JAMHUURIYADDA DIMOQRAADIGA SOMAALIYA
WASAARADDA BEERAHA
SOMALI DEMOCRATIC REPUBLIC
MINISTRY OF AGRICULTURE

GENALE-BULO MARERTA PROJECT

VOLUME 1
Master Plan

Main Report

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Your Ref:

Our Ref: 457/1/1

Date: 28th August 1979

The Director General
Ministry of Agriculture
Mogadishu
SOMALI DEMOCRATIC REPUBLIC

Dear Sir

GENALE-BULO MARERTA PROJECT
MASTER PLAN REPORT

We refer to our meeting with you on 6th May 1979 and to your two letters dated 22nd May 1979 reference WB/X/15/3049 and 3051 approving the draft report subject to agreed adjustments being incorporated in the final report.

In accordance with Clause 1.5 of the Agreement for this Project we now have pleasure in enclosing 100 copies of the Final Master Plan Report and each of the supporting Annex Reports which incorporate the adjustments.

We should like to take this opportunity of recording our thanks and appreciation for the co-operation and assistance we have received from the Somali Authorities in carrying out this assignment.

Yours faithfully
SIR M. MACDONALD AND PARTNERS LIMITED

C. D. Fielder

C. D. Fielder

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PROJECT AREA AND STUDY AREA

This study contained two elements, a Master Plan covering 67 400 hectares and a feasibility study of 5 000 hectares.

Throughout the reports the term Study Area refers to the area covered by the Master Plan studies and the term Project Area is used for the feasibility study area.

ABBREVIATIONS USED IN THE REPORTS

ADB	African Development Bank
ADC	Agricultural Development Corporation
CARS	Central Agricultural Research Station - Afgooye
DAP	Diammonium phosphate
EDF	European Development Fund
ENB	National Banana Board
FAO	Food and Agriculture Organisation
FAO/PP	FAO Pilot Project (Afgooye - Mordiile Project)
HASA	Hides and Skins Agency
HTS	Hunting Technical Services Limited
HV	High volume (crop sprayer)
IBRD	International Bank for Reconstruction and Development (the World Bank)
ITCZ	Inter-tropical convergence zone
ITDG	Intermediate Technology Development Group (London)
JOSR	Jowhar Offstream Storage Reservoir
LDA	Livestock Development Agency
Libsoma	Libya-Somalia Agricultural Development Company
LSU	Livestock unit
LV	Low volume (crop sprayer)
MLFR	Ministry of Livestock, Forestry and Range
MMP	Sir M. MacDonald & Partners
NCA	Net cultivable area
NCB	National Commercial and Savings Bank (formerly National Commercial Bank)
ONAT	National Farm Machinery and Agricultural Supply Service
PLO	Palestine Liberation Organisation
SDB	Somali Development Bank
SNAI	Jowhar Sugar Estate
TDN	Total digestible nutrients
TDP	Total digestible protein
ULV	Ultra-low volume (crop sprayer)
UNDP	United Nations Development Programme
USBR	United States Bureau of Reclamation
USDA SCS	United States Department of Agriculture, Soil Conservation Service
WHO	World Health Organisation

SPELLINGS OF PLACE NAMES

Throughout the report Somali spellings have been used for place names with the exception of Mogadishu where the English spelling has been used. To avoid misunderstanding, we give below a selected list of Somali, English and Italian spellings where these differ.

Somali	English	Italian
Afgooye	Afgoi	Afgoi
Awdheegle	-	Audegle
Balcad	Balad	Balad
Baraawe	Brava	Brava
Buulo Mareerta	Bulo Marerta	Bulo Mererta
Falkeerow	-	Falcheiro
Gayweerow	-	Gaivero
Golweyn	-	Goluen
Hawaay	Avai	Avai
Hargeysa	Hargeisa	-
Janaale	Genale	Genale
Jelib	Gelib	Gelib
Jowhar	Johar	Giohar
Kismaayo	Kisimaio	Chisimaio
Marka	Merca	Merca
Muqdisho	Mogadishu	Mogadiscio
Qoryooley	-	Coriolei
Shabeelle	Shebelli	Scebeli
Shalambood	Shalambot	Scialambot

GLOSSARY OF SOMALI TERMS

Cambuulo	-	Traditional dish of chopped boiled maize with cowpeas or green grams.
Chiko	-	Chewing tobacco
Der	-	Rainy season from October to December
Dharab	-	Five jibals or approximately 0.31 ha
Gu	-	Rainy season in April and May
Hafir	-	Large reservoir on farms for storing water for use in dry periods
Hagai	-	Climatic season June to September characterised by light scattered showers
Jibal	-	Area of land approximately 25 m by 25 m or 0.0625 ha
Jilal	-	Dry season from January to April
Kawawa	-	Two man implement for forming irrigation ditches
Moos	-	Measurement of land area equal to a quarter of a jibal
Quintal	-	Unit of weight measurement equivalent to 100 kg
Uar	-	See hafir
Yambo	-	Small short-handled hoe
Zareebas	-	Thorn cattle pen

ACKNOWLEDGEMENTS

Sir M. MacDonald & Partners Limited wish to thank Hunting Technical Services Limited who carried out the agricultural and economic aspects of the study.

Thanks are also due to J.A. Storey & Partners who carried out the necessary ground control survey and photogrammetric mapping.

The Consultants retained on the grapefruit project provided useful information concerning their present assignment which was much appreciated.

The preparation of this report would not have been possible without the help of the Ministry of Agriculture and its staff, other Government officials, the staff of FAO, UNDP and the EDF delegate, all of whom so willingly gave of their time.

RATE OF EXCHANGE

Throughout the period of the study, the rate of exchange remained fixed at:

US $ 1.00 = SO. Shs. 6.295

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Citaco (Rome)	Final design for a grapefruit plantation, 1974
Dastane, N.G.	FAO Irrigation and Drainage Paper Nr 25, Effective rainfall in agriculture, 1974
Doorenbos, J. and Pruitt, W.O.	FAO Irrigation and Drainage Paper Nr 24, Crop water requirements (1975, revised 1977)
Fantoli, A.	Contributo alla climatologia della Somalia, 1975.
Hunting Technical Services Ltd	Project for the water control and management of the Shabeelle river, (UNDP Special Fund, 1969)
IBRD	Report of the IBRD Project Identification Mission, Nairobi, 1973
International Labour Organisation	Economic transformation in a socialist framework, Addis Ababa, 1976
Lockwood Survey Corporation	Agriculture and water surveys, FAO, Rome, 1968
Sir M. MacDonald & Partners	Jowhar offstream storage project, pre-design phase report, 1973
State Planning Commission	Annual development plan, 1976
State Planning Commission	Pre-feasibility study for a rice project, 1977

SUMMARY

1. Maximum irrigation within the Master Plan area is dependent upon the effective use of the three existing barrages. To accomplish this they must be well maintained. At present the Janaale barrage is in poor condition and measures should be put in hand to carry out the repairs and rehabilitation required.

2. The need for the formation of a Shabeelle River Authority, which has been recommended in previous reports, is again stressed. With the Jowhar project due to come into operation in 1979 and the extensive agricultural development existing or planned along the river, the Authority's role is clearly apparent.

3. In the gu season it is only possible to meet the present irrigation requirements in three years out of four. It is therefore strongly recommended that no expansion of gu cropping in the Lower Shabeelle Flood Plain be approved. The aim of any planning in the gu season should be to maximise the existing supplies by effective water control and use.

4. Apart from the EDF grapefruit project near Golweyn, any development of perennial crops in the Master Plan area should cease unless suitable supplies of good quality groundwater can be proven. Our studies have shown that this criterion is only met in the small area earmarked for the EDF project.

5. The banana industry in the Master Plan area has shown a marked decline in recent years. This we believe is due to technical, financial and marketing constraints.

6. It is considered that a study of the drainage problems in the banana growing areas is required and that field trials could be instituted quickly, in advance of any long term project. A review of the existing research and extension services at present provided by the National Banana Board should be carried out to determine how these might be improved to arrest the decline in yields.

7. The Master Plan area has been divided into separate projects suitable for improvement of irrigation with an integrated management structure. Development zones have also been identified where a more gradual improvement is recommended.

   The Qoryooley project is the subject of the feasibility study. The project includes a totally new irrigation system with farming managed by eight village co-operatives. A pilot farm for applied research and training has been incorporated. The internal rate of return for the feasibility study was 9.6% but for the sake of comparison the costs of the pilot farm have been omitted from this report. This raises the internal rate of return to 10.2%. It is recommended that the implementation of the Qoryooley project should start as soon as possible.

8. The banana drainage project shows the best economic return of the developments proposed for the Master Plan area. This is followed by the Golweyn project which is similar to the Qoryooley project which is the subject of the feasibility study. We recommend that the Qoryooley project be the first development since the project studies are far more advanced than any of the others and its implementation will assist in refining the criteria for other projects proposed.

9. The der flood project is a development of the principle of a single irrigation prior to planting of sesame. This is most profitable in the location selected and it is recommended that the feasibility study should start as soon as possible. This feasibility study could be undertaken with the initial studies for the banana drainage project.

10. It is recommended that in the development zones, where specific investment recommendations have not been made, the existing agricultural infrastructure should be improved. The office of the Regional Co-ordinator for Agriculture at Janaale should be fully staffed with trained personnel and the regional organisation of ONAT should be examined and extended so that it meets the requirements of smallholders.

11. It is considered desirable to make detailed surveys of areas in the Lower Shabeelle where development is planned. To expedite this, it is recommended that a similar arrangement to that previously operated by FAO, whereby an expatriate surveyor organised the training of Somali surveyors within the Ministry of Agriculture, should be revived. Surveys could be carried out as part of the training. Alternatively this could be done in conjunction with the Survey and Mapping Department of the Ministry of Defence.

12. When the Qoryooley pilot farm has been established, a small monitoring and evaluation unit should be formed to report on progress and identify constraints. The findings of this unit would be used to assist in future planning of developments. We consider this unit should be part of the State Planning Commission but that its work should initially be concentrated wholly in the Master Plan area.

13. There have been considerable changes in available market data etc. since 1971, when the report on the EDF grapefruit project was prepared. We believe that there should be another market survey for the grapefruit project. There should also be a reappraisal of the project to assess the effects of supplementary irrigation using groundwater which is moderately saline.

CHAPTER 1

INTRODUCTION

1.1 Location

The Study Area is located in the Lower Shabeelle Flood Plain and is almost the last area of cultivable land before the River Shabeelle enters the swamps. The area is approximately 100 km south-west of Mogadishu between longitude 44°30' and 45°00'E and latitude 1°30' and 2°00'N (Figures 1.1 and 1.2). It comprises an area of 67 400 ha measuring approximately 40 km by 20 km and the River Shabeelle runs through the middle (see Figure 1.1 - Location Plan).

The area is a typical flood plain with level terrain and fine textured soils; generally speaking the river is on a slight levee. The climate is tropical semi-arid. The Study Area is bounded on the south-east by a line of coastal sand dunes, by swamps in the south-west and, in part, by old river channels in the south and north. The remaining boundaries link these natural limits in such a way that the area forms a cohesive unit which could be considered irrigable from the basic irrigation system which was established between 1925 and 1959.

This study contains two elements, a Master Plan for 67 400 ha, and a feasibility study of a 5 000 ha project. This report is only concerned with the Master Plan and throughout the report the 67 400 ha area studied is referred to as the Study Area. The feasibility study is reported upon separately (Volume 2) and this area is referred to as the Project Area in this report. Generally speaking this expression refers to the Qoryooley project which was the subject of the 5 000 ha feasibility study.

1.2 Previous Reports

The development of the Janaale area dates from 1925 and the first canals and the barrage at Janaale were brought into operation in 1927. Initially, 182 holdings were demarcated and these covered a gross area of some 30 000 ha; holdings varied in size from 40 to 621 ha. Originally, all these holdings were allotted to Italians. There are no records in Somalia from this period.

In 1955, the Administration started work on the Buulo Mareerta project. The intention was to add 25 000 ha of controlled irrigation in approximately equal areas on each bank of the river downstream of the Janaale system. The project was to include three river barrages at Gayweerow, Qoryooley and Falkeerow, but only the last two were built. Three new main canals were built, the Fornari (now called the Wadajir), the Qoryooley (now Liibaan) and the Buulo Mareerta canal (Bokore). The project was only partially implemented and today it can be said that only the Bokore canal operates successfully; even now the area irrigated is far less than that originally intended. In 1961, a USAID team made a reconnaissance soil survey of the Buulo Mareerta project area and the report was submitted in 1964 as Appendix I to the first annual report of the Agricultural Experimental Station at Afgooye.

In 1962 and 1963 aerial photographs were taken of the Lower Shabeelle Flood Plain under the direction of FAO. An attempt was made at a ground control survey of the Janaale area, but this had to be curtailed due to lack of organisation and funds.

In 1968, under FAO, the Lockwood Survey Corporation prepared a report entitled 'Agriculture and water surveys'. This covered both the Shabeelle and Juba rivers, and included considerable field work in the Jeerow area in anticipation of photogrammetric mapping.

Before the Lockwood report was published, Hunting Technical Services Limited, in association with Sir M. MacDonald & Partners, started work as executing agency for FAO on the 'Project for the water control and management of the Shabeelle River' (the Shabeelle report).

This report was published in 1969 and it was here that the area of the Master Plan, which is the subject of this report, was first identified and delineated (Main Report, Section 6.1). The Shabeelle report also recommended the remodelling of the area served by the Canale Principale (now called the Dhamme Yaasiin canal).

There were of course other projects examined in the Shabeelle Flood Plain, but these are outside the present Study Area. However, the Shabeelle report also stated that 'other than the Afgoi-Mordile Controlled Irrigation Project no increase in area of controlled irrigation can be recommended without some regulation of the river supply', but the report also examined the possibility of an offstream storage reservoir near Jowhar, some 250 km upstream from Janaale, and two dam sites on the river further upstream.

In 1973, the pre-design phase report was published by Sir M. MacDonald & Partners (MMP), and work commenced on the design of the Jowhar offstream storage reservoir. Work commenced on the contracts for the construction of the reservoir in 1973, but these contracts have not yet been completed.

In 1972, the IBRD sent a mission team for the preliminary identification of projects in the agricultural sector. In the mission's report, it was also stated that any further development should not be contemplated unless means of storage of floodflows, which could be released to supplement the discharge in months of the low flow, are constructed.

In 1974, Citaco of Rome produced a report entitled 'Final design for a grapefruit plantation'. This outlined a project for the development of 1 386 ha of grapefruit in the Study Area near Golweyn. The designs allowed for the irrigation of grapefruit by trickle irrigation and the use of groundwater was proposed in the dry seasons in years when the riverflows were inadequate. The project also included 966 ha of annual crops to be farmed by the labourers who worked on the grapefruit plantation. This project is currently being implemented but with several important modifications. The work is financed by the European Development Fund (EDF) and is being supervised by an Italian consultant firm, Agrotec.

In about 1974, the area was covered by aerial photography done by a team from the USSR. The photographs were used to make maps of the area in 1977 but these maps of the area have never been made available to the Study Team. Under the FAO African Development Bank (ADB) Co-operative Programme, the FAO Investment Centre published a report entitled 'Somalia, agricultural development of the Genale-Bulo Marerta area. Identification of terms of reference study'. This report was dated 18th September 1976.

LOCATION OF THE STUDY AREA

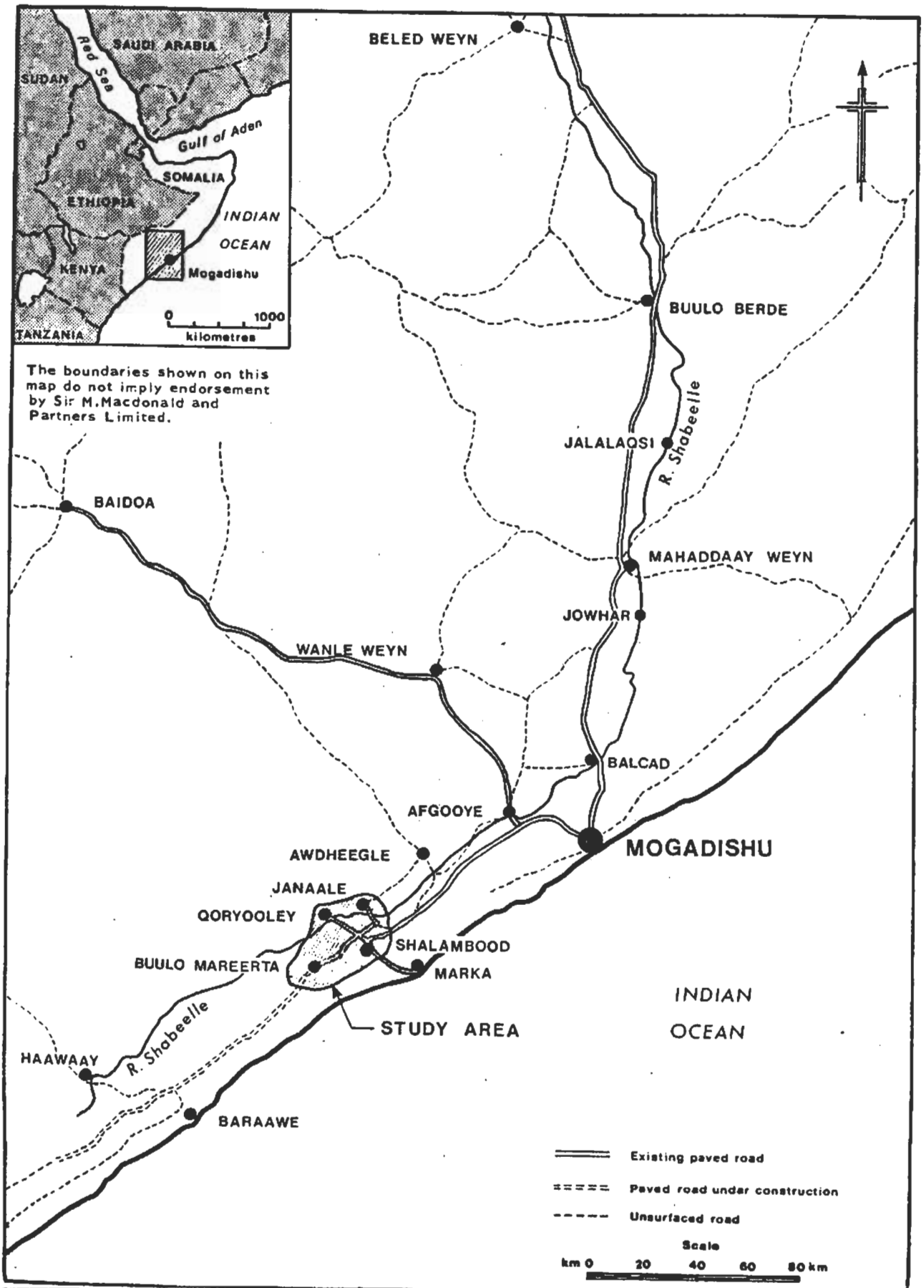


FIGURE [illegible]

STUDY AREA – PROPOSED DEVELOPMENT

A. PROJECT AREAS

- A.1 Qoryooley project
- A.2 Faraxaane project
- A.3 Asayle project
- A.4 Der flood project
- A.5 Mukoy Dumis project
- A.6 Banana drainage project
- A.7 EDF grapefruit production scheme
- A.8 Shalambood project
- A.9 Golweyn project

B. LAND DEVELOPMENT CLASSIFICATION AND ZONES

- B.1 Non development zones
  1. Acacia woodland
  2. Marginal agriculture
- B.2 Existing systems with upgraded technical services
  1. Janaale zone
  2. Degwariiri zone
  3. Bandar zone
  4. Majabto zone
  5. Haduuman zone
  6. Jcerow zone
  7. Waaymde zone
  8. Prima Secondario Banana zone
  9. Tahlil zone

In 1977, the team of UN advisers of the State Planning Commission prepared a pre-feasibility report for a net area of 5 000 ha within the Master Plan area. This area is the same as the area recommended for remodelling in the Shabeelle report of 1969, i.e. the area served by the Dhamme Yaasiin canal, but the pre-feasibility report was based on the intensive cropping of upland rice.

1.3 Terms of Reference

On 17th April 1976, the Ministry of Agriculture wrote to Sir M. MacDonald & Partners Limited requesting the firm to submit a proposal for the remodelling and development of the Janaale-Buulo Mareerta area. The formal proposal, produced in association with Hunting Technical Services Limited, was submitted on 25th June 1976 and included, inter alia, a reconnaissance survey of the whole river from Beled Weyn to the swamp below Falkeerow: this was required to determine the existing demand for water from the River Shabeelle outside the Study Area to permit the calculation of water available for use within the Study Area. The proposal included both Master Plan studies and a feasibility study for a Project Area of 5 000 ha, and the total time estimated for the work was eighteen months. The Ministry of Agriculture wrote to the Consultants on 14th October 1976 asking that the programme be revised so that the feasibility study be given more emphasis and the starting date for that section of work should be brought forward. The Consultant submitted a revised proposal in October 1976 in which the programme showed the draft feasibility report for the 5 000 ha being presented at the end of month 18.

The agreement for the studies was signed on 25th March 1977. This agreement allowed the Consultant one month to mobilise and then 14 month's work in Somalia. An Inception Report had to be submitted within two months of commencement identifying the area selected for the 5 000 ha feasibility study. Work on the feasibility study and the Master Plan were then to continue simultaneously and the draft feasibility report was to be presented upon completion of the work in Somalia, i.e. at the end of month 14. The Master Plan report was to be submitted one month later.

There are obvious disadvantages in selecting an area for development before the Master Plan studies have been completed but, on the other hand, the fact that the feasibility study and Master Plan study were done simultaneously has enabled the Consultant to collect far more accurate data on costs for the Master Plan than would have been possible if this section of work had been completed long before the feasibility study.

A summary of the terms of reference is given below but it should be noted that the reconnaissance survey of the existing irrigation on the Shabeelle Flood Plain was omitted from the final agreement; instead the Consultant has had to plan using the records of riverflows kept by the Ministry of Agriculture.

The terms of reference for the Master Plan contained the following major headings:

(a) soil survey with special emphasis on salinity problems

(b) topographic survey to prepare maps at a scale of 1: 25 000 using the 1962/63 FAO aerial photography

(c) agricultural development mapping

(d) survey of existing water use and the irrigation system

(e) study of hydrology and the need for flood protection

(f) survey of existing hydrogeological data

(g) demographic, economic and social studies.

Much of the work on the assignment is common to both the Master Plan and the feasibility study and for this reason it was decided to use common annexes for both reports. Volume 1 Master Plan - Main Report brings together all matters relevant to the 70 000 ha Study Area and Volume 2. Feasibility Study - Main Report, similarly covers the selected 5 000 ha Project Area.

1.4 Inception Report

One of the most important requirements of the Inception Report was the selection of an area of 5 000 ha for rehabilitation and extension of the irrigation system within the Study Area. When the Team arrived, it was discovered that the extent of existing irrigation was far greater than had been shown previously and also that funds had been made available for two projects, the EDF financed grapefruit scheme and the State Planning Commission rice project. This greatly restricted the outstanding possibilities for selection of 5 000 ha suitable for development as the feasibility study project. Finally, three possible 5 000 ha projects were demarcated, but one of them, the Asayle project, was not recommended because of anticipated drainage problems. There appeared to be little to choose on economic or technical grounds between the other two projects, which were the Qoryooley project on the right bank of the Shabeelle river and the Faraxaane project on the left bank, so the Client was presented with the opportunity to make the selection on social or political criteria. The Qoryooley project was chosen as the feasibility study area.

Apart from the extensive development within the Study Area, it was also discovered that irrigation was expanding or being planned elsewhere on the Lower Shabeelle. Therefore, an extensive desk study was carried out for the Inception Report, and the Ministry of Agriculture was requested to confirm that each proposed development was likely to be implemented. In the course of the study since the Inception Report, it has been necessary to make many minor alterations to the areas of development projects outside the Study Area since these areas have a significant effect on the demand for water and the volume of water available for irrigation in the Study Area. Once work commenced on the study of water resources and the balance of supply and demand, it was discovered that in the months of June and July the demand far exceeded the supply. In view of this, it has been decided to base the plans on the present day basis but allow for projects which are definitely to be implemented.

The Inception Report is reproduced in Annex XI of the supporting reports.

1.5 Economic and Agricultural Background

Somalia has an estimated per capita gross domestic product of approximately US $100. The economy of the country is based on agriculture and 80% of the workforce is employed in this sector. Exports are almost totally derived from the agricultural sector, dominated by live animals at 50 to 60% plus livestock products at 10% and bananas at 20 to 28% of the total. Despite falling volumes recently, the value of exports has been maintained with the terms of trade moving in Somalia's favour. The fall in exports of animals during the last two years has mainly been a result of the drought of 1974/5 which had a delayed reaction on livestock sales, reduced agricultural production in the period and necessitated large cereal imports which have continued.

The balance of payments position is characterised by large deficits on the balance of goods and services. These are increasing and have reached nearly So. Shs. 1 000 million, being mainly financed by large inflows of grants and loans. The net balance is positive but small at So. Shs. 47 million and unstable on account of the reliance on outside capital.

1.6 Execution

The resident expatriate members of the project Team arrived in Mogadishu at the end of April and early in May 1977. A project office was opened in Basiglio near to Golweyn and work was based there until late March 1978 after which the Team moved to Mogadishu, as field work and data collection had been completed. In Mogadishu, the drafting of the reports commenced and at the end of May staff returned to UK to complete the production of the reports.

1.7 Objectives

After the submission of the Inception Report, the Ministry of Agriculture wrote to the Consultant saying, inter alia, that 'the country is striving for self-sufficiency in staple food', and in the Annual Development Plan for 1976 it was stated that the economy was being geared to change from an urban to a rural base with a 'heavy emphasis on irrigated farming, and development of state farms and co-operatives'. In subsequent discussions with the staff of the ministry, the Consultants were told that state farms were regarded as the ultimate stage in development, but in the meantime the policy was to encourage the development of various forms of co-operative farms. This policy is being actively pursued in other areas of the Lower Shabeelle Flood Plain.

1.8 Planning Approach

The major factors which influence the selection of areas for development within the Study Area are soils, topography, local variations in groundwater, the existing system of barrages and canals, and the distribution of population and current land use. Apart from these factors, there are limitations on water supply and marketing constraints which affect the whole of the Study Area.

In the early months of the study, specific project areas were identified and these areas were then studied. One other practical consideration was that each of these projects should be sufficiently large to be self-contained and to justify a specific feasibility study at a later date. With the data from these studies, it would be possible to rank the projects in order of merit on economic terms.

Once the areas for project development had been identified, the rest of the Study Area was considered and development zones were outlined where there was potential for increased production.

These zones were either too small or unsuitable for comprehensive planning and only general recommendations for their development have been made. In addition to the proposed project areas and development there remained some areas which are difficult zones to irrigate. No development is proposed for these marginal areas which would continue as a source of rough grazing and firewood. The proposed development is shown in Figure 4.2.

CHAPTER 2

PHYSICAL RESOURCES

2.1 Soils

2.1.1 Methods of Study

The soils were surveyed at semi-detailed level, involving an examination of profiles at an overall density of one site per 100 ha. Salinity analyses were performed on samples from the upper metre for each site and samples from selected sites were subjected to detailed analysis. Tests were performed in the field to evaluate soil behaviour under irrigation. Results are presented in Annex I, with accompanying maps at a scale of 1 : 50 000 showing soils, land suitability for irrigation and survey site location.

2.1.2 Soil Parent Materials

The soils are derived entirely from the Meander Flood Plain sediments of the Shabeelle river. These comprise deep and predominantly clay textured deposits which are broadly divisible into old, semi-recent and recent alluvium. Dark greyish brown to brown clays of the alluvium underlie the whole area and form the parent materials for soils throughout the northern and south-eastern regions. The terrain is level on the main flood plain but uneven along the several major channel remnants which dissect the area. Semi-recent alluvium, comprising reddish brown clays and some silty layers, occurs extensively in the central and south western regions; except for minor channel remnants the terrain is level although some gilgai micro-relief occurs locally. Recent alluvium is confined mainly to the levees and overflow channels associated with the present course of the Shabeelle river; the terrain is often uneven and the alluvium ranges in texture from clay to fine sand.

2.1.3 Soil Characteristics

The soils are classified as Vertisols, or their intergrades, being formed on expanding lattice clays and exhibiting the Vertisol properties of deep cracking and self-mulching. These properties are less well expressed in some soils of the recent and semi-recent alluvium which contain significant layers of silty, medium textures. Profiles are deep and moderately well drained in the natural state.

Eleven soil series were differentiated and used in the soil mapping (Figure 2.1). Series separation was primarily based on the division of the parent materials into old, semi-recent and recent alluvium. Dark greyish brown to brown clay textured Chromic Vertisols are the principal soils in the old alluvium. Similarly, Chromic Vertisols predominate on the semi-recent alluvium but colours are reddish brown, structure is more stable and profiles often include silty loam horizons. On recent alluvium, the soils are more varied in texture and profile characteristics. Figure 2.1 shows the general distribution of the principal soil units, while their areas are summarised in Table 2.1.

