur, the laterals will be spaced at 69 m intervals. The 4 ha. plot served by a lateral will be divided into two halves and an individual farmer will crop one of the resulting 2 ha. areas in each of 2 adjacent fields usually on the same watercourse.

The proposed 4 ha. holding constitutes the largest area which an average family could manage to operate following the proposed cropping pattern with a minimum of assistance from hired labour during peak seasons. An assessment of the labour requirements for each cultural operation for the recommended crops has been made and the total labour input for each ten day period throughout the year calculated. It has been assumed that a farmer will work up to eight days in any ten day period and that his family could provide the equivalent of five man days for planting, weeding and groundnut harvesting operations and eight man days for cotton picking in a similar period, the balance of labour required being hired. Most of the hired labour is required for cotton picking and for the subsequent uprooting operation, which latter being a strenuous task is unsuitable for family labour. A little hired labour may be necessary at planting times and during the peak weeding season of cotton and rice.

The total labour input required for a 4 ha. holding is estimated to be 414 man days per year of which the farmer would provide 242 days and his family 106 with 66 man days being provided by hired labour.

It has been assumed that tractor drawn equipment will be operated 8 hours per day, except at peak seasons when 10 hours per day for certain operations will be required. In the event of field operations being unduly delayed by unusually wet weather or by mechanical breakdowns, operation of equipment for 12 hours per day would be possible in order to achieve timely completion of cultivation. In drawing up the cultivation programme for the mechanical equipment, care was taken to maintain uniform utilisation of tractors as far as possible throughout the year.

In order to keep the tractors in the field supplied with fuel and water, tanker trailers of 2, 000 litres and 1, 000 litres capacity respectively will be required.

Besides tractor drawn machinery, hand operated cotton root pullers for the cotton uprooting operation and syphons for the application of irrigation water will be required.

The total recommended requirements for agricultural machinery and equipment are shown in Table 3. 3. The number of implements and machines includes reserve equipment to allow for sub optimal machinery performance and for unserviceable machinery. Seasonal shortage of machinery and delays in cultural operations could prove disastrous, therefore any proposal to economise in the proposed scale of mechanisation should be resisted.

A full assessment of the labour and mechanisation needs of the project is included in the Technical Annex to this report. (Volume III A).

TABLE 3.3 Machinery and Equipment Requirements

Items	No. Required
Combine harvesters	8
Tractors wheeled 70 H.P.	25
Chisel Ploughs 2.4 m width	12
Wide level discs sets 3 m wide	12
Fertiliser attachments for discs	12
Seeding attachments for discs	12
Toolbars mid-mounted	12
Cultivator tines - sets of 5	12
Fertiliser spreaders front mounted	12
Toolbars rear mounted	12
Ridger bodies - sets of 4	12
Groundnut blades - 2 row	12
Boom Sprayers	6
Land levellers	9
Lateral formers	2
Trailers 5 ton capacity	15
Fuel trailers, 2,000 litre	3
Water trailers, 1,000 litre	3
Cotton root pullers	750
Syphons 4 cm I.D. plastic	6,000
Syphons 3 cm " "	2,000

3.5 Management

A sound management structure is essential if the implementation and operation of the project is to be successful. The success of an irrigation scheme depends not only on the rate at which land is canalised, levelled and settled, but on the rate at which crops of acceptable yields are harvested.

The efficient organisation of crop production is thus of paramount importance.

The project whilst having a significant influence on the welfare of the local population should be operated on accepted business lines as a financially viable economic proposition. In order to achieve this the managing authority should have the maximum degree of autonomy compatible with wider national interests. The ultimate responsibility for the project must rest with the Somali Government as the body responsible for negotiation of development finance.

When instituting a managing body for the project the Somali Government would establish the necessary legislation on which the authority of such management will be based in order that the required discipline in the agricultural activities of the tenants may be maintained.

The great importance of agricultural development to the national economy of Somalia makes it essential to give careful consideration to the formation of the upper management structure which will be responsible for basic production policy and for high level project staff matters and finance.

The present chronic staff shortage within Ministries precludes the setting up of a separate development board or similar body. In view of the importance of co-ordinated development it is recommended that a Ministerial Project Committee be established within the Ministry of Planning on a bilateral or multilateral basis to provide for representation of both the Somali Government and the country or organisation which finances the project. The Project Committee would include representatives of:

Ministry of Planning.
Ministry of Finance.
Ministry of Agriculture (and Agricultural Development Agency).
Ministry of Public Works Department of Irrigation.

Other persons with special knowledge and experience such as prominent business men could also be co-opted from time to time but the committee should not become too large. When necessary the Project Manager's attendance would be invited.

The committee should have a secretary for co-ordination who would deal directly with the Project Manager.

The committee would issue directives for the efficient operation of the project and would be responsible for the approval of financial estimates, the authorisation of charges and payments to tenants in respect of crop production and the award of contracts for major project works. The committee would provide liaison with the Government Ministries and organisations providing services to the project including the necessary social services, and with any commodity marketing organisations which may be established. Such a committee might serve as a policy formulating body for a number of projects.

The supervision and co-ordination of project activities would be the responsibility of the Project Management Staff who together with local representatives of the Ministries of Agriculture, Natural Resources and Public Works and with representatives of local government and the project tenants would form a small management committee in which such matters as tenant management disputes may be settled. It is recommended that the project management staff should comprise an Administrative Manager in overall executive charge of the project, a Field Manager and an Engineer each with an assistant.

Because of the acute shortage of qualified and experienced local personnel in Somalia in all disciplines it is anticipated that these three senior posts will require to be filled by expatriates. Suitably qualified local personnel selected as assistants will in time acquire sufficient experience to take over the senior posts. In view of the considerable practical experience necessary and taking into account the likely continued shortage of experienced local personnel due to the need to staff other developments in the future, it has been assumed that expatriate

senior staff will be required for at least ten years from the inception of the project and that their phasing out will be gradually completed over the following ten years.

The Field Manager and his assistant should have at least two agricultural officers, each responsible for direct supervision of the tenant farmers in his section of the project.

The proposed management structure is shown diagrammatically in Figure 3.5.

3.6 Infrastructure

Within the project, transport to and from the fields will be by tractor drawn trailers and if necessary these may be supplemented by hired trucks during the dry seasons.

