DEMOCRATIC REPUBLIC

OF

SOMALIA

MOGANBO IRRIGATION PROJECT

FEASIBILITY STUDY

(NOTE: HAND WRITTEN COMMENTS ARE SOME OF THE CRITICISM MADE BY FUNDING AGENCIES.)

MAIN REPORT

May 1977

Prepared for the:

State Planning Commission
and
Kuwait Fund for Arab Economic Development

Tippetts-Abbett-McCarthy-Stratton - New York

Financial and Technical Services - Cairo

TAMS / FINTECS
CONSULTANTS
ENGINEERING · AGRICULTURE · ECONOMICS
24 Elmansour Mohamed St., Zamalek
Cairo, Arab Republic of Egypt.
Tel. 814106 - Cables: TAMSFINTEC Cairo

تـــامس / فـــنتكس
مستشارون
هندسة ـ زراعة ـ اقتصاد
٢٤ شارع المنصور محمد ـ الزمالك
القاهرة ـ جمهورية مصر العربية
تليفون ٨١٤١٠٦ ـ برقيا : تامسفنتك القاهرة

May 22, 1977

Mohamed Youssef Werah, Chairman
State Planning Commission
Mogadishu
Somalia

Dear Sir:

Transmitted herewith is the final report on an irrigated agricultural project on the Juba River, now known as the Moganbo Irrigation Project. This report is submitted in accordance with the contract dated 6 April 1976 between the Government of Somalia and Financial and Technical Services of Cairo, Egypt, and Tippetts-Abbett-McCarthy-Stratton of New York, U.S.A.

In addition to this report, there is a short summary report. Both reports are supported by three volumes of appendices (nine parts) and one portfolio of drawings. The appendices have been reproduced in limited quantity and are intended for use by those who may wish to see supporting information.

A draft of this report was reviewed in a conference in Kuwait attended by representatives of the Government of Somalia, the Kuwait Fund for Arab Economic Development, and the Consultant on April 10 and 11, 1977.

2/..

Mohamed Youssef Werah, Chairman

State Planning Commission
Mogadishu, Somalia

../2

Comments discussed at this meeting have been considered in the preparation of this final report.

TAMS/FINTECS takes this opportunity to thank you, members of your staff and the many people working in the Government of Somalia for the kindness and cooperation shown our staff.

Sincerely,

M. Moghazi

Mohamed El Moghazi
Executive Director
Financial & Technical Services

Paul H. Berg

Paul H. Berg
Project Manager
TAMS/FINTECS

Dana E. Low

Dana E. Low, Partner
Tippetts-Abbett-McCarthy-Stratton

CURRENCY EQUIVALENTS

U.S.$ 1.00 = SoSh. 6.30

SoSh. 1.00 = U.S.$ 0.16

ABBREVIATIONS

ADC	Agricultural Development Corporation
CARS	Central Agricultural Research Station
LDA	Livestock Development Agency
ARI	Agricultural Research Institute

WEIGHTS AND MEASURES

All weights and measures are in the metric system

CONTENTS

1. INTRODUCTION

1.01 The development strategy of Somalia gives emphasis to agriculture. In considering economic prospects for this sector, availability of water is the major determinant, since the country is arid to semiarid and susceptible to periodic droughts over extensive areas. Attention is being focused on the Juba River Valley where the land and water resources have not yet been fully developed. The proposed land area initially considered for an irrigated agricultural project consisted of 5,000 to 10,000 hectares located on the right bank of the Juba River north of Kamsuma and extending westward and downstream into the bush.

1.02 The feasibility study was carried out in accordance with the following terms of reference.

"1) Review all the available data, studies and reports on the Juba River Scheme and in particular those parts relating to the area indicated

*2) diagnose the economic setting of the country including a detailed analysis of the agricultural sector and its present and potential contribution to the future growth of the economy. Such analysis to include trends in agricultural livestock production, yields, crops, farm prices and income, changes in the supply of agricultural requisites and the behaviour of agricultural exports, imports and agricultural resources (land, forestry, fisheries and water supply)

*3) From (2) above to distill and single out the major constraints which are likely to affect in one form or another the formulation and implementation of agricultural projects, e.g. resource constraints, infrastructure constraints, institutional policy constraints and technical constraints

*4) From (2) and (3) above to assess the agricultural development priorities related to the technical, economic and institutional aspects of agriculture