TABLE 2.1

Summary of Soil Mapping Units

Soil parent material	Principal soil unit[1]	Soil series	Area ha	Area %
Old Alluvium				
Flood plain	Chromic Vertisols	Saruda, Golweyn, Dhoblow, Majabto	28 986	43.0
Channel remnant	Vertic Cambisols	Shalambood	4 247	6.3
Semi-recent Alluvium				
Flood plain	Chromic Vertisols	Qoryooley, Madhuulow, Mukoy Dumis	27 369	40.6
Channel remnant	Eutric Cambisols	Buulo Mareerta	3 370	5.0
Recent Alluvium				
Levee and over-flow channel remnant	Eutric Cambisols and Vertic Cambisols	Faraxaane, Gayweerow	3 438	5.1
TOTAL			67 410	100.0

Note: (1) Classification according to FAO/UNESCO (1974) legend.

Soil physical properties are strongly influenced by soil moisture content; in the dry state the clays crack deeply, forming a surface mulch and discrete structural aggregates in the lower horizons. The cracks close and aggregates disintegrate when the soil is saturated. This alternation of soil morphology on wetting and drying reduces the flexibility of tillage operations and complicates soil-water relations, especially in respect of moisture movement. Infiltration is rapid into dry, cracked profiles but slow in moist soils. Drainability is limited by slow hydraulic conductivities (mean 0.23 m/d), especially in the underlying clays of the old alluvium. Total available water capacities are high but much of this water is held outside the easily available range.

The soils are calcareous and base-saturated, with low to negligible alkalinisation hazard. Salinities are generally low, with mean ECe values for the 0 to 0.5 m and 0.5 to 1.0 m horizons being 2.0 and 2.9 mmhos/cm, respectively. In terms of soil chemistry, leaching of salts should not cause a deterioration of soil permeability. Moderate to low fertility levels currently exist in most soils.

FIGURE 2.1

SOILS

SOILS LEGEND

Physiography	Soil Unit	Principal Series	Symbol
Old Floodplain Alluvium			
Floodplain	Chromic Vertisols	Baraada Golweyn Majabto	
Channel Remnant	Vertic Cambisols	Shalambood	
Semi-recent Floodplain Alluvium			
Floodplain	Chromic Vertisols	Madhuulow Goryooley Muraqoye Dumis	
Channel Remnant	Eutric Cambisols	Buulo Mareerta	
Recent Alluvium			
Levée and Overflow	Eutric Cambisols	Faraxaane	
Channe Remnants	and Vertic Cambisols	Gaywserow	

TOPOGRAPHICAL LEGEND

- River
- Major channel remnant
- Main canal existing
- Surfaced road
- Unsurfaced road
- Track
- Contour
- Study area boundary
- Village

SCALE

km 1 0 1 2 3 4 5 km.

2.1.4 Land Suitability for Irrigation

The land was ranked according to its suitability for irrigation of annual crops, adopting the principles of the US Bureau of Reclamation (1954) classification. Specifications were defined for classes 1 (highly suitable), 2 (suitable), 3 (moderately suitable) and 6 (unsuitable). Soils were classified according to their permanent and rectifiable deficiencies. The former include the relatively non-correctible limitations imposed by soil profile characteristics, such as texture, available water capacity and infiltration, whereas rectifiable deficiencies include topography, salinity and flooding hazard, which are more readily correctible. Land suitability sub-classes were mapped on the basis of these permanent and rectifiable deficiencies (see Figure 2.2).

The distribution of land suitability classes is summarised in Figure 2.2 and details of the areas of classes and sub-classes are shown in Table 2.2. This table shows that some 90% of the area is either suitable or moderately suitable for irrigation of annual crops; only 10% is classed as unsuitable. No class 1 land is recognised due to the fine clay textures of the soils and/or the anticipated poor drainability of the subsoils.

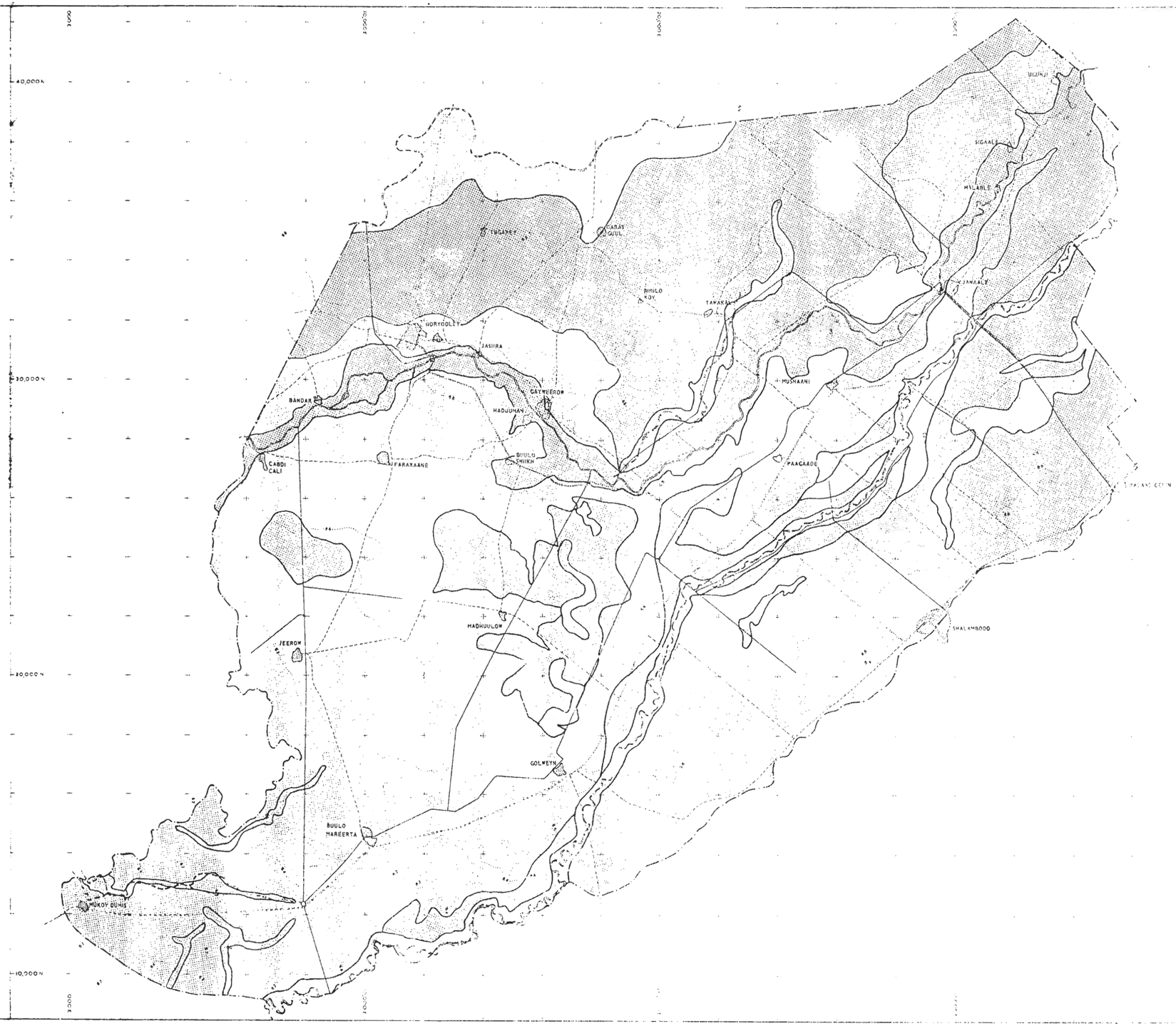
Class 2 lands are mapped extensively in areas of soils derived from semi-recent and recent alluvium. They are broadly divisible into two groups. The first group, occupying some 5.5% of the area, comprises soils which have profile characteristics of class 1 quality due to significant depths of medium textured horizons but have an overall drainability deficiency due to slow hydraulic conductivities in the subsoil. The second group includes soils with both profile and drainability deficiencies; these lands occupy extensive areas of soils derived from semi-recent alluvium, occupying some 37% of the area. Each group also includes land with rectifiable deficiencies of salinity and, to a lesser extent, topography.

Most of the class 3 lands (43% of the area) are mapped in areas of soils derived from old alluvium, in which the relatively impermeable clay profiles with poor aggregate stability and slow infiltration rates result in class 3 deficiencies of both profile and drainability characteristics. The majority of such lands also have a salinity hazard. In addition, class 3 land is mapped locally in areas of soils derived from semi-recent alluvium which have basically class 2 deficiencies but are affected by flooding hazard or topography, particularly in the vicinity of the Shabeelle river.

Class 6 lands comprise channel remnant areas which are excluded from the irrigable classes principally on topographic grounds. Some areas of land with otherwise class 3 quality are downgraded to class 6 in view of the combination of high salinities and poor drainability characteristics; until leaching of these soils is proved to be feasible, they are treated as being unsuitable for irrigation.

FIGURE 2.2

LAND SUITABILITY FOR IRRIGATION



LAND SUITABILITY LEGEND

Suitability for surface irrigation of annual crops excluding paddy rice

Class	Symbol
Suitable	
Moderately suitable	
Unsuitable	

TOPOGRAPHICAL LEGEND

- River
- Major channel remnant
- Main canal existing
- Surfaced road
- Unsurfaced road
- Track
- Contour
- Study area boundary
- Village

TABLE 2.2

Land Suitability Classes

Class/sub-class[1]	Area ha	Area %
Class 1 - Highly suitable	-	-
Class 2 - Suitable		
2d	1 732	2.6
2d/t	350	0.5
2d/s	800	1.2
2d/st	835	1.2
2pd	11 557	17.1
2pd/s	12 105	18.0
2pd/t	180	0.3
2pd/st	1 021	1.5
Sub-total	28 580	42.4
Class 3 - Moderately suitable		
3d/f	89	0.1
3d/s	137	0.2
3d/st	178	0.3
3d/fst	1 942	2.9
3d/ft	485	0.7
3pd	6 256	9.3
3pd/s	19 973	29.7
3pd/st	838	1.2
3pd/f	137	0.2
3pd/s	1 846	2.7
Sub-total	31 881	47.3
Class 6 - Unsuitable	6 949	10.3
Sub-total	6 949	10.3
TOTAL	67 410	100.0

Note: (1) Suffixes denoting sub-class deficiencies are:

p - profile characteristics, d - drainability, s - salinity hazard, t - topography, f - flood hazard.

2.2 Climate

The Study Area lies just two degrees north of the equator and consequently the climate is determined by the strength and position of the inter-tropical convergence zone, where the surface winds of the north and south hemispheres meet in a zone of considerable atmospheric instability. The movement of this zone produces a well defined annual cycle of climatic conditions.

Starting in January, the first three to three and a half months form the jilal season in which dry, strong north-east monsoon winds dominate, and there is practically no rainfall. Around mid-April the winds die away and humidity increases with the start of the gu rains. These rains continue well into May when they are reinforced by coastal showers (hagai) brought in by the south to south-west monsoon winds. The combined gu - hagai rainfall extends into July. The total rainfall for the four months, April to July (mean value 285.1 mm), represents 60% of the annual total. The south to south-west winds finally die away after seven months with the onset of the second rainy season at the beginning of November. These, the der rains, are much less significant than the gu - hagai rainfall, and are far less reliable. In December the rains give way quickly to the dry season as the north-east winds re-establish themselves.

Climatic records for the Study Area are available from the Janaale meteorological station. Readings were taken intermittently between 1929 and 1958, and recorded by Amilcare Fantoli (Fantoli, 1965). No records exist after this date until 1978, when the station was rebuilt as part of the present study. Some spatial variation in climatic parameters, especially rainfall, is apparent, and significant differences may occur over the Study Area. It is therefore recommended that an additional raingauge is established close to Qoryooley with at least two more in the Study Area. The existing records from Janaale are summarised in Table 2.3.

The main features of the table are the very consistent temperatures (both between mean monthly figures and maxima and minima), the uniformly high humidities (except in the dry season), and the fairly windy conditions in most months. From the data the climate can be classified as tropical, semi-arid.

Despite this, the rainfall can make a significant contribution towards the crop irrigation requirements, especially in the gu - hagai period. Table 2.4 lists the monthly 75% reliable rainfalls and the estimated proportion of these which is expected to be used by crops for evapotranspiration.

The basic climatic data have also been used to calculate the reference crop evapotranspiration for each month using the Penman method (Table 2.4).

2.3 Water Resources

The existing irrigated agriculture in the Study Area (nearly 21 000 ha), represents 54% of the controlled irrigation on the Shabeelle Flood Plain. Water is supplied from the river itself in the two high flow periods. The first, the gu flood, occurs in April and May but is quite shortlived and unreliable; the date of the rise of the flood is variable in time and is often associated with high salinity levels and considerable amounts of detritus. After the gu flood there is a period of one or two months of lower flows before the rise of the second (der) flood in August. Discharges in this period are consistently high

TABLE 2.3

Climatic Data for Jamaale

Parameter	Period of record	Unit	Month												
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean monthly maximum temperature	1930 - 39 1953 - 58	°C	32.3	32.7	33.5	33.1	31.5	29.6	28.6	28.9	29.5	30.5	31.6	31.0	31.1
Mean monthly minimum temperature	1930 - 39 1953 - 58	°C	21.0	21.6	22.9	23.6	23.3	21.8	21.4	21.2	22.1	22.7	22.2	21.6	22.2
Mean monthly temperature	1930 - 39 1953 - 58	°C	26.6	27.2	28.2	28.3	27.4	25.7	24.9	25.1	25.8	26.6	26.6	26.6	26.6
Absolute maximum temperature by months	1930 - 39 1953 - 58	°C	38.0	38.0	39.0	39.0	38.0	35.0	34.0	35.0	36.0	35.0	35.0	36.0	39.0
Absolute minimum temperature by months	1930 - 39 1953 - 58	°C	13.0	17.0	18.0	20.0	19.0	18.0	17.2	17.0	18.0	19.5	19.0	15.0	13.0
Relative humidity	1930 - 39 1953 - 58	%	76	74	76	77	81	82	82	82	81	81	82	80	79
Wind speed at 2 m (mean monthly)	1953 - 58	m/s	1.4	1.6	1.4	1.2	1.8	2.2	2.4	2.4	2.5	1.8	0.9	1.2	1.7
Mean monthly cloud cover	1930 - 39 1953 - 58	1/10 ths	2.2	2.2	2.6	3.8	4.4	5.0	5.3	4.3	3.7	4.3	3.9	3.0	3.7
Mean monthly total sunshine hours	1933 - 39 1953 - 58	h	290.7	264.6	292.2	246.4	239.9	198.1	194.8	235.2	255.6	237.1	219.9	255.8	2 930.7
Monthly mean rainfall	1929 - 40 1944 - 48 1951 - 58	mm	1.5	0.1	3.9	75.9	73.9	80.5	54.8	47.4	21.5	32.7	52.6	26.2	471.0
Mean number of rainy days	1929 - 40 1944 - 48 1951 - 58	d	0.7	0.0	0.4	6.0	8.5	10.4	11.6	9.6	3.5	3.4	5.7	3.0	62.8
Dominant wind direction	1932 - 38 1953 - 58	-	NE	NE&E	E	SE&S	S&SW	SW	SW	SW	SW&S	S	E&SE	NE&E	-

Source: Contributo Alla Climatologia Della Somalia, Amilcare Fantoli (1965)

TABLE 2.4

Reliable and Effective Rainfall: Reference Crop Evapotranspiration

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
75% reliable rainfall (mm)	1.1	0.1	2.8	55.4	54.0	58.8	40.0	34.6	15.7	23.9	38.4	19.1	334
Effective rainfall (mm)	-	-	2.5	48.9	47.7	51.7	35.6	30.9	14.1	21.5	34.2	17.2	304
Reference crop evapotranspiration (mm/d)	5.03	5.44	5.65	5.06	4.66	4.26	4.21	4.55	5.11	4.77	4.26	4.54	

with the river flowing at or close to the bank-full stage for up to five months. The water quality during the der season is acceptable, with electrical conductivities (EC) in the region of 0.5 mmho/cm during August, September and October. After the der flood finally subsides in December or January, low flows may persist until the rise of the next gu flood. Moreover, in some years the river dries up for one or two months and occasionally longer.

The Shabeelle river is used for controlled irrigation from above Jowhar to Hawaay (see Figure 1.1) and no part of this reach can be considered in isolation. Consequently, the cropped areas and water requirements had to be estimated for the whole system. The future availability of the river water will be affected by the commissioning of the Jowhar offstream storage reservoir and the proposed Duduble flood relief channel. The former will provide 200 Mm^3 of live storage on the left bank of the river near to Jowhar. Flood-flows will be stored to meet irrigation requirements during perids of low riverflow. The Duduble flood relief channel will provide an escape for dangerously high flood-flows before entering the irrigated reach.

The source of water to the irrigated reach, upstream of the controlling reservoir and the flood relief channel has been estimated from the riverflow records at Mahaddaay Weyn (Annex II, Appendix C). Table 2.5 summarises the riverflow record, clearly showing the two main seasons of high flow.

A significant proportion of the existing crops in the Study Area is perennial (with a total of over 4 000 ha of bananas) and, therefore, to guarantee water supplies during the dry season, a total of 132 irrigation tubewells have been drilled. These tap an extensive aquifer from which the present abstraction is considerably less than the recharge. However, studies (Annex II, Part II) have shown that the groundwater is highly saline, with EC values greater than 1.5 mmhos/cm even in the best quality areas. Following the United States Department of Agriculture classification of irrigated water (see Figure 4.3, Annex II) the salinity hazard can be classified as high and, when above 2.25 mmhos/cm, very high. The consequences on crop yields of irrigating with this type of water have been discussed in Annex II, Chapter 9. If crops were irrigated solely from groundwater, yields would be practically zero except for highly tolerant crops such as cotton. With only supplementary use of groundwater (20% of the total supply) crop yield reductions of around 25% are still expected, and with more sensitive crops such as citrus, up to 50% reductions may occur. It has been concluded therefore that no further development of groundwater should be undertaken except for minor supplementary irrigation purposes. Even this should be limited to the zone of 'best' quality groundwater associated with the Primo Secondario canal (see Annex II, Figure 9.1). Outside this area the water quality deteriorates rapidly and it is unsuitable for irrigation. However, in Section 6.3 of this report the establishment of a Shabeelle River Authority is recommended, and one of the tasks of this Authority is to monitor groundwater levels and quality which should be constantly reviewed. After the commissioning of the Jowhar offstream storage reservoir the use of groundwater in the Study Area should initially diminish as the reliability of the river supplies increases. However, with the total development envisaged it will not be possible to reduce the present use of groundwater in the long term.

Gross irrigation requirements have been calculated for two reaches of the river. The upper, Jowhar, reach covers all the areas upstream of the outlet from the offstream storage reservoir. The downstream reach covers all the areas downstream of the outlet (including the Study Area). Total water requirements were found by applying the cropped areas to the unit water requirements derived according to the recommendations of Doorenbos and Pruitt (1975 and 1977). An

TABLE 2.5

Riverflow Record at Mahaddaay Weyn/Sabuun (Mm^3)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1951				315	346	276	67	147	204	123	336	242	
1952	29	13	14	13	208	58	28	63	286	211	110	12	1 050
1954	31	28	30	189	161	69	11	172	335	347	179	90	1 640
1955	15	7	21	22	103	35	7	54	242	338	103	18	965
1956	16	10	26	49	318	74	108	251	331	317	317	81	1 890
1957	36	16	41	130	343	265	125	283	311	132	134	105	1 930
1958	25	40	112	55	170	30	38	270	336	347	179	53	1 660
1959	26	18	15	13	192	61	38	185	300	311	267	62	1 490
1960	167	61	30	54	159	97	99	206					
1961	30	29	16	22	117	44	108	305	335	346	336	347	2 040
1962	42	8	11	30	147	40	24	71	176	217	326	186	1 280
1963	17	8	9	131	344	264	136	260	338	249	122	216	2 090
1964	99	43	20	65	95	48	81	240	334	341	230	71	1 670
1965	138	40	20	18	126	38	13	46	166	219	278	121	1 220
1966	32	10	78	90	227	116	108	165	281	257	201	52	1 620
1967	11	2	1	89	270	195	79	257	351	352	305	331	2 240
1968	103	48	191	204	371	312	222	281	334	310	180	184	2 740
1969	76	58	268	283	306	163	143	298	347	265	136	47	2 390
1970	26	57	119	267	368	113	51	265	363	372	261	71	2 330
1971	37	25	11	88	252	143	221	306	374	316	225	124	2 120
1972	44	50	56	87	361	221	207	336	367	335	212	80	2 360
1973	35	18	8	8	138	89	45	233	386	308	100	22	1 390
1974	4	0	0		158	177	189	274	333	240	63	26	
1975	13	0	0	35	163	133	131	371					
Maximum	167	61	268	315	371	312	222	371	386	372	336	347	2 740
Mean	46	26	48	99	227	128	93	218	306	284	209	116	1 800
Minimum	4	0	0	8	95	30	7	54	166	123	63	12	965

Source: HTS, 1977

overall water application efficiency of 45% has been adopted (60% field efficiency with 75% distribution efficiency). Indeed, water usage measurements in the Study Area have shown that the actual efficiency is probably only about 20%. The expected losses from the Shabeelle itself have been included in the total requirements of the downstream reach which are estimated for both the existing and also the 'proposed' levels of irrigated agriculture. Any scheme for which there is a firm commitment, either financially or conceptually, has been included in the 'proposed' level of development. Within the Study Area the Qoryooley project feasibility study, the Ministry of Agriculture grapefruit production scheme and the level of banana cropping proposed by ENB have been included in the 'proposed' level.

The availability of water during the period 1961 - 1973 has been simulated by a computer program using a 5-day time interval. This operational study attempts to allocate the water resource whilst obeying certain control rules for the reservoir and the flood relief channel (Annex II, Chapter 15). The computer program rejects the first 10 days of the rising gu flood in order to exclude any river water of unsuitable quality for irrigation.

The Jowhar offstream storage reservoir has a live storage capacity of 200 Mm^3 but seepage and evaporation losses have been estimated to be about 30 Mm^3/month. Clearly the reservoir is not suitable for over-season storage. The computer operational studies have followed simple rules evolved since the program was first used in 1973 (MMP, 1973). However, a brief study of Table 2.5 shows that the unregulated riverflows in the month of July vary considerably. The reservoir usually contains very little water at the start of the gu season and the volume of this flood is often insufficient to fill the reservoir, particularly since the first 10 days of the flood is not impounded due to its high salinity. As a result, the reservoir often empties during June and July and these are, therefore, the most critical months. Since it is not possible to predict the volume of the gu flood at the start of the dry season in January, operation of the reservoir in the dry season cannot be governed by demands after the gu flood. The operational studies assume that the reservoir is operated optimally, storing all surplus water and timing the releases carefully. This will demand an efficient operating staff who, apart from anything else, will need to know the actual irrigation requirements. For this purpose the establishment of a separate operating organisation called the Shabeelle River Authority is recommended and its role is defined in Annex VII, Chapter 16 and summarised in Chapter 9.

The results of the simulation computer runs have been analysed in terms of the flows available in the downstream reach at two given levels of reliability. The percentage reliability of a flow indicates the proportion of years in which the particular flow will be equalled or exceeded. For example if a 50 Mm^3 flow has an 80% reliability then it will be equalled or exceeded four years out of five. For annual crop production, a minimum acceptable reliability of 75% has been widely used in Somalia and this has been adopted for this study. For perennial crops, a higher reliability is appropriate in view of the higher establishment costs and in this case, 90% has been adopted.

Figure 2.3 shows the existing total water requirements in the downstream reach and the flows available at the 75% level. This shows that although water is available for the expansion of irrigation, none of this water is available in the gu season. Consequently, there is little opportunity for increasing the area under crop in this season. Moreover, since perennial crops also require water during the gu season, no significant expansion of these crops can be recommended unless groundwater is used. The use of groundwater, however, has been ruled out because of the high salinity hazard associated with its use.

TABLE 2.6

Modified Proposed Situation : Irrigation Requirements and Operational Study Results (Mm^3)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Irrigation requirements in the Jowhar reach	36.08	29.74	36.25	22.67	24.26	29.41	27.70	30.62	36.09	26.08	28.11	33.95	361.00
Normal downstream requirements including channel losses	50.6	24.4	27.3	17.4	54.6	97.2	88.7	40.2	87.6	143.0	147.7	112.8	891.5
Modified downstream requirements including channel losses	41.0	24.4	27.3	17.4	54.6	97.2	88.7	40.2	100.1	165.3	148.5	86.5	891.2
Available downstream flow reliability													
50% *	44	24	33	65	106	94	78	111	150	195	165	105	1 180
75% *	41	24	13	31	64	73	61	54	100	181	147	87	930
90% *	38	10	2	12	52	32	2	23	100	161	144	80	762
Available downstream flow with backpumping into Jowhar sugar estate reliability													
50% *	43	23	32	64	106	92	77	110	149	195	165	105	1 170
75% *	41	23	7	31	64	61	61	54	100	179	147	87	918
90% *	32	5	0	7	51	32	0	23	100	161	144	80	752

Note: Modification achieved by changing the planting date of 8 073 ha of der season maize in the downstream reach from mid-September to mid-August.

* Not an homogeneous sequence.

In the der season (September to January), the situation is totally different, with large amounts of water available right through until the end of November. Although natural supply is insufficient, in December and January irrigation requirements may be met by controlled reservoir releases. However, these releases are available only as long as priority is not given to conserving water for the dry season (January to early April) to meet perennial crop demands. If priority is given to the der season crops, water for a further area of 20 000 to 24 000 ha is available at the 75% level.

The feasibility of this general plan has been confirmed by an operational study for a 'modified proposed' level of development (Table 2.6). The modified level involves the planting of der maize one month earlier, in mid-August, to reduce requirements in December and January. The supplies available at the 50, 75 and 90% levels of reliability have been calculated with and without back-pumping from the reservoir into Jowhar sugar estate (up to a maximum of 1.8 m^3/s), sufficient to supply half the estate at a watering rate of 100 mm per month.

Figure 2.4 compares the requirements for the 'modified proposed' level of development with the 75% reliable flows (without back-pumping). The increased der season cropping of 22 500 ha in the downstream reach (with a total area of 9 450 ha in the Jowhar reach) can be fully satisfied at the 75% level of reliability.

For perennial crops, a reliability of 90% has been recommended. There is a significant difference between the 90% and 75% flows (Table 2.7). The dry season deficit in perennial crop requirements (48.1 Mm^3) is approximately equal to the capacity of the existing 132 tubewells in the Study Area. Therefore, it should be possible to meet the requirements of the perennial crops in nine years out of ten by supplementing river supplies with groundwater.

TABLE 2.7

Comparison of Proposed Irrigation Demand (for Perennial and Der Season Crops) and Riverflows in the Dry Season (Mm^3)

	Jan	Feb	Mar	Apr	Total
Modified requirements including channel losses	41.0	24.4	27.3	17.4	110.1
Flow available, at 90% reliability	38.0	10.0	2.0	12.0	62.0
Deficit	3.0	14.4	25.3	5.4	48.1

Note: All figures are for the river discharges downstream of the outlet to Jowhar offstream reservoir. Available flows based on the situation with no back-pumping to Jowhar sugar estate.

Source: Table 2.6.