Transport to and from Afgoi and Mogadiscio is facilitated by the existing all weather road passing the southern boundary of the scheme and from which an all weather road will be constructed to the project headquarters. These two centres will take all the produce of the project and transport will be by large trucks and trailers already available for hire.

The headquarters for the scheme will be sited within the Project village and will consist of an office, a store and workshops.

The ginning capacity that exists within easy reach of the Project on all-weather roads is considered to be adequate. For this reason no provision has been made in the estimate for the construction of any new ginning facilities for the cotton crop.

A groundnut decortication plant has been included in the estimates consisting of a single decorticating machine. This unit would be able to handle over two tonnes of unshelled nuts per hour.

The project village will be located at the south-eastern corner of the canalised area and no building will be sited within 500 metres of any canal. Most of the scheme's employees will live in this village and

also a large proportion of the farmers working on the Project. A suitable layout for this village has been prepared. Two other villages would be established for farmers, one on the south-western and the other on the north-western edges of the Project.

The two small villages at present within the proposed project boundary will be removed. This recommendation follows discussions with experts of the World Health Organisation assigned to study health aspects of irrigation development in the Shebelli Valley. The villagers will be rehoused in the new villages and a small allowance has been made in the estimate to compensate them for loss of their homes. The only housing included in the estimates comprise eight dwellings to accommodate senior staff.

An electricity supply planned for the Project consists of a 50 KW set to serve the eight senior staff houses, the administration offices and the two tubewells proposed for the water supply. The estimate includes a sum sufficient to provide a building and oil storage tank.

The estimates include the cost of drilling and fully developing two tubewells for a domestic water supply at the project village and one at each of the two proposed farmers' villages. Provision has been allowed for a 75 millimetre plastic ring main and an elevated reinforced concrete tank of 225,000 litres capacity at the project village and for ground level concrete tanks of 22,500 litres at each of the other two villages.

The proposed telephone lines comprise a line from the pump house at Mordile to the headquarters office, a line from the office to the main Merca/Afgoi road, then utilising the existing telephone poles to both Afgoi and Mogadiscio.

Whilst the provision of social services such as a dispensary, an animal clinic, a community centre and an abattoir are highly desirable, the costs of such services should be met from government finances for the provision of such facilities and have not therefore been included in the project estimates.

CHAPTER 4

PROJECT COSTS

4.1 Construction Costs and Programme

It is recommended that construction of the Project be completed over a period of 20 months. There are several contractors in Somalia who are capable of carrying out the earthworks and there are also contractors who could construct the structures, pump station, roads, buildings and services. It is recommended that the works are let as two contracts, one for the earthworks, bush clearance and land smoothing and one for the other works as the building of the complete project is too large an undertaking for one contractor within the time allowed. It is considered desirable that the engineering and supervision of construction is carried out by a firm of international repute and that there is specialist supervision of the installation of the mechanical equipment for the pump station.

The construction rates have been based on quotations received from local contractors and include allowances for customs duty. Although agricultural development is exempt from these duties at the present time, it is not likely that contractors will alter their rates since their plant and existing stocks of material have already had duty levied on them; also it is not certain that they will obtain duty free fuel since all their work is not necessarily for the project. No figures for customs' duty have been included in the detailed estimates. The item for telephones is based on a quotation from the Ministry of Communications who have indicated that they would be willing to carry out the work. The foreign exchange figures given in the estimates are not the direct foreign exchange costs of the project but include contractors' foreign exchange requirements for fuel, lubricants, spares and depreciation or replacement of their plant. Hence they represent the total foreign exchange cost of the national economy.

The programme of construction assumes that work would start on January 1st of year 1, and that the contractors and the supervisory staff, including the project management, would be in position at that date. The scheme area should be dry at this time and the river level will be low and hence conditions will be suitable for land clearance and commencement of foundation works for the pump station. The scheme buildings, workshops, surfaced roads and electricity and water supplies should be completed as early as possible so that the scheme management can proceed with recruitment and training of staff. Initial bush clearance should proceed as quickly as possible followed by survey teams to enable the final canalisation layout to be drawn up and detailed designs completed. The clearance teams should clear the village and pump station areas as a first priority to facilitate farmers living within the scheme area to be moved as soon as possible. Earthworks and minor structures are scheduled to avoid the months with the highest rainfall and to provide for completion of essential works to permit the planting of the groundnut crop in the 'Gu' season of year 2. The decortication plant will be required for the first groundnut harvest and it is anticipated that the whole of the project will be under crops in September of year 2. Table 4.1 gives the proposed phasing of works and structures.

TABLE 4.1 Summary of Construction Cost Estimates and Construction Programme

Description	Amount 000 Shs.	Foreign Exchange 000 Shs.	Commence-ment	Completion
Irrigation Works, Buildings and Services				
Preparatory Work	58.6	35.2	Feb. Yr 1	June Yr 1
Purchase of Land and Compensation	160.0	-		Jan. Yr 1
Pump Station	1,561.5	1,157.8	Jan. Yr 1	Jan. Yr 2
Canal Headreach and Pool	57.6	10.0	Nov. Yr 1	Feb. Yr 2
Distributaries Earthworks	1,179.6	530.8	Aug. Yr 1	Jul. Yr 2
Structures	607.8	334.3	Aug. Yr 1	Jul. Yr 1
Drains	415.8	200.9	Jan. Yr 2	Aug. Yr 2
Workshops	100.0	80.0	Apr. Yr 1	Apr. Yr 2
Management Building	759.9	384.0		
Other Buildings(1)	(57.3)	(24.6)	Apr. Yr 2	Aug. Yr 2
Water Supply	411.8	226.5	Jan. Yr 1	Jul. Yr 1
Electricity Supply	134.5	108.8	Feb. Yr 1	Jul. Yr 1
Communications	695.0	364.8	Mar. Yr 1	Apr. Yr 2
Sub-Total	6,142.1	3,433.1		
Agricultural Processing Plant	150.0	132.0	Apr. Yr 2	Aug. Yr 2
Land Preparation	2,651.0	1,325.5	Jan. Yr 1	Mar. Yr 2
Agricultural Equipment	2,292.3	2,240.3		By Dec. Yr 1
Contingencies	1,123.5	713.1	-	-
Engineering and Supervision	1,336.0	890.7	-	-
Project Total	13,694.9	8,734.7		

Footnote: (1) Other Buildings are supplied by Government and are not included in the project total.

