UNITED NATIONS DEVELOPMENT PROGRAM
(SPECIAL FUND)

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

EXECUTING AGENCY
FOOD AND AGRICULTURE ORGANISATION OF THE UNITED NATIONS

VOLUME I

GENERAL REPORT

NOVEMBER 1969

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VOLUMES COMPRISING THE REPORT

VOLUME I	General Report
VOLUME II	The Balad Flood Irrigation Project Feasibility Study
VOLUME IIA	The Balad Flood Irrigation Project Feasibility Study Technical Annex
VOLUME III	The Afgoi-Mordile Controlled Irrigation Project Feasibility Study
VOLUME IIIA	The Afgoi-Mordile Controlled Irrigation Project Feasibility Study Technical Annex
VOLUME IV	Water Resources and Engineering
VOLUME V	Soils and Agriculture
VOLUME IV/V A	Annexes to Volumes IV and V Water Resources and Engineering Soils and Agriculture

FOREWORD

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

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

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

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

CONCLUSIONS AND RECOMMENDATIONS

IT IS CONCLUDED THAT:

(a) Provided flows of the Shebelli River entering Somalia are not appreciably reduced by upstream abstraction, they can support limited expansion of irrigated agriculture in the Shebelli Valley.

(b) The best location for a new controlled irrigation development is in Afgoi-Mordile area where a 3,075 ha (net) development using the natural river flows would cost about 13.7 million Somali shillings. The economic rate of return would be about 8%.

(c) A favourable location for flood irrigation is on the west side of the valley below Balad. A 7,000 ha (net) development relying on natural flood flows would cost about 28.5 million Somali shillings. The economic rate of return would be about 7.5%.

(d) Before implementation of any new irrigation project is undertaken a pilot irrigation scheme should be established and operated to permit more reliable estimating of agricultural inputs and crop yields and production costs than was possible on the basis of the limited experimentation so far carried out in the valley.

(e) The storage of flood flows for subsequent use during periods of low flow would permit a considerable expansion of controlled irrigation and would reduce the downstream flood hazard. However this would preclude major flood irrigation projects downstream.

(f) Storage sites on the Shebelli River in Somalia present serious problems and construction costs would be prohibitive.

(g) The best off-stream storage site is on the left bank of the river below Johar. Here, 18,700 ha.m. of storage could be provided at a first cost of the order of 22 million Somali shillings. This would make it possible to increase the area under controlled irrigation from the present 30,200 ha to 57,780 ha.

(h) The rehabilitation of existing irrigation facilities in the Genale area should be undertaken and extension of irrigation in this area could, with smaller development schemes elsewhere, utilize the entire water supply obtainable through off-stream storage.

(i) To ensure effective management of agricultural development projects, steps must be taken to improve extension and research services, to provide credit facilities and to encourage the formation of cooperatives.

(j) Appropriate legislation governing land tenure must be enacted to enable agricultural development projects to be successfully implemented.

(k) The establishment of an effective and permanent hydrological organization is essential to rational planning and use of Shebelli River water.

(l) Effective control of Shebelli River water use is fundamental to successful expansion of irrigated agriculture.

IT IS RECOMMENDED THAT:

(a) A regional water committee for the Shebelli River be set up as provided for in the present Water Law.

(b) The Irrigation Department of the Ministry of Public Works be re-organized to create sections responsible for irrigation licensing and control and for flood fighting and works maintenance.

(c) A detailed study of the proposed off-river storage and flood control project at Johar be carried out before any major irrigation development is undertaken.

(d) A controlled Irrigation Pilot Project of about 100 ha. be established and operated in the Afgoi-Mordile area.

(e) Neither the Balad nor Afgoi-Mordile development be implemented until economic feasibility is reliably demonstrated on the basis of data obtained from the pilot project operation.

CONTENTS

TABLES IN THE TEXT

FIGURES IN THE TEXT

SELECTED REFERENCES

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STATISTICAL DEPARTMENT - MINISTRY OF PLANNING - MOGADISCIO Somali Statistics and other publications.

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SYMBOLS AND UNITS USED

Distance, Area, Volume and Weight

Metric measurements have been used throughout the report.

Monetary Units

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

Shs. 7.14 = US $ 1.00

Foreign currency is quoted in US. Dollars.

Conversion Factors

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

GLOSSARY OF LOCAL TERMS

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

CHAPTER 1

INTRODUCTION

1.1 Project Scope

This project had as its subject area the Shebelli River Valley from Bulo Burti down to Avai. Within this area the following work was carried out.

a. The selection of an area of about 3,000 hectares for controlled irrigation development and an area of about 10,000 hectares for flood irrigation development.

b. The execution of topographic surveys, soil surveys, agronomic studies, hydrological and groundwater investigations in relation to development of the selected areas and the preparation of engineering designs for the two schemes in sufficient detail to enable cost estimates to be made sufficiently accurate for economic and financial feasibility analysis.

c. The identification of possible further areas for future development within the limits imposed by the available irrigation supplies.

d. The formulation of a Water Management Plan for the Shebelli River Valley.

e. Recommendations for the organisation of a Government Hydraulic Service for the control of the Shebelli River.

This report describes the work executed and presents the findings and conclusions reached.

1.2 Execution of the Project

The FAO Resident Engineer arrived in Somalia in December 1966 to set up the Project Headquarters. Vehicles and equipment required for the project were ordered early in 1967 and in December of that year the first members of the Contractor's team arrived to start field operations.

During the course of the field studies, difficulties were experienced in obtaining the counterpart personnel and equipment as laid down in the Plan of Operation. Suitable counterpart professional staff were difficult to find due to the acute shortage of technically competent personnel in Somalia and the demands imposed by the numerous other UN projects running concurrently. The Survey and Mapping Department unit set up under the previous Agricultural and Water Surveys Project to collect and process data for future land and water use planning had ceased to function and the staff who had gained experience during the previous project had dispersed.

In spite of these problems, the project aims were achieved in all fields of study except the groundwater investigations. Here the shortage of Government furnished equipment in working condition and the lack of facilities for its proper operation, repair and maintenance prevented full accomplishment of the planned programme. The Contractor had completed all field studies by July 1969, when the last member of the team withdrew from Somalia. The Project Headquarters was closed down and the FAO Resident Engineer departed in August 1969.

1.3 Acknowledgements

During the project the members of the Contractor's team received assistance, advice and cooperation from many individuals and organisations. We wish to express our gratitude and thanks to the following:

The Ministry of Public Works whose successive Directors General provided assistance and advice; the Survey and Mapping Department who provided office accommodation and facilities and the Water Department who assisted with the groundwater studies.

The Ministry of Planning

The Ministry of Agriculture

The Ministry of National Resources Livestock Division

The Agricultural Development Agency

The Livestock Development Agency

The United States Agency for International Development

Afroi Research Station and members of the Wyoming University Team

Mogadiscio Water Agency

Societa Nationale Agricola Industriale, Johar

Societa Azionaria Cultivatori Agricoli, Scialambot

Sig. L. Cavazzani, Director CIEFFE SpA, Scialambot

Ing. A. Forlani, Mogadiscio

Ali Sheik Mohammed D. P. C.E., M.I.C.E., M. Inst. H.E. Somal Contract, Mogadiscio

Karmi and Associates, Mogadiscio

National Engineering and Construction Co. Ltd., Mogadiscio

Scebel Oil Co., Mogadiscio

Sinclair Somal Oil Co., Mogadiscio

Finally our thanks are due to the Office of the United Nations Resident Representative in Somalia and the assistance provided by United Nations experts engaged in other projects in Somalia including the National Grain Marketing and Price Stabilisation Project whose workshops under Mr. P. Leifer did so much to keep the Project vehicles in operation.

The above list is far from complete and in many cases information and assistance was obtained from or given by individual farmers, government officers and other interested parties, all too numerous to mention.

CHAPTER 2

THE SETTING

A. The National Setting

2.1 General

Somalia is a country of some 637,660 square kilometres, situated at the eastern extremity of the African Continent. The people are traditionally pastoralists and subsistence grain farmers. The land is semi-arid to arid and the unreliability of rainfall and water supplies have necessitated a nomadic existence, except in areas where perennial river flows or year round water supplies from surface storage or wells is assured. As a result, life for a considerable proportion of the population is precarious and loss of crops and livestock in drought years with resulting famine occurs all too frequently.

Natural resources other than abundant land and scarce and local supplies of water are few. Recent surveys executed with the assistance of the United Nations Development Programme Special Fund have revealed the existence of mineral deposits and exploration for possible reserves of oil and natural gas is in progress. It is not possible, at present, to estimate how soon or to what extent these potential sources of national wealth may be exploited. In the immediate future, therefore, development and extension of existing agricultural production will remain a major factor in national development.

2.2 The National Economy

Somalia depends on exports of agricultural produce to provide most of its foreign exchange income. In the past, this has not been sufficient to pay for imports and the country has had to rely largely on official donations and long term capital inflow to balance its external payments. Although this is quite normal in a newly independent country, Somalia is facing extreme difficulties in generating both the

external and internal revenues, which are necessary, if the capital required for development is to be paid for in the future. The situation would be alleviated should the exploitation of the mineral mining concessions proves profitable, thereby generating substantial exchange and internal revenue.

Since becoming independent on 1st July 1960, the major economic achievements have been in irrigated agriculture and in the livestock industry. Between 1960 and 1965, banana output rose from 91,000 to 157,000 tons. Due to sales contract difficulties and a major re-planting programme with a new variety, output fell in 1966 to 126,000 tons, but was increasing again during the first months of 1967. Since the closing of the Suez Canal, the industry has been experiencing considerable difficulties in maintaining exports, but an exact assessment of the situation will not be possible until complete production and export figures, since the time of the canal closure, are obtainable.

During the period 1960-1966, output of sugar cane rose from 11,800 tons to 35,000 tons whilst between 1954 and 1965, cattle exports rose from 8,700 head to 31,800 head; camels from 700 to 24,000; goats from 70,000 to 375,000 and sheep from 236,000 to 416,900.

The Agriculture and Water Survey reported estimated production of rainfed crops to be 66,970 tons of maize, 151,650 tons of sorghum, 7,160 tons of cotton and 11,580 tons of other crops. There are no estimates to indicate whether production in this sector has increased or declined since independence, but a decline in cotton exports, continuously increasing levels of cereal imports and a continuous scarcity of sesame seed would suggest that the level of development in the non-irrigated agriculture sector has been virtually stationary, if not declining.

Industrial development has been limited largely to fish, meat and crop processing industries, the expanded Johar sugar factory, a meat factory in Mogadiscio and the recently built meat processing plant in Kismayu, a milk factory in Mogadiscio, a fish processing plant in Kismayu and a textile mill at Balad. Most other manufacturing units are

small, employing up to 40 workers and consist mainly of cotton ginning, tanning, leather goods, soft drinks, iron rods, confectionery and food processing plants.

There has been considerable investment in infrastructure since independence, largely in the form of all weather roads and improved port facilities at Kismayu and Berbera, but the level of infrastructure facilities in all fields, relative to the needs of development are inadequate. There are only approximately 900 kilometres of all weather roads in the country, built largely to service the three ports of Berbera, Mogadiscio and Kismayu. Deep berthing facilities have only recently been installed in Kismayu and Berbera ports, while a feasibility study is being undertaken for a new port in Mogadiscio. Installed electrical capacity in Mogadiscio was 4,100 kilowatts by 1966. The cost of electricity is high at 60 cts a kilowatt hour and is unlikely to decrease until demand has increased to a sufficient extent to allow larger bulk deliveries of imported fuel and reduced unit transmission costs.

2.3 Exports, Imports and the Balance of Payments

The pattern of exports and imports over the period 1960 to 1966, as calculated from the customs returns is shown in Table 2.1.

TABLE 2.1 The Value in Millions of Shillings of Exports and Imports 1960-1966

	1960	1961	1962	1963	1964	1965	1966
Exports	164	188	180	227	258	237	233
Imports	216	230	270	319	391	354	300

Of the total exports, bananas and the livestock group account for approximately 90 per cent in each year, while the major imports in proportion to total imports are essential foodstuffs 30 per cent, textiles and clothing 15 per cent and machinery and transportation materials 26-30 per cent.

The balance of payments figures shown in Table 2.2 are calculated from actual money receipts and expenditure on international transactions. The import figures are generally higher than those shown in Table 2.1 due to the inclusion of imports under commodity aid programmes, which are excluded from the customs returns.

TABLE 2.2 Balance of Payments Statistics 1961-1968 in millions of shillings

	1961	1962	1963	1964	1965	1966	1967	1968[1]	1969[2]
Exports	175	149	199	215	240	216	209	220	230
Imports	249	275	315	421	410	319	309	335	352
Visible Trade Balance	-74	-126	-116	-206	-170	-103	-100	-115	-122
Other goods & services Net	-33	-92	-40	-29	-44	-33	- 8	-45	-49
Net Goods & Services	-107	-218	-156	-235	-214	-136	-108	-160	-171
Net Transfer Payments	107	198	105	83	111	71	40	138	88
(a) Private	-10	10	- 7	-15	-13	- 3	- 5	3	2
(b) Official Donations	117	188	112	98	124	74	35	135	86
Long Term Capital Net	13	37	77	104	87	76	65	26	83
(a) Private Investment	13	30	2	25	12	13	12	- 2	39
(b) Net Govt. borrowing	-	7	75	79	75	63	53	28	44
Short Term Capital Net	23	-31	- 7	-10	-10	- 1		9	
Net B.O.P.	36	-14	19	-58	-26	7	- 5	13	
Monetary Movements	-38	+17	-19	69	21	-11	13	-10	
Errors & Omissions	2	- 3		-11	5	4	8	3	

[1] Provisional.

[2] Forecast.

The figures in both tables 2.1 and 2.2 show that exports have over the period tended to fluctuate whilst imports tended to rise steadily. The large rise in imports in 1964 was due to crop failure and to speculative stockpiling in anticipation of a rise in import duties while the subsequent drop is explained by running down of these accumulated stocks to more normal levels and by the stabilisation measures taken by the Government in 1965. In every year since independence, Somalia has had a substantial trade deficit, which has in general been balanced by official donations and net government borrowing on the long term capital account except during the crisis years of 1964 and 1965. Present debt service obligations are approximately 15 million shillings, not all of which have been met. Total debt negotiated or under negotiation is approximately one thousand million shillings. If this debt is fully utilised, debt repayment commitments will rise to approximately 85 million shillings by the mid 1970's.

2.4 Future Development Plans

The revised planned development expenditures of Somalia's First Five Year Plan published in 1963 totalled 2,427 million shillings. Incomplete estimates show an actual expenditure of 631 million shillings in the planned period of which 272 million shillings was on completed projects, largely in the industrial and transport sectors and 360 million shillings on projects still to be completed.

The Short Term Development Plan 1968-1970, which follows on from the first development plan lists the major objectives during the period as:-

a) Completion of ongoing projects.

b) Introduction of basic structural changes in the administrative set-up, with a view to gear it to the needs of rapid development.

c) Closing the existing budgetary gap and the mobilisation of more domestic resources for development.

Deficiencies of the administrative machinery of government were considered by the Short Term Development Plan to be "probably the most important factor responsible for the disappointing performance of the first five year plan". These deficiencies are due not only to the complicated and ponderous machinery brought about by lack of adequate delegation of authority, but also to the fact that a large proportion of civil servants "have not yet received the fundamental education and specialised training to carry out their assigned tasks". In the appointment of civil servants the plan states that: "Currently political influence plays a major role ------ and very little consideration is given to merit, experience or qualification. Proper discipline is lacking and rigid personnel regulations coupled with political influence have the effect of protecting the inefficient".

In addition to the objectives of this consolidatory programme, two other elements are considered in the Plan to be of prime importance in the current development strategy. The first of these is the integration of the Somali economy into the East African Economic Community, and the second is the initiation of the steps necessary for the integrated development of the Juba River Valley.

The proposed allocation of expenditure on agriculture and related activities for the present programme is 7.7 per cent of the total proposed outlay of 698 million shillings and a further 0.5 per cent on the irrigated sector in which the present survey of the Shebelli River is incorporated, although there are no allocations for the development of the Juba River, for which negotiations for finance have been undertaken.

The specific objectives of the short term development programme commit Somalia to heavy development expenditures in the next few years, 80 per cent of which are in the essential, but not directly revenue producing infrastructural sector. It is hoped that revenue will be produced by consolidation and rationalisation of existing projects and enterprises and by attractive foreign finance for major investments for exploitation of the mineral deposits and for irrigation projects on the Shebelli and Juba Rivers.

2.5 Problems of Implementating Proposed Developments

Somalia's key problems are shortages of local funds and skilled manpower, which makes effective organisation of the resources for development difficult, while the immediate prospects for increased exchange earnings, on which ultimately depends the ability to pay for borrowed capital, are not bright. The future export prospects for livestock are good but the prospects of increasing the supply quickly are not, since there are considerable problems of range management and herd sex structure to be overcome before higher annual take-off can be achieved, as well as the problems of quarantine control, which will be necessary as health and quality regulations in the traditional livestock markets become stiffer.

The banana industry, at the moment, is facing severe difficulties. Production, transport and ship loading costs are high and although freight rates around the Cape are now lower than immediately after the Suez Canal closure, they are an added difficulty to the critical competitive position of Somali bananas, which is at the moment, utterly dependent on the preference given in the Italian market. The preference has been renegotiated from year to year for the last two years and it is hoped it will be extended to the end of 1970. Latest reports are that the growers in the Juba River area are managing to repay debt commitments and maintain sufficient income to remain in production. But the Shebelli growers cannot meet debt obligations while considerable further investment infrastructure is required, if f. o. b. costs are to be reduced in order that the present high port charges at Merca can be absorbed.

The situation of large investment needs and inability to raise exchange earnings quickly in the short term requires very careful selection and effective co-ordination and implementation of all projects. It also requires careful consideration of the logistics of development, in order that the correct balance is maintained between non-direct revenue producing projects and those which not only can pay their way, but produce a surplus. The presentation of the Short Term Development

Programme has been a major accomplishment by the Planning Commission and all Government personnel involved. But it must be pointed out that the problems of the First Development Plan, shortage of local finance, deficiencies in the administrative machinery and lack of basic information still exist and this makes effective planning very difficult.

B. The Shebelli Valley

2.6 Location

The Shebelli River has its source in Ethiopia near the town of Yirgalem, some 250 km south of Addis Ababa. It flows at first in a direction north of east for some 325 km, then turns to flow south-east for about 650 km to the International Boundary with Somalia, 30 km north of Belet Uen. The course of the river is then south through Bulo Burti, Mahaddei Uen and Johar to Balad, where it turns south west and runs roughly parallel to the coast from which it is separated by a range of sand hills about 25 kms wide. After passing through Afgoi, Audegle and Coriole, the river flows into the first of three swamp basins, which extend to Avai. Below Avai, the river resumes a defined channel but flows are much reduced and it is only in seasons of exceptionally high flows, that water discharges into the Juba River at the confluence south of Cansuma and thence to the Indian Ocean at Kismayu.

2.7 Climate

The climate of the Shebelli Valley ranges from tropical semi-arid near the coast to tropical arid in the region of the Ethiopian border. Annual rainfall averages about 500 mm in the Johar, Balad, Afgoi, Genale area and decreases northwards to about 200 mm at Belet Uen. This rainfall is very variable in amount from year to year and is mostly distributed in two distinct seasons associated with the passing of the inter-tropical front. In the vicinity of Balad, Afgoi and

Genale, these wet seasons occur in April to June, and October to December, locally called the 'Gu' and 'Der' seasons respectively. In addition, coastal showers locally called 'Hagai' rains occur during July and August, amounts being greatest near the coast, so that Genale receives about three times and Afgoi about twice as much rain as Balad in these months. North of Johar, the rainy seasons are of shorter duration and rainfall in the 'Hagai' season is negligible. At Belet Uen, the 'Gu' rains occur in April-May and the 'Der' rains in October-November only. The seasonal rainfalls for selected stations are shown in Table 2.3.

TABLE 2.3 Rainfall at Selected Stations in mms

Station	Years of Records	Mean Rainfall			Wettest Year	Driest Year
		'Gu' Season	'Der' Season	Annual		
Belet Uen	34	108	85	227	446	44
Bulo Burti	25	144	161	349	711	96
Mahaddei Uen	10	163	192	459	1171	226
Johar	40	206	209	497	1089	236
Balad	25	209	220	507	959	276
Afgoi	26	237	173	503	975	192
Genale	20	230	112	472	1045	149
Gelib (Alessandra)	20	304	183	586	944	415

The fact that rainfall is distributed in two seasons, the relatively small amounts of rain in these seasons and the great variability in rainfall from year to year place a severe limitation on crop production under rainland conditions of farming. An analysis of rainfall expectation for each of the two cropping seasons was made for selected stations. Probability graphs were produced showing the accumulated rainfalls during the seasons in relation to their frequency of occurrence. They indicated that stations having a mean annual rainfall of some 500 mm are

likely to suffer a partial or complete failure of one raingrown crop, due solely to inadequate rainfall, as frequently as two years out of every five. Under such conditions, attempts to increase raingrown crop yields by means of expensive inputs for mechanisation, fertiliser applications and pest and disease control are unlikely to prove economically attractive.

Temperatures in the Shebelli Valley remain relatively uniform. The hottest periods are February-April and October-November. Mean monthly maximum and minimum temperatures for selected stations are shown in Table 2.4.

TABLE 2.4 Mean Monthly Maximum and Minimum Temperature for Selected Stations in ^{o}C.

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Belet Uen												
Maximum	34.5	35.4	36.7	36.9	34.9	34.0	33.0	33.8	35.3	34.4	34.8	34.5
Minimum	22.0	22.0	23.4	23.9	23.4	22.8	22.6	21.6	22.7	22.6	22.3	22.3
Afgoi												
Maximum	33.7	33.4	34.8	34.1	31.7	30.5	28.4	30.1	31.1	32.0	31.9	32.5
Minimum	21.7	21.9	23.0	23.6	23.2	22.7	21.5	21.5	21.8	22.1	21.9	21.7
Gelib (Alessandra)												
Maximum	35.1	35.6	36.0	35.5	33.4	32.1	30.5	31.3	32.4	33.1	33.8	34.5
Minimum	22.2	21.8	22.4	23.1	23.0	21.4	20.6	20.3	20.4	21.5	22.1	21.9

Relative Humidity is highest near the coast and decreases further inland. Highest humidity occurs at the end of the 'Gu' rains and during the 'Hagai' season. Monthly mean humidity for selected stations is shown in Table 2.5.

TABLE 2.5 Monthly Mean Relative Humidity Per Cent for Selected Stations

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Belet Uen	58	57	57	60	64	61	65	64	59	64	63	62
Afgoi	65	64	66	69	73	75	74	72	69	68	68	68
Gelib	68	67	66	72	78	78	77	75	72	73	76	74

The North-East Monsoon which blows from January to March and the South-West Monsoon from July to September have an ameliorating effect on the climate at these seasons. Previous records of wind speed are appreciably lower than those recorded at Afgoi during the period 1968-69 which are shown in Table 2.6. The mean wind velocity during both monsoon seasons appears to be about 3.5 m/sec. or 300 km/day at 2 m above ground level.

TABLE 2.6 Monthly Mean Wind Velocity at 2 m Recorded at Afgoi during 1968/69

	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Km/day	269	347	306	196	205	143	324	305	312	248	144	204
m/sec	3.1	4.0	3.5	2.3	2.4	1.7	3.7	3.5	3.6	2.9	1.7	2.4

Reliable records of Solar radiation were not available for the Shebelli Valley. Sunshine hours and Solar radiation using a Gunn Bellanni Distillometer were recorded at Afgoi during the period 1968-69 and these results are shown in Table 2.7.

The total sunshine recorded in the year was 2567 hours and the mean daily radiation was 516 langleys. These may be compared with values of 3082 hours and 577 langleys previously recorded for Mogadiscio.

TABLE 2.7 Mean Values of Solar Radiation at Afgoi during 1968-69

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Mean daily sunshine hours	8.2	9.1	8.1	5.2	6.4	6.9	5.9	8.0	8.9	6.8	4.5	6.5
Mean daily radiation (Langleys)	580	611	575	470	484	511	481	533	575	522	409	425

Reliable records of seasonal evaporation losses were not available. The meteorological station at the Afgoi Research Station was resited in February 1968 and the necessary instruments installed to permit the computation of theoretical open water evaporation using Penman's method. Later an evaporation pan was installed so that observations of pan evaporation corrected for advected energy could be compared with computed evaporation values. The results are shown in Table 2.8.

TABLE 2.8 Mean Daily Evaporation in mm for Afgoi 1968-69

	1968										1969	
	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb
E_o (Penman)	7.8	5.8	5.7	6.0	5.4	5.7	6.8	6.6	4.6	5.2	6.1	7.6
Pan Evaporation	-	-	-	-	-	6.0	6.8	6.7	4.4	-	5.7	-

The total computed evaporation over the year was 2223 mm, which compares well with the value of 2263 mm quoted previously for Johar.

The agreement with the Pan measurements was very satisfactory. Kohler suggests a factor of 0.7 be applied to computed Pan evaporation to obtain an estimate of losses from large bodies of open water. Applied to the above figures, this would give an estimated annual loss of some 1,550 mm from a lake or reservoir with daily losses varying from 3 to 6 mm.

2.8 Topography

The Shebelli River rises in the Harar Plateau at an altitude of 2680 m from which it descends to the Audamboi Plain in Southern Ethiopia and crosses the International Boundary at an altitude of some 300 m. Southwards to Bulo Burti, the river flows in a closely confined channel with a narrow flood plain. The Valley sides are low. Outcrops of basement rock occur transverse to the Valley. Below Bulo Burti, the flood plain broadens becoming flat and featureless and is dissected by old river channel remnants. The plain is bounded on the south by the coastal range of sand hills and extends south-westwards to the confluence with the Juba River.

2.9 Soils

The soils of the Shebelli Valley were surveyed at reconnaissance level by the Agricultural and Water Survey. Some additional reconnaissance survey work has since been executed and a detailed study has been made of two possible development areas near Balad and Afgoi respectively. Without further investigation only approximate correlations can be made between the soil classification of this report and that of the Agricultural and Water Survey.

Above Bulo Burti, some 73 per cent of the area consists of rugged hilly tracts and shallow saline soils unsuitable for cultivation. Of the remainder of the area, some 59,000 ha. is considered suitable for cultivation. These suitable soils are located close to the river in the narrow flood plain. They are mainly fine textured and contain gypsum in the lower horizons, which detracts from their suitability for irrigated agriculture.

Below Bulo Burti and Mahaddei Uen, the soils adjacent to the river were originally classified predominantly as Solonetz and reddish brown Calcic soils and are probably mainly Aridisols in our classification. All have a salt hazard and in some cases gypsum occurs in the subsoil. East of Mahaddei Uen, a large area of reddish brown Aridisols occurs with salt accumulation in the subsoil and a thick concretionary layer at 1 m depth. These soils are extensively used for rainland cultivation. These soils, in general, appear poorly suited to irrigation development, but the areas with more favourable topography might be further

investigated as possible future sites for small flood irrigation schemes.

From Mahaddei Uen to Johar, the soils on both banks adjacent to the river consist of fine textured brown Vertisols, previously described as Grumosols. They have a good water holding capacity, are non-saline and are extensively used for rainfed crops, flood irrigation and controlled irrigation on the Johar Sugar Scheme. Further from the river on the right bank occur areas of Aridisols and Vertisols, previously Solonetz and Brown Grumosol, with a sodium hazard in the subsoil. Both these soil types are marginal for agriculture and unsuited to irrigation development.

Between Johar and Balad, the soils adjacent to the river are grey Vertisols with Entisols on the recent river alluvium. They are non-saline and suitable for irrigation although more difficult to manage than the brown Vertisol soils above Johar. Further from the river, on the right bank, an area of predominantly non-saline brown Vertisols occur. Although these soils have considerable agricultural potential, they are dissected by old river channel remnants and the resulting irregular topography would make irrigation difficult.

From Balad through Afgoi and Genale to Coriole, the river is bounded on both banks by a wide expanse of fine textured non-saline brown Vertisol soils, which extend beyond Coriole, south of the swamp basins. These soils are well suited to irrigation development and have been extensively developed for irrigation in the Afgoi and Genale areas. Further from the river, on the right bank, the soils are fine textured dark brown Vertisols, suitable for irrigation but generally the land is sufficiently high to be difficult to command.

The soils immediately adjacent to the swamp areas downstream of Coriole, consist of saline grey and brown Vertisols, generally unsuited to irrigation, although the areas bordering the swamps and part of the swamps themselves may be considered worth further survey in the future to ascertain their suitability for paddy rice cultivation. Between these soils and the coastal range of sand hills, an area of non-saline grey Vertisols occurs. This and the non-saline brown Vertisols around Avai, which are subject to flooding from the swamps could also be considered for future paddy rice cultivation.

Below Avai, a narrow strip of grey brown Vertisols occurs close to the river. All other soils in this area are unsuitable for cultivation.

The Agriculture and Water Survey Soils Report indicates an area of some 450,000 ha. of soils suitable for irrigation development in the Shebelli Valley between Bulo Burti and Avai.

2.10 People and Economy

The Shebelli River Valley above Mahaddei Uen is sparsely populated, except for the townships of Bulo Burti and Belet Uen. The people are predominantly of hamitic origin and are mainly nomads engaged in livestock farming and the seasonal cultivation of rainfed crops on sloping land, where the accumulation of surface run-off behind low bunds provides adequate soil moisture for plant growth. Between Mahaddei Uen and Coriole, the valley is more densely populated by tribes of both hamitic and negro origin. The former are predominantly nomadic herdsmen and the latter generally settled cultivators living in villages close to the river. Besides the cultivation of rainfed maize, sorghum and sesame, flood irrigation is practised generally in small basins on bends in the river, which are planted to a range of subsistence crops. Besides working on their own and neighbouring farms, some of the people find seasonal employment on the irrigated sugar and banana plantations and in the townships, giving rise to a complex income structure.

In the villages, the houses are generally of adobe construction, with a grass thatch. The average household consists of a man and his wife with between 2 and 4 children and sometimes other relatives. Health is generally poor, particularly in the more intensively irrigated areas, due to the prevalence of schiotosomiasis, ascaris and helminthes infestations and malaria.

Both rainland and flood irrigation farmers suffer as a result of wide variation in yields and prices resulting from the uncertain rainfall and variation in flood levels from year to year. Attempts to improve yields and stabilise prices through the creation of the Agricultural Development

Agency and the Grain Marketing and Storage Project have met with little success.

Besides banana production for export, the major industries contributing to the economy of the area are the sugar industry at Johar, which by 1970 plans to produce approximately 200 tons of sugar per day; the recently completed Balad Textile Factory with an ultimate capacity of 1,500 tons lint cotton per year; the Italso meat factory at Mogadiscio with an annual throughput of 30,000 head to produce corned beef and gelatine and the Mogadiscio milk factory with capacity to handle 20,000 litres of milk per day. Two oil seed processing plants have also been established in Mogadiscio and although it has proved difficult to get an exact estimate of capacity, this is thought to be of the order of 7,000 tons oil seeds per year, although present production is small and spasmodic. The Mogadiscio Cotton Ginnery equipped with ten saw gins produces some 200 tons lint cotton per year, which is well below capacity and a smaller ginnery at Afgoi is equipped with eight roller gins.

2.11 Present Agriculture

The rainfall of the Shebelli Valley above Bulo Burti is too sparse to support large scale rainfed cultivation. Agriculture in this area is limited to livestock grazing by nomadic herdsmen and small areas of rainfed cultivation in which grain crops predominate. Frequently such crops are grown in bunded areas which trap sufficient surface run-off to ensure a crop in most seasons. A flood irrigation scheme exists at Belet Uen but was not cropped during the 1968 season.

Downstream of Bulo Burti the broad flood plain is extensively cultivated for rainfed crops. Flood irrigation is practised near the river and at Johar, Afgoi and in the Genale area controlled irrigation both by gravity and by pumping is used for the production of mainly perennial crops of which sugar and bananas are the most important.

Rainfed cultivation is generally operated as a family farm using hired labour only at peak seasons. Traditional cultivation is with a short handled hoe although hired tractors are being increasingly used for primary tillage operations. The presence of tsetse fly in the vicinity of the river precludes ox cultivation. Before planting ridges are made to divide the field into rectangular areas of 4-10 sq. m as a rainfall conservation measure. Maize is the major 'Gu' season crop and is commonly interplanted with green gram, cowpea, sesame, tomatoes or squash. Cotton is also occasionally interplanted in the maize crop. Sorghum and occasionally groundnuts are planted at this season. In the Afgoi and Genale areas rainfall during late June and July is in some years sufficient for a crop of sesame to be planted in the maturing maize crop at this time and harvested in mid-October. During the 'Der' season sorghum is the major crop and is again frequently interplanted. No recognisable crop rotation is practised and shifting cultivation is common although movement from area to area is not regular.

Local varieties of maize and sorghum are grown. Yields are thought to be of the order of 400-500 kg per ha. for maize and 300-400 kg per ha. for sorghum. An improved local maize variety and higher yielding imported sorghum are as yet not available for widespread distribution to farmers. Sesame is the next most important crop and yields of 250-350 kg per ha. are achieved although losses from shattering can be high if harvesting is delayed by shortage of labour. Only very small areas of cotton are grown at present but efforts are being made to expand cultivation of this and imported seed of Acala 4-42 and Carolina Queen is being distributed. Yields are extremely low due to failure to control insect pests and lack of proper control of cotton uprooting to reduce the incidence of pests and disease. Average annual yields are probably between 300 and 400 kg seed cotton per ha.

Cultivation practices and crops in the flood irrigated areas are similar to those for rainfed farming. Yields are not appreciably higher but the reliable 'Der' season river flows assure production of crops at this time. Little flooding is practised in the 'Gu' season as river flows at this time are unreliable and rainfed crops are generally grown. In recent years production has been much reduced or has ceased altogether on some flood irrigation schemes. This has been brought about by low returns obtained by the farmers as a result of poor husbandry practices, the lack of adequate extension services and the failure of the scheme owners to ensure the proper maintenance and operation of the irrigation system and to provide proper organisation and management of the enterprises.

