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 II

THE BALAD FLOOD IRRIGATION PROJECT FEASIBILITY STUDY

NOVEMBER 1969

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GLOSSARY OF HYDROGEOLOGICAL TECHNICAL TERMS

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

Symbols and Units Used

Distance, Area, Volume and Weight

Metric measurements have been used throughout the report.

Monetary Units

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

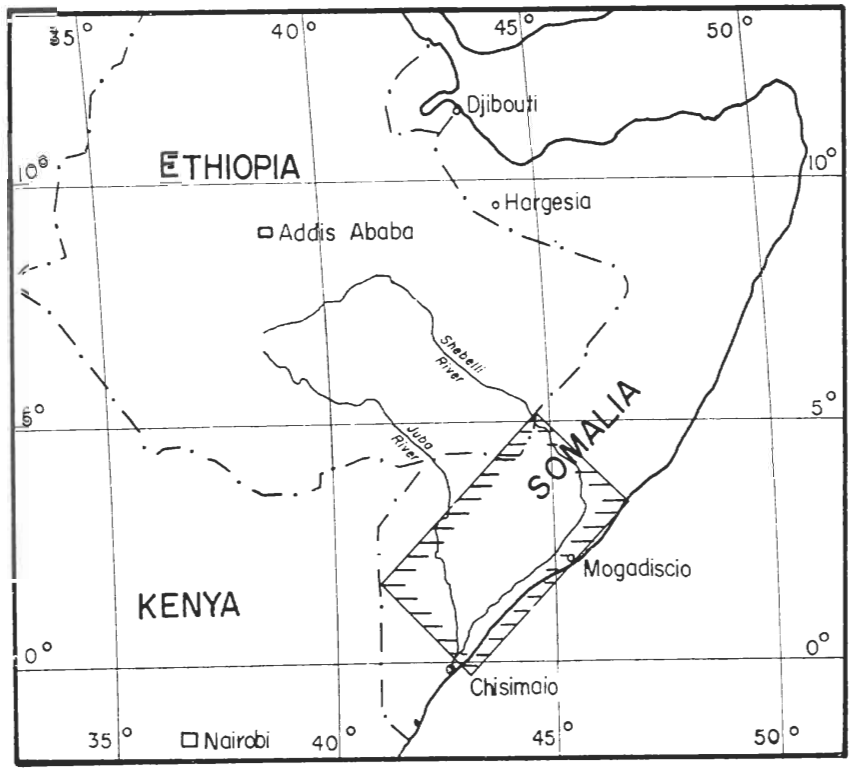
Shs 7.14 = U.S. $ 1.00

Conversion Factors

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

GLOSSARY OF LOCAL TERMS

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



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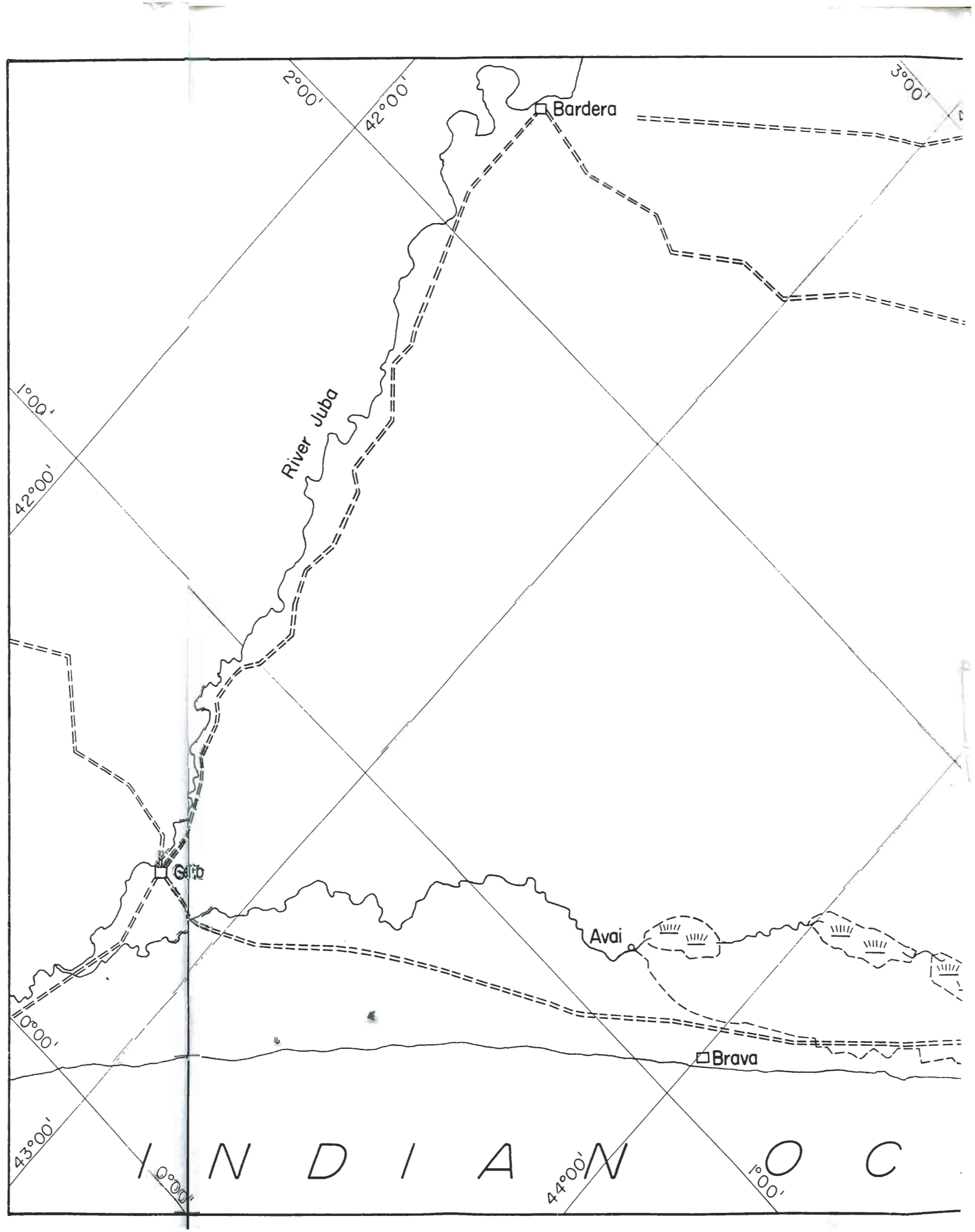

SOMALI REPUBLIC & UNITED NATIONS DEVELOPMENT PROGRAMME	
THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER	
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS	
LOCATION MAP	
SCALE 1:1,000,000	
SERIAL No.	HUNTING TECHNICAL SERVICES LIMITED *LAND USE & AGRICULTURAL CONSULTANTS* 6, ELSTREE WAY, 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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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* 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 II - Balad Flood Irrigation Project, Feasibility Report; the others being Volume I - General 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.

* 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.

To ensure effective management, steps must be taken to improve extension and research services and it will be necessary to encourage the formation of co-operatives and provide credit facilities.

It is recommended that within the Shebelli Valley as a whole, the development of off river storage (as described in Volume I of this Project Report) should be implemented, which would permit a 30,000 hectare expansion of controlled irrigation, thus precluding development of the Balad Flood Irrigation Project.

It is further recommended that in the event of off river storage being implemented, a 3,900 hectare controlled irrigation project be developed in the Balad area to provide an alternative livelihood for farmers presently engaged in flood irrigated cultivation in the area.

CONCLUSIONS AND RECOMMENDATIONS

Following the feasibility study of the Balad Flood Irrigation Project the following conclusions were reached.

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

Providing existing natural flows in the Shebelli River during the period from late August to early October are maintained or not appreciably reduced by upstream abstractions, a sufficiently reliable supply of water is available to flood irrigate a cropped area of 7, 200 hectares.

The selected location at Balad is very suitable for a flood irrigation project but would be equally well suited for development of a 3, 000 hectare controlled irrigation project. The topography and soils of the area are both suitable for irrigation development.

The Balad Project should be a settlement project and would be suitable for settlement of nomadic people.

On the basis of information obtainable on suitable crops and cultural practices, the Balad project, under effective management could provide an increased output amounting to Shs. 4, 925, 000 annually as against a capital expenditure of Shs. 28, 522, 000 and an annual operating and maintenance cost of Shs. 974, 500 excluding loan servicing charges and replacement costs. This results in an internal rate of return which varies between 7 and 9 per cent depending on the value taken on the opportunity cost of the farmers' labour. The Cost/Benefit ratio is of the order of 1:1. 25 taking the opportunity cost of capital as being 7 per cent and with a zero opportunity cost for the farmers' labour.

The foreign exchange portion of the capital cost would be equivalent to U. S. $ 2, 356, 000 while the annual foreign exchange income and servicings generated by the project are estimated to be U. S. $ 1, 225, 000.

CHAPTER 1

BASES FOR PROJECT PLANNING

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

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

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

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

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

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

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

f) Economic studies to include an assessment of potential markets, an economic and financial appraisal of the proposed project and an analysis of the effects of development on the national and regional economies.

The Project for the Water Control and Management of the Shebelli River was a follow up project to the UNDP/SF Agriculture and Water Surveys - Somalia completed in 1966 and the information at reconnaissance

level contained in that project report was used as the foundation of the present study.

The recommendations which are included in this report are based on the assumption that present natural river flows from the catchment in Ethiopia and particularly those occurring at the onset of the flood season in late August and September are maintained.

In all fields of investigation the serious lack of basic data resulted in the need to make a number of estimates in the feasibility analysis based upon experience in other countries. Should it be decided to proceed with implementation of the Balad Flood Irrigation Project proposal these estimates should be verified as early as possible either on a pilot scale or on completion of the first development phase in year 1 of development.

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

CHAPTER 2

THE PROJECT AREA

2.1 Location and Reasons for Selection

The Balad Flood Irrigation Project area is 10,000 hectares in extent of which some 7,000 hectares could be cropped. It lies on the right bank of the Shebelli River downstream of Balad and to the west of the Balad to Johar main road.

Irrigation water for the project would be abstracted at a site some 2 km upstream of the offtake for the existing Balad Co-operative Scheme.

Following a brief soils and engineering reconnaissance during December 1967 and January 1968, this area was selected for the Flood Irrigation Feasibility study. Alternative locations on the right bank of the river at Mahaddei Uen and on the left bank at Barire downstream of Afgoi were considered. The soils of the Barire area had already been subjected to long periods of inundation, which may have rendered them less suitable for flood irrigation. Furthermore, the Barire area could, at a later stage, be developed as an extension to a 3,000 ha. controlled irrigation scheme located upstream for which a feasibility study has also been executed.

Soils at Mahaddei Uen also appeared to be inferior to the soils at Balad and previous reports had indicated that extensive flooding of the area could occur during high river flows. The reported volume of flood water involved, inferred the need for extensive flood protection works to safeguard development of this area and the costs involved would have been disproportionate to the scale of development envisaged. Subsequent studies of topography in this area and observation of flooding during very high river flows have shown previous reports of serious flooding there to be erroneous, but it was then too late to reconsider the selection of the area for study.

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

TABLE 2.2 Expectation of accumulated rainfall in mm at monthly intervals over 'Gu' and 'Der' cropping seasons

Season	Period	Accumulated rainfall normally exceeded	
		5 years in 10	9 years in 10
'Gu'	April	145	70
	April-May	235	145
	April-June	245	170
	April-July	255	190
'Der'	October	60	0
	October-November	140	45
	October-December	170	70
	October-January	200	95

Source: Derived from same sources as Table 2.1.

Temperatures in the Shebelli Valley remain relatively uniform throughout the year, the hottest periods being February to April and October to November. Mean monthly maximum temperatures range from 29 to 36°C and mean monthly minimum temperatures remain uniform at 21 to 22°C.

Relative humidity is highest during the April-June and October-November rainy seasons and during the July-August 'Hagai' season and monthly means range from 65 to 75 per cent.

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

Recorded wind velocities give monthly averages between 150 and 350 km per day being highest in February-March and July-September. Sunshine averages range from 4.5 hours per day during the rainy seasons to 9 hours per day and open water evaporation was of the order of 5.5 mm per day during the rains increasing to 7.5 mm per day in the driest months.

2.3 Water Resources

River flow records over a period of seventeen years for Balad gauging station were studied to determine the expectation of seasonal river discharge quantities and are shown graphically in Figure 2.1. The site at which water would be abstracted for the Balad Flood Irrigation Project lies upstream of the gauging station but the results obtained are applicable to the off-take site. Present use and possible future demand downstream of the off-take must be taken into account when assessing the availability of water for a flood irrigation project at Balad. Present downstream use is estimated at 12 cumecs but a minimum flow downstream of the off-take of 20 cumecs has been assumed. The supply canal feeding the existing co-operative flood scheme located about 2 km downstream of the proposed intake site requires a river level of approximately 93.00 metres (75 cumecs) to ensure full flood. In 1968 this canal was used only with very small flows and the scheme was not watered. As far as could be ascertained the canal is not used until late October and November so that the proposed project could abstract large quantities of water in September and early October without interfering with the existing scheme.