4.2 Annual Operation and Maintenance Costs

The annual costs of the scheme for years 1, 2 and 3 are summarised in Table 4.2. The costs for year 3 are the annual charges for the fully developed scheme except for minor variations. These annual costs do not include loan servicing charges or charges for replacement of equipment which are dealt with separately in the economic analysis. Costs directly chargeable against individual crops are also omitted including attributable costs of operating agricultural machinery. These have been allowed for in assessing the gross margins of the individual crops which are shown in Chapter 5, Tables 5.2 to 5.4.

Minor variations in the cost of senior management due to replacement of expatriates by local personnel after year ten have been allowed for in the economic analysis but are not shown in the summary table.

Detailed construction cost estimates and annual operation and maintenance costs are tabulated as appendices to the Technical Annex accompanying this report.

TABLE 4.2 Summary of Annual Operation and Maintenance Costs
Year by Year. Shs.

Year	1	2	3
Permanent Staff			
Senior Management	350,200	350,200	350,200
Other Personnel	196,700	494,400	517,600
Sub-Total	546,900	844,600	869,800
Works			
Pump Station	-	56,200	56,200
Distributary canals	-	50,930	50,930
Drains	-	18,000	36,000
Workshops, Buildings	-	54,420	54,420
Sub-Total		179,550	197,550
Services			
Water and Electricity Supply	7,000	21,130	21,130
Communications	3,000	21,300	28,400
Decortication Plant	-	13,000	13,000
Agricultural Equipment	50,000	73,560	73,560
Miscellaneous	-	25,000	25,000
Sub-Total	60,000	153,990	161,090
Total	606,900	1,178,140	1,228,440

CHAPTER 5

ECONOMIC AND FINANCIAL EVALUATION

5.1 Benefits

The direct measurable benefits of the Afgoi-Mordile Controlled Irrigation Project to the economy of Somalia consist of the gross value of the crops produced less the economic cost of producing them. Other direct but not easily measurable benefits are the net foreign exchange savings generated by domestic production and the net increased factor (labour, management, capital) income of the external servicing organisations (transport, processing, suppliers of agricultural inputs, etc.) to the project. Finally there is the multiplier effect on the community income as a result of the initial increase in income generated by the project. The initial income to the farmers from the project leads to an increased demand for goods and services by the farmers which in turn leads to a secondary increase in income to the suppliers of these goods and services which results in a further increased demand. However, without adequate statistical information it is not possible to put a numerical factor to this multiplier effect and it can only be stated generally that to the extent the increased income from the project does not lead to import buying and non-productive saving the investment will have a multiple effect on the income of the community.

The indirect benefits are the impact the project will have if successfully implemented upon the general level of development. It is difficult to anticipate what this impact will be since it depends upon the quality of the response to the opportunities opened up by the project, by the people involved both directly and indirectly. Generally it can be stated that the Project will provide the Somali farmer with experience of controlled irrigated farming of rice, cotton and groundnut. Successful growing of these crops on one scheme could have a significant impact on the whole farming community in both rainland and irrigated sectors by

these crops would also require that crop handling, processing and marketing facilities are efficiently run. Efficient organisation of these facilities is difficult at the moment because production is poorly organised. In turn production is inhibited due to lack of adequate transport, processing and marketing facilities. If the latter are provided with a production base on which to organise effectively this could also benefit producers outside the Afgoi area. Profitable growing, milling and marketing of rice from the Project would be of particular importance as there is a large import demand for rice and there is a strong interest among the farming community in promoting domestic production.

5.2 Valuation of Direct Measurable Benefits

Benefits have been valued at the shadow prices given in Table 3.1. The shadow price is an attempt to provide a competitive norm in the light of present world and domestic market conditions, around which, it is thought the price for produce will tend to fluctuate in Somalia. Distortions due to present high sea freight costs, and lack of efficient harbour facilities are difficult to compute. Possibly, in the future, freight and harbour handling costs will be reduced resulting in a higher theoretical export price. The import price of competitive commodities would at the same time be lowered and since the Project output will be consumed domestically no adjustment has been made to present costs. A risk factor should also be incorporated in the shadow prices to allow for unforeseen circumstances in world markets which could lead to a depression in price. It is important that the net benefits of the scheme in the early years, when the major difficulties of successful implementation are faced, should not be overstated.

The economic rate of return is calculated in terms of the present value of benefits and costs over the project life. The present value of benefits in the earlier years is greater than later years and it is therefore essential that benefit valuation should allow for the period when the risk

therefore tends to be the most conservative value of the calculated range.

5.3 Valuation of Costs

a) Internal Costs

(i) Imported Inputs

These have been valued at their current c.i.f. cost, plus a dealer margin and transport charges to the project area. This slightly overstates the cost to the economy since there is an element of increased factor earnings which should be included as a benefit. It has not been possible to separate these increased earnings from cost and only in the case of fertilisers where the quoted delivered price is high compared with c.i.f. cost has an adjustment been made to allow for bulk deliveries.

(ii) Labour

Preliminary investigations indicate that hired labour is relatively scarce in the riverain areas, although preliminary statistical surveys carried out by the Ministry of Planning indicate considerable under employment in certain areas to the south and west of the Afgoi-Genale area. The norm quoted for hiring a man for 6 hours in the Afgoi area is 3.50 shillings although in times of scarcity it is claimed labour can cost 10.0 shillings for a ten hour man-day. The cursory socio-economic survey of the project area found that during slack periods farmers would accept casual labour employment for Shs. 2.50 per day. From the findings of this study an average man-day input and an average income from 2.3 hectares of cultivation was calculated as shown in Table 5.1. This income divided by the man-day input gives a cost of approximately 2.50 shillings per man-day. It has been assumed that this figure represents the opportunity cost of labour which indicates the value

of farm production which will be lost to the economy of Somalia by withdrawing farm labour from the present occupation and resettling on the Project.