Gravity fed controlled irrigation has been made possible by the installation of barrages on the river at Johar and in the Genale area. Elsewhere, and particularly in the Afgoi area, pumps are used to supply water for controlled irrigation. Bananas are the most important crop grown under controlled irrigation, production being concentrated in the Afgoi and Genale areas. To provide irrigation during the months of January-April when river flows are usually low and frequently cease for up to 100 days, surface storage reservoirs and wells have been constructed. The variety Poyo is now almost exclusively grown. The land is ploughed before planting to a depth of 50 cm and a basin irrigation layout prepared, each basin being generally 25 m square. Planting which usually takes place in the 'Der' rains is in holes prepared by hand usually spaced 2 m apart on the square, both sets and suckers being used as planting material. Weed control is maintained during the early stages of growth by discing and hand weeding, little use being made as yet of herbicides. The standard of husbandry, particularly of weeding and pruning varies considerably from holding to holding. Fertilisers are being increasingly used, applications of 10:5:20 N.P.K. at 800 to 900 kg per ha. over a 3 year cycle being given although there is little evidence to support the use of compound fertilisers in preference to straight N applications. A fertiliser trial at Afgoi indicated a good response to heavy nitrogen applications of 100 gms urea per stool every 2 months ($1\frac{1}{2}$ tons per ha. per year). Irrigation is given at 15-20 day

intervals when required. Although no accurate estimates of water use have been made applications appear to be of the order of 10-15 cm. It is likely that overwatering frequently occurs during seasons of abundant river flows and conversely underwatering occurs during drought periods. Overwatering, particularly on heavier soils coupled with inadequate drainage and occasional use of saline water at the commencement of the flood season is responsible for a build up of the water table in the Genale area and increasing soil salinity which has resulted in the abandonment of considerable areas of land. Aerial spraying for control of Sigatoka disease is practised. There are no major pests although Cosmopolites sordidus and Radolphoulus similis are becoming more prevalent.

Harvesting commences some 9-12 months after planting and continues for 3-4 years. Average yields are estimated to be 23 tons per ha. per year although yields of 30 tons are achieved by more efficient growers. After a period of cultivation the land is fallowed for at least 2 years. The need for this fallow period has been attributed to reduced soil fertility and to build up of the eelworm population. Increased use of fertilisers, particularly nitrogen and the use of chemicals for eelworm control could reduce the need for fallowing.

The other major perennial crop is sugar cane, cultivated exclusively on the Johar estate. The cultivated area has been recently expanded and it is estimated that 6,000 ha. will be planted at the end of 1969. Most of the area is planted to the variety NCO 310. Land preparation is by Rome ploughing and discing followed by ridging, the ridges being 1.7 m apart. Sets are heat treated and dipped in Aratan before planting by hand in the furrows. Phaseolus mungo is planted as a cover crop. Planting takes place in May-June and September. Inter-row cultivation and hand weeding are practised when the cover crop fails to control weed growth. Little use is made of herbicides. Urea is applied at 400 kg per ha. for each crop. Irrigation is applied down the furrows at 600-1200 m^3 per ha. depending on the age of the cane. The irrigation interval varies from 14 to 35 days depending on soil water holding capacity. No serious pests or diseases occur. Average yield of

cane is 75 tons per ha. with an approximate 12 month season crop yields are as high as 120 tons/ha. on the best areas.

In recent years some 800 ha. of land have been abandoned due to soil salinity. A high water table to within 50 cm of the surface has been largely responsible due to lack of adequate drainage coupled with poor irrigation practice and failure to prevent excessive seepage losses from canals. The installation of drainage pumps and an improved system of drains is now in progress.

Citrus and particularly grapefruit are grown on a small scale. They are generally furrow irrigated at 25 day intervals in dry weather, and applications of 1200-1500 m^3 per ha. of irrigation water are usually made. Yields of 100-150 kg grapefruit per tree are obtained at maturity, about 12 years after planting. Fertilisers are not used, pruning is usually neglected and little is done to control pests and diseases.

Pawpaw, coconuts, guava and avocado pear are also grown, all except pawpaw on a very small scale.

Controlled irrigation has declined in recent years due to poor management of many holdings and failure to maintain irrigation canals, pumps and structures. Extensive areas have been abandoned or, in more recent schemes, remain undeveloped.

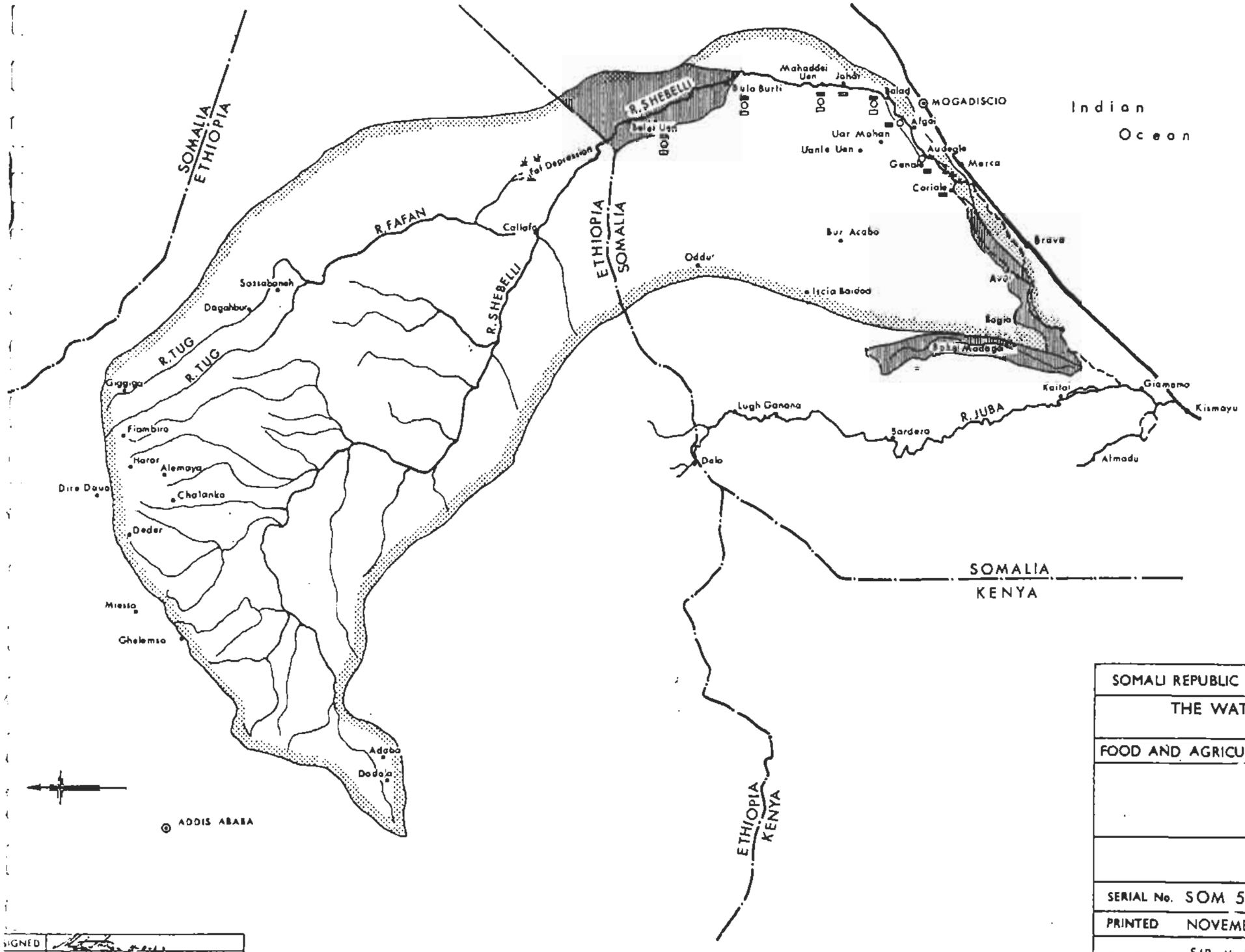
Rehabilitation of existing and abandoned areas would seem to warrant a high priority in the Somali Government's plans to increase agricultural production. Such rehabilitation must however be based on satisfactory land tenure legislation and be accompanied by strong measures to establish control and discipline in the use of irrigation water, and an intensive agricultural extension programme to teach the farmers the essential husbandry techniques to achieve economic returns from investment in controlled irrigation.

2.12 Surface Water Resources

(a) Description of River

Figure 2.1 shows the catchment areas of the Shebelli River and its geographical location. The river rises in the high plateau of eastern Ethiopia and has a total drainage area of about 300,000 square

FIGURE 2-1



LEGEND

STAFF GAUGE

STAFF GAUGE AND WATER LEVEL RECORDER

DISCHARGE MEASUREMENTS

EFFECTIVE CATCHMENT AREA IN SOMALIA

SEDIMENT SAMPLINGS AND WATER ANALYSES

WATERSHED BOUNDARY

INTERNATIONAL BOUNDARY

SCALE

Kms 50 0 50 100 150 Kms

SIGNED	
CED	30.10.69
VED	30. 10. 69

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

RIVER SHEBELLI

CATCHMENT AREA

SCALE
AS SHOWN

SERIAL No. SOM 5	HUNTING TECHNICAL SERVICES LIMITED *LAND USE & AGRICULTURAL CONSULTANTS* 6, ELSTREE WAY, BOREHAM WOOD, HERTS., ENGLAND. in Association with SIR M. MACDONALD & PARTNERS *CONSULTING ENGINEERS* HANOVER HOUSE, 73 HIGH HOLBORN, LONDON W.C.I.
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kilometres, two-thirds of which are within Ethiopia. The total length of the river is over 1800 kilometres with approximately 1100 kilometres within the Republic of Somalia. A profile of the river below Belet Uen is given on Figure 2.2.

b) Hydrology

Using the incomplete gauge records for Belet Uen taken between 1951 and 1963 and the stage discharge relationship for this station, synthetic hydrographs were produced by the Agriculture and Water Surveys project for the downstream stations of Bulo Burti, Mahaddei Uen, Balad, Afgoi and Audegle. The present project carried out a current metering programme and the original stage discharge curves have been checked and revised where necessary. At most sites a reasonable correlation was obtained. A major revision was required for the stage discharge curve for Belet Uen which considerably underestimated the flow in the medium to high discharge range.

The original hydrographs have been revised for the six gauging stations and extended to the end of 1968. These hydrographs are recorded for the years 1951 to 1959 on Figure 2.3 and for 1960-1968 on Figure 2.4.

The flow ranges at Belet Uen from less than 10 cubic metres per second to the 380 cubic metres per second recorded in December 1961. In general the high flows in the 'Gu' flood which occurs from April to May are of short duration whilst in the 'Der' flood, during August to December, the high flows are usually sustained. The low flow period with the flow less than 10 cumecs is usually of about two months duration but can extend up to five months or in a good year last less than two weeks. The inflow to the river from the catchment in Somalia all occurs between Belet Uen and Bulo Burti and accounted for approximately ten per cent of the total annual flow in 1968.

The natural topography of the riverain areas from Belet Uen to Mahaddei Uen results in flood flow self regulation being achieved.

High flows are lost throughout overbank spillage and in the small primitive inundation canal systems. The artificial river control upstream of the weir of the Johar Sugar Estate (S. N. A. I.) causes high flood stage levels and this is not complemented by adequate flood bank maintenance so that spillage also occurs in the reach below Mahaddei Uen. Further spillage again takes place between Johar and Balad. In 1968, the largest recorded annual flow since records were first taken in 1951, 70 per cent of the spillage took place between Gialalassi and Balad and a further 23 per cent in the Audegle-Genale reach of the river. The areas flooded in 1968 and a water balance for that year are shown on Figure 2. 5 and Figure 2. 6.

c) Present Water Use

No storage facilities now exist along the river so that water supplies for irrigation purposes are both intermittent and unpredictable. The present water use along the river is described briefly below:-

i) Ethiopian border - Belet Uen

Small inundation schemes only.

ii) Belet Uen - Bulo Burti

A flood scheme of about 2000 hectares is located at Belet Uen which can take up to 15 cumecs at peak floods. Small flood schemes are sited along the rest of this reach.

iii) Bulo Burti - Gialalassi

Very little inundation farming practised.

iv) Gialalassi - Mahaddei Uen

Considerable inundation farming on areas of overbank spillage and some flood schemes. One pump scheme operative on 100 hectares.

FIGURE 2·5

WATER BALANCE FOR 1968 IN HECTARE METRES

ITEM	GENALE TO FALCHEIRO	AUDEGLE TO GENALE	AFGOI TO AUDEGLE	BALAD TO AFGOI	MAHADDEI UEN TO BALAD	BULO BURTI TO MAHADDEI UEN	BELET UEN TO BULO BURTI
A	157,500	199,200	208,300	224,500	274,500	333,300	320,300
B	−200	−300	−1,100	−800	−3,700	−2,600	−2,200
C	−2,300	−2,700	−2,400	−12,500	−9,400	−12,900	−12,500
D	−3,500	−16,000	−2,900	−2,400	−11,600	−500	Neg
E	−	−22,700	−2,700	−500	−25,300	−42,800	−3,000
F	−	−	−	−	−	−	+27,000
G	−	−	−	−	−	−	+3,700
H	−6,000	−41,700	−9,100	−16,200	−50,000	−58,800	+13,000
J	151,500	157,500	199,200	208,300	224,500	274,500	333,300

ITEM LEGEND

A... FLOW ENTERING REACH.

B... ESTIMATED RIVER CHANNEL EVAPORATION AND EVAPO-TRANSPIRATION LOSSES DURING THE YEAR.

C... ESTIMATED RIVER CHANNEL INFILTRATION LOSSES.

D... ESTIMATED CONTROLLED IRRIGATION USE OF RIVER WATER.

E... ESTIMATED OVER BANK SPILLAGE AND INUNDATION FARMING USE OF RIVER WATER.

F... ESTIMATED INFLOW ACCRETIONS, LOCAL RAINFALL RUNOFF OR ACQUIFER EFFLUENT FLOW

G... INFLOW RESULTING FROM DRAINAGE OF UPSTREAM DIVERSION

H... TOTALS OF INFLOWS (+ve) AND LOSSES (−ve).

J... FLOW LEAVING REACH.

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

SHEBELLI RIVER BELET UEN TO FALCHEIRO AREAS FLOODED AND WATER BALANCE 1968

SCALE AS SHOWN

SERIAL No. SOM 7

PRINTED NOVEMBER 1969

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HERTS., ENGLAND.
in Association with
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CONSULTING ENGINEERS
HANOVER HOUSE, 73 HIGH HOLBORN,
LONDON W.C.I.

FIGURE 2.4

DESIGNED
CHECKED
APPROVED 30.10.69

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THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

RIVER SHEBELLI

HYDROGRAPH 1960 - 1968.

SCALE AS SHOWN

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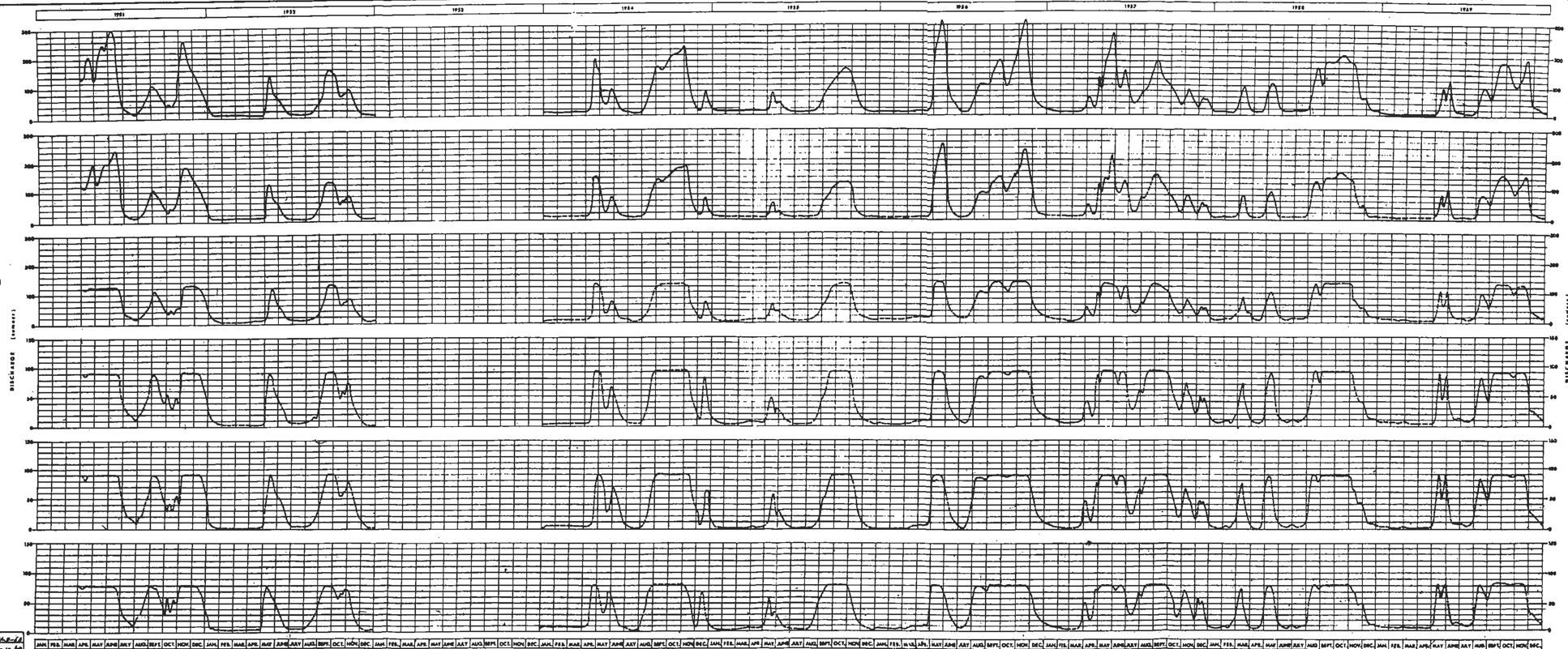
FIG 23



BASED ON W.L. RECORDS ———

SYNTHETIC NO W.L. RECORDS – – – –

DESIGNED	
CHECKED	
APPROVED	

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THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

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RIVER SHEBELLI

HYDROGRAPH 1951 – 1959

SCALE AS SHOWN

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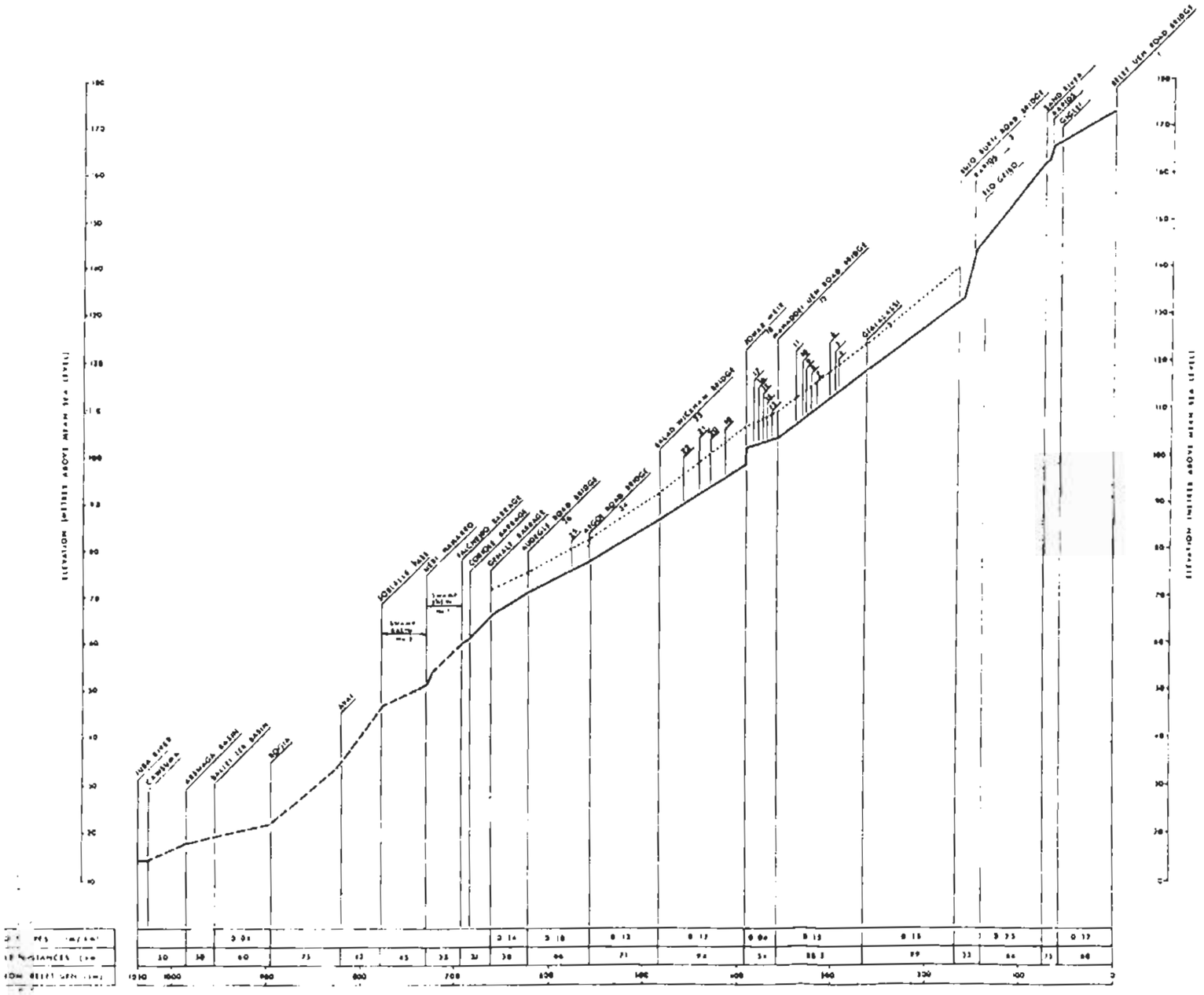
FIGURE 2·2



LEGEND

- WATER SURFACE 1968 HIGH FLOOD LEVEL
- RIVER BED PROFILE
- BED LEVELS IN SWAMP AREAS DOWNSTREAM OF FALCHERO BARRAGE BASED ON O.I. COMPANY TRACE LEVELS APPROXIMATE ONLY
- 1 – 26 RIVER CROSS SECTIONS LOCATIONS

NOTES

1. THE DISTANCES SHOWN ARE MEASURED ALONG THE CENTRE LINE OF THE RIVER CHANNEL
2. MEAN SEA LEVEL AT MOGADISHU SURVEY AND MAPPING DEPARTMENT DATUM
3. FOR BANK AND RIVER BED LEVELS BETWEEN GALALASSI AND BALAD SEE PLATE 17

HORIZ SCALE

– 25 0 25 50 75 100 km

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

SHEBELLI RIVER PROFILE

SCALE
AS SHOWN

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FIGURE 2-6

WATER BALANCE FOR 1968 IN HECTARE METRES

ITEM	AVAI TO BALLEI IER	FALCHEIRO TO AVAI
A	19,800	151,500
B	−17,000	−107,000
C	−3,000	−34,200
D	Negligible	Negligible
E	Negligible	Negligible
F	+2,600	+9,500
G	Negligible	Negligible
H	−17,400	−131,700
J	Nil	19,800

ITEM LEGEND

A... FLOW ENTERING REACH.

B... ESTIMATED RIVER CHANNEL EVAPORATION AND EVAPO-TRANSPIRATION LOSSES DURING THE YEAR.

C... ESTIMATED RIVER CHANNEL INFILTRATION LOSSES

D... ESTIMATED CONTROLLED IRRIGATION USE OF RIVER WATER.

E... ESTIMATED OVER BANK SPILLAGE AND INUNDATION FARMING USE OF RIVER WATER.

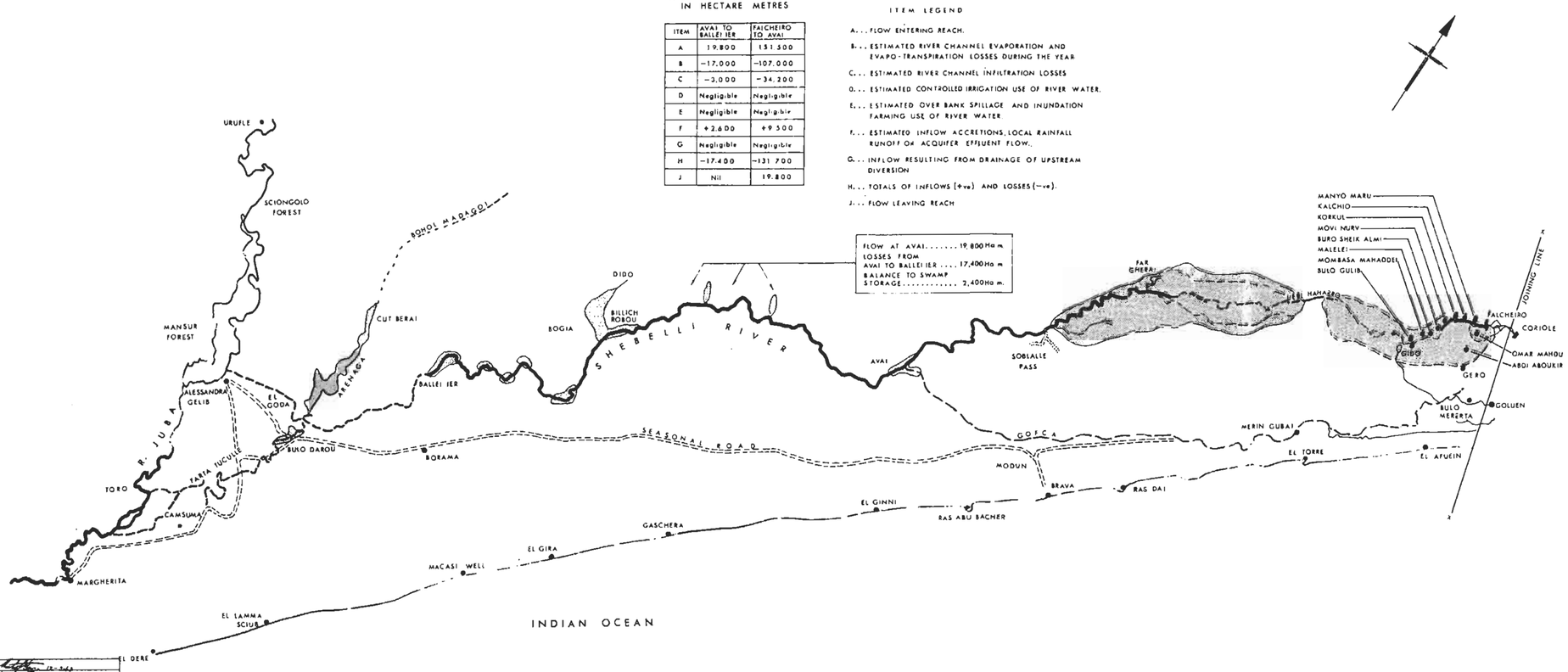
F... ESTIMATED INFLOW ACCRETIONS, LOCAL RAINFALL RUNOFF OR ACQUIFER EFFLUENT FLOW.

G... INFLOW RESULTING FROM DRAINAGE OF UPSTREAM DIVERSION

H... TOTALS OF INFLOWS (+ve) AND LOSSES (−ve).

J... FLOW LEAVING REACH

FLOW AT AVAI..... 19,800 Ha m.
LOSSES FROM AVAI TO BALLEI IER .... 17,400 Ha m.
BALANCE TO SWAMP STORAGE..... 2,400 Ha m.



DESIGNED	
CHECKED	
APPROVED	

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

SHEBELLI RIVER DOWNSTREAM FALCHEIRO AREAS FLOODED AND WATER BALANCE 1968

SCALE AS SHOWN

SERIAL No. SOM 6	HUNTING TECHNICAL SERVICES LIMITED *LAND USE & AGRICULTURAL CONSULTANTS* 6, ELSTREE WAY, BOREHAM WOOD, HERTS., ENGLAND. in Association with SIR M. MACDONALD & PARTNERS *CONSULTING ENGINEERS* HANOVER HOUSE, 73 HIGH HOLBORN, LONDON W.C.1.
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v) Mahaddei Uen - Johar

Inundation schemes on both banks of the river prove a constant source of flood damage due to poor bank maintenance.

An experimental farm irrigated by gravity or pumps built by the Chinese Government is located about 5 kilometres upstream of the Johar weir.

Johar Sugar Estate has under cultivation 6300 hectares of cane and some 50 hectares of grapefruit.

vi) Johar - Balad

Inundation schemes exist on both banks and near Balad there is a large co-operative of nearly 1000 hectares.

vii) Balad - Afgoi

Except for just downstream of Balad irrigation can only take place by pump in this reach. Some fifty-nine pumps are sited in this seventy one kilometres of river but few operate and then, at much less than full capacity.

viii) Afgoi-Audegle

Numerous small inundation schemes exist and at Barire a major flood canal feeds a large area which is used mostly for rough grazing. A number of pumps are located in this reach but they are not all used.

ix) Audegle - Falcheiro

Major spillage occurs on the left bank between Audegle and Genale and in addition a number of pumps and inundation schemes are operative.

The total of controlled gravity irrigation between Audegle and Falcheiro consisted of around 5650 hectares of bananas and 1200 hectares of maize in 1968.

*) Falcheiro - Avai

Small areas around the edges of the swamp are utilised in the two swamp basins but access is difficult and high flows flood the crops before maturity.

2.13 Groundwater Resources

The first stage in the investigation of the project area consisted of a reconnaissance electrical resistivity survey. Electrical soundings were made at approximately 5 km intervals along most of the roads and tracks within the region. This work confirmed the extreme variability of the alluvial deposits which had been indicated already by the lack of lithologic correlation in boreholes less than 50 metres apart. It also showed that groundwater at distances greater than 20 km from the river was likely to have an electrical conductivity (E. C.) of more than 2500 micromhos per centimetre. Four lines of electrical soundings, at right angles to the river, were also made at locations between Afgoi and Balad in an attempt to determine the groundwater contours close to the river. The results of this work were inconclusive.

The drilling programme carried out by the project consisted of five observation wells and one test tubewell, drilled to a maximum depth of 150 metres below ground level. Lithologic records, compiled with the assistance of electric logs at each well site also showed the extreme variability of the alluvial strata which consisted of alternating layers of unconsolidated clay, sand and gravel, containing abundant calcareous material. The best depth interval for aquifers was found to be 50-125 metres with an average of 69 per cent of permeable strata. The aquifer grain size varies throughout the valley. Near Afgoi medium to fine sand predominates, while towards Uanle Uen poorly sorted coarse-grained sands and gravels are present. At Genale extensive gravel aquifers are understood to occur.

Except in the Genale irrigation area the depth to water table at distances of more than 2-3 km from the river, varies between 40 and 72 metres below ground level, the average depth being 58 metres with 85 per cent of the observations over 50 metres. Close to the river the water table generally rises to within a few metres of ground surface (see Plate 9, Volume IV). At Afgoi and Audegle there is evidence to suggest the existence of a perched water table. In the irrigated area at Genale depth to the water table varies between 2 and 40 metres with an average of 10 metres. The deeper levels occur near the boundary of the area.

The number of drilled wells within the project area is approximately 200, just over half being located in the irrigated banana plantations of the Genale area. The well locations are shown on Plate 10, Volume IV. Visits were made to 62 wells during the course of the project and, of these, approximately 60 per cent were in working order for at least part of the duration of the project. All the functioning wells were motor-powered. Fourteen tubewells powered by windmills were all out of order due to lack of servicing and maintenance. The average depth of wells in the Genale irrigated area is 75 metres, and in the remainder of the project area, 110 metres. The average discharge rate for eight 10-inch wells in the Genale area was 190 m^3 per hour, and for eleven 6-inch wells at sites distributed over the remainder of the project area was 8.2 m^3 per hour.

Groundwater quality deteriorates away from the river. None of the electric logs recorded any substantial increases in salinity with depth. Groundwater with an E. C. less than 2500 micromhos per centimetre which is considered suitable for irrigation of crops, occurs in a strip running parallel to the river (see Plate 10, Volume IV). Thirty-four chemical analyses of water samples were carried out and these showed no residual Sodium Carbonate and low Sodium Adsorption Ratios. Sulphate and Bicarbonate concentrations tended to be high, however, reflecting the predominance of hard water.

Values of transmissibility of about 100 and 225 cubic metres per day per metre for the Afgoi and Genale areas respectively, have been calculated using available data. Unfortunately, the data is insufficient to make a quantitative assessment of groundwater availability within the project area. The majority of the observation well hydrographs do not reflect seasonal fluctuations of river flow and precipitation although in some wells a general rise in water level may be due to the exceptionally high river flows of 1968 and early 1969. Downstream of Genale recharge is probably quite considerable, however, due to seepage from irrigation canals, the presence of large reservoirs up to 10 hectares in area, and the increasing area of swamp. It is possible that parts of the banana plantations may become waterlogged in the near future due to the rise in the water table.

The cost of groundwater exploitation is considered to be too high for irrigation purposes except for high-value crops such as bananas. Groundwater for domestic supplies can be extracted from within the area bounded by the E. C. 2500 contour, and for livestock supply within the E. C. 4000 contour (see Plate 10, Volume IV).

2.14 The Need for Development of Agriculture

During the Agriculture and Water Survey (1962-66) an estimate was made of the potential cultivable land and land currently cropped in the Shebelli Valley and adjacent regions. The result is shown in Table 2.9.

Within the country as a whole it is estimated that 8 million hectares of land are suitable for cropping and a further 12 million hectares are suitable for grazing. Of the land suitable for crops approximately 240 thousand hectares are suitable for irrigation. Agricultural and related activities presently provide income for at least 90 per cent of the population and virtually all foreign exchange income is dependant on the export of agricultural produce. A large part of foreign exchange expenditure is on agricultural commodities which in many instances it is technically possible to produce in the country.