The water required for the proposed project has to be applied in a single application and in order that full benefit is obtained from the November rains, agronomic considerations require planting to be completed as early as possible in October. Study of the available flow records show that abstraction of the required canal flows could commence in three years out of four by 6th September. Basin land forms, areas and

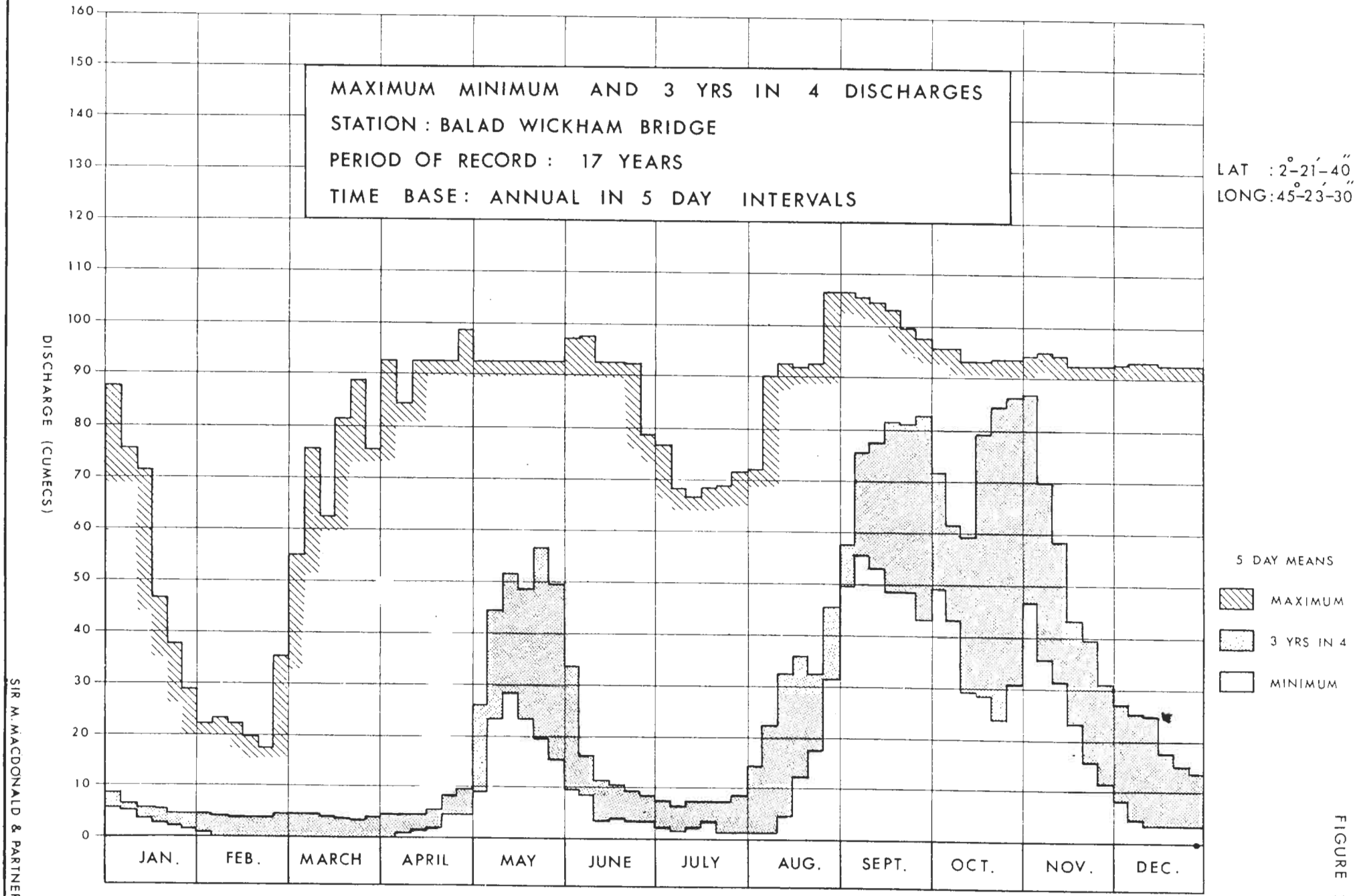
MAXIMUM MINIMUM AND 3 YRS IN 4 DISCHARGES
STATION : BALAD WICKHAM BRIDGE
PERIOD OF RECORD : 17 YEARS
TIME BASE: ANNUAL IN 5 DAY INTERVALS
LAT : 2°-21'-40"
LONG: 45°-23'-30"
DISCHARGE (CUMECS)
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
JAN.
FEB.
MARCH
APRIL
MAY
JUNE
JULY
AUG.
SEPT.
OCT.
NOV.
DEC.
5 DAY MEANS
MAXIMUM
3 YRS IN 4
MINIMUM
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FIGURE 2.1

soil infiltration characteristics require a canal of 40 cumecs capacity flowing for 31 days to complete the watering. Thus watering should be completed by 7th October or possibly a little earlier as watering could take place prior to 6th September using flows lower than canal design capacity.

During the period proposed for extraction, September and early October, the water quality has been very good with, in 1968, a salinity of less than 300 parts per million and a sediment concentration of less than 500 parts per million. A complete chemical analysis was made of a water sample taken from the river near the proposed off-take site in late August 1968. The full analysis given below confirms the excellent quality of the water.

E. C. at 25° mmho: 0.49

Sediment: 295 p.p.m.

Composition of dissolved salts:

Na	0.8 meq/l	Carbonate	0.1 meq/l
K	0.2 "	Bicarbonate	3.15 "
Ca	3.25 "	Chloride	0.6 "
Mg	1.0 "	Sulphate	1.3 "

2.4 Topography

The topographic map, Figure 2.2, shows the area to be gently undulating with old river levees along the northern boundary and with higher ground adjacent to the present river channel forming the southern boundary. Other ridges divide the area into three natural basins.

Two sample areas each of 250 hectares were levelled in greater detail along traces cut at 200 metre intervals in order to provide information of local variations in level necessary for irrigation engineering design and estimation of quantities.

2.5 Soils and Vegetation

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) using field profile descriptions and chemical analysis results. Two soil Orders were identified in the area, namely Entisols and Vertisols (Table 2.3).

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

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

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

Previous studies of infiltration at the Afgoi Research Farm indicated a steady infiltration rate of approximately 0.4 cm/hour after rapid initial infiltration in dry soil through cracks. Two further field tests in the Afgoi area confirmed this infiltration value which may be used for the similar soils of the Balad area. It is not possible to forecast accurately the effects of irrigation on the soils over a long period. The possibility of changes arising in hydraulic conductivity due to the presence of salts and sodium in the irrigation water must be borne in mind. Reduction in permeability would affect the time taken for the required flood irrigation application to infiltrate into the soil, resulting in possible underwatering or delay in planting.

Soil moisture retention characteristics were measured on undisturbed core samples from eight sites, typical of the more important soil series. Available moisture is defined as the differences in moisture content of the soil between Field Capacity and Permanent Wilting points. A soil suction of 0.3 atmospheres is frequently taken as the Field Capacity condition, but under flood irrigation conditions, a value of 0.1 atmosphere suction would seem more applicable for this condition after an extended period of flooding and subsequent drainage. A soil suction of 15 atmospheres is taken as being equivalent to the permanent wilting point. Using 0.1 atmosphere suction as field capacity, the soils can retain between 20 and 25 per cent v/v available moisture, but if the value of 0.3 atmosphere is used available moisture is only 12 to 15 per cent. Thus 1 metre depth of wet soil contains at the most 20 to 25 cm of moisture available to the plant.

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

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

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

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

d) Texture, five textural classes are recognised.

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

f) Profile characteristics affecting drainage and root development.

The results indicate that the land in the area is predominantly class 2 and class 3 being moderately to well suited for irrigated cropping. Classes 4 and 6 land is generally confined to ridges which would not be inundated or cropped but could be used for grazing.

Approximately 82 per cent of the area is bush covered, the remainder being either cultivated or has been cleared and cultivated in the past with little regeneration of bush. A further 17 per cent of the area is covered with regenerated bush comprising mainly Comiphora spp. with some Acacia nubica, A. nilotica and Dobera glabra with extensive open grassy spaces. Another 43 per cent of the area has denser cover of the same species and Acacia seyal, A. bussei, Cordia gharaf, Grewia spp., Dichrostachys glomerata, Euphorbia spp. and Salvadoria persica with few grassy spaces. The remainder of the area is covered by impenetrable Dischrostachys glomerata thicket.

A total area of some 6,970 ha will require to be cleared of bush and root ploughed before development can proceed.

2.6 Population

The project area is sparsely populated and only a very small part is cultivated. The township of Balad is the largest settlement near to the project area and other villages are located along the Shebelli River and north of Balad along to main road. Two surveys of the population of the area have been made, one in 1963 and another in 1966, the results of each census being shown in Table 2.5.

The figures for the two surveys indicate an increase in the number of families over the period 1963-66 and it is likely that the trend has continued since 1966 although no later statistics are available. The increases appear to be in Balad township and in the larger villages; the smaller isolated villages are probably decreasing in population.

The proposed Balad Flood Irrigation Scheme will require some 1,100 farmers when fully implemented. It is evident from the population data that such numbers could not be found in the immediate locality of the scheme, especially as a considerable number of farmers from Balad, Gululei and Farah Gululei already cultivate land in the existing Balad Co-operative Flood Scheme and adjacent lands or land served by lesser flood canals near the river.

TABLE 2.3 Soil Classification. Balad.

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 1all	medium/fine overlying medium/coarse	< 4
	Gl 1a21)	medium/fine overlying	< 4
	Gl 1a22)	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		
	G13 11	medium/fine overlying fine	< 4
CHROMUSTERT (Old Alluvial)	Sr		
Udic Chromustert	Sr 1		
	Sr 111)	medium/fine overlying	< 4
	Sr 112)	fine	> 4
Udorthentic Chromustert	Sr 21		
	Sr 211)	medium/fine overlying	< 4
	Sr 212)	fine	> 4
FLOOD PLAIN SLACKWATER			
VERTISOLS			
PELLUSTERT	Sc		
Udorthentic Pellustert	Sc 11		
	Sc 111	medium/fine overlying fine	< 4
CHANNEL REMNANT (Levee Soils)			
ENTISOLS			
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 stratifications	< 4

TABLE 2.4 Land Classification for Flood Irrigation Schemes

Class	1	2	3	4	6	Symbol
Minimum soil depth to different texture class (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 ESP 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	clay loam to permeable clay	clay loam to moderately permeable clay	sandy clay loam to moderately permeable clay	loamy to clay	unlimited	b = stratifications v = very coarse texture l = moderately coarse texture m = moderately fine texture h = very fine texture
Topography	no restrictions	no restrictions	moderate restrictions	moderate restrictions	unlimited	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 2.5 Population of settlements located close to the Balad Project area

Name of Settlement	1963 Survey by Ministry of Health and Labour			1966 Survey by Balad Municipality
	Total Population	No. of Families	Average No. in Family	Total No. of Households
Adaley	25	5	5.0	8
Balad	1,233	240	5.1	366
Cassani	-	-	-	16
Culunta	101	20	5.0	19
Don Adaley	103	28	3.7	32
Ferah Gululei	110	28	3.9	48
Garas Wein	158	30	5.3	22
Gululei	527	139	4.1	158
Moro Marerey	114	24	4.7	23
Walahoi	153	20	7.6	23
Total	2,524	534	4.7	715

The farming pattern envisaged for the proposed scheme including integrated livestock production is considered to be well suited to the settlement of nomadic tribes. Before this project is implemented it would be advisable to undertake more searching enquiries to ascertain the attitude of these people to participation and their willingness to reside on tenancies for periods of six months in the year.

2.7 Present Agriculture

In the past little of the land within the proposed boundary of the project has been cultivated. Rainland cultivation of sorghum and other crops on some 50 ha around the small village of Cassani within the project boundaries and around Colunta and Garas Uen immediately west of the project is long established. Residents of small settlements along the Shebelli River cultivate crops close to the river and outside the proposed irrigated area.

To the east of the project area lies the Balad Co-operative Flood Scheme of over 1,000 ha in extent. This scheme which is not a co-operative in the true sense of the word has in the past concentrated on the cultivation of sesame. No crops were grown during 1968 although irrigation water was plentiful; the supply canal was however used to flood areas outside the scheme boundary on which sesame was grown by local farmers who no doubt had previously grown crops within the scheme. Some of the land so cropped falls within the proposed boundary of the Balad Flood Irrigation Project.

Upstream of Balad considerable areas of both rainland and flood irrigation exist and a large proportion of the settled population in this area are engaged in cultivation of crops - neither land nor flood irrigation water are currently in short supply in the area and it is doubtful if the local farmers would be attracted towards resettlement on a Flood Scheme operated by government with a much more strictly controlled cropping regime. Land is traditionally held on a tribal basis and each member of a tribe has a right to cultivate land in his sub-tribal area. Members of other tribes are allowed to cultivate within an area if adequate land is available, and providing they conform to the customs of the host tribe.

Cultivation rights pertaining to individual plots are in general inherited through the male line but women also hold rights to cultivate. Sale of land is rare but renting is more common, a normal rent being Shs. 5 per year. Re-distribution of land within the proposed irrigation development will give rise to claims for compensation both for land presently in use and for other uncultivated areas to which members of the local tribe can lay claim.

A small sample of farmers was interviewed from villages in the vicinity of the project and results indicated that in general dryland farming in the Balad area differs little from that at Afgoi where a more detailed survey was possible. Maize is the major crop in both 'Der' and 'Gu' seasons, sorghum being also grown extensively in the 'Der' season. 'Hagai' rains in the area are generally inadequate to permit a crop to be planted sufficiently early to mature during the 'Gu' season for harvesting in August-September. Sesame is frequently grown in the 'Der' season.

Numerous flood irrigation canals have been dug in the past around Balad. Although none are presently maintained a number of farmers are still able to use these canals to flood their land in the 'Der' season. There is generally no control over the people using these canals or the amount of water abstracted. Maintenance of canals is generally limited to clearing weed growth with the result that they gradually silt up. On the flood irrigated areas sesame is customarily cultivated in the 'Der' season and rainfed crops of maize or sesame are often grown in the 'Gu' season.

The study in the Afgoi area indicated holdings to average between 2 and 2.5 ha in extent with the largest holding measured being 5.7 ha. Yields quoted for the major crops are shown in Table 2.6. The table also shows the proportion of crop failures and the prices obtained for crops sold.

TABLE 2.6 Approximate yields and sale prices of major rainland crops grown in 1968-69 in the Afgoi area

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

In the Balad area yields of sesame as high as 5 'quintals' per ha. were claimed for the 1968 'Der' season. One 'quintal' generally represents a weight of 94-96 kg. Balad farmers interviewed quoted rather higher prices averaging Shs. 57 per quintal for maize and Shs. 182 per quintal for sesame.

During the study in the Afgoi and Balad areas it was recognised that many of those interviewed experienced difficulty in giving precise quantitative

answers to questions on area cultivated and crop yields. In view of this problem and the natural suspicion of strangers coupled with the reluctance to provide information which might be used for taxation purposes, the results of the enquiry must be looked upon as giving only a general indication of family activities in agriculture and the results should be interpreted with caution.