TABLE 5.1 Rainland Farm Income and Labour Inputs in the Afgoi Area

	Average Yield kg. per hectare	Project Price Shs. per 100 kg.	Average hectares cultivated	Average crop income	Total man-day input of 6 hrs.
Maize	400	35	2.3	322	340
Sorghum	400	35	2.3	322	
Sesame	100	120	2.3	120	
Other Products	-	-	-	50	
			Total	814	340

(iii) Local Management Personnel

Managerial staff recruited locally have been charged at current market rates, as it is impossible to state what the true opportunity cost is. As there is an acute shortage of skilled staff at almost all levels, which is likely to grow in the short term, the salary scales used may understate their opportunity cost to the economy. To a certain extent this understatement of costs is balanced by a corresponding overstatement of external costs discussed below.

(iv) Depreciation of equipment has not been deducted as a current cost but is included in the internal rate of return calculations when the net benefits are compared with the initial investment and the annual cost of replacement.

b) External Costs

These have been overstated since there is a factor income element which, although it is a cost to the project, is also a benefit to the economy. In the case of new processing facilities

for the project (rice milling) or industries which have to be substantially re-equipped (cotton ginning) it has been assumed, where the throughput is small, that the ratio of profit (benefit) to the extra cost involved will be the same as the ratio of benefit to cost on the project and will thus not significantly alter the rate of return. The case of oilseed processing is different since present capacity is under utilised and costs of processing will not rise in proportion to increased throughput. Processing costs have therefore been adjusted to what are thought to be reasonable levels compared with experience elsewhere for the estimated level of throughput.

Transport rates quoted vary considerably according to road conditions and the facilities provided by the haulier. There is no evidence that present facilities are under utilised and Sh. 0.95 per ton kilometre has been taken as the competitive rate for carrying produce from the Afgoi-Mordile Project.

5.4 Crop Returns per Hectare

The crop production costs and returns per hectare given in Tables 5.2 to 5.4 show the gross revenue per hectare less the direct crop production costs and therefore indicate the relative profitability of different crops. These crop returns should not be confused with the financial return to the farmer since they represent the net direct benefit before the deduction of the annual charges of the scheme. Thus although the opportunity cost of the farmer's labour is deducted from the gross returns, since there is a cost of withdrawing him from his previous employment, it is not a deductable cost to him personally and is therefore added back in the analysis on farm income. Depreciation of agricultural and irrigation equipment is also ultimately charged to the farmer but this is taken into account in the discounting procedures of replacement and annual costs and are not therefore itemized in the crop returns for the economic analysis. In calculating the returns, maximum inputs have

maximum yields will not be achieved until the fifth cropping year. This allows for a running-in period during which the farmer can develop the aptitudes and skills necessary for controlled irrigation farming and will enable management to overcome any organisational problems. The variable costs of mechanical operations have been assessed and are allocated to the individual crops. Seed has been charged at the farm gate price plus a margin for storage and treatment and fertilisers have been charged at the bulk delivery rate excluding duty. Bags have been costed on the assumption that 50 per cent will be replaced each year. Working capital charges are based on Shs. 600 for annual subsistence plus credit for seeds, bags, fertilisers and chemicals.

TABLE 5.2 Cotton crop returns and production costs in Somali Shillings (rounded figures) per hectare)

Cropping Year	1	2	3	4	5
Yield (kg/ha)	700.00	800	1,100	1,200	1,500
Price (So.Sh/kg)	1.00	1.00	1.00	1.00	1.00
Gross revenue (So.Sh.per ha)	700.00	800.00	1,100.00	1,200.00	1,500.00
Production Costs					
Seed (25 kg/ha @ 40 cts/kg)	10.00	10.00	10.00	10.00	10.00
Fertiliser (100 kg/ha @ 850 Sh. MT)	85.00	85.00	85.00	85.00	85.00
Aerial spraying four sprayings @ 45 shs. per ha)	180.00	180.00	180.00	180.00	180.00
Bags @ 3 shillings each	57.00	36.00	54.00	54.00	60.00
Interest on working capital	19.00	19.00	19.00	19.00	19.00
Labour (96 MD family; 25 MD hired @ 2.50 per day	223.00	255.00	270.00	285.00	303.00
Mechanisation[6]	69.00	69.00	69.00	69.00	69.00
Total cost per hectare	643.00	654.00	687.00	702.00	726.00
Profit per hectare (before deduction of annual management charges)	57.00	146.00	413.00	498.00	774.00

TABLE 5.3 Rice crop returns and production costs in Somali Shillings (rounded figures) per hectare

Cropping Year	1	2	3	4	5
Yield (kg/ha)	1,000	1,400	1,800	2,200	2,500
Price (So. sh. per kg)	0.60	0.60	0.60	0.60	0.60
Gross revenue per hectare	600.00	840.00	1,080.00	1,320.00	1,500.00
Production Costs					
Seed (100 kg/ha @ 80 cts kg)	80.00	80.00	80.00	80.00	80.00
Fertiliser (150 kg/ha @ 850 sh. MT)	128.00	128.00	128.00	128.00	128.00
Herbicides	100.00	100.00	100.00	100.00	100.00
Bags @ 3 sh. each	48.00	42.00	54.00	60.00	60.00
Interest on working capital	19.00	19.00	19.00	19.00	19.00
Labour (27 MD family, 6 MD hired @ sh. 2.50 per day	83.00	83.00	83.00	83.00	83.00
Mechanisation	124.00	124.00	124.00	124.00	124.00
Total Cost	582.00	576.00	588.00	594.00	594.00
Profit per hectare (before deduction of annual management charges)	18.00	264.00	492.00	726.00	906.00

TABLE 5.4 Groundnut crop returns and production costs in Somali shillings (rounded figures) per hectare

Cropping Year	1	2	3	4	5-40
Yield (kg/ha shelled)[1]	870.00	870.00	1,090.00	1,090.00	1,310
Price (So. Sh. kg)	0.70	0.70	0.70	0.70	0.70
Gross revenue	609.00	609.00	763.00	763.00	917.00
Production Costs					
Seed (100 kg/ha @ 90 cts kg)	90.00	90.00	90.00	90.00	90.00
Fertiliser (100 kg @ 850 sh. M.T.)	85.00	85.00	85.00	85.00	85.00
Bags @ 3 sh. each	60.00	30.00	45.00	45.00	45.00
Interest on working capital	14.00	14.00	14.00	14.00	14.00
Labour (51 Man days family man days hired @ 2.50 P.M.D.	133.00	133.00	133.00	133.00	133.00
Mechanisation	78.00	78.00	78.00	78.00	78.00
Total cost	460.00	430.00	445.00	445.00	445.00
Profit per hectare (before deduction of annual management charges)	149.00	179.00	318.00	318.00	472.00

Note: [1] A shelling out percentage of 61% has been taken.