5) From (1) above and the relevant parts of (2) to (4) to identify a reasonably sized irrigated agricultural project

6) To formulate the identified project and to examine in depth its essential features and in particular to review and describe the project area - physical resources, population and employment, economic and soil infrastructure, institutions, economy and agriculture of the project area

7) Describe the project in detail and in particular its essential features, e.g. purpose, choice of location, production process and size, project major works and other components, their design specifications, equipment and construction requirements, phasing of of works and time schedule of execution and any special problems of execution

8) Prepare detailed capital costs estimates for the project broken down by component items and phases of execution as well as an itemized local and foreign components of said capital costs.

9) To prepare for the aforesaid project estimates of itemized production costs (seeds, fertilizers, insecticides, fuel, hired agricultural labor, technical and managerial staff, machinery repair, transportation, miscellaneous and separately overhead costs.

10) Estimate the financing required showing both the external and internal sources of project funding and for this purpose to prepare a consolidated financial sheet showing all sources of project funds and their uses both during construction and over its economic life

11) Describe the agricultural development proposed for the project and in particular, the form of development envisages, proposed land use, cropping pattern, yields, volume of output, input mix, including research and extension, credit, supply of inputs, farm labour, existing or proposed cooperatives and other farmer's associations, etc.

12) Analyse the market outlook for the commodities produced by the project, such analysis is to include the future local and foreign demand and a review of the main variables and parameters affecting them and will ascertain the reliability and accuracy of the data used in the demand analysis. The market outlook should not only show the quantities of commodities demanded but also deal with the observative capacity of the market particularly the laws and regulations governing local and foreign trade. The study should include a review of the adequacy of storage and transportation facilities, a major point in the market outlook is the estimation of future prices (farmgate, wholesale and export prices)

13) Calculate the expected increase in agricultural income at the project level on the basis of the increase in the value of agricultural production, the increase in value added by agriculture, and the incremental value of agricultural production, all in the project areas. Furthermore the increase in non-farm income in the project area is also to be calculated.

14) To evaluate the economic and financial aspects of the project and for this purpose prepare projections of income statement, profit and loss statements, cash flow statements and proforma balance sheets for the economic life of the porject and indicate break-even points. The economic and financial analysis and evaluation should show the internal economic rate of return, the internal financial rate of return, benefit-cost ratio, net present worth, value added, impact on GDP, the net improvement in the balance of payments, impact on government finance if any. The employment opportunities created by the project must be shown together with any other non-economic benefits.

15) To present a sensitivity analysis on the basis of increased capital costs or increased operation costs or reduction of yields or prices, delay in execution and a suitable combination of the five factors in different possibilities. Similarly a sensitivity analysis on the basis of decreased capital costs, decreasedoperating costs, earlier completion and higher yields and prices should be done and a suitable combination of all five factors. If justified the basic

internal economic rate of return should be shadow-priced, full justification being given for the assumptions adopted.

16) Propose a suitable organizational set-up, operating procedure and a suitable financial structure for the administrative arrangements to be established to run the project

17) The full details of all calculations should be tabulated and appended to the report with sufficient explanatory notes showing how they are made up and arrived at.

18) Regardless of the generality of all the foregoing, to undertake all that is necessary for the preparation of a comprehensive and detailed Project Report up to the standards of international development lending institutions.

*(2), (3) and (4): By letter dated July 16, 1975, the Kuwait Fund for Arab Economic Development requested that items 2, 3 and 4 be deleted from these terms of reference.

1.03 The Government of Somalia contracted with the joint venture consultant, Tippetts-Abbett-McCarthy-Stratton of New York and Financial and Technical Services of Cairo on April 6, 1976, to conduct the study. Funds for the study were provided by the Kuwait Fund for Arab Economic Development.

1.04 When representatives of the joint-venture consultants, TAMS/FINTECS, arrived in Somalia in late May 1976, they were informed of a change in project area. The area finally selected for study was near Moganbo on the west bank of the river and south (downstream) of the original area. Approval of the Moganbo area for study was received by the Government from the Kuwait Fund on 21 June 1976.