TABLE 2.9 Estimated Areas of Land Suitable for Cultivation and Proportion Cultivated in 1963

Region	Total Area '000 ha.	Potentially Cultivable			Total	Proportion Cropped	
		Controlled Irrigation	Flood Irrigation	Rainfed		Total Cropped	Irrigated Crops
Upper Shebelli Valley and Adjacent Regions	4,298	-	1	188	189	22%	-
Shebelli Flood Plain and Adjacent Regions	4,421	35	89	393	517	30%	5%
Total	8,719	35	90	581	706	-	-

Although there are hopes of developing mineral resources to provide a substantial national income in the future this is still uncertain and it is likely that agriculture will remain a primary source of national income. There are advantages in locating agricultural development in the river valley where soils are generally more fertile, labour resources are more readily available and where the availability of water for irrigation provides a more assured return on investment.

Sustained agricultural development will require expenditure of considerable magnitude on research, extension, market organisation, the the import of physical inputs, irrigation facilities, infrastructure and all the related activities necessary for viable development. As there is little prospect of generating surplus domestic revenues for financing development at present most of this expenditure will have to be foreign financed. As a result agricultural activity will not only have to provide returns which will allow for an increase in the per capita income but also eventually pay for the investment necessary to bring about that increase. The relatively low returns likely to be generated by agricultural production in Somalia are

unlikely to prove adequate if investment is at normal rates of interest. Nevertheless there exists a great social need for development in Somalia and in view of lack of opportunity for development in other spheres of production the provision of development finance at soft loan interest rates would be justified.

In the present social and political climate of Somalia further expansion of estate development under expatriate management is likely to prove unpopular. Furthermore it is considered that in the long term the development of settlement schemes operated by tenants on small family farms would achieve better results by providing a secure livelihood for the greatest number of people, an incentive to increased production which would directly benefit the individual farmer and do much to reduce or halt the present drift of the younger people away from agriculture.

CHAPTER 3

AGRICULTURAL DEVELOPMENT POTENTIAL

3.1 Possible Locations for Development

Within the Shebelli Valley and those areas immediately adjacent, availability of water for domestic purposes, livestock watering and for irrigation crops to supplement the meagre rainfall is an important constraint on agricultural development. Away from the Shebelli River dry season supplies of water are only obtainable from surface storage tanks or 'Uars', or from wells. The depth to the water table, variability in aquifer characteristics and frequent poor quality of groundwater away from the river makes well water expensive, limited in quantity and only locally suitable for agricultural or domestic use. The existence of suitable locations within the Shebelli Valley for irrigated agriculture using river water offers the most promising avenue of agricultural development in the area.

In order to be potentially useful for irrigation development land should have a generally uniform and slight slope with limited undulations. The soil should have generally only slight to moderate land use limitations equivalent to U. S. B. R. classes 2 and 3 and should be permeable and well drained except in the case of flood irrigation where excessively free draining soils should be avoided. Finally the land should be easily commanded by irrigation canals served by either gravity or pumped water supplies from the river.

Following study of available air photographs an engineering and soils reconnaissance was made of the Shebelli Valley to identify possible areas for future development which fitted the above criteria. The areas examined are shown in Figure 3.1 together with the locations of possible storage reservoirs.

3.2 Potential Markets and Price Projections for Crops and Livestock

The seasonal nature of normal Shebelli River flows severely restrict the irrigation season either using flood or controlled irrigation techniques.

The production of high value perennial crops is thus impossible without the provision of storage facilities for river water or the use of expensive groundwater to extend the irrigation season. The limited availability and high cost of good quality groundwater is likely to result in its use being uneconomic except in particularly favoured localities for high value crops with a well assured future market.

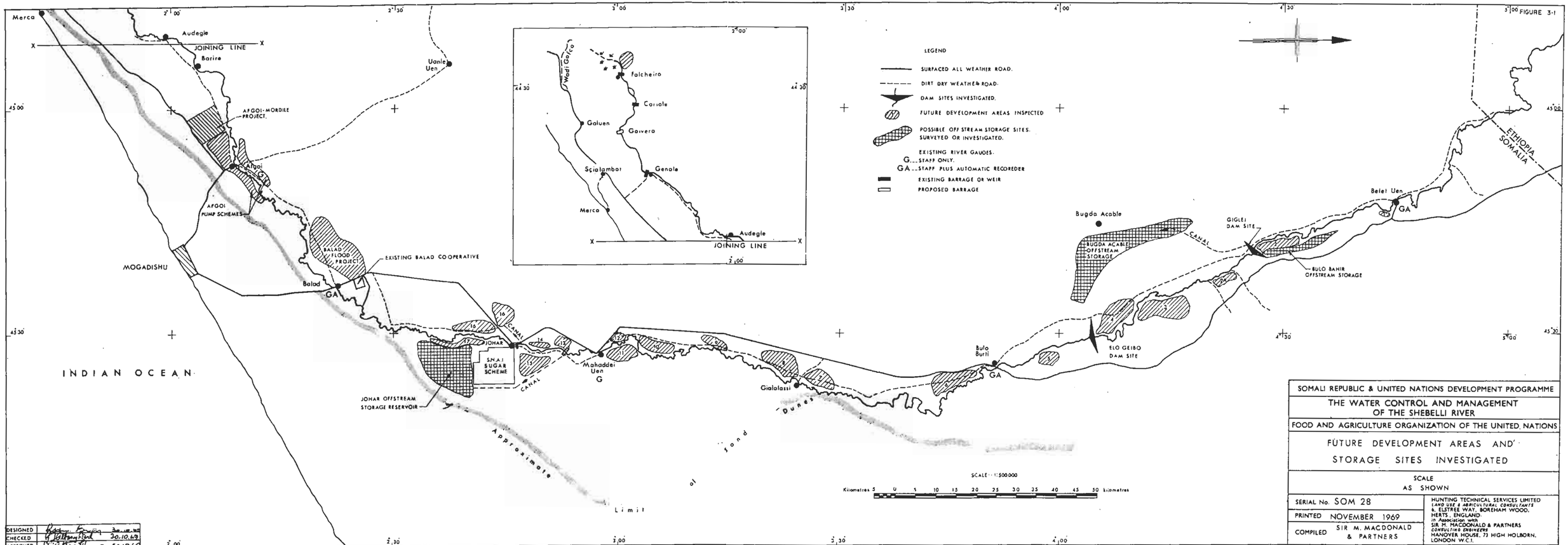
Of the perennial crops which might be cultivated using stored river water for irrigation during the season of normally low river flows, only bananas and sugar cane are extensively cultivated in Somalia at the present time. Transportation problems to European markets resulting from the closure of the Suez Canal and uncertainty over future prices in the existing market in Italy makes future market and price projections for bananas impossible at the present time and expansion of production cannot be recommended. The existing sugar industry at Johar is being expanded and will meet a large part of the domestic demand for sugar. The low and fluctuating value of sugar on the world market and high investment costs of sugar processing make the development of a new sugar plantation economically unattractive

The possibility of producing grapefruit for export has been proposed but there is insufficient information on the costs and returns to this crop under local conditions to justify the recommendation of extensive development at present. Research into local production techniques for this crop should however be continued.

In view of the limitations to the development of perennial crops the detailed examination of potential markets for produce has been limited to annual crops having a suitable growing season and to livestock.

Assessment of the potential export market is difficult because, apart from bananas and livestock and small quantities of cotton, there has been no sustained export of agricultural produce over the past ten years. There are prospects of exporting certain agricultural commodities

FIGURE 3-1



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CHECKED		30.10.69
APPROVED		30.10.69

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

FUTURE DEVELOPMENT AREAS AND STORAGE SITES INVESTIGATED

SCALE AS SHOWN

SERIAL No. SOM 28

PRINTED NOVEMBER 1969

COMPILED SIR M. MACDONALD & PARTNERS

HUNTING TECHNICAL SERVICES LIMITED
LAND USE & AGRICULTURAL CONSULTANTS
& ELSTREE WAY, BOREHAM WOOD, HERTS., ENGLAND.
in Association with
SIR M. MACDONALD & PARTNERS
CONSULTING ENGINEERS
MANOVER HOUSE, 73 HIGH HOLBORN, LONDON W.C.1.

primarily to Middle Eastern markets but there has as yet been no investigation into the potential volume required of such commodities and because of this, immediate possibilities for export have to be discounted. On the other hand, past import trends give a clear indication of potential future internal demand for crops, which can substitute for these imports.

The export of livestock has considerable future promise, providing certain problems can be overcome. This has been the fastest growing sector of exports during recent years, exports of live animals having risen from 448,000 in 1958 to 1,151,000 in 1966. Although few reliable figures of total livestock production are available, the Agriculture and Water Survey report estimates that some 60 per cent of production is consumed internally and the balance exported. Export demand for livestock is expected to remain buoyant, especially in Saudi Arabia, which currently takes approximately 60 per cent of Somalia's livestock exports. Present substantial but unrecorded exports to Kenya are expected to decrease with a corresponding increase in throughput at the Mogadiscio and Kismayu meat factories, the latter having hopes of developing a market for its products in Pakistan. Internal consumption of livestock is expected to rise by about 3 per cent annually. All livestock marketing in Somalia has, so far, been by private trading and the fact that exports have increased each year since 1958 indicates this to be a well run and successful business. This success has been achieved despite the great distances over which animals have to be moved, inadequate port and shipping facilities and prices per head, which are not unduly high. The present policy of the Livestock Development Agency (L. D. A.) is limited to introducing buying by weight and auction buying and to establishing minimum prices in areas, particularly in the south, where present prices to the farmer are unattractive. Should Somalia in the future be able to meet the health and quarantine requirements for exports to markets for higher quality meat, the L. D. A. may have to play a more active role in providing the facilities required to sell meat on these markets.

Statistical records of internal crop marketing operations in Somalia are sparse and it is, therefore, difficult to assess the capability of the private trading structure to handle substantial volumes of produce efficiently enough to allow a reasonable handling profit, an attractive price to the farmer and a competitive price to the consumer. The Government has tried to establish regularised marketing outlets for the major grain crops through the establishment of the UNDP/FAO assisted National Grain Marketing, Storage and Price Stabilisation Project, and for cotton through the activities of the Agricultural Development Agency. Marketing of sesame, the other major crop, at present is left entirely to the private trader.

The grain marketing project was established with the aim of providing a stable market for the farmer and a reasonable price to the consumer. It has been found that low farm gate prices for grain relative to high wholesale prices at certain times were due to fluctuations in grain supply, poor access to grain growing areas and scarcity of transport facilities rather than to monopolistic and inefficient trading. Moreover, the prices paid to farmers for sorghum grain and maize are at times, above the c. i. f. price for these commodities in European ports. The operations of the Grain Marketing Project have been temporarily suspended, while a new strategy to improve the marketing structure is developed. The indications are that the project organisation will remain as an advisory and research body to assist and regulate the private trading sector and only itself undertake trading operations where it is proved that the private trade cannot dispose of produce efficiently.

Seed cotton is presently bought and ginned by private merchants, and the Agricultural Development Agency, which is intended to be the sole supplier for the Balad Textile Mill, purchases lint cotton from these merchants. The price of lint delivered to the Balad Mill has during 1969 been equivalent to the average projected c. i. f. price in European ports for top quality cotton. This high price has been due largely to high collecting, transport and ginning charges. The Agency has agreed to waive

its commission charges, but even allowing for this, it is unlikely that the newly established textile mill can pay more for its local supplies than the projected f. o. b. price. If a reasonably attractive price to the farmer is to be maintained, ginning and marketing costs must be considerably reduced.

It will be necessary to resolve these uncertainties in the future marketing situation, in order to ensure satisfactory disposal of produce for internal markets from new development projects.

Apart from bananas and small exports of cotton and citrus, external marketing of crops has not been developed. Part of the function of the National Agency for Foreign Trade (E. N. C. E.) is to undertake export promotion of agricultural produce. So far, E. N. C. E. has only dealt with imports, more particularly dealing with the import and administration of commodity aid items. The organisation is keenly interested to develop exports, but although enquiries regarding importation of Somali produce have been received mainly from Middle Eastern markets, the lack of a sound production base for the commodities has prevented viable export production. Although the short term possibilities for export of produce are remote, irrigation schemes if implemented might provide the sound base on which future export markets might be developed.

The calculation of producer price projections is hypothetical, since such calculations depend on assumptions about future world and local markets, national infrastructure and processing efficiencies. They give an indication of the average price, the farmer may expect for his produce in the future. Projecting prices is a hazardous procedure as although a certain pattern can be discerned from past trends, changes in taste, technology (especially in tropical agriculture), international trading policies, the system of internal settlement, sea freight rates and other extraneous factors to the market such as political upheaval can radically alter such a pattern in the future.

The off farm costs of transport, processing, handling and port charges have been based on the rates quoted by various sources and adjusted, where applicable in the light of experience elsewhere. All tend to be high, because of the limited development of the country's infrastructural resources. In the long run, improvements in these facilities, especially of the Mogadiscio port, will tend to reduce these costs and therefore from the point of view of export price calculation, a higher price could be assumed to the farmer. But high freight rates, port handling and transport charges also insulate the domestic producer to a certain extent from internal competition. This allows the price to him for domestic processing of, for example, oilseeds, to be higher than it would be under full competitive conditions on the assumption that newly established domestic processing will not be as efficient as larger established facilities elsewhere. This means that farm price policy, whether freely competitive or controlled is a matter for continual review and adjustment in the light of changing actual conditions in the marketing complex.

The following are assessments of the potential for expansion of production of individual agricultural crops considered for such schemes and the prices the producer is likely to receive.

a) Grain Crops

Although the future market for rice appears promising with a considerable and increasing domestic consumption presently met almost entirely by imports, the high water requirements of paddy rice make this an unsuitable crop where water availability is a limiting factor. Upland rice however could be grown to substitute for current imports.

Rice at present constitutes the largest single import into Somalia, on average just under 8 per cent of the total annual value of imports over the years 1962-1966. Annual quantities for this period are shown in Table 3.1.

TABLE 3.1 Rice Imports 1962-66

Year	Quantity metric tons	Value Shs. '000	% of Total Imports by Value
1962	16,774	18,984	7.0
1963	22,804	21,749	6.8
1964	36,618	38,535	9.9
1965	28,795	29,793	8.4
1966	22,078	22,498	7.5

Source: Somalia Statistical Abstracts.

F.A.O. projections of rice consumption in Somalia range from approximately 29,000 tons on a low G.D.P. assumption to 40,000 tons on a high G.D.P. assumption by 1985. Under controlled irrigation yields of the order of 2.5 tons per ha. would not appear unrealistic and at this level rice gives one of the highest gross returns of all annual crops considered.

The c.i.f. London price for Siam Patna No. 2 rice averaged 160 dollars per metric ton from 1955 to 1965. Since then the price has been around 180 dollars per ton. The F.A.O. export price for rice rose from an average figures of 104 for 1963-65 to 153 in April 1968. This rise has largely been occasioned by poor crops in 1965 and 1966, and although there was a substantial improvement in 1967, prices have remained high, especially for long/medium grain varieties, because the demand for current consumption and stockbuilding has been high. The price of rice from Thailand, Somalia's largest supplier in 1966, dropped after February 1969. The current c.i.f. price from that source is $156 per metric ton. In general the indications are that import prices for rice are unlikely to drop significantly below their existing levels but it is impossible to state with any certainty that they will rise.

At present c.i.f. prices, the landed price of rice is approximately Shs. 1.20 per kilo. Both cheaper and more expensive rice is imported, the latter mainly under commodity aid agreements and the wholesale price ranges from approximately Shs. 1.70 to Shs. 2.20 per kilo. Rice has only been cultivated on a small scale in Somalia in the past and there are no records of the acceptability of local rice or of hulling costs and efficiencies.

The landed price at the lower end of the price range has been taken as the price with which a local mill will need to compete. Assuming an average outturn of 51 per cent whole rice and 19 per cent broken with an acceptance of 5 per cent broken at the wholesale level the price of unhulled rice per ton may be calculated as follows:

		Shs.
Income from sales		
560 kg @ 1.20 Sh. per kg		672
140 kg @ .60 sh. per kg		84
		756
Less transport charges on 700 kg		25
Total income from sales		731
Processing cost per ton of unhulled rice	Shs. 50	
Transport farm gate to mill per ton	10	
Total cost	60	
Net income from sales		671
Allow profit per ton processed of 71 shs.		
Farm gate price of unhulled rice		600

Taking into consideration the unknown potential of local rice and the uncertainty concerning future world demand and supply conditions it seems unlikely that the farmer could receive a price much above Shs. 600 per ton without substantial restrictions being placed on imports of rice.

During the last ten years, international trade in coarse grains has risen at a rate of ten per cent per annum. Further rises in imports will be closely related to increase in livestock production in developed countries which is not expected to be so rapid as in the last ten years. Sorghum and maize are expected to increase their share in world grain utilisation, because of their relative cost advantages and sorghum production may continue to increase in areas of marginal rainfall. The projected demand for livestock products in developing countries, the limited potential for increased domestic production of feed grains in Europe (the major importer of feed grains) due to climatic factors and projected increases in the demand for food grains of 90 to 100 million tons by 1985, all point to larger international trade in coarse grains.

Projections for the future demand of coarse grains in Somalia by 1985 range from 300,000 tons on a low assumption to 340,000 tons on a high assumption. At the moment, the market for sorghum in Somalia fluctuates considerably depending on the domestic harvest and supplies from Ethiopia. Although the returns from sorghum production are not particularly attractive compared to those from other crops, the Somali farmer traditionally likes to produce his own family grain requirements.

Prices quoted as received by farmers for sorghum vary from 20-70 shillings per 100 kg. Wholesale prices in Mogadiscio during 1967 and 1968 for the most expensive variety, range from 40 to 65 shillings per 100 kg.

The National Grain Marketing Organisation have estimated an average farm gate price of 38 shillings per hundred kilos, but this was based on limited data. Subsequent investigation indicated that this price level was dependent on severe shortage conditions because of poor harvests and the cut off of Ethiopian supplies during that period.

The current c.i.f. London price for high quality feed grain sorghum is approximately 40 shillings per hundred kilos and therefore

the lower end of the wholesale price range in Mogadiscio would seem to be the best indicator of the long term average wholesale price. Much depends on whether sorghum maintains its relative importance as a food grain or finally gives way to rice as the basic cereal in the national diet. On the irrigation projects it has been assumed that sorghum will be used mainly for the farmers own food consumption, that it will not be grown on a large scale as a livestock feed grain in the foreseeable future and will thus maintain a relatively high value. A projected wholesale price of 35 shillings has, therefore, been taken as the value of sorghum to the farmer.

b) Cotton

The commencement of production at the Somaltex Cotton Factory at Balad in July 1968, provided for a substantial expansion in the domestic market for cotton. The factory will produce cheap dyed or bleached cloth for domestic consumption from medium staple cotton, which at present is only grown in small quantities. Production will need to be expanded considerably to provide the 1,500 tons of lint per year required by the factory, when the operating capacity will be met without the need for imports.

Cotton fabrics presently constitute a substantial percentage of total imports as shown in Table 3.2.

TABLE 3.2 Imports of Cotton Fabrics 1964-66

Type of Material	Year	Metric tons	Value (million So. Shs.)	% Total Imports by Value
Grey Unbleached	1964	635	4,813	1.2
	1965	361	2.429	.8
	1966	320	2.315	.8
Bleached, dyed, etc.	1964	1,752	22.588	5.8
	1965	1,208	14.199	4.0
	1966	1,946	18.539	6.2

Present plans by ADA to supply the requirements of the factory through promotion of cotton production under both rain-fed and irrigated cultivation by established farmers could result in production over and above domestic needs if the Balad Project and a controlled irrigation scheme near Afgoi were both implemented and produced cotton in substantial quantity. Under existing farming conditions, however, considerable difficulties are foreseen in producing cotton efficiently, particularly in view of pest and disease problems. In the event of a domestic surplus arising, it is likely that the relatively small amounts of cotton involved could be exported as in the past.

The world market price for shorter staple cotton is largely determined by the price for American Middling Cotton, which in turn is determined by legislation in the U. S. in the light of the current supply and demand situation. In 1966/67, legislation was implemented and a cotton programme announced for 1967/68, which will keep the U. S. production at a predetermined level and maintain a minimum export price of 22 U. S. cents a pound. In fact, the c. i. f. Liverpool price for American Middling Cotton has fluctuated around this level in the past six years at 53-57 U. S. cents per kilogramme or 3786-4072 Somali shillings equivalent per ton.

The long term outlook for cotton prices would indicate that the price of shorter staple cotton is not likely to rise in real terms, above present prevailing prices and in fact, may drop in the face of stiff competition from man made fibres and the possibility of a 38 per cent export surplus in excess of import requirements developing by 1975. Good quality Acala cotton can command a slight premium over short staple varieties and assuming projects produced acceptable qualities, the net back price to the ginnery would be as follows:-

Acala Cotton c.i.f.		4100 Shs. per metric ton
Sea freight	280/-	
Port charges	80/-	
Transport from ginnery to port	27/-	
Handling, storage, etc.	20/-	407 " " " "
Price at ginnery of lint		3693 Shs. per metric ton

Assuming a processing cost plus profit of 300 shillings for collecting and ginning and a 35 per cent ginning out turn, the price to the farmer would be calculated as follows:

Income from sales	
350 kilos of lint @ 3.69 per kilo	1293 shillings
640 kilos of seed @ 31 cents per kilo	192 "
Total Income from Sales	1485
Less collecting, processing and profit	300
Price to farmer per ton of seed cotton	1185 shillings

At the moment the farmer receives 800-1200 shillings per ton of seed cotton, collection, processing and storage costs amount to between 600 and 700 shillings. The price of lint cotton delivered to the Balad Textile Mill including transport and commission charges to the Agricultural Development Agency was originally negotiated at 4200 to 5120 shillings per ton according to grade and staple length. This price is equivalent to the world market price for good quality cotton delivered to the mill.

It is extremely unlikely that a newly established mill could compete at this raw material price. In fact, it is unlikely that the price delivered to the mill could be much more than the net back export price of lint from the gin plus transport charges. This means that present ginning, collecting and storage costs must be reduced from their present level of 600-700 shillings per ton, to the hypothetical level of 320 shillings (300 processing + 20 shs. handling and storage)

per ton in the above calculation, if a price of 1200 shillings per ton of seed cotton is to be maintained to the farmer. It should be possible to substantially reduce ginning cost with intensive centralised production of seed cotton, since collection would be very much easier that at present and a larger guaranteed throughput should enable unit costs of ginning and storage to be reduced.

Reduced freight rates and handling charges would mean a higher hypothetical export price eventually, but in view of the need to improve competitiveness at all stages of growing, ginning, handling and manufacture, it is not expected that in the long term, the price range for the different grades of cotton in Somalia can rise much above the present level of 800-1200 shillings per ton without subsidy. An average price to the farmer, assuming he will supply a mixture of grades, has therefore been projected as 1000 shillings per ton.

c) Oilseeds

F. A. O. Agricultural Commodities projections for 1975 and 1985 estimate consumption of vegetable oils in Somalia will be between 10,000 and 13,000 metric tons by 1985. Imports of vegetable oils into Somalia in recent years are shown in Table 3.3.

TABLE 3.3 Imports of Vegetable Oils 1963-66

Year	Weight (Metric Tons)	Value (Million So. Shs)	% Total Imports by Value
1963	n. a.	6.234	2.0
1964	4,901	13.335	3.4
1965	5,765	15.241	4.3
1966	4,128	8.958	3.3

The major importer of refined oils in Mogadiscio has indicated imports during 1967 and 1968 as being well over 5,000 tons each year.

There are two local oil crushing plants in Mogadiscio and the owner of one has expressed strong interest in processing oil seeds from new development projects.

There is a strong local preference for sesame oil and at present sesame seed and oil are scarce and expensive. Sesame seed does not enter international trade to the same extent as other oil seeds. Sudan accounts for approximately 10 per cent of the world production and 40 to 50 per cent of total world exports to the principal markets of Japan, Venezuela, Italy and Egypt. Sesame oil is very popular in Middle Eastern countries (Somalia sesame seed and oil is reported to be sold in Saudi Arabia) and in Asian countries as a sweetmeat. The demand is expected to grow, but no large increases in production are foreseen.

The range of wholesale prices for sesame seed and oil in Mogadiscio during 1967 and 1968 is shown in Table 3.4. The average prices for seed were 168 and 190 shillings per 100 kg. and for oil were 474 and 500 shillings per 100 kg. in 1967 and 1968 respectively.

TABLE 3.4 Monthly Wholesale Price of Sesame Seed and Oil in Mogadiscio 1967 and 1968. (Shillings per 100 kg.)

	1967			1968	
	Seed	Oil		Seed	Oil
January	-	504.17	January	-	444.44
February	163.33	426.06	February	171.25	475.38
March	167.92	482.06	March	194.17	539.31
April	175.00	474.38	April	193.00	525.56
May	182.00	460.00	May	192.31	503.13
June	184.80	480.56	June	184.36	507.56
July	187.08	490.63	July	184.17	524.31
August	163.50	476.06	August	183.44	523.56
September	152.00	499.75	September	185.59	521.00
October	155.00	468.75	October	187.00	514.66
November	168.88	468.56	November	198.00	522.19
December	156.88	468.13	December	227.00	454.00

Since sesame is a relatively low yielding crop and there are considerable disease problems, no large increases in production are expected, while although the preference for sesame oil is strong, a high price will lead to consumer substitution of other oils. Seed prices are therefore expected to remain at around the current wholesale level of 180-190 shillings per hundred kilogrammes. There is little information on current wholesale margins, farmers claim they are abnormally high but investigations carried out by the Grain Marketing Organisation have indicated that this is not normally so, low farm gate prices and high wholesale prices being associated with times of extreme scarcity and bad road conditions to farming areas. If a 50 per cent wholesale margin is allowed, this would give the farmer a price of 120 shillings per hundred kilos.

Groundnuts would have a good local market and prices around the projected world market price are likely. Rather lower prices would be offered for cotton seed as oil crushers are doubtful about the market for cotton oil cake.

The prevailing average price for groundnuts of fair to average quality c. i. f. European ports has fluctuated during the last nine years at around $ 187 per ton. However, in view of the highly competitive nature of the fats and oilseeds markets and the doubts concerning the future role the centrally planned economies will play on the world market, it cannot be safely assumed that the price will remain at the above figure. During 1962/63, the world market for fats and oils was in equilibrium, when prices reached their lowest level since 1955. For a country which has not previously produced groundnuts on any considerable scale before it is safer to assume that the average prevailing price will remain nearer to the 1962/63 levels than to the present levels.

In 1962/63, the average price per metric ton of groundnuts was $165 c. i. f. European ports, which is approximately equivalent to 1180 So. Shs. Present freight rates are expensive and quotations

for produce such as oilseed, difficult to obtain. It is thought that, at present rates, the freight cost would be approximately 140 shillings per ton, although this would be reduced if the Suez Canal were re-opened and better port facilities were available. The net back price can therefore be calculated as follows:

Projected c.i.f. price European ports		1180 So. Shs. per metric ton
Less		
Present average freight rates	140 Shs.	
Port charges	40 "	
Transport charges at 0.95 Shs. per ton/km - say	36 "	
Handling and storage beyond farm gate	20 "	236 So. Shs. per metric ton
		944 So. Shs. per metric ton

The above calculations are somewhat theoretical since Somalia is not at present exporting nor has the possibility of exporting in the future been very thoroughly examined. The above projected farm gate price, therefore, can only serve as an indication of the average price a farmer could expect to obtain, if competing on the world market under present infrastructural conditions and in the event of no taxes or commissions being levied on production.

When determining the price of groundnuts for local oil extraction, the picture becomes more complicated since the price the local producer can pay depends upon the processing cost, the consumer preference for different types of oil, the landed price for those oils and the price that can be obtained for oilseed cake.

The price for groundnut oil fluctuates much more than that of groundnuts as can be seen from Table 3.5.

TABLE 3.5 Wholesale Price of Groundnut Oil in Somalia 1967-68
(Shs. per ton)

	1967	1968
January	3430	3960
February	3570	4300
March	3730	4300
April	3690	3940
May	3790	3540
June	4000	3470
July	4030	3240
August	3870	3160
September	3750	3150
October	3830	3340
November	3900	3030
December	3930	3100

The lowest price for groundnut oil, c.i.f. European ports in the last twenty years was the 1963 average of 1914 shillings, equivalent per metric ton. The price of refined oils imported into Somalia in the last six months has been as low as 1800 shillings per ton c.i.f. and the average landed price in the last year has ranged between 2400 shillings and 2900 shillings.

One local crusher has stated that he would be willing to pay 750 shillings per ton of good quality nuts, assuming an average extraction rate of 30 per cent based on the following calculation:

Prdduction Costs

1 ton of Groundnuts	750 Shs.	
Processing costs per ton	200 "	
Total Production Cost		950 Shillings

Operating Revenue

300 kg. of oil @ Shs. 2.90 per kg.	870 Shs.	
600 kg. of cake @ 50 cents per kg.	180 "	
Total Operating Revenue		1050 Shillings
Operating profit per ton of nuts		100 Shillings

In effect the farmer would receive less than Shs. 700 per ton of nuts after deduction of transport, handling and storage charges.

However, this calculation overstates the economic return to local processing since there is a 30 per cent duty included in the landed price of oil and local processing if it is not to be subsidised must be able to meet the landed price without duty. In order to do this processing cost must be reduced and present extraction rates considerably improved. According to a preliminary study, details of which are shown in Appendix XI, Volume IIIA, the processing cost per ton of a 6,000 metric ton integrated oil mill generating its own electricity is approximately 80 shillings per ton of oilseed processed. If payment for the mill over 10 years is included the processing cost is approximately 115 shillings. This last cost averaged over a plant life of 25 years gives an average processing cost of 90 shillings per ton. If the present mill in Mogadiscio, which is interested in the potential Afgoi oilseed output, were to be expanded to absorb that output, capacity would give a processing cost including re-equipment charges of approximately 100 shillings per ton. With good quality seed from a controlled irrigation project an extraction rate of 40.5 per cent refined oil should be obtained and under these assumptions a local processer could compete with a landed price for refined oil of 2,000 shillings as follows:

Production Costs

1 ton groundnuts	760 shillings	
Processing cost per ton	100 "	
Total Production Cost		860 shillings

Operating Revenue

405 kg. of oil @ 2.00 shillings per kg.	810 shillings	
500 kg. of cake @ 30 cts. per kg.	150 "	
	960 shillings	
Profit per ton of nuts processed		100 shillings

In these assumptions the price to the farmer for decorticated nuts would be 760 shillings less 56.00 shillings for transport and handling or approximately 700 shillings per metric ton. Although the processing costs are fairly high and the groundnut cake price low compared with the net world market price of 40-50 cents per kilogramme, it is doubtful if the farmer could expect to receive very much more for his seed from local processors. Conceivably, in the longer terms with higher capacity utilisation of crushing machinery, processing costs can be reduced and a higher price can be obtained for cake. But most of the revenue comes from oil which has to compete with cheap imported rapeseed and soya bean oil.

d) Cotton Seed

The export price for white cotton seed projected on the same basis as for groundnuts gives a price of approximately 320 shillings per ton at the ginnery in Mogadiscio. Allowing a 14 per cent extraction rate and a price of 30 cents per kilogramme for cake and 850 shillings per ton for an Oil Mill could just pay this price and obtain the same profit levels as on groundnuts. The projected price of white cotton seed ex-ginnery in Mogadiscio has been taken as 300 shillings per metric ton.

e) Meat

The F. A. O. Agriculture and Water Survey reported evidence for heavy overselling of male stock from Somali cattle herds. The number of cattle which can be carried under present grazing conditions is nearing its limit and more intensive methods of production will eventually have to be introduced if the export supply is to be maintained. Present export prices are unlikely to rise sufficiently to meet the cost of intensive beef production, until Somalia can attain the health and quality requirements of higher priced markets. There is, however, a growing shortage of finished stock, which can command a premium price in the present export market. Irrigation Schemes could produce considerable quantities of crop residues suitable for fodder, in addition to providing areas of improved grazing potential. The utilisation of these resources for beef production appears economically viable, although currently prevailing prices are unlikely to provide outstanding high returns.

'F. A. O. Agricultural Commodities Projections for 1975 and 1985' state that "Beef is the most important single item entering the international meat trade" and is a major export earner for primary producers in both developed and developing regions. Meat is a major export for certain East African countries including Somalia. At present, major exports of cattle from Somalia are through Berbera in the northern region. The number of cattle available for export varies according to the season. Normally, in the 'dry' season when grazing is scarce, the supply increases but the animals are in poor condition and the price drops. During the rainy season, the cattle men hesitate to sell although the animals are in better condition and the export price correspondingly higher. Even at the end of the rainy season, however, the cattle are seldom in top condition by the time they reach the ship owing to having been walked long distances.

The other major market is in the south with irregular export to Kenya of approximately 50,000 head per year. It is hoped that Kismayu meat factory will eventually absorb most of this flow and the Livestock

Development Agency is developing a holding ground, from which it is hoped to supply the factory. Buying over the scales has just been introduced and the animals are rested and given any necessary veterinary treatment before being passed on to the factory. This leaves the central region for which there is virtually no market except the domestic one and the Italso Meat Factory, which is primarily interested in the corned beef and extract trade. The price for cattle in this region is correspondingly low.

In view of the projected shortage of beef in the world market, prices can be expected to rise. Present prices for Somalia beef on the hoof are relatively low, but even without a break through into the higher price markets, a higher return could be achieved by supplying a better quality animal to the traditional markets. (Somalia sheep in good condition sell for 10 shillings per kilo liveweight in Jeddeh). At the moment, only low quality animals (store cattle, immature bulls and treck oxen) form the bulk of exports and there is evidence that this supply is in danger of being reduced, because of overgrazing and the prohibition on exports of female stock, which means there has been heavy overselling of male stock. The problem of supply to the traditional markets will depend for its solution on the implementation of a range and herd management programme which will take some time to implement. But in short term, much can be done to improve the income of the cattle man and facilitate the implementation of a range management programme by providing inexpensive finishing facilities. The Balad Scheme, with substantial crop residues and dry season grazing is in an excellent position to provide fattened cattle for the export market, if adequate harbour facilities are made available at Mogadiscio.