5.5 Internal Rate of Return

The internal rate of return is calculated by projecting the direct benefits and costs, including the initial investment and replacement costs, and selecting the discount rate which equalizes the present discounted value of these benefits and costs over the project life. This discount rate is the internal rate of return of the project and expresses the ratio of benefits to costs over the project life in terms of an annual rate of interest earned on capital and thus provides some measure of the efficiency of the investment.

Table 5.5 shows the net cost/benefit stream projected over 40 years, the assumed life of the project. The gross benefit streams have been calculated by multiplying the gross revenue per hectare from cropping years 1-5 assuming that 50 per cent of the cultivable area will be settled in each of the project years 2 and 3. Crop production costs for cotton, rice and groundnuts have been similarly derived and deducted from the gross benefit stream to give the net benefit stream for these crops. To this net benefit stream has been added an assumed equivalent net return of Shs. 2000 per hectare for produce from the homestead lots for the farmers own consumption and a net return of Shs. 4000 per hectare for the 7 hectares of vegetable production. The costs of the investment are shown in Table 4.1 and replacement of equipment and the annual costs of irrigation and agricultural management as summarised in Tables 5.6 and 5.7 are then deducted from the net benefit stream to give the net projected cash flow of the project. These net disbursements and receipts over the project life are converted to their present value using compound interest factors and the rate of interest which equalizes the present value of disbursements and receipts is the internal rate of return which in the case of the Afgoi-Mordile Project is approximately 8 per cent. A cost benefit ratio has also been worked out by discounting costs and benefits at 7 per cent (the normal international lending rate for development projects) giving a ratio of 1:1.08.

Afgoi-Mordile Project Internal Rate of Return

Farm gate value rice	Farm gate value cotton	Farm gate value groundnut	Net Benefits Homestead Lots	Total Benefits	Crop Production Costs			Total	Net Benefits	Annual Management cost	Investment	Replacement	Net cost/ benefit
					Labour	Mechanisation	Other						
450.000	525,000	456,750	68,000	1,499,750	238,500	203,250	731,250	1,273,900		649,400	13,694,900		-14,344,300
080,000	1,125,000	913,500	136,000	3,224,500	691,500	406,500	1,419,750	2,517,750	366,750	1,294,240			- 927,490
440,000	1,425,000	1,029,000	164,000	4,058,000	717,750	406,500	1,410,750	2,535,000	706,750	1,380,640			673,890
600,000	1,725,000	1,144,500	164,000	4,833,500	740,250	406,500	1,449,000	2,595,750	1,523,000	1,383,840			139,160
115,000	2,025,000	1,260,000	164,000	5,564,000	765,500	406,500	1,458,000	2,630,000	2,237,750	1,357,040		285,200	595,510
256,000	2,250,000	1,375,000	164,000	6,039,000	778,500	406,500	1,467,000	2,652,000	2,934,000	1,285,440			1,648,560
									3,387,000	1,278,740		1,341,680	766,580
										1,247,440			2,139,560
										1,247,440			2,139,560
										1,271,440		435,800	1,679,760
										1,221,840			2,165,160
										1,221,840		665,460	1,499,700
										1,221,840			2,165,160
										1,221,840		1,341,680	823,480
										1,245,840		285,200	1,855,960
										1,140,240			2,226,760
										1,140,240			2,226,760
										1,140,240			2,226,760
										1,140,240			2,226,760
										1,184,240		1,662,900	539,860
										1,091,240		1,341,680	954,080
													2,295,760
													2,295,760
												680,000	1,615,760
												285,200	2,010,560
													2,295,760
													2,295,760
												1,341,680	954,080
													2,295,760
												435,200	1,860,560
													2,295,760
													2,295,760
													2,295,760
													2,295,760
												1,626,880	665,910
												484,000	1,811,760
													2,295,760
													2,295,760
													2,295,760
													2,295,760

Internal Rate of Return = 8 per cent.

TABLE 5.6 Equipment Replacement Schedule Showing Value in Shs.

Year	Agricultural Equipment	Decorticating Plant	Mechanical Plant and Water Supply	Total
5	285, 200			285, 200
7	1, 341, 680			1, 341, 680
10	285, 200	150, 000		435, 200
12	665, 440			665, 440
14	1, 341, 680			1, 341, 680
15	285, 200			285, 200
20	285, 200	150, 000	1, 227, 700	1, 662, 900
21	1, 341, 680			1, 341, 680
24	680, 000			680, 000
25	285, 200			285, 200
28	1, 341, 680			1, 341, 680
30	285, 200	150, 000		435, 200
35	1, 626, 880			1, 626, 880
36	484, 000			484, 000

TABLE 5.7 Project Annual Management Costs

	Managerial Staff	Other Staff	Works	Services	Int. on[1] Working Capital	Total
1	350, 200	196, 700		60, 000	42, 500	649, 400
2	350, 200	494, 400	142, 330	148, 930	106, 100	1, 093, 030
3	350, 200	517, 600	160, 330	163, 030	154, 200	1, 345, 360
4	350, 200	517, 600	160, 330	163, 030	157, 400	1, 348, 560
5	350, 200	517, 600	160, 330	163, 030	130, 600	1, 321, 760
6	350, 200	517, 600	160, 330	163, 030	59, 000	1, 250, 160
7	350, 200	517, 600	160, 330	163, 030	52, 300	1, 243, 460
8	350, 200	517, 600	160, 330	163, 030	21, 000	1, 212, 160
9	350, 200	517, 600	160, 330	163, 030	21, 000	1, 212, 160
10	374, 200	517, 600	160, 330	163, 030	21, 000	1, 236, 160
11-14	324, 600	517, 600	160, 330	163, 030	21, 000	1, 186, 560
15	348, 600	517, 600	160, 330	163, 030	21, 000	1, 210, 560
16-19	262, 000	517, 600	160, 330	163, 030	21, 000	1, 104, 960
20	287, 000	517, 000	160, 330	103, 030	21, 000	1, 148, 960
21-40	194, 000	517, 600	160, 330	163, 030	21, 000	1, 055, 960

N.B.: [1] Based on yearly net cash requirements at 7% until year 7 and on net cash requirements in per season only thereafter.