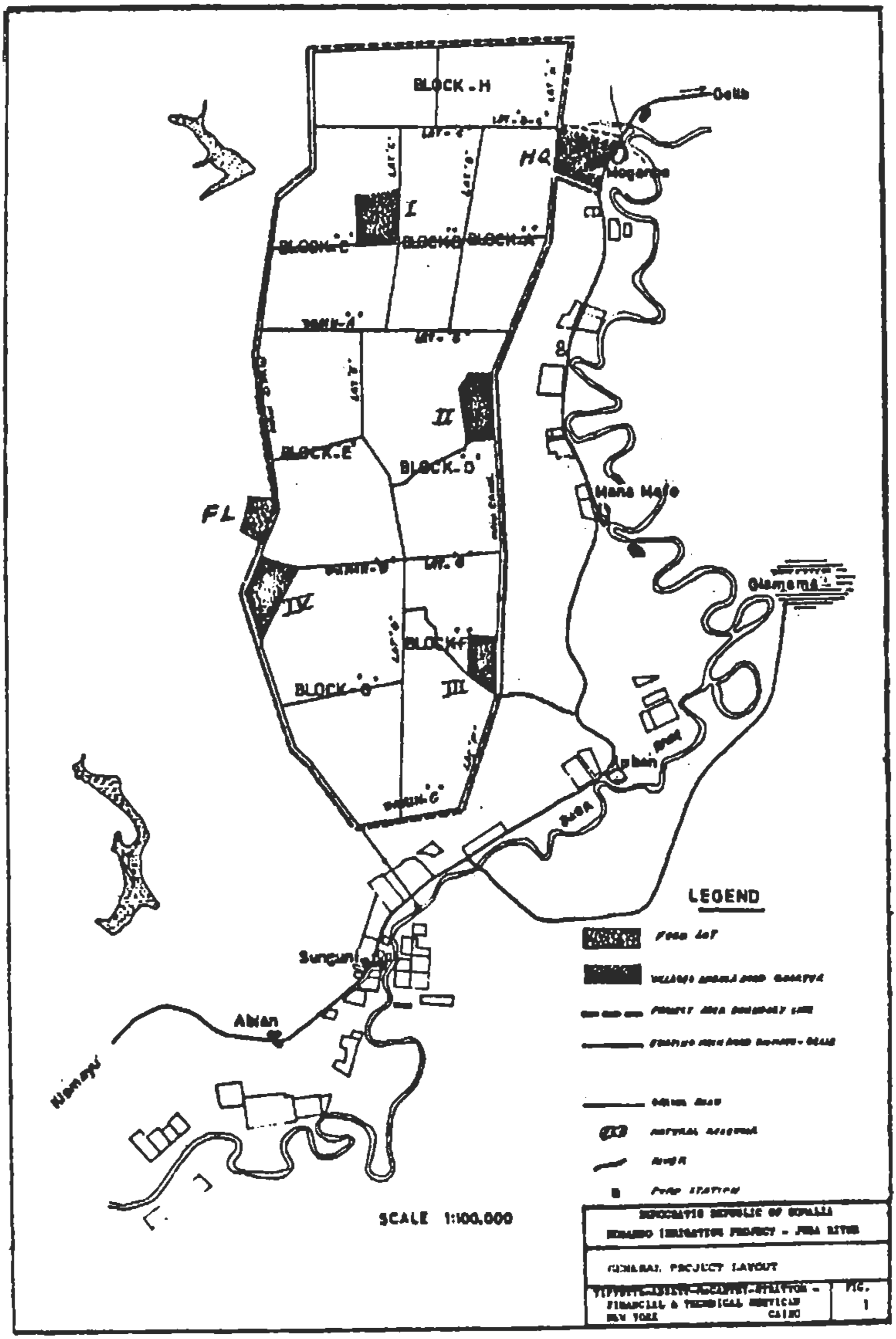
1.05 Field work was initiated after approval of the new project area by the Kuwait Fund. Topographic surveys were performed by Somali survey engineers employed by the consultant. Specialists in the various disciplines associated with an agricultural irrigation project collected all available data from whatever sources. After four months of field work, data were taken to Cairo where detailed analyses were performed by the staff.

1.06 This report presents the conclusions of their findings. It describes a feasible irrigation project under state farm management for the production of food and fiber, which are currently in short supply. A feedlot component is included to use by-products from the farm for cattle fattening. The intent is to develop maximum benefit from the combination of land, water and labor.