At present, the f. o. b. price at Berbera varies from approximately 460 shillings to 500 shillings, which gives a per kilogramme dead-weight price range for an average 270 kilogrammes beast of 1. 70 to 1. 85 shillings. The present Kismayu holding ground price is 81 cents per kilogramme liveweight, but if it is to compete with the Kenya trade,

the price will eventually have to rise to approximately 1.10 cents per kilogramme liveweight. Steers are not at present sold by liveweight in Mogadiscio, but an average figure would be approximately 64 cents per kilogramme. Provided Somalia does not lose a part of her markets to other producers, because of inability of supply, all present prices should rise, especially for well finished cattle. It has therefore been assumed that the export floor price for a well finished animal will be 1.85 cents per kilo liveweight and that the internal price in the central region for a steer for fattening will have risen to approximately 1.30 cents per kilogramme liveweight.

f) Milk

Insufficient statistics are available on milk production and consumption to state with any degree of certainty what increases in production the domestic market could absorb, while there has been insufficient development in the industry to consider processing for export. The milk factory at Mogadiscio is having considerable difficulty in getting supplies, but even if the problem is overcome, there is no way, without considerable market survey work, of determining the potential of the market, at the present time, to absorb the factory's designed throughput of 20,000 litres per day. General indications are that present retail marketing is weak, although the reason why is not clear. Possibly, the public are not yet ready to consume processed milk in any considerable quantity and even with a reduction in price, a fairly intensive promotion campaign would be required to increase sales appreciably. In these circumstances and in view of communications problems within the Shebelli Valley, which would make collection difficult during the wet seasons, milk production on any appreciable scale cannot be recommended.

3.3 Possible Types of Development

Agricultural development may be either rainfed, flood irrigated or with controlled irrigation. Rainfed agriculture is severely limited by the

uncertain nature of the rainfall as described in Section 2.7. The current increased use of machinery for land preparation may well in the long term prove uneconomic in view of the low returns from the traditional subsistence crops. Ox cultivation methods have proved successful but tsetse fly precludes the use of oxen in areas near to the river. It is likely that improvements in rainfed agriculture will be mainly through the introduction of new short season varieties giving a greater chance of obtaining a satisfactory crop in years of below average rainfall and in the development of improved cultivation techniques giving better soil moisture conservation. The widespread use of fertilisers and pest and disease control chemicals, whilst improving yields in good rainfall years, is less attractive when bad years are taken into account and certainly provision of credit for such inputs would be extremely risky. As long as more reliable methods of crop production with irrigation can be developed it would appear wiser to utilise scarce financial resources in the development of irrigated agriculture.

Flood irrigation provides the crop's needs of irrigation water as a single inundation prior to planting. The water is allowed to infiltrate into the soil and up to 50 cm of moisture may be stored in the soil to a depth of 2 m. Large scale flood irrigation development is possible when suitable gravity fed natural basins exist in which the inundation water may be held with the minimum of artificial retaining banks. The basins should be flat as otherwise excessive quantities of water will be necessary to submerge the higher areas.

The type of crops and length of growing season is restricted under flood irrigation by the amount of moisture which can be stored in the depth of soil which the crop roots can exploit. The use of rainfall to supplement moisture reserves can prove valuable in extending the possible growing season resulting in higher yields. In the Shebelli Valley flood water is available from late August till mid-December but it is essential to flood irrigate and plant as early as possible if the maximum benefit is to be obtained from such rainfall as occurs in October-November. Flood irrigation is not normally practised during the 'Gu' flood season. This is due

to the poor water quality during the first ten days of this flood, the unreliable timing and volume of the high river flows and the relatively short season available between the 'Gu' and 'Der' season floods which barely permits the maturation of even a short season crop.

Although flood irrigation utilises the high river flows which might otherwise remain unused, it does require large quantities of water over a short period of time. The provision of on or off river storage to be filled during the season of high flows could not only allow utilisation of the high flows over a longer period but also provide flood protection for downstream areas throughout the flood season. The construction of such storage works would however prevent the operation of flood irrigation schemes in downstream areas, the resulting lower river flows being inadequate to give command of the flood irrigation basins by gravity.

Controlled irrigation, whereby regular irrigation applications are made throughout the crop growing season provides the most efficient utilisation of water and maintains soil moisture conditions near the optimum for plant growth. Applications must however be more accurate than in the case of flood irrigation necessitating the subdivision of the irrigated area into relatively small units, each carefully smoothed to ensure uniform water application. This and the more intricate canalisation system required makes controlled irrigation considerably costlier to construct and operate.

Within the Shebelli Valley the relatively short season of assured natural river flows limits the irrigation seasons and thus restricts the range of suitable crops and planting dates. The possibility of on or off river storage of flood season river flows does however give an opportunity under controlled irrigation to appreciably extend the irrigation season with a consequent wider choice of crop varieties and an extended planting season. Even without year round storage the possibility of cultivating perennial irrigated crops is extended providing stored water can be used for the greater part of the January-March low river flow period.

3.4 The Potential for Increased Production without Irrigation

Conditions in Somalia necessitate rainfed agriculture being extensive rather than intensive. As shown in Table 2.9 of an estimated 706,000 ha. of potentially cultivable land in the Shebelli Valley and adjacent areas, only some 200,000 ha. is presently cultivated. In 1963 about 15 per cent of this cultivated area was irrigated and this figure has since declined as a result of flood schemes being abandoned and a reduction of the cropped area under controlled irrigation at Genale.

The existing area of rainland cultivation is spread throughout the region which has a total area of over 8 million ha. The task of the agricultural extension services is made extremely difficult by this widely dispersed cultivation and by the almost complete lack of education among the cultivators. It is not surprising that these extension services, acutely short of trained and experienced personnel and of finance to provide transport and other necessities have achieved very little impact on productivity. It is however through the extension services that the distribution of improved varieties and the introduction of improved cultivation methods must be brought about.

Providing that necessary trained extension and research staff become available through a well organised and practically orientated training programme and that the necessary finances for their operations are forthcoming an expansion of rainfed agriculture by some 60,000 ha. over a period of 12 years should prove possible. In order to maximise the cost effectiveness of the extension services it is essential their operations and the expansion of cultivation should be concentrated at specific focal points when the conditions for agricultural production are most favourable.

The area cultivated by the individual farmer is at present limited to the amount of land he and his family can prepare for planting and maintain free from weed infestation using traditional hand tools. The introduction of work oxen for land preparation and interrow cultivation in those areas where tsetse fly is not a hazard would result in an appreciable increase in

the area a farmer could cultivate. Such an inovation would however necessitate the establishment of training facilities for the farmers' oxen and the provision of cheap locally constructed but efficient ox-drawn implements. Most farmers would be unable to pay for these immediately and their introduction would depend upon medium term credit being provided.

Short term credit would also be required to pay for labour at peak periods, tractor mechanisation where such tractors already exist and are under utilised and for improved seeds, bags, insecticides for certain crops such as cotton, possibly fertilisers at a later stage, and for livestock drugs. As co-operatives are only in an early stage of development a special credit organisation would need to be established and staffed in the selected development areas.

The relatively high risk of crop failure due to drought makes the introduction of large scale mechanised crop production schemes unlikely to prove economic. Where these have been successful in other countries such as the Sudan the rainfall expectation during the crop season is approximately twice that occurring in the Shebelli Valley. For this reason the further introduction of expensive, tractors and equipment is not recommended.

Water supplies for human and animal consumption in the area are presently inadequate and a farmer's family frequently spend a large part of their time carrying water over long distances during dry weather. The provision of reliable sources of water is essential in selected development areas and would free a considerable amount of labour for productive work.

Very little data is available on present crop yields and the prediction of future yields is even more difficult due to the paucity of experimental yield data and lack of trials on the farmers' own land. It is reasonable to assume that an average farmer might achieve 40 per cent of the average experimental yields at the end of a 12 year development period providing deficiencies in infrastructure, extension services, credit facilities and field experimentation are made good and improved varieties are introduced.

This estimate takes into account the insuperable problem of the vagaries of seasonal rainfall. Table 3.6 gives estimates of present and future yields for the major rainfed crops.

TABLE 3.6 Estimated Present and Future Yields of Rainfed Crops in kg. per ha.

Crop	Present		Future	
	'Gu'	'Der'	'Gu'	'Der'
Sorghum	300	250	450	400
Maize	400		550	
Cotton	150		300	
Sesame	200		300	
Groundnuts (shelled)		300		400
Others (average)	300	200	400	300

It seems likely that increases in the cultivated area of the more profitable cotton, sesame and groundnut crops will be considerably greater in proportion than those of the staple food grains, maize and sorghum the expanding local demand for which would be largely met by increases in yield. Estimates of current areas and approximate future areas following a 12 year development programme are shown in Table 3.7.

TABLE 3.7 Estimated Present Areas of Crops and Future Areas Following a 12 Year Development Programme

Crop	Present area ha.	Future area ha.	Increase
Sorghum	90,000	110,000	20,000
Maize	55,000	65,000	10,000
Cotton	8,000	15,000	7,000
Others	17,000	40,000	23,000
Total	170,000	230,000	60,000

The Agriculture and Water Survey report indicates an area of some 115,000 sq. km suitable for livestock grazing within and adjacent to the Shebelli Valley. Estimates of present stocking rates for cattle indicate a present population of some 600,000 animals in this area in addition to some 425,000 camels and over 1 million goats and sheep. It is probable that significant increases in numbers will be largely confined to beef cattle and with improved water supplies, better control of disease and improved marketing an increase of 50 per cent over a period of 12 years would seem reasonable, taking into account the constraints already discussed in development of crop production. This would result in a cattle population of 900,000 and assuming a 5 year period to reach maturity would provide an annual production of perhaps 150,000 mature beef steers or an increase of 50,000.

The estimated value of increased agricultural production during a 12 year development period is shown in Table 3.8.

TABLE 3.8 Value of Estimated Increased Production after a 12 Year Period of Rainland Development

Production Increment		Value Shs. '000
20,000 tons sorghum	@ Shs. 250	5,000
12,000 tons maize	@ Shs. 300	3,600
3,300 tons cotton	@ Shs. 1000	3,300
9,800 tons other crops	@ Shs. 700	6,900
50,000 beef cattle	@ Shs. 350	17,500
Total		36,300

Without a more detailed study an accurate assessment of the cost of such a development programme for rainfed agriculture is not possible. The order of magnitude of development financial requirements may be as follows:-

a) Extension and Research Services

Headquarters personnel would comprise approximately 15 Extension, Animal Health and Research Senior Officers with

administrative staff. Salaries and Headquarters operating costs including transport would amount to perhaps Shs. 300, 000 annually with a similar sum required for the provision of buildings and other capital items making a total of Shs. 600, 000. Field staff would comprise up to 150 Agriculture, Animal Health and Experimental Officers whose annual cost for salaries, transport and other expenditure would be of the order of Shs. 1, 800, 000.

b) Ox Training

Training schools would need to be established with a staff of perhaps 10 instructors. The annual cost would be in the region of Shs. 150, 000.

c) Water Supplies

The envisaged programme to provide adequate water supplies for domestic purposes and livestock is likely to cost Shs. 200, 000 annually.

d) Credit

Credit requirements are likely to be of the order of Shs. 10, 000, 000 the interest charge on such an amount being annually Shs. 600, 000 at 6 per cent.

In addition it will be necessary to have a staff of credit officers numbering 6 in head office and perhaps 50 in the field with supporting administration, the cost of these personnel and their office facilities and transport amounting to perhaps Shs. 600, 000 per year.

A summary of these possible financial requirements is shown in Table 3. 9. It has been assumed that these development costs will build up to a maximum in year 6 and thereafter will remain relatively constant.

TABLE 3.9 Summary of Possible Financial Requirements in '000 Shs.

Item	Year						Total over 12 years
	1	2	3	4	5	6-12	
Extension & Research	300	300	400	500	600	600	5,100
" " "	600	800	1,000	1,200	1,500	1,800	14,100
Ox training	50	100	100	150	150	150	1,300
Credit	100	200	300	400	500	600	4,500
Credit Admin.	100	200	300	400	500	600	4,500
Water Supplies	200	200	200	200	200	200	2,400
Contingencies	135	180	230	285	345	395	3,940
	1,485	1,980	2,530	3,135	3,795	4,345	35,840

3.5 Constraints Affecting Irrigation Development

The major constraint limiting agricultural development is the availability of irrigation water. The 'Gu' season flood on the Shebelli River is of short duration and irregular in occurrence so that cultivation of irrigated crops at this season is uncertain of success. The 'Der' season flood is much more regular in its onset at the end of August and is generally of at least $3\frac{1}{2}$ months duration. However present irrigated cultivations utilise most of the early and late flows so that only a limited area may be developed before the season for subsequent irrigation projects is reduced to 3 months. Allowing for the necessary spread of planting dates this results in the later planted crops having only some $2\frac{1}{2}$ months of irrigation which is marginal for their development to maturity.

Peak 'Der' season flood flows in the Shebelli River are much in excess of present use for a period of about 2 months. During this time very high flows frequently give rise to extensive flooding and damage. The possibility of storing these peak flows would not only provide water to extend the irrigation season but would also eliminate the risk of serious flood damage.

These possibilities are examined in Chapter 7. It is estimated that an off river storage scheme could provide assured supplies of water until late February and permit the development of an additional 30,000 ha. of controlled irrigation. The possibility of utilising the peak flows supplemented by a minimum of stored water for paddy rice cultivation was considered, but the areas selected for feasibility study were not thought ideally suited to this crop and local farmers have no experience of the specialised techniques for paddy rice production. The possibility of future paddy rice production has been discussed in Section 6.9.

The availability of manpower in areas suitable for further irrigation development could become a serious limiting factor. This is particularly so when normal river flows limit the irrigation season and therefore necessitate planting being completed as rapidly as possible. An acute labour peak results not only at planting but also at harvesting due to the sharp cut-off of irrigation supplies with the result that all crops tend to reach maturity at the same time. The possibility of storage of flood flows to extend the irrigation season would alleviate these peaks and the need to plant all the crops over a very short period would no longer apply.

Other limiting factors which apply both to irrigated and rainfed development are the shortage of extension and managerial personnel, lack of research information of crop performance and cultural requirements and lack of information on potential markets for produce. There is an immediate need for the establishment of training and research programmes to meet these needs and if they are implemented these limitations could be eliminated in the not too distant future.

CHAPTER 4

THE BALAD FLOOD IRRIGATION SCHEME FEASIBILITY STUDY

A. General

4.1 Location and Climate

Following a brief soils and engineering reconnaissance, an area of 10,000 ha. was selected on the right bank of the Shebelli River, downstream of Balad and to the west of the Balad to Johar road for the Flood Scheme feasibility study. This location was preferred to alternative sites near Mahaddei Uen and near Barire, as in both these areas the soils appeared less suitable. The Mahaddei Uen area appeared from information in previous reports to require considerable flood protection works and at the Barire site there was the possibility of future extension of an area upstream previously selected for controlled irrigation.

The climate of the area has been described in Chapter 2 and is similar to conditions at Afgoi, where estimates of evaporation have been made.

4.2 Topography and Soils

Using existing benchmarks on the Balad-Johar road and on the track from Balad to Afgoi, levelling was done along traces cut at 2 km intervals over the entire area measuring some 18 km by 6 km. In addition, two sample areas, each of 250 ha. were levelled in greater detail on a 200 metre grid. Contours subsequently drawn from the levels, augmented by photo-interpretation show the ground to be moderately undulating, the area being bounded on the north by old river levees and on the south by higher ground adjacent to the present river channel. Natural ridges divide the area into three basins.

A semi-detailed soil survey of the area was carried out at a density of 2 sites per square km. 443 samples taken at fixed depths from 102 routine sites were analysed. The sites were selected on the basis of photo-interpretation and field inspection. The soils were classified on the basis of the U.S. Department of Agriculture Soil Classification 7th Approximation (1960) and subsequent supplements (1954 and 1967). In the area, two Orders were recognised.

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

Entisols occur as isolated patches on narrow, relatively high ridges corresponding to former river levees. They are coarse to moderately fine textured and are generally more saline and alkaline than the Vertisols, especially in the subsoil.

The two orders have been subdivided into series on the basis of the electrical conductivity in the top 50 cm horizon as shown in Table 4.1.

Land Class Maps have been prepared, based on the U.S. Bureau of Reclamation Standards Specifications, modified to suit prevailing local conditions. The characteristics of each land class are shown in Table 4.2.

TABLE 4.1 Soil Classification

Landform, Subdivision Order, Series and Subseries	Mapping Symbol	Texture	EC mmhos/cm
FLOOD PLAIN MEANDER			
VERTISOLS			
CHROMUSTERT (Recent Alluvial)	Gl		
Udic Chromustert: hue 10YR.	Gl 1a		
	Gl 1a11	medium/fine overlying medium/coarse	< 4
	Gl 1a21	medium/fine overlying fine	< 4
	Gl 1a22	medium/fine overlying fine	> 4
	Gl 1a31	medium/fine overlying stratifications	< 4
Udic Chromustert: hue 7.5 YR.	Gl 1b		
	Gl 1b11	medium/fine overlying medium/coarse	< 4
	Gl 1b21	medium/fine overlying fine	< 4
	Gl 1b31	medium/fine overlying stratifications	< 4
Udorthentic Chromustert	Gl 1		
	Gl 211	medium/fine overlying medium /coarse	< 4
	Gl 221	medium/fine overlying fine	< 4
PELLUSTERT	Gl		
Udorthentic Pellustert	G 13		
	Gl3 11	medium/fine overlying fine	< 4
CHROMUSTERT (Old Alluvial)	Sr		
Udic Chromustert	Sr 1		
	Sr 111	medium/fine overlying fine	< 4
	Sr 112	medium/fine overlying fine	> 4
Udorthentic Chromustert	Sr 21		
	Sr 211	medium/fine overlying fine	< 4
	Sr 212	medium/fine overlying fine	> 4
FLOOD PLAIN SLACKWATER			
VERTISOLS			
PELLUSTERT	Sc		
Udorthentic Pellustert	Sc 11		
	Sc 111	medium/fine overlying fine	< 4
CHANNEL REMNANT (Levee Soils)			
ENTISOLS			
USTORTHENT	C		
Typic Ustorthent	C 11		
	C 111	coarse/medium throughout profile	< 4
	C 121	coarse/medium overlying fine	< 4
	C 131	coarse/medium overlying	< 4

TABLE 4.2 Land Classification for Flood Scheme Projects

Class	1	2	3	4	6	Symbol
Minimum soil depth to horizon limiting to root development (cms.)	100	75	60	50	50	d
Salinity E. C. /mmhos depth in cm						
0-50	< 4	< 4	4-8	8-12	Unlimited	
50-100	< 4	< 4	< 8	8-12	Unlimited	s
100-150	< 4	4-8	< 8	unlimited	"	
E. S. P. depth in cm						
0-50	<15	< 15	< 15	15-25	Unlimited	
50-100	<15	< 15	< 15	< 25	Unlimited	a
100-150	<15	< 15	< 15	unlimited	"	
Texture	Clay loam permeable clay	Clay loam moderately to permeable clay	Sandy clay-loam to moderately permeable clay	Loam to clay	Unlimited	v very coarse texture l moderately coarse texture m moderately fine texture h very fine texture b stratifications
Topography	No restrictions	No restrictions	Moderate restrictions	Moderate restrictions	Unlimited	t
Profile Characteristics	No limit to water movement or root development. Well structured.	Water movement and root development a little impeded. Well to moderately structured.	Water movement and root development moderately restricted. Moderately structured.	Water movement and root development moderately to severely restricted. Moderately to poorly structured.	Unlimited	p

4.3 Vegetation and Bush Clearance

A classification of the vegetation over the area was made by observation and photo-interpretation. The natural vegetation consists of grass, thicket (Dichrostachy glomerata) and shrub and tree species (Acacia nilotica; A. nubica; A. bussei; A. seyal; Commiphora spp; Cordia gharaf; Dobera glabra; Grewia spp; Euphorbia spp; and Salvadoria persica).

Mechanised clearance will involve the use of crawler tractors of 100 HP or larger, preferably equipped with a front mounted rock rake, to uproot the bush and windrow it for burning. The operation should be followed by root ploughing. The clearance work involved is shown in Table 4.3.

TABLE 4.3 Estimate of Tractor Hours Required for Bush Clearance and Root ploughing for the Balad Irrigation Project

Bush Clearance Class	Estimated Area ha.	Estimated Tractor hours per ha.	Total hours
I. Cultivated or abandoned with little regeneration and scattered trees	1,530	-	-
II. Light bush and scattered trees	1,445	2.5	3,612
III. Moderate bush with frequent trees some large	3,655	5.0	18,275
IV. Dense thicket	1,870	4.0	7,480
		Sub-Total	29,367
Root ploughing	6,970	2.0	13,940
		Total	43,307

Estimated cost based on the prevailing hiring charge of Shs. 52 per hour for the type of equipment required is Shs. 2,702,356 including a 20 per cent contingency factor or Shs. 388 per hectare cleared. This compares with costs Shs. 270 quoted for recent clearance at Johar and Shs. 300-500 for recent work at Afgoi.

The area to be cleafed includes that requiring to be surveyed to define the edges of the basins and land taken up by roads, canals etc. in addition to the 7,000 ha. cropped area.

4.4 Population

The Balad project area is sparsely populated, only one small village of 16 families lying within the area to be developed. A number of other small villages exist outside the area and to the east lie the townships of Balad, with a population of about 366 families, and Gululei with 158 families. Most of the people in the area adjacent to the proposed project are already engaged in agriculture and a large number of farmers from Balad and Gululei cultivate land in the Balad Co-operative flood scheme. It is evident that the total population of the area from whom potential settlers might be selected is insufficient to provide the numbers needed for the proposed project.

4.5 Present Agriculture

Very little cultivation occurs at present in the area of the proposed scheme. To the east of the scheme, the Balad Co-operative Flood Scheme occupies an area of some 1000 ha., served by a canal abstracting water from the river at a point 11 km upstream of Balad. An extension of this canal has been constructed to serve a further area of 500 ha. part of which will lie within the proposed scheme. Another flood canal serves an area of some 200 ha., near the western boundary of the proposed scheme. The main crops of these flood schemes are sesame, sorghum and to a lesser extent, maize. Other small inundations occur along the river, growing the same crops. Rainland cultivation of maize and sorghum occurs adjacent to villages near the scheme and an area of about 50 ha. is cultivated around the village of Cassane inside the scheme. The total cultivated area at present inside the scheme amounts to some 5 per cent of the total area. Yields from the raingrown crops are generally poor and very variable from year to year. The Balad Co-operative

Flood Scheme appears to have grown successful crops, but no crops were planted in the 1968 season. The term 'Co-operative' appears to be a misnomer as, in fact, the scheme is financed by an association of businessmen and farmed on a share cropping basis by local farmers.

B. Flood Irrigation Development

4.6 Agricultural Production - Crops and Livestock

In order to justify the considerable capital outlay for a large flood scheme, it was necessary to select a cropping pattern involving production of cash crops giving considerably higher returns than the traditional flood irrigation subsistence crops of sorghum and maize. The crops selected as being suitable for this type of cultivation are medium staple cotton, groundnuts and sesame, whilst a limited area of sorghum has been included in the rotation to provide the subsistence needs of the farmer's family. Whilst cotton yields under flood irrigation are likely to be appreciably lower than under controlled irrigation, the close proximity of the scheme to the Somaltex Textile Factory at Balad was a further reason for selecting this crop. The local demand for oil seeds makes both groundnuts and sesame attractive and their relatively short season makes them suitable for cultivation under flood irrigation. Safflower, sunflower and castor are other possible crops, but there is no data available on their local performance under flood irrigation conditions and for this reason, they have been omitted from the chosen cropping pattern.

The cropping of the scheme is restricted to the 'Der' season since reliable river flows in the quantity needed to flood the basins only occur in the September to November period. As crop yields on soil moisture alone are not likely to be high, it is essential that crops be established in time to benefit from the rainfall occurring in October and November. Flooding of the basins will begin as early as possible and usually during the last week in August. Planting of cotton and groundnuts will be completed as soon as possible after the basins have been drained of excess water during September and planting will be completed by early October. Land preparation will consist

of disc ploughing and this will be completed prior to flooding the basins. All subsequent cultural operations will be performed by hand labour.

The proposed 3 course rotation in successive years will be:

Cotton - $\frac{1}{2}$ Sesame - Groundnuts
$\frac{1}{2}$ Sorghum

Crop residues from groundnuts and sorghum might be utilised for supplementing livestock fodder supplies during the dry months immediately following harvesting. Alternatively, the material could be sold off the scheme to milk producing enterprises in Mogadiscio, although the extent of the market is difficult to assess. At present, sorghum residues are transported considerable distances by lorry into Mogadiscio.

Livestock would also benefit from additional dry season grazing provided around the margins of the basins and in the area over which excess water will be discharged when the basins are drained.

The estimated yields shown in Table 4.4 assume fertiliser application only for the cotton crop. The relatively low standard of husbandry expected from the potential settlers makes successful results from fertilisation on other crops unlikely as yield responses would probably be marginal.

TABLE 4.4 Estimated Crop Production Under Flood Irrigation

Crop	Area ha.	Estimated yield kg/ha.				
		Year 1	Year 2	Year 3	Year 4	Maturity
Seed cotton	2,320	600	700	850	1,000	1,200
Groundnuts (in shell)	2,330	850	1,000	1,150	1,400	1,700
Sesame	1,160	300	400	400	450	450
Sorghum	1,160	500	600	800	900	1,000

In addition, it is estimated that the scheme could fatten 1,600 beef steers in year 2, increasing to 7,000 steers per year by year 5. These animals would be grazed over land adjacent to the scheme as well as utilising supplementary grazing within the scheme, supplemented by available crop residues.

4.7 Water Requirements

Laboratory studies indicate the water holding capacity of the Balad area soils to be of the order of 20 to 25 cm of available moisture per metre depth. Plant roots may be expected to exploit this moisture to a depth of some 2 metres, so that assuming the soils to be dried out to permanent wilting before irrigation, an application of some 40 to 50 cm could be utilised by the crop. This soil moisture reserve would be supplemented by effective rainfall estimated to amount to at least another 10 cm in most years, giving a total moisture reserve of 60 cm for crop production.

The limited moisture available makes it essential to select crop varieties having short growing seasons in order that they produce a crop before their moisture supply is exhausted. At present, inadequate local information is available to recommend varieties. Selection of suitable varieties must be made by a pilot study before the scheme is implemented.

4.8 Labour and Machinery Requirements

It is proposed that each farmer be allotted a 6 ha. holding which would fully utilise the labour capacity of himself and his family throughout the 7 month cropping season and in addition, necessitate the employment of hired labour during planting and harvesting seasons. Such a holding will, it is estimated, require a total labour input equivalent to 406 man days over the period. Of this, the farmer would provide 180 man days, his family 141, and the remaining 85 man days would be provided by hired labour.

The only operations requiring machinery on the project are land preparation and transport of produce to collecting centres. For this, fifteen tractors equipped with disc ploughs and with trailers would be adequate. Alternatively, equipment could be hired for the ploughing operation and animals and hired lorries used for transport of produce. If project tractors are available they should also be used to lift the groundnut crop.

If the project has its own tractor fleet, maintenance facilities will be required. It would be convenient to operate the tractors as a single unit with a mobile workshop and fuel and water bowsers to move through the project with the tractors.

4.9 The Irrigation and Drainage Layout

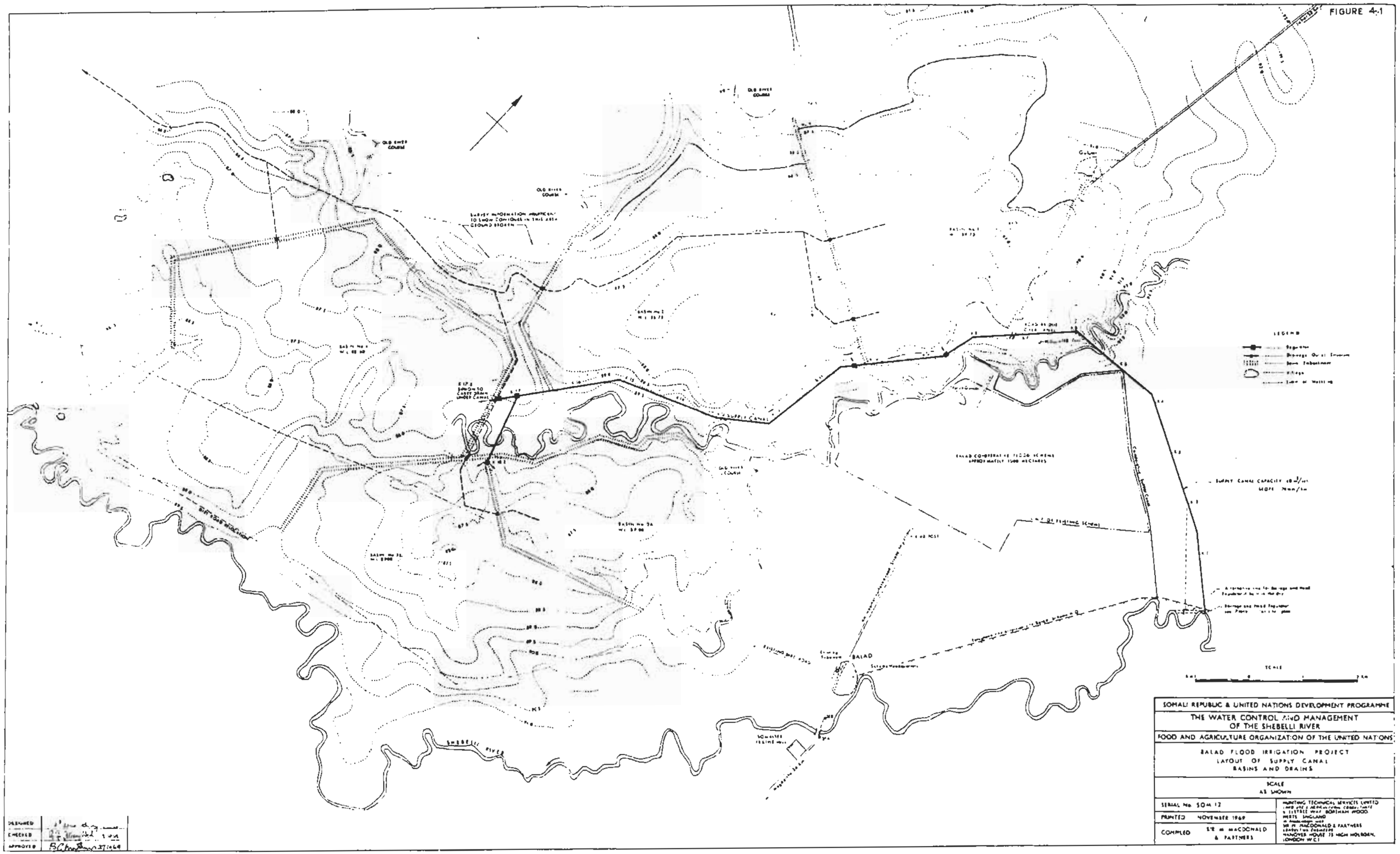
The Balad area selected for the flood irrigation scheme is in three natural basins. It was necessary however to subdivide two of these basins to ensure that the filling, infiltration and draining of the whole scheme could be completed in approximately 40 days. This time limit was dictated by the agronomic requirement that planting could be completed as early as possible in October so that the crops as they mature could take full advantage of the rains during the growing season.

The proposed layout of the scheme is shown on Figure 4.1.

The capacity of the main canal was governed by the basin size and time restriction described in the previous paragraph and it was found that the minimum size feasible was 40 cumecs. The headworks for this canal would be located approximately 13 kilometres upstream of the road bridge at Balad. To ensure a diversion of this size from a river with a maximum flood flow of about 105 cumecs it is necessary to build a gated structure across the river just downstream of the head regulator of the supply canal.