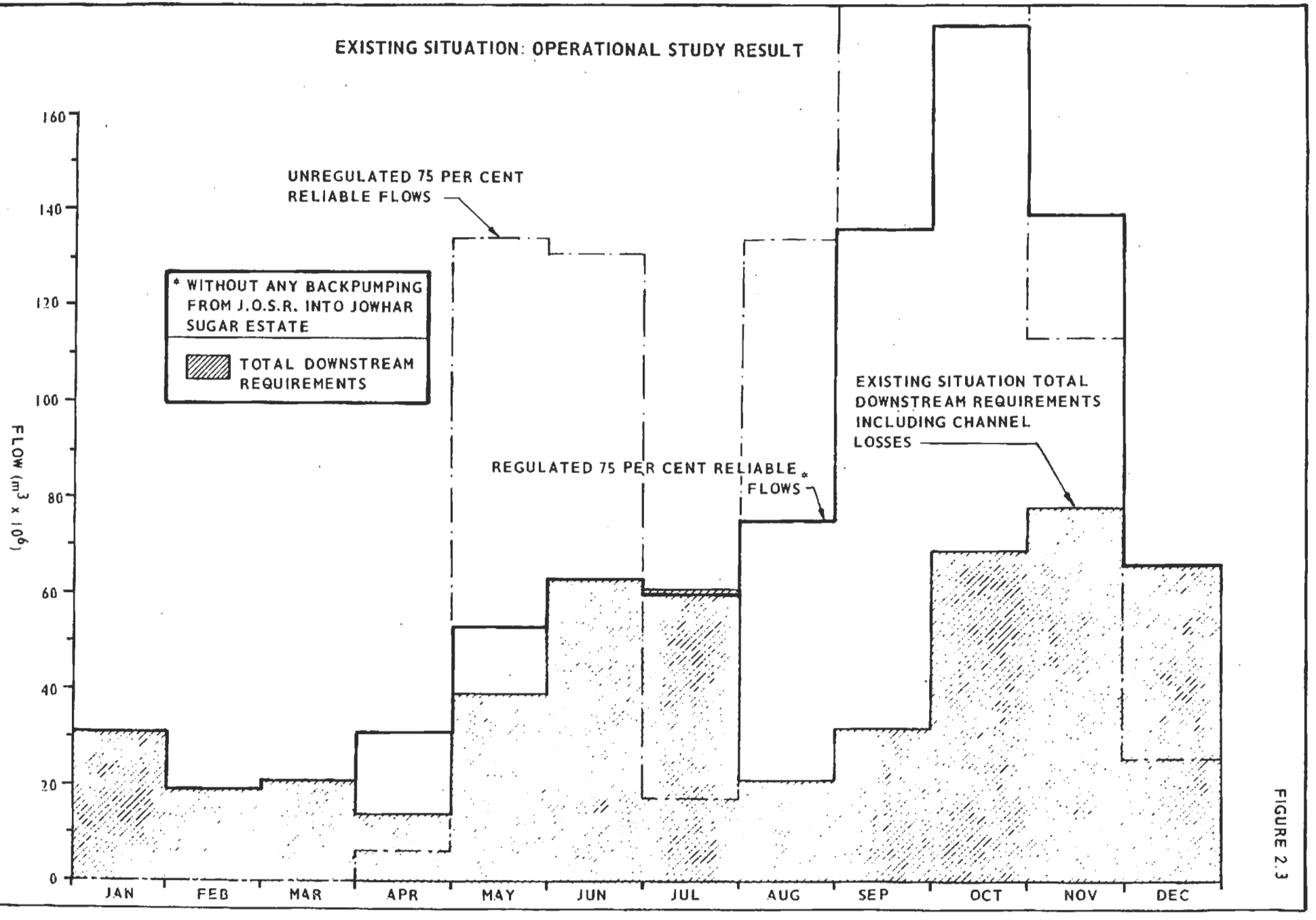

EXISTING SITUATION: OPERATIONAL STUDY RESULT
UNREGULATED 75 PER CENT RELIABLE FLOWS
* WITHOUT ANY BACKPUMPING FROM J.O.S.R. INTO JOWHAR SUGAR ESTATE
TOTAL DOWNSTREAM REQUIREMENTS
EXISTING SITUATION TOTAL DOWNSTREAM REQUIREMENTS INCLUDING CHANNEL LOSSES
REGULATED 75 PER CENT RELIABLE * FLOWS
FLOW ($m^3 \times 10^6$)
160
140
120
100
80
60
40
20
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

FIGURE 2.3

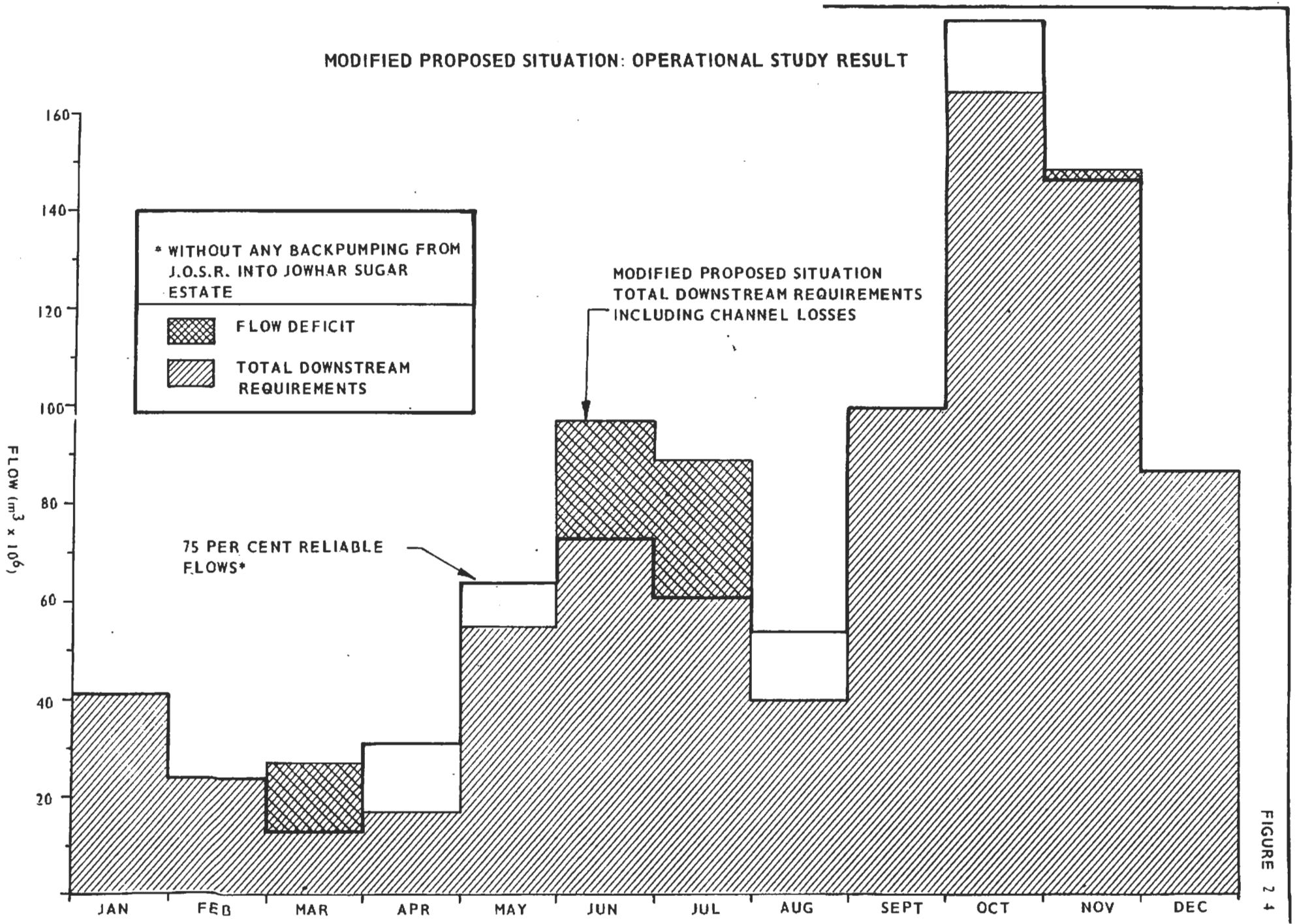

MODIFIED PROPOSED SITUATION: OPERATIONAL STUDY RESULT
160
140
120
100
80
60
40
20
FLOW ($m^3 \times 10^6$)
* WITHOUT ANY BACKPUMPING FROM J.O.S.R. INTO JOWHAR SUGAR ESTATE
FLOW DEFICIT
TOTAL DOWNSTREAM REQUIREMENTS
MODIFIED PROPOSED SITUATION TOTAL DOWNSTREAM REQUIREMENTS INCLUDING CHANNEL LOSSES
75 PER CENT RELIABLE FLOWS*
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC

FIGURE 2.4

It is concluded that there is insufficient water for any increase in the area of the gu season or perennial crops. However, there is sufficient water for an increase of approximately 23 000 ha of mixed cropping, to be added to the existing der crops in the downstream reach of the river (after allowing for a total area of 9 450 ha to be grown in the Jowhar reach).

CHAPTER 3

HUMAN RESOURCES AND INSTITUTIONS

3.1 Introduction

The population of Somalia is estimated as being 3.2 million in 1975 (IBRD, 1977) and the rate of growth is 2.6% per annum; the area of the country is 637 000 km^2. The population is predominantly nomadic or agricultural and, whereas the population of Mogadishu is approaching 500 000, towns such as Marka, Kismaayo or Qoryooley have fewer than 20 000 inhabitants. The agricultural population is concentrated along the Lower Shabeelle river and the Juba river, and the Study Area is the most densely populated agricultural area in Somalia.

The Study Area is approximately 100 km south-east of Mogadishu to which it is connected by a good surfaced road. Communications, although relatively poor, are good compared with the rest of Somalia. For location of the Study Area see Figure 1.1.

3.2 National Government

At the moment about 85% of Somalia's foreign earnings come from livestock and agriculture and responsibility for these sectors has been split between many ministries and other organisations. The division of responsibility is such that a state farm relies on the National Farm Machinery and Agricultural Supply Service (known by its old name ONAT) for the supply of inputs and the Agricultural Development Corporation (ADC) for marketing. ONAT is under the Minister for Agriculture and ADC under the Minister for Commerce. (Since this report was drafted the Agricultural Development Corporation has been transferred to the Ministry of Agriculture). In the Ministry of Agriculture most functions are dealt with by ministry staff under six directors who report to the Director-General. There are, however, autonomous agencies, such as ONAT or the National Banana Board (ENB), which report directly to the Minister of State for Agriculture. Such agencies are common in other ministries and have the advantage that they are not bound by the same government regulations as the ministries themselves and therefore have more freedom to respond to special situations. Their pay scales are slightly higher than those of the ministries which helps in the recruitment of staff. The roles of the most important agencies and departments are discussed in Section 3.9 below.

3.3 Local Government

The Study Area is located in Lower Shabeelle region (Gobolka Shabeelles Hoose) which is one of the sixteen regions of Somalia. The regional governor's office is just outside Shalambood and therefore on the edge of the Study Area. The Study Area lies entirely in Qoryooley and Marka districts. Until this study there were no accurate maps of the area and division between villages. The approximate boundary between Qoryooley and Marka districts is shown on Figure 1.2. It should be noted that Mukoy Dumis used to belong to Baraawe district and has only recently been transferred to Marka district.

Each ministry should have a regional co-ordinator who is responsible for carrying out the functions of that ministry within the region, in co-operation with the governor. Where necessary there should be an official for most ministries at district level but in practice these posts are often left vacant due to lack of suitable staff. The problem of shortage of skilled staff is most apparent in the region; many posts are unfilled and those staff that are in office are often inadequately trained and poorly motivated. In addition the regional and district staff have inadequate support, and office facilities and transport are insufficient for the work requirements.

3.4 Communications

3.4.1 Roads

Compared with the rest of Somalia the Study Area is well served by roads. There is a good surfaced road from Mogadishu to Shalambood which is in the Study Area and Shalambood is connected by surfaced roads to Janaale, Qoryooley and Golweyn; these roads were constructed to serve the majority of the banana farms. There is also a short length of surfaced road between Janaale and Buufo (Bacaad Celin) and this forms part of an important short cut from Janaale to Mogadishu, avoiding Shalambood, although this route cannot be used after rains because part of it is not surfaced.

From Shalambood there is an old surfaced road to Marka, the seat of the district commissioner for part of the Study Area and the port for export of bananas. Construction of the road from Golweyn to Jelib has started and plans have been made for a road from Janaale to Awdheegle on the right bank of the river. This will assist the banana farms in the neighbourhood of Uguunji and Mubaarig. Apart from this, the new roads will not influence the development of the area significantly since the major market for produce is Mogadishu and the new roads are unlikely to enable other areas to compete with the Study Area.

The surfaced roads and major earth tracks are shown in Figure 1.2. Earth tracks are extensive within the Study Area but they have never been properly constructed apart from the installation of culverts where canals pass under the road. During heavy rainfall, or when irrigation water spills onto them, these tracks quickly become impassable because of the heavy clay nature of the soils.

It might be expected that the river would form a barrier to communication, but the area is well endowed with crossings; there are five road crossings and eleven passenger ferries which consist of boats attached to cables. In consequence there is never more than 8 km between river crossings within the Study Area.

3.4.2 Ports

Marka is the nearest port to the Study Area and this is almost entirely used for the export of bananas. Port facilities are poor and all loading has to be done by lighter. There are no plans to develop the port although a feasibility study is believed to be planned. Mogadishu is about 100 km from Shalambood and the new harbour there is ideally situated to deal with all imports and exports, including bananas.

3.5 Electricity Supplies

There is no electricity distribution network in the Study Area but there are diesel alternator sets at Shalambood, Janaale and Qoryooley. However the units at Janaale and Qoryooley are restricted to evening operation and only at Shalambood is power supplied continuously.

Rural electricity supplies are the responsibility of the district offices which are generally short of expertise and finance. Advice is given by the National Electricity Authority (ENEE) but the demand in the Study Area is insignificant and there is little prospect of the Mogadishu system being extended beyond Mordiile, which is more than 60 km away.

Many large farmers have their own generators.

3.6 Telecommunications

Telecommunications within the Study Area are poor, but connections from the main telephone exchanges to Mogadishu are quite good. There are exchanges at Janaale, Qoryooley and Shalambood and also at Marka, just outside the Study Area. Janaale, Qoryooley and Marka are connected to the radio link between Mogadishu and Kismaayo but Shalambood is connected by overhead line to Marka and a call from Shalambood to Qoryooley has to be routed via Mogadishu. In addition the line between Shalambood and Marka is unreliable and requires renovation.

3.7 Population

The Study Area is heavily populated with just under 112 500 people living in 128 villages throughout the area. This represents nearly 170 people/km^2 compared with the national average of 5/km^2. The average family size is just under six persons so that there are about 18 900 families in the area. Each family comprises, on average, two adults, two children below the age of 14 and one or two older children.

Nearly all the resident population are smallholders engaged in farming and, with crop production widespread throughout the Study Area (see Chapter 5), this population is fairly evenly distributed. However, following a village centralisation programme carried out by the Government in Qoryooley district, there are fewer, but larger, villages in this part of the Study Area (see Table 3.1) than in the area of Marka district.

TABLE 3.1

Study Area Population and Distribution

District	Area (km^2)	Population	No. of villages	Average village population
Qoryooley	216.1	44 611	21	2 124
Marka	458.0	67 705	107	633
Total	674.1	112 316	128	-

There are also 20 to 25 Italian banana growers, including dependants, still remaining in the area.

Migration is also reported of nomads and farmers from areas north of Qoryooley district during the dry season and in bad rainfall years. This migration is unpredictable and unquantifiable.

3.8 Land Tenure

3.8.1 Smallholders

Smallholders comprise the vast majority of farmers in the Study Area and, until recently, ownership and title rights were established according to the traditional Islamic law. Inheritance was through male members of the family and land could be rented or, if available, purchased. Surveys carried out for this study showed that 73% of the community held title to all their land, 16% farmed land to which they had no title and the remaining 11% held title to some land and farmed land to which they had no title. The average holding size varies from 1 to 3 ha per family although in villages away from the banana growing areas, the average size is just under 2 ha per family.

Recently, the Government has introduced several social reforms which include the prohibition of land rental and sale. The introduction of equal rights between sexes has meant that women can now inherit land although, at the time of this study, less than 17% of families included in the survey possessed land that was owned by women.

3.8.2 Large Scale Producers

In October 1975, a Land Registration Act was introduced which cancelled all previous land tenure laws, substituting the following basic regulations :

(a) The maximum permissible private holding is 30 ha for irrigated annual crops and 100 ha for irrigated perennial crops.

(b) All large holdings must be registered with, and approved by, the Ministry of Agriculture.

(c) Land rental and sale are prohibited.

(d) Larger private holdings are only possible through the formation of a registered company or co-operative.

(e) Large holdings can be inherited by family members but only if the above laws are not contravened.

Within the Study Area these regulations affected an estimated 50 large scale annual crop farmers and 41 banana farms but most have overcome any problems by registering as co-operatives or companies.

3.9 Present Infrastructure (Crop Production)

With the exception of a small private sector involving tractor hire and the local marketing of fruit and vegetables, agricultural infrastructure within the Study Area is the responsibility of the Ministry of Agriculture, together with three major state organisations: the National Farm Machinery and Agricultural Supply Service (ONAT), the Agricultural Development Corporation (ADC), and the National Banana Board (ENB). All four organisations have their regional offices and depots for Lower Shabeelle region within the Study Area.

The Ministry of Agriculture is responsible for :

(a) management of irrigation supplies and canal maintenance

(b) operation of several state production farms

(c) establishment and organisation of smallholder co-operatives

(d) pest control and advisory service

(e) land registration

(f) general extension services.

The ministry also operates a research station, a seed multiplication centre and an agricultural secondary school at Afgooye, about 65 km upstream of the Study Area, all of which have a direct influence on agricultural work in the Study Area.

ONAT is responsible to the Ministry of Agriculture and operates a tractor hire service as well as being the only official supplier of agricultural equipment, spare parts, seeds, chemicals and fertilisers.

ADC is responsible to the Ministry of Commerce and is the only official purchaser and wholesaler of oilseeds and most cereals produced in Somalia. ADC mantains two depots as well as 18 temporary buying stations in the Study Area.

The National Banana Board (ENB) is a more autonomous organisation responsible to the Minister of Agriculture, handling all facets of banana production, packaging, commercialisation and export.

Infrastructural services serving the agricultural sector are, in general, in need of improvement. The present situation and problems are summarised below :-

(a) The shortage of sufficient and qualified staff within the Ministry of Agriculture is such that, apart from limited development of co-operatives, virtually no impact has been made by extension services on the farming community.

(b) The lack of properly organised long term research programmes since the establishment of CARS, Afgooye, in 1964 has resulted in few valid recommendations for improved methods of crop production. Coupled with this, the lack of properly supervised seed multiplication and inspection has also resulted in the lack of pure stocks of any recommended annual crop variety.

(c) Agrochemical and fertiliser supplies are generally adequate with shortfalls reflecting demand more than supply.

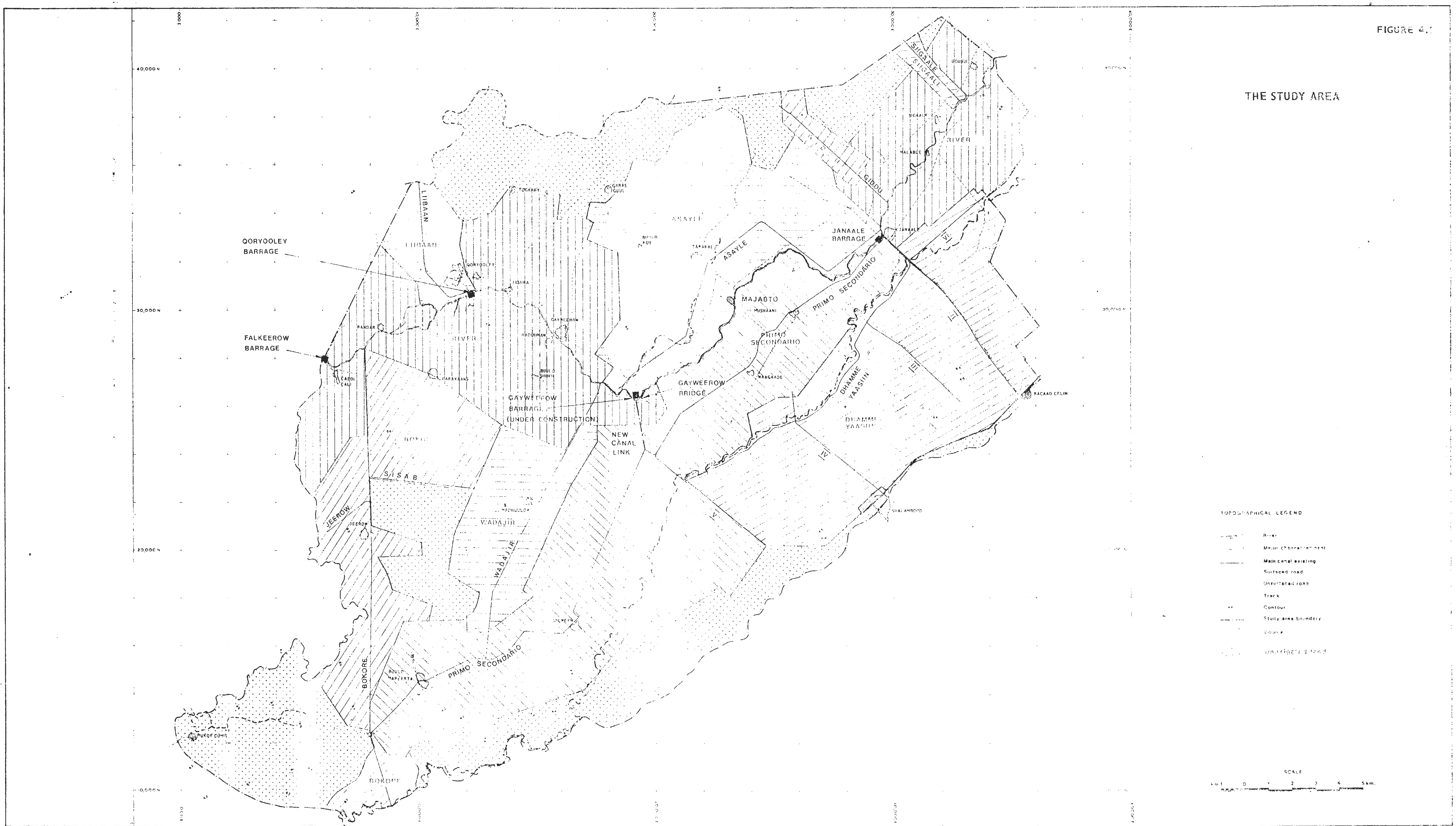
(d) Export marketing of bananas, organised by ENB, is erratic and, along with high FOB costs and technical charges, is a major reason for poor productivity.

(e) Tractor hire, maintenance facilities and spare parts availability are insufficient.

(f) Marketing organisations (private and state) for surplus produce, particularly grain crops, are good. ADC operations in the Study Area are a reasonable model for other institutions to follow.

(g) The first students from the new agricultural school and university faculty of agriculture graduated during 1975. As these graduates become available for project development, the present shortage of qualified staff should improve.

FIGURE 4.1



THE STUDY AREA

CHAPTER 4

ENGINEERING

4.1 Existing Situation

4.1.1 General Description

The Study Area is irrigated from the River Shabeelle. Comprehensive development started in the period 1925 to 1930 with the construction of Janaale barrage and the associated canal system. At first cotton was grown in the area but in the 1930s bananas were introduced as the major crop. To overcome water shortage in the dry season on-farm reservoirs were built to store der flood water for later use. In 1960 a consortium of banana growers was formed to install tubewells to irrigate bananas and citrus in the dry season and since then most of the reservoirs have fallen into disuse. A total of 132 tubewells is now in operation and, on average, they are used for two to three months every other year, depending on riverflows.

In 1955 work commenced on the Buulo Mareerta project which included the Qoryooley and Falkeerow barrages and the Wadajir, Liibaan, and Bokore canals. At various times other modifications have been made with the result that the Primo Secondario canal, which was originally a secondary canal off the Dhamme Yaasiin, is now the most important supply canal. The Wadajir canal joins this canal which in turn flows into Shangaani basin near the tail of the Bokore canal. Figure 4.1 and Table 4.1 show the areas irrigated from each canal.

In 1976 work commenced on the grapefruit project financed by the EDF. Under this scheme a new barrage is being constructed near Gayweerow and a short canal will link this barrage to the Primo Secondario canal. The downstream portion of the Primo Secondario canal will be fed solely from this link canal.

Remodelling of the downstream section of the Primo Secondario canal is proposed, to permit the canal to pass the increased discharge required for the grapefruit project.

Janaale barrage is in poor condition and this is described in detail in Annex VII, Chapter 3. The main features are 11 sluice gates on the left bank side, 11 weirs on the right bank side and there are also several scour sluices. Of the 11 sluice gates only 3 are operating satisfactorily; the remaining gates have no operating gear and are opened by jacks or with the assistance of hydraulic excavators. Occasionally the sluice openings have been deliberately closed by bunds of branches and banana leaves. Apart from the difficulties of maintaining the correct pond level there is a great danger that a sudden flood could arrive before the gates could be opened, and flooding would occur upstream. There is also a deep scour hole immediately downstream of the apron and there is a risk that the barrage could be undermined. Repairs to the sluice gates and the scour hole should be made as quickly as possible.

TABLE 4.1

Areas Irrigated from Main Canals

Canal	Location of offtake	Gross area irrigated	
		ha	percentage of Study Area
Sigaale	8.4 km upstream of Janaale	290	0.4
Giddu	1.7 km upstream of Janaale	600	0.9
Asayle	Janaale	7 550	11.2
Dhamme Yaasiin	Janaale	9 630	14.3
Primo Secondario	Janaale	13 690	20.3
Wadajir	8.2 km upstream of Qoryooley	2 890	4.3
Liibaan	Qoryooley	1 230	1.8
Bokore	Falkeerow	5 730	8.5
Total (main canals)	-	41 620	61.7
Irrigation direct from river	-	21 560	18.6
Total irrigated area	-	54 180	80.3
Unirrigated land	-	13 230	19.7
TOTAL Study Area	-	67 410	100.0

Qoryooley and Falkeerow barrages are similar and both include nine large sluice gates. Both structures appear to be sound although there is considerable erosion on the left bank downstream of Falkeerow barrage which requires urgent attention. In each barrage the gates need repair, but Qoryooley barrage may be redundant in a few years if the Faraxaane project goes ahead, and in consequence only temporary works are required until the continued need for the barrage has been shown.

All the canals in the area are unlined (apart from a small area of the ENB farm near Golweyn where concrete channels have been constructed). The canal head regulators are in poor condition and the cross-regulators are rarely used. This means that it is often necessary to pass surplus water into the canals merely to raise water levels sufficiently to feed offtakes. The concentration of sediment in the river is very high and consequently the canals frequently become blocked by silt and need constant clearance. This problem is made worse by inadequate water surface slopes on most canals. In contrast to the other canals the Primo Secondario canal appears to be in regime and comparatively little silt is deposited. This canal is worthy of greater study so that a clearer understanding of silting may be obtained and the design of other canals improved. Weed growth along the canals is rapid and constant cutting or chemical control methods are required.

Access along many canal banks is very difficult because of narrow bank tops or mounds of silt left after canal clearance. The Study Area is comparatively flat, canal commands up to 2.5 m or 3.0 m occur in low lying areas and seepage water from canals often ponds at the outer toes of the canal banks. There is no surface water drainage system in the area.

Offtakes from canals vary from gated structures to pipes through the bank or occasionally a trench through the bank. In many areas the canal lacks command and pumps are required which are generally driven by a belt from a tractor. The pumps were fabricated locally at Shalambood but this has now ceased. Along the river, offtakes are similar to those on the canals but there are many small channels through the bank where discharge is controlled by earth or wattle bunds.

4.1.2 Operation and Maintenance of the Canal System

The Ministry of Agriculture is responsible for allocation of river water and operation and maintenance of the main canals. The regional co-ordinator for agriculture is based at Janaale and the staffing of the irrigation office is described in Annex VII, Table 1.5. There are three hydraulic excavators allocated to canal clearance and a further three for flood prevention works in the region. During the period of the study, five of the excavators were working on canal clearance and one was awaiting spares. Little maintenance is done on canal regulator gates, the staff have little experience and no equipment to maintain the barrage gates effectively although attempts are made to replace defective gates in the dry season using the facilities of ONAT at Shalambood.

Generally the canals carry as much water as they can without overtopping, but the discharge decreases steadily as silt and weeds build up. The main canals operate continously and, since farmers only irrigate by day, the flows at night pass down the canals until they reach the tail where they usually discharge into old river channels. Also at night the canal water is often passed into the old reservoirs. Generally farmers can take water whenever required but, when river levels fall, the canals are divided into reaches and each reach is only permitted to take water in rotation. However, because of the lack of cross-regulators, the efficient allocation of water is difficult.

When river levels are low, the Sigaale and Wadajir canals are unable to obtain water because they are so far upstream of the controlling barrages that the river level falls below the offtake level. This also applies to the many minor canals which offtake directly from the river.

Tubewells are generally installed by ENB which also supplies the pump, gearboxes and diesel engines, and maintains a stock of spares at Shalambood. However, the cost of drilling and equipping wells and the cost of operation are paid by the farmer.

4.1.3 Methods of Irrigation

The predominant crops in the area are maize in the gu season and maize and sesame in the der season. Most crops are irrigated by small basins of about one jibal or 25 m by 25 m but where the land is very uneven a jibal may be divided into four smaller basins. No land levelling is done and water distribution is not very efficient. In addition only about three irrigations are applied per season. Crop yields are low, farmers obviously rely on rainfall to a great extent and this is usually insufficient. Some inter-cropping is practised and this is partly done because of the risk of failure of the first crop. Once the first gu rains have fallen cropping calendars are very flexible as the farmers take advantage of rains or irrigation water supplies when available. It has been reported that as many as four crops have been planted on the same land between dry seasons but probably not more than two of the crops would be harvested successfully.

Sesame is often grown following a single irrigation before planting. For this purpose bunds have been built round large fields up to 3 ha in area. The field is then flooded to a depth of about 0.3 m when water is plentiful early in the der season. Because the land has not been levelled the depth of water varies considerably throughout the fields. As the water level recedes, sesame is planted to grow using the residual soil moisture. If possible an additional irrigation might be given, and there is usually some rain to help the crop. The adoption of this method is the basis of the der flood project, but the method is not proposed with any other crop. Much further work in soil-water relationships is required before the method can be recommended for other crops, although cotton is grown in this way on special soils in a few other parts of the world.

Bananas are irrigated by furrows in their first year but after that the furrows are bunded off and the system reverts to basin irrigation. There appears to be a tendency for bananas to be over-irrigated so that waterlogging occurs. This has the effect of restricting the rooting depth and encouraging nematodes. The shallow rooting systems often lead to banana plants being overturned by high winds.