ACKNOWLEDGEMENT

1.07 The Consultants, a joint venture of Tippetts-Abbett-McCarthy-Stratton of New York, U.S.A., and Financial and Technical Services of Cairo, Egypt (TAMS/FINTECS) received cooperation and assistance from the Chairman of the State Planning Commission and his staff for which they are grateful. Many others in the Government of Somalia, particularly in the Ministry of Agriculture, were helpful in gaining access to important sources of information.

1.08 General supervision of the work was by Mohamed El Moghazi, Executive Director of FINTECS and Dana E. Low, Partner-in-Charge for TAMS. Immediate supervision and direction of the feasibility study was by Paul H. Berg, Project Manager for TAMS/FINTECS. The professional staff included: Dr. A.R. Abou Akkada, Livestock Specialist; Dr. A.A. Abdel-Bary, Agronomist; Dr. H.A. El Attar, Soils Scientist, Dr. H.M. Bakr, Water Resources Engineer; Dr. I.A. El Dimeery, Road Engineer; R.F. Kreiss, Hydrologist; Dr. K.S. Reda, Agricultural Economist, and Dr. S.M. El Zoghby, Rural Sociologist. Topographic surveys were made by Bashir Gouled Mohamed, Survey Engineer; Saeed Mohamed Liben, Survey Engineer, and Saiid Hussein Ali, Draftsman, all of Somalia. Statistical analysis was carried out by Y.O. Alawany and M.M. Morsy. Assistance in report preparation was provided by B. Trottier and typing by M. Dungan-Megalli.


BLOCK-H
HQ
BLOCK-E
BLOCK-D
FL
BLOCK-F
BLOCK-G
Abian
LEGEND
SCALE 1:100,000
FIG.
1
CAIRO

2. BACKGROUND

A. General

2.01 Somalia, with an area of over 637,000 square kilometers, lies on the eastern "horn" of Africa. Its climate is typically tropical arid to semi-arid, and rainfall is low and irregular. The 1971-72 Manpower Survey projects a population of about 3.1 million for 1974, implying a population growth rate of about 2.6% per year (1970-1975). The most recent information indicates a population of about 4 million in 1976. In 1974, GNP was about U.S.$ 240-250 million with per capita incomes at an average of U.S.$ 80.

2.02 Since 1969, there has been a creditable performance in economic development, but Somalia is still a poor country with an economy depending on subsistence from livestock and agriculture. Exports, over 85% of which are livestock, livestock products, and bananas, rose to U.S.$ 62 million in 1972, the best recent economic year (compared to U.S.$ 35 million in 1969) and imports increased to U.S.$ 83 million (compared to U.S.$ 58 million in 1969). The rains failed in 1973 and especially in 1974 and 1975, seriously disrupting the economy. Imports rose sharply to U.S.$ 142.6 million in 1974.

2.03 In spite of improved export performance and substantial capital inflows, the country's net balance of payments deficits have been increasing (1973-1974) mainly due to the rapid rise in the amount and value of imports. The deficit was largely caused by increased food imports at higher

world prices, higher oil imports and prices and increased development effort. Foreign exchange reserves dropped by SoSh. 45 million in 1973 and were estimated to have dropped by SoSh. 56 million in 1974.

Planning Objectives

2.04 The Government has given highest priority to agricultural development, with an emphasis on increasing self-reliance. The 1971-73 Plan placed self-sufficiency in food production as one of the primary development objectives. Efforts concentrated on transport and infrastructure improvements as an essential support to development. Performance was commendable, with the achievement of two-thirds of objectives and self-sufficiency in maize and sorghum in 1972 and 1973. The drought of 1974-75 severely depressed both crop and livestock production.

2.05 The current 1974-78 Plan is a continuation of the first plan but it is production-oriented. The long-term objectives are to raise the rural standard of living, generate employment opportunities and increase exports. Large investments have been planned for irrigated agriculture with a view to eliminating Somalia's principal resource constraint - water. The plan also includes the establishment of state farms, more farmer cooperatives, better support services and agro-industrial development.

B. People

Population

2.06 The people of Somalia are all ethnic Somali and are basically nomadic. Of the estimated 4 million people in 1976, roughly 20 per cent are farmers, 20 per cent live in urban areas and the other 60 per cent are nomads or semi-nomadic.

2.07 The 1971 Labor Force Projection of the International Labor Organization shows the distribution by age groups as follows.