Low banks are located between and around the five basins, the relevant details of the basins and banking are tabulated below:-

FIGURE 4-1



SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

BALAD FLOOD IRRIGATION PROJECT
LAYOUT OF SUPPLY CANAL
BASINS AND DRAINS

SCALE
AS SHOWN

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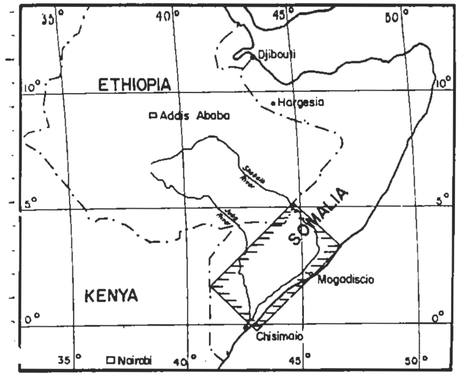

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SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME	
THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER	
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS	
LOCATION MAP	
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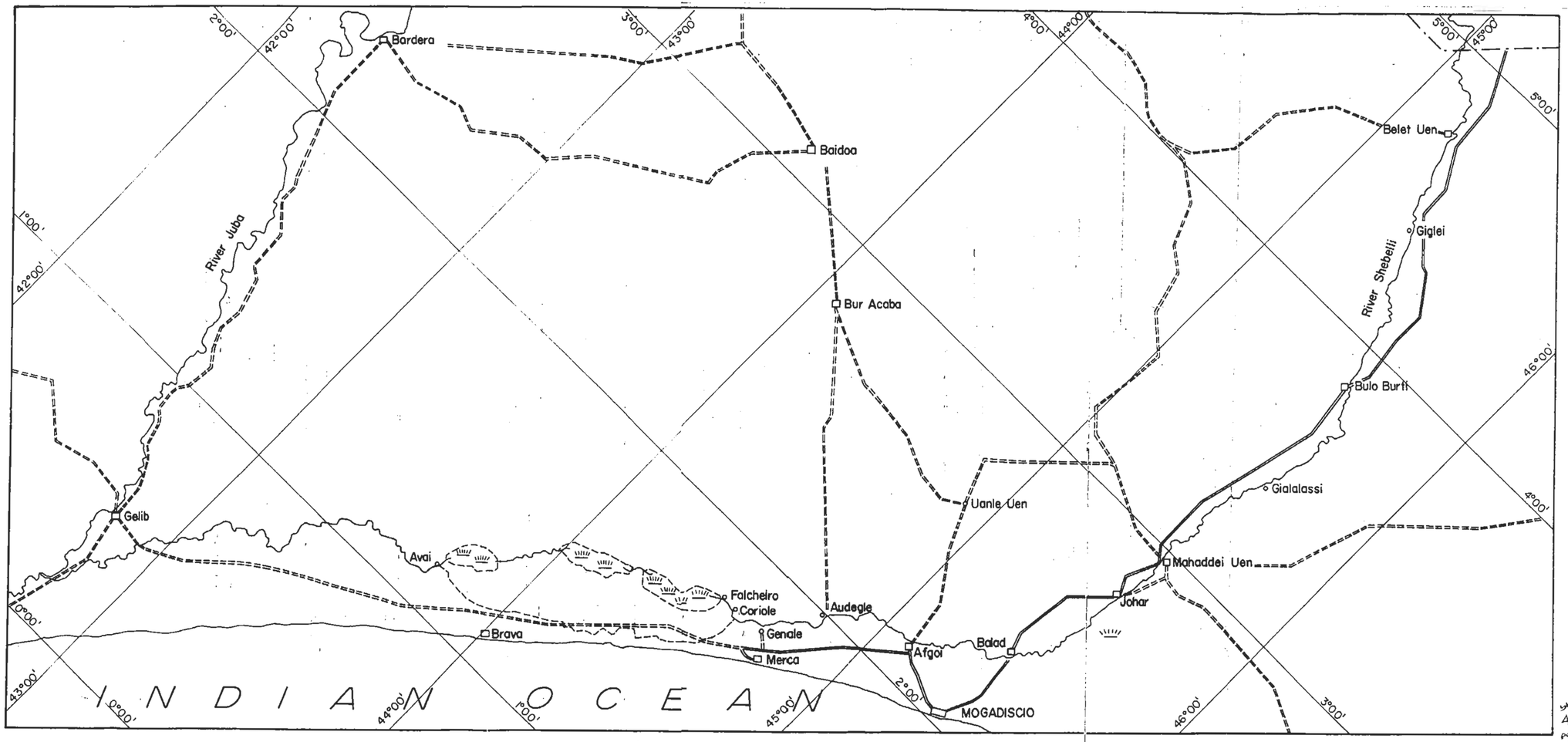


TABLE 4.5 Basin Areas and Flood Banks

Basin No.	Area ha.		Maximum Water Depth m	Banking Details	
	Watered	Cropped		Length m	Maximum Height m
1	1,800	1,640	0.10	3,100	0.90
			1.65	4,750	2.15
2	2,000	1,840	1.35	3,400	1.85
3A	950	890	0.75	8,500	1.25
3B	1,100	940	1.40	4,300	1.90
4	2,050	1,890	1.30	11,200	1.80
TOTAL	7,900	7,200	-	35,250	-

The main supply canal after passing under the Balad-Johar road follows the natural ridge through the middle of the area and its total length is 18.8 kilometres.

The drains have been aligned as far as possible along natural drainage lines and each basin has been provided with separate drainage although this has been relaxed where natural basins have been sub-divided. The estimate for the drain earthworks includes for the excavation of the main drain for a distance of 4 kilometres beyond the boundary of the scheme.

Water control structures have been sited at each basin offtake along the main supply canal and outlet structures have been provided in the basin banks along the drainage lines. The drain from basins 3A and 3B passes under the supply canal at K. 17.3 and the cost of a suitable syphon is included in the cost estimates.

The filling, infiltration and draining schedule is given on Figure 4.2. The water drained from basin 1 is used to supplement the flow from the supply canal to speed the filling of basin 2. The draining of basin 3A cannot commence until the filling and infiltration has been completed in basin 3B. The schedule is the one that would be followed with high flows in

in the river occurring in late August. If the flows were delayed it might be possible to commence filling of the smaller basins 3A and 3B prior to dealing with basin 1.

4.10 Management and Organisation

A Ministerial Project Committee should be established within the Ministry of Planning which would make policy decisions and issue directives, and be responsible for financial matters and liaison with Government Organisations for the efficient operation of the project. The Committee should include representatives of both the Somali Government and the country or organisation which finances the development. Government representation should include the Ministers of Planning, Finance, Agriculture (and the Agricultural Development Agency), Natural Resources (Livestock Division) and Public Works (Irrigation Department) whilst other persons with special knowledge might be co-opted when required. The Committee would have a secretary for co-ordination with the project management.

The project management staff together with local representatives of relevant Government Ministries, local Government and Project Tenants should form a small management committee. It is recommended that the management staff should comprise:

a) General Manager in overall executive charge. He would initially be an expatriate.

b) Office Manager responsible for stores and accounts.

c) Field Manager responsible for crop production.

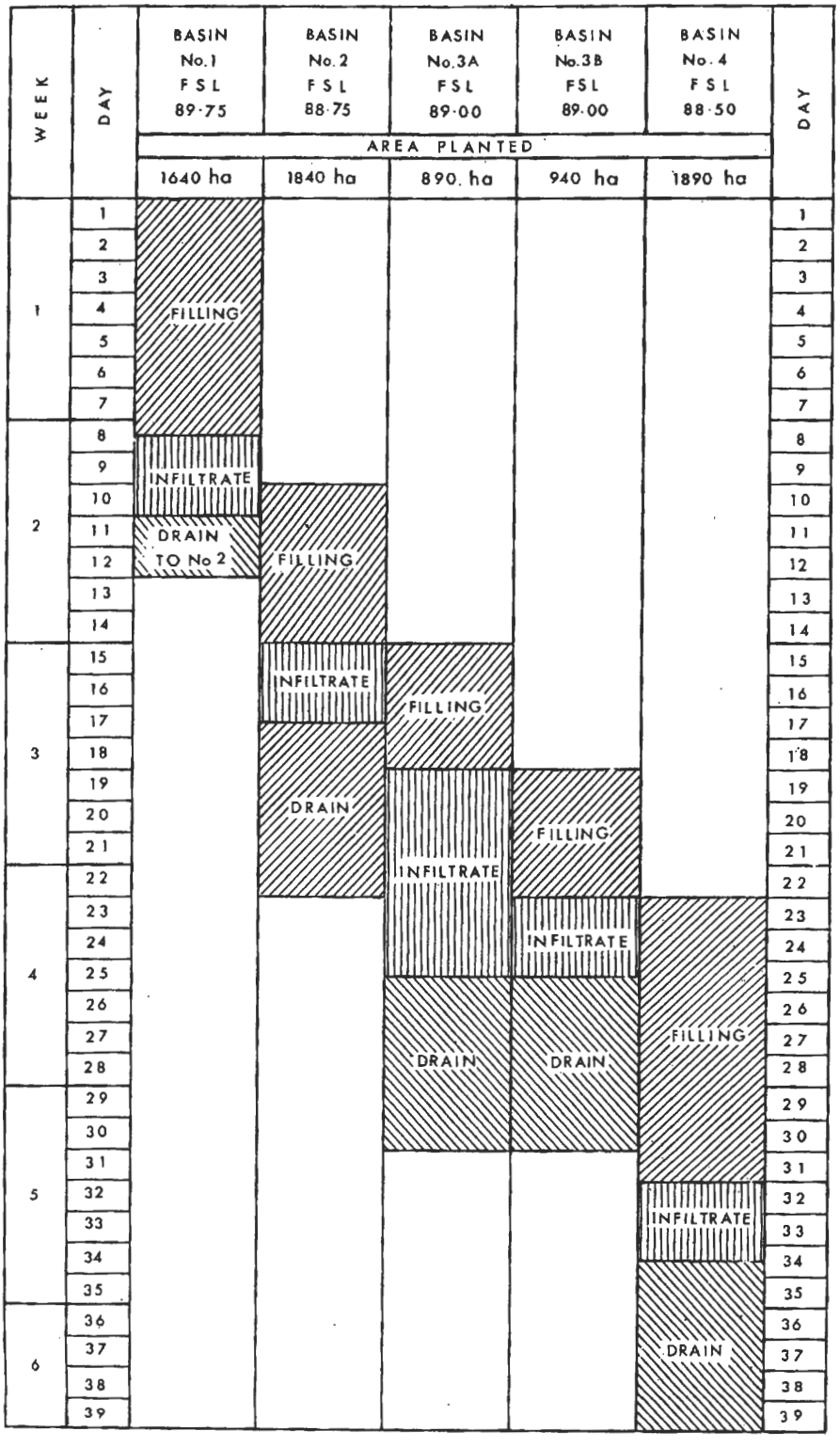
d) Livestock Officer responsible for livestock production.

e) Engineer responsible for operation and maintenance of irrigation facilities and also workshops, electricity, water supply and building maintenance.

FIGURE 4·2

BALAD FLOOD PROJECT

FILLING INFILTRATION & DRAINAGE SCHEDULE WITH 40 CUMEC SUPPLY CANAL



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The Field Manager will supervise 5 agricultural officers each in charge of cultivation of one irrigation basin. It is recommended that groups of about 12 tenant farmers should be formed and one of their member selected as Group Leader who would explain management instructions, co-ordinate the work of the group and translate to management the problems and grievances of the tenants. It is essential that tenant farmers maintain a satisfactory standard of crop husbandry on their holdings and complete the required cultural operations on time. Failure to do so can best be countered by the management completing the task with hired labour at an ultimate cost to the farmer considerably above the equivalent local rate. Repeated failure on the part of a tenant to meet his obligations should result in forfeiture of his holding.

The annual costs of management and of operating and maintaining the project facilities have been estimated and are summarised in Table 4.6.

TABLE 4.6 Annual Costs of Balad Flood Irrigation Project Year by Year in Shs.

Year	1	2	3	4 onwards
Permanent staff	399,100	524,900	576,900	625,800
Irrigation and drainage works	15,100	18,600	25,800	29,700
Workshops and buildings	171,500	181,000	231,000	231,000
Transport	12,000	12,000	12,000	12,000
Crop processing		15,000	17,850	17,850
Other services	20,000	20,000	20,000	20,000
Tools	3,000	3,250	3,250	3,250
Total	620,250	747,750	886,400	939,600

The revenue from sales of crops and livestock will provide an income from which both a fixed annual charge to meet the project's loan servicing commitments and a variable amount covering annual management and operating costs may be deducted. The balance will be distributed to

the tenant farmers the amount being related to their respective crop yields. From the amount,the costs of direct crop production services such as seed, fertilisers, pest control and mechanical cultivation provided by the project will be recovered. In order to prove attractive a farmer's net income including the value of sorghum consumed by his family should be of the order of Shs. 2500 per year.

4.11 Sources of Settlers

Approximately 1,165 farmers will be required for the proposed scheme. The area is at present sparsely populated and the project would provide the opportunity of settlement for nomad people. The 7 month cropping season would suit such a settlement scheme as nomads would probably be unwilling to be tied to cultivate a holding throughout the year. The inclusion of livestock in the scheme to utilise crop residues and limited dry season grazing would be an incentive to such nomads to settle.

It would also appear necessary to employ nomad families to assist in the planting and harvesting operations, as presently, settled people along the river would be busy on their own rainland and flood irrigation farms at that time of year. To attract them in sufficient numbers, it may prove necessary for the farmer to provide food in the form of sorghum and grazing for their cattle on crop residues, in addition to paying a money wage. Such incentives are presently used to attract cotton pickers to the Gezira scheme in the Sudan.

4.12 Infrastructure

The headquarters for the scheme will be located in the existing village of Balad which already has a water supply from a tubewell. Here would be built the five houses for the senior staff members of the scheme, an administrative office, mechanical workshops, two storesheds and a decortication plant.

A small generating plant would be installed to supply the five houses and office. From the head of the main canal at the diversion site on the Shebelli River a telephone line would be constructed to the project office and to provide a direct link with the capital, a line would be underslung below the existing line from Johar to Mogadiscio.

No all weather roads are proposed for this scheme, but the existing dirt track from Balad to Afgoi will be relocated for a distance of 14.5 kilometres. This relocation will not be surfaced but will be raised and provided with cross drainage works.

The farmers will live either in Balad or in one of the existing villages situated around the periphery of the scheme. The estimates include a sum to provide a water supply to four of these villages with a tubewell and ground level storage tanks.

No provision has been made in the estimates for housing for any junior project staff or farmers. Although the estimates show the cost of a veterinary clinic, holding compound and dispensary for Balad these have not been included in the project cost as it is felt these should be provided by the Government.

Similarly no schools have been included in the estimate but the residents of the new or enlarged existing villages, once they are well established, will be able to apply for help in either kind or cash from the Somali Government. It is expected that any such request would receive favourable consideration.

4.13 Construction Programme and Estimates

The construction of the scheme is scheduled to take 42 months starting in January of year 1.

The ordering of the mechanical plant, transport and agricultural equipment should begin well in advance of the start of construction to make sure that the essential items from overseas are on site at the required time. The one expatriate and the senior Somali staff for the

project should be recruited before construction commences and be on site from the beginning of year 1.

The main supply canal as far as basin 1 with the head regulator and diversion structure should be completed in year 1 so that watering of basin 1 may take place in late September or early October of that year. The additional main canal, drains, and structures are added each year so that basin 2, basins 3A and 3B and basin 4 follow in the three subsequent years.

There are several contractors in Somalia who are capable of undertaking the earthworks. The construction programme for the structures, buildings and services is large and time short in year 1 but the existing contractors in Somalia if grouped together should be able to carry out the work satisfactorily. Suitable consulting engineering firms to supervise the design and all phases of the construction are not available in Somalia so it is recommended that an expatriate firm with the specialised knowledge be retained.

The unit rates used in the estimates were obtained from a number of local contractors operating in Mogadiscio. The rates for Balad would be approximately 10 per cent higher than those prevailing in the capital and this has been included. The cost of the telephone line from the head regulator to Balad and from Balad to Mogadiscio is based on the rates given by the Ministry of Communications who would be willing to carry out the work.

A summary of the project costs is shown in Table 4.7. Allowance has been made in these estimates for "Engineering and Supervision" by a firm of expatriate consulting engineers and this cost would include the preparation of the detailed designs, contract documents and the supervision of the construction of the works. It would not include the detailed survey work included in the Cost Item I.A. - Preparatory Work.

TABLE 4.7 Summary of Balad Flood Irrigation Project Capital Costs

Item	Description	Amount 1,000 '000 Shs.	Foreign Exchange '000 Shs.
I.	IRRIGATION WORKS, BUILDINGS AND SERVICES		
I. A	Preparatory Work	140.0	98.0
I. B	Purchase of Land and Compensation	-	-
I. C	River Diversion Works	4,295.5	2,650.5
I. D	Main Canal		
	Earthworks	3,003.0	1,351.4
	Structures	4,378.0	2,989.7
I. E	Basin Embankments	786.5	354.0
I. F	Drains		
	Earthworks	3,531.0	1,589.0
	Structures	1,741.3	1,186.7
I. G	Workshops	80.0	64.0
I. H	Buildings for Agricultural & Irrigation Management	509.0	255.8
I. J	Other Buildings	(50.0)	(21.5)
I. K	Water Supply	320.0	176.0
I. N	Electricity Supply	64.6	52.3
I. O	Communications		
	Roads	413.9	218.2
	Telephones, etc.	72.4	49.3
	Item I sub-Total	19,335.2	11,033.9
II.	AGRICULTURAL PROCESSING PLANT		
	Groundnut Decortication Plant	210.0	185.0
	Item II sub-Total	210.0	185.0
III.	EXCAVATING PLANT	820.0	800.0
	Item III sub-Total	820.0	800.0
IV.	LAND PREPARATION		
	Bush clearance	2,520.0	1,134.0
	Item IV sub-Total	2,520.0	1.134.0
V.	AGRICULTURAL MANAGEMENT		
	Vehicles	171.7	167.1
	Tractors	435.8	425.8
	Agricultural Implements	301.9	296.8
	Miscellaneous Plant (W/S. Eqpt.)	54.8	53.7
	Item V sub-Total	964.2	943.4
	Items I, II, III, IV & V Total	23,849.4	14,096.2
VI.	CONTINGENCIES(1)	2,384.9	1,409.6
VII.	ENGINEERING AND SUPERVISION(2)	2,288.5	1,529.0
	SCHEME TOTAL	28.522.8	16.821.1

NOTE:

(1) Taken as 10 per cent on Items I, II, III, IV and V.

(2) Taken as 10 per cent on Items I, II, II and IV.

4.14 Economic and Financial Evaluation

The projected net benefits, annual management, investment and replacement cost of the Balad flood irrigation project are shown in Table 4.8. Crop and livestock outputs have been valued at the projected prices discussed in Section 3.2 and as far as possible inputs have been charged at their real cost to the economy. Labour has been valued on two different assumptions because of the difficulty of establishing an accurate opportunity cost of withdrawing labour from its present occupation. Studies in the Afgoi area indicated an opportunity cost of 2.50 shillings per man-day for farm labour. There is insufficient statistical information to estimate the opportunity cost of withdrawing the nomadic herdsmen, who could be settled on the scheme, from their present occupation, but it would appear that if extensive beef production is to be increased the number of herdsmen using the range will have to be substantially reduced which would mean that the opportunity cost to the economy of settlement is negligible. Settled labour has therefore been valued at zero opportunity cost and at 2.50 shillings per man-day as an indication of the likely range within which the true opportunity cost lies. Local managerial staff have been valued at competitive rates but as there is an acute scarcity of trained staff at all levels these rates may understate their true opportunity cost.

The internal rate of return of the project is 9.5 per cent assuming zero opportunity cost of labour and 7.5 per cent assuming an opportunity cost of 2.50 shillings per man-day. The project would also generate substantial foreign exchange saving and provide adequate supplies of raw material for the cotton textile mill at Balad and the oilseed processing facilities in Mogadiscio. At this rate of return and allowing the farmer an income of 2,500 shillings the project would, from the ninth year of development provide a surplus of 823,000 shillings annually for debt servicing. Debt service commitments on a foreign exchange loan for the investment total would be 2,160,000 shillings annually. The present inability to raise sufficient revenues because of inadequate taxation machinery would make it difficult to raise the balance over and above the surplus generated by the project. The project therefore could constitute a further burden in the short term on Somalia's already critical debt position.

TABLE 4.8 Economic Rate of Return '000 Shillings

Year	Net Benefits	Annual Management	Investment	Replacement	Net Cost/ Benefit
1		663.6	15,217.5		-15,881.1
2	545.4	928.3	4,084.0		- 4,346.8
3	1,301.2	928.5	6,848.4		- 6,545.6
4	2,158.2	1,047.9	2,372.9		- 1,262.5
5	3,204.5	1,022.5		171.7	2,010.3
6	3,810.8	974.5			2,836.3
7	4,329.7	956.0(7-40)		232.4	3,141.3
8	4,722.7			58.1	3,708.6
9	4,935.0(9-40)			58.1	3,920.9
10				468.9	3,510.1
11					3,979.0
12				146.5	3,832.5
13				46.9	3,932.1
14				46.9	3,932.1
15				465.7	3,573.3
16				58.1	3,920.9
17				58.1	3,920.9
18					3,891.9
19					3,979.0
20				1,321.1	2,657.9
21	4,935.0(21-40)	956.0(21-40)		232.4	3,746.6
22				58.1	3,920.9
23				58.1	3,920.9
24				233.7	3,745.3
25				218.6	3,760.4
26				46.9	3,902.1
27				61.6	397.4
28				232.4	3,746.6
29				58.1	3,920.9
30				439.8	3,539.2
31				87.2	3,891.8
32					3,979.0
33					3,979.0
34					3,979.0
35				550.6	3,428.4
36				105.0	3,874.0
37				58.1	3,920.9
38				43.0	3,935.9
39					3,979.0
40					3,979.0

Internal Rate of Return 9.5% assuming zero opportunity cost of settler labour.

Internal Rate of Return 7.5% assuming opportunity cost of 2.50 shillings per MD for all labour.

The project does have considerable potential as the first step in a programme for intensive cattle raising in the central region provided adequate harbour facilities are made available. It could therefore be considered suitable for a soft loan which would reduce debt service commitments to a level only slightly above the surplus generated internally by the project. But at a 7.5 per cent to 9.5 per cent rate of return the investment is a marginal one and a decision to implement must be considered against the possible economic returns to other forms of irrigation on the Shebelli River.

4.15 Pre-requisites for Successful Implementation

In view of the limited resources available for agricultural development care is needed in development planning in order to channel these resources into those projects giving the best and quickest economic return. Within the Shebelli Valley a number of alternatives require to be considered in deciding the priority of the Balad Project. In particular the possibility of off river storage to extend the season of controlled irrigation and permit considerable further expansion of irrigated cropping. This off river storage if implemented would reduce the flood season river flow downstream to a level where gravity flooding of the Balad Project would be impossible. It is only within the national and regional context that the decision whether to implement the Balad Project can be properly made.

To permit successful implementation of agricultural development projects the establishment of appropriate legislation covering land ownership is considered essential and for irrigated agriculture the existing water law should be enforced and should be modified where necessary. Provision for the enforcement of necessary legislation for control of crop pests and diseases should be made.

Existing facilities for agricultural research must be maintained and the extension and other services improved by removing unproductive elements so that the available funds may be concentrated on those fields of production giving the greater return.

Whilst co-operatives in the true sense of the word are practically non-existent at present promulgation of the law on Co-operative Societies in 1969 was an important step and the development of such organisations should be encouraged.

The development of irrigation projects such as the proposed Balad Project giving as it does a reasonably assured income for the farmer opens up possibilities for the establishment of agricultural credit facilities on a reasonably secure basis. The provision of such facilities could prove to be of considerable benefit to the farming community.

CHAPTER 5

THE AFGOI-MORDILE CONTROLLED IRRIGATION SCHEME FEASIBILITY STUDY

A. General

5.1 Location and Climate

Following a brief soils and engineering reconnaissance, an area of 3,000 ha. was selected on the left bank of the Shebelli River, about 19 km downstream of Afgoi and lying between the river road from Afgoi to Barire and the Afgoi to Merca road. Other possible locations west of Balad, immediately west of Afgoi and the Fornari area were rejected; soils in the Balad area being inferior, the area nearer Afgoi being already extensively developed and including the currently developing West German assisted dairying enterprise. The Fornari area had no advantages over the area selected, gave no opportunity for future expansion of the scheme beyond the original 3,000 ha. and because of possible difficulties over re-acquisition of abandoned Italian concessions was not favoured by the Somali Government.

The climate of the area has been described in Chapter 2, paragraph 2.7.

5.2 Topography and Soils

Existing benchmarks on the two roads bounding the scheme were used to establish spot heights at 200 m intervals along a grid of traces spaced at 1 km intervals over the entire area. In addition, a sample area of 300 ha. was levelled in greater detail on a 200 m grid. Contours subsequently drawn from the levels, augmented by photo-interpretation show the ground to have a slope of some 30 centimetres per kilometre in a direction parallel to the river. Local undulations occur particularly adjacent to old river channels.

A semi-detailed soil survey of the area was made at a density of one site per 15 ha. 475 samples taken at fixed depths from 109 routine sites were analysed. The sites were selected on the basis of photo-interpretation and field inspection. The soils were classified on the basis of the U.S. Department of Agriculture Soil Classification 7th Approximation (1960) and subsequent supplements (1964 and 1967). In the area, two Soils Orders were recognised, namely Vertisols and Entisols. The characteristics of these soils have been described in Chapter 4, Section 4.2 and their classification is shown in Table 4.1.

Land Class Maps have been prepared, based on the U.S. Bureau of Reclamation Standards Specifications, modified to suit prevailing local conditions. The characteristics of each land class are shown in Table 5.1.

5.3 Vegetation and Bush Clearance

A classification of the vegetation over the area was made by observation and photo-interpretation. The natural vegetation consists of species identical to those listed in Section 4.3.

Mechanised clearance will require the use of crawler tractors, equipped with a front mounted rock rake to uproot and windrow the bush for burning and should be followed by a root ploughing operation. The clearance work involved is shown in Table 5.2.

TABLE 5.1 Land Classification for Controlled Irrigation Schemes

Class	1	2	3	4	6	Symbol
Minimum soil depth to horizon limiting to root development (cms)	100	60	60	50	50	d
Salinity						
E. C. in mmhos at fixed depths						
0-50 cm	< 4	< 4	4-8	8-12	Unlimited	s
50-100 cm	< 4	< 4	< 8	8-12	"	
100-150 cm	< 4	4-8	< 8	Unlimited	"	
Alkalinity						
E.S.P. at fixed depths						
0- 50 cm	<15	<15	<15	15-25	Unlimited	a
50-100 cm	<15	<15	<15	< 25	"	
100-150 cm	<15	<15	<15	Unlimited		
Texture	Sandy loam to friable clay	Loamy sand to permeable clay	Loamy sand to moderately permeable clay	Loamy sand to clay	Unlimited	b= stratifications v= very coarse texture l= moderately coarse texture m= moderately fine texture h= very fine texture
Topography	Little gilgai formations or no restrictions	Moderate gilgai formation or no restrictions	Moderate gilgai formation or moderate restrictions	Severe gilgai or moderate restrictions	Unlimited	g= gilgai t = topography
Profile Characteristics	No limit to water movement or root development. Well structured.	Water movement and root development a little impeded. Well to moderately structured.	Water movement and root development restricted. Moderately structured.	Water movement and root development moderately to severely restricted. Moderately to poorly structured.	Unlimited	p

TABLE 5.2 Estimate of Tractor Hours Required for Bush Clearance and Root Ploughing of the Afgoi-Mordile Project Area

Bush Clearance Class	Estimated Area ha.	Estimated Tractor Hours per ha.	Total Hours
I. Cultivated or abandoned with little regeneration and scattered trees	1,010	-	-
II Light Bush and scattered trees	760	2½	1,900
III Moderate bush and frequent trees, some large	890	5	4,450
IV Dense thicket	1,140	4	4,560
		Sub-Total	10,910
Root ploughing	2,790	2	5,580
		Total	16,490

Estimated cost based on the prevailing hiring charge of Shs. 52 per hour for the type of equipment required in Shs. 1,029,000 including a 20 per cent contingency factor or Shs. 369 per ha. cleared.

The area to be cleared includes some 328 ha., which lies within the scheme boundary, but which will not be included in the cropped area, as well as the land taken up by roads, canals, etc.

5.4 Population

A census was undertaken in three villages lying immediately adjacent to or within the project area. This indicated a present population of 111 families. Table 5.3 shows the composition of this population. A census made for Tax purposes in 1966 covered 11 villages including the three within the project's area and indicated a population of 682 households.

TABLE 5.3 The Population of the Afgoi-Mordile Project Area

Village	No. of families	No. of Adults			No. of Children	Total Population
		Male	Female	Total		
Mordile	63	58	77	135	100	235
Idamoun	39	44	46	90	105	195
Bulo Shan	9	9	9	18	10	28

These people are presently engaged in rainfed subsistence farming, although some flood irrigation is practised by the Mordile villagers, who work land adjacent to the river. These settled cultivators are predominantly of negro origin. Small temporary settlements of nomadic people are established in the area from time to time.

A survey of the Afgoi municipality in 1964 indicated 5,009 persons engaged in agriculture.

5.5 Present Agriculture

Rainfed agriculture within the project area amounts to between 10 and 15 per cent of the total area although the cropped area probably varies considerably from year to year. Planting takes place during both the 'Gu' and 'Der' season rains and also during the Hagai season when rainfall is adequate. The main crops are maize, sorghum and sesame with small areas of beans and other vegetables. Some farmers keep cattle which are frequently grazed away from the area, sheep and goats and chickens.

Yields are generally low and very dependent on rainfall. Estimated average production of the major crops within the scheme area is shown in Table 5.4.

TABLE 5.4 Estimated Average Rainfed Crop Production in the Afgoi-Mordile Project Area

Crop	Area cultivated		Yield kg. per ha.		Total production tons	
	*Gu	Der	*Gu	Der	*Gu	Der
Maize	122	30	400	300	49.3	9.2
Sorghum		85		400		35.4
Sesame	70	11	75	125	5.2	1.4

*Gu and Hagai season sowings.

B. Controlled Irrigation Development

5.6 Agricultural Production

Suitable crops for controlled irrigation were selected from those currently grown along the Shebelli River and from promising recent introductions grown at the Afgoi Research Station. Perennial crops would require supplementary sources of irrigation water during the December to April season when river flows practically cease for up to four months in some years. Their cultivation would only be made possible by use of groundwater at that season or by the construction of on or off river storage facilities of adequate capacity. The high capital cost of either alternative would necessitate both a high return from the crops grown and an assured future market. The existing sugar estate is capable of meeting the domestic demand for this commodity and of other possible perennial crops, bananas were ruled out because of marketing uncertainty and grapefruit, whilst being a promising crop, requires further investigation into suitable varieties and cultural practices before a sound evaluation of its possibilities can be made.

Of the annual crops, upland rice, medium staple cotton and groundnuts were selected as being best suited to the requirements of the scheme.

The proposed rotation is:-

Year 1	Gu season	Groundnuts
Year 1	Der season	Medium Staple Cotton
Year 2	Gu season	Fallow
Year 2	Der season	Upland Rice

Groundnuts will be planted in late April on previously prepared ridges. Germination will depend on rainfall as availability of river water is unreliable at this season. A short season variety maturing in some 100 days is necessary in order that the crop may be cleared in time to prepare the land for the succeeding crop of cotton.

Medium staple cotton will be planted in mid-September. The land will be ridged before planting. Harvesting will take place from late December until the end of February. Spraying to control pests and diseases will be essential and after harvesting it will be necessary to uproot and burn all cotton residues as a field sanitation measure.

Rice will be planted in late August and early September. During the preceding fallow, the land will be ploughed, levelled and low bunds constructed to facilitate uniform application of irrigation water. A herbicide application to control weed growth is recommended after planting. Harvesting by combine will take place in January.

Estimated yields for the selected crops are shown in Table 5.5.

In addition to the 3000 ha. of arable crops, an area of 1/10 ha. will be made available for each farmer to grow vegetables. It is assumed that 10 per cent of this total area of 75 ha. will be used for intensive vegetable production for the Mogadiscio market.

TABLE 5.5 Estimated Yields in Kgs/ha. for the Selected Crops Under Controlled Irrigation

Crop	Area ha.	Year 1	Year 2	Year 3	Year 4	Maturity Yield
Groundnuts (shelled)	1,500	980	980	1,190	1,190	1,400
Cotton	1,500	700	800	1,100	1,200	1,500
Upland Rice	1,500	1,000	1,400	1,800	2,200	2,500

The intensive cropping pattern will result in the farmer and his family being occupied almost continuously throughout the year. It is thought unlikely that any appreciable subsidiary livestock production will take place within the scheme as the potential farmers are not at present livestock owners on any large scale and when settled on the scheme will have little time to spare for such an enterprise. Proximity to the river and surrounding bush will result in a considerable risk of tsetse borne trypanosomiasis during the rainy seasons. In the absence of livestock production, however, crop residues suitable for fodder may be sold. There is likely to be a good market for the groundnut haulm amounting to some 4,000 tons annually and it may prove possible to dispose of rice straw similarly, as this would be available during the dry February-March season when fodder is scarce.

An area of 328 ha. within the scheme area, but not included in the irrigated area, could be planted with suitable tree species for the production of timber or firewood.

5.7 Irrigation Requirements

In the absence of reliable information on crop water use under local conditions, the irrigation requirements have been calculated from estimates of evaporation. Because of the unreliability of the 'Der' season rains, these have been ignored in assessing the water use of cotton and upland rice. Rainfall during the 'Gu' season has been taken into account

in the estimation of irrigation need for the groundnut crop. The mathematical model used for the water balance calculation, by which the irrigation needs were estimated takes account of the crop growth stage, surface characteristics and root depth and of the soil moisture retension characteristics and the effect of increasing soil moisture tension on crop evaporation. The model assumes irrigation to take place when a previously determined level of moisture stress occurs, the permissible stress being dependent on the current crop growth phase. The amount of irrigation water required at each application is that needed to return the soil within the crop root zone to field capacity, plus amounts to wet successively deeper soil layers within the ultimate zone of root exploitation. Before this zone is fully wetted, an irrigation field efficiency factor of 85 per cent has been applied to allow for losses during irrigation. Subsequently, a factor of 66 per cent has been used to allow for such losses and also for deep percolation beyond the crop root zone.

The total estimated crop irrigation requirements are shown in Table 5.6.

TABLE 5.6 Crop Irrigation Requirements

Crop	Amount in cms	m^3/ha.	No. of Irrigations
Groundnuts	59.0	5,900	8
Cotton	72.0	7,200	8
Upland Rice	68.5	6,850	11

These quantities do not allow for any preplanting irrigations, as in some seasons river flows would be insufficient at the time pre-irrigation would be applied. An irrigation immediately following planting is assumed in each case. The requirement for groundnuts applies to a season of low rainfall, as would occur once in 10 years. In a season of median rainfall, the total irrigation required for the groundnut crop

would be 24 cm or 2400 m^3 per ha. in 3 irrigations and rainfall at time of planting would be adequate for germination.

Irrigation water for the 75 ha. of vegetable plots will be provided during the irrigation season.

The water will be applied by plastic syphons of 7.5 cm internal diameter, able to water a 135 m furrow in 2 hours.