4.1.4 Efficiency of Application

Throughout this report a field application efficiency of 60% has been used, with a system distribution efficiency of 75%. This gives an overall efficiency of water use of 45%. With training and management these figures should be attainable. An attempt was made to measure the overall efficiency by comparing the discharges at the head of the canals with the theoretical crop water requirements of the actual area under cultivation within that canal command. The existing overall efficiency was calculated at about 20%. It must be recalled that the canals flow continuously but irrigation is only carried out during daylight. This is one obvious reason for the low efficiency but during the test the surplus discharge from Shangaani basin was less than 7% of the water entering that system. Another major reason for the low efficiency is the need to pass sufficient water to maintain canal levels high enough to supply offtakes.

On the other hand the annual crops are not given enough irrigations and on account of this the efficiency of application should be reasonably high. This existing application efficiency should only be taken as a general guide since water was not in short supply over the period of the test although there is no reason to believe that efficiencies will be higher at times of water shortages since those farmers who do not have pumps cannot take water when the canal water levels are low. A further reason for the reduced efficiency in the der season is that the canals are also used to divert flood water away from the river; this is discussed in the following section.

4.1.5 Flood Protection

In parts of the Study Area the river is on a levee and there is a risk of flooding. However the damage caused by flooding is reduced because the river banks are very stable and do not erode easily under low flows. Over the years flood banks have slowly been built up so that when the river overtops its bank in one area it is near to bank top level along the whole length from Jowhar to Falkeerow. Thus a further slight increase in level leads to overtopping elsewhere with the result that the river levels are self regulating and it appears that the river rarely overtops its banks by more than 0.1 m. In consequence, erosion of the banks is rare and flooding can often be avoided along the Study Area reach by an additional low bund where bank levels are low. For these reasons, very serious flooding has not occurred in the area for several years. However, the situation needs constant attention sinces breaches can occur due to damage by hippopotami or in places where minor canals have been cut through the flood bank. Furthermore there is evidence that the river bed is silting up in the vicinity of the barrages.

When the river is high, the Dhamme Yaasiin and Primo Secondario canals are used as flood relief channels. Water is passed along these canals to reduce the riverflow downstream of Janaale. This water passes into the old storage reservoirs or into the old river channels at the tail of the system.

4.2 Definition of Types of Development

From the previous sections, it can be seen that the introduction of an efficient irrigation system is not the only requirement for the improvement of irrigated agriculture. Farming methods need to be changed. Indeed considerable benefits may be obtained solely by improvement of the extension service and provision of inputs. However, it is considered that improvement of extension services alone will not yield the desired benefits without the provision of adequate and reliable water supplies. Therefore this study has been directed towards the identification and ranking of definite distinct projects for integrated development so that maximum benefits can be obtained.

The soils of the Study Area are comparatively uniform and there is no prospect of developing groundwater outside the area served by the Primo Secondario canal and within that zone there is already a project for more extensive use of groundwater for the irrigation of grapefruit. There are not sufficient records to indicate any variation in climatic conditions in the area although during the 1977 der season it was observed that there was noticeably more rainfall in the Qoryooley area than in the south-east of the Study Area ; but this was a subjective judgement and it will take many years of observations for significant differences to be proven.

It is considered unlikely that climatic phenomena other than rainfall vary throughout the area, but if it were to be found that rainfall in any zone is significantly higher than elsewhere in June and July, then this would influence the priorities for development since the use of effective rainfall at these times would enable the river water to be used to irrigate a more extensive area.

In the absence of any other criteria, the identification of other projects should be based on engineering principles. The most important of these is the location of barrages and existing canals. Any canal which does not offtake from the river directly upstream of a barrage will have an erratic water supply since the river level will fluctuate according to the discharge. Hence there are two solutions, the construction of a new barrage or a pumping station. Barrages are expensive and the area is already well served. The only area which cannot be effectively fed from the existing barrages or the new Gayweerow barrage is the area upstream of Janaale barrage. However, this area totals only 5 635 ha gross (Janaale development zone 3 165 ha on the left bank and Degwariiri development zone 2 470 ha on the left bank (see Figures 4.1 and 4.2)). However of this 5 635 ha, 600 ha are already irrigated by the Giddu canal and more than half the Janaale zone is irrigated from the second and sixth secondary canals of the Dhamme Yaasiin system. The balance in this area could be served by pumps. Other areas along the river which are served from direct offtaking canals and are susceptible to loss of command can, if required, be served by contour canals taking off from the nearest existing barrage upstream.

Another important feature in the determination of project boundaries is the location of existing or proposed projects. The grapefruit project has already been located in the best area for development and at the start of the study it was understood the State Planning Commission were giving consideration to funds being made available for a rice project at Shalambood. There were also several Crash Programmes and co-operative farms and it was considered preferable not to incorporate these into specific projects. For the location of these areas see Figure 3 of the Inception Report (Annex XI).

During the preparation of the Inception Report, three specific projects of 5 000 ha were identified, viz. Qoryooley, Faraxaane and Asayle. The Qoryooley project was selected by the Somali Government for the detailed feasibility study.

One of the criteria in the selection of development projects was that the area should be of sufficient size to justify a specific integrated project and that the area should form a cohesive unit. The selection of such units would obviously leave gaps between projects and it was decided to consider these as development zones where less intensive inputs would be provided, based mainly on the improvement of the extension service and repairs and remodelling of the existing canals. Certain areas on the margin of the Study Area are out of command and because of the shortage of water it is recommended that these are left as rough grazing and a source of firewood.

Three types of development were considered as follows :

(a) Irrigation of perennial crops such as bananas and citrus

(b) Seasonal controlled irrigation of annual crops

(c) Seasonal flood irrigation involving a single application of water prior to planting.

FIGURE 4.2

STUDY AREA – PROPOSED DEVELOPMENT

A. PROJECT AREAS

- A.1 Qoryooley project
- A.2 Faraxaane project
- A.3 Asayle project
- A.4 Der flood project
- A.5 Mukoy Dumis project
- A.6 Banana drainage project
- A.7 EDF grapefruit production scheme
- A.8 Shalambood project
- A.9 Golweyn project

B. LAND DEVELOPMENT CLASSIFICATION AND ZONES

B.1 Non development zones 1. Acacia woodland
2. Marginal agriculture

B.2 Existing systems with upgraded technical services
1. Janaale zone
2. Degwariiri zone
3. Bandar zone
4. Majabto zone
5. Haduuman zone
6. Jeerow zone
7. Waagade zone
8. Primo Secondario Banana zone
9. Tahliil zone

TOPOGRAPHICAL LEGEND

- River
- Major channel remnant
- Main canal existing
- Surfaced road
- Unsurfaced road
- Track
- Contour
- Study area boundary
- Village

SCALE

0 1 2 3 4 5km

The studies were also to examine the integration of livestock into the irrigation projects.

An examination of water resources showed that river water would not be sufficiently reliable to irrigate perennial crops in the dry season and that groundwater was far too saline over most of the area. Even in the best areas, the quality of groundwater was only moderate and these areas are already using groundwater for banana plantations or their use is being proposed for the grapefruit project. For these reasons, further expansion of perennial crops has not been considered. Seasonal flood irrigation is already practised in the area and although this is a comparatively inexpensive form of irrigation, it is not generally considered worthwhile to develop such areas comprehensively since the increased yields are unlikely to justify the expense involved. However, to test the viability of this type of development one area has been selected and studied in detail (see Section 4.3.10).

4.3 Description of Development Projects and Development Zones

The previous section describes the difference between a development project and a development zone. The Study Area has been divided into specific projects or zones which are shown in Figure 4.2. The salient features of each zone are presented in Table 4.2 and this section gives an outline of each project or zone. For the sake of convenience, the Study Area can be sub-divided into three areas: the area north of the Shabeelle, the area between the Shabeelle and the Primo Secondario canal, and the remaining area which is predominantly south-east of the Primo Secondario canal.

4.3.1 Degwariiri Zone

This zone, lying to the north of the Shabeelle, contains some banana plantations and is predominantly irrigated from the river or from the Sigaale and Giddu canals. The area is not considered large enough for a separate project but considerable gains may be made by staged improvements to the canal system.

4.3.2 The Asayle Project

This area is irrigated by the Asayle canal which is effective in its upper reach, as far as Tawakal. There are some banana plantations and eleven large farms in the area.

4.3.3 Majabto Development Zone

Whereas the upper reach of the Asayle canal is reasonably effective, the lower reach has very unreliable supplies. At times of water shortage very little water reaches the downstream reach. The Majabto zone lies between this downstream reach and the river, and is irrigated from each side. The zone is not very wide and forms a basin where there are considerable flooded areas caused by seepage from the Asayle canal and the river. If the Asayle project is developed this area should benefit from improved water supplies, but in addition a central surface drain is required. The drainage water will have to be pumped back into the river, or to the Qoryooley project, since there is no natural outlet from the zone.

TABLE 4.2

Features of Development Projects and Zones

	Location	Gross project area (ha)	Present NCA (ha)	Perennial cropping (ha)	Annual crops NCA (ha)	Households (No.)
Projects						
Faraxaane	Faraxaane	5 000	2 324	-	2 324	2 640
Der flood	East of Jeerow	1 200	229	-	229	260
Mukoy Dumis	East of Mukoy Dumis	2 060	113	-	113	130
Shalambood	North of Shalambood	6 255	2 101	358	1 743	1 980
Golweyn	East of Golweyn	3 700	854	108	746	850
Asayle	West of Janaale	4 170	1 505	144	1 361	941
Banana drainage	Beside Primo Secondario canal	2 830	1 560	1 560	-	-
Development Zones						
Janaale	East of Janaale	3 165	1 310	272	1 038	1 180
Degwariiri	North of Janaale	2 470	1 157	381	776	880
Bandar	West of Qoryooley	1 815	691	-	691	790
Majabto	Between Asayle canal and river	1 760	579	9	570	650
Haduuman	Between Qoryooley road and river	1 940	823	-	823	930
Jeerow	West of Jeerow	2 325	1 028	-	1 028	1 170
Waagade	Between Dhamme Yaasiin and Primo Secondario canal	3 790	903	333	570	650
Primo Secondario banana	West of Primo Secondario canal	3 020	1 451	1 067	384	440
Tahliil	North of grapefruit scheme	2 765	907	50	857	1 070

4.3.4 The Qoryooley Project

This is the area selected for the feasibility study. The area is to be irrigated from the new Gayweerow barrage and low head pumping is required for 90% of the area. At the request of the Client, an alternative supply has been investigated using the Asayle canal to supply about half of the area by gravity. This has led to the possibility that the Qoryooley project could be integrated with the Asayle project.

4.3.5 Bandar Development Zone

The Bandar zone is in the north-west corner of the area between the Liibaan canal, the river and the Study Area boundary. Under the Bokore project (1955), it was intended that this area be irrigated from the Liibaan canal but the water surface slope of the canal is almost flat for the first two kilometres and silts up rapidly and most of this zone is now irrigated by small canals from the river.

4.3.6 The Banana Drainage Project

The first area to be considered on the left bank of the river is the area chosen for the banana drainage project. This project has been selected for a study of the problems of drainage of bananas and an outline design has been presented. The first part of the project lies between the river and the Primo Secondario canal and the later stages of development will cover land on the other bank of the Primo Secondario canal downstream.

4.3.7 The Primo Secondario Banana Zone

The Primo Secondario canal is the main source of irrigation water to the banana plantations. The lower reach of the canal is to be remodelled to take the increased discharge for the grapefruit project. The privately-owned banana plantations take care to ensure that their farm distribution systems are satisfactory and hence it is not considered that further works will be necessary for their irrigation systems. Drainage works may be required later depending on the results of the banana drainage project. This zone would require a separate main drain since it is on the opposite bank of the Primo Secondario canal to the drain for the banana drainage project.

4.3.8 The Faraxaane Project

The Faraxaane area is an area of the left bank which is extensively irrigated by small canals mainly from the river. It is difficult to say how much of this area can be fed by gravity from the new Gayweerow barrage but the boundaries have been drawn to exclude areas which obviously cannot be fed by gravity.

4.3.9 The Haduuman Development Zone

Between the Faraxaane project area and the river is a small strip of land at river level which cannot be fed reliably by gravity from the new Gayweerow barrage. This area is already irrigated intensively from the river and any

benefits due to the provision of properly designed canals are likely to be minimal due to the level of existing production. The area is ideally suited to small local improvements combined with a more effective extension service.

4.3.10 The Der Flood Project

The area near the junction of the Sisab canal and the Bokore canal has been selected for this project in response to the requirement to investigate the possibilities for a system of irrigation by a single flood prior to planting. This area has a reliable water supply immediately adjacent which results in the capital cost being minimal.

4.3.11 The Tahliil Development Zone

Immediately south of the Faraxaane project and the der flood project is the Tahliil zone. The boundaries of the two projects were drawn rather arbitrarily on an estimate of the extent of land which could be commanded from the source of irrigation, and it may be that one or both of these projects could be extended to include part of the Tahliil zone. Alternatively, the zone could be incorporated with the grapefruit project which forms the southern boundary. Only a detailed survey will show the best way to develop this zone.

4.3.12 The Jeerow Development Zone

The area west of the Bokore canal is referred to as the Jeerow zone. The gross area of this zone within the Study Area is 2 325 ha and this area is mainly irrigated from the Bokore canal. Beyond the Study Area boundary, the area is irrigated from a branch of the river which starts immediately downstream of Falkeerow barrage. Agriculture in this area has expanded in recent years following the construction of a flood bund on the left bank of the river. In the south, the zone is bounded by swamps. Reported yields of staple crops are higher in this area than elsewhere presumably because the soil fertility has not yet been reduced by continuous cropping. Water supplies from the Bokore canal are good and the area is suitable for small improvement works. Further studies of this zone should include the area between the Study Area boundary and the river.

4.3.13 The Janaale Development Zone

The Janaale zone is on the eastern edge of the Study Area on the left bank of the river. Ideally, most of this zone should be developed as part of the Shalambood project since most of the area is irrigated from two secondary canals of the Dhamme Yaasiin system. However, there is a large co-operative farm adjacent to the Shalambood project and it may be assumed that development of this farm may precede the project. This zone will benefit from the remodelling of the Dhamme Yaasiin canal envisaged under the Shalambood project.

4.3.14 The Shalambood Project

The Shalambood project was first identified by Hunting Technical Services Limited in 1969. The Project Area has been the subject of a pre-feasibility study for a rice project (State Planning Commission 1977). However, during the course of this study further information has become available which indicates

that the area is more suitable for development in a similar manner to the Qoryooley project and an area to the west of the project has been transferred to the Golweyn project because the existing water supply is from the Primo Secondario canal rather than the Dhamme Yaasiin canal.

4.3.15 The Golweyn Project

This project lies to the west of the Shalambood project and is fed from the Primo Secondario canal.

4.3.16 The Waagade Development Zone

The area between the Dhaame Yaasiin and Primo Secondario canals is the Waagade zone. This is a major banana growing area. The method of water supply to the grapefruit scheme will affect the operation of the Primo Secondario canal. The requirements of this zone should be considered most carefully.

4.3.17 The Grapefruit Production Scheme

This project is financed by the EDF and decisions on the extent of development for grapefruit will depend on consultations between the financiers, the project consultants and the Ministry of Agriculture.

4.3.18 The Mukoy Dumis Project

At the request of the Client, the possibility of clearing bush within the Study Area for development has been considered. The only area of bush, except for the margins of the Study Area, is on the road to Mukoy Dumis. This area was examined and since it is crossed by old river channels, it was split into two completely separate phases. Only Phase I has been costed for this study and these costs will also be applicable to Phase II.

FIGURE 5.1

STUDY AREA LAND USE

LEGEND

UNCULTIVATED LAND

- 1a — MAINLY ACACIA WOODLAND, THICKET AND LOW SCRUB
- 1b — MAINLY ABANDONED LAND AND RIVERINE VEGETATION

MARGINAL ANNUAL CROP PRODUCTION

- 2a — 10–30% LAND USE INTENSITY, INCLUDING RAINFED CROPPING
- 2b — 40–70% LAND USE INTENSITY, MARGINAL IRRIGATION

IRRIGATED ANNUAL CROP PRODUCTION

- 3a — MAINLY 30–50% LAND USE INTENSITY
- 3b — 60–70% LAND USE INTENSITY

IRRIGATED PERENNIAL CROPS

- 4 — MAINLY BANANA PRODUCTION

TOPOGRAPHICAL LEGEND

- River
- Major channel remnant
- Main canal existing
- Surfaced road
- Unsurfaced road
- Track
- Contour
- Study area boundary
- Village

NOTE

THIS FIGURE IS ABSTRACTED FROM INFORMATION GIVEN ON MAP IE. PRESENT LAND USE SCALE 1:50000

N

SCALE

km 1 0 1 2 3 4 5km.

CHAPTER 5

AGRICULTURE

5.1 Present Situation

Present land use in the Study Area is shown in Figure 5.1 and summarised in Table 5.1. Uncultivated areas are mainly Acacia woodland and scrub (12 950 ha). The area under cultivation is widespread, occupying about 74% of the Study Area, but with a low intensity of land use. Although annual crop production occupies 63% of the Study Area, the average land use intensity is only 39%. The main annual crops grown are maize and sesame under a system of double cropping as follows:-

Cropping intensity (%)

Crop	Gu	Der
Maize	100	40
Sesame		60
Total	100	100

Crop production in class 2 areas is similar to that in class 3 areas except for poorer irrigation supplies. Perennial crop production is dominated by banana production (4 000 ha net).

There are, basically, two farming systems in the Study Area. Annual crop production is dominated by smallholder farming and bananas by commercial growers, both of which utilise hand labour for nearly all field operations. Land preparation for bananas represents the only extensive use of machinery, with the small area of upland rice (400 ha) being the only form of truly mechanised farming. However, labour availability studies indicate that, with few exceptions, the necessity to mechanise farming is limited.

TABLE 5.1

Study Area Present Land Use

Land use category	Gross ha	Gross %	Net area ha	Net area %
Uncultivated land	17 450	26	-	-
Marginal annual crop production	15 565	23	5 078	24
Irrigated annual crop production	27 010	40	11 512	55
Irrigated perennial crop production	7 385	11	4 372	21
TOTAL	67 410	100	20 962	100

Maize is planted during the rains in April and May and harvested during July and August. Der crops are planted in October and harvested in January and February. Planting in a rough check-row pattern is carried out in small irrigation basins (150 to 160 m^2). Crops are weeded one to three times but weeding is often late and weed control poor. One to three irrigations are usually applied but this is inadequate and distribution is inefficient. No form of land levelling is practised, further decreasing irrigation efficiency. Crops are heavily dependent upon rainfall distribution, and irrigation supplies are in effect supplementary and not the main source of water. Harvesting is done by stooking and cob picking is undertaken several weeks later. Maize stalkborer (Chilo partellus) and occasional cutworm attacks are the only serious pests observed. Severe yield reductions can occur through stalkborer attack. No serious diseases occur. Yields are low due to poor management, pests and low soil fertility, and range between 6 and 10 q/ha (shelled).

Sesame is planted in the same way as maize; in October and November for der season crops, and in July and August for the small area of hagai season catch-cropping. Before planting, a single flood irrigation is applied but this is often inadequate. A few farmers have fields with high earth banks so that a deep flooding, which takes several weeks to complete, can be practised. Several weedings are carried out and, occasionally, a second irrigation given if water is available. Like maize, crops are dependent on der season rainfall distribution. The local variety cultivated is a dehiscent type and is harvested and stooked after 90 days, before capsules open. Threshing by hand is carried out two weeks later. Isolated but serious attacks of cutworm during early growth stages cause the only severe pest problem on der season crops. Hagai crops can only be attacked by webworm (Antigastra sp) and seed set is affected by cloudy conditions. As with maize, yields are low, varying between 2.5 and 4 q/ha.

Banana production has declined over the last ten years due to many interrelated agronomic and economic problems. Present net returns are low and, as a result, overall crop management is minimal. There is insufficient nematode control and fertiliser usage and drainage, weed control and irrigation are poor. Seasonal labour shortages are experienced, and the continued seasonal usage of moderately saline groundwater must also be contributing to this decline.

A wide range of other crops are cultivated but on a small scale. These include pulses, which are usually intercropped with maize, as well as groundnuts, tomatoes, chewing tobacco, grapefruit and coconuts. Previously, cotton, castor and groundnuts had been grown extensively in the Study Area.

5.2 Development Proposals

The most important agricultural development in the Study Area is the improvement of existing annual crop production. It is Government policy to encourage annual crop production along the Shabeelle river and limit perennial crop production to the extent discussed later in this chapter (Sections 5.11 and 5.12).

The existing area under annual crops is already extensive and is dominated by smallholder agriculture. Current Government policy towards development of smallholder agriculture is the formation of either co-operative societies (multi-purpose societies) or co-operative farms (group farms). Development proposals are based, therefore, on the improvement of the present irrigated farming system on the basis of co-operatives, either through specific projects or through the general improvement of technical services to the present agricultural community within particular development zones.

5.2.1 Development Projects

In these projects, provision is made for full farm management and technical supervision, machinery availability, the organisation of input supplies (seed, chemicals, fertilisers, etc.) and marketing of surplus produce. Projects will be provided with a system of main canals, secondary canals and field canals (watercourses), as either the extension of existing systems or as completely new systems. Surface drainage systems will also be introduced.

The main project proposed is the Qoryooley project, for which a full feasibility study and design has been undertaken. Data presented in Sections 5.3 and 5.7 are based on recommendations for the Qoryooley project and modifications for other projects discussed in Section 5.8.

5.2.2 Development Zones

The remaining areas within the Study Area have been demarcated as development zones. Within each zone, development proposals will be based on upgrading existing services, particularly extension services and canal maintenance. No change in the existing farming systems is proposed, and technical inputs to these zones will therefore be less than in development projects.

5.3 Crop Production Development - Annual Crops

Crop development proposals must include maize and sesame for domestic consumption by the large population of the Project Area. Other crops considered agronomically suitable for the area include:-

cotton	safflower
rice	castor
groundnuts	tomatoes
sunflower	tobacco

However, there is a lack of technical information on the performance of most of these crops under irrigated conditions in Somalia and, consequently, apart from maize, sesame, cotton, rice and groundnuts, they have been excluded from immediate development proposals until further research is carried out to confirm their suitability to determine the most appropriate methods of production. Minor crops, such as tomatoes and pulses, already grown in the Study Area, cannot be included in any wide scale development because of their limited markets. The tomato paste factory at Afgooye is under-utilised at the moment and so the possibility of growing tomatoes on a commercial scale was considered; it was rejected at this stage because the factory is some 100 km from the Study Area. It is apparent that tomatoes grown closer to the factory would be more competitive. However, if required, a crop could usefully be grown by the farmers in their household plots.

However, in order to maintain and improve output from the present livestock population, recommendations are given for production of forage. This includes the cultivation of a short season drought-tolerant mixed cereal/legume forage in the gu season when predicted water shortages will restrict full irrigation of arable crops (see Chapter 2).

Recommended improved crop production methods are based on maximising the use of hand labour. The Study Area population is so large that beyond basic requirements for land preparation the necessity for mechanised operations is limited.

Land preparation operations are required solely to control weeds and incorporate any crop residues remaining in the field. For all crops, disc harrowing must be carried out immediately after harvesting. During the jilal season, further ploughing and harrowing may be carried out, if necessary, prior to planting all crops. The final operation to produce a weed-free seed bed will be:-

(a) a light cultivation for crops to be planted on the flat (for example, rice);

(b) ridging for crops to be furrow irrigated.

Regular cultivation of fallow land will also be necessary during the gu season to control weeds. It is considered that field re-levelling should be carried out during the jilal season and only on fields to be planted in the gu season. Therefore, re-levelling each field will take place after every two or three seasons of cropping.

In conjunction with this, it is recommended that improved hand tools, hand-operated equipment and selected animal-drawn implements are introduced into the Study Area in order to minimise mechanisation.

Recommended production methods for selected annual crops are given below and are based on the use of either basin or furrow irrigation. However, some of these recommendations include estimated requirements and further research is necessary for their confirmation or modification. Yields and irrigation requirements are given in Sections 5.5 and 5.4, respectively.

5.3.1 Maize

Maize should be planted in April (gu crops) or August and September (der crops) using 100 to 105 day composite varieties. Either check-row or line-row planting may be used to obtain about 50 000 plants per hectare (20 kg/ha seed rate). Fifty kg/ha of diammonium phosphate (DAP) should be applied at planting with 150 kg/ha urea as a top dressing. Control of maize stalkborer (Chilo partellus) will require two ULV sprays of Nuvacron (5 l/ha) within 20 days of planting. Three weedings will be necessary before tasselling (50 days). Harvesting is by picking unhusked cobs directly from the field in August and December to January when risk of rainfall is minimal. Shelling is carried out using stationary self-powered shellers; stover can then be cut and, if necessary, carted for feeding livestock. Estimated labour requirements from planting to handling stover are between 430 and 445 manhours/ha or, assuming four manhours/d, about 110 mandays/ha.

5.3.2 Sesame

Sesame should only be grown in the der season to avoid pest and disease problems as well as poor pod set. Before planting, a flood irrigation should be applied to provide sufficient water for the first 35 to 40 days crop growth to avoid irrigating during susceptible early growth stages. Check-row planting of the

90 day local variety can then be carried out on the flat or on ridges at a seed rate of about 8 kg/ha. Accurate spacing and thinning is unnecessary due to the ability of sesame to compensate for a certain degree of stand variability. Planting in October or November is necessary to allow good pod set after the November rains. Only two early weedings will be required. Cutworm control may be necessary every two years, necessitating applications of Carbofuran (Furadan) granules to the seeds before planting. Traditional harvesting and threshing methods are to be used to avoid seed losses through shattering. Estimated labour requirements are about 370 manhours/ha (92 mandays/ha). Estimated fertiliser requirements are 25 kg/ha of DAP and 40 kg/ha of urea.

5.3.3 Upland Rice

Rice is the only crop under consideration that will require a certain amount of mechanisation, due particularly to high labour requirements at harvesting. Gu season crops should be planted in May when irrigation water should be available. In many years it may be possible to plant earlier and this should be encouraged to reduce damage by Quelea quelea. Der season crops must be planted in August and before mid-September to enable harvesting before the serious bird attacks which usually occur in the jilal season. The recently introduced higher yielding 105 day variety, Vista, should be drilled at a seed rate of about 100 kg/ha before bunds and field channels (laterals) are prepared. Fifty kg/ha of DAP should be applied at planting, with 140 kg/ha of urea as a top dressing. To control the severe weed problem in rice, an early post-emergence herbicide application (12 l/ha Stam F34 or a combination of Stam F34 and Preforan) is necessary using hand-operated micro-sprayers, followed by two hand weedings from five weeks onwards. Two ULV sprays at tillering and just before weeding may be necessary to control moderate attacks of rice stemborer (Chilo partellus). Bird scaring will be necessary from heading to harvesting (35 days) for any crops heading from mid-July onwards. Quelea quelea and Ploceus spp. are the main species attacking rice during this period with attacks intensifying after December. Combine harvesting is recommended and should be easily carried out if bunds and laterals have been prepared properly. Threshed paddy will then be transported to the rice mill in Shalambood. Two mills should be in operation after 1978. Estimated labour requirements, excluding mechanised operations and milling, are 275 manhours/ha (69 mandays/ha).

5.3.4 Paddy Rice

Direct drilling paddy rice can be grown as an alternative to upland rice on certain soils with low infiltration and deep percolation characteristics (for example, Saruda soils). Although weed problems would be less serious, it is likely that after continuous mono-cropping of rice in basins, aquatic weed infestations (mainly sedges) could build up to levels which require specific control measures. The advantages, however, are higher yield potential and slightly lower labour requirements. However, large flat basin areas must be prepared to allow the permanent flooding necessary from about 25 days after planting (for 105 day varieties). Consequently, apart from double-cropping, only flood irrigated sesame can be cultivated on the same land. These basin areas can only be economically prepared where the land is relatively flat initially. Management requirements are the same as for upland rice except that no weeding will be necesary during the flooded period from 25 days to 90 days after planting. Estimated labour requirements are lower and are about 170 manhours/ha (42 mandays/ha) for mechanised production.

5.3.5 Cotton

Upland cotton (G. hirsutum) is the only type recommended for the area, having the shorter growing season necessary to avoid predicted water shortages and enable picking to be completed during the jilal season. Suitable varieties (for example, Acala 4-42 or its derivatives) should be planted in August by check-row (on the flat) or line-row (on ridges) methods at a seed rate of 30 kg/ha (un-delinted). Fifty kg/ha of DAP should be applied at planting followed by a top dressing of 150 kg/ha of urea about one month later. Four weedings will be necessary during the first two months. Pest control will be required from 40 days onwards mainly to control American bollworm (Heliothis), jassids and stainers. Eight to ten ULV sprays (2.5 l/ha Nuvacron per spray) every eight to ten days are considered necessary to provide adequate control. Three pickings will be carried out from December to February, assuming planting is over a 30 day period. After the final pick, cotton plants should be uprooted by blading (as for groundnuts), raked and burned. The bagged seed cotton will require trans-portation to the ginnery at Balcad, 40 km north of Mogadishu. Estimated labour requirements are 855 manhours/ha (214 mandays/ha).