Work on the holdings is normally done by the farmer assisted by his family. The labour provided by women in villages away from the river is limited by their having to carry water from the river during dry periods of the year. Labour peaks occur during pre-planting cultivation, weeding and harvesting of the crops and at these times additional labour may be needed. The normal daily rate for such labour is Shs. 2.50 plus food for working between 6 am and midday. If the labourer also works in the afternoons the normal rate is Shs. 5.00. At busy times the rate may be appreciably higher.

Approximately half the farmers interviewed at Afgoi used private contractors for ploughing during 1968-69, the normal rate being Shs. 25 per hour. Frequently the farmer borrowed money for the hire of machinery and there is a strong desire among farmers for machinery to be more readily available on credit terms.

Half the people interviewed in the Balad area owned cattle, numbers quoted ranging from 1 to 60 animals. Goats are kept and most farmers kept poultry. The area provides seasonal grazing for large numbers of cattle and camels belonging to nomadic people and recognised watering points on the river are used.

2.8 The Need for Development of Agriculture

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

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

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

The income from dryland farming is low and the small margins coupled with the uncertainty of rainfall and frequency of crop failure suggests that the introduction of improved techniques will be hazardous. The increased production costs resulting from such new methods whilst being compensated by higher yields in good seasons might prove disastrous in years of partial or complete crop failures. It is unlikely that the net family income from an average dryland holding at present exceeds Shs. 900 per year. Thus only by development in the irrigated sector can the repayment of capital investment costs be assured.

CHAPTER 3

THE BALAD PROJECT

3.1 Project Layout

The Balad Project is designed as a settlement scheme to provide flood irrigation of 7,200 ha of crops and a further watered area around the perimeter of the flood basins and where excess drainage water is discharged suitable for grazing. Irrigation water will be abstracted from the Shebelli River at a site 2 km upstream of the existing offtake of the Balad 'Co-operative' Flood Irrigation Scheme. The layout of the project is shown in Figure 3.1.

The water has to be applied in a single application and to suit the agronomic conditions making full use of the rains that fall during the October-December period it is necessary that planting be completed within the scheme by the end of the first week in October if possible. This necessitates flooding the basins to the required level, allowing sufficient time for infiltration to take place to ensure 50 centimetres has entered the soil followed by drainage of the basins in approximately 40 days.

The limited time available for these three phases rather than the actual water requirement is the determining factor in computing the size of the supply canal for the scheme, whilst the infiltration rate places an upper limit on the size of flood basin which can be served by a canal of a specific capacity.

It was found that, with the scheme area divided into five basins the filling, infiltration and draining could be completed in thirty-nine days by a 40 cumec supply canal. A schedule showing the filling, infiltration and draining is given in Figure 3.2.

Smaller capacity canals were found to be inadequate to fill basins to the required level and could only have been justified by further sub-division of the five basins with additional costs for banking and water control structures.

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Smaller capacity canals were found to be inadequate to fill basins to the required level and could only have been justified by further sub-division of the five basins with additional costs for banking and water control structures.

The filling of the existing three large natural basins identified in the topographic survey was not possible because a situation arises where virtually the entire supply canal capacity is required to keep pace with the infiltration over the area already flooded and any further increase in the water level is extremely slow.

Of the three natural basins, the largest (approximately 3,800 ha) is the one to the west of the Balad-Johar road and this, together with the basin astride the Balad-Afgoi track (about 2,000 ha), require further subdivision to ensure that the filling of all basins can be completed in the time available from the proposed 40 cumecs supply canal.

The final layout selected consists of five basins, designated 1, 2, 3A, 3B and 4, having a total wetted area of 7,900 ha, of which some 6,900 ha will receive the full irrigation of 0.5 metre of water. It is proposed to utilise the periphery of the scheme which takes between 0.5 and 0.4 metre of water for cultivation of the standard cropping pattern and the total area capable of being planted is 7,200 ha. Table 3.1 shows the areas of the various basins, wetted, fully irrigated and planted.

TABLE 3.1 Areas of basins in Hectares

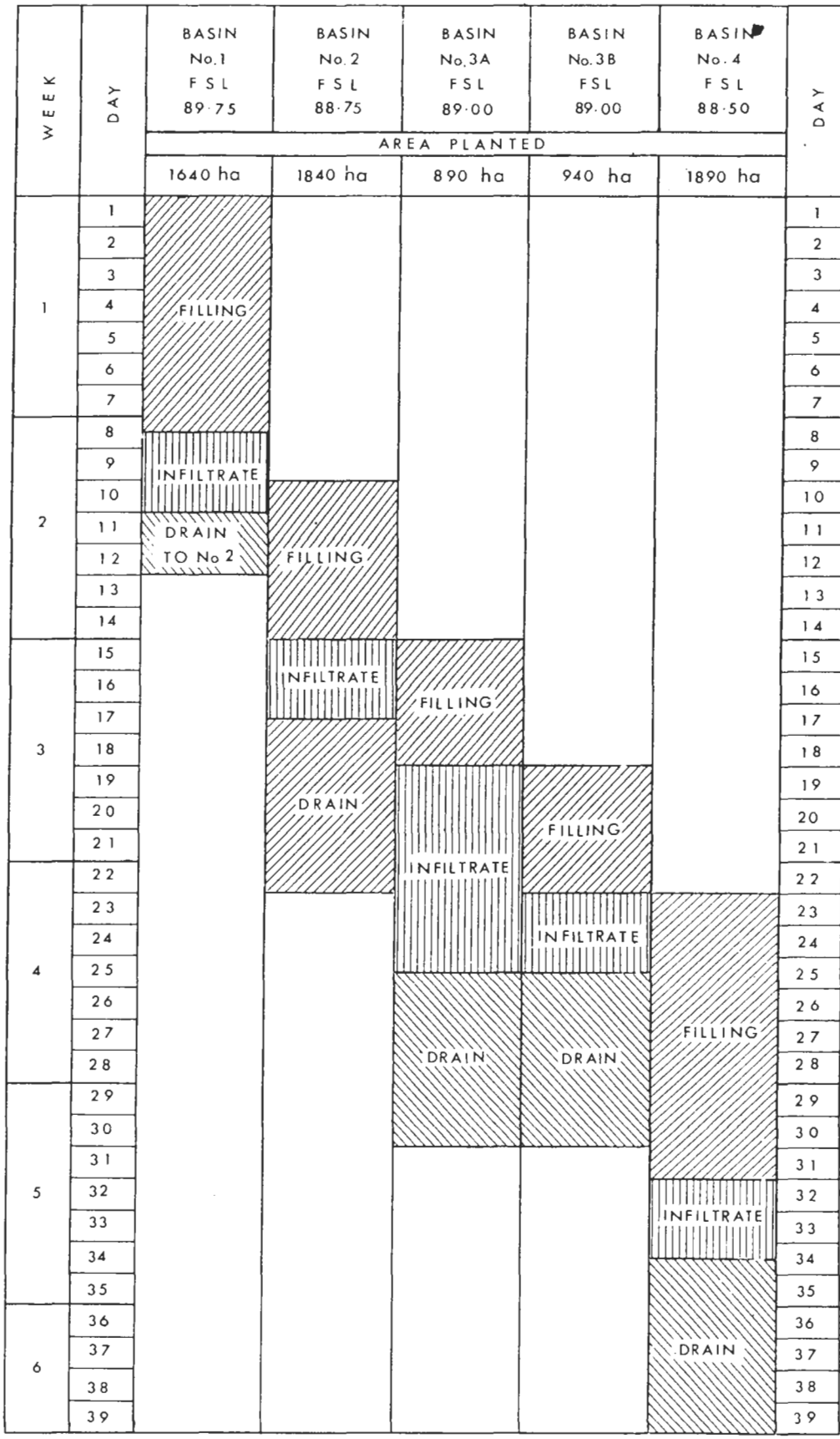
Basin	Total Area Watered	Area to be planted[1]	Area fully irrigated[1]
1	1,800	1,640	1,550
2	2,000	1,840	1,755
3	950	890	860
4	1,100	940	900
5	2,050	1,890	1,800
Total	7,900	7,200	6,865

[1] The area fully irrigated should receive at least 0.5 m whilst the area planted is that receiving at least 0.4 m of water.

FIGURE 3·2

BALAD FLOOD PROJECT

FILLING INFILTRATION & DRAINAGE SCHEDULE WITH 40 CUMEC SUPPLY CANAL



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The maximum flow recorded at Wickham Bridge, the Balad gauging station, thirteen kilometres downstream of the offtake site, is approximately 105 cumecs. The flows that may be expected during the time the diversion will be needed for the flood scheme, late August to early October, are discussed in Section 2.3.

With the diversion of 40 cumecs, and a river flow of 100 cumecs, the river level would fall over two metres and for this reason a structure must be built across the river to ensure that the quantity required can be diverted into the main supply canal.

The head regulator and barrage are shown in Figure 3.3 and the proposed layout at the diversion site in Figure 3.4. The barrage would be equipped with five number 4.0 metre gates to permit the full flood flow of the river to be passed with the head regulator closed.

During the construction of the barrage any flood flows would be diverted through a channel cut across the loop of the river on the left bank and the river would be bunded to permit the work to proceed unheeded in the dry in the river bed.

An alternative to the method proposed would be to construct the barrage and head regulator in the dry on the right bank, just below the offtake surveyed. In this case the construction would be in the dry and a realigned river channel would be cut. This alternative which would minimise construction problems is shown in Figure 3.1. Prior to final design an extended site survey should investigate this proposal.

The estimated cost of building the barrage in the river is Shs. 3,285,000. An additional sum of Shs. 100,000 has been included to cover the cost of any bank protection that may be required upstream of the structure.

Trials indicate that the initial infiltration during the first twenty-four hours of basin flooding will be about 28.5 centimetres and that the subsequent rate will be approximately 11 centimetres per day. This means the water must stand at least two days in any basin following the initial day's percolation.

The supply canal section has been designed according to the revised Lacey regime equations and checked with Manning's 1/n = 45 to ensure that the canal dimensions were adequate to pass the required flow. The recommended procedure is generally in accordance with the practice followed by the Ministry of Irrigation and H. E. P. in the Republic of the Sudan and reported upon in that Ministry's Technical Note No. 3/52 "Investigation of Stable Channels in the Gezira Canalisation Scheme".

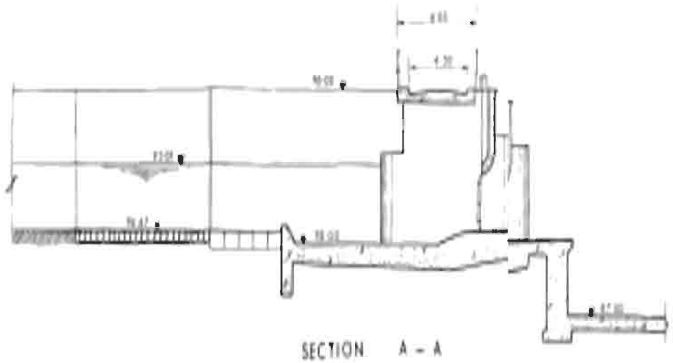
During the investigation, silt samples were taken from the canal beds of the main supply canal of the Johar Sugar Scheme (S. N. A. I.) and one of the main supply canals at Genale (S. A. C. A.). These samples were analysed and the particle size distribution for each sample is shown in Figure 4.1, Volume IIA. The value of Lacey's f calculated from each of these curves shows the silt load in the Shebelli River to be very similar to that of the Blue Nile in the Sudan. This justifies the use of the present design of practices used by the Sudanese which have been tried and proven.

The required 40 cumecs capacity of the supply canal is obtained with a canal of 20 m bed width, a water depth of 2.54 m and a water slope of 75 mm per km. The bank has been designed with a minimum top width of 5.0 m to give a motorable surface.

To avoid deep cutting over the headreach of the canal, it is proposed to construct a 2.0 m unregulated drop at K. 6 and so economise in excavation.

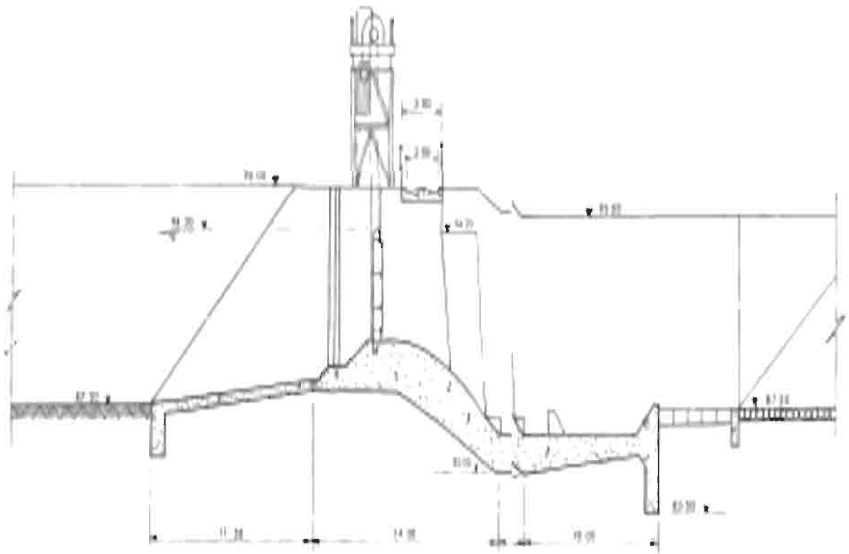
Figure 3.5 gives the longitudinal section of the canal showing ground, bed and water levels. The section of the canal from the river to the Balad-Johar road was surveyed on the ground, but it is possible that a more economical alignment may be found when the survey is completed before final design and construction. The ground levels beyond K. 7.2 were obtained from the contoured topographic map of the area.

After crossing the road the canal is aligned on the ridge of higher ground between basins 2 and 3. Cross regulators at K. 8.6 and K. 10.2 serve basins 1 and 2 respectively and at K. 17.0 the main canal divides at a suitable structure to serve basin 4 to the west and basins 3A and 3B to the south. The total length of the supply canal is 18.8 km.