5.8 Requirements of Labour and Machinery

It is proposed that each farmer be allotted a 4 ha. holding, this being an area which under the proposed rotation could be cultivated by a farmer with assistance from his family and with the minimum of hired labour during peak times. The total labour input for such a holding is estimated as being 414 man days per year. Of this, the farmer would provide 242 man days his family 106, mainly during harvesting of groundnuts and cotton, but also during weeding of cotton and rice crops. Hired labour, mainly for cotton and rice weeding, cotton harvesting and for the pulling and burning of cotton residues after harvest would total 66 man days. The requirements of labour for the individual crops are shown in Table 5.7.

TABLE 5.7 Labour Required for Afgoi-Mordile Project Cropping Pattern in Man-days per ha.

Crop	Farmer	Family	Hired	Total
Groundnuts	36	13	2	51
Cotton	67	31	26	124
Rice	19	8	6	33

On a settlement scheme of this type, it is essential to utilise to the full the available manpower of each family and conversely mechanisation should be kept to a minimum. Apart from land preparation operations comprising ploughing, harrowing, smoothing and ridging,

the use of machinery has been restricted to supplementing manpower in weed control in the growing crops and in groundnut lifting, to achieving timely sowing of rice and to harvesting of the rice crop. Assistance to the farmer in weed control will be achieved by a re-ridging operation in cotton and groundnuts, which will also facilitate irrigation application, whilst in rice, an early herbicide spray is recommended. Timely sowing of rice is achieved by combining fertiliser application, final discing and sowing in one operation using wide level discs equipped with seed and fertiliser hoppers. As cotton harvesting commences before rice harvest, labour is in short supply and harvesting of rice by combine is essential.

The machinery requirement is listed in Table 5.8. The scale of equipment was derived from a tractor work plan based on estimated outputs for each type of equipment, which aims at maximum utilisation of the tractor fleet throughout the year. Little information on the output of implements under local conditions being available, care was necessary to avoid over estimation, which especially during the early years of the scheme could result in difficulties.

The intensive spraying programme required for pest and disease control on the cotton crop will be executed by aerial spraying contractors, who at present are used for Circospora control on the Genale banana plantations.

5.9 Irrigation and Drainage Layout

A canalisation layout has been produced based on the information from the topographical survey described in Section 5.2. This layout is shown in Figure 5.1. The field size was chosen in accordance with the maximum water duty of the main crops. A standard field of 36 ha. can be watered in 5 days when planted with rice and in $7\frac{1}{2}$ days when planted with cotton. The field is normally divided into nine plots of 4 ha. and two farmers work on each plot. On steeper ground the plots may be reduced to 2 ha. and in this case each farmer has his own plot. The layout has been

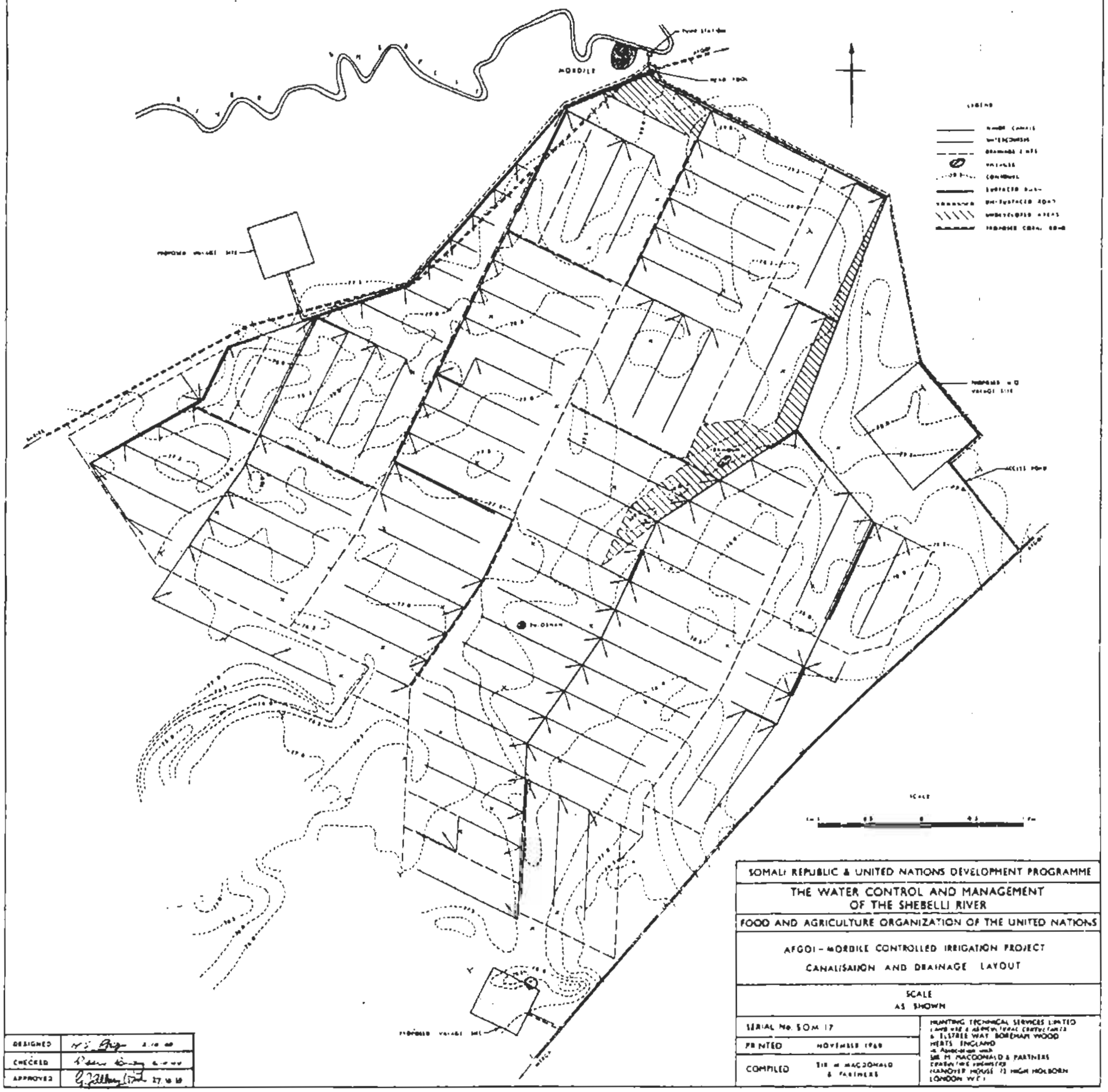
TABLE 5.8 Machinery and Equipment Required for the Afgoi-Mordile Project

Item	Number Required
Tractors 66 H.P. with hydraulic lift and power take off	25
Chisel ploughs	12
Wide Level Discs with fertiliser and seed attachments	12
Land Levellers	9
Lateral Formers	2
Tool Bars rear mounted	12
Tool Bars mid-mounted	12
Ridger Bodies (sets of 4)	12
Cultivator Tines (sets of 8)	12
Groundnut lifting blades (sets of 2)	12
Tractor Mounted boom sprayers	6
Tipping Trailers 5 ton Capacity	15
Combine Harvesters	8
400 gal. fuel tank Trailers	3
200 gal. Water tank Trailers	3
Cotton Root Pullers	750
Syphons (7.5 cm ID. Plastic)	6,000

arranged so as to accommodate as many full size standard fields as possible. The minor canals are aligned along natural ridges where possible so that most high ground can be commanded.

The net cultivable area is 3075 hectares which is 81 per cent of the gross scheme area of 3,800 hectares. The remaining 725 hectares is taken up by canals, drains, roads and areas not canalised or out of command.

FIGURE 5·1


MORDILE
SCALE
SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME
THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
AFGOI - MORDILE CONTROLLED IRRIGATION PROJECT
CANALISATION AND DRAINAGE LAYOUT
SCALE AS SHOWN
SERIAL No. SOM 17
PRINTED NOVEMBER 1969
COMPILED SIR M MACDONALD & PARTNERS
HUNTING TECHNICAL SERVICES LIMITED
ELSTREE WAY BOREHAM WOOD HERTS ENGLAND
SIR M MACDONALD & PARTNERS
MARLOWE HOUSE 22 HIGH HOLBORN LONDON WC1
DESIGNED
CHECKED
APPROVED

It is recommended that watering of crops is confined to hours of daylight so that adequate control is achieved and efficient water use maintained. The maximum pumping period is 14 hours per day starting before sunrise so that all the minor canals are filled to capacity before the field outlet pipes are opened and the watering of the fields begins at dawn.

The maximum pumping requirement is 4.75 cumecs and this occurs from 31st October to 19th November. The detailed irrigation requirements are shown in Figure 5.2 but the last 15 days of cotton irrigation are not considered essential. The withdrawal of the irrigation water needed for the Afgoi-Mordile Project would not adversely affect present down-stream irrigation in the Genale area.

The river hydrology is discussed in Section 2.12 and from the hydrographs, (Figures 2.3 and 2.4), it can be seen that in years of low flow there may be some shortage of water in December. In the event of offstream storage being available then this could be used to reduce the deficiency and ensure adequate supplies in all years.

The drainage requirement is very small since most of the heavy storms are likely to be absorbed within 24 hours owing to the high infiltration rate. However in order that the area should dry out as quickly as possible after rain so that interrow cultivation can continue and so that easy access to the scheme is maintained, a full system of minor drains is recommended and has been incorporated in the layout. The excavation from the drains will be used to raise the level of the adjacent roads so that the roads drain quickly and are kept in good condition. Field drains have not been allowed for as the small amount of run-off from a field will flow along the field access roads to the minor drains without causing serious damage. Short lengths of major drains have been included to remove run-off from the scheme area so that there is no health hazard from standing water within the scheme.

5.10 Organisation and Management

A Ministerial Project Committee should be established within the Ministry of Planning which would make policy decisions and issue directives, and be responsible for project financial matters and liaison

with Government organisations for the efficient operation of the project. The Committee would include representatives of both the Somali Government and the country or organisation which finances the development. Government representation should include the Ministries of Planning, Finance, Agriculture (and the Agricultural Development Agency), and Public Works (Irrigation Department) whilst other persons with special knowledge might be co-opted when required. The committee would have a secretary for co-ordination with the project management.

The project management staff together with local representatives of relevant goverment ministries, local government and project tenants should form a small management committee. It is recommended that the senior management staff should comprise:

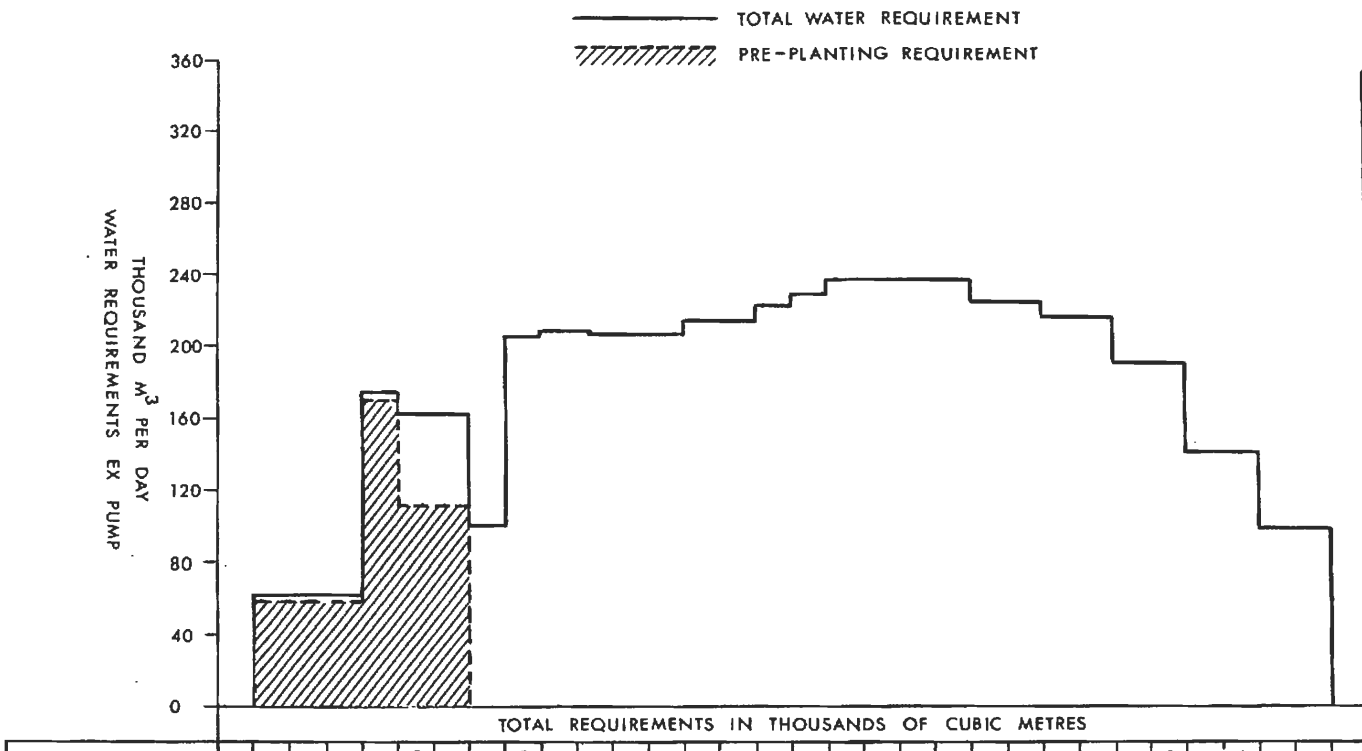
a) Administrative Manager in overall executive charge and with specific responsibility for office, stores, accounting and also sales activities.

b) Field Manager responsible for all agricultural activities.

c) Engineer responsible for the operation and maintenance of irrigation facilities, workshops, electricity and water supplies and building maintenance.

Each of these staff would have an assistant. Because of the acute local shortage of qualified and experienced personnel it is envisaged that the three senior staff members would in the first instance be expatriates. In time the local assistants would become sufficiently experienced to take over the senior posts and it has been assumed that expatriate staff would be phased out gradually.

The Field Manager and his Assistant would supervise two Agricultural Officers each responsible for direct supervision of tenant farmers on his section of the project. It is unlikely that more than two suitable candidates for these posts could be found in view of the shortage of experienced personnel and the needs of other organisations.



MONTH	AUG					SEPT						OCT						NOV						DEC					JAN			SEASON
RICE	–	294·0	294·0	294·0	294·0	231·0	231·0	483·0	483·0	504·0	504·0	504·0	504·0	524·8	524·8	566·8	566·8	609·0	609·0	609·0	609·0	546·0	546·0	504·0	504·0	462·0	462·0	210·0	210·0	–	–	–	12 683·2
COTTON	–	–	–	–	560·0	560·0	560·0	–	525·0	525·0	520·0	517·0	517·0	531·0	531·0	531·0	560·0	560·0	560·0	560·0	560·0	560·0	560·0	560·0	560·0	476·0	476·0	476·0	476·0	476·0	476·0	–	13, 773·0
GARDENS	–	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	19·5	–	585·0
TOTAL	–	313·5	313·5	313·5	873·5	810·5	810·5	502·5	1027·5	1048·5	1043·5	1040·5	1040·5	1075·3	1075·3	1117·3	1146·3	1188·5	1188·5	1188·5	1188·5	1125·5	1125·5	1083·5	1083·5	957·5	957·5	705·5	705·5	495·5	495·5	–	27,041·2

'DER' SEASON WATER REQUIREMENTS

FIGURE 5·2

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Staff other than senior management are available locally although supply is limited and technical ability often lower than desirable.

It is recommended that groups of about 20 tenant farmers should be formed and one of their member be selected as a group leader who would explain management instructions, co-ordinate the work of the group and translate to management the problems and grievances of the tenants. It is essential that each tenant maintains the required standards of husbandry on his holding and the project management will require to take appropriate steps to ensure that tenants fulfil their obligations.

The annual costs of management and of operating and maintaining the project facilities have been estimated and are summarised in Table 5.9.

TABLE 5.9 Annual Costs of the Afgoi-Mordile Project Year by Year in Shs.

Year	1	2	3 onwards
Permanent staff	546,900	844,600	867,800
Irrigation and drainage works	-	125,130	143,130
Workshops and buildings	-	17,200	17,200
Communications	3,000	21,300	28,400
Agricultural equipment	50,000	75,000	75,000
Other services	7,000	46,130	46,130
	606,900	1,129,360	1,177,660

The revenue from sales of crops will provide an income from which both a fixed annual charge to meet the project's loan servicing commitments and a variable amount covering annual management and operating costs may be deducted. The balance will be distributed to the tenant farmers, the amount being related to their respective crop yields.

From the amount so distributed the costs of direct crop production services such as seed, fertilisers, pest control and mechanical cultivations provided by the project will be recovered. In order to prove attractive the project should provide the industrious farmer with an annual income after deduction of charges of the order of Shs. 2, 500 from a 4 ha. holding including the value of any produce from his vegetable garden.

5.11 Source of Settlers

Approximately 750 settlers will be required for the scheme. Most of the families now living in or adjacent to the area would take up holdings. Outside the immediate project area, a number of quite large villages occur along both banks of the river between Afgoi and Audegle. A proportion of the subsistence farmers living in these villages and the Afgoi township, together with those now resident in the scheme area would provide sufficient potential settlers to populate the proposed scheme.

5.12 Infrastructure

In accordance with the recommendations of the experts of the World Health Organisation the three villages now located within the proposed canalised area would be removed.

The estimates have allowed for the laying out of a project village at the south-eastern corner of the scheme which will be joined to the existing Afgoi-Merca road by an all weather road.

This village will house the employees of the scheme and a large proportion of the farmers. Housing has been costed for the eight senior officials and some assistance in kind is proposed for all other staff, but not for the farmers.

An administrative office, workshops, store and decortication plant will be located at this headquarters village and a water supply from two tubewells, with an elevated tank and ring main are included.

Provision has been made for a small electricity generating set to supply power to the wells, senior staff housing and office. A telephone line will be constructed between the pump station at Mordile and to the project office and the existing line from Merca to Mogadiscio would be underslung to provide direct lines from the scheme to both Afgoi and the capital.

To prevent farmers having too far to walk to their fields, two other villages will be cleared and building lots demarcated to the north-west and south-west of the scheme. Each of these villages will have a water supply from a tubewell and a ground level tank.

To allow access from the project village to the pump house and the suggested farmers' village along the Barire track, it is proposed to construct a raised dirt road surfaced in coral rock along the eastern and northern boundaries of the scheme. A short length of a similarly constructed road is included in the estimates to join the other farmers' village to the Afgoi-Merca road.

The estimates show the cost of providing a veterinary clinic, holding compound, dispensary and slaughter area for the project headquarters but it is felt that this social infrastructure should be provided by the Somali Government and for this reason they have not been included in the project cost.

No schools have been costed but the Somali Government would give favourable consideration to giving assistance in kind or cash to allow the local residents to construct schools when the village becomes established.

5.13 Construction Programme and Estimates

The construction of the project is scheduled to take 20 months starting in January of year 1. It is suggested that ordering of mechanical plant, transport and agricultural equipment should commence 9 months before construction and that the expatriate management personnel

are available to help supervise the construction. All minor canals and structures and half the field channels should be completed by March in year 2 so that the groundnut crop can be planted and irrigated. The remainder of the irrigation works should be complete by July of year 2 in time for planting the 'Der' Season crops. All the ancillary works and services should be completed by the end of August of year 2 so that the scheme can operate under normal conditions through its first full cropping season.

There are several contractors in Somalia who are capable of carrying out the earthworks required for the scheme and there are also contractors who could construct the irrigation structures, pump station, roads, buildings and services. However, it is recommended that there is expatriate supervision of all phases of construction and specialist supervision of the installation of mechanical equipment.

The rates used in the estimates are based on quotations from local contractors except for the telephones estimate which is based on a quotation from the Ministry of Communications who have indicated that they would be willing to do the work.

A summary of the estimates for the whole scheme is given in Table 5.10. The item for 'Engineering and Supervision' includes the cost of detailed designs, contract documents and supervision of construction, but does not include the detailed survey work which is included in Item I.A.

TABLE 5.10 Summary of Estimates

Item No.	Description	Amount 000 Shs.	Foreign Exchange 000 Shs.
I.	IRRIGATION WORKS, BUILDINGS AND SERVICES		
I.A.	Preparatory work	58.6	35.2
I.B.	Purchase of land & compensation	160.0	-
I.C.	Pump Station	1,561.5	1,157.8
I.D.	Canal headreach and pool	57.6	10.0
I.E.	Distributaries - Earthworks	1,179.6	530.8
	Structures	607.8	334.3
I.F.	Drains	415.8	200.9
I.G.	Workshops	100.0	80.0
I.H.	Management building	759.9	384.0
I.J.	Other buildings(1)	(57.3)	(24.6)
I.K.	Water supply	411.8	226.5
I.L.	Electricity supply	134.5	108.8
I.M.	Communications	695.0	364.8
II.	AGRICULTURAL PROCESSING PLANT	150.0	132.0
III.	LAND PREPARATION	2,651.0	1,325.5
IV.	AGRICULTURAL EQUIPMENT	2,292.3	2,240.3
V.	CONTINGENCIES	1,123.5	713.1
VI.	ENGINEERING AND SUPERVISION	1,336.0	890.7
	PROJECT TOTAL	13,694.9	8,134.7

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

5.14 Economic and Financial Evaluation

The projected net benefits, annual management investment and replacement costs of the Afgoi controlled irrigation scheme are shown in Table 5.11. Crop outputs have been valued at the projected prices discussed in Section 3.2 and as far as possible inputs have been charged at their real cost to the economy. Farm labour has been valued at an opportunity cost of 2.50 shillings per day based on the findings of the preliminary socio-economic study on the project area. Local managerial staff have been valued at competitive rates but as there is an acute scarcity of trained staff at all levels these rates may understate true 'opportunity cost' to the economy.

The internal rate of return of the project is 8 per cent, annual exchange savings would be in the order of 3,000,000 shillings and the internal surplus generated over and above a minimum farm income of 2,500 shillings could meet approximately 50 per cent of loan service requirements after the sixth year of Development. Since raising revenues from surpluses generated outside of the project might be difficult in present conditions in Somalia implementation of the project under normal loan terms for development capital could place a further burden on the country's already strained domestic budget and foreign debt service commitments. If the project were considered suitable for a soft loan of $1\frac{1}{2}$ per cent the internal surplus generated would be sufficient to meet loan service commitments.

In view of the difficulty of projecting farming performance because of the present lack of knowledge, the Afgoi Controlled Irrigation scheme is only of marginal economic viability. It is therefore recommended that a small scale pilot stage is implemented initially in order that an estimate based on actual performance can be made of the potential return to controlled irrigated farming of the recommended crops before a full scale investment is made.

ABLE 5.11 Afgoi-Mordile Project Internal Rate of Return - (Shs.)

ropping Year	Farm gate Value Rice	Farm gate Value Cotton	Farm gate Value Groundnut	Net Benefits Homestead Lots	Total Benefits	Crop Production Costs				Net Benefits
						Labour	Mechanisation	Other	Total	
1	450,000	525,000	456,750	68,000	1,499,750	238,500	203,250	731,250	1,173,000	326,750
2	1,080,000	1,125,000	913,500	136,000	3,244,500	691,500	406,500	1,419,750	1,517,750	706,750
3	1,440,000	1,425,000	1,029,000	164,000	4,058,000	717,750	406,500	1,410,740	1,535,000	1,523,000
4	1,300,000	1,725,000	1,144,500	164,000	4,833,500	740,250	406,500	1,449,000	2,595,750	2,237,750
5	2,115,000	2,025,000	1,260,000	164,000	5,564,000	765,500	406,500	1,468,000	2,630,000	2,934,000
6	2,256,000	2,250,000	1,375,000	164,000	6,039,000	778,500	406,500	1,467,000	2,652,000	3,387,000

roject Year	Net Benefit	Annual Management Costs	Invest-ment	Replace-ment	Net Cost/ Benefit	Project Year	Net Benefit	Annual Manage-ment cost	Replace-ment	Net cost/ benefit
1		649,400	13,694,900		-14,344,300	21-40	3,387,000	1,055,960	1,341,690	981,360
2	326,750	1,093,030			- 766,280	22				2,331,040
3	706,750	1,345,360			- 638,610	23				2,331,040
4	1,523,000	1,348,560			174,400	24			680,000	1,651,040
5	2,237,750	1,321,760		285,200	630,790	25			285,200	2,045,840
6	2,934,000	1,250,160			1,683,840	26				2,331,040
7-40	3,387,000	1,243,460		1,341,680	801,860	27				2,331,040
8		1,212,160			2,174,840	28			1,341,680	989,360
9		1,212,160			2,174,840	29				2,331,040
10		1,236,160		435,500	1,715,040	30			435,200	1,895,840
11		1,186,560			2,200,440	31				2,331,040
12		1,186,560		665,460	1,534,980	32				2,331,040
13		1,186,560			2,200,440	33				2,331,040
14		1,186,560		1,341,680	858,760	34				2,331,040
15		1,210,360		285,200	1,891,240	35			1,626,880	704,160
16		1,124,960			2,262,040	36			484,000	1,847,040
17		1,124,960			2,262,040	37				2,331,040
18		1,124,960			2,262,040	38				2,331,040
19		1,124,960			2,262,040	39				2,331,040
20		1,148,960		1,662,900	575,140	40				2,331,040

Internal Rate of Return 8%

5.15 Pre-requisites for Successful Implementation

In view of the limited resources available for agricultural development care is needed in development planning in order to channel these resources into those projects giving the best and quickest economic return. Within the Shebelli Valley a number of alternatives require to be considered in deciding the priority of the Afgoi-Mordile Project and in particular the possibility of developing off-river storage and flood control at Johar and its effects on present and possible future projects must be taken into account. Stored water providing assured irrigation during January and February in most years would greatly extend the 'Der' cropping season and would permit the cultivation of suitable perennial crops without the need to provide expensive groundwater for irrigation. It is only within the national and regional context that the desirability of implementing the Afgoi-Mordile Project can be decided.

Other pre-requisites namely the establishment and enforcement of land tenure, water and crop protection legislation, improvement of extension services, encouragement of farmer co-operatives and the provision of farm credit are similar to those discussed in Section 4.15 for the Balad Flood Irrigation Project.

CHAPTER 6

FUTURE IRRIGATION DEVELOPMENT

6.1 Introduction

Chapters 4 and 5 summarise Volumes II and III respectively and it is considered that the Afgoi-Mordile Controlled Irrigation Project is the only controlled irrigation which can be recommended unless regulation of the river is introduced. Flood schemes have been poorly managed in the past in Somalia and generally large quantities of water are wasted. Very small flood inundation schemes should be allowed to continue provided they are well controlled and so long as the river is unregulated.

In Chapter 7 the various possibilities for river regulation and flood control are discussed. It is considered that lack of flood control will endanger existing controlled irrigation areas due to expansion of the swamps and poor bank maintenance upstream of the existing river control points at Genale and Johar.

If regulation of the river is achieved and flood storage is available, then a large increase in the area of controlled irrigation is possible and one method of achieving this is described in the Shebelli River Development Plan.

6.2 Shebelli River Development Plan

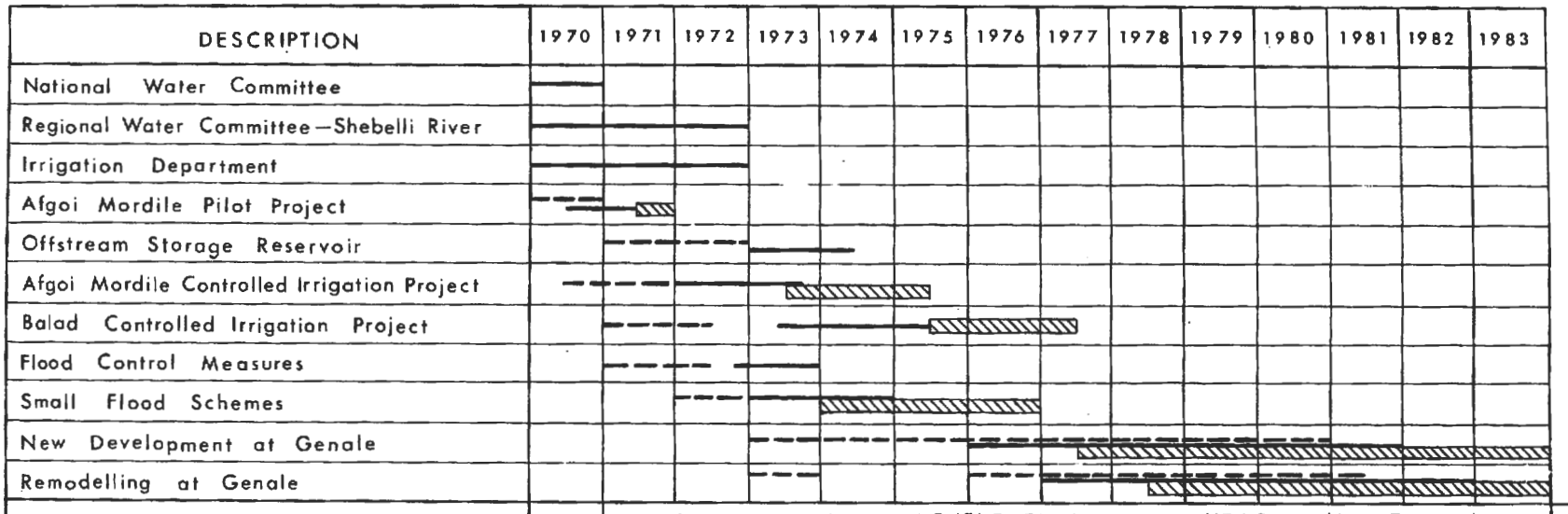
a) General Description and Schedule of Development

The plan and the factors affecting development are described in detail in Volume IV, Chapter 13. The existing banana farms in the Genale-Bulo Mererta area have been assumed to develop as outlined in the Agriculture and Water Surveys report of 1968 with the exception that no cotton will be grown on these areas. The area under crops in pump schemes in the Afgoi region is expected to increase if improved water

availability through storage is promised. The Johar Sugar Estate has plans for further development and these are taken into account by the Development Plan. Other existing farms near Johar which irrigate by pumps are also likely to expand although the total amount of water needed will be small. The annual water requirements for all these existing irrigation schemes were considered together with allowances for losses and domestic uses and in order that the best use may be made of the remaining river flow, all the new development is recommended to grow seasonal crops with a similar cropping pattern to that for the Afgoi-Mordile Controlled Irrigation Project, but the choice of crops may vary. The storage is limited and cannot provide water for perennial crops in a median year and the existing perennial crops will continue to rely on tubewells in low flow periods although the tubewell requirements will be considerably reduced. It has been calculated that a total of 23, 580 hectares of seasonal crops can be supplied every year in the 'Der' season and 5 years in 10 in the 'Gu' season assuming the water requirements are similar to those of the Afgoi-Mordile project. The soils reconnaissance has shown that the best soils are between Balad and Falcheiro and all the new development proposed is along this reach of the river except for one area just upstream of Balad and downstream of the storage reservoir. This area has been included so that the flood inundation farmers along the reach of the river from Johar to Balad will still have a means of livelihood after the implementation of the flood control and storage necessary. Most of the new development is in the Genale-Bulo Mererta area and remodelling of some of the existing irrigation may be necessary. The various parts of the plan are briefly described in the other sections of this chapter and more fully in other volumes of this report. A summary of the Development Plan showing the Schedule of Development of existing areas, areas for remodelling and new development, flood control measures and offstream storage is given in Figure 6. 1. The rate of development has been kept to a level at which the local construction industry should be able to implement most of the works.

SHEBELLI RIVER DEVELOPMENT PLAN

DEVELOPMENT SCHEDULE



DESCRIPTION	EXIST. AREAS	NET CULTIVABLE AREAS DEVELOPED YEAR BY YEAR (HECTARES)													FINAL DEVELOPMENT
		1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	
New Irrigation Projects		100		1434	1541	1940	1955	2000	2550	4070	4310	1700	1700	280	23.580
Existing S.A.C.A. Farms (in use)	21,000								(2000)	(1450)	(1090)	(1710)	(1710)	(3370)	21,000
Pump Schemes	2000				2200										4200
S.N.A.I. Sugar Estate	7000	1000													8000
Flood Inundation	21,500				(2000)	(1000)	(250)								3250
Other Farms u/s Johar	200	800													1000
Total	51,700														61,030

INVESTIGATION AND DESIGN

ORGANISATION OR CONSTRUCTION

FIRST CROPPING SEASON

NOTE:
FIGURES IN BRACKET INDICATE REMODELLED AREAS

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FIGURE 6-1

b) Cost of Development Plan

The total cost of the Development Plan is approximately 150 million Shs. and this expenditure is spread over 14 years. The maximum annual expenditure with the existing schedule is 26 million Shs. If the offstream storage and flood control measures were postponed by one year and the period of construction was increased then the maximum annual expenditure could be reduced to about 20 million Shs. without seriously affecting the rate of development of new irrigation. The year by year development costs are given in Table 6.1.

The costs given for the various parts of the Plan are based on the estimates given in other volumes and the resultant total is intended only as a guide and not as a firm estimate for financing the Plan.

The organisation required to administer and control the supply and use of the river flow and storage is described in Chapter 16 of Volume IV and briefly in Chapter 8 of this Volume. The cost of this management will partly be met by the revenues from water duties and partly from the central government budget.

The cost of the increase in area of the controlled irrigation at Johar Sugar Estate, the Chinese Research Farm, the Egyptian Farm and the pump schemes near Afgoi are not included in the development costs because these will be privately financed and the timing of the investment is indefinite.

6.3 Afgoi-Mordile Pilot Project

The first development on the Shebelli River should be the construction of a small pilot project to confirm that the crops chosen for the Afgoi-Mordile controlled irrigation project are suitable, to evaluate the performance of farmers and machinery and to give opportunities for the training of managerial and technical staff. The size of the pilot project should be large enough to do meaningful experiments with crops and machinery and should be laid out and operated in a manner similar to that proposed for the full project.