5.3.6 Groundnuts

Groundnut production can only be considered for the der season. Isolated hagai storms will affect late growth of gu season crops on the heavy soils by either inducing germination of mature pods or preventing lifting. Only short season (120 days) erect varieties should be grown to facilitate management on these heavy soils. Planting should be from mid-August to mid-September to allow maturation to occur after the November rains and to enable a final light irrigation to be applied near harvesting, if necessary, to moisten the soil and facilitate lifting. Planting should be on 60 cm ridges at a seed rate of 90 kg/ha (shelled), with about 75 kg/ha DAP applied at the same time. At least four weedings will be necessary during the first two months of growth. No pest control measures are considered necessary. Harvesting should be by blading, with final lifting and gleaning by hand. After several days air drying in the field, pods are removed from the hay using small hand-operated strippers. No shelling is required because ADC purchases groundnuts unshelled. One major problem affecting groundnuts is moderate iron deficiency, resulting from the high soil pH. However, selection of adapted strains from existing varieties grown in the Shabeelle river area should overcome this problem. Estimated labour requirements are about 595 manhours/ha (148 mandays/ha).

5.3.7 Forage

A short season drought-tolerant forage crop suitable for the gu season is a mixture of a bulrush millet and Dolichos lablab. Both have reasonable field resistance to general pests affecting other cereal and legume crops, so that management requirements are minimal. To make maximum use of rainfall and May irrigation water availability, planting should be in April at a seed rate of 25 kg/ha. Local varieties will be suitable. About 120 to 160 kg/ha of urea should be applied at planting. Two weedings will be sufficient and cutting can start at 50 days after planting. Cutting should be completed after 70 days. The forage can then be fed directly to livestock and/or preserved (see Section 4.13). Estimated labour requirements are about 375 manhours/ha (94 mandays/ha).

5.4 Water Requirements

Crop water requirements have been calculated using the guidelines given by Doorenbos and Pruitt (1975 and 1977). Monthly reference crop evapotranspiration rates (ET_o) were calculated by the Penman method and based on climatic data recorded at Janaale and presented in Chapter 2. Crop coefficients (kc) were derived from Doorenbos and Pruitt using this climatic data and known agronomic data. Effective rainfall (r) was calculated using the USDA Soil Conservation Service method (Dastane, 1974). The monthly net irrigation requirement per crop (I_n) was then calculated using data and the following equation:-

$$I_n = n.ET_o.kc - r$$

where n = number of days per month

Monthly net irrigation requirements for crops included in cropping pattern A are given in Table 5.2 together with the calculated values of ET_o (see Section 5.7).

The irrigation intervals required for each crop were estimated using the net irrigation requirements per crop and either values for readily available soil moisture (RAM) or the maximum net application per irrigation. The maximum net application per irrigation for the Project Area soils has been taken to be 60 mm of water for a six hour irrigation period. Therefore, when estimated RAM values are greater than 60 mm of water, available soil moisture is then limited by the maximum application rate per irrigation. This occurs during mid-growth stages for all crops except upland rice when estimated RAM values at maximum root depth are 64 mm to 100 mm of water. For upland rice, estimated RAM at maximum root depth is only 36 mm of water.

In general, several early full irrigations are required in order to bring the soil up to field capacity to the maximum root depth as soon as possible. This is mainly to enable sufficient leaching to take place. Maximum leaching will be restricted to the small amount of deep percolation that can take place in the heavy soils. However, it has been calculated that leaching will be sufficient and will not restrict yields of the crops in cropping pattern A (Section 5.7.).

Estimated irrigation intervals for each crop are as follows:-

(a) Maize will require six irrigations until about 75 days after planting.

(b) Mixed forage will need only three irrigations during May.

(c) For sesame, because of its susceptibility to waterlogging, the early irrigations should be applied as pre-planting irrigations such that only two or three post-planting irrigations will be necessary at the stage of maximum flowering.

(d) Cotton will require steady fortnightly irrigations until about 130 days after planting.

(e) Upland rice will require many light irrigations at four to ten day intervals until about 85 to 90 days after planting.

However, further research is necessary before exact irrigation requirements and irrigation intervals can be determined. Research should investigate infiltration rates, permissible soil moisture depletion and irrigation requirements in relation to rainfall.

TABLE 5.2

Monthly Net Irrigation (Net Crop Water) Requirements (mm)[1]

			Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	
		ET_o (mm/d)	6.2	5.5	5.1	4.7	4.6	5.0	5.6	5.3	4.7	5.0	5.5	6.0	
Season	Crop	Planting date													Total
Gu	Maize	April 15th		0	81	104	100								285
	Forage	April 15th		0	81	32									113
	Upland rice	May 1st			110	111	128	52							401
Der	Maize	Sep 15th							16	74	119	125			334
	Upland rice	August 30th							147	159	126	64			496
	Cotton	August 15th						3	49	120	119	147	153	59	650
	Sesame	October 30th									12	125	153		290
---	Misc. crops[2]	May-December	-	-	89	72	86	99	124	113	86	110	68	-	847

Notes: (1) The net irrigation requirements are the gross crop water requirements in mm minus the effective rainfall. The monthly requirement is weighted to allow for the spread of the planting season.

(2) Vegetables and minor crops grown in houseplots.

5.5 Projected Yields

Projected yields for selected crops are given in Table 5.3. Estimated yields for the fourth year of production are those yields which can be obtained with the given crop management recommendations. Year 8 yields are considered as the maximum yield potential following further agronomic research and development. Forage yields will vary between 40 and 80 t/ha (fresh weight) depending on irrigation availability. An average yield of 65 t/ha has been taken. The yields given in Table 5.3 are only applicable to development projects.

TABLE 5.3

Projected Yield: Annual Crops (q/ha)

Crop	Existing	Year 1	Year 4	Year 8	Notes
Maize	6 - 10	18	35	40	Shelled
Sesame	2.5 - 4	5	8	10	Threshed
Cotton	-	10	20	25	Seed cotton
Upland rice	16	16	25	30	Unmilled (1)
Paddy rice	-	20	35	45	Unmilled (1)
Groundnuts	8	12	20	25	Unshelled (2)

Notes: (1) Estimated milling percentage = 65

(2) Estimated shelling percentage = 70

5.6 Gross Margins

Estimated production costs and gross margins for selected crops for year 4 yields are given in Tables 5.4 and 5.5. Costs are based mainly on 1977 ONAT prices and gross returns based on 1977 ADC produce prices. Tractor costs were estimated at So.Shs. 70/h, combine harvester costs at So.Shs. 190/h and labour is costed at So.Shs. 1.00/manhour. Required inputs have been summarised in Section 5.3. Forage production is excluded because it will be utilised within each project. Estimated forage production costs represent a cost of So.Shs. 18 to So.Shs. 24/t (fresh weight).

5.7 Cropping Patterns

Factors influencing cropping intensity and crop selection are soil constraints, water availability, cropping calendars, rotational constraints, crop relative profitability and labour availability.

Study Area soils are generally consistent and will not constrain any selected cropping pattern.

Full irrigation availability will allow 100% cropping in the der season. However, in the gu season, the maximum cropping intensity in any area is limited to the net area of existing irrigated production because of predicted shortages in June and July (see Chapter 2).

TABLE 5.4

Annual Crop Production Costs/ha (So. Shs.)

Input	Maize	Sesame	Cotton	Upland rice	Paddy rice	Ground-nuts	Mixed forage
Tractors	311	150	412	339	358	304	902
Combine harvesters	-	-	-	234	234	-	-
Micro-sprayer costs	5	-	24	9	9	-	-
Miscellaneous machinery (e.g. shellers)	12	-	-	-	-	15	-
Seed	15	20	15	227	185	156	40
Fertiliser	270	89	270	257	257	109	216
Chemicals (including seed dressing)	186	2	830	625	625	13	4
Grain drying (1)	25	-	-	18	25	-	-
Transport & milling (rice only)	-	-	-	387	542	-	-
Cost without labour	824	261	1 551	2 096	2 235	597	1 162
Labour cost	427	368	855	695	589	593	374
Cost with labour	1 251	629	2 406	2 791	2 824	1 190	1 536

Note: (1) Gu season crops only under certain circumstances.

TABLE 5.5

Annual Crops: Gross Margins

Crop	Year 4 yield (q/ha)	1977 ADC producer price (So. Shs./q)	Gross returns (So. Shs./ha)	Costs (So. Shs./ha) With labour costed	Costs (So. Shs./ha) Without labour costed	Gross margins (So. Shs./ha) With labour costed	Gross margins (So. Shs./ha) Without labour costed
Maize	35	75	2 625	1 251	824	1 374	1 801
Sesame	8	240	1 920	629	261	1 291	1 659
Cotton	20	250	5 000	2 406	1 551	2 594	3 449
Upland rice	16.25(1)	350	5 688	2 791	2 096	2 897	3 592
Paddy rice	22.75(1)	285	6 484	2 824	2 235	3 660	4 249
Groundnuts	20	120	2 400	1 190	597	1 210	1 803

Note: (1) Milled yields. ADC purchases milled rice only.

Summarised details of growing seasons of selected annual crops are given in Table 5.6. Gu crops are restricted to maize, rice and forage for agronomic reasons. Growing season limitations for der crops are mainly to enable the required irrigation to be completed before early January. In general, gu rice and maize can only be followed in the der by 90 to 100 day crops that can be planted from September onwards. Likewise, der crops requiring planting in August can only be preceded by gu crops of less than 90 days, such as forage, or a fallow.

TABLE 5.6

Cropping Calendars

Crop	Planting date	Harvesting date	Growing season (days)	Required[1] irrigation period (days)
Gu season				
Maize	April	August	105	75 - 80
Rice	May	August	105	90
Forage (mixed)	April	June/July	50 - 70	45 - 50
Der season				
Maize	Aug/Sep	Dec/Jan	105	75 - 80
Rice	Aug/Sep	December	105	90
Cotton	August	Dec-Feb	180	120 - 130
Sesame	Oct/Nov	Jan/Feb	90	55 - 60
Groundnuts	Aug/Sep	Dec/Jan	120	95

Note:- (1) Full irrigation availability predicted for May and August to mid-January. Limited availability predicted in June and July and nil availability from mid-January to end of April.

There are no severe rotational constraints to limit the annual cultivated area of any crop. Although not recommended for general agronomic reasons, mono-cropping may be practised.

Crop profitability has been assessed by estimated gross margins per crop based on financial prices and costs (see Section 5.6) and this is summarised in Table 5.5.

Rice and cotton are the most attractive crops financially and must be included to the maximum extent in any cropping pattern together with maize and sesame, which are required for domestic consumption.

Labour availability is the final factor influencing cropping patterns and, in most cases, will be the limiting factor restricting the maximum intensity of any selected crop. Estimated daily labour requirements are given in Table 5.7. Bird scaring requirements are not included as these will limit the net area of rice that can be grown to an estimated 20% cropping intensity per season. As rice production must be spread over the entire Project Area in order to obtain this labour, upland rice production is recommended in preference to paddy rice. The areas of suitable soils for paddy rice are limited to only certain parts of the Study Area.

To determine final cropping patterns it is assumed that the resident population will form the only source of labour. The reported seasonal immigration of people into the area is too unpredictable to be considered (see Chapter 3). On the basis of the known average family and holding sizes per family in the Study Area, production proposals have assumed 2 ha per family. From the average family size of five to six members, at least two members can be considered as permanently available manpower i.e. for every 100 ha, available labour will be 100 people. A working day is taken as four hours per day.

Consequently, three cropping patterns have been formulated:

Cropping Pattern A

The basic recommended pattern including upland rice and cotton. Modifications discussed in Sections 5.8 and 5.9 are based on this pattern.

Cropping Pattern B

An alternative pattern excluding cotton as Government policy may favour cotton development elsewhere in Somalia.

Cropping Pattern C

An alternative pattern excluding rice and maximising the cultivable area of cotton as the only other suitable cash crop.

The composition and labour requirements of these patterns are given in Tables 5.8 and 5.9. In each pattern the gu season water restrictions are met, in that only a 40% intensity will require full irrigation after May. Available labour will be sufficient to meet requirements, except during December to February if pattern C is practised. This coincides with cotton picking and it is expected that other members of the family will be able to assist during that period. Gross margins for each pattern (excluding forage) are given below:-

	Gross margin(1) (So.Shs./ha)
Pattern A	2 940 - 3 780
Pattern B	2 470 - 3 200
Pattern C	2 510 - 3 310

Note: (1) At year 4 yields

TABLE 5.7

Annual Crops: Labour Requirements

Average daily labour requirements per 100 ha (net[1])

Crop	Planting date	Planting period (days)	Apr		May		Jun		Jul		Aug		Sep	
(a) Gu season														
Maize	April	15	-	86	146	130	130	46	46	21	108	28	-	-
Upland rice (2)	May	15	-	-	31	37	38	121	99	32	31	41	-	-
Mixed forage	April	15	-	85	135	135	79	114	76	-	-	-	-	-

Crop	Planting date	Planting period (days)	Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar	
(b) Der season																		
Maize	September	30	-	-	83	133	136	127	86	44	32	74	74	-	-	-	-	-
Upland rice (2)	Aug-Sep	30	-	30	33	36	100	131	64	30	38	10	-	-	-	-	-	-
Cotton	August	30	73	114	117	126	98	77	64	35	35	151	217	175	136	64	-	-
Sesame	Oct-Nov	30	-	-	-	-	20	58	100	107	79	51	27	82	126	51	-	-
Ground-nuts	Aug-Sep	30	-	99	141	100	114	114	86	58	44	144	139	10	-	-	-	-

Notes: (1) Half monthly means for daily number of working people required per crop per 100 ha (net) and assumes only four hours per working day.

(2) Bird scaring requirement not included.

TABLE 5.8

Cropping Patterns

Crop	Cropping Intensity (%) Pattern A Gu	Der	Total	Pattern B Gu	Der	Total	Pattern C Gu	Der	Total
Maize	20	20	40	20	30	50	40	25	65
Upland rice	20	20	40	20	20	40	-	-	-
Mixed forage	20	-	20	20	-	20	20	-	20
Cotton	-	35	35	-	-	-	-	50	50
Sesame	-	25	25	-	25	25	-	25	25
Groundnuts	-	-	-	-	25	25	-	-	-
TOTAL	60	100	160	60	100	160	60	100	160

TABLE 5.9

Cropping Patterns : Labour Requirements

Cropping pattern	Daily labour requirement per 100 ha(1) Mar		Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan		Feb	
A	-	-	-	34	62	60	50	56	44	10	53	60	65	78	86	94	77	55	47	83	98	82	79	35
B	-	-	-	34	62	60	50	56	44	10	28	45	67	72	94	107	86	61	49	73	64	24	31	13
C	-	-	-	52	85	79	68	42	34	8	79	89	92	97	86	75	68	53	57	108	115	109	99	45

Notes: (1) Half monthly means and assuming four hours per working day.
(2) Maximum available labour estimated at 100 people per 100 ha (net) assuming 2 ha per family and two working members per family.

Source: Tables 5.6 and 5.7

5.8 Development Projects

The areas considered suitable for development as projects are shown in Figure 4.2. This includes the Qoryooley project upon which the above recommendations and cropping patterns are based. Modifications for the remaining projects are given below.

5.8.1 Faraxaane, Shalambood and Golweyn Projects

No modifications are necessary for these projects because of the similarity of present land use of the areas with the area in which the Qoryooley project is located.

5.8.2 Asayle Project

Modifications are necessary because of the number of large-scale farmers within the project area. It is therefore assumed that smallholders within this area will have a holding size of 1.0 to 1.5 ha per family in order to provide sufficient labour for these large-scale farmers. Modified cropping patterns are given below:-

(a) Smallholders

Crop	Cropping intensity (%) Gu	Der	Total
Maize	40	20	60
Sesame	-	50	50
Cotton	-	30	30
Forage (optional)	20	-	20
TOTAL	60	100	160

(b) Large-scale Farmers

Crop	Cropping intensity (%) Gu	Der	Total
Maize	20	20	40
Rice	20	20	40
Cotton	-	15	15
Sesame	-	25	25
Forage (optional)	20	-	20
TOTAL	60	80	140

These modifications will allow smallholders to produce sufficient maize and sesame for domestic consumption and avoid any labour shortage that the large-scale farmers may experience.

5.8.3 Mukoy Dumis Project

No irrigated gu season cropping will be possible due to water shortages. Therefore a modified cropping pattern is necessary to enable sufficient maize and sesame production in the der season.

This pattern is:-

	Cropping intensity (%)		
Crop	Gu	Der	Total
Maize	-	30	30
Cotton	-	40	40
Sesame	-	30	30
Forage (optional)(1)	20	-	20
TOTAL	20	100	120

Note: (1) Rainfed forage

Rice is excluded from this pattern because it will be uneconomical to provide the necessary machinery (drills, combines) for only one season per year.

5.8.4 Der Flood Project

This project is designed to provide irrigation through a single pre-planting flood to be supplemented with a few post-planting irrigations in order to utilise the der season surplus water supplies.

The modified cropping pattern that can be incorporated is as follows:-

	Cropping intensity (%)		
Crop	Gu	Der	Total
Maize	20	20	40
Sesame	-	60	60
Cotton	-	20	20
Forage	20	-	20
TOTAL	40	100	140

5.9 Development Zones

Modified cropping patterns are necessary for these zones for the following reasons:-

(a) Higher labour requirements because minimal or nil mechanisation can be expected.

(b) Gu season water shortages in certain areas.

(c) A greater emphasis on maize and sesame production due to lower yields as the result of expected poorer management and irrigation than on projects.

(d) Labour for banana production must come from these zones, particularly Waagade, Majabto and the Primo Secondario banana zone (see Figure 5.2). For these three zones, it is assumed that the average holding size will be only 1 ha per family.

Modified cropping patterns for these zones are given in Tables 5.10 and 5.11. Projected yields are given below:-

Yields (q/ha)

	Year 4	Year 8	Notes
Maize	20	25	Shelled
Sesame	6	8	Threshed
Cotton	12	15	Seed cotton
Upland rice	15	20	Unmilled

TABLE 5.10

Banana Labour Supply Zones: Cropping Patterns for 1 ha Holdings

Cropping intensity (%)

Crop	With rice			With cotton			Waagade zone		
	Gu	Der	Total	Gu	Der	Total	Gu	Der	Total
Maize	40	20	60	40	20	60	20	50	70
Sesame	-	50	50	-	50	50	-	50	50
Cotton	-	-	-	-	30	30	-	-	-
Rice	-	20	20	-	-	-	-	-	-
TOTAL	40	90	130	40	100	140	20	100	120

TABLE 5.11

Development Zones : Cropping Patterns for 2 ha Holdings

	With rice			With cotton			With rice & cotton			With tobacco			With tomatoes		
Crop	Gu	Der	Total	Gu	Der	Total	Gu	Der	Total	Gu	Der	Total	Gu	Der	Total
Maize	20	30	50	40	20	60	20	30	50	40	-	40	40	-	40
Sesame	-	30	30	-	30	30	-	30	30	-	30	30	-	30	30
Cotton	-	-	-	-	20	20	-	20	20	-	-	-	-	-	-
Rice (1)	20	20	40	-	-	-	20	-	20	-	-	-	-	-	-
Tobacco	-	-	-	-	-	-	-	-	-	-	20	20	-	-	-
Tomatoes	-	-	-	-	-	-	-	-	-	-	-	-	-	25	25
TOTAL	40	80	120	40	70	110	40	80	120	40	50	90	40	55	95

Note: (1) 20% cropping intensity maximum per season due to bird scaring requirements.

5.10 Infrastructural Improvements

5.10.1 Development Projects

Each project will require suitably qualified technical staff. The present training facilities at Afgooye will provide sufficient staff but it is essential that adequate practical experience is obtained beforehand. This is one aim of the pilot farm which is to be established at the Qoryooley project.

It is essential that the present agronomic research programmes are improved to provide the necessary recommendations. This research must be done at both the pilot farm and the research station at Afgooye (CARS) and must examine fertiliser requirements, pest control methods, irrigation requirements as well as produce suitable varieties, particularly maize.

Seed multiplication facilities at Afgooye are limited and cannot provide pure seed stocks for each project. The centre at Afgooye must therefore be used to maintain pure stocks that each project can use when replacement stocks are required. It is therefore essential that a seed inspection service is established in order to supervise multiplication of seed at each project to provide planting material of adequate quality.

Each project will obtain its agricultural supplies (chemicals, fertilisers, spare parts) directly from ONAT and it is essential that there is an improvement in the overall operational efficiency of ONAT itself.

All surplus produce except cotton is to be sold via ADC. It is estimated that at full development of the Qoryooley project, between 20 and 25 lorries will be needed each day during harvesting periods to transport surplus produce. Also ADC will need to expand its present storage capacity at Qoryooley and Shalambood by 1 000 tonnes, for the Qoryooley project, and by about 4 900 tonnes for every 5 000 ha fully developed as projects.

With full development of the Qoryooley project and with projected rice production in other areas along the Shabeelle river, both rice mills at Shalambood will be operating at nearly full capacity. Further development of rice production will therefore require the establishment of more rice mills.

5.10.2 Development Zones

Recommendations for training, research and seed multiplication given for development projects are also applicable to the development zones.

An improvement in the extension services of the Ministry of Agriculture is also essential. About 100 trained extension agents will be required and it is also recommended that:-

(a) the pest control service is abandoned as being wasteful of scarce resources compared with the need to train farmers

(b) the Janaale farmer training centre is fully utilised in order to maximise the training capacity of the extension services.

Improvement of ONAT operations within the Study Area is also required. Small sub-depots should be established in large villages in the same way that ADC operates its buying stations. These sub-depots will enable farmers to obtain fertilisers, chemicals, seeds and implements.

The ONAT tractor hire service will also require both improvement in its operational efficiency and in capacity. With full development of all nine development zones, over 140 tractors will be needed to carry out required land preparation.

It is also estimated that at full development of both projects and zones, ADC will need a further temporary storage capacity of about 29 000 tonnes and that three more rice mills will be necessary.

5.11 Banana Production

Banana production in the Study Area accounts for about 10% of Somalia's exports (on a financial basis) and is, therefore, a major industry. However, production has declined over the last ten years due to many inter-related agronomic and economic problems. Present net returns are very low and, as a result, overall crop management is minimal. Major agronomic problems are insufficient nematode control and the lack of field drainage. Inadequate fertiliser usage, weed control and inconsistent irrigation also contribute to poor productivity. On the other hand, export marketing of bananas, organised by the National Banana Board (ENB) is erratic mainly due to bad shipping arrangements, and, with high FOB costs and technical charges levied by ENB itself, is another contributory factor to the decline. Despite the fact that the bananas are of a good quality, the marketing contract with several Gulf states was rescinded in 1977 and it was only after a delay of several months that a new short-term agreement was made early in 1978.

The net area under production is about 3 400 ha with plans, mainly by ENB, to expand this up to about 4 000 ha net. Due to predicted river water shortages, any expansion will necessitate greater seasonal usage of poor quality groundwater (see Chapter 2). This, in turn, will further affect yields. Because of the risk of a build-up of salinity, it is recommended that there is no further expansion of the area under bananas.

Revitalisation of existing production depends on improvement of both crop management and infrastructural services. Main agronomic recommendations are the establishment of in-field drainage, regular applications of Furadan (carbofuran) granules to improve nematode control, the use of herbicides to overcome labour shortages for weeding during the first year of growth and balanced fertiliser applications. It is also essential to improve the overall quality of field practices from selection of clean planting material to handling harvested produce.

Infrastructural services (i.e. the operations carried out by ENB) that require immediate attention are given below:-

(a) A reduction of the high carton costs to a realistic level and the establishment of regular shipping and marketing as the first step to increasing returns and regenerating interest in improving crop management.

(b) The instigation of a much needed research programme to investigate fertiliser, irrigation and pest control requirements as well as screen new varieties.

(c) The introduction and multiplication of new planting material to replace existing nematode-infested stocks.

(d) A better liaison with other banana-exporting nations as part of a comprehensive technical staff training programme to improve expertise and experience.

It is considered that these improvements will lead to an increase in crop life from three years to six years and that gross annual yields can improve from the present 200 q/ha/year to 250 and 300 q/ha/year after five and ten years, respectively, after the instigation of recommended improvements. Projected exportable yields will therefore be from the present 130 q/ha/year to 175 q/ha/year at year 5 and 240 q/ha/year at year 10.

A specific banana drainage project is recommended in the area served by the Primo Secondario canal (see Figure 4.2). This involves the provision of a main collector drain which will enable farmers to install tile drains and open collector drains. The project will take many years to implement since tile drains can only be installed after each field is cleared of bananas. In addition, much basic research is required and it is recommended that a preliminary trial area is first established. For banana farms outside the project area, the installation of in-field drainage will also be applicable but alternative means of drainage water disposal (for example, pumping) will be necessary.

5.12 Grapefruit Production

The European Development Fund (EDF) is presently financing and supervising the development of a grapefruit production scheme within the Study Area (see Figure 4.2). At full development, it will occupy 2 485 ha of the Study Area of which 1 386 ha gross (966 ha net) will be given over to grapefruit production with the remaining area for annual crop production. Over 70% of projected maximum production (30 000 t/year) is to be exported. With the wide range of technical problems that will be encountered, Phase I of this scheme (230 ha net), which is presently under development, is regarded as a pilot project before development of Phase II (465 ha net) is started. The decision concerning the mode of development of Phase II and, if future funds are made available, Phase III (691 ha net) rests between the EDF and the Ministry of Agriculture. However, it is recommended that a new market survey is undertaken to confirm the existence of an export market. This is necessary because the previous survey used 1971 data and the world market price for grapefruit has fallen since then (see Annex VIII). It is also considered that with the predicted water shortages and the dependence upon seasonal usage of poor quality groundwater, productivity and yields of grapefruit are likely to be seriously affected.

5.13 Livestock

No detailed plans have been prepared for the development of livestock in the Master Planning area. There can be no doubt that the integration of livestock with crop production systems will be important and the Consultants consider that

development of livestock extension units (LEU) of the sort described for Qoryooley project will probably be the most effective system. Tenants will wish to retain their stock when entering the scheme and the relatively low cost approach offered by LEUs could do much to improve production and increase returns to livestock owners.

Recent studies undertaken for other projects elsewhere in Somalia have indicated that large-scale feedlots are unlikely to be economic under present market conditions. Feedlotting can not therefore be recommended as an alternative method of livestock production for the Janaale-Buulo Mareerta project.

One important aspect that must always be borne in mine when planning the integration of livestock is the need for the management of the schemes to maintain control on the number of animals within the project. The most important reason for this is to reduce the amount of damage that can be done by livestock to both crops and the irrigation works.

CHAPTER 6

MANAGEMENT

6.1 Definition of Requirements

The development of irrigation in the Study Area demands that functions defined below be carried out:-

(a) control of water extraction from the Shabeelle river

(b) remodelling of existing canals and development of irrigation and drainage systems

(c) provision of extension services, agricultural credit and farm supplies

(d) farm management

(e) processing and marketing

(f) development of infrastructure.

For certain forms of development, all of the above functions may not be required. For example, increases in production may be possible without modifying the existing irrigation system in any way but by strengthening the extension services, or a state farm would take over the complete tasks of provision of farm inputs, farm management and processing.

There is no need to follow the same pattern of management throughout the Study Area. Crops such as bananas which are grown for export, demand a vertically integrated form of management linking growing, shipping and marketing, whereas crops such as maize can easily be grown on a small scale.

Prior to the implementation of the Jowhar offstream storage reservoir, it is the intention of the Ministry of Agriculture to set up a special section responsible for the reservoir storage and release operations. It is strongly recommended that this section should be responsible for the allocation of all water along the whole river and should form the basis for a Shabeelle River Authority. The duties of this proposed Authority are considered in Section 6.3.

There is also a case for the establishment of a separate authority in the Study Area responsible for the implementation of the proposed projects. The effort required for the successful implementation of all or even a few of the projects proposed will be immense, even at a slow rate of development, and considerable expertise will be required. It could also be argued that this responsibility should be handed over to the proposed Shabeelle River Authority, but it is recommended that the responsibility for these new projects should remain with the Ministry of Agriculture. In each project, a separate project authority should be established within the ministry itself and the headquarters for each project should be in the Study Area.

The development zones will present several problems, but the works required, apart from provision of extension services, could be carried out by the Regional Co-ordinator for Agriculture. For this purpose, the staff of the regional co-ordinator would first of all have to be brought up to strength by the recruitment of trained and dedicated staff and also increased by the addition of an engineer's office which would be capable of survey work, measurement of water discharges, design of simple hydraulic structures, and supervision of construction of small works. The engineer in charge of this section could be trained by the consultants responsible for the Qoryooley project. The extension services provided by the regional office will also have to be improved. This is a difficult task since trained and experienced staff are in short supply in Somalia and many will be needed. The problem is widespread and it is of interest that recently the IBRD has been considering an aid programme which would include the training of extension staff. It appears likely that one of the state farms at Janaale or Degwariiri would be used as the training centre and this would be an excellent opportunity for staff in the region.

6.2 Survey Work Required

For this study, maps at a scale of 1 : 25 000 were prepared using the 1962/63 aerial photographs (at a nominal scale of 1 : 30 000) and a special ground control survey. These maps have contours at 2 m intervals and have been used for the Master Plan study. For the feasibility study, a separate survey was undertaken to prepare maps at a scale of 1 : 5 000 with contours at 0.25 m intervals. The 0.25 m contour interval is ideal for detailed planning and the map scale can be reduced to 1 : 10 000 without loss of detail. As an alternative, the survey section of the Ministry of Agriculture would be re-established.