TABLE 2-1

Estimated and Projected Population of the Somali Democratic Republic 1950 - 1980 (by age)

	Year						000's
Age Group	1950	1955	1960	1965	1970	1975	1980
0-9	564	627	707	899	930	994	1193
10-14	215	239	267	317	368	435	410
15-19	187	207	231	263	307	357	423
20-24	161	178	197	218	254	296	346
25-44	435	475	525	541	628	733	860
45-54	128	137	148	136	158	184	218
55-65	80	85	93	80	92	108	128
65+	56	57	59	47	54	63	76
Total	1826	2005	2226	2500	2789	3171	3653

Source: Labour Force Projection, Part II - Africa, ILO, Geneva, 1971

2.08 A survey of the population of 12 villages in the general vicinity of the proposed project shows the breakdown by numbers of families, males and females, as in Table 2-2:

TABLE 2-2

Population of Selected Villages
Near Project Site

Village	No. of Families	Males	Females	Total Population
Moganbo	335	776	755	1531
Bulo Yag	128	275	309	584
Taugagungo	89	182	143	325
Sheik Cambul	257	590	524	1114
Borini Muniyo	72	151	177	328
Borini Ginis	63	125	92	217
Monamufo	438	1122	811	1933
Bola Farxan	120	292	287	579
Beled Raxwa	260	462	424	886
Koban	604	1417	1435	2852
Arara	107	261	242	503
Tansaniya	65	125	127	252
Total	2538	5778	5326	11,104

Source: Survey, Statistical Dept., February 1975

2.09 Along the eastern boundaries of the project, i.e. along the western river bank, there are more than twenty villages and hamlets with a total population of 15-20,000.

Twelve of these were surveyed to estimate their population. The four largest villages (200-600 families) are Moganbo, Sheik Cambul, Monamufa and Koban, having a total combined population of over 7500 people. Each of these functions as the central village for a number of smaller surrounding villages.

Labor Force

2.10 The 1962-64 manpower survey revealed a working-age population equal to about 58% of the total population, comparing favorably with the UN-estimated average for all of Africa. However, only 6 out of 10 Somalis of working age were employed in jobs outside the subsistence economy, representing an actual labor force of about 38% of total population (approximately 879,000 persons). The 1:3 dependency burden (unemployed excluded) is high compared to the all-Africa (1960) ratio, 1:1.79, raising acute problems in meeting the needs of the non-producing population. The low participation rate of the potential labor force may be attributed to low levels of education, shortage of skilled workers, and lack of adequate job opportunities. Traditionally, pastoral Somalis have had strong prejudices regarding certain occupations, such as farming. However, there is a definite movement from the nomadic to a settled way of life, an expansion of agricultural activity, and movement towards the major cities.

2.11 A rough estimate shows that the working-age population (15-59) in the immediate area of the project would number about 7500. Assuming a fairly even split between male and female populations, this would represent a total

male labor force of about 3750 men. Women and older children could be employed to increase the labor force during harvesting of maize and cotton.

2.12 Perhaps the most critical constraint on development in Somalia is the shortage of skilled and experienced manpower which prevails throughout the country. In agriculture, technical and managerial staff of sufficient competence and experience is in very short supply. Greater emphasis has been given to general education since 1971, and a massive literary crash program began in 1973. Both secondary and higher education have received attention and emphasis is being placed on pre-service and in-service training in all fields. These efforts should begin to bear fruit towards the end of the current plan period when graduates in agriculture and diploma students enter the work market. The concentration of available trained people on state farms and cooperatives would be a good focal point for an efficient production-oriented strategy.

C. Climate

2.13 The Moganbo Irrigation Project would be located in the Lower Juba River Valley which is a typical semi-arid, tropical region. There are several sources of climatic data but none give complete records over long periods of time. They confirm that the only climatic constrainst on length of growing season is moisture availability. Air temperatures do not vary greatly, the maximum recorded at Giamama being 37°C and the minimum 18.2°C. Mean annual

temperature is 27.8°C and mean monthly temperatures vary from 26°C to 29.4°C (Table 2-3).