TABLE 6.1 Year by Year Development Costs

Item	Year by Year (million Shs.)														
	1970	71	72	73	74	75	76	77	78	79	80	81	82	83	Total
Pilot Project	1.0	-	-	-	-	-	-	-	-	-	-	-	-	-	1.0
Ngoi-Mordile C.I.P.	-	0.7	8.0	5.0	-	-	-	-	-	-	-	-	-	-	13.7
Malad C.I.P.	-	0.5	0.5	3.7	8.0	4.6	-	-	-	-	-	-	-	-	17.3
Offstream Storage	-	1.0	1.0	12.0	13.7	-	-	-	-	-	-	-	-	-	27.7
Flood Control Measures	-	0.2	2.6	4.0	-	-	-	-	-	-	-	-	-	-	6.8
Flood Schemes	-	-	0.1	0.4	0.3	-	-	-	-	-	-	-	-	-	0.8
New Development(1)	-	-	-	0.6	0.5	0.5	8.3	10.4	16.2	17.5	6.4	7.4	-	-	67.8
Remodelled Areas (1)	-	-	-	0.4	-	-	0.5	2.7	1.9	1.5	1.9	1.9	3.8	-	14.6
Total	1.0	2.4	12.2	26.1	22.5	5.1	8.8	13.1	18.1	19.0	8.3	9.3	3.8	-	149.8

(1) This development is in the Genale District.

The proposed area of the pilot project is 108 hectares net cultivable area which will be divided into three 36 hectares standard fields as described in Chapter 5, Section 5.9, and more fully in Volume III. Plans to implement this project are in hand and the estimated cost is approximately one million Shs.

6.4 Offstream Storage Reservoir and Flood Control Measures

These items are discussed fully in Volume IV and a brief description is given in Chapter 7. The flood control measures outlined should ensure that no damage by flooding occurs downstream of Mahaddei Uen where nearly all the existing and proposed development is situated and the off-stream storage will improve the existing supplies to the S.A.C.A. banana plantations around Genale and will guarantee adequate supplies to all the new development during the 'Der' season. These measures are scheduled early in the Development Plan so that flood dangers are quickly reduced and the benefits to existing areas are immediate. Also the pumping requirements at Afgoi-Mordile are reduced if the storage is completed before that project since the minimum river level during pumping periods will be higher than if no storage exists.

The net volume of storage available for irrigation downstream is approximately 13,000 hectare metres when the reservoir is full and the estimated cost of providing this is 27.7 million Shs. The cost of the flood control measures is estimated to be 6.8 million Shs.

6.5 Afgoi-Mordile and Balad Controlled Irrigation Projects

The Afgoi-Mordile Project is described in detail in Volume III and a short summary appears in Chapter 5 of this volume. The scheme has a net cultivable area of 3075 hectares and the cropping pattern is shown in Table 6.2.

TABLE 6.2 Cropping for Afgoi-Mordile Project

Crop	Area in Hectares	
	'Der' season	'Gu' season
Rice	1,500	-
Cotton	1,500	-
Groundnuts	-	1,500
Gardens	75	75
Total	3,075	1,575

The total cost of the project is approximately 13.7 million Shs. and the construction is expected to take 20 months.

The Balad Project was included in the Development Plan so that existing inundation and flood scheme farmers could continue their farming operations after the offstream storage reservoir has been built. The existence of flood control outlets and an offstream storage reservoir will reduce the peak river level downstream to a point at which flood inundation becomes impossible. It is envisaged that the scheme will be similar in layout and organisation to the Afgoi-Mordile Project with a pumped supply serving 36 hectare fields during daylight hours only. The net cultivable area will be 3895 hectares of which 95 hectares will be gardens for farmers' free choice crops and the other 3800 hectares will be for seasonal rotation crops with 100 per cent cropping in the 'Der' season and 50 per cent cropping in the 'Gu' season. It is estimated that the project would take 2 years to build at a cost of 17.3 million Shs.

6.6 Small Flood Schemes

Although flood irrigation is not generally recommended for the river, three small schemes have been included in the plan, all of them upstream of Johar and downstream of Mahaddei Uen. Taken together, these schemes would inundate approximately 3,250 hectares and require 10 cumecs for 25 days. This water could be made available in time of high flood when the flow passing Mahaddei Uen exceeds 110 cumecs or the

flow passing Johar exceeds 60 cumecs. A study of the records for Mahaddei Uen shows that water would be available sometime during the 'Der' season, in 9 out of 10 years. The approximate cost of these schemes is estimated to be 0.8 million Shs.

6.7 New Development and Remodelling in Genale and Bulo Mererta Areas

The area to be considered for possible irrigation development comprises 70,000 hectares gross and is shown on Figure 6.2. About half this area is included in the existing irrigation systems which together now serve just under 21,000 hectares net of operating farms. Most of these farms are primarily concerned with banana plantations and they are supplied from the Genale canal system which was established from 1925-26 onwards. In addition there are, however, nearly 11,000 hectares of abandoned farms, previously supplied by the Genale canals, most of which are on the left bank between Goluen, Scialambot and Genale.

The Bulo Mererta project was established between 1955 and 1959 and intended to serve 25,000 hectares but the canal distribution systems were never completed and only about 1,000 hectares of farms are operative. The completed works include three primary canals, arbitrarily sited, which cannot function properly and also two regulators in the river at Coriole and Falcheiro.

For the future development in the Genale and Bulo Mererta areas it is proposed that all irrigation should be from canals offtaking at the existing Genale barrage and at a second barrage to be sited at Gaivero. The Gaivero barrage with a holding level of 69.0 metres would be more suitable than the present arrangement with the regulators further downstream at Coriole and Falcheiro and these structures may not be needed in the future.

Much of the original Bulo Mererta area can be served from the Gaivero site. Two new primary canals, the Goluen and Farhani, are proposed for the left bank area and on the right bank a primary canal migl be aligned to follow the river bank downstream to Gaivero and Coriole vil

There are a number of faults in the Genale canal system which could be eliminated by remodelling of the canals. The faults are summarised below:-

(1) System is now only partially operative due to abandoned farms.

(2) Wasteful use of water due to lack of control and poor condition of regulators.

(3) Insufficient secondary canals for distribution - this causes watering difficulties.

(4) Some farms have to pump all their irrigation water.

(5) Canals have excessive command; this is causing seepage from some canals which may result in roads becoming flooded.

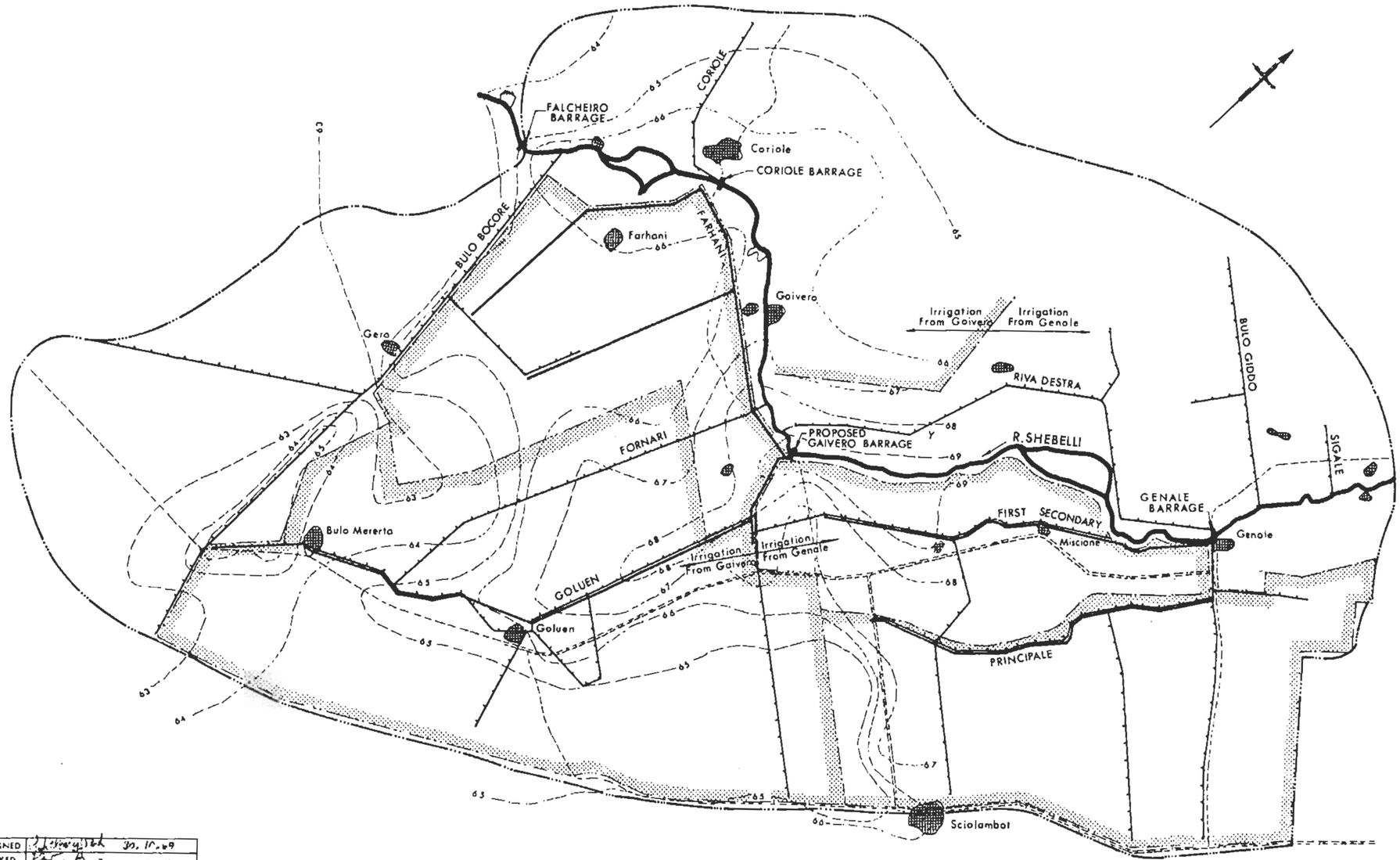
(6) Standing water in pools and swamps adjacent to canals constitute a hazard to health.

The extent of remodelling and development which is possible will be limited by the available water in the river. The proposed off-stream reservoir south of Johar will provide an additional 18,000 hectare metres for use during the 'Der' season. The additional water has to be shared between use on the existing banana farms in the S. A. C. A. concession and for development of new farms in the area where the use will be for seasonal crops.

The supply will enable remodelling of 11,300 hectares and new development of 16,500 hectares to be carried out on the left bank as shown in Table 6.3. Allowance is made for watering seasonal crops on 100 per cent of the available area during the 'Der' season for the new areas and for irrigation of the banana plantations in 9 out of 10 years until mid-February and in 5 out of 10 years until mid-March.

Parts of the Genale Canal System are illustrated in the Photo Plates 1 and 2.

FIGURE 6-2



LEGEND

- RIVER CHANNEL
- EXISTING CANAL
- PROPOSED CANAL
- PROPOSED IRRIGATION BOUNDARY
- BOUNDARY FOR SOIL SURVEY
- SURFACED ROAD
- UNSURFACED ROAD
- CONTOURS IN METRES A.S.L. 67
- VILLAGE

Base map compilation by Lockwood Survey Corporation Ltd. from 1:30,000 Scale uncontrolled mosaics (1962 photography)

SCALE

Km 1 0 1 2 3 4 5 Kms.

DESIGNED	[illegible] 30.10.69
CHECKED	[illegible] 30.10.69
APPROVED	[illegible] 30.10.69

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

PROPOSED REDEVELOPMENT OF GENALE - BULO MERERTA AREA

SCALE AS SHOWN

SERIAL No.	SOM 32
PRINTED	NOVEMBER 1969
COMPILED	SIR M. MACDONALD & PARTNERS

HUNTING TECHNICAL SERVICES LIMITED
LAND USE & AGRICULTURAL CONSULTANTS
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in Association with
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TABLE 6.3 Genale and Bulo Mererta Left Bank. Existing and Possible New Areas for Proposed Remodelling

	Area in hectares (Net cultivable)		
	Existing Farms in Use	Proposed New Area	Total
Offtake at Genale Barrage:			
Principale	3,420	3,400(1)	6,820
Primo Secondario	3,370	280(1)	3,650
Offtakes at Proposed Gaivero Barrage:			
Goluen	3,450	8,550	12,000
Farhani	1,090	4,310(2)	5,400
Total	11,330	16,540	27,870

Note: (1) All abandoned farms.

(2) Mainly land not previously developed.

If development is to be carried out on both sides of the river then only part of the left bank remodelling shown in Table 6.3 can be implemented because of the limited available water supply. It is therefore important to carry out soil surveys and detailed contour surveys to determine the most favourable areas for development before finalising the project plans.

The total cost for the remodelling of 27,900 hectares on the left bank is estimated at 82.4 million Shs. of which 67.8 million Shs. is needed for 16,500 hectares of new development and 14.6 million Shs. is for the remodelling of the canalisation serving 11,300 hectares of operating farms.

6.8 Private Development

All the existing controlled irrigation on the Shebelli River is privately owned with the exception of the Johar Sugar Estate in which the Government has a controlling interest but is managed by expatriates and for the purposes of this Plan is considered to be private development.

The largest area of private development is at Genale where there are approximately 21,000 hectares of farms in use within the S.A.C.A. concession areas. As described in Section 6.7 some of this area is scheduled for remodelling but there is no extension planned.

There are many pump schemes in the Afgoi district, most of which are abandoned. It is considered likely that the prospect of a more reliable water supply will revive these schemes. A strict enforcement of water use licence regulations will be required to prevent this expansion causing uneconomic use of water. The present area under crops in this region is approximately 600 hectares and the plan envisages intensification of existing farms and expansion so that the final area developed should be 4,200 hectares of which 2,100 hectares would be under crops during the 'Der' season.

The Sugar Estate at Johar has plans for expansion and these are allowed for in the Plan. The final net cultivable area is expected to be 8,000 hectares of which 7,200 hectares will be under perennial crops.

The Chinese Research Farm at Johar is experimenting with tobacco and paddy rice and a full development area of 500 hectares has been assumed in the Plan.

A small farm run by an Egyptian company just upstream of Mahaddei Uen has been growing cotton and groundnuts and its present area is about 100 hectares, the final development is assumed to be 500 hectares.

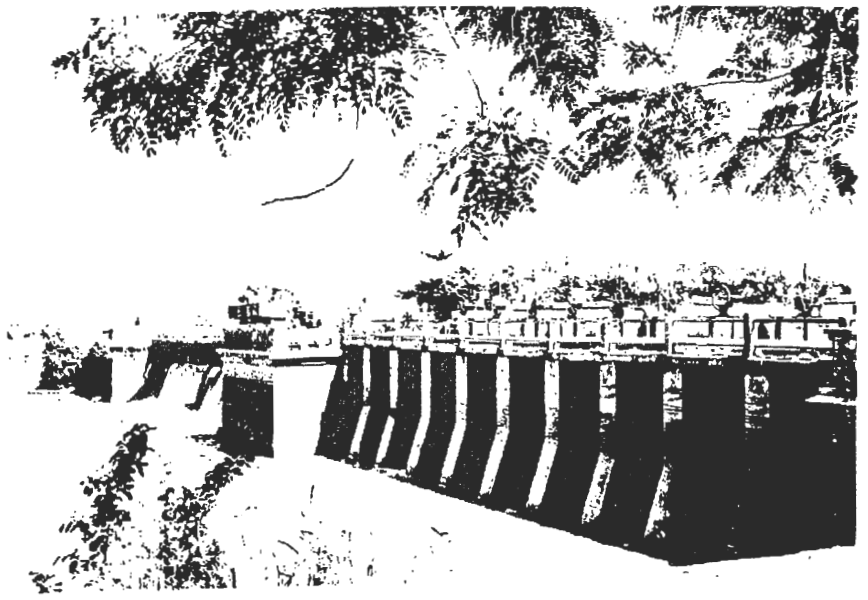
6.9 Paddy Rice Production in Swamp Basins

In the swamp basin area located between Uebi Haharro and Soblalle Pass a limited area of land is cultivated around the edges of the swamp in years of average flood.

In 1968, aerial reconnaissance showed that the areas that had been planted to maize had been flooded by the abnormal rise in the water level in the swamp due to the sustained high river flows passing Falcheiro.

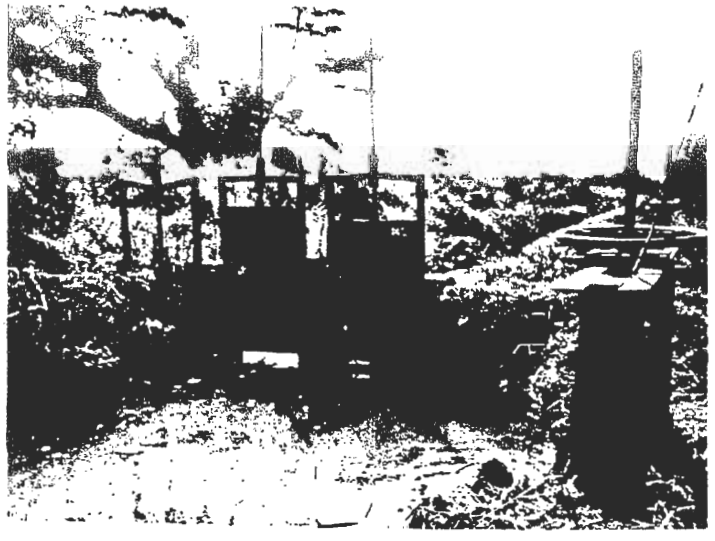
After the offstream storage is built and the flood protection works are operative north of Makaddei Uen the quantity of water reaching the swamp will be greatly reduced. It may then be possible to utilise the edges of the swamp basins for paddy rice cultivation.

Investigations should be made as soon as possible to measure the salinity of the water in the existing basins to determine whether it is within the range that rice cultivation would accept. Attempts by both vehicle and boat during this project to reach these basins failed. Should paddy rice cultivation prove feasible the problems of access and health hazards will also need to be solved if the area is to be developed.



Genale Barrage
from downstream.

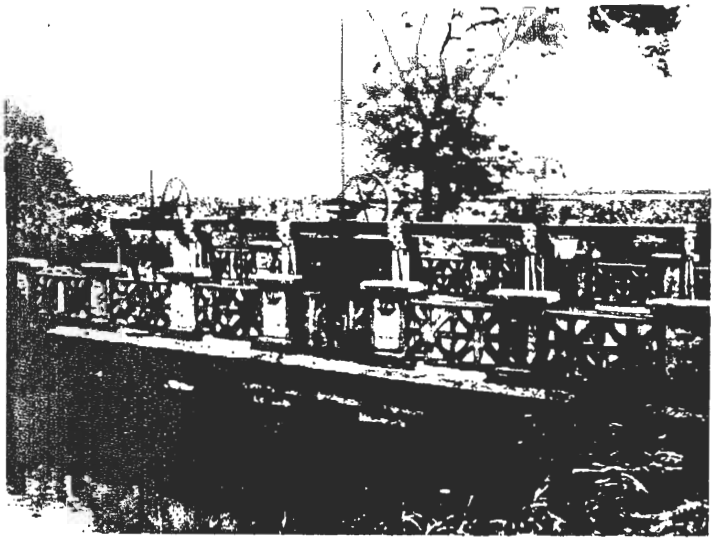
New road under
construction
Genale to Goluen,
March 1969.

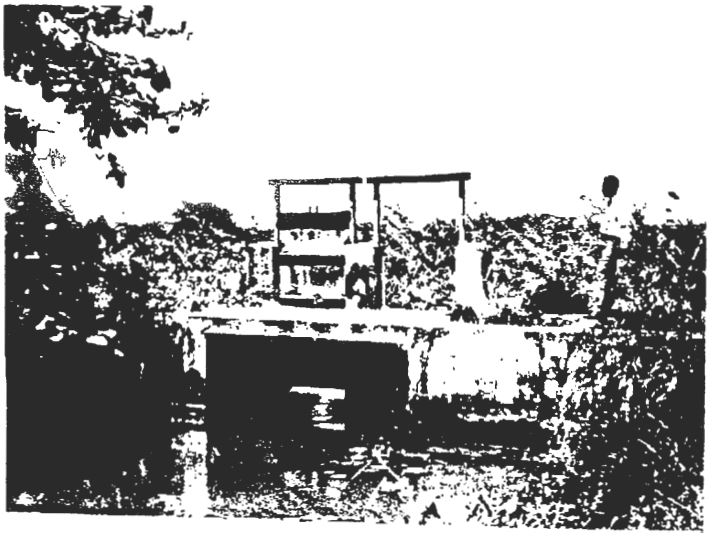


Cross Regulator and
Offtakes on 2nd Secondary
Canal. Note holes in
raised gates.

2nd Secondary Canal Head Regulator from downstream.
Gates closed but leakage fills canal.

Cross Regulator at Km. 4.8 On Principale Canal and Head Regulator for 3rd Secondary Canal - gate at left side.





4th Secondary Canal Head Regulator. Gates and frames require replacement.

CHAPTER 7

RIVER STORAGE AND FLOOD CONTROL

7.1 On River Storage

Two dam sites were investigated on the Belet Uen to Bulo Burti reach of the river which is the only reach in Somalia where on river storage is possible. Both sites are topographically poor with long embankments required. The two sites are at Giglei and Elo Geibo.

The Giglei site is 60 kilometres downstream of Belet Uen and the Elo Geibo site is 32 kilometres upstream of Bulo Burti. There are rock outcrops in the river valley at both sites.

A geological reconnaissance at both sites was carried out and the detailed report can be found in Appendix XII, Volume IV/VA. Both sites have foundation and construction problems but the geologist's report indicates that the better site is Elo Geibo.

Cost estimates for the construction of both dams were prepared and the Elo Geibo site proved the cheaper. With the information at present available, the Elo Geibo dam site appears the more attractive.

A plan of the Giglei reservoir is shown on Figure 7.1 and of the Elo Geibo reservoir on Figure 7.2. Both sites are described in detail in Chapter 14, Volume IV and a brief description of the Elo Geibo dam and reservoir is given here.

a) El Geibo Reservoir

A simplified reservoir operation study was carried out for the Elo Geibo dam site using the flow records from 1951 to 1968 for Belet Uen. The water requirements from the river downstream of the dam were assumed to be those outlined in the Shebelli River Development Plan which is described briefly in Chapter 6 and more fully in Volume IV.

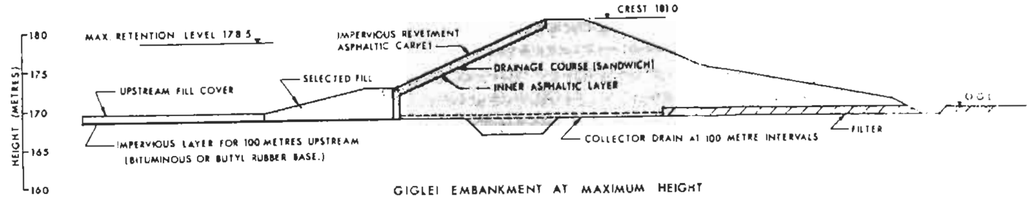
The losses due to evaporation and seepage were assumed to be 200 mm per month. The operation study showed that, with a reservoir capacity of 75,000 hectare metres, the downstream requirements could have been met throughout the study period, except for March 1956, February 1966 and March 1967. With inflow between Belet Uen and Bulo Burti taken into account these deficiencies are eliminated with the exception of two weeks in March 1956. The operation provides some flood flow regulation except in years of sustained high flows. The worst month for spillage would have been May 1968 when approximately 70,000 hectares metres would have been passed downstream which is equivalent to 265 cumecs. Therefore to ensure flood control the measures outlined in section 3 of this chapter are required even with a dam of this size. With an adequate flood warning system of high rainfall in the Ethiopian catchment area the peak dam spillage could be considerably reduced. The silt deposited in the reservoir should not prove a serious problem with the proposed operation; only seven thousand hectare metres storage being lost in 40 years.

b) Dam Design and Construction

The retention level to store 75,000 hectare metres at Elo Geibo would be 161.2 metres above mean sea level referred to Survey and Mapping Department datum. The reservoir has a long fetch of over 20 kilometres and a freeboard of 2.3 metres is proposed and hence the crest level of the dam would be 163.5.

The embankment length would be 8.75 kilometres, the alignment was chosen to avoid badly fissured rock outcropping up to 2 kilometres from the right bank. The geologist's report does not recommend a design with an impermeable core and so the embankment shown on Figure 7.2 is suggested as a feasible alternative provided that a proportion of gypsum can be tolerated in the material forming the bank. The silty deposits forming the surface layer have a low permeability and leakage will be small except where sand pockets occur. These pockets should be

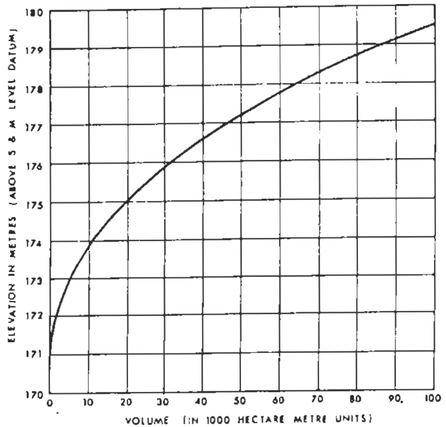
FIGURE 7-1



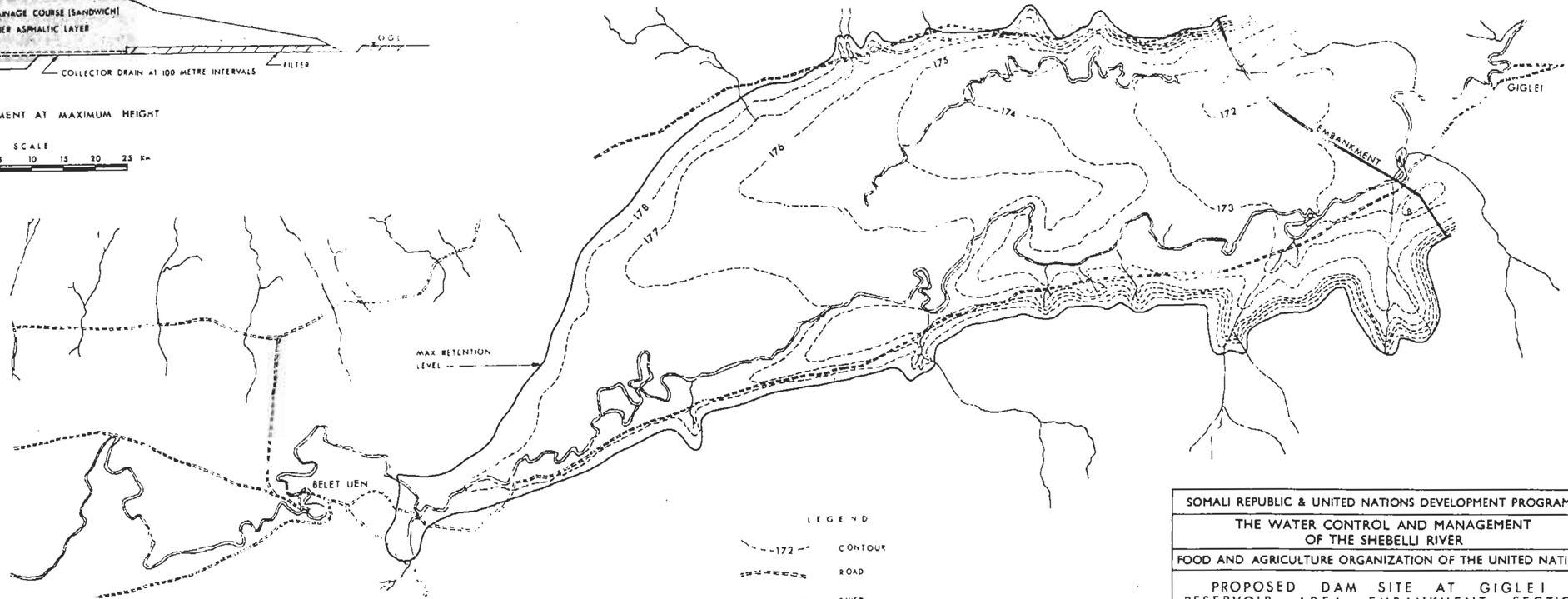
GIGLEI EMBANKMENT AT MAXIMUM HEIGHT

SCALE

Km. 5 0 5 10 15 20 25 Km.



GIGLEI RESERVOIR CAPACITY CURVE



DESIGNED		17-9-69
CHECKED		30.10.69
APPROVED		30.10.69

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THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

PROPOSED DAM SITE AT GIGLEI RESERVOIR AREA, EMBANKMENT SECTION AND CAPACITY CURVE

SCALE AS SHOWN

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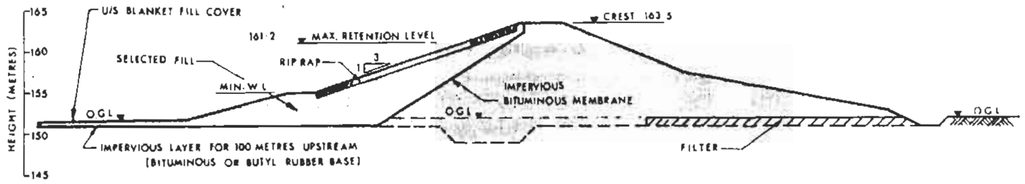
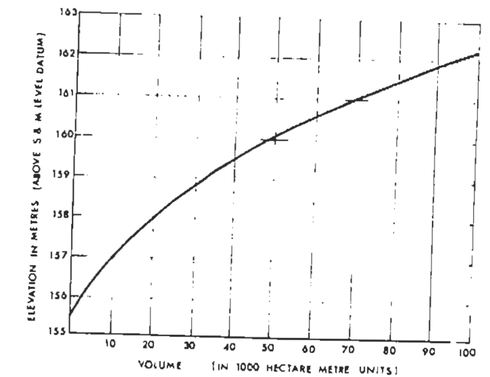
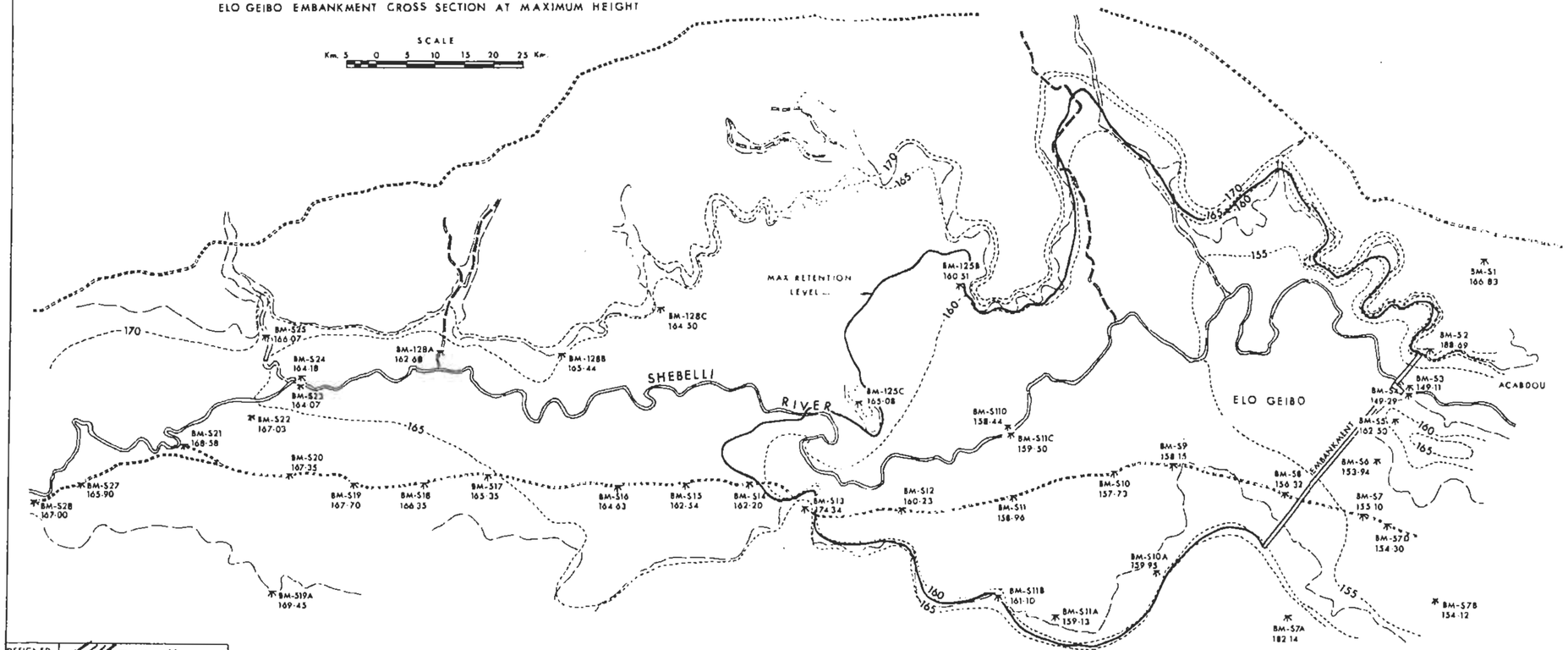
FIGURE 1-2



ELO GEIBO EMBANKMENT CROSS SECTION AT MAXIMUM HEIGHT



ELO GEIBO RESERVOIR CAPACITY CURVE



DESIGNED	12-8-69
CHECKED	20.10.69
APPROVED	20.10.69

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

PROPOSED DAM SITE AT ELO GEIBO RESERVOIR AREA EMBANKMENT SECTION AND CAPACITY CURVE

SCALE AS SHOWN

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removed and grouted or replaced with impermeable material. The grouting of fissures in the limestone bedrock would also be necessary. The embankment material would be mainly silt with a low clay content and some gypsum. It is considered necessary to protect the main fill with an impervious membrane covered with selected fill. The protection against wave action would be conventional rip-rap. To prevent 'piping' a layer of butyl rubber or bituminous carpet extends from the membrane 100 m upstream at maximum bank height reducing towards the flanks in proportion to the head of water. The carpet is itself protected by selected fill and to accommodate foundation seepage a blanket filter is provided. A ditch at the toe of the downstream face will carry away surface run-off.