5.6 Financial Evaluation

The total net farm income in project year 6 is shown in Table 5.8 below. To establish the level of farm income which will attract a settler to a controlled irrigation project is difficult in Somalia because there is so little information on present farm incomes. A net farm income of Shs. 2, 500 has been selected as the minimum level, compared with the present level reported in the Afgoi Socio-economic survey, which will give the settler the incentive to make the additional effort required. If this minimum level is acceptable this would leave a surplus from the sixth

project year of Shs. 709 annually, per holding, which could be assigned to debt service of the loan required for the project, and would give a total annual surplus including income from 7 hectares of vegetable production of Shs. 560, 000.

TABLE 5.8 Farm Income from a 4 ha. Holding in the 5th Cropping Year

	Shillings
Net revenue Groundnuts	944
Net revenue Cotton	1, 548
Net revenue Rice	1, 812
Net revenue Homestead Lots	181
Add back cost of family labour	873
Total Farm Income	5, 358
Deduct Irrigation, Management and Replacement costs	2, 149
Total Net Farm Income	3, 209

In view of the present difficulties in raising local finance as stated in the Short Term Development Plan, it has been presumed that foreign exchange will be required for the total investment. If such a loan were negotiated on normal terms for long term development capital this would mean that Somalia would have to find Shs. 1, 027, 254 annually in foreign exchange to meet project debt service commitments. A very preliminary estimate of the exchange saving generated by the Project shown in Table 5.8 indicates an amount of approximately Shs. 3, 300, 000 annually, sufficient to cover these commitments.

At the present time however it is extremely difficult to raise revenues from domestic taxation, the internal budget is balanced with grant aid from abroad and implementation would lead to a loss of Shs. 1, 500, 000 in revenue from import duties. The project would therefore, if financed on normal loan terms, place a further burden in the early years on Somalia's already difficult internal revenue and foreign

TABLE 5.6 Equipment Replacement Schedule Showing Value in Shs.

Year	Agricultural Equipment	Decorticating Plant	Mechanical Plant and Water Supply	Total
5	285, 200			285, 200
7	1, 341, 680			1, 341, 680
10	285, 200	150, 000		435, 200
12	665, 440			665, 440
14	1, 341, 680			1, 341, 680
15	285, 200			285, 200
20	285, 200	150, 000	1, 227, 700	1, 662, 900
21	1, 341, 680			1, 341, 680
24	680, 000			680, 000
25	285, 200			285, 200
28	1, 341, 680			1, 341, 680
30	285, 200	150, 000		435, 200
35	1, 626, 880			1, 626, 880
36	484, 000			484, 000

TABLE 5.7 Project Annual Management Costs

	Managerial Staff	Other Staff	Works	Services	Int. on Working Capital [1]	Total
1	350,200	196,700		60,000	42,500	649,400
2	350,200	494,400	142,330	148,930	106,100	1,093,030
3	350,200	517,600	160,330	163,030	154,200	1,345,360
4	350,200	517,600	160,330	163,030	157,400	1,348,560
5	350,200	517,600	160,330	163,030	130,600	1,321,760
6	350,200	517,600	160,330	163,030	59,000	1,250,160
7	350,200	517,600	160,330	163,030	52,300	1,243,460
8	350,200	517,600	160,330	163,030	21,000	1,212,160
9	350,200	517,600	160,330	163,030	21,000	1,212,160
10	374,200	517,600	160,330	163,030	21,000	1,236,160
11-14	324,600	517,600	160,330	163,030	21,000	1,186,560
15	348,600	517,600	160,330	163,030	21,000	1,210,560
16-19	262,000	517,600	160,330	163,030	21,000	1,104,960
20	287,000	517,000	160,330	103,030	21,000	1,148,960
21-40	194,000	517,600	160,330	163,030	21,000	1,055,960

N.B.: [1] Based on yearly net cash requirements at 7% until year 7 and on net cash requirements in per season only thereafter.

5.6 Financial Evaluation

The total net farm income in project year 6 is shown in Table 5.8 below. To establish the level of farm income which will attract a settler to a controlled irrigation project is difficult in Somalia because there is so little information on present farm incomes. A net farm income of Shs. 2,500 has been selected as the minimum level, compared with the present level reported in the Afgoi Socio-economic survey, which will give the settler the incentive to make the additional effort required. If this minimum level is acceptable this would leave a surplus from the sixth

project year of Shs. 709 annually, per holding, which could be assigned to debt service of the loan required for the project, and would give a total annual surplus including income from 7 hectares of vegetable production of Shs. 560, 000.

TABLE 5.8 Farm Income from a 4 ha. Holding in the 5th Cropping Year

	Shillings
Net revenue Groundnuts	944
Net revenue Cotton	1, 548
Net revenue Rice	1, 812
Net revenue Homestead Lots	181
Add back cost of family labour	873
Total Farm Income	5, 358
Deduct Irrigation, Management and Replacement costs	2, 149
Total Net Farm Income	3, 209

In view of the present difficulties in raising local finance as stated in the Short Term Development Plan, it has been presumed that foreign exchange will be required for the total investment. If such a loan were negotiated on normal terms for long term development capital this would mean that Somalia would have to find Shs. 1, 027, 254 annually in foreign exchange to meet project debt service commitments. A very preliminary estimate of the exchange saving generated by the Project shown in Table 5.8 indicates an amount of approximately Shs. 3, 300, 000 annually, sufficient to cover these commitments.

At the present time however it is extremely difficult to raise revenues from domestic taxation, the internal budget is balanced with grant aid from abroad and implementation would lead to a loss of Shs. 1, 500, 000 in revenue from import duties. The project would therefore, if financed on normal loan terms, place a further burden in the early years on Somalia's already difficult internal revenue and foreign exchange position. Even in the sixth year of development when the project

TABLE 5.9 Annual Identifiable Foreign Exchange Costs and Returns
(Current c. i. f. Prices in Shs.)