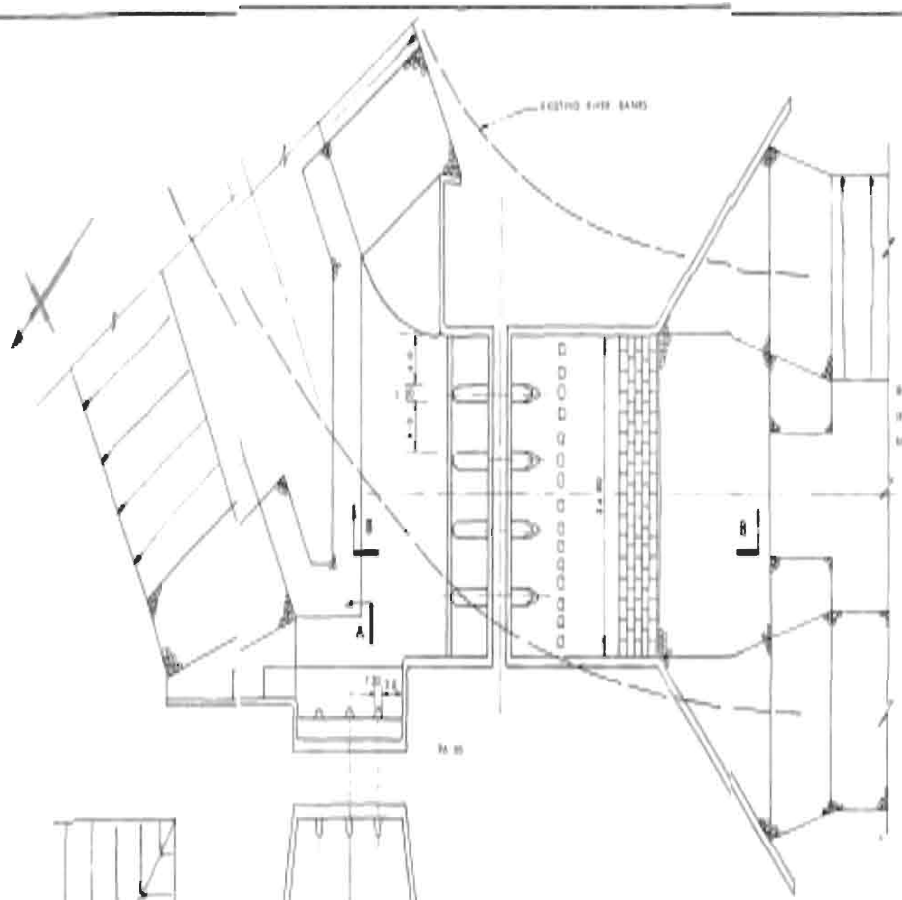
SECTION A – A

THROUGH CANAL HEAD REGULATOR



SECTION B–B

THROUGH BARRAGE



PLAN

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THE WATER CONTROL AND MANAGEMENT OF THE SHEBELLI RIVER	
FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS	
BALAD FLOOD IRRIGATION PROJECT RIVER SHEBELLI BARRAGE AND HEAD REGULATOR	
SCALE AS SHOWN	
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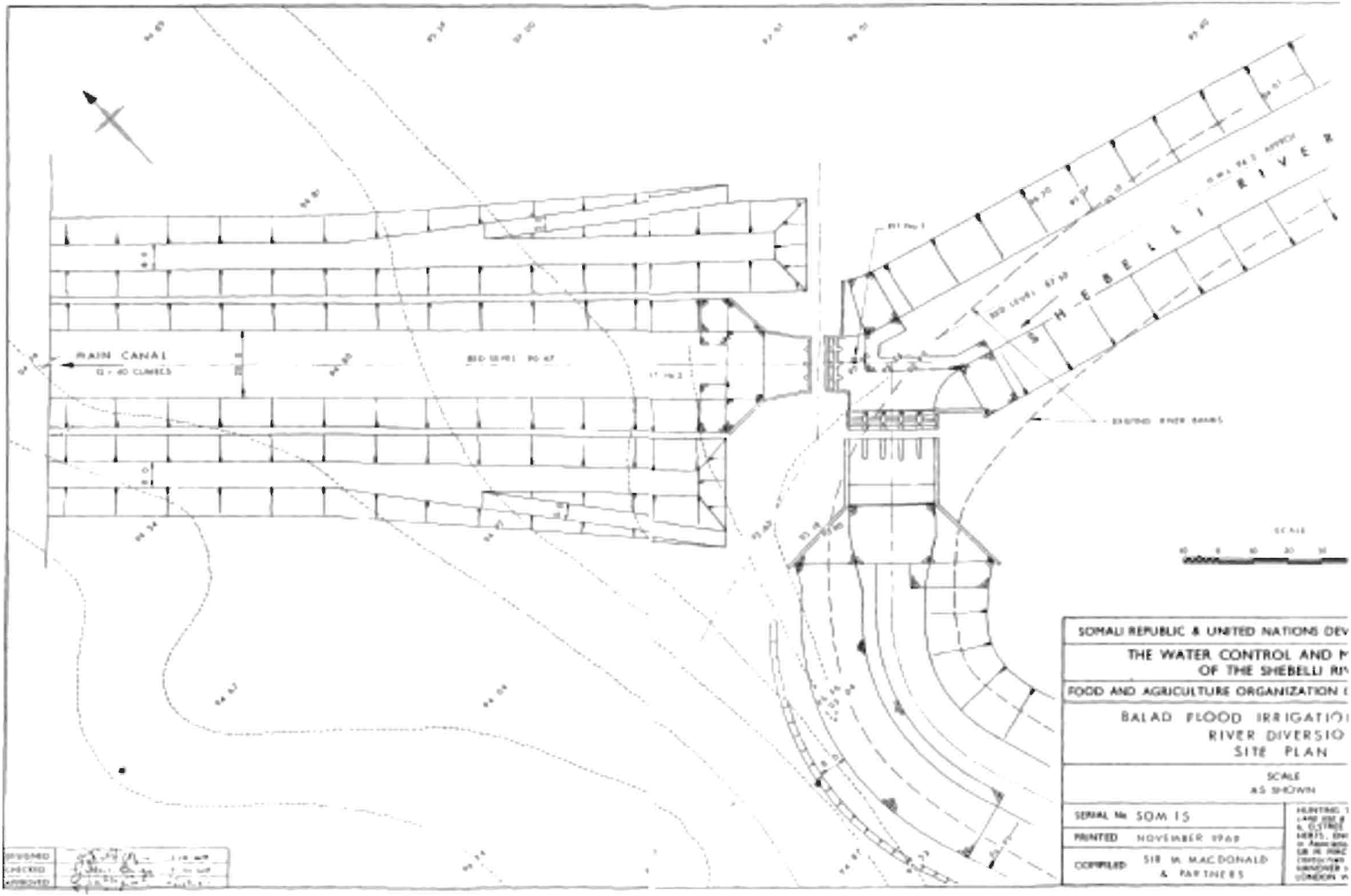

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AS SHOWN

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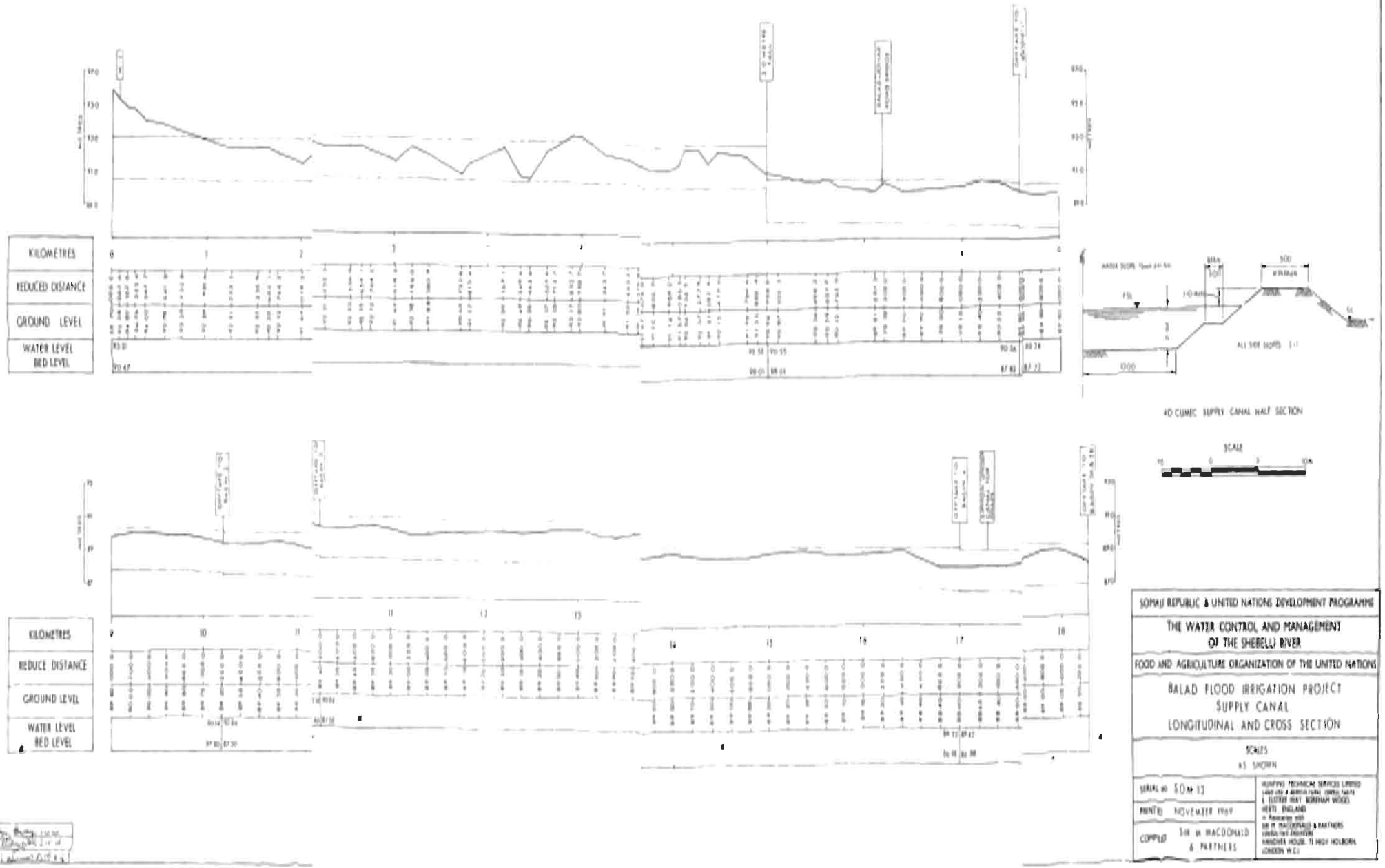
FIGURE 39



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
SUPPLY CANAL
LONGITUDINAL AND CROSS SECTION

SCALES
AS SHOWN

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The only canal losses that are likely to occur once the initial rapid infiltration has taken place over the wetted perimeter of the canal, will be those due to a reduced rate of infiltration of approximately 4 millimetres per hour and the evaporation loss of not more than 8 millimetres a day. In all probability, the infiltration rate on the wetted perimeter will decrease as silt is deposited when the canal has been in use.

Maximum losses will occur when the greatest length of the supply canal is in operation watering the basins which lie furthest from the headworks and at that time the losses should not exceed 2 per cent of the flow.

The banking around natural basins and their subdivisions has been designed with 4.0 metre top width to provide a motorable road along the crest. This is necessary to permit rapid access to the drainage structures sited in the banks. Ramps have been included on each side of the banks at approximately one kilometre intervals and sufficient space has been allowed at these points for vehicles to pass. A minimum of 0.5 metre above full supply level in each of the basins has been provided on all flood banks.

Basin 1 has two banks, one being required to protect the existing all weather road to Johar and the other at the bottom of the basin to divide the large natural basin into two.

Basin 2 requires only a single bank joining the high broken ground in the north of the basin to the supply canal bank in the south.

The bank along the northern boundary of basins 3A and 3B is eight and a half kilometres long, it is low for much of its length. In all probability, when a more detailed survey has been completed prior to construction, it will be found that it will not be necessary to construct this bank over the whole of its length. A further bank subdivides this southernmost basin of the scheme.

The longest flood bank almost surrounds basin 4, but for over half the length it is less than 1.0 metre high. The excavation of the drain from basins 3A and 3B will provide the necessary material for the bank, where the flood bank and the drain run parallel.

Table 3.2 summarises the details of the proposed banking.

TABLE 3.2 Basin Flood Banks

Basin No.	Area Ha.	Maximum water depth m	Banking Details	
			Length m	Maximum height m
1	( )	0.10	3,100	0.90
1	(1,550) ( )	1.65	4,750	2.15*
2	1,755	1.35	3,400	1.85
3	( )	0.75	8,500	1.25
3	(1,760) ( )	1.40	4,300	1.90
4	1,800	1.30	11,200	1.80
Total	6,865	-	35,250	-

* In only one case, the bank between basins 1 and 2, does the bank height exceed 2 m and this is for a length of approximately 1.5 km.

The water enters the supply canal through the head regulator sited just upstream of the barrage. This structure will be fitted with four 3.0 metre roller sluice gates.

The water flows down the canal and at K. 6.0 passes over the 2.0 m fall. At K. 7.2 the canal flows under a reinforced concrete bridge built to span the canal and carry the traffic on the Johar-Balad road.

The first cross regulator is at K. 8.6 and a combined structure is required which allows the full flow of the canal to either enter basin 1 or, when the basin is full, to continue on down the canal. The regulator into basin 1 will, like the cross regulator, be provided with four 3.0 m gates.

Similar structures to that at K. 8.6 will be sited at K. 10.2 to fill basin 2 and at K. 17.0 which will either serve basin 4 or permit the water to flow into the reach of the main canal serving basins 3A and 3B. The structure for filling basins 3A or 3B will be two regulators and each will serve one side of the sub-dividing bank.

The drains have been designed as far as possible with the design water level below ground level with a slope of at least 150 millimetres per kilometre and a Manning's n = 1/45. Where possible natural drainage lines have been used in aligning the drains and the earthwork quantities allow for the excavation of the drain for a distance of at least 4 kilometres beyond the boundary of the scheme.

The survey information collected during the levelling programme undertaken during the UNDP/SF Agriculture and Water Survey Project, 1962/1966, and reconnaissance levelling carried out during the present project, indicates that the water, after discharging from the drain, will spread in north-easterly and south-westerly directions.