A spillway structure incorporating deep sluices with radial gates passing 60 cumecs is provided and the main spillway should be capable of passing the full Ethiopian flood flow together with local storm run-off. This is likely to be as high as 450 cumecs. The bed rock being badly fissured, the grouting costs will be very high, and the suitability of the local rock as aggregate is unknown. The spillway site is on the right bank of the river.

c) On River Storage Cost

In view of the construction problems mentioned in the previous section it is obvious that the cost of construction will be high. The cost of the Elo Geibo dam is, at present, estimated to be 98,000,000 Shs. and the breakdown of the cost is given in Volume IV. The estimates are based on reconnaissance level investigations and detailed studies may show that considerable savings could be made, but existing information does not justify a lower estimate.

7.2 Offstream Storage

Several sites were investigated as possible storage areas and of these the best is considered to be south of the Johar Sugar Estate on the

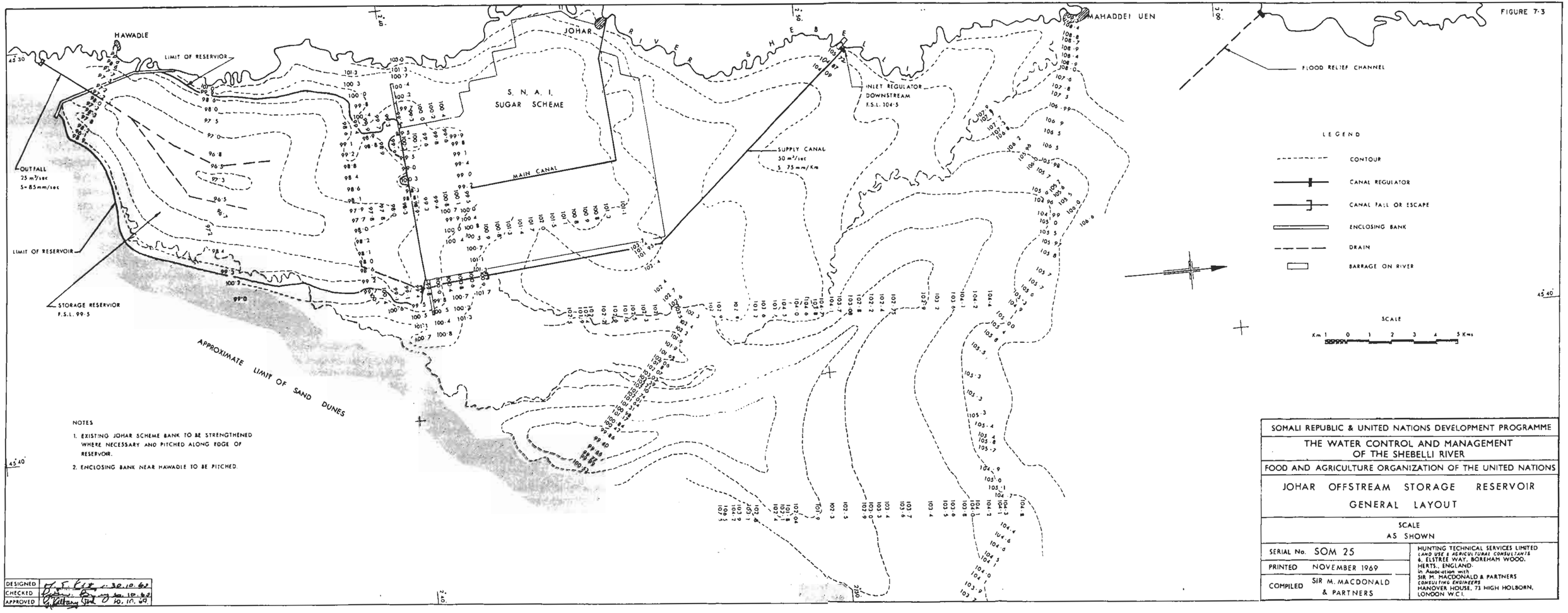
left bank of the river. A reconnaissance survey of the area was carried out and this revealed a low lying swamp area generally lightly bushed except near the sand dunes to the East. The dunes, river banks and Johar Sugar Estate provide good boundaries on three sides of the reservoir. A short length of bank to the south will seal off the storage basin. The general layout of the offstream storage proposals is shown on Figure 7.3.

a) Storage Capacity and Regulation

The capacity of the reservoir for various retention levels is shown on Figure 7.4. The retention level chosen for the proposed reservoir is 99.5 metres above mean sea level (S. and M. datum). This level was chosen for two reasons. Firstly this retention level is the highest which can be achieved every year, and secondly a higher level would require a longer and higher closing bank considerably increasing the cost of the reservoir. A study of 17 years records showed that the volume of water stored would be sufficient to meet the irrigation demands outlined in the Shebelli River Development Plan until mid-February 9 years in 10 and until mid-March 5 years in 10. The seepage and evaporation losses were assumed to be 7 mm per day and rainfall was considered to be non-effective.

In order to be sure of filling the reservoir in the worst year all flows exceeding 50 cumecs in the river after 1st August must be extracted with a maximum diversion of 50 cumecs. The methods of operation for filling and discharge of the reservoir are shown in Tables 7.1 and 7.2 respectively.

FIGURE 7·3



NOTES

1. EXISTING JOHAR SCHEME BANK TO BE STRENGTHENED WHERE NECESSARY AND PITCHED ALONG EDGE OF RESERVOIR.
2. ENCLOSING BANK NEAR HAWADLE TO BE PITCHED.

DESIGNED	30.10.69
CHECKED	30.10.69
APPROVED	30.10.69

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

JOHAR OFFSTREAM STORAGE RESERVOIR GENERAL LAYOUT

SCALE AS SHOWN

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FIGURE 7·4

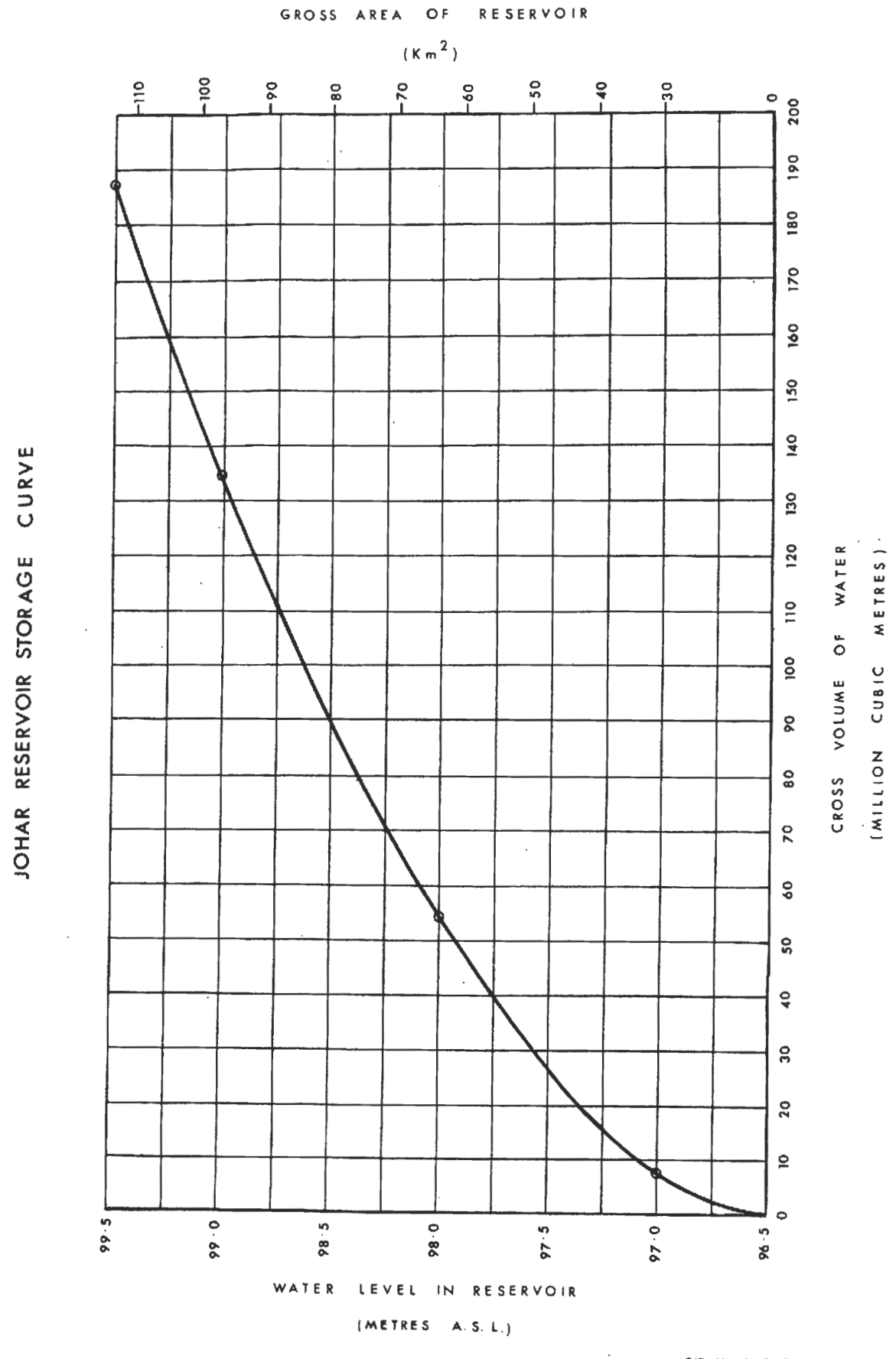

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FIGURE 7-5

FLOOD RELIEF CHANNEL

OLD RIVER CHANNEL
(DISCONTINUOUS)

Bula Burti

Dadublé

Dinlawe

Mansur

FLOOD RELIEF CHANNEL

FLOOD RELIEF CHANNEL

Mahaddei Uen

R. SHEBELLI

Johar

PROPOSED OFFSTREAM STORAGE SUPPLY CANAL

SCALE

Km. 0 1 2 3 4 5 Km.

DESIGNED		30.10.69
CHECKED		30.10.69.
APPROVED		30.10.69.

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME

THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

RIVER SHEBELLI

POSSIBLE FLOOD RELIEF SITES

SCALE
AS SHOWN

SERIAL No. SOM 30

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TABLE 7.1 Storage Extraction for Various River Flows (cumecs)

River Flow at Maheddei Uen	0-50	60	70	80	90	100	110	120	130	140
Extracted for Storage	0	10	20	30	40	50	50	50	50	50
Net River Flow	0-50	50	50	50	50	50	60	20	80	90

TABLE 7.2 Reservoir Discharge Operation (cumecs)

River Flow at Reservoir Outlet	30 and above	25	20	15	10	5-0
Storage discharge	0	5	10	15	20	25
Total	-	30	30	30	30	30

b). Design and Construction of Storage Reservoir

The supply canal with a capacity of 50 cumecs takes off the left bank of the river at a point just upstream of the village of Muriale where the river has broken its banks in recent years. The canal route follows the eastern boundary of the Johar Sugar Estate and discharges into the reservoir at km 23. The outfall drain has a capacity of 25 cumecs, and is approximately 2.5 km in length.

Allowance has been made for drainage channels within the reservoir to drain the low areas in the reservoir basin. The closing embankment will be a rolled earth fill bank and have a freeboard of 1.5 m above maximum retention level. The material for the bank should be taken from inside the reservoir area, this material has a low permeability. The bank will be protected against wave action by rubble pitching. The bank at the southern boundary of the sugar estate will be strengthened and pitched in

a similar manner. The head regulator and outfall structures will be of reinforced concrete construction with vertical lifting gates. Two falls have been allowed for on the supply canal and these would either be constructed in reinforced concrete or as gabion weirs.

c) Cost of Storage

The total estimated cost for the survey, design and construction of the offstream storage proposals described in this chapter is 22,138,000 Shs. The breakdown of this cost is given in Volume IV, Chapter 13, Table 13.4. The estimates are based on a reconnaissance survey carried out in April 1969 and assume reinforced concrete structures and allow for the haulage of large amounts of stone into an area with poor access facilities.

7.3 Flood Control

a) Present Flooding

The existing self regulation of the Shebelli River in Ethiopia limits the peak flow entering Somalia to less than 400 cumecs. Floods of this magnitude threaten the town of Belet Uen but otherwise there is little flooding north of Bulo Burti. Where flooding does occur it is well contained and causes no damage.

From Bulo Burti to Gailalassi the river is well contained and little spillage occurs. Downstream of Gailalassi serious spillage occurs. Large riverine depressions are filled between Gailalassi and Afgoi Addo and downstream of Afgoi Addo large areas on both banks are flooded. On the left bank downstream of Daduble a depression 30 km long and 1.5 km wide takes flood water from the river in several places.

From Mahaddei Uen to Falcheiro the channel capacity is halved from 140 to 70 cumecs and with most of the major irrigation farming lying on this part of the river flooding problems are more serious than upstream of Mahaddei Uen.

Between Mahaddei Uen and Johar lack of maintenance has caused frequent breaches in the banks upstream of Johar weir. Between Johar and Balad flooding occurs on both banks and although causing little damage the water is uncontrolled and largely wasted. From Balad to Afgoi there is no overbank spillage but downstream of Afgoi spillage occurs in many places along the river towards Genale. This flooding is caused by lack of bank maintenance, loss of control by inundation farmers and hippopotami breaking the weak banks. There is no flooding between Genale and Falcheiro barrages but below Falcheiro barrage the high flows of recent years have caused encroachment of the swamp basins on to valuable farm lands, and more are threatened. Avai has been cut off for at least two years and the flooding beyond Avai is largely caused by local run-off from catchment areas north of the river. High flood flows from the Shebelli River do reach the swamps between Bogia and Ballei Ier.

Beyond Ballei Ier only local run-off from the north causes flooding which cuts the main Gelib to Mogadiscio road and this area is independent of Shebelli River control.

It is considered that the Shebelli River flows have not reached the Juba for many years and that the flows which reach the Juba come from a catchment area north of Avai, Ballei Ier and Camsuma.

b) Flood Control Measures

Belet Uen town could most easily be protected by building a bund round the town to such a level that the flood waters would be excluded.

In order to protect the existing irrigation schemes or those proposed in the Shebelli River Development Plan, the high flood flows must be prevented from reaching the irrigated areas. The development proposals will themselves help to reduce the amount of water reaching the swamps by making better use of the water and the offstream storage will provide some regulation of the flows below Mahaddei Uen but in years of sustained high flow this is not sufficient. The existing flooding upstream of Mahaddei Uen

does little damage and the river should be encouraged to spill the large flows in this section. In the past it has been found difficult to provide protection by means of flood banks since these are expensive and require considerable maintenance which is difficult due to poor access to many areas. It is therefore considered that the best solution is to remove large quantities of water at fixed points on the river upstream of Mahaddei Uen and to forbid inundation farming below Mahaddei Uen where it is inefficient and dangerous.

If the Shebelli River Development Plan is to be implemented then complete protection for the Middle Shebelli (Mahaddei Uen to Falcheiro) can be achieved by the construction of two 50 cumecs flood control structures. Figure 7.5 shows one arrangement for removing the flood flows just upstream of Mahaddei Uen. The peak discharge at Mahaddei Uen is normally 140 cumecs but after the break at Muriale it increased to 160 cumecs. It is considered that by removing 100 cumecs the flow at Mahaddei Uen could be reduced to less than 100 cumecs and with normal usage downstream there would be no flooding. The flow from the two diversion structures should be conveyed to the low ground on either side of the river and spread over the plains to provide water and grazing for cattle.

The cost of the flood control structures together with the necessary earthworks is 6,827,000 Shs. A breakdown of this cost is given in Table 14.1 of Volume IV.

These proposals and estimates are based on a brief reconnaissance, and a detailed survey should be made to establish that the flood waters can be diverted as suggested.

CHAPTER 8

RECOMMENDATIONS FOR CONTROL AND MANAGEMENT OF SHEBELLI RIVER WATERS

8.1 Water Rights

During the Agriculture and Water Surveys Project in 1963 the importance of the Somali Government introducing a law governing water use was realised and a special study under the auspices of the Food and Agricultural Organisation produced a report "Water Legislation and Administration" which included a draft water law, which was published in 1964.

The Somali Government adopted this draft and the Organisation of Water Law, No. 13 was passed and became effective on 1st August 1966.

Unfortunately there is no evidence that the provisions of the Act have been implemented. It is essential that the Act be enforced if the orderly development of the Shebelli River is to be achieved.

Article 7 of the Act provides for the Water Department to keep a Register of Users. Immediate steps should be taken to complete this register as soon as possible. Until it is made up the existing rights along the river cannot be assessed nor can the priorities be established. A large number of pumps are located between Balad and Barire but only a few are active. The survey to complete the Register would provide the opportunity of determining which of them have been used recently and still retain some rights. Article 10 of the Act allows for any right to be revoked if the user has not made use of it during the preceding year.

8.2 Establishment of River Authority

The present Water Law in Articles 14 and 16 provides for the setting up of water committees at both national and regional levels.

A single regional water committee is proposed for the whole of the Shebelli River basin with the following members:-

1) Ministry of Planning and Commerce (Representative).

2) Ministry of Public Works (Representative).

3) Chief Engineer, Shebelli Division, Irrigation Department.

4) Director, Water Department.

5) Ministry of Agriculture (Representative).

6) Ministry of Justice (Police Representative).

7) Ministry of Health (Representative).

The representatives from the Planning and Public Works would act as co-chairmen of the committee.

In the future, if the Shebelli River Development Plan is to be carried out the Regional Water Committee for the Shebelli basin will have a most important part in ensuring its implementation. The Committee will have to review water permit applications of both existing and new users. They will be responsible, assisted by technical advice from the Irrigation Department, for compiling the first Register of Users for the river.

As the Development Plan proceeds the relocation of farmers and the allocation of farms within the new controlled irrigation areas will require fair judgement, skill and tact if the Plan is to be made a success.

The drafted but unpublished Regulations which have been discussed in Section 8.1 provide in Article 16 that the Committee in its function can include factual and technical investigations concerning the granting of water permits, ascertain existing water use and declare restricted use areas and assist the Water Department with planning and administration of water use on a local, regional or a watershed basis. It may also provide technical assistance to individuals, water users' associations, local administrations and other users and all aspects of water utilisation.

If the Committee can, with the required technical assistance from the proposed Shebelli Division, carry out these functions efficiently it will provide a firm base for the future good management of the waters of the Shebelli River basin.

8.3 Cost of Providing Services

a) Revenue from Water Use

At the present time the Somali Government does not collect any rates or fees from water users along the Shebelli River.

The Water Law No. 13 discussed in Section 8.1 does not enumerate any water charges, but these are detailed thoroughly in the drafted, but unpublished, Regulations provided for in Article 20 of the Law.

The charges proposed are contained in four schedules as follows:

Schedule 'A'	Sundry Fees
Schedule 'B'	Surface Water Permit Application Fees
Schedule 'C'	Groundwater Permit Application Fees
Schedule 'D'	Water Rates

The annual revenue from water use would come mostly from the water rates in Schedule 'D' (5) General Irrigation and these are tabulated in Table 8.1.

Details were obtained from the Ministry of Finance of the budget provisions made to the Irrigation Section in 1968 and 1969 and the actual expenditure made in 1968 on maintenance and works. These are shown in Table 8.2 below.

TABLE 8.1 Water Regulations - Schedule 'D' (5) - Water Rates

Crop	Rate Shs.		
	Government owned canal	Privately owned canal	Private Pumping Plant
a) Banana	50	25	15
b) Grapefruit	50	25	15
c) Sugar Cane	50	25	15
d) Cotton	20	10	5
e) Sesame	20	10	5
f) Maize	15	10	5
g) Beans	15	10	5
h) Groundnuts	15	10	5
i) Other Crops	As assessed by National Water Committee		

Note:- a) to e) per hectare per annum.
f) to i) per hectare per planting.

TABLE 8.2 Expenditure and Provision 1968/69 (Shs.)

Item	Budget Provision		Actual Expenditure
	1969	1968	1968
Maintenance of canals	270,000	270,000	202,000
Irrigation Works and Construction of Canals	100,000	170,000	90,000
Total	370,000	440,000	292,000

Calculations show that, had the water rates contained in Schedule 'D' (5) been collected in 1968, about 435,000 Shs. would have been due from farmers with crops grown on controlled irrigation alone. In addition to this sum, there would have been the revenue due from the areas cropped by flood and inundation farmers.

This total revenue would more than have offset the provision made in the budget in 1968 and was well above the actual expenditure for canal maintenance and irrigation works.

At final development, if the Shebelli River Development Plan is implemented, the revenue from the water rates from the controlled irrigation farmers' areas will increase to approximately 1,250,000 Shs. and this can be used to finance some of the expenditure of the new Irrigation Department discussed in Chapter 9.1.

The Regulations only provide for an annual charge based on the type of crop and area irrigated. It is felt that an annual fee should also be charged to all permit holders based on the quantity of water allowed under his permit irrespective of usage. This will tend to reduce the quantities requested by existing and future users.

b) Collection of Revenue

The field staff of the Irrigation Section stationed along the river Shebelli would record the areas of each crop being watered each season and make a return to the Licencing Section.

The Licencing Section would then bill each user for his water rates and annual fee as outlined in the section 8.3.a).

No difficulty should be experienced in collecting these accounts because if a water permit holder does not pay, the Water Law No. 13 covers this contingency and a water permit may be revoked by the Water Department under Article 10, which reads:-

"Permissions may be revoked by the Water Department of the Ministry of Public Works;

f) If the user does not pay the water fees within 60 days from the date he receives the order to pay from the appropriate authorities".

CHAPTER 9

RECOMMENDATIONS FOR IMPROVED GOVERNMENT SERVICES

9.1 Irrigation Department

a) Present Situation

The present Irrigation Section is part of the Water Department of the Ministry of Public Works. It has a staff of some sixty-seven with fifty-four of these stationed along the Shebelli River between Johar and Falcheiro. The Section does not operate in the Juba River area and thus is entirely concerned with irrigation along the Shebelli River.

The Head Office is located in Mogadiscio and has very few records of any kind. The Head of Section changed three times whilst the present project was in progress. It is considered that this position should be held by a qualified engineer who can retain the post for some time if the efficient running of the Section is to be achieved.

b) Future Proposals

In the future the status of the Section should be raised to that of Department with probably three Divisions, Shebelli, Juba and Northern Somalia as shown in the organisation chart on Figure 9.1. The Shebelli Division should be set up immediately to be able to supervise the implementation of the Shebelli River Development Plan but the other divisions would only be staffed as the development in the other regions warranted.

The organisation chart shows the proposal for the division to be sub-divided into four Sections, Irrigation, Licencing, Flood Control and Maintenance.

The function of these Sections is described in detail in Chapter 16 of Volume IV but briefly the Irrigation Section supervises the areas being

irrigated and investigates new licence applications, and the Flood Control Section operates the flood control structures and the filling and emptying of the offstream storage. The Licencing Section keeps the Register of Users, deals with permits and water fees and rates, and keeps the hydrological records up to date from the daily returns submitted from the Irrigation and Flood Control Sections. The Maintenance Section would ensure that the equipment, plant and water control structures under the Divisions' control were kept in top operating condition.

No attempt has been made at this stage to detail an establishment for the proposed Shebelli Division other than in Figure 9.1. The establishment already provided for the existing Irrigation Section supplemented by the Hydrological Section from the Survey and Mapping Department will form the basis of the new Department. It will be essential that fully qualified engineers be available to fill the posts of Chief Engineer and to head the Irrigation and Flood Control Sections. It may be necessary during the initial period for the Somali Government to recruit expatriate engineers to work with and to train suitably qualified local staff.

9.2 Hydrological Service

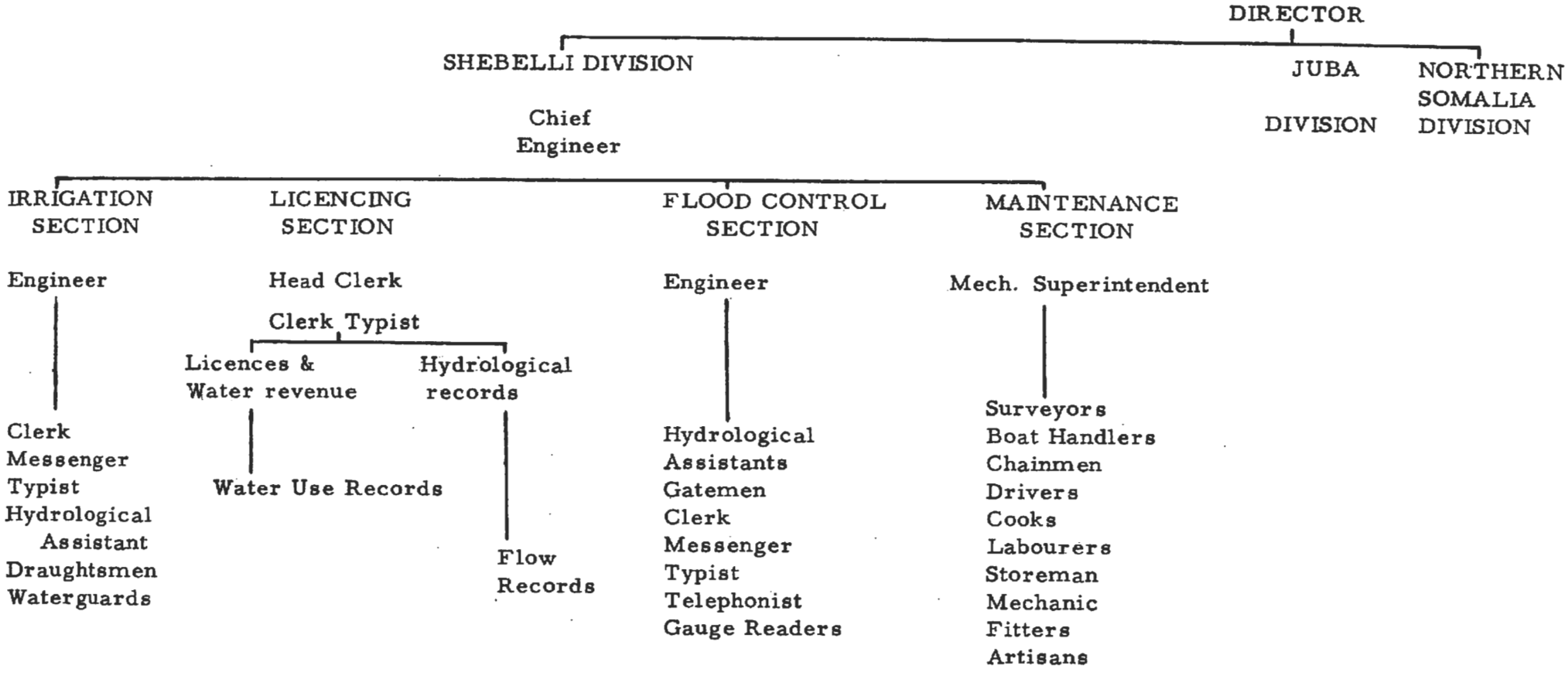
The existing situation where the gauges along the Shebelli River are read by three departments of Government and S.N.A.I. at Johar is not very satisfactory.

The Hydrological Section now within the Survey and Mapping Department should be transferred to the proposed Irrigation Department when it is set up and all the records will be kept by its Licencing Section, see Figure 9.1.

The records taken at Genale, Belet Uen and Johar by Government and S.N.A.I. should also be reported to this Licencing Section so that the complete records are available at one office.

IRRIGATION DEPARTMENT ORGANISATION CHART

Figure 9.1



In the future it is suggested that the Army and Police Post personnel at gauging stations should be trained to read the gauges and should take over recording. In this way the gaps in records that occur when the present gauge readers are sick or on holiday will be avoided. This will lead to a more efficient service, reduced expenditure and allow for gauges to be established at any point along either the Shebelli or Juba where a Police or Army Post is located.

9.3 Extension Services

At present the extension services suffer from an acute shortage of adequately trained and experienced staff and of finance with the result that extension is largely ineffective. The shortages are aggravated by the fact that agriculture and livestock are separated in two Ministries namely Agriculture and Natural Resources. In addition separate agencies for Livestock Development and Agricultural Development have been set up under the Ministries of Rural Industry and Natural Resources respectively resulting in duplication of effort and of the administrative machinery for the support of the field extension personnel.

As in other branches of the civil service, staff appointments are made less on ability than on political expediency and it is not uncommon for the efforts of enthusiastic and qualified junior officials to be suppressed by their less able superiors.

In order to achieve the optimum results from the money allocated for extension a thorough reorganisation of the present system is obviously necessary. Present financial considerations preclude any appreciable increase in total expenditure on extension. The reorganisation must therefore be aimed at economies through the removal of unproductive elements, the elimination of duplicated efforts, the unification of the supporting administrative services and the concentration of effort in those localities and spheres of activity which offer the greatest potential for increased productivity.

As a first step in the re-organisation it is recommended that agriculture and livestock be combined under the Ministry of Agriculture and that the Agricultural Development Agency and Livestock Development Agency be absorbed by the Ministry of Agriculture. By doing so considerable economies should be possible in administration.

Secondly the ability of each member of the extension services should be assessed and personnel unable to execute the duties required should be removed from their posts. The resulting vacancies would provide avenues for promotion for the more able junior officers and thereby give an extra incentive for increased effort.

The number of extension officers assigned to an area should be related to the number of farmers and the intensity of cropping and animal husbandry in that area. Shortage of qualified and experienced staff and financial stringency may result in most thinly populated and uncultivated areas having no extension service but the present Somali economy cannot afford the luxury of extension staff in areas of low production whilst areas of potentially high production are understaffed.

Any economies resulting from the above recommendations will enable increased transport and other vital tools of extension to be provided. To be effective an extension officer must be able to travel continually in his area and meet all the farmers at frequent intervals. The appointment of an extension officer however able he might be is unjustified if adequate travel facilities cannot be provided.

However well qualified an extension officer may be it is his practical ability rather than theoretical knowledge and his ability to communicate new techniques to the farmer which will ultimately achieve results. To keep extension officers informed of new inovations the research organisation must provide instruction courses in which extension officers can gain practical experience of the new methods.

At present there exists too great a gap between research findings and field practice. New techniques must be thoroughly evaluated under field conditions before research experience can be translated into farm practice.

9.4 Research

At present agricultural research is largely confined to the Afgoi Research Station and its substation for rainlands agriculture at Bonka. The importance of these stations for the future of agriculture development must be stressed in view of the proposed withdrawal of the U. S. AID Wyoming University research personnel over the next few years. It is unlikely that Somalia can maintain the present research effort without help with both staff and finance and international assistance to maintain and extend agricultural research in Somalia will be necessary.

So far research has very largely been concentrated on variety selection. Whilst this work is important more study is required in other important fields including cultivation methods, irrigation techniques and pest, disease and weed control. Little information is available on the economics of agricultural practices and the evaluation of crop production techniques under field conditions is vital for future planning.

The establishment of a pilot project for controlled irrigation as a preliminary to the Afgoi-Mordile Project has been recommended to confirm the many assumptions made in the execution of the feasibility study for that project. The pilot project could subsequently be used for field trails of new irrigated farming techniques and similar trial areas and demonstration farms should be set up in other important areas of both irrigated and rainfed agriculture and livestock production.

9.5 Animal Health and Crop Protection

Currently a systematic programme of vaccination for rinderpest control is in progress and inocculation for control of contagious bovine pleuropneumonia is also being undertaken simultaneously. A gradual expansion of the animal health service is planned through a training scheme for animal health assistants. In view of the importance of the livestock industry to the Somali economy these developments are encouraging. Under the extensive range conditions existing in Somalia communications is a major problem. Well organised local animal health centres are necessary and adequate transport facilities for staff must be provided. The possibility of establishing grazing lots at strategic locations has been proposed. Animals would be purchased from the nomadic herdsmen and sorted, the best being sent for fattening, others for slaughter for domestic consumption and inferior animals for factory processing. Such centres would be valuable as local centres for animal health to which the nomads would bring their herds thus eliminating much of the travelling necessary to treat animals on the open range.

Whilst a crop protection service is in existence relatively little is achieved in pest and disease control largely due to lack of finance and problems of communications. It would appear necessary through financial stringency largely to restrict the activities of crop protection to the more intensive areas of production where regular crop inspection to identify the presence of pests and diseases and their subsequent control can be properly organised.

Particularly in the case of cotton cultivation the enforcement of existing legislation to control the incidence of harmful pests and diseases by the elimination of crop residues and the preservation of a 'dead' season between crops should be given priority in areas where cotton is to be extensively grown.

9.6 Agricultural Education

Apart from the newly instituted training school for animal health assistance few facilities for agricultural education exist at present but an agricultural school is proposed at Afgoi. It is vitally important that suitable courses in practical agriculture be provided in order to train personnel for subsequent employment in extension work. In addition facilities for the training of farmers in new cultivation methods are required. The establishment of centres for field trials and demonstration would provide facilities where short practical courses in crop and animal husbandry methods could be given for local farmers.

The orientation of the curriculum in rural schools towards agriculture would also be valuable for the training of future farmers in good husbandry techniques and could be achieved through co-operation between local education and agricultural extension departments.

9.7 Social Services

Areas which are selected for development should have priority for the provision of social services although these should be provided from funds normally allocated by the Government and not financed from development loan capital.

The provision of medical services is of primary importance. The study of health in the Shebelli Valley made by the World Health Organisation as part of the project for the Water Control and Management of the Shebelli River indicated a high incidence of schistosomiasis, ascaris and helminthes infestations and malaria. Schistosomiasis was particularly prevalent in areas of existing irrigation with infestations as high as 100 per cent of village population. All have a severe debilitating effect and successful treatment and eradication could result in an appreciable increase in individual productivity with marked financial benefit to both the farmers and to development projects.