For development projects, 1 : 10 000 maps will be required. These will also be helpful for land registration and improvement of development zones. Normally, such maps are not prepared until the feasibility study stage but a great deal of time can be saved if these maps are prepared in advance. The Survey and Mapping Department of the Ministry of Defence does not have the number of staff required for the programme of survey work required. Therefore, it is recommended that an experienced, expatriate field surveyor is seconded to the Survey and Mapping Department to commence the programme of survey work required in the Study Area and to train Somali surveyors who would then continue the survey work. The expatriate would be required for at least three years but there is a similar need for survey work outside the Study Area and the benefits would be widespread.

6.3 The Shabeelle River Authority

The commissioning of Jowhar offstream storage reservoir should cause a radical change in the irrigation of the Lower Shabeelle region. No longer will the river discharges be erratic; they will be controlled, within limits, and this control will require positive action and decisions. The reservoir will have to be filled and emptied and conflicting interests will need to be considered, balanced, and compromises made. It will take the farmers a number of years to realise the benefits (and limitations) of the reservoir but every effort should be made to keep the learning period as short as possible. One obvious change will be that planting dates in the der season should be brought forward as early as possible to reduce releases in January and February when water is required for existing

perennial crops. This, in turn, will require that ONAT has seed ready in its depots in time for the earlier planting dates. The duties of the Shabeelle River Authority are manifold and are discussed in detail in Annex VII, Chapter 16. They may be summarised as follows:-

(a) flood control

(b) river gauging

(c) monitoring groundwater levels and quality

(d) registration of users of river water and groundwater

(e) development planning for the river basin

(f) licensing of abstraction of river water and groundwater both for present users and future users

(g) operation of Jowhar offstream storage reservoir

(h) enforcement of controls on abstraction

(i) maintenance of barrages and canals

(j) control of water-borne diseases

(k) development of fisheries.

It is strongly recommended that the proposed Authority is established as quickly as possible. (Note: Since this report was drafted the Ministry of Agriculture has proposed the establishment of a Shabeelle Water Authority within the ministry, but governed by an inter-ministerial committee).

6.4 Qoryooley Project Management

The management structure of the Qoryooley project is discussed in the Feasibility Study Main Report (Volume 2 of this report). Many of the projects proposed will be similar to the Qoryooley project and therefore the proposed management structure for this project is summarised below.

The Project Area will be divided into eight co-operative farms plus a pilot farm. This fits in well with Government policy for the development of co-operatives although the average size of the proposed co-operative farms of some 400 ha is about twice that of other co-operatives being formed elsewhere in the Shabeelle basin. It is considered that the 400 ha size recommended fits the irrigation layout better.

Most of the farms will be sited near existing villages where farmers will live. Each family will be allotted 2 ha of which 0.125 ha will be for a household plot, and the remainder will be the family's share of a field unit. It has been estimated that each family will contribute two full time workers to the field unit which is a self-contained irrigation unit averaging 24 ha in area. These field units will be farmed communally under the village co-operative farm's direction.

The village co-operative farm will have a full-time farm manager, two assistant managers, a mechanic and tractor drivers, a store-keeper and clerical assistant. The farm will be responsible for providing all inputs and routine servicing of machinery. Where possible, the farm manager should be elected by the co-operative members but nominations should be restricted to those with suitable qualifications or experience.

There will be a project headquarters with staff who will be responsible for determining policy, providing technical advice and training. The structure of the project authority is shown in Figure 6.1.

The pilot farm will be used for training and also for applied research into specific requirements of the Project Area.

The research role of the pilot farm may be summarised as follows:-

(a) selection of varieties (in conjunction with CARS)

(b) optimisation of planting dates (in conjunction with CARS)

(c) seed multiplication (in conjunction with CARS)

(d) development of fertiliser and pest control techniques

(e) development of cultivation techniques, especially those related to irrigation practices

(f) experiments with hand tools and animal-drawn equipment

(g) understanding of soils-water physics with special reference to salinity problems

(h) development of irrigation techniques.

The need for training is manifest and will be required throughout most activities undertaken by the project. The scope of training envisaged is indicated by the training requirement proposed for field supervisors which is summarised as follows:-

(a) application of correct cultivation techniques

(b) demonstration of advantages of using correct varieties

(c) demonstration of advantages of optimum planting dates

(d) use of siphons for irrigation

(e) estimating optimum irrigation application and frequency.

It is understood that the National Extension Service and Farm Management Training Project is shortly to be established. This is likely to consist of a 400 ha pilot farm at Janaale and a 60 ha practical training farm for managerial techniques attached to the training centre at Afgooye. The farmer training centre at Janaale is being revived and this could be used to train field supervisors and lower grades of staff such as tractor drivers.

STRUCTURE OF PROJECT AUTHORITY

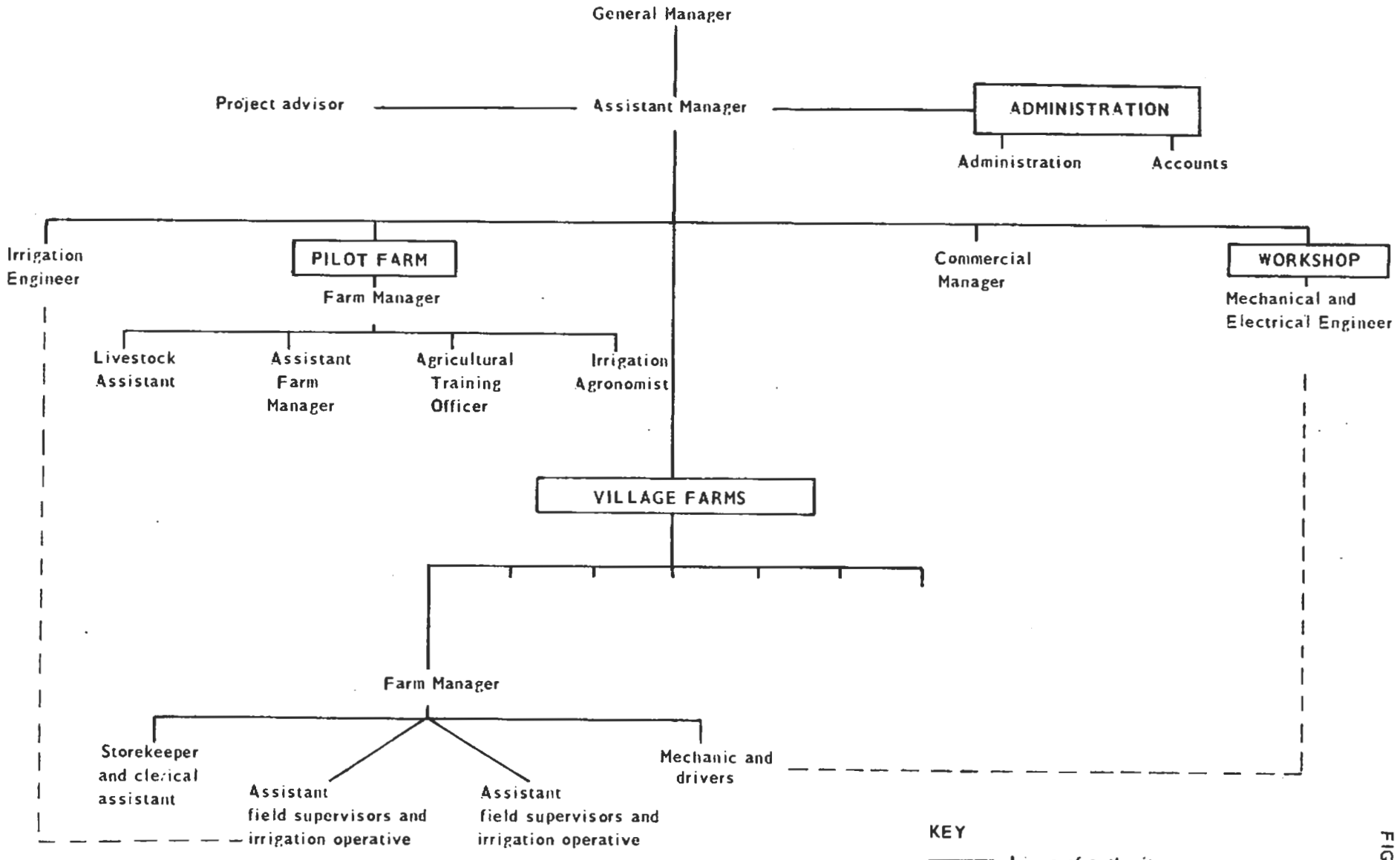


FIGURE 6-1

If the training function is removed from the pilot farm and the research into irrigation techniques is carried out elsewhere, the only role remaining for the pilot farm would be seed multiplication, which could be carried out on selected areas within the Project Area. It must be stressed that the activities assigned to the pilot farm are essential to the success of the project and only if all are catered for elsewhere could the pilot farm as such be omitted from the project.

The project authority has to be built up from nothing and it is unlikely that experienced staff will be found. The farm managers are likely to be graduates of Mogadishu University and will need training in the practical side of farm management. Training will also be required for the assistant management, store-keepers, mechanics and tractor drivers.

The management, training function and extension services provided by the project headquarters are essential for the success of the project. Therefore, because of the shortage of experienced Somali staff, it is recommended that expatriate assistance of 528 man-months is included in the first eight years of the project life and this has been allowed for in the estimates. The expatriates would have the direct role of implementation, training of Somali staff, and building up a strong extension service within the project and, later, the Study Area. The staff requirements and staff programme for the Qoryooley project are shown in Figures 6.2, 6.3 and 6.4.

At present, there is an average of 3.14 livestock units per family in the Project Area although half the families own no livestock at all. For social reasons, it has been decided to retain the livestock although integration of livestock into intensive irrigation schemes is not easy. A livestock improvement scheme has been proposed which will enable the average ownership to be increased to four livestock units per family. It has been calculated that there will be enough basic feed-stuff produced for an average of five livestock units but project benefits have been determined on only four units. A further increase to an average of five units will depend upon the results of research at the pilot farm.

Livestock will still remain in private ownership and thus the existing imbalance in holdings will be maintained at the introduction of the new farming system. This will serve to encourage those with larger holdings of land at the moment but it is expected that, as the benefits of increased production become evident, poorer families will start to purchase cattle and sheep and the imbalance will decrease.

Poultry make an important contribution to family budgets at present. Productivity is low and a poultry improvement unit has been proposed to introduce more suitable breeds into the area. This scheme is inexpensive, easy to manage and produces good returns. The size of this proposed poultry unit has been made sufficient to cover the whole of the Study Area.

6.5 Faraxaane, Golweyn and Shalambood Projects

In the Qoryooley district, the Government policy of village centralisation has already been carried out in many areas including the Qoryooley Project Area and the Faraxaane project area. The relocated villages fitted in very well with the irrigation layout although inevitably some further movement of farmers will be

necessary. At an early date the Government plans to implement the village centralisation programme in Marka district. At present, Golweyn and Shalambood project areas are characterised by many small villages. The new plans for village centralisation should take account of the development possibilities of the area. Apart from the relative sizes of villages, there are no substantial social and agricultural differences between Qoryooley and Faraxaane, Golweyn and Shalambood areas and a similar management structure is recommended. The later projects will not require a pilot farm but an agricultural teacher should be included in the project staff. The Qoryooley project includes a poultry unit which is large enough to serve the whole Study Area and no further poultry units are planned.

6.6 Asayle Project

The level of development of the Asayle project will be similar to the Qoryooley project but the area contains 11 large farms. Under the proposed development, these 11 farms would be limited to 30 ha each which is the maximum permitted for private holdings under irrigation. Thus, there will be 330 ha of large farms. There are also 144 ha of perennial crops in the area and the permitted level of annual cropping is 990 ha. At present, it is estimated that there are 930 families who will be available to farm the 990 ha. These families will also have to provide labour for the large farms which will not require the organisation of services. It is proposed to set up a basic management structure similar to the Qoryooley project for the remaining area.

6.7 Mukoy Dumis Project

Because of the shortage of water in the gu season, no gu cropping is permitted on the Mukoy Dumis project. The der cropping pattern recommended is 40% cotton and 30% each for maize and sesame. A total of 2 ha has been allocated to each family and the project management will be similar to Qoryooley.

6.8 Banana Drainage Project

This project requires a great deal of field work and trials before it goes ahead. The National Banana Board should be responsible for the early stages of this project. Once implemented, this project will require little supervision since the routine work will be done by the farmers themselves. The only work required by the operating authority will be operation and maintenance of the main drain pumps, drain de-silting, weeding and minor repairs. The main beneficiaries of the project will be the banana farmers and the National Banana Board could be responsible for operation.

The regional office of the Ministry of Agriculture will need to do similar work throughout the Study Area and will probably be better equipped for this work. Making the regional office responsible will also avoid problems due to the wishes of smallholders to use the drainage facilities provided.

FIGURE 6-2

HEADQUARTERS MANAGEMENT STAFF AND PROGRAMME

JOB TITLE	No. of posts	ANNUAL cost 000's So Shs.	YEAR 1	2	3	4	5	6	7	8	9
General manager	1	30									
Assistant manager #	1	300									
Project advisor #	1	–									
Pilot farm manager #	1	250									
Assistant farm manager	1	25									
Technicians	1	8									
Livestock assistant #	1	120									
Poultry animal health assistant	1	12									
Livestock extension workers	3	10									
Poultry unit labourer	1	3.5									
Agricultural training officer #	1	200									
Assistant agricultural training officer	1	25									
Irrigation agronomist #	1	200									
Assistant irrigation agronomist	1	25									
Mechanical and electrical engineer #	1	200									
Assistant mechanical and electrical engineer	1	20									
Fitters	3	12									
Building foreman	1	15									
Carpenter	1	12									
Mason	1	12									
Electrician	1	12									
Commercial manager #	1	180									
Assistant commercial manager	1	25									
Administrative officer	1	25									
Personnel manager	1	20									
Nurse	1	15									
Ordering clerk	1	12									
Accountant	1	25									
Accounts clerks	3	12									
Interpreter	1	12									
Storemen	4	8									
Clerk typists	8	7									
Drivers	6	7									
Labourers and watchman	20	3.5									

Notes - # Indicates expatriate post initially

– – Means that not full complement of staff required

Cost of project advisor is covered by consulting engineer's fees

IRRIGATION OPERATION AND MANAGEMENT STAFF AND PROGRAMME

JOB TITLE	No. OF POSTS	ANNUAL COST 000's So Shs.	YEAR 1	2	3	4	5	6	7	8	9
Irrigation engineer	1	24	●	●	●	●	●	●			
Record clerk	1	6		■	■	■	■	■	■	■	■
Inlet operators	4	4				■	■	■	■	■	■
Canal regulator operators	12	4				■	■	■	■	■	■
Canal tail observers	8	3				■	■	■	■	■	■
Canal pump operators	3	6			■	■	■	■	■	■	■
Drain pump operators	1	6				■	■	■	■	■	■
Driver	1	5		■	■	■	■	■	■	■	■
Nightwatchmen	1	3				■	■	■	■	■	■
Dragline operatives	2	12						■	■	■	■
Hydraulic excavator operatives	2	12						■	■	■	■

Notes ● ● The irrigation engineer spends three years in training with the consulting engineers

■ ■ Indicates that full complement of staff is not required

FARM UNIT STAFF AND PROGRAMME

JOB TITLE	No. OF POSTS	ANNUAL COST 000's So Shs.	YEAR 1 2 3 4 5 6 7 8 9
Farm manager	8	15	
Assistant farm manager	15	12	
Mechanics	8	10	
Storeman	8	8	
Clerical assistants	8	7	
Tractor drivers	90	8	
Irrigation operatives	14	6	

Note.- ■■■ Indicates that full complement of staff is not required

6.9 Der Flood Project

This project is very basic and will only take water when river supplies are plentiful. There should be little need for routine control and the system will operate very much as the existing sytem in the area. It is therefore proposed that this project is run by the regional co-ordinator's office. The only problem envisaged is the collection of repayment charges since these are likely to be much higher than the existing annual fees for registered irrigated land. However, this problem should be overcome without the establishment of a separate project authority.

CHAPTER 7

ECONOMIC AND FINANCIAL ANALYSIS

7.1 Introduction

The economic and financial aspects of the Master Plan are described fully in Annex VIII, Part IV. The most important results and conclusions are discussed here. The background to the analysis, covering the marketing prospects, prices, cropping patterns, yields, rate of development and the farm requisites necessary for the development, is given. An economic analysis of identified projects has been carried out, and internal rates of return calculated. In addition, alternatives to the proposal are discussed and analysed. An order of priority for implementation and a desirable rate of development are proposed based on economic, technical and social criteria. A number of development zones comprising areas not included in the projects identified are also considered. Details of cropping patterns, costs and likely returns are given, but a full scale analysis of these has not been carried out.

7.2 Marketing

7.2.1 Supply and Demand

Maize and sesame are traditional crops and account for the majority of the crop output from the Study Area. Most of the maize produced, and about 80% of the sesame, is consumed within the area, the balance being sold in Mogadishu. The country is presently importing 30 000 tonnes of maize per annum and this is likely to rise to 50 000 tonnes by 1990. The proposed increase in production for the Study Area could amount to 20 to 30 000 tonnes per annum in 30 years time but should be well within the country's increased requirements.

Sesame oil is the preferred vegetable oil in Somalia. About 50% of the country's vegetable oil requirements are imported and are not extracted from sesame oils. Only relatively small increases in sesame production are expected after implementation of the proposed developments. It is anticipated therefore that there will be a ready market.

At present, rice production in Somalia is limited. Imports have been rising and reached 27 000 tonnes in 1977. A rice deficit of 50 000 tonnes is forecast by 1990. Consequently, in the Study Area, future production of about 15 000 to 20 000 tonnes at maturity should be easily absorbed.

Somalia's only cotton mill, Somaltex at Balcad, processed about 900 tonnes of fibre in 1977. Of this, about 260 tonnes were produced from local cotton, the balance being imported. The mill has a total capacity of 2 250 tonnes, about 50% of the estimated total demand of 4 500 tonnes of cotton fibre. There is, therefore, considerable room for expansion of cotton growing for the home market.

Bananas are the only crop produced for export in Somalia and they account for 20 to 28% of the total export earnings. In the Study Area 43% of the country's bananas are grown. About 35 000 tonnes were exported from 4 000 ha recently. There has been a steady decline in the banana hectarage because of the falling profitability, to which low yields and prices were the main contributors. The traditional market for Somali bananas has always been Italy, but this has declined in importance. Export to the Middle East market expanded rapidly in the early 1970s, but has since declined and last year a contract was rescinded. A special contract was negotiated early in 1978 for a period of six months only. Given good quality bananas and better marketing organisation, there would appear to be no reason why exports of Somali bananas should not expand, particularly to the Middle East.

Livestock production in the area contributes an estimated 25% of the household income at present. At the national level, livestock production is of even greater significance, amounting to about 65% of the country's exports. Cattle are the most important livestock in the Study Area and surplus animals are sold through local markets supplying the meat factory or Mogadishu. Although there are possibilities for livestock exports from the south, these are not being exploited. The relatively small increases in production proposed should find a ready market through the present channels.

7.2.2 Prices

The commodity farm gate prices, financial and economic, derived in Annex VIII and used in the analysis, are summarised in Table 7.1. Economic prices for fertiliser are between 7 and 14% greater than the market prices.

TABLE 7.1

Projected Farm Gate Prices of Crops and Livestock

Commodity	Market price	Economic price
Crops	So. Shs./quintal	
Maize	75	911
Sesame	240	250
Upland rice (65% milled basis)	350	338
Cotton	250	320
Pulses	100	125
Bananas (1)	50	71
Grapefruit	100	100
Livestock	So. Shs./head	So. Shs./head
Cattle	900 - 950	900 - 950
Small stock	275 - 300	275 - 300
Milk per litre	0.60	0.60

Note: (1) Farm gate excluding packing but including cartons.

7.3 Identification of Areas and Present Agricultural Production

7.3.1 Identification of Project Areas

A number of projects have been identified in the Study Area. Their boundaries are based on existing area boundaries, canals and land units. Also, boundaries have been rationalised to ensure that project areas are large enough to support the necessary overheads. After all the projects had been identified, a number of areas remained which could not be consolidated within the main project area. A general upgrading of these areas, called development zones, many of which border on rivers and main canals, is envisaged through extension services and provision of inputs. All of this is fully discussed in Annex VI as are the options for each area.

Table 7.2 lists the project areas identified and gives their gross and present net cultivated areas. The estimated number of households residing in these areas, based on 0.88 ha cultivated per family, is also shown (0.88 ha represents the total net cultivated area divided by the number of families in the Study Area). The larger towns, particularly Qoryooley, may distort the figures for population engaged in agriculture in the areas immediately adjacent to them, because some people from the town will be engaged in agricultural activities.

TABLE 7.2

Master Plan Areas - Gross and Present Net Cultivated Areas and Population

Projects	Gross project area (ha)	Present NCA (ha)	Perennial cropping (ha)	Annual crops (ha)	Households (No.)
Faraxaane	5 000	2 324	-	2 324	2 640
Der flood	1 200	229	-	229	260
Mukoy Dumis	2 060	113	-	113	130
Shalambood	6 255	2 101	358	1 743	1 980
Golweyn	3 700	854	108	746	850
Asayle	4 170	1 505	144	1 361	941
Banana drainage	2 830	1 560	1 560	-	-
Development zones					
Janaale	3 165	1 310	272	1 038	1 180
Degwariiri	2 470	1 157	381	776	880
Bandar	1 815	691	-	691	790
Majabto	1 760	579	9	570	650
Haduuman	1 940	823	-	823	930
Jeerow	2 325	1 028	-	1 028	1 170
Waagade	3 790	903	333	570	650
Primo Secondario banana	3 020	1 451	1 067	384	440
Tahliil	2 765	907	50	857	1 070

More detailed demographic work will be necessary to ascertain the exact population status before any implementation is carried out. Therefore, for future feasibility studies in the area, demographic studies should be as detailed as those for the Qoryooley project, to consider the effects of new developments on the existing population. The livestock populations in the Study Area are estimated on a livestock holding per household basis rather than on a per hectare basis and will change if population moves into or out of an area.

At present, the average household has 3.14 livestock units with an average holding of 3.5 head of cattle and 1.25 head of small stock. However, 50% of the households possess no cattle. It is anticipated that the average livestock holding will be four livestock units. Any redistribution of livestock would be entirely voluntary and ownership patterns would be dependent upon the individual households.

Improvement of livestock production will result from the increased availability of forage and improved practices being introduced by the extension service. It has been assumed that milk yields will improve and fat animals will achieve a higher price than previously, because of better feeding and management.

7.3.2 Details of Projects

The projects of Faraxaane, Shalambood and Golweyn are all similar to Qoryooley and consequently there is no reason to suggest an alternative type of development. The proposed basic cropping pattern as shown in Table 7.3 includes cash crops of rice and maize. Yield build-up and rate of development are assumed to be similar to those projected for Qoryooley. As the details of these areas are not finalised, an average build-up of gross margins over the first 11 to 14 years of the project has been taken. It is assumed that organisation, management and headquarters costs would be similar to those for Qoryooley. Although a pilot farm would not be necessary, there would still be an agricultural teacher and irrigation engineer based at project headquarters.

TABLE 7.3

Basic Project Cropping Pattern

Crops	Intensity (%)	
	Gu	Der
Maize	20	20
Upland rice	20	20
Mixed forage	20	-
Cotton	-	35
Sesame	-	25
	60	100

Note : This cropping pattern is cropping pattern A from Qoryooley project and is recommended for Faraxaane, Golweyn and Shalambood projects.

The comparison between projects has been made excluding the small number of banana farms because of the difficulty of assigning their benefits and the unreliability of the data. The yield potential of the bananas is considerable, but external infrastructure is required so project ranking could be inaccurately influenced by their inclusion.

The der flood project is a low cost project where no land levelling is required and overheads are low. The cropping pattern proposed and yields expected are :-

Maize	40%	30	quintals
Sesame	60%	10	quintals
Cotton	20%	18	quintals

As an alternative to the der flooding, the possibility of including this gross area of 1 200 ha in with the Faraxaane project has been tested. In this case, the area was assumed to have returns similar to Qoryooley with the same organisation and management.

The Mukoy Dumis project has been considered to test the feasibility of developing 'virgin land' for irrigation. The cropping is limited to 100% intensity in the der season because of water constraints. The proposed cropping pattern is :-

Maize	30%
Sesame	30%
Cotton	40%

The yields and infrastructural development assumed are similar to those proposed for Qoryooley. The alternative to this type of development is to use the area purely as grazing for cattle.

The Asayle project area differs from Qoryooley partly because there are eleven large-scale farmers in the area, and holding sizes for smallholders are less. It is proposed that the eleven large farmers will farm 30 ha each, the maximum allowable. The remaining 990 cultivated hectares will be available for co-operatives established on the basis of 1 ha per family. The families would be free to provide labour to the large farmers and the 138 ha of banana plantations in the area. The proposed cropping patterns are :-

(a) Large farmers		(b) Smallholders	
Maize	40%	Maize	60%
Rice	40%	Sesame	50%
Sesame	25%	Cotton	30%
Cotton	15%		

The yields assumed are the same as those projected for the Qoryooley Project Area. The large farmers will not require the organisation of services, but infrastructure will have to be set up for the co-operatives.

A drainage project is proposed for an area of 2 830 ha of bananas where yields are at present declining. It has been assumed that yields will continue to decline from their present levels of 200 quintals to 150 quintals per year if drainage is not installed. With drainage, the average yield per hectare is expected to rise, over a ten year period, to 300 quintals and the average life of a plantation is expected to increase from three to six years. Because of the reliance on outside inputs besides drainage, the sensitivity of the project to reduced yields was tested.

The development zones not included in specific projects amount to almost 10 000 net cultivable hectares. A general upgrading for these areas through the provision of improved extension services is proposed (Annex VI). An analysis has been carried out to give an indication of the magnitude of the returns. The cropping patterns and yields proposed are shown in Table 7.4.

TABLE 7.4

Proposed Cropping Patterns and Yields for Development Zones

Development Zone	Crop	Alternative cropping patterns (1)	(2)	(3)	Yields (q/ha)
Janaale) Degwariiri) Bandar) Haduuman) Jeerow) Tahliil)	Maize	50%	50%	60%	25
	Sesame	30%	30%	30%	8
	Rice	20%	40%	-	20
	Cotton	20%	-	20%	15
Majabto) Primo Secondario) banana)	Maize	60%	60%	-	25
	Sesame	50%	50%	-	8
	Cotton	30%	-	-	20
	Rice	-	20%	-	15
Waagade)	Maize	70%	-	-	25
)	Sesame	50%	-	-	8

7.4 Farm Requisites

The details of the farm inputs required, such as seed, fertilisers, machinery and chemicals are given in Annex VI. Table 7.5 summarises the requirements of fertilisers and chemicals at maturity after 30 years, indicating the annual quantities that ONAT would have to supply. This includes fertilisers valued at about So. Shs. 14 million and chemicals valued at So. Shs. 19 million. The volumes currently handled by ONAT are small in comparison with the amounts that will be handled when the proposed developments are completed. ONAT's local structure and organisation will have to be strengthened to cope with the increased volumes.

The machinery requirements for the Qoryooley project, summarised in Table 7.6, give an indication of the requirement for the other project areas. Again, there is a need for ONAT to be strengthened to supply this machinery. If all the projects are implemented, they will require So. Shs. 55 million for purchase of machinery with an annual expenditure, excluding replacements, amounting to So. Shs. 2 to 3 million.