The filling, infiltration and drainage schedule, (Figure 3.2), shows that the drain must be capable of draining basin 2 in eight days. It is this eight day period which will govern the capacity of the drain. Studies indicate that a 15 cumec capacity drain will be adequate, allowing some spare capacity in case a rainstorm occurs during the drainage operation.

From basin 3 the drain passes under the main canal at approximately K.17.3; the cost of a siphon to carry the water under the canal at this point has been included in the estimates.

The drainage structures consist of two 20 cumec capacity outlets in the bank dividing basins 1 and 2 and 15 cumec structures on the drainage lines; at the exit to basin 2, between basins 3A and 3B, at the outlet from basin 3B and at the outlet from basin 4. A reinforced concrete siphon will carry the water from basins 3A and 3B under the supply canal at K.17.3.

In the construction of all the structures rubble masonry with the harder type of coral rock should be used as much as possible; it is confirmed that local masons are able to build this type of structure. The steelwork for the structures has been estimated assuming that this item will be imported already fabricated. There is a possibility that some minor items of the steelwork would be made up in Somalia.

All the structures used for filling and draining the basins will be built with a 4.0 metre road bridge to facilitate movement around the scheme during the irrigation period.

3.2 Crops and Cropping Pattern

The limited number of potential settlers living within or adjacent to the project area will necessitate resettlement of farmers from outside the immediate locality. A flood irrigation scheme of the type envisaged will not prove particularly attractive to farmers already settled elsewhere in the Shebelli River Valley, many of whom are already engaged in some form of irrigated agriculture. Settlers must, therefore, be found either from the rainland cropping areas away from the river or from nomadic people presently engaged primarily in livestock grazing.

The settlers will benefit by having a better and more assured livelihood and in particular by having year round supplies of water for their families and livestock, the present precarious nature of such water supplies being the major reason for their nomadic existence. The likelihood of the project being settled at least in part, by such people having little previous experience in organised agricultural production, has been taken into account in the selection of crops and cultural practices.

Whilst a number of flood schemes already exist along the Shebelli Valley, none are at present operating satisfactorily. The range of crops grown is extremely limited and husbandry practices are generally poor. No basic research has ever been attempted on the possible ways and means of improving this type of farming. Consequently, the recommendations for agricultural production under flood irrigation are largely based on experience in other countries.

Existing areas of flood irrigation are cropped almost exclusively with sesame, sorghum and to a lesser extent, maize. None of these crops are particularly profitable, except in years of poor rainfall as they compete directly with rainfed production. The construction of a large new flood project involving a large capital outlay cannot be justified for the production

of these crops alone and consequently a range of cash crops were investigated, the most promising of which are considered to be suitable for cultivation under the envisaged basin irrigation system.

Cotton is well suited to flood irrigation, having good drought resistance due to its extensive root system, moreover it is Government policy to encourage production of medium staple cotton to supply the Somaltex Factory at Balad. 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 operating to full capacity.

It is not possible with the limited available information to make any definite recommendation on which variety of medium staple cotton should be grown. Field trials of a range of varieties should be made under flood irrigation conditions as soon as possible in order that the correct choice of variety can be made.

At the Afgoi Research Station, under controlled irrigation,yields of 3000 kg seed cotton per ha have been achieved. It is considered that with adequate pest control measures average yields of 1, 500 kg per ha. can be obtained, whilst in years when rainfall in October-November is good, yields well in excess of 2000 kg per ha are possible.

Currently Somalia imports considerable quantities of vegetable oils to supplement locally produced supplies and a good market for oilseeds is anticipated providing the price is competitive with imported oils.

There is a strong local preference for sesame oil and at present sesame seed and oil are scarce and expensive.

Although local yields of sesame rarely exceed 500 kg per ha, the local variety produces reasonable returns and is capable of reaching maturity on stored moisture reserves in the soil, if planted after the rains have ended. It is the most widely grown and successful crop on existing flood irrigation schemes.

Good quality groundnuts would have a sound local market but the prices paid to the farmer will depend on the landed price for imported refined oils. The same arguments apply to cotton seed but there is some doubt whether a market could be found at present for cotton seed cake. Groundnuts have a relatively low water requirement and are able to withstand drought conditions over limited periods without serious reduction in yield. Experience in the Sudan had shown that groundnuts can be grown successfully on heavy soils, and without appreciable supplementary water supplies, providing the soil within the potential root zone is fully wetted before planting, either by rainfall or pre-planting irrigation. Unfortunately, there is no information on the performance of this crop under flood irrigation or rainfall in Somalia.

A number of grain crops were considered for inclusion in the rotation but most were excluded on agronomic grounds. 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 customarily likes to produce his own family grain requirements. It is recommended that a limited area of sorghum be included in the Balad rotation to meet the farmers' food grain needs and it is not anticipated that any major problem would arise in disposing of any production surplus. The straw may be utilised as fodder for livestock during the dry season.

Maize is not noted for its drought resistance and the chances of crop failure may be high. It could be cultivated in place of sorghum providing a variety having a sufficiently short season of less than 100 days could be found.

Safflower should be well suited to the growing conditions, as it has excellent drought resistance. Although, it has only recently been introduced in Somalia, it has given promising results in trials at the Afgoi Research Station. Providing a satisfactory market could be found, it might be included in the cropping pattern at a later date. Likewise, sunflower has

given encouraging results and when more experience has been gained with its cultivation and handling and providing that losses due to bird damage are not severe, it may be considered as a potential future crop.

Soya beans have been grown at the Afgoi Research Farm and some dwarf varieties included in trials would be suitable for flood irrigation cultivation because of their low water requirements. However, it cannot be recommended at present, because of doubts as to the availability of markets. Castor is another possible crop for the future, but it suffers considerably from insect pest attack, hence it is not possible to recommend its inclusion in the cropping pattern at present.

Leguminous food crops such as green gram, cowpeas, pigeon pea and French beans could be grown, but local markets for these crops are small and their extensive cultivation in the future, will depend on satisfactory export markets being found. The main cropping season is necessarily restricted to the September-January season, as reliable supplies of water in sufficient quantity to flood the basins are only available during the September-November period.

The following crop rotation is recommended for the area of 7200 ha. which will be irrigated within the basins:-

Year 1	Cotton	
Year 2	½ Sesame	½ Sorghum
Year 3	Groundnuts	

As irrigation will be limited to one heavy pre-planting application, crop yields on soil moisture reserves alone are unlikely to be very high and it is essential that the maximum benefit be obtained from rainfall. It will normally be possible to commence flooding of the basins during the last week in August and the first basin will be ready for planting by the second week of September. All planting will be completed by mid-October before the 'Der' season rains commence. Rainfed crop production would be possible on a limited scale during the 'Gu' season, when rainfall during April is adequate. The need for timely preparation of the land before

commencement of flooding in the following August would strictly limit the area, which could be cropped. No recommendations for such 'Gu' season rainfed cropping have been made and it is proposed that no attempt be made to grow such crops until the project has been satisfactorily established under a regime of one cropping season per year.

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

Forecasts of future farm gate prices for produce have been made, based upon current and projected prices of lint cotton, vegetable oils and grain sorghum, allowance being made for transport, handling, storage and processing when applicable.

Table 3.3 shows the yield and price projections for the selected crops.

TABLE 3.3 Anticipated crop yields in kgs per ha. and projected prices

Crop	Year					Price Shs/kg.
	1	2	3	4	5	
Cotton (seed cotton)	600	700	800	1000	1200	1.00
Sesame	300	400	400	450	450	1.20
Sorghum	500	600	800	900	1000	0.35
Groundnuts (in shell)	850	1000	1150	1450	1700	0.69[1]

[1] Price of shelled nuts, a shelling percentage of 61 being assumed.

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

3.3 Livestock

Crop residues amounting to some 3 tons per ha. from 2,330 ha. of groundnuts and 1,160 ha. of sorghum will be available for feeding to livestock. In addition, approximately 1,000 ha. of land around the perimeters of the basins will receive some irrigation water, although insufficient to grow an arable crop. A further area probably of the order of 3,000 ha. lying outside the irrigation scheme boundary will be inundated when excess water is drained from the basins before planting. These watered areas will provide a considerable amount of assured grazing. A number of alternative systems of livestock husbandry were considered in order to utilise these crop residues and grazing areas for beef production. Although it would be possible to bring young animals into the scheme after weaning and maintain them until maturity, it is more attractive economically to bring in selected mature animals off the open range for final finishing over a period of about 5 months prior to marketing. As tsetse fly is prevalent along the river during the rainy seasons, it is advisable to keep animals on the scheme only during the drier months, December to March.

The Livestock Development Agency proposes to establish grazier schemes in suitable areas away from the river. In these areas, supplies of drinking water from wells would be provided and range improvements carried out. Stock would be brought in from surrounding range areas and kept until mature. One of these schemes would be established in the area west of Bulo Burti and would provide a source of selected mature animals for finishing in the Balad Project.

It is recommended that mature steers for finishing be brought into the project early in December, having been walked down from the Bulo Burti area during the previous month. They would graze over the available grazing during the next two months and during the latter part of January and early February be gradually introduced to the crop residue ration. The crop residues available would support 7290 animals for 4 months on the proposed daily ration.

Mortality over the period is unlikely to exceed 4 per cent, giving an output of 7000 finished steers at the end of the period. The animals should average 270 kg. liveweight on arrival and will be marketed at about 320 kg. during mid-April to mid-June.

3.4 Crop Water Use and Flood Irrigation Needs

The seasonal consumptive use calculated by Blaney and Criddles' method for the recommended crops is as follows:-

Cotton	58 cms
Sesame	50 cms
Sorghum	44 cms
Groundnuts	49 cms

During the growing season at least 10 cms of rainfall may be expected in 9 years out of every 10 and the average expectation is 20 cms. In order for the crops to fully mature, a minimum application of 50 cms of flood irrigation water is necessary for cotton and 40 cms for the other crops. The soils have a moisture holding capacity of between 20 and 25 cms available moisture per metre depth of soil, so that the storage of some 50 cms of available moisture within the top 2 m of the soil profile is possible from a single pre-planting flood irrigation.

As the gradual increase in moisture stress, during the later part of the growing season, will result in evaporation losses from the crop being rather lower than allowed for in the Blaney and Criddle computation, this reserve of moisture supplemented by rainfall should prove adequate for the needs of the crops at the yield levels previously postulated.

3.5 Mechanisation and Labour Requirements

Within each basin, the land should be subdivided into strips, each strip being planted uniformly to one crop. This layout will greatly facilitate the spraying of the cotton crop by aircraft.

It is recommended that each settler should cultivate a 6 ha. holding comprising 2 ha. each of cotton and groundnuts and 2 ha. equally divided to sesame and sorghum. Each settler will thus require a 2 ha. plot in each of three adjacent strips. It will be necessary to leave narrow lanes between each strip for ease of access and for the transportation of the crops.

The 6 ha. holding which it is proposed to allocate to each farmer on the scheme is the largest area using the proposed cropping pattern which the labour capacity of an average family could manage with a minimum of assistance from hired labour during peak planting and harvesting periods. Whilst there would be no objection to a farmer operating more than one 6 ha. holding, providing that he possessed the necessary skills, the second and subsequent holdings would require to be cultivated entirely by hired labour and the return to the farmer would be considerably lower than the family holding due to the increased production cost. Difficulties would arise through shortage of labour at peak seasons and during the early years of development when yields may be expected to be low, the farmer may, in fact, receive no return from such a second holding. It is recommended that in the early years of the project each family is limited to one 6 ha. holding. This restriction might be removed later when the skills needed to operate a large holding have been acquired and if the acquisition of multiple holdings by one family were considered expedient.

An assessment of the labour requirements for each cultural operation for the recommended crops has been made and the total labour input for each ten day period throughout the year calculated for a typical holding. It has been assumed that a farmer would contribute 9 man days of work during each 10 day period throughout the cropping season lasting some seven months. Similarly, his family could provide the equivalent of an additional 9 man days for planting and weeding and 12 man days during cotton harvesting during each 10 day period. The balance of labour required on the holding would then have to be hired. The total labour input for a 6 ha. holding is estimated to be 407 man days per year, of which the farmer would provide 180 days, his family 142 leaving a balance of 85 man days for hired labour.

In a settlement scheme of this nature in which few high valued cash crops can be included, it is essential to utilise as fully as possible all the available man power of the farmer and his family. Mechanisation should only be introduced for the essential land preparation operations and to supplement the available manpower to complete tasks when labour becomes a constraint and timeliness is of vital importance. Although the work output expected from the farmer and his family during the cropping season may appear high, they will have little activity for some five months of the year, following the harvest. Reduction of their work input could only be achieved either by increased use of hired labour or by reduction of holding size, either of which would result in the farmer's income being reduced to a level which is unlikely to be attractive to potential settlers.

Mechanisation should be limited to the initial ploughing operation before irrigation, the blading operation to facilitate the lifting of the groundnut crop and transport of produce from the field to collecting centres. Of these operations, ploughing is the most important and largely determines tractor requirements. Blading of groundnuts can easily be accomplished by the tractor fleet required for ploughing and although the quantity of produce to be transported is large, tractor drawn transport could, at peak periods, be supplemented by animal transport. As harvesting occurs during the dry months, there is no great urgency for produce to be removed from the fields.

It has been assumed that during ploughing operations, tractors will work an 8 hour day whilst for groundnut blading and transporting of produce, a 10 hour working day should be possible.

In order to keep the tractors in the field supplied with fuel and water, two tankers will be required. It is recommended that the tractor fleet is operated as a single unit and is accompanied as it progresses through the scheme by a mobile workshop, equipped to carry out all maintenance and minor repairs.

Besides the tractor drawn equipment described above, hand operated cotton root pullers for the cotton uprooting operation will be required, one for each farmer.

The total recommended requirements for agricultural machinery and equipment are shown in Table 3.4, the numbers including some reserve to allow for lower rates of work, unserviceable equipment and lost time in service and maintenance.

TABLE 3.4 Machinery and Equipment Requirements

Item	Number required
Tractors wheeled 70 HP	15
Disc ploughs	15
Tool bars rear mounted	15
Groundnut blades (pairs)	15
Trailers 5 ton	15
Water tanker 4000 l.	1
Fuel tanker 4000 l.	1
Mobile workshops complete	1
Cotton root pullers	1,200

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

3.6 Management

A sound management structure is essential if the implementation and operation of the project is to be successful. The success of a flood irrigation scheme depends not only on the rate at which land is cleared and settled and irrigation facilities constructed but on the rate at which crops of acceptable yields can be harvested. The efficient organisation of crop production is thus of paramount importance.