Foreign Exchange Costs		Import Substitution Savings	
1. Project Costs			
Fertiliser	338,000	Rice	2,339,400
Bags	165,000	Cotton	3,152,000
Herbicides	145,000	Groundnut oil	1,572,000
Agric. Equipment		Cotton seed oil	416,000
Running & maintenance	500,000	Total gross saving	7,479,400
Cereal spraying	270,000		
Expatriate staff	270,000		
Replacement	400,000		
Running & maintenance Mech. Plant	90,000		
Total Annual Cost	2,178,000		
2. External Facilities			
Re-equipment running & maintenance of processing facilities	500,000		
Other	500,000		
3. Estimated Increased Import buying	1,000,000		
Total estimated increase in Foreign Exchange outflow	4,178,000		

Loss of revenue from Import duties 1,542,000.

could develop a surplus sufficient to meet approximately 50 per cent of debt service requirements this would still leave Shs. 467, 000 annually to find from other sources as well as the loss in import duties to make up. Presumably the main tax burden would have to fall on the external facilities directly benefiting from the project. Even assuming an efficient tax collection system is in operation by that time it is unlikely that the processing facilities would be competitive enough to absorb that burden.

Since Somalia's debt service ratio is extremely high it has been argued in the Short-Term Development Plan that foreign debt will need extensive rescheduling and further debt commitments will have to be negotiated on concessionary terms. If the Afgoi Controlled Irrigation Project were considered as a soft-loan project on terms of a $1\frac{1}{2}$ per cent service charge on loan capital the annual debt service requirements would be Shs. 457, 820. If a loan could be negotiated for the project on these terms, this would mean, given satisfactory performance on implementation, that the project would be self-financing.

5.7 Conclusion

At an 8 per cent rate of return the Afgoi Controlled Irrigation Scheme is only of marginal viability in present economic conditions in Somalia, where, because of difficulties in raising revenues through general taxation and heavy foreign debt service commitments, projects should as far as possible be self-financing. Even on soft-loan terms there is little margin for error between projected and actual performance upon implementation. Little recorded knowledge of present farming conditions exists and agricultural research is only in the early stages. This makes projection of performance under improved conditions hazardous, while the ability of the external servicing facilities to meet the projected farm performance has also yet to be proved.

For the above reasons it is recommended that a pilot project should be implemented initially. This would provide both the opportunity to check actual performance and time to recognise and examine any major problems which might arise in connection with the introduction of the

CHAPTER 6

DEVELOPMENT PRIORITIES, LAND, WATER AND CROPS LEGISLATION AND IMPROVED GOVERNMENT SERVICES REQUIRED

6.1 Priorities for Development

In view of the limited resources available for agricultural development in Somalia, and particularly the scarcity of capital and skilled manpower, it is necessary that development planning should channel these resources into those projects giving the best and quickest economic return. Since present data on which to determine such priorities is often lacking it is essential that the relevant data be collected in order that the Ministry of Planning may establish priorities between development projects for the allocation of the nations resources.

Within the Shebelli Valley a number of development alternatives require to be considered in deciding the priority of the Afgoi-Mordile project. The possibility of an off-river storage and flood control scheme above Johar has been investigated. This scheme would extend the irrigation season, provide irrigation water for about 11 months for the banana crop in most years and permit the development of an additional area of 30, 000 ha. of irrigated crops similar to those proposed for Afgoi-Mordile. This storage would maintain appreciably higher flows in the river during the period when natural flow is low thus appreciably reducing the required maximum pump lift and resulting in some economies in the capital cost and operation of pumps for the Afgoi-Mordile Project. There would thus be an advantage in delaying development until completion of the storage project.

The Balad Flood Irrigation Project which has been studied appears economically equally attractive with the Afgoi-Mordile Project but its implementation is likely to raise problems of settlement and farmer training and as it is wasteful of water appears less attractive than controlled irrigation.

Its implementation would be impossible if the Johar offstream storage and flood control proposal were implemented so that a 7,000 ha. flood irrigation development would preclude the development of some 30,000 ha. of controlled irrigation but give a marginally higher internal rate of return.

It is only within the national and regional context that the place of the Afgoi-Mordile Project, in terms of development priority, can be considered but whether or not the project should proceed in the near future could have important repercussions on subsequent development.

6.2 Land, Water and Crops Legislation

No land law has yet been approved by the Somali Government although the need for such a law has been stressed many times by previous development studies. Any attempt to limit the area which an individual may own is certain to meet with opposition from the present influential owners of very extensive areas. Traditional cultivation rights over considerable areas are also claimed by tribal groups although only a small proportion of such areas are cultivated at any one time. In order to increase productivity the reallocation of at least part of the presently uncultivated areas is desirable but would meet with considerable opposition.

A satisfactory land law should result in an increase in the area available for cultivation and protect the interests of both landlord and tenant cultivator in order to promote greater productivity. To do so it should provide for;

a) The classification of land suitability and in the case of land suitable for crop production establish state powers to requisition and redistribute such land if crops have not been grown during a statutory period of time. perhaps 2 years.

b) The right of land-owners and tenants to compensation when land under cultivation is requisitioned by the government for any purpose and to provide the machinery for assessing the level of such compensation and for arbitration in cases of dispute.

c) The need for tenants on cultivated holdings to achieve a satisfactory standard of crop husbandry and where this is not done to enable landlords to take necessary measures including possible eviction.

d) The right of tenants who follow good husbandry practices and cultivate their holdings in accordance with the conditions laid down in their tenancy agreement to security of tenure.

Unless such legislation is passed by the government the establishment and operation of the Afgoi-Mordile Project as envisaged in this report is unlikely to prove successful.

A law No. 13 dated August 1, 1966 concerning the Organisation of Water at present exists.

This law was the result of a study carried out on behalf of the United Nations in 1963/64 by Dante A. Caponera whose report to the Government of Somalia on Water Legislation and Administration was published by F.A.O., in Rome in 1964.

Although the law was drafted in Italian an English translation was obtained and studied during the course of the present project. The law is fairly comprehensive but there is no evidence that any attempt has been made to carry out the provisions it contains.