TABLE 7.5

Summary of Fertiliser and Chemical Requirements at Maturity in the Study Area

	Fertilisers		Chemicals
	tonnes	('000 So. Shs.)	('000 So. Shs.)
Cotton	1 700	2 500	4 500
Rice	1 400	2 100	4 800
Maize	1 400	3 150	1 700
Sesame	420	715	115
Forage	480	720	76
Bananas	3 600	4 800	8 000
TOTAL	9 000	13 985	19 181

TABLE 7.6

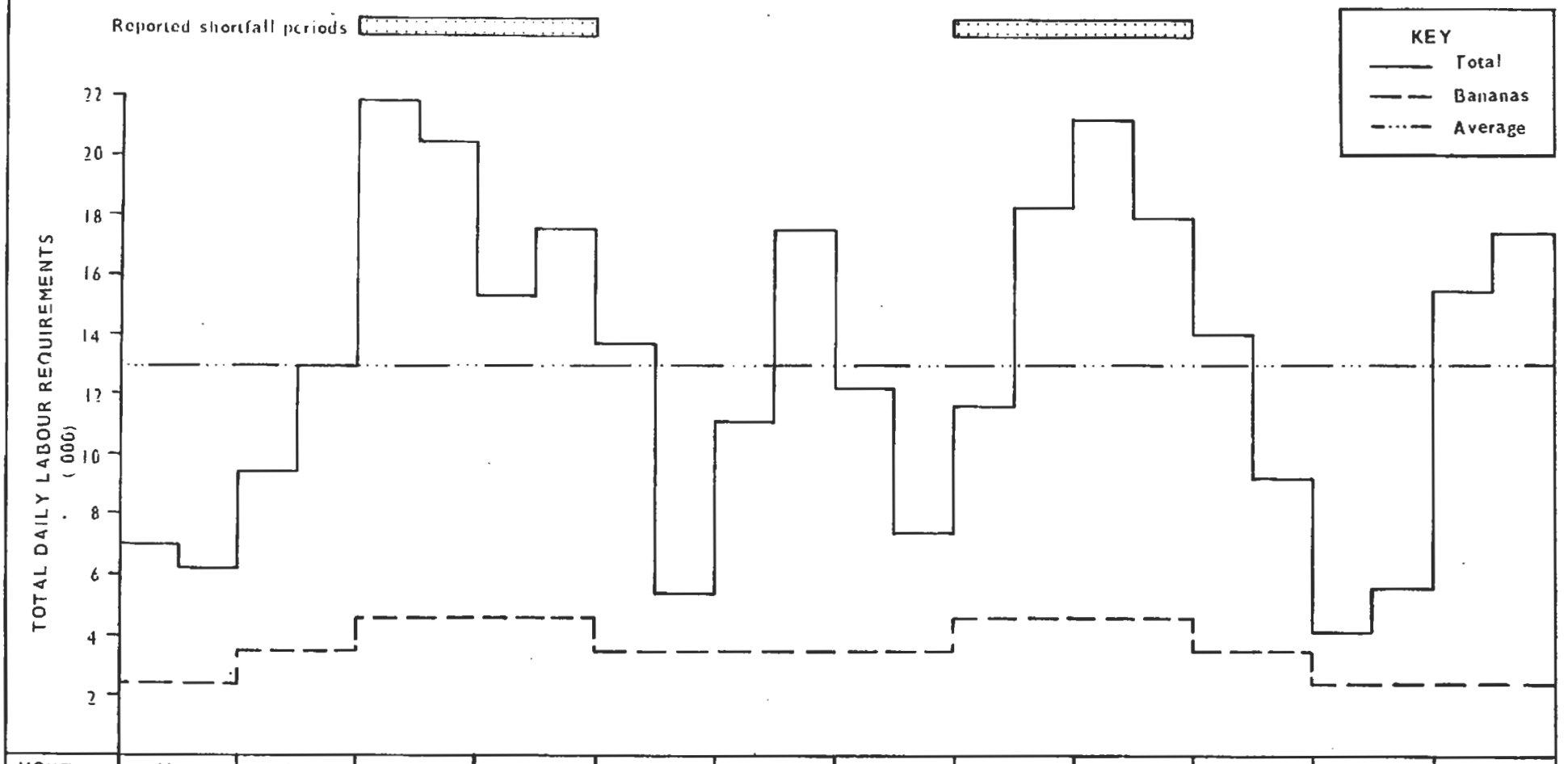
Agricultural Machinery Required for Qoryooley Project

	No.	('000 So. Shs.)
Tractors	51	4 750
Combine harvesters	9	2 520
Ploughs	9	72
Harrows	11	143
Tool bars and bodies	53	100
Rice drills	9	225
Land levellers	9	311
Earthworking bodies	38	132
Trailers	61	990
Sprayers	114	23
Elevator	9	180
Shellers	22	70
Mowers	9	99
Sundry equipment	-	393
TOTAL		10 008

Note: For calculations of requirements see Annex VI, Chapter 20, Farm Equipment Requirements.

7.5 Labour

The population and labour availability of the area have been discussed in detail in Annex III, Chapter 4, and Annex IV, Appendix A. Overall it is estimated that there are 18 940 families (average of 5.93 members each) fairly evenly distributed over the Study Area. The analysis of the labour supply and demand, related to the present cropping of the area, indicated that there is considerable unemployment and underemployment (see Figure 7.1) despite the problems of labour recruitment sometimes encountered by the banana farmers. The problems of unemployment and labour shortage are both seasonal since the demand for labour varies and this is clearly demonstrated by fluctuations of wages for casual labour from So. Shs. 4 to So. Shs. 12 or even So. Shs. 20 per day. The problem is considered in detail in Appendix A of Annex IV where it is shown that part of the labour shortage in the peak season on banana farms is due to the distribution of population. Nevertheless, this is not a full explanation and another reason may be a preference of smallholders to work in their own fields even when there is considerable demand for labour on the banana farms. For planning purposes, it has been assumed that each household has two full-time man equivalents available per family, and that the co-operatives proposed (in most cases) would be based on 2 ha per family (i.e. 1 ha per working man). The labour requirements of the Qoryooley cropping pattern, which is also proposed for the other projects, are compared with the labour availability on a 100 ha basis in Table 7.7. This indicates that there is adequate labour available at all times, with the highest demand being in October and January. In certain areas of high population density, it is proposed that only 1 ha would be available per family. These areas, however, are adjacent to banana plantations or the larger farms of Asayle which require labour and the household income would be supplemented by wage employment.



MONTH	M		A	M		J		J		A		S		O		N		D		J		F	
SEASON	Jilal		Gu					Hagai						Der						Jilal			
Annual Crop	4680	3930	5900	9380	17120	15740	10620	12850	10210	1830	7600	14050	8710	3920	6960	13560	16510	13290	11070	5710	1720	3160	13120	15060
Bananas	2360	2360	3500	3500	4640	4640	4640	4640	3500	3500	3500	3500	3500	3500	4640	4640	4640	4640	3500	3500	2360	2360	2360	2360
TOTAL	7040	6290	9400	12880	21760	20380	15260	17490	13710	5330	11100	17550	12210	7420	11610	17200	21150	17930	14570	9210	4080	5520	15480	17420

Maximum daily labour requirement - 21760 working people per day (May)
Maximum available workforce - 37880 people (3)
Maximum utilization - 57.4% available manpower

Notes:- (1) See Figure A. 2
(2) See Section A.7
(3) See Section A.2

Source Annex IV Appendix A

STUDY AREA CROP PRODUCTION
TOTAL DAILY LABOUR REQUIREMENTS AND AVAILABILITY (1977)

FIGURE 7-1

TABLE 7.7

Labour Requirement per Proposed Cropping Pattern (per 100 ha net) by 15 Day Periods(1)

	Intensity	Apr		May		Jun		Jul		Aug		Sep		Oct		Nov		Dec		Jan		Feb		Mar	
Gu Season																									
Maize	20	-	17	29	26	26	9	9	4	22	6														
Rice	20	-	-	6	7	8	24	20	6	6	8														
Forage	20	-	17	27	47	16	23	15	-	-	-														
Der Season																									
Maize	20											17	27	27	26	17	9	6	15	15	-	-	-	-	-
Rice	20									-	6	7	7	20	26	13	6	8	2	-	-	-	-	-	-
Cotton	35									25	40	41	44	34	27	22	13	13	53	76	61	48	22	-	-
Sesame	25													5	15	25	27	20	13	7	21	31	13	-	-
TOTAL		-	34	62	60	50	56	44	10	53	60	65	78	86	94	77	55	47	83	98	82	79	35	-	-
Available labour(2)												100													

Notes: (1) Excludes bird scaring for rice

(2) Maximum labour availability assumes 2 working persons per household - family and 2 ha per family, i.e. 100 working persons per 100 ha (net)

Source: Annex VI, Table 18.3 and Appendix D

7.6 Economic Analysis

7.6.1 Basis for the Analyses

Hired labour is shadow priced at 50% of the current wage rate of So. Shs. 2/h. However, it is only required on the banana farms, the large farms of Asayle, and for bird scaring on the co-operative farms before rice harvest. All family labour was shadow priced at zero as it has been assumed that the net value of present production represents the opportunity cost of labour and of land.

Economic prices of all the agricultural commodities and fertilisers have been calculated and are shown in Table 7.1. These prices were based on the assumption that Somalia will continue in an import dependent position for the foreseeable future.

Local currency is considered to be over-valued by between 50 and 80%, as discussed in Annex VIII, Chapter 5. In the basic economic analysis, foreign exchange rates are valued at the current rate. The effect of up-valuing foreign exchange by 50% was tested in a sensitivity analysis in the Qoryooley feasibility study. The effect on other projects is likely to be similar. All the foreign exchange components assumed are listed in Annex VIII.

The net incremental benefits have been determined by deducting the net value of present production from the net value of production with the project. The net cash flow was then derived by comparing the project costs (capital, operation and maintenance) with the net incremental agricultural benefit stream.

7.6.2 Crop Budget

Summaries of the crop budgets and the direct production costs are shown in Tables 7.8 and 7.9 and are applicable to all the project areas except the der flood project where lower yields are expected. Details are given in Annex VIII, Part IV, which also includes the livestock budgets. The budget for bananas after ten years of improvement is shown in Table 7.12 and is based on yields rising to 300 q/ha with an average crop life extended from three to six years.

7.6.3 Costs

A summary of the project capital costs is given in Table 7.10 (including an estimate of costs for feasibility studies). The costs are scheduled over an implementation period which is dependent largely on the scale of project and availability of technical staff. The Qoryooley estimates are given on a similar basis (without a pilot farm) so that they are directly comparable with other projects.

The operation and maintenance costs of the project are summarised in Table 7.11. The staff costs are based on the Qoryooley organisation and management structure excluding the pilot farm. They include, however, an agricultural teacher and irrigation agronomist. Estimates of the foreign exchange elements are also shown.

TABLE 7.8

Direct Crop Production Costs at Full Yields at Maturity (Year 8) (So. Shs./ha)

Crop	Materials[1]	Machinery	Labour[2]	Drying,[3] transport etc.	Total	Foreign exchange (%)
Financial prices						
Upland rice	1 154.15	702.8	420	198	2 474.95	
Cotton	1 332.45	497.9	-	168	1 998.35	
Sesame	176.05	323.8	-	-	499.85	
Maize	599.55	409.7	-	168.05	1 177.30	
Mixed forage	304.80	1 076.30	(748)	-	1 381.10	
		671.00[4]			975.8	
Economic prices						
Upland rice	1 172.96	588.80	210	189	2 160.76	44
Cotton	1 377.71	422.60	-	144	1 944.31	58
Sesame	188.71	269.90	-	-	458.61	54
Maize	645.28	344.30	-	151.5	1 141.08	60
Mixed forage	327.26	914.90	(374)		1 242.16	52
		567.50[4]			894.76	

Notes: (1) Years 1 to 4 have different input levels.

(2) Hired labour is only for bird scaring. Shadow wages of 50% have been taken as large numbers are required despite the fact that the workers are women and children.

(3) Cost dependent on yield.

(4) Tractor work reduced under the livestock improvement programme.

TABLE 7.9

Summary of Qoryooley Type Crop Budgets at Maturity (So. Shs./ha)

Crop	Yield (q/ha)	Economic Prices: Price (So.Shs./q)	Economic Prices: Gross revenue	Economic Prices: Costs	Economic Prices: Gross margin	Financial Prices: Price (So.Shs./q)	Financial Prices: Gross revenue	Financial Prices: Costs	Financial Prices: Net revenue
Upland rice(1)	19.5	338	6 591	2 161	4 430	350	6 825	2 475	4 350
Cotton	25	320	8 000	1 920	6 080	250	6 250	1 970	4 280
Sesame	10	250	2 500	459	2 041	240	2 400	500	1 900
Maize	40	119	4 760	1 111	3 649	75	3 000	1 144	1 856
Mixed forage(2)	65 t/ha			895				976	

Notes: (1) Milled rice basis, 65%

(2) For livestock improvement programme

TABLE 7.10

Capital Costs for Study Area Projects ('000 So. Shs.)

	Feasibility study	Project costs	Years 1	2	3	4	5
Qoryooley	2 076	90 629	40 783	18 126	13 594	9 063	9 063
Faraxaane	2 076	94 659	42 597	18 932	14 199	9 466	9 466
Mukoy Dumis	1 199	41 677	20 839	8 335	8 335	4 168	-
Shalambood	2 244	92 426	41 592	18 485	13 864	9 243	9 243
Golweyn	972	39 940	17 470	6 988	6 988	3 490	-
Asayle	760	29 700	17 820	5 940	5 940	-	-
Der flood	498	10 984	6 590	2 197	2 197	-	-
Banana drainage							
Main drain	765	3 848					
In-field works		27 050					

TABLE 7.11

Summary of Operation and Maintenance Costs ('000 So. Shs.)

	Engineering and buildings	Staff	Total	Foreign exchange
Qoryooley	1 549	1 425	2 974	1 000
Faraxaane	1 716	1 364	3 080	1 133
Mukoy Dumis	834	563	1 397	550
Shalambood	1 609	1 474	3 083	1 000
Golweyn	767	639	1 406	506
Asayle	517	499	1 016	341
Der flood(1)	88	150	238	58
Banana drainage - Main	90	-	-	-
- Field	374	20(2)	484	306
Development zones	-	550(3)	550	-

Notes: (1) 10 people for 960 ha with a small central storage area.

(2) 2 extension assistants

(3) 50 extension assistants and 2 full time supervisors

TABLE 7.12

Banana Crop Budget at Maturity (Economic Prices in So. Shs./ha/year)

Returns			Total
Yields (q/ha)(1)	200	50 (50% sold)	
Price (So. Shs./q)(2)	71	20	
Return	14 200	50	14 700
Costs:			
Mechanisation	1 125		
Chemicals (including application)	1 995		
Fertiliser	1 220		
Labour	2 060		6 400
Gross Margin	8 300		8 300

Notes: (1) Annual yield based on 200 q/ha for a three year crop life

(2) So. Shs. 71 economic price allowing for cartons at So. Shs. 24 (economic price) and FOB costs of So. Shs. 25 from a price of So. Shs. 120/q FOB.

7.6.4 Incremental Benefits and Net Cash Flows at Maturity

Table 7.14 summarises the gross margin and net incremental benefits of all the projects at maturity at economic prices. Bananas are treated separately in each case so that project results will not be biased by their influence.

Table 7.13 compares the net cash flow per hectare of each project at maturity. Benefits from bananas would cover their share of the operation and maintenance costs.

TABLE 7.13

Summary of Projects at Maturity (So. Shs./ha)

Project	Hectares NCA	Gross margin	Net incremental benefit	Operation and maintenance	Net cash flow
Qoryooley	4 000	6 450	5 090	743	4 347
Golweyn	1 873	6 450	5 480	751	4 729
Shalambood	4 324	6 450	5 404	713	4 691
Faraxaane	4 000	6 450	4 860	770	4 090
Mukoy Dumis	1 650	4 720	4 250	847	3 403
Asayle	1 464	5 520	3 447	694	2 753
Der flood	960	3 173	2 799	248	2 551

TABLE 7.14

Summary of Gross Margins and Net Benefits at Maturity for Study Area Projects and Development Zones : Economic Prices ('000 So. Shs.)

	Faraxaane	Der flood	Mukoy Dumis	Shalambood	Golweyn	Asayle	Banana drain-age	Develop-ment zones	Qoryooley	Total
Net cropped area (ha)	4 000	960	1 650	4 324	1 873	1 464	1 560	11 970	4 170	
No. of households	2 000	480	825	1 983	883	990	-	-	2 089	
With project										
Gross crop revenue	31 860	3 917	8 874	31 589	14 058	8 542	-	45 290	31 326	175 456
Direct costs(1)	8 384	910	2 044	8 313	3 699	2 023	-	13 590	8 028	46 991
Crop gross margin	23 476	3007	6 830	23 276	10 359	6 519	-	31 700	23 298	128 465
Livestock gross margin	2 324	557	958	2 305	1 025	767	-	6 950	2 364	17 250
Total gross margin except bananas	25 800	3 564	7 788	25 581	11 384	7 286	-	38 650	25 662	145 715
Banana gross margin	-	-	-	2 971	896	1 145	12 948	17 530	-	35 490
TOTAL gross margin	25 800	3 564	7 788	28 552	12 280	8 031	12 948	56 180	25 662	181 205
Without project										
Gross margin excluding bananas	6 359	877	775	4 148	1 713	2 736	-	17 830	5 439	39 877
Gross margin including bananas(1)	6 359	877	775	4 985	1 965	3 059	3 646	22 766	5 439	49 871
Net benefit										
without bananas	19 441	2 687	7 013	21 433	9 671	4 550	-	20 820	20 223	105 838
with bananas	19 441	2 687	7 013	23 567	10 315	5 372	9 302	3 414	20 223	131 334

Notes: (1) Labour not costed to Asayle large farms as co-operative members in same area benefit
(2) Labour costed on all banana plantations.

7.6.5 The Economic Analysis

Cash flows have been generated for a 30 year period for each project. The net incremental benefit of each project has been compared with the project costs to establish the net cash flow at economic prices. Both are given in Annex VIII, Appendix E. A summary of the Qoryooley cash flow from the feasibility study is shown in Table 7.16 and a summary of all the project cash flows is given in Table 7.17.

The internal economic rates of return of each project and their net present values discounted over a 30 year period, at 10%, are given in Table 7.15.

TABLE 7.15

Internal Economic Rates of Return and Net Present Values at 10%

Project	IRR	NPV at 10% ('000 So. Shs.)	NPV/ha at 10% (So. Shs.)
Qoryooley	10.2	2 208	552
Golweyn	13.1	12 401	6 621
Shalambood	10.9	8 293	1 918
Faraxaane	9.0	-8 616	-2 154
Mukoy Dumis	8.1	-7 024	-4 257
Asayle	6.1	-12 236	-8 358
Der flood	12.6	3 083	3 211
Banana drainage:			
Basic assumption(1)	15.0	11 428	7 326
Yield differences(2)	13.0	6 888	4 415

Notes: (1) Assumes yield increase with project and decrease without (difference of 200 q/ha after 10 years)

(2) Assumes yield increase with project such that difference between with and without project is 100 q/ha after 10 years.

The banana drainage project has the highest internal rate of return (IRR) when it is assumed that the banana yields will decline in the without project situation. This tends to understate the real situation as it has been assumed that yield decline only starts when each area is brought into the project. The effect of reducing the yield from 200 q to 100 q has been tested and indicated that the IRR would be reduced to 13%. The IRR of the Golweyn project at 13.1% was the highest of those projects regarded as similar to Qoryooley.

The analysis of the der flood project indicated that this was an attractive concept and the possibility of implementing a der flood type of project in other areas was considered. It was rejected, however, because of the higher costs per hectare of implementation compared with the der flood project itself.

TABLE 7.16

Summary of Cash Flow of Qoryooley Project
Economic Prices ('000 So.Shs.)

Year	With project			Without project			Net benefits	Project costs	Net cash flow
	Revenue	Costs	Net revenue	Revenue	Costs	Net revenue			
1	-	-	-	0.20	0.01	0.19	-0.19	19.49	-19.69
2	0.76	0.64	0.12	0.25	0.01	0.24	-0.12	28.80	-28.92
3	0.95	0.60	0.35	1.31	0.07	1.24	-0.89	11.64	-12.53
4	5.82	2.92	2.90	2.50	0.12	2.39	0.51	19.94	-19.43
5	10.79	4.75	6.05	3.91	0.17	3.74	2.31	15.60	-13.29
6	16.76	6.59	10.15	5.53	0.21	5.41	5.01	11.27	- 6.27
7	25.68	8.48	17.20	5.65	0.21	5.44	11.76	4.60	7.17
8	26.88	8.64	18.24	5.65	0.21	5.44	12.80	3.80	9.00
9	59.57	8.78	20.79	5.65	0.21	5.44	15.35	4.05	11.29
10	35.51	8.90	22.61	5.65	0.21	5.44	17.17	3.68	13.50
11	32.77	9.02	53.75	5.65	0.21	5.44	18.31	3.85	14.46
12	33.52	9.04	24.48	5.65	0.21	5.44	19.05	4.09	14.96
13	34.04	9.05	24.99	5.65	0.21	5.44	19.55	3.12	16.43
14	34.28	9.05	25.23	5.65	0.21	5.44	19.79	5.18	14.61
15	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.90	15.89
16	34.28	9.05	25.23	5.65	0.21	5.44	19.79	4.16	15.64
17	34.28	9.05	25.23	5.65	0.21	5.44	19.79	4.08	15.71
18	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.31	16.48
19	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.89	15.90
20	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.80	16.00
21	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.79	16.00
22	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.78	16.01
23	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.12	16.67
24	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.90	15.89
25	34.28	9.05	25.23	5.65	0.21	5.44	19.79	4.12	15.67
26	34.28	9.05	25.23	5.65	0.21	5.44	19.79	4.34	15.45
27	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.92	15.87
28	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.43	16.36
29	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.83	15.96
30	34.28	9.05	25.23	5.65	0.21	5.44	19.79	3.49	16.30

Notes: Net present value at 8% = 17.85. Net present value at 10% = -3.71.
Internal rate of return 9.6%

(1) Each area of land is taken out of production one year before completion.

TABLE 7.17

Summary of Master Plan Net Cash Flow (So.Shs. million)

Year	Faraxaane	Shalambood	Mukoy Dumis	Golweyn	Asayle	Der flood	Qoryooley[1]	Difference between der flood and enlarged Faraxaane project
1	(44.73)	(43.51)	(21.46)	(18.23)	(18.87)	(6.87)	(42.83)	(3.84)
2	(21.75)	(20.76)	(9.26)	(8.10)	(7.95)	(2.67)	(20.71)	(2.65)
3	(16.98)	(15.67)	(9.10)	(7.89)	(8.16)	(2.56)	(15.96)	(1.70)
4	(11.84)	(10.11)	(3.93)	(3.08)	(0.55)	(.45)	(10.68)	(3.10)
5	(10.13)	(7.78)	1.88	2.80	0.55	.99	(8.70)	2.77
6	5.01	7.09	2.89	4.28	1.57	1.20	6.04	.65
7	8.62	10.68	3.90	5.76	2.37	1.88	9.65	0.84
8	10.94	12.98	4.68	6.90	2.81	2.09	11.97	1.18
9	13.52	15.54	5.07	7.47	3.17	2.27	14.55	1.62
10	14.56	16.56	5.38	7.92	3.39	2.38	15.58	1.77
11	15.58	17.58	5.54	8.15	3.53	2.45	16.61	1.94
12	16.10	18.09	5.62	8.27	3.53	2.45	17.13	2.07
13	16.36	18.35	5.62	8.27	3.53	2.45	17.39	2.13
14 - 36	16.36	18.35	5.62	8.27	3.53	2.45	17.39	2.13

Note: (1) Qoryooley project net cash flows have been modified to be directly comparable with other projects.

The possibility of combining the der flood project with the Faraxaane project was analysed, adopting the Faraxaane cropping pattern and yields. Implemented at the same time, the internal rate of return of 9% on the difference between cash flows indicates that the project should be amalgamated if capital cannot be invested to give a return of over 9% elsewhere. However, as discussed below in Section 7.9, the der flood project could be recommended for immediate implementation whilst, on the basis of economic priority, the Faraxaane project would be delayed for approximately ten years.

The sensitivity analysis carried out for the Qoryooley feasibility study gives an indication of the likely effects to be expected from various changes in output, cost or revaluation of foreign exchange. Table 7.18 summarises these effects with the net present values discounted at 8 and 10%.

TABLE 7.18

Economic Indicators of Qoryooley Project

		Net present values ('000 So. Shs.)	
		Rates of discount	
	IRR	8%	10%
Basic analysis(1)	9.6	17.7	-3.7
Project with 20% drop in output	5.1	-29.5	-40.7
Project with 20% increase in capital cost	8.2	2.2	-18.2
Foreign exchange shadow priced up 50%	12.4	65.2	28.2
Foreign exchange flow	-	104.6	68.5

Note: (1) Note that this is the actual Qoryooley project not the re-worked example. Hence, the IRR is lower than in Table 7.15.

7.7 Financial Implications

A financial analysis of each project was made to examine household and project repayment capacities. The financial situation at maturity on a per hectare basis is shown in Table 7.19.

The analysis indicates that Asayle and Mukoy Dumis have a low capacity for repayment of capital works.

TABLE 7.19

Summary of Project Repayment Capacities at Maturity (So. Shs./ha)

Project	Gross margin (ha)	Household income/ha	Operation and maintenance	Residue for capital	Ratio of residue to capital invested
Golweyn	4 878	2 200	751	1 927	1:09.7
Shalambood	4 878	2 200	713	1 965	1:10.9
Faraxaane	4 878	2 200	770	1 908	1:12.4
Mukoy Dumis	3 420	2 200	847	373	1:67.7
Der flood	2 851	2 200	248	403	1:28.4
Asayle:					
Co-operative(1)	4 383	4 400(1)	(694)	Nil	
Large farms	3 678(2)		(694)(3)	Small	

Notes: (1) Co-operative is based on 1 ha per family, and the estimate assumes that the target family income will be derived from a share in the co-operative.

(2) Includes labour costs.

(3) The large farms are expected to meet all the operation and maintenance costs which leaves So. Shs. 18 000 per farm for other farm expenses and income. It is likely therefore that the capacity for capital repayment will be low.

7.8 Banana Drainage Project

The average gross margin of So. Shs. 520/ha currently achieved by the banana farmers is expected to rise to So. Shs. 4 100/ha at maturity. If the farmers have to borrow the capital costs for the drainage from the Somali Development Bank, the annual repayment would amount to So. Shs. 2 070 for a 20 years loan at 6%. This level of repayment would be difficult to meet in the early years before the benefits of the improved drainage could be realised.

7.9 Implementation

Internal rates of return and net present values per hectare (discounted at 10%) shown in Table 7.15 indicate that in terms of economic priority for implementation, projects should be ranked as shown in Table 7.20.

The Asayle project with its low internal rate of return of 6% would appear to be the least attractive of the projects based on annual crops. It is suggested that a pre-feasibility study is carried out at a later stage when more information is available from other projects.

TABLE 7.20

Ranking of Projects

Project	NCA (ha)	Banana hectarage as a percentage of total
Golweyn	1 873	6
Der flood	960	0
Shalambood	4 324	7
Faraxaane	4 000	0
Mukoy Dumis	1 650	0
Asayle	1 464	11

The Mukoy Dumis project demonstrates that a reasonable economic return can be achieved from a virgin land project. Social benefits from development as settlement schemes would be considerable.

It is proposed that implementation should be carried out in the order (see Table 7.20) Qoryooley, Golweyn, Shalambood, Faraxaane and possibly Mukoy Dumis, with the feasibility studies of Golweyn and Shalambood executed together to ensure the best allocation of resources in that area.

The der flood project should start immediately as should the banana drainage scheme and the upgrading of the development zones. It should be emphasised that there are 2 000 ha of bananas in the development zones and every effort should be made to raise the levels of production as soon as possible.

It is recommended that a study of the banana industry with the objective of determining the best means of raising the level of production and increasing exports should be initiated. Forty-two per cent of the country's bananas are grown in the Study Area, providing 10% of the country's foreign exchange with potential for considerably more. It is essential therefore that a positive policy is taken towards this important crop.

7.10 Barrage Renovation

The condition of three barrages, Qoryooley, Janaale and Falkeerow, is verging on critical. Work costing up to So. Shs. 5.95 million is necessary at once on Janaale barrage. Falkeerow barrage is not as critical and could wait for up to five years for repairs, amounting to So. Shs. 2 million at current prices, to be completed. Downstream works of So. Shs. 400 000 must, however, be completed immediately. The renovation of Qoryooley barrage, amounting to So. Shs. 2.53 million, is essential for the Faraxaane area before it is developed as a project. However, when Faraxaane is developed, this barrage would no longer be required. It is proposed, therefore, that the Qoryooley barrage be renovated at a cost of So. Shs. 500 000 to enable it to last for another ten years. The total capital costs of renovation are likely to amount to So. Shs. 9.49 million and annual maintenance cost to So. Shs. 949 000.

CHAPTER 8

SUMMARY OF PROJECTS

8.1 Introduction

The location and main features of the projects selected within the Study Area have already been described in this volume, and engineering aspects of each project, with maps at 1 : 25 000 scale, are given in Annex VII of this report. Tables 8.1 to 8.8 summarise the essential features of each project.