The project whilst having a significant influence on the welfare of the settlers should be operated on accepted business lines as a financially viable economic proposition. In order to achieve this aim the managing authority should have a maximum degree of autonomy compatible with

wider national interests. The ultimate responsibility for the project must rest with the Somali Government as the body responsible for negotiation of finance for development.

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

The great importance of agricultural development to the national economy of Somalia points to the need for careful consideration to be given to the formation of the structure of high level management which will be responsible for basic production policy and for matters relating to project staff and finance.

The present chronic staff shortage within Ministries precludes the establishement of a separate development board or similar body. In view of the importance of co-ordinated development it is recommended that a Ministerial Project Committee be constituted within the Ministry of Planning on a bilateral or multilateral basis to provide for representation between the Somali Government and the country or organisations which participate in or provide finance in the project. This Project Committee should include representatives from:

Ministry of Planning
Ministry of Finance
Ministry of Agriculture (and Agricultural Development Agency)
Ministry of Natural Resources (and livestock Development Agency)
Ministry of Public Works, Department of Irrigation

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

The Committee should have a secretary for co-ordination who would deal directly with the Project General Manager. The Committee would issue directives for the proper operation of the project and would be responsible for the approval of financial estimates, the authorisation of charges and payments to tenants in respect of crop and livestock production and the award of contracts for major project works. The Committee would provide liaison with the Government Ministries and organisations providing services to the project including the necessary social services, and with any commodity marketing organisations which may be established. Such a committee might serve as a policy formulating body for a number of projects. Responsibility for the supervision and co-ordination of project activities will initially be vested in the Project General Manager. In order to foster the full co-ordination of participants it is suggested that a small management committee be nominated with representatives from the Ministries of Agriculture, Natural Resources, Public Works, Local Government and Tenants to assist the General Manager.

It is recommended that the project management staff should comprise: A General Manager in overall executive charge of the project, an Office Manager, Field Manager, Livestock Officer and Engineer.

Due to the acute shortage of qualified and experienced local personnel in Somalia in many disciplines it is anticipated that the post of General Manager will be filled by an expatriate. If a suitably qualified person is selected as Field Manager he would in time acquire sufficient administrative experience to take over the senior post. In view of the considerable experience necessary and taking into account the likely continued shortage of experienced local personnel due to the need to staff other developments in the future, it has been assumed that the expatriate General Manager will be required for a period of up to ten years from the inception of the project.

The Field Manager should have a staff of at least 5 agricultural officers, each responsible for direct supervision of the tenant farmers in the area of one basin.

3.7 Infrastructure

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

Transport to and from Mogadiscio is a distance of 36 km by the existing all-weather road passing through Balad. Transport of produce to Mogadiscio will be by larger trucks and trailers already available for hire.

The headquarters for the scheme will be established at Balad and an office, store and workshops will be required.

Privately owned ginneries exist at Afgoi and in Mogadiscio. The present ginning capacity within easy reach of the scheme on all-weather road is considered to be adequate, and for this reason no provision has been made in the estimates for the construction of any new ginning facilities.

The groundnut decortication plant proposed for the Balad Scheme would be a single unit of two decorticating machines and would be sited at Balad. Each decorticating machine would be capable of handling over two tonnes per hour of unshelled nuts.

The only houses included in the estimate for the Balad Project are for the five senior management staff.

At the present time an all-weather road traverses the eastern boundary of the proposed scheme. This road is adequate and the only additional provision allowed for in the cost estimate is for a 6 metre road bridge at a point where the main supply canal crosses the road some seven kilometres north of Balad.

The line of the existing earth road from Balad to Afgoi passes through basins 3A and 3B and will require relocation over a distance of 14.6 kilometres. The proposed relocated section would be raised a minimum of 50 centimetres above natural ground level, ditched each side and where necessary, cross drainage structures will be installed.

With a regular grading and maintenance programme this road should remain in good condition if some control of its use is enforced after heavy rains.

The only electricity plant planned for Balad is one to supply the five senior staff houses and the administrative office. If these buildings could be sited within the Somaltex textile mill compound use could be made of the electricity supply which already exists.

Groundwater resources in the area will be adequate for the provision of water supplies and water quality is satisfactory although it deteriorates somewhat further from the river. A tubewell exists in Balad village and no additional well is proposed. The estimates do include provision for four additional tubewells complete with 23,000 litre ground level tanks to be installed at four selected villages around the perimeter of the Scheme. These villages will house the future tenants of the Scheme.

The telephone lines costed in the estimates include a line from the diversion site on the Shebelli River to the administrative office in Balad. The office will be fitted with a small telephone exchange. It is also proposed to install a direct line to Mogadiscio by underslinging a line from Balad on the existing line which connects Mogadiscio with Johar.

For communication during the irrigation period four transceivers (walkie-talkie radios) will be provided. The type envisaged have been in use by the harbour authority in Mogadiscio for some time and have proved both serviceable and robust.

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

CHAPTER 4

PROJECT COSTS

4.1 Construction Costs and Programme

It is recommended that construction of the project be phased over a period of 4 years, an area of about 2,000 ha equivalent to one of the larger basins being completed each year. A detailed construction programme is given in the Technical Annex accompanying this report.

There are in Somalia, contractors who are capable of carrying out the earthworks for the Balad Flood Scheme.

Building contractors who could construct the barrage, regulators, bridge and other irrigation structures operate from Mogadiscio. It may be necessary for two or more of these contractors to join forces if the civil works are let as one contract to ensure that the works can be completed on time.

No firm of consulting engineers capable of undertaking the design and supervision of construction at present exists in Somalia and this work will have, of necessity, to be placed in the hands of an international firm specialising in the design of irrigation projects.

The construction rates used in the estimate were based on quotations obtained from local contractors. These rates include a customs duty allowance and although the Somali Government has since January 1969, declared all agricultural development to be exempt from these duties it is unlikely that the rates quoted would be altered. The contractors who provided the rates used in the costings will have existing stocks of materials and plant on which duty has been paid and it is not certain whether they will qualify for duty free fuel since the control of this and other materials, if duty free, would prove very difficult.

In the detailed estimates no customs duties have been included. The foreign exchange costs do however include items which contractors will require, e.g. fuel, lubricants, spares and wear and tear on their imported plant and vehicles.

Table 4.1 summarises the project construction costs and foreign exchange costs and the construction costs from year 1 to year 4 during the build up period.

4.2 Annual Operation and Maintenance Costs

The annual costs for the project from year 1 until year 4 when the scheme is in full operation are shown in Table 4.2. The annual costs do not include loan servicing charges or charges for replacement of equipment which are dealt with separately in the economic analysis.

Costs directly chargeable against individual crops including attributable costs of operating agricultural machinery are also omitted. These have been allowed for in assessing the gross margins of the individual crops which are shown in Chapter 5, Tables 5.2 to 5.5.

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

TABLE 4.1 Summary of Project Capital Costs

Item	Description	Amount Shs. '000 Year 1	Year 2	Year 3	Year 4	Total	Foreign Exchange So. Sh.
I	IRRIGATION WORKS, BUILDINGS AND SERVICES						
A	Preparatory Work	40.0	35.0	35.0	30.0	140.0	98.0
B	Purchase of Land and Compensation	-	-	-	-	-	-
C	River Diversion Works	4,295.5	-	-	-	4,295.5	2,650.5
D	Main Canal						
	Earthworks	1,448.7	288.4	1,190.0	75.9	3,003.0	1,351.4
	Structures	1,408.0	990.0	1,980.0	-	4,378.0	2,989.7
E	Basin Embankments	242.9	63.7	244.8	235.1	786.5	354.0
F	Drains						
	Earthworks	2,485.0	-	780.0	266.0	3,531.0	1,589.0
	Structures	497.2	220.0	440.0	584.1	1,741,3	1,186.7
G	Workshops	80.0	-	-	-	80.0	64.0
H	Buildings for Agricultural & Irrigation Management	439.0	-	70.0	-	509.0	255.8
J	Other Buildings	(50.0)	-	-	-	(50.0)	(21.5)
K	Water Supply	80.0	80.0	80.0	80.0	320.0	176.0
N	Electricity Supply	64.6	-	-	-	64.6	52.3
O	Communications			190.0	-		
	Roads	223.0	-	-	-	413.9	218.2
	Telephones, etc.	72.4	-	-	-	72.4	49.3
	Item I sub-Total	11,376.3	1,677.1	5,010.7	1,271.1	19,335.2	11,033.9
II	AGRICULTURAL PROCESSING PLANT						
	Groundnut Decortication Plant	-	210.0	-	-	210.0	185.0
	Item II sub-Total	-	210.0	-	-	210.0	185.0
III	EXCAVATING PLANT	-	820.0	-	-	820.0	800.0
	Item III sub-Total	-	820.0	-	-	820.0	800.0
IV	LAND PREPARATION						
	Bush Clearance	750.0	600.0	600.0	570.0	2,520.0	1,134.0
	Item IV sub-Total	750.0	600.0	600.0	570.0	2,520.0	1,134.0
V	AGRICULTURAL MANAGEMENT						
	Vehicles	171.7	-	-	-	171.7	167.1
	Tractors	232.4	58.1	58.1	87.2	435.8	425.8
	Agricultural Implements	146.5	46.9	46.9	61.6	301.9	296.8
	Miscellaneous Plant (W/S. Eqpt.)	54.8	-	-	-	54.8	53.7
	Item V sub-Total	605.4	105.0	105.0	148.8	964.2	943.4
	Items I, II, III, IV & V Total	12,731.7	3,412.1	5,715.7	1,989.9	23,849.4	14,096.2
VI	CONTINGENCIES(1)	1,273.2	341.2	571.6	198.9	2,384.9	1,409.6
VII	ENGINEERING AND SUPERVISION(2)	1,212.6	330.7	561.1	184.1	2,288.5	1,529.0
	SCHEME TOTAL	15,217.5	4,084.0	6,848.4	2,372.9	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, III and IV.

TABLE 4.2 Annual Operation and Maintenance Costs Year by Year (Shs.)

Year	1	2	3	4
Permanent staff				
Expatriate	107,000	107,000	107,000	107,000
Local (excluding tractor drivers)	292,100	417,900	469,900	518,000
Sub-Total	399,100	524,900	576,900	625,800
Works				
Diversion Structure	5,000	5,000	5,000	5,000
Main Canal	5,600	7,400	11,700	13,200
Drains and banks	4,500	6,200	9,100	11,500
Mechanical Workshops	150,000	160,000	210,000	210,000
Buildings	21,000	21,000	21,000	21,000
Sub-Total	186,100	199,600	256,800	260,700
Services				
Mechanical Transport	30,500	30,500	30,500	30,500
Posts and Telegraphs	2,000	2,000	2,000	2,000
Water supply, Electricity Supply, etc.	18,000	18,000	18,000	18,000
Groundnut decortication		15,000	17,850	17,850
Sub-Total	50,500	65,500	68,350	68,350
Tools	3,000	3,250	3,250	3,250
TOTAL	638,700	793,250	905,300	958,100

Interest on Working Capital	Yr.1	Yr.2	Yr.3	Yr.4	Yr.5	Yr.6	Yr.7-40
	43,400	80,580	112,079	108,271	82,915	34,887	16,443

Interest on working capital based on net cash requirements Years 1-6 calculated as 50% of annual management cost for six months thereafter.

CHAPTER 5

ECONOMIC AND FINANCIAL EVALUATION

5.1 Benefits

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

The indirect benefits of the project are the impact it will have, if successfully implemented, upon the general levels of development. This impact is difficult to forecast as it depends on the quality of response to the opportunities opened up by the project, by the people involved directly and indirectly. In general, it can be stated that a flood irrigation scheme with a cropping season of only seven months provides an opportunity to give nomadic herdsmen a more gradual introduction to the experience of settled farming than a controlled irrigation scheme cropped throughout the year and thus provides the basic skills and attitudes necessary for further expansion of commercial farming. More specifically, if the scheme is to be viable, it will require efficient marketing, processing

and supply services and if these are provided, they could, since they have been largely lacking in the past, have a considerable impact on agriculture outside the project area.

5.2 Valuation of Benefits

The direct measurable benefits have been valued at the shadow prices shown in Table 3.3 while foreign exchange earnings have been valued at current c.i.f. prices. The shadow price is an attempt to provide a competitive norm, in the light of knowledge of present world and domestic market conditions, around which it is thought the price for produce will tend to fluctuate in Somalia. Possible distortions due to present high sea-freight costs and high port charges are difficult to deal with, since although a reduction in these costs would give a higher theoretical export price, it would also mean a lower import price for competitive commodities. There is also a risk factor incorporated in these shadow prices to allow for unforeseen circumstances in world markets and also to allow for possible difficulties in achieving the targets set out for the scheme. It is also important that the returns to the scheme in the early years, when the major difficulties both on the project and in setting up the external servicing organisations are faced are not overstated since the present value of income earned in the initial years is much higher than that earned in later years. The final shadow prices selected, therefore, tend to be the most conservative of the calculated range. Duties, in the case of vegetable oils have been excluded in the import price calculations as they are not a benefit to the economy but only a transfer payment from the consumer to the government which may in practice, if local production displaces imports, be passed on to the producer by allowing him to charge higher prices. Such an inflated price does not represent the real benefit of domestic production to the economy.

5.3 Valuation of Costs

a. Internal Costs

(i) Imported Inputs

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

(ii) Labour

An attempt has been made to value the cost of labour at its opportunity (real) cost to the economy. The opportunity cost of labour is an indicator of the agricultural production which will be lost to the economy of Somalia if labour is withdrawn from its present employment and re-settled on an irrigation scheme. It is assumed that potential settlers for the Balad Scheme will be drawn primarily from the nomadic population. Preliminary studies of this population and the number of cattle owned have only recently been initiated and therefore no precise estimate of the production which will be lost through settlement can be made. Discussion with the officers of the Livestock Development Agency however revealed that if a programme of range management, allowing increases in extensive beef production, is to be implemented, the number of herdsmen on the range will have to be considerably reduced. It would therefore appear that settling nomads on the Balad Scheme need not reduce cattle production and the assumption can be made that the opportunity cost of this particular form of settlement will be zero.