Had the suggested Register of Users Article 7 been prepared by the Water Department an accurate assessment of the present use or entitlement could have been made.

Article 10 allows for a water permit to be revoked if amongst other reasons the user misuses his right, abandons it for more than one year or fails to pay the required water fee. Had these conditions been observed a number of existing users would already have forfeited any rights they may have held in the past.

The Regulations that accompany the law have been drafted but so far have not been issued. It is essential that these are put into force as

The Law and the Regulations must be enforced to ensure that users with the prior right receive a supply. It is appreciated that during the initial years an Irrigation Department established on the lines proposed in Volume IV is going to experience difficulty in providing the degree of control required along the river. However without control the planning of any major irrigation project cannot proceed, with any certainty of successful implementation.

The point has been reached where the water control and management of the Shebelli River must now become effective to allow the maximum development of irrigable land for the benefit of the population along the river and to the advantage of Somalia as a whole.

The fees received each year from the farmers would assist in supplying the revenue necessary to administer the proposed Irrigation Department.

The control of pests, diseases and pernicious weeds in crops is essential to maintain high levels of productivity. Failure by a farmer to execute control measures can often prejudice not only his own crop but those of neighbouring farmers. In the case of more serious pests and diseases on crops of national importance legislation regarding control of pests and diseases is from time to time necessary. Such legislation is however useless unless the personnel are available to ensure enforcement. The existing legislation restricting the cotton season and requiring adequate clearing of the crop residues should be modified to suit the conditions of the proposed Afgoi-Mordile Project and the machinery for its enforcement established.

6.3 Improvement of Agricultural Services

At present the Agricultural Extension, Training and Crop Protection services are relatively ineffective. This is due to:

a) Shortage of trained and experienced field staff and lack of motivation among staff generally.

b) Lack of funds to provide transport and essential facilities for staff to execute their duties in the field.

These are problems which affect the Civil Service to a greater or lesser extent throughout government. In Somalia financial stringency is likely to continue in the foreseeable future and improvement must be brought about by the concentration of available resources in those fields of production which will give the greater return. The elimination of unproductive staff, continued training with an emphasis on practical rather than theoretical aspects, establishment of discipline and motivation of individuals with a sense of responsibility and a desire for progress is essential if an effective service is to be provided.

Besides the direct crop production field of Government services the Afgoi-Mordile Project will require assistance from Government Departments dealing with Local Government, Health, Housing, Water Supplies, Communications and Commerce and Industry. Such a wide range of activities must result in some degree of inter-departmental conflict but such difficulties must be overcome.

6.4 Agricultural Research

At present agricultural research has concentrated on the selection of crops and varieties suitable for cultivation and relatively little data is available on production techniques and their cost effectiveness. The investigation of irrigation practices under local conditions of soil and climate should be accorded a high priority in view of the general lack of information at present on crop water requirements. During the course of agricultural development including the establishment of the Afgoi-Mordile Project numerous practical problems in the field of crop production will arise and the research services must be ready to utilise their resources in the solution of these difficulties as rapidly as possible.

The recognition of such problems, the execution of research into possible solutions and the dissemination of resulting new and improved methods of crop production requires the closest possible liaison between

production management and the research and extension services.

It is unfortunate that the United States A.I.D. participation in the operation of the Afgoi Research Station is being withdrawn over the next three years. Sufficient local staff with suitable experience and qualifications to operate the research station are not available, especially in view of the need for such personnel in other fields of agricultural development. The present uncertainty over the future of the Afgoi Research Station and agricultural research in Somalia generally could have an adverse effect on agricultural development. It would be expedient for international assistance to be provided through the auspices of the United Nations to ensure the continuation of the research services and avoid any rundown during the period when the present Wyoming University team withdraw.

6.5 Co-operatives and Credit

A law on Co-operative Societies was promulgated early in 1969 which defines a Co-operative Society as:

> "An association of persons ---------- in which members actively participate.
> Except as provided otherwise in the ordinance ------- the village shall be the natural unit on which the co-operatives shall be based.
> A co-operative may cover one or more villages."

With certain outstanding exceptions it would appear that co-operatives formed in the past were never based on the philosophy and organisation normally associated with the movement. Groups of people formed associations with the main object of receiving financial assistance, either from foreign agencies or from the Government. Money was allocated more in faith than on the submission of a technically and economically sound development plan. Even when the enterprise was reasonable, a large proportion of the funds allocated were never used for the purpose for which they were intended.

In the more isolated areas away from the impact of the entrepreneur associations have however begun to develop which, providing they can be transformed into co-operatives within the meaning of the Ordinance (and entrepreneurs excluded) may flourish, assuming individual and collective responsibilities are recognised and where technical guidance is given.

It must be emphasised that although a great deal has been written in the past about the place of co-operatives in development in Somalia the concept of co-operatives in the real sense of the word is new to Somalia. Under the law providing it is scrupulously implemented and a co-operative advisory service is built up, a sound co-operative movement could be established. This will however take time and co-operatives are unlikely to become a major instrument for development in the foreseeable future.

At present no adequate arrangements exist for the provision of credit facilities to farmers. An Agricultural Credit Bank has been established but the Somali farmer generally lives in such poor circumstances that he is unable to find the security for loans without which any sound banking operation cannot operate. When credit has in the past been given without proper security for such things as seeds, fertilisers, pest control services by various govennment organisations, failure to repay has been the rule rather than the exception. The project envisaged in this report, giving as it does greater control over marketing of the farmers' produce opens up greater possibility for satisfactory credit arrangements and the farmer's tenancy agreement could include a clause requiring him to meet his credit liabilities with the ultimate threat of eviction in the event of his failing to do so.

Initially the advance of sufficient funds to meet the farmer's needs against completion of various cultural operations on the crops is envisaged together with provision of seeds, fertilisers and other necessities by the project, the advances being recovered when final payments for the farmer's produce are made at the end of the season. Allowance for these has been included in the economic assessment as an interest charge on working capital.

It is hoped however that as the farmer's standard of living rises and his agricultural techniques become more advanced he will learn to appreciate the value of satisfactory credit arrangements to finance improvements to his holding and increase its productivity. In order to promote such borrowing special arrangements might be made by the Credit Bank whereby preference rates of interest on loans might be given to tenants whose application was supported by the project management committee.