TABLE 8.1

Project Summary Sheet - Qoryooley

Location of project			East of Qoryooley	
Principal soil series			Saruda and Qoryooley	
Gross Project Area (ha)			5 820	
Proposed net cultivated area of annual crops (ha)			4 170	
Existing area of perennial crops (ha)			-	
Cropping pattern (%)	Gu		Der	
	Maize	20	Maize	20
	Rice	20	Rice	20
	Forage	20	Cotton	35
			Sesame	25
	Total	60		100
Source of irrigation water			Gayweerow barrage	
Main form of field irrigation			Furrow	
Approximate extent of irrigation pumping			90%	
Special engineering features			Night storage in reservoir at head of distributary canals	
Farm management			Village co-operatives	
Estimated population at present (families)			1 639	
Population required (families)			2 089	
Capital cost (So.Shs. million)			93.7	
Net benefit (So.Shs. million)			20.2	
Interest rate of return (on basis of Master Plan)			10.2%	
Repayment capacity			Good	
Net present value/ha at 10% discount rate (So.Shs.)			552	

TABLE 8.2

Project Summary Sheet - Faraxaane

Location of project			Faraxaane	
Principal soil series			Qoryooley and Madhuulow	
Gross project area (ha)			5 000	
Proposed net cultivated area of annual crops (ha)			4 000	
Existing area of perennial crops (ha)			-	
Cropping pattern (%)	Gu		Der	
	Maize	20	Maize	20
	Rice	20	Rice	20
	Forage	20	Cotton	35
			Sesame	25
	Total	60		100
Source of irrigation water			Gayweerow barrage	
Main form of field irrigation			Furrow	
Approximate extent of irrigation pumping			50%	
Special engineering features			Night storage in reservoirs at head of distributary canals	
Farm management			Village co-operatives	
Estimated population at present (families)			2 640	
Population required (families)			2 000	
Capital cost (So.Shs. million)			96.7	
Net benefit (So.Shs. million)			19.4	
Internal rate of return			9.0%	
Repayment capacity			Moderate	
Net present value/ha at 10% discount rate (So.Shs.)			-2 154	

TABLE 8.3

Project Summary Sheet - Golweyn

Location of project			East of Golweyn	
Principal soil series			Saruda and Golweyn	
Gross project area (ha)			3 700	
Proposed net cultivated area of annual crops (ha)			1 765	
Existing area of perennial crops (ha)			108	
Cropping pattern (%)	Gu		Der	
	Maize	20	Maize	20
	Rice	20	Rice	20
	Forage	20	Cotton	35
			Sesame	25
	Total	60		100
Source of irrigation water			Primo Secondario canal or Gayweerow barrage	
Main form of field irrigtion			Furrow	
Approximate extent of irrigation pumping			Nil	
Special engineering features			Night storage in reservoirs at head of distributary canals	
Farm management			Village co-operatives	
Estimated population at present (families)			850	
Population required (families)			883	
Capital cost (So.Shs. million)			34.0	
Net benefit (So.Shs. million)				
without bananas			9.7	
with bananas			10.3	
Internal rate of return			13.1%	
Repayment capacity			Good	
Net present value/ha at 10% discount rate (So.Shs.)			6 621	

TABLE 8.4

Project Summary Sheet - Shalambood

Location of project			North of Shalambood		
Principal soil series			Saruda and Golweyn		
Gross project area (ha)			6 255		
Proposed net cultivated area of annual crops (ha)			3 966		
Existing area of perennial crops (ha)			358		
Cropping pattern (%)	Gu			Der	
	Maize	20		Maize	20
	Rice	20		Rice	20
	Forage	20		Cotton	35
				Sesame	25
	Total	60			100
Source of irrigation water			Dhamme Yaasiin canal		
Main form of field irrigation			Furrow		
Approximate extent of irrigation pumping			Nil		
Special engineering features			Night storage in distributary canals		
Farm management			Village co-operatives		
Estimated population at present (families)			1 980		
Population required (families)			1 983		
Cpital cost (So.Shs. million)			94.7		
Net benefit (So.Shs. million)					
without bananas			21.4		
with bananas			23.6		
Internal rate of return			10.9%		
Repayment capacity			good		
Net present value/ha at 10% discount rate (So.Shs.)			1 918		

TABLE 8.5

Project Summary Sheet - Mukoy Dumis

Location of project			East of Mukoy Dumis
Principal soil series			A complex of semi-recent alluvium
Gross project (ha)			2 060
Proposed net cultivated area of annual crops (ha)			1 650
Existing area of perennial crops (ha)			-
Cropping pattern (%)	Gu	Der	
	-	Maize	30
	-	Sesame	30
	-	Cotton	40
	Total		100
Source of irrigation water			Bokore canal
Main form of field irrigation			Furrow
Approximate extent of irrigation pumping			100%
Special engineering features			This area has been selected to evaluate the cost of bush clearance. This project is suitable for settlement.
Farm management			Village co-operatives
Estimated population at present (families)			130
Population required (families)			825
Capital cost (So.Shs. million)			42.9
Net benefit (So.Shs. million)			7.0
Internal rate of return			8.1%
Repayment capacity			Very low
Net present value/ha at 10% discount rate (So.Shs.)			-4 257

TABLE 8.6

Project Summary Sheet - Asayle

Location of project					West of Janaale		
Principal soil series					Saruda		
Gross project area (ha)					4 170		
Proposed net cultivated area of annual crops (ha)					1 320		
Existing area of perennial crops (ha)					144		
Cropping pattern (%)	Smallholder				Large farms		
	Gu		Der		Gu		Der	
	Maize	40	Maize	20	Maize	20	Maize	20
	Forage	20	Sesame	50	Rice	20	Rice	20
	Cotton	-	Cotton	30	Forage	20	Cotton	15
							Sesame	25
	Total	60		100		60		80
Source of irrigation water					Asayle canal		
Main form of field irrigation					Furrow		
Approximate extent of irrigation pumping					90%		
Special engineering features					Night storage reservoirs at head of distributary canals, irrigated areas modified to avoid unsuitable soils		
Farm management					Mixture of large farms and village co-operatives		
Estimated population at present (families)					941		
Population required (families)					990		
Capital cost (So.Shs. million)					30.5		
Net benefit (So.Shs. million)							
without bananas					4.5		
with bananas					5.4		
Internal rate of return					6.1%		
Repayment capacity					Very low		
Net present value/ha at 10% discount rate (So.Shs.)					-8 358		

TABLE 8.7

Project Summary Sheet - Der Flood

Location of project			East of Jeerow	
Principal soil series			A complex of semi-recent alluvium	
Gross project area (ha)			1 200	
Proposed net cultivated area of annual crops (ha)			960	
Existing area of perennial crops (ha)			-	
Cropping pattern (%)	Gu		Der	
	Maize	20	Maize	20
	Forage	20	Sesame	60
			Cotton	20
	Total	40		100
Source of irrigation water			Bokore and Sisab canals	
Main form of field irrigation			Pre-planting flood irrigation	
Approximate extent of irrigation pumping			Nil	
Special engineering features			This are has been specially selected for a cheap irrigation system with good water supplies	
Farm management			Smallholder	
Estimated population at present (families)			260	
Population required (families)			480	
Capital cost (So.Shs. million)			11.5	
Net benefit (So.Shs. million)			2.7	
Internal rate of return			12.6%	
Repayment capacity			Low	
Net present value/ha at 10% discount rate (So.Shs.)			3 211	

TABLE 8.8

Project Summary Sheet - Banana Drainage

Location of project	Beside the Primo Secondario canal
Principal soil series	Qoryooley
Gross project area (ha)	2 830
Proposed net cultivated area of annual crops (ha)	-
Existing area of perennial crops (ha)	1 560
Source of irrigation water	Primo Secondario canal
Special engineering features	This project is to install field drains and a disposal system to avoid waterlogging and to assist in nematode control. Trials must be made before the project can be implemented
Farm management	Banana plantations
Capital cost (So.Shs. million)	28.2
Net benefit (So.Shs. million)	9.3
Internal rate of return at full increase in yield	15.0%
Internal rate of return at half increase in yield	13.0%
Repayment capacity	Low
Net present value/ha at 10% discount rate (So.Shs.)	7 326

CHAPTER 9

IMPLEMENTATION

9.1 Introduction

The comprehensive development of some 70 000 ha is a major task which requires considerable planning. The development projects are all separate units which are independent of one another and each can be developed independently. There are cases where two projects may be profitably combined, such as Qoryooley and Asayle or Golweyn and Shalambood, but this does not alter the fact that each is independent and can be considered in isolation. There are two tasks which should be undertaken as soon as possible - the formation of the Shabeelle River Authority and the repairs to Janaale barrage. These are discussed in the following sections.

9.2 The Establishment of the Shabeelle River Authority

The terms of reference for the study applied only to the Study Area and did not include for a review of the whole Shabeelle Flood Plain. However, a study of the availability of water had to include an examination of irrigation along the river outside the Study Area and the operation of Jowhar offstream storage reservoir. The computer operation analyses were carried out throughout the period of the study and constantly refined but they are by no means exhaustive and finite. However, they clearly show that, at present, there is a shortage of water in one year in four in June and July. Clearly the successful operation of Jowhar offstream storage reservoir is essential for the development of new projects and the improvement of yields in existing areas. The proposed Shabeelle River Authority would operate the reservoir, collect and record all hydrological and development data and control irrigation in the flood plain. It should be established before further development is implemented.

9.3 Repairs to Janaale Barrage

Janaale barrage is the key to successful agricultural production in the Study Area since more than half the area under irrigation receives its water from canals controlled by this barrage. The main gates on the barrage need to be replaced and planning of this work should commence as soon as possible so that the main works and repairs may be done during the dry season at the beginning of 1980.

There is a deep scour pool immediately downstream of the apron and this must be examined and filled urgently.

9.4 Ranking of Projects

The projects have been subject to a conventional economic analysis and the results, in order of merit, are given in Table 9.1.

TABLE 9.1

Economic Ranking of Projects

Project	Internal rate of return (%)	Net present value at 10% discount rate ('000 So. Shs.)	Net present value/ha (So. Shs.)
Banana drainage	15.0	11 428	7 326
Golweyn	13.1	12 401	6 621
Der flood	12.6	3 083	3 211
Shalambood	10.9	8 293	1 918
Qoryooley (1)	10.2	2 208	552
Faraxaane	9.0	-8 616	-2 154
Mukoy Dumis	8.1	-7 024	-4 257
Asayle	6.1	-12 236	-8 358

Note : (1) Economic analysis for Qoryooley based on Master Plan analyses, which are slightly different from the feasibility study analysis, in order to make the project directly comparable with other projects.

Source : Table 7.15

The ranking in Table 9.1 should only be taken as a general guide since other factors, such as the element of risk involved, should also be taken into account. Furthermore, it is not considered advisable to rank projects solely on the basis of the internal rate of return. The net present value is often considered the most reliable guide but in this case the ranking, according to net present value per hectare, is the same as the ranking according to the internal rate of return.

Social benefits may also be taken into account; for example more people may benefit from a particular project. Most of these projects have a labour constraint in the der season which limits the area which can be worked by one family to 2 ha and this has been adopted as a standard project criterion. In most cases only a slight increase in population is permissible, the two exceptions to this being the der flood project and the Mukoy Dumis project where there is the possibility of bringing in larger numbers of people. In most cases the value of existing production is a major factor in determining the returns to a particular project, but this is restricted to some extent by the recommendation to limit gu cropped areas to the existing levels due to water shortages in the gu season.

The Study Area cannot be considered in isolation from the rest of Somalia and it is not possible to propose that all the projects identified should be implemented without considering opportunities for investment outside the Study Area. There are no established criteria for investment decisions in Somalia and the decision to proceed with a project must be made on the basis of direct comparison with alternatives. Therefore it is not possible to make definite recommendations for all the projects identified here, but an internal rate of return of between 8 and 10% is often regarded as the minimum acceptable.

Table 9.1 clearly shows that the banana drainage project is the most worthwhile investment. Yields are declining rapidly and, since the project is a long-term one, work should commence as soon as possible so that the benefits will occur before the banana industry deteriorates further.

The second ranked is the Golweyn project which has an internal rate of return of 13.1%. This is adjacent to the Shalambood project with an internal rate of return of 10.9%. These two projects are in the area originally covered by the State Planning Commission rice project and therefore could not be considered for the feasibility study at the time of the Inception Report.

The third highest ranking (coming between the Golweyn and Shalambood projects) is the der flood project. This has a very good internal rate of return (12.6%) and a feasibility study should be done as soon as possible.

The Qoryooley project has an internal rate of return of 10.2% when analysed in the same way as the other Master Plan projects. Since this project is more advanced than the others and since the feasibility study has already been prepared, this project could proceed immediately provided that the internal rate of return of 10.2% is acceptable in general planning terms to the Somali Government. It should be noted that the internal rate of return for the feasibility study was 9.6%. The difference between this figure and the Master Plan figure is mainly attributable to the fact that the costs of applied research work have distorted the ranking. Those costs are needed for the first project to be implemented, whichever it is.

The Faraxaane project has an internal rate of return of 9%. This project must come lower down in the priorities for implementation but may be considered worthwhile if no other projects outside the area can yield greater incremental benefits.

The Mukoy Dumis project is different from those previously considered in that the area is not widely cultivated at present and costs of clearance of light bush have been included.

Little water is used during the gu season in the area at present and, as there is no surplus water at that time, cropping must be limited to the der season. On the other hand this constraint on water supplies may be applied to the whole of the Shabeelle Flood Plain and, if there is a need to settle people, this scheme provides one opportunity, although naturally the benefits are lower than for those projects for which a greater cropping intensity may be established. However, although this area is the best that could be found within the Study Area and the bush is not very dense, it is very broken and pumping will be required. It is probable that better areas occur elsewhere within the Shabeelle Flood Plain.

The Asayle project has a very low rate of return and poor repayment prospects. The decision to proceed with a feasibility study for this project should await the result of the Qoryooley project.

The need to assess progress on the Qoryooley project before commencing work on further feasibility studies is paramount. The amount of work involved justifies the establishment of a special unit consisting of an agronomist and an economist. This monitoring and evaluation unit will be concerned with the study of progress on the field trials on the Qoryooley project and the success of the implementation. Ideally, the unit should be attached to the State Planning Commission since the reports of the unit will be relevant to the whole of agricultural development within Somalia. The unit should be established in year 4 and initially attached to the Qoryooley project.

9.5 Development Zones

Improvement of development zones is required and recruitment, training and staffing should commence immediately. The highest priority should be given to extension work in the banana zones since the present rate of decline of yields may lead to farmers abandoning banana plantations within the next few years.

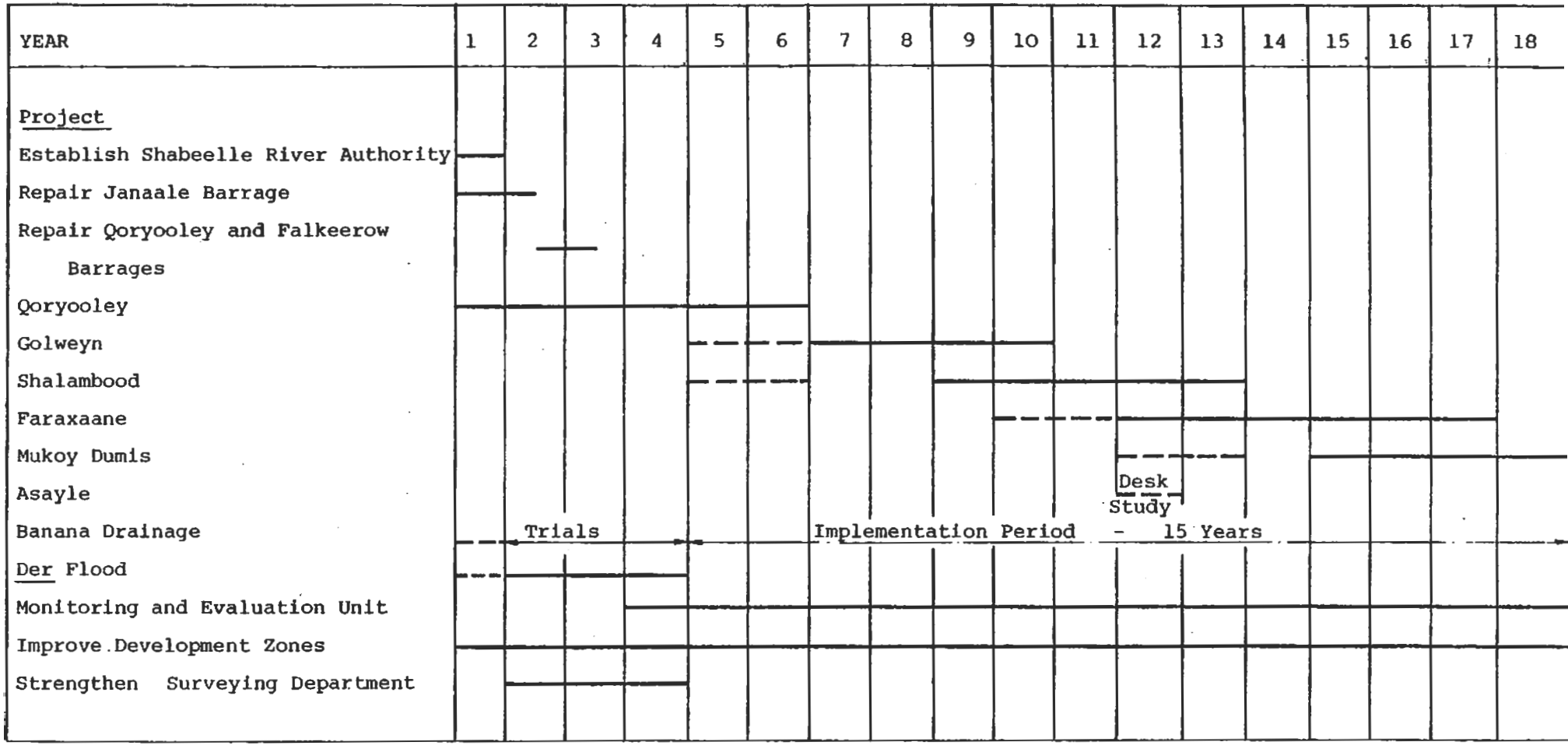
9.6 Expansion of Surveying Facilities

For all feasibility studies, detailed surveys will be required. Time can be saved if the maps are available in advance and there would be a substantial saving if the majority of this work could be undertaken by Somali surveyors. At present the Survey and Mapping Department has not sufficient personnel to do this work and the recruitment of an experienced expatriate surveyor to train surveyors and supervise the mapping is recommended.

9.7 Programme of Implementation

The programme for implementation of the project works is shown in Figure 9.1. The main feature of this programme is that comprehensive projects similar to the Qoryooley project have been spread over a long period in order to reduce the problems of implementation. The Qoryooley project should be implemented first because studies are advanced and a delay of two years would be inevitable if a project with apparently greater benefits was to be selected. The programme for the start of the Qoryooley project has been arranged so that field tests on the pilot farm may commence at the beginning of year 2. Therefore by the end of year 4 there should be tangible benefits from this field work. At this stage the feasibility study for the Golweyn project could commence and would be able to take into account the experience gained on the relevant soils and climatic conditions. Since the Shalambood project is adjacent to the Golweyn project the feasibility study should be done at the same time although implementation should be phased to start later. The Faraxaane and Mukoy Dumis feasibility studies are timed to allow the commissioning of project areas to take place at an even rate after completion of the Shalambood project. In the case of the Asayle project, because of the low internal rate of return, it is recommended that a further desk study is made later to check the viability of this project in the light of information gained during implementation of the Qoryooley and Golweyn projects. All other projects may commence immediately but priority should be given to the establishment of the Shabeelle River Authority and repairs to Janaale barrage.

MASTER PLAN - PROGRAMME OF IMPLEMENTATION



Key ——— Feasibility Study

——— Implementation

Figure 9.1

The banana drainage project will be of long duration and since the benefits are considerable and preliminary trials are required, work should commence as soon as possible. The der flood project is also very profitable even though it is comparatively small. It is recommended that the feasibility study for this project should be done concurrently with the banana drainage project since much of the engineering, economic and basic agricultural expertise would be similar.

The strengthening of extension services in the development zones should also commence immediately and the general expansion of ONAT and ADC services should be phased to meet the growing production needs. The improvement of tractor hire facilities, and the training of drivers, should be commenced at once.

CHAPTER 10

CONCLUSIONS AND RECOMMENDATIONS

10.1 Soils

The soils of the Study Area are uniform and 90% of the area is suitable for irrigation. The 10% which has been classed as unsuitable mainly consists of narrow river channel remnants which meander across the area. Due to the heavy nature of the soils, none has been placed in land class 1 which comprises the best soils for irrigation purposes. The land class 2 category (suitable for irrigation) includes soils with both profile and drainability deficiencies and occupies some 42% of the area. The land class 3 category (moderately suitable for irrigation) has limitations due to poor aggregate stability, slow infiltration rates and the majority also have a salinity hazard. These lands occupy 47% of the Study Area. The narrow strips of unsuitable land, and the relatively small differences between class 2 and class 3 soils do not influence the development of the area appreciably.

10.2 Groundwater

In general, the groundwater underlying the area is saline. There is a narrow zone of recharge from the river as far as Janaale and then along the line of the Primo Secondario canal. The river does not contribute to recharge downstream of the new Gayweerow barrage. This narrow zone of recharge means that there are only a few areas where the groundwater reaches moderate quality in terms of salinity but, in these areas, there is a risk of substantial crop yield reductions, even if the groundwater is only used to supplement riverflows. Therefore, further use of groundwater must be considered most carefully and is not recommended, except for the grapefruit project where the decision to proceed will be based on the advice of the consultants for the scheme.

10.3 River Water Supplies

The simulation studies of the operation of Jowhar offstream storage reservoir show that, even at the present level of development, there will be a shortage of water in one year in four in the months of June and July. This level of reliability is acceptable for annual crops, but is too low for perennial crops. Furthermore, if the area of perennial crops was to be expanded, the demand for water in the dry season would further reduce the reliability of supplies in June and July, and so no benefit would be obtained. This is because the gu season flood cannot be relied upon to fill the reservoir. Therefore it is recommended that no expansion of perennial crops be permitted except where groundwater supplies are adequate, and that the area under gu crops should be maintained at its present level. The water supplies permit the der crops to be expanded by about 23 000 ha in the river flood plain.

10.4 Shabeelle River Authority

The fact that water supplies are so critical for much of the year highlights the need of the filling and releases from Jowhar offstream storage reservoir for very careful control and planning. The reservoir can bring great benefits to the

Shabeelle Flood Plain, but only if the possible advantages are maximised. The more reliable supply at the tail of the gu season and the extension of riverflows beyond the der season will allow a considerable amount of forward planning by farmers. The benefits should be seen by all and the inauguration of the reservoir should be used as the first step in changing the existing irrigation practices in which too much reliance is placed on rainfall and crop planting dates are varied in accordance with the variable riverflows. The estimation of demand downstream will require considerable field work to calculate areas under each crop and information about irrigation requirements will have to be disseminated. The construction of the Jowhar reservoir is under the direction of the Ministry of Agriculture. So far no team for the future operation has been formed. This needs to receive consideration as quickly as possible so that the selected personnel can be trained by the Consultant's staff before they leave. We believe that this team should be part of a larger organisation which will have the full authority of the Somali Goverment to allocate priorities to water users to ensure that the water in times of shortage is used to the greatest benefit of the country as a whole. This will mean that the organisation recommended, the Shabeelle River Authority, will include nominees and staff from outside the Ministry of Agriculture.

10.5 Repairs to Barrages

Remedial works are required to the sluice gates at Janaale barrage and the deep scour hole downstream of the concrete apron requires repair. Planning of these works should start immediately so that the bulk of the repairs can be done early in 1980. Rehabilitation works are also required to Qoryooley and Falkeerow barrages.

10.6 Method of Project Analysis

Suitable projects were delineated within the Study Area based on the existing features such as barrages and main canal systems. To warrant selection, projects had to have an area of land which formed a cohesive unit large enough to warrant a full feasibility study later. The studies were complicated by the need to select an area of 5 000 ha for the feasibility project early in the study period. A further complication was that, at the start of the study, the State Planning Commission was preparing a pre-feasibility report for the Shalambood rice project which meant that the area was already committed and could not be considered for the project feasibility study. As a result of the early work on the Master Plan, it was realised that the Shalambood area did not differ noticeably from the Qoryooley Project Area and the same form of development would be applied. On detailed examination of the Shalambood area, it was decided to divide it into two projects based on water supplies from the Dhamme Yaasiin canal and the Primo Secondario canal. The two projects were named the Shalambood project and the other, extending to the west, the Golweyn project.

The projects have been subject to a standard economic analysis. In the early stages of the study, consideration was given to ranking the projects according to benefits per cubic metre of water as well as per hectare of land, but the first reservoir simulation studies showed that water was critical in the gu season at the present levels of cropping. It was therefore decided that no expansion of irrigation of gu crops could be permitted and all the projects proposed conform to this rule. Therefore, the projects may be compared on a standard economic basis.

Political and social factors are also important in the selection of priorities. There are two types of farming in the Study Area: large plantations growing perennial crops, mainly bananas, and smallholders growing annual crops. It has been calculated that one household can provide labour to manage 2 ha in the der season with a minimum of mechanisation. If the gu crops are limited to about 50% because of the restricted water supply the family can, on average, have the recommended minimum family income of So. Shs. 4 400 per annum and cover operation and maintenance costs. The surplus, for servicing and repayment of capital, depends on the profitability of the individual project, but is sufficient to repay a soft loan in the case of the Qoryooley project. If the size of holdings is reduced, either the average income falls or the repayment capacity becomes less.

An average holding size of 2 ha is slightly greater than the present size in irrigated areas, and there will be little movement of farmers between projects. Therefore there is little scope for settling people from outside in the Study Area. In two projects, however, the land is scarcely cultivated at present so there is the possibility to settle farmers from outside the Study Area. Because of the restriction on gu water supplies, these two projects, the der flood and the Mukoy Dumis projects, take most of their water in the der season. The der flood project is reasonably profitable and a feasibility study would be made according to the normal economic criteria, but the Mukoy Dumis project has a marginal rate of return (8.1%) and poor repayment capacity. However, it may be considered suitable for a feasibility study on social grounds.

Areas not suitable for comprehensive projects have been designated as development zones and in these areas improvements can take place in a steady manner by the strengthening of the agricultural services.

10.7 Summary of Projects

In recent years, yields in the banana plantations have declined due to technical, financial and marketing problems. There is no sign that this decline is slowing down and there is a great danger that the poor returns to farmers may lead to the abandonment of plantations or a change over to annual crops. This is a grave problem as the bananas exported from the Lower Shabeelle region account for almost 10% of the country's foreign exchange earnings. There are many reasons for this decline but two of the technical problems are caused by poor drainage and nematode attack. The two are thought to be related and improvement in drainage is likely to assist in control of nematodes. It is not within the scope of this report to differentiate between poor drainage and nematode attack as the major cause of the decline in yields, but in 1974, 276 q/ha were being exported. This figure has dropped to 108 q/ha whereas exporters consider that between 250 and 300 q/ha should be obtainable. If an increase in yield of 200 q/ha is obtained, the banana drainage project will have an internal rate of return of 15.0% and, even if the benefits are only half, the internal rate of return will be 13.0%. Clearly, the project is worthwhile, but it must be pointed out that the full implementation will require many years since fields may only be drained after the plants have been taken off and trials are necessary before the final designs can be made. Other inputs are also required for bananas and these should be carried out as part of the improvement of development zones. The der flood project has been mentioned briefly in the previous section and a feasibility study should commence as soon as possible. However, the net cultivated area is small (960 ha) and it is considered preferable to combine the feasibility study with the banana drainage project.

The Faraxaane, Golweyn and Shalambood projects are all similar to the Qoryooley project. The Qoryooley project cropping pattern recommendation is as follows :

Gu season		Der season	
Maize	20%	Maize	20%
Upland rice	20%	Upland rice	20%
Forage crop	20%	Cotton	35%
		Sesame	25%
Total	60%		100%

The average holding of livestock will be increased from 3.14 to 4.0 livestock units. The farming will be done by eight village co-operatives under the direction of project headquarters. Each family will be given 0.125 ha for private use and will farm the watercourse units (average size 24 ha) communally. The Qoryooley feasibility study has been completed and costs have been calculated precisely. The internal rate of return for the feasibility study was 9.6% but, when this was calculated on the same basis as the other Master Plan costs, the rate of return rose to 10.2%. The difference is mainly due to the cost of setting up the pilot farm and training facilities. The Golweyn and Shalambood projects have internal rates of return of 13.1 and 10.9% respectively. The Qoryooley project is more advanced and, since it is also profitable, the implementation should go ahead immediately. The feasibility studies for the Golweyn and Shalambood projects could be combined since the projects are similar and adjacent and could commence when results are available from the pilot farm at Qoryooley and the first co-operative farms have been commissioned. The Faraxaane project should be studied later.

The internal rate of return of the Asayle project is much lower at 6.1% and this project has a poor repayment capacity. It is recommended that a desk study should be carried out later when more information is available.

The Mukoy Dumis project has been mentioned earlier as a project which may be desirable on social grounds since there is a need to settle people in the area, if it is to be developed. The costs for this project allow for the clearance of light bush and only one crop per year will be permitted. Even so, the internal rate of return is 8.1% but there is little prospect of repayment of capital.

The grapefruit scheme is being financed by the EDF and supervised by independent consultants. We believe a further market survey is warranted since the data used in the original survey are now out-of-date. The results of the groundwater survey indicate that there is a considerable risk of declining yields due to a build-up of salinity if the groundwater is used as a supplementary source of irrigation. Until now, there has been no clear understanding of the reliability of water supplies in the Shabeelle Flood Plain, but the work published in this study (Annex II) enables an estimate to be made of the extent of use of groundwater. The grapefruit project is located in the area where groundwater is least saline and a careful study is required to assess the hazard of using groundwater of moderate salinity on a crop which is susceptible to salinity.

10.8 Development Zones

The most urgent need is the revitalisation of the banana industry. This has been partially dealt with in the banana drainage project, but a thorough investigation of the industry is required with particular reference to marketing, introduction of new stock, and training of staff overseas to improve expertise and increase experience.

Extension services throughout the area must be improved and the regional co-ordinator's office at Janaale must be upgraded and fully staffed with trained personnel. Full use of the farmer training centre at Janaale should be made and the proposed IBRD programme for the training of extension workers should be used to the maximum extent.

The services of ONAT need to be improved, particularly by increasing the number of tractors available for hire and improving the training of operators. The annual programme for the sale of seeds must be reviewed in view of a possible change in cropping calendars permissible by the inauguration of Jowhar offstream storage reservoir.

10.9 Strengthening of Survey Training

Considerable benefits could result from strengthening either the Survey and Mapping Department or providing survey training within the Ministry of Agriculture which would then be able to provide detailed maps before feasibility studies commence.

This should be done by the employment of an experienced expatriate land surveyor who could lead field teams on these surveys and at the same time train Somali surveyors.