On the other hand if the settlement population is drawn from nomads who are already cultivating in the flood season there will be a definite opportunity cost to settlement on the Balad Scheme. It is also doubtful if the settler could rely on the primarily nomadic population to provide regular hired labour which would probably have to come from the farming areas further north. At the moment the cost of this labour can only be estimated from preliminary studies in the Afgoi area. These studies indicate that on an average holding of 2.3 hectares under cultivation the yearly man-day input is 340 days to produce an income of 800 shillings. The assumption that this man-day input represents full utilisation of available labour would give an opportunity cost of about Shs. 2.50 per man-day (6 hr.). The other assumption is that full utilisation of available labour is only achieved at the peak April-June period when weeding of maize requires a 97 man-day input. This would mean that there is approximately 400 man-days available throughout the year and would reduce the opportunity cost to approximately Shs. 2.00 per day. This further assumes that wives and children are normally considered as part of the work force while the impression gained from interviews was that this is not generally the case and that they only perform work if adult male labour is not available at peak times. However it is not possible to state with any certainty what the available labour force or its utilisation is in any particular area without further statistical study.

It is thought that the opportunity cost of labour will be between the range of zero opportunity cost for nomadic labour and Shs. 2.50 per man-day for labour from the farming areas. Therefore the net farm outputs for the Balad Scheme have been calculated using two different assumptions in respect of the opportunity cost of labour. The first is that settler labour will be provided at zero opportunity cost to the economy while the small amount of hired will be provided at Shs. 2.50 per man-day. At the other extreme it has been assumed that all labour will be provided at a cost of Shs. 2.50 per man-day.

TABLE 5.1 Farm Income and Labour Inputs derived from a Reconnaissance Survey in the Afgoi Area

	Average yield kilos per hectare	Projected Price shillings per 100 kilos	Average hectares cultivated	Average crop income	Total man-day input (6 hrs.)
Maize	400	35	2.3	322	340
Sorghum	400	35	2.3	322	
Sesame	100	120	2.3	120	
Other produce	-			50	
Total				814	340

(iii) Local Management Personnel

An attempt has been made to cost managerial staff recruited locally at a competitive rate for different grades. However as there is an acute shortage of skilled staff at most levels, which is likely to grow in the short term, the salary scales used may understate their opportunity cost to the economy. As it is not possible to state what the true opportunity cost is, the current market rates have been taken, but to a certain extent, this understatement of costs balances the overstatement of costs discussed below under external costs.

b) External Costs

These have been overstated since there is a factor income element which although it is a financial cost to the project nevertheless it is a benefit to the economy. In the case of new processing facilities (cotton ginning) which have to be substantially re-equipped to deal with the output of the project, it can be assumed that the ratio of extra benefit for extra cost will be, where the throughput is relatively small, the same as the return on the project and thus will not significantly alter the rate of return.

The case of oilseeds is slightly different since present capacity is underutilised and costs will not rise in proportion to the increased throughput. It has not been possible to get a complete breakdown of local processing costs, but the figures quoted and the profits margins allowed have been adjusted to what are thought to be reasonable levels compared with experience elsewhere.

5.4 Crop Returns per Hectare

The crop returns per hectare given in Tables 5.2 to 5.5 show the gross revenue per hectare, less the direct crop production costs and therefore indicate the relative profitability of different crops. These crop returns should not be confused with the financial return to the farmer since they represent the net direct benefit, before the deduction of the annual charges of the scheme. Thus although the opportunity cost of the farmer's labour is deducted from the gross returns, since there is a cost of withdrawing him from his previous employment, it is not a deductable cost to him personally and is therefore, added back in the analysis on farm income. Replacement of agricultural and irrigation equipment is also normally charged to the farmer eventually, but this is taken into account in the discounting procedures and is not therefore itemised in the crop returns for the economic analysis. In calculating the returns, maximum inputs have been assumed from the first cropping year, but it has been assumed that maximum yields will not be achieved until the fifth cropping year, in the case of cotton, groundnuts, sorghum and the fourth cropping year, in the case of sesame. This allows for a running in period, during which the farmer can develop the attitudes and skills necessary for irrigated farming and the management overcome any organisational problems.

5.5 Returns to Cattle Fattening

The returns to cattle fattening have been estimated in Table 5.6 in which projected f.o.b. prices are assumed and normal production costs deduced. Labour charges are for hired labour only and all other

TABLE 5.2 Groundnut-Returns and Production Costs - Somali Shillings per Hectare

Year	1	2	3	4	5-40
Yield kg/ha (shelled)[1]	518	610	702	854	1,037
Price (sh. per kg)	.69	.69	.69	.69	.69
Gross revenue (sh. per ha.)	357.00	421.00	484.00	589.00	716.00
Production Costs					
Seed (100 kg/ha @ 90 cts/kg)	90.00	90.00	90.00	90.00	90.00
Bags @ 3 sh. each[2]	30.00	21.00	30.00	30.00	30.00
Int. on working capital	9.50	9.00	9.50	9.50	9.50
Sub-Total	130.00	120.00	130.00	130.00	130.00
Labour					
(i) 8 M.D. hired @ 2.50 per M.D.[3]	20.00	20.00	20.00	20.00	20.00
(ii) 45 M.D. @ 2.50 per M.D.[4]	112.50	112.50	112.50	112.50	112.50
Ploughing and Internal Transport[5]	34.42	34.42	34.42	34.42	34.42
Total Crop Production cost					
(i)	184.42	174.42	184.42	184.42	184.42
(ii)	276.92	266.92	276.92	276.92	276.92
Profit per hectare (before deduction of annual charges)					
(i)	172.58	246.58	299.58	404.58	531.58
(ii)	180.08	154.08	207.08	312.08	439.08

1. Shelling out percentage assumed to be 61%
2. Assumed 50% bags replaced annually
3. Assuming zero opportunity cost for settled labour
4. Assuming opportunity cost of Shs. 2.50 per man-day for all labour
5. See Appendix VI

TABLE 5.3 Seed Cotton Returns and Production Costs - Somali Shillings per Hectare

Year	1	2	3	4	5-40
Yield (kg/ha)	600	700	850	1,000	1,200
Price (So. Sh. kg)	1.00	1.00	1.00	1.00	1.00
Gross revenue (So. Sh. per ha.)	600.00	700.00	850.00	1,000.00	1,200.00
Production Costs					
Seed (25 kg/ha @ 40 cts. kg)	10.00	10.00	10.00	10.00	10.00
Fertiliser (100 kg/ha @ 8.50 sh. M. T.		85.00	85.00	85.00	85.00
Spraying (four aerial sprayings @ 45 sh. per ha)	180.00	180.00	180.00	180.00	180.00
Bags @ 3 So. Sh. each[1]	48.00	33.00	48.00	48.00	48.00
Interest on working capital	13.60	14.00	16.60	16.60	16.60
Sub-Total	251.60	322.00	339.60	339.60	339.60
Labour					
(i) 31 MD hired @ 2.50 per MD[2]	50.00	55.00	65.00	70.00	70.00
(ii) 101 MD @ 2.50 per MD[3]	225.00	230.00	240.00	245.00	252.50
Ploughing and internal transport[4]	28.06	28.06	28.06	28.06	28.06
Total Production Costs					
(i)	329.66	405.06	432.66	437.66	437.66
(ii)	504.66	580.06	607.66	612.66	620.16
Profit per hectare (before deduction of annual management charges)					
(i)	270.34	294.94	417.34	562.34	762.34
(ii)	95.34	119.94	242.34	387.34	579.84

1. Assuming 50% bags replaced annually
2. Assuming zero opportunity cost for setled labour
3. Assuming opportunity cost of Shs. 2.50 per man-day for all labour
4. See Appendix VI

TABLE 5.4 Sorghum Returns and Production Costs - Somali Shillings per Hectare

Year	1	2	3	4	5-40
Yield (kg/ha)	550	600	800	900	1,000
Price (So. Sh. kg)	0.35	0.35	0.35	0.35	0.35
Gross revenue (So. Sh. per ha)	192.50	210.00	280.00	315.00	350.00
Production Costs					
Seed (12 kg/ha @ 40 cts. kg)	5.00	5.00	5.00	5.00	5.00
Bags @ 3 sh. each[1]	30.00	21.00	30.00	30.00	30.00
Interest on working capital	6.50	6.20	6.50	6.50	6.50
Sub-Total	41.50	32.20	41.50	41.50	41.50
Labour					
(i) 4 MD hired @ 2.50 per MD[2]	10.00	10.00	10.00	10.00	10.00
(ii) 50 MD @ 2.50 per MD[3]	125.00	125.00	125.00	125.00	125.00
Ploughing and internal transport[4]	22.35	22.35	22.35	22.35	22.35
Total crop production cost					
(i)	73.85	64.55	73.85	73.85	73.85
(ii)	188.85	179.55	188.85	188.85	188.85
Profit per hectare (before deduction 2% of annual charges)					
(i)	118.65	145.45	209.15	241.15	276.15
(ii)	3.65	30.45	91.15	126.15	161.15

1. Assuming 50% bags replaced annually
2. Assuming zero opportunity cost for settled labour
3. Assuming opportunity cost of Shs. 2.50 per man-day for all labour
4. See Appendix VI

TABLE 5.5 Sesame Returns and Production Costs - Somali Shillings per Hectare

Year	1	2	3	4-40
Yield (kg/ha)	300	400	400	450
Price (So. Sh/kg)	1.20	1.20	1.20	1.20
Gross revenue (So. Sh. per ha)	360.00	480.00	480.00	540.00
Production Costs				
Seed (8 kg @ 1.40 kg)	11.00	11.00	11.00	11.00
Bags @ 3 sh each	18.00	15.00	15.00	15.00
Interest on working capital	6.30	6.20	6.20	6.20
Sub-Total	35.30	32.20	32.20	32.20
Labour				
(i) 5 MD hired @ 2.50 per MD[2]	12.50	12.50	12.50	12.50
(ii) 65 MD @ 2.50 per MD[3]	162.50	162.50	162.50	162.50
Ploughing and internal transport[4]	17.14	17.14	17.14	17.14
Total Crop Production Costs				
(i)	64.94	61.84	61.84	61.84
(ii)	214.94	211.84	211.84	211.84
Profit per hectare (before deduction of annual charges)				
(i)	295.06	418.16	418.16	478.16
(ii)	145.06	268.16	268.16	328.16

1. Assuming approximately 50% bags replaced annually
2. Assuming zero opportunity cost of settled labour
3. Assuming opportunity cost of Shs. 2.50 per man-day for all labour
4. See Appendix VI

TABLE 5.6 Cattle Costs and Returns - Somali Shillings

Price of steer at buying point - 270 kilos at 1.30 per kilo liveweight	351
Transport on hoof to Balad at 3 cts per head per kilometre for average 200 kilometres	6
Brokerage & Commission & market fees 8% of sales value	28
	385
Costs of Production	
Price of steer	385
Labour per steer	25
Veterinary costs per steer	20
	430
Costs till f. o. b.	
Trucking Balad-Mogadiscio at 4 shillings per head	4
Port handling at 5 shillings per head	5
Port Veterinary Inspection at 7 shillings per head	7
F.O.B. Cost of steer	446
F.O.B. Price of steer 320 kilos at 1.85 per kilo	592 shs.

Total number of steers bought every year 7,250

Total number of steers sold every year 7,000

Total on farm costs 7,250 x 430 shillings = 3,117,500 shillings

Total costs from farm gate till F.O.B.

7,000 x 16 shillings = 112,000 "

Total F.O.B. Cost 3,229,500 "

Total return at F.O.B. price 7,000 x 592 shillings 4,144,000 shillings

Profit (before deduction of annual management charges) = 914,500 shillings

production costs are those which have been quoted by the Livestock Development Agency in Somalia. The profit from the production of 7,000 fattened steers would be of the order of Shs. 914,400 before deduction of Management charges.

5.6 Internal Rate of Return

It has been assumed that Settlement proceeds at a more or less constant rate over 4 years hence the area of crops grown and numbers of cattle fattened increases over the first four years as shown in Table 5.7.

Settlement has been assumed to start in project year one after the main canal has been established which would mean the first crop would be grown in project year 2. Therefore it has been assumed that the scheme will be settled over project years 2, 3, 4 and 5. Although a faster rate of development is theoretically possible this would greatly increase initial management problems and place a particularly heavy burden on newly recruited agricultural officers. Settlement has therefore been phased over four years to allow for the difficulties of settler recruitment and to allow for a smaller number of settlers per agricultural officer until the latter has gained experience of settlement problems.

TABLE 5.7 Rate of Settlement in terms of cropped areas and livestock numbers

Cropping Yr.	Groundnut ha.	Cotton ha.	Sorghum ha.	Sesame ha.	Total	Cattle No.
1	546	546	274	274	1,640	1,600
2	614	614	306	306	1,840	1,800
3	610	610	305	305	1,830	1,800
4	630	630	315	315	1,890	1,800
Total	2,400	2,400	1,200	1,200	7,200	7,000

TABLE 5.6 Cattle Costs and Returns - Somali Shillings

Price of steer at buying point - 270 kilos at 1.30 per kilo liveweight	351
Transport on hoof to Balad at 3 cts per head per kilometre for average 200 kilometres	6
Brokerage & Commission & market fees 8% of sales value	28
	385
Costs of Production	
Price of steer	385
Labour per steer	25
Veterinary costs per steer	20
	430
Costs till f. o. b.	
Trucking Balad-Mogadiscio at 4 shillings per head	4
Port handling at 5 shillings per head	5
Port Veterinary Inspection at 7 shillings per head	7
F.O.B. Cost of steer	446
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Total number of steers bought every year 7,250

Total number of steers sold every year 7,000

Total on farm costs 7,250 x 430 shillings = 3,117,500 shillings

Total costs from farm gate till F.O.B.

7,000 x 16 shillings = 112,000 "

Total F.O.B. Cost 3,229,500 "

Total return at F.O.B. price 7,000 x 592 shillings 4,144,000 shillings

Profit (before deduction of annual management charges) = 914,500 shillings

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1	546	546	274	274	1,640	1,600
2	614	614	306	306	1,840	1,800
3	610	610	305	305	1,830	1,800
4	630	630	315	315	1,890	1,800
Total	2,400	2,400	1,200	1,200	7,200	7,000

Assuming this rate of settlement the projected net benefits (which are calculated by multiplying the net return per hectare for the different crops and the net return to cattle fattening by the rate of settlement) are those given in Table 5.8. The annual management investment and replacement costs are then substracted from the net benefits as shown in Table 5.10 to give the net cost-benefit flow over the project life. This flow is converted to its present value using compound interest factors and the rate of interest which equalizes the present value of costs and benefits is the internal rate of return of the project.

When the opportunity cost of settled labour is taken as zero the internal rate of return becomes 9.0 per cent, alternatively with the opportunity cost of all labour taken as Shs. 2.50 per man-day the internal rate of return becomes 7.0 per cent.

A cost-benefit ratio has also been worked out at 7 per cent (which has been taken as the normal interest rate for long term international development capital) giving a ratio of 1:1.25 assuming zero opportunity of labour.

5.7 Financial Analysis

Table 5.11 shows a farm income of Shs. 3,186 by project year nine, after all costs except project loan debt service commitments have been deducted. It is difficult to state with any certainty what level of income will attract and keep a settler in an organised flood irrigation scheme but it has been assumed that 2,500 shillings per annum would be sufficiently attractive. If this level is sufficient a surplus of 620 shillings would be left per holding and a project total of Shs. 744,000 annually from the ninth project year which could be put towards debt service commitments.

According to the Short-term Development Plan it is extremely difficult to raise funds for long-term development from domestic sources and therefore it must be presumed that any loan for the project would have to come from foreign sources. If a foreign exchange loan for the total investment were to be obtained at normal interest rates debt service commitments would be 2,160,000 shillings annually from the first year.

TABLE 5.8 Balad Flood Irrigation Scheme: Net Benefits (before deduction of annual management, investment and replacement charges). Shs.

a) Assuming zero opportunity cost of settler labour

Cropping Yr.	Groundnut	Cotton	Sorghum	Sesame	Cattle	Total
1	94, 229	147, 605	32, 510	80, 846	209, 029	564, 219
2	240, 597	327, 026	76, 160	204, 864	444, 186	1, 292, 833
3	420, 245	573, 807	138, 003	332, 526	679, 343	2, 143, 924
4	663, 982	913, 513	211, 781	479, 456	914, 500	3, 183, 232
5	877, 144	1, 201, 905	259, 065	536, 592	914, 500	3, 789, 206
6	1, 052, 162	1, 490, 267	299, 600	554, 892	914, 600	4, 311, 421
7	1, 195, 782	1, 703, 617	320, 355	573, 792	914, 500	4, 708, 046
8-40	1, 275, 792	1, 829, 167	331, 380	573, 792	914, 500	4, 925, 029

b) Assuming opportunity cost of 2.50 shillings for all labour

Cropping Yr.	Groundnut	Cotton	Sorghum	Sesame	Cattle	Total
1	43, 724	52, 055	1, 000	39, 746	209, 029	345, 554
2	133, 297	124, 026	9, 460	117, 864	444, 186	828, 833
3	256, 520	264, 057	36, 228	199, 776	679, 343	1, 435, 924
4	441, 982	475, 570	73, 781	299, 456	914, 500	2, 205, 229
5	655, 144	763, 905	121, 065	356, 592	914, 380	2, 811, 206
6	830, 162	1, 052, 267	161, 600	374, 892	914, 500	3, 333, 421
7	973, 792	1, 265, 617	182, 355	313, 792	914, 500	3, 730, 046
8-40	1, 053, 792	1, 391, 617	193, 380	353, 792	914, 500	3, 947, 081

TABLE 5.9 Replacement Schedule Shs. '000

Project Year	Vehicles	Tractors	Implements	Mechl. Plant	Decortn. Plant	Total
5	171.7					171.7
6						
7		232.4				232.4
8		58.1				58.1
9		58.1				58.1
10	171.7	87.2			210.0	468.9
11						
12			146.5			146.5
13			46.9			46.9
14			46.9			46.9
15	171.7	232.4	61.6			465.7
16		58.1				58.1
17		58.1				58.1
18		87.2				87.2
19						
20	171.7			939.4	210.0	1,321.1
21		232.4				232.4
22		58.1				58.1
23		58.1				58.1
24		87.2	146.5			233.7
25	171.7		46.9			218.6
26			46.9			46.9
27			61.6			61.6
28		232.4				232.4
29		58.1				58.1
30	171.7	58.1			210.0	439.8
31						
32		87.2				87.2
33						
34						
35	171.7	232.4	146.5			550.6
36		58.1	46.9			105.0
37		58.1				58.1
38						
39		43.0				43.0
40						

TABLE 5.10 Balad Flood Irrigation Scheme Internal Rate of Return
(Shillings)

Yr.	Net benefits	Annual Management[1]	Investment[2]	Replacement	Net cost/ benefit
1		682, 100	15, 217, 500		-15, 899, 600
2	564. 219	873, 830	4, 084, 000		- 4, 393, 611
3	1, 292, 833	1, 071, 379	6, 848, 400		- 6, 572, 946
4	2, 143, 924	1, 066, 371	2, 372, 900		- 1, 295, 347
5	3, 183, 232	1, 041, 015		171, 700	1, 970, 517
6	3, 789, 206	992, 987			2, 796, 210
7	4, 311, 421	974, 543		232, 400	3, 104, 478
8	4, 708, 046			58, 100	3, 675, 403
9	4, 925, 029			58, 100	3, 892, 386
10				468, 900	3, 481, 586
11					3, 950, 486
12				146, 500	3, 803, 986
13				46, 900	3, 903, 586
14				46, 900	3, 903, 586
15				465, 700	3, 484, 786
16				58, 100	3, 892, 386
17				58, 100	3, 892, 386
18				87, 200	3, 863, 286
19					3, 950, 486
20				1, 321, 100	2, 629, 386
21				232, 400	3, 718, 086
22				58, 100	3, 892, 386
23				58, 100	3, 892, 386
24				233, 700	3, 716, 786
25				218, 600	3, 731, 886
26				46, 900	3, 903, 586
27				61, 600	3, 888, 886
28				232, 400	3, 718, 096
29				58, 100	3, 892, 386
30				439, 800	3, 510, 686
31				87, 200	3, 863, 286
32					3, 950, 486
33					3, 950, 486
34					3, 950, 496
35				550, 600	3, 399, 886
36				105, 000	3, 845, 486
37				58, 100	3, 892, 386
38				43, 000	3, 907, 486
39					3, 950,486
40					3, 950, 486

4, 925, 029 Annually

974, 543 Annually

1. See Table 4. 2
2. See Table 4.1
3. See Table 5.10

Internal rate of return i) 9. 0% when opportunity cost of settled labour is zero.
ii) 7. 0% when opportunity cost of all labour is Shs. 2. 50

Although the surpluses generated outside the project are considerable as indicated by the gross foreign exchange earnings and savings it will be extremely difficult to tax these surpluses equitably until an adequate tax collection system has been introduced. It is also stated in the Short Term Development Plan that Somalia's external debt position is critical and foreign debt will have to be rescheduled and further debt commitments granted on concessionary terms. Therefore any new projects should be self liquidating as far as possible.

In these circumstances it would be difficult to meet debt service obligations except by reducing settler income to an unattractive level. On the other hand if the project is considered suitable for soft-loan at a $1\frac{1}{2}$ per cent service charge per annum this would reduce debt service commitments to approximately 960,000 shillings annually which would leave 216,000 shillings annually to be found over and above the internal surplus generated by the project.

TABLE 5.11 Farm Income from a 6 ha. holding after maturity (Shs.)

Net revenue groundnuts	1,063.16	
Net revenue cotton	1,524.68	
Net revenue sorghum	276.15	
Net revenue sesame	478.16	
Net revenue livestock	762.00	
Total		4,104.15
Loss		
Annual management charges	812.11	
Replacement charges	168.00	
		980.11
Total Net Farm Income		3,124.04

5.8 Conclusions

At an internal rate of return ranging from 7.0 per cent to 9.0 per cent the Balad Flood Irrigation is a marginal one in terms of the direct measurable benefits generated. The scheme would not at the assumed

level of farm income generate internal surplus at an acceptable level for loan repayment on normal terms in present circumstances in Somalia. However the project if implemented could lead to considerable other benefits in the form of substantial exchange saving and earnings, provision of raw cotton for the Balad textile mill, a continuous supply of oilseeds for the present processing facilities in Mogadiscio and a production base on which to organise crop handling and marketing services. The most important indirect benefit would be the opportunity provided to settle nomadic people and the provision of a base for the future expansion of intensive cattle raising in the central region. The project therefore could be considered a suitable one for soft-loan financing.

A decision to implement the Balad project as a soft-loan scheme would depend on some assessment being made of other possible ways of developing the irrigation potential of the Shebelli River, such as on or off stream storage in Somalia or Ethiopia. The provision of storage upstream of Balad would probably eliminate the possibility of flood irrigation downstream. Three possibilities have only been given preliminary consideration, but on further detailed examination, they might indicate a higher rate of return on capital invested or provide a greater absolute production potential for the same rate of return. The successful implementation of the Balad Scheme would also depend to some extent on the provision of harbour facilities in Mogadiscio. This development in itself could change the economic potential of the Shebelli Valley and make a flood irrigation scheme unattractive compared with more efficient means of water utilisation.

CHAPTER 6

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

6.1 Priorities for Development

In view of the limited resources available for agricultural development in Somalia and particularly the scarcity of capital and skilled manpower, it is essential that development planning should channel these resources into those projects which give the best and most rapid return. At present data on which to determine such priorities is often lacking. It is desirable that the relevant data be collected in order that the Ministry of Planning may establish the development priorities for the allocation of national resources.

Within the Shebelli Valley a number of development alternatives require to be considered when deciding the priority of the Balad Project. The possibility of an off river storage and flood control scheme above Johar has been investigated, this scheme, if implemented would so reduce flood season river flows downstream as to preclude the operation of flood irrigation projects such as that proposed for Balad. This storage scheme which is discussed in Volume IV would maintain appreciably higher flows in the river during the season when natural flows are low with considerable benefit to controlled irrigation projects and particularly areas devoted to perennial crops.

It is only within the national and regional context that the plan for the Balad Project (in terms of development priority) can be considered.

6.2 Land, Water and Crops Legislation

No land law has yet been approved by the Somali Government although the need for such a law has been stressed many times in previous development studies. Any attempt to limit the area which an individual may own

will inevitably meet with opposition from the existing influential land owners. Traditional cultivation rights over considerable areas are also claimed by tribal groups, although only a small proportion of such areas are cultivated at any one time. In order to increase productivity the reallocation of at least part of the present uncultivated areas is desirable but would meet with considerable opposition.

Legislation for the rationalisation of land ownership and land utilisation should result in an increase in the area available for cultivation and protect the interests of both landlord and tenant cultivator. It is considered that legislation should provide for the following:-

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

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

c) The need for tenants on cultivated holdings to achieve a satisfactory standard of crop husbandry. In the event of default landlords should be permitted to take necessary remedial measures and as a last resort evict the tenant.

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

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

This law was the result of a study carried out on behalf of the United Nations in 1963/4 by Dante A. Caponera whose report to the Government of Somalia on Water Legislation and Administration was published by F.A.O., Rome, in 1964.

Although the law was drafted in Italian an English translation was obtained and studied during the course of the present project. The law is fairly comprehensive but there is no evidence that any attempt has been made to carry out the provisions it contains. Had the suggested Register of Users,(Article 7),been prepared by the Water Department an accurate assessment of the present use or entitlement could have been made.

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

The Regulations that accompany the law have been drafted but so far have not been issued. It is essential that these are put into force as soon as possible so that water use along the Shebelli River can be rationalised. The Law and Regulations must be enforced to ensure that users with the prior right receive a supply. It is appreciated that during the initial years an Irrigation Department established on the lines proposed in Volume IV will experience difficulty in providing the degree of control required. However without control the planning of any major irrigation project cannot proceed with any certainty of successful implementation.

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

The fees payable by water users under the existing law would assist in supplying the revenue necessary to administer the proposed Irrigation Department.

The control of pests, diseases and pernicious weeds in crops is necessary to maintain high levels of productivity. Failure by a farmer to execute control measures can often prejudice not only his own crop but those of neighbouring farmers. In the case of more serious pests and diseases of crops of national importance, new legislation may be necessary to cover a particular situation, however legislation in itself is useless unless personnel can be made available to enforce the law. Existing legislation restricting the cotton season and requiring adequate clearing of the crop residues, should be modified to suit the conditions of the proposed Balad Project and the machinery for its enforcement established.

6.3 Improvement of Government Services

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

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

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

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

In addition to Government services associated with crop production aspects the Balad Project will require assistance from Government Departments relating to Local Government, Health, Housing, Water Supplies,

Communications and Commerce and Industry. Such a wide range of activities may result in some degree of conflict but such difficulties must be overcome.

6.4 Agricultural Research

At present agricultural research has concentrated on the selection of crops and varieties suitable for cultivation and relatively little data is available on production techniques and their cost effectiveness. The investigation of irrigation practices under local conditions of soil and climate should be accorded a high priority in view of the general lack of information at present on crop water requirements.

During the course of agricultural development including the establishment of the Balad Project numerous practical problems in the field of crop production will arise and the research services must be ready to utilise their resources in the solution of these difficulties as rapidly as possible.

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

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

6.5 Co-operatives and Credit

A Law pertaining to the establishment of Co-operative Societies was promulgated early in 1969.

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

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

It must be emphasised that although a great deal has been written in the past about the place of co-operatives in development in the Republic the concept of co-operatives in the real sense of the word is new to Somalia.

At the present time adequate arrangements for the provision of credit facilities to farmers are inadequate. An Agricultural Credit Bank has been established but the Somali farmer generally lives in such poor circumstances that he is unable to provide the security for loans without which any sound banking operation cannot operate. When credit has in the past been given without proper security for such things as seeds, fertilisers, pest control services by various government organisations, failure to repay has been the rule rather than the exception. The project envisaged in this report, giving as it does greater control over marketing of the farmers' produce opens up greater possibility for satisfactory credit arrangements and the farmer's tenancy agreement could include a clause requiring him to meet his credit liabilities.