2.14 Monsoons, from the northeast December through March and from the southeast May through October seem to control the climate. The heaviest rainy period in the project area is generally the first ("Gu") period from April to May, followed by the relatively dry "Hagai" (June to September) period and wet "Der" period (September to November). The dry season, "Gilah," is from December to March. Rainfall amounts fluctuate very widely and the pattern can even reverse itself, as it did in 1961. Average annual precipitation is 414 mm, which is not sufficient for dependable crop production under rainfed conditions (Table 2-4). The area is not touched by tropical cyclones.

2.15 Solar radiation data from nearby locations indicate that solar radiation in the project area would be higher than 570 cal/cm^2, cloudiness should not exceed 34% and hours of sunshine should average 66% per day. Dew point temperatures are highest in March, April and May, which are the most oppressive months. Relative humidity is highest in June and July (Table 2-5). Winds are generally light, from the south and southeast. Evaporation should be about 7.1 mm/day.

SOMALIA

MOGANBO IRRIGATION PROJECT

TABLE 2-3

Summary of Air Temperatures at Giamama
(Oct.-Dec. 1931; Jan. 1933 - Nov. 1936)

(°C)

Month	Absolute Maximum	Mean Maximum	Mean	Mean Minimum	Absolute Minimum
Jan	36.0	33.2	28.5	23.9	21.0
Feb	37.0	34.0	28.9	23.8	21.0
Mar	35.0	33.4	28.6	23.8	23.0
Apr	37.0	34.2	29.4	24.7	22.0
May	35.0	33.4	28.5	23.6	22.0
Jun	35.0	31.8	27.1	22.3	21.0
Jul	34.0	30.0	26.1	22.2	20.0
Aug	32.5	30.9	26.1	21.4	18.2
Sep	33.6	32.0	26.8	21.7	20.0
Oct	35.0	32.9	27.7	22.6	21.0
Nov	37.0	33.0	28.0	23.1	20.0
Dec	37.0	33.5	28.4	23.3	22.0
Year	37.0	32.7	27.8	23.0	18.2

Source: Contributo alla Climatologia della Somalia, A. Fantoli, Rome, 1963.

TABLE 2-4

SOMALIA

KOGANDO IRRIGATION PROJECT

Comparison of Concurrent Rainfall Records at Gimamma & Kismayo

	JAN		FEB		MAR		APR		MAY		JUN		JUL		AUG		SEP		OCT		NOV		DEC		TOTAL	TOTAL
	G	K	G	K	G	K	G	K	G	K	G	K	G	K	G	K	G	K	G	K	G	K	G	K	G	K
YEAR	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm
1929													111.0	41.0	15.0	33.5	95.0	66.0	72.0	0	49.0	0	91.0	20.0		
1930	0	0	0	0	57.5	17.0	82.0	18.0	362.0	85.0	88.0	40.0	87.0	0	-	0	27.0	0	191.0	0	70.0	22.0	6.0	0	970.5	182.0
1931	0	0	0	0	1.0	0	0	0	215.0	117.0	41.0	50.0	-	-	-	-	-	-	21.0	0	3.0	-	0	-		
1932	0	-	0	-	-	-	37.5	-	80.5	-	32.0	-	-	-	-	-	-	-	-	-	-	-	-	-		
1933	12.0	5.8	0	0	0	0	70.0	93.0	16.0	58.0	62.0	189.0	94.0	138.0	26.0	68.0	23.0	58.0	0	11.0	0	-	0	-	313.0	620.8
1934	0	0	0	0	0	0	69.0	29.0	99.0	83.0	86.0	206.0	48.0	59.0	89.0	19.1	7.0	5.1	4.0	0.5	0	0	0	1.0	402.0	402.7
1935	0	0	0	15.0	0	0.5	34.0	5.0	23.0	24.0	141.0	58.0	41.0	31.0	24.5	40.0	8.0	13.0	3.5	23.5	16.0	0	32.0	1.0	323.0	211.0
1936	0	1.5	33.0	0	0	0	91.0	31.0	4.0	43.0	140.0	243.0	31.0	134.0	15.0	-	188.0	-	-	-	0	-	42.0	-	544.0	452.5
1937	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1953	-	4.4	-	0	-	0	-	2.3	8.0	103.8	111.0	72.4	145.5	93.6	41.0	17.4	0	8.0	0	26.8	0	11.0	0	0	305.5	339.7
1954	0	0	0	0	0	0	44.0	31.3	37.0	28.4	112.0	79.8	41.0	24.6	19.0	18.1	0	3.4	0	0.5	5.0	22.1	10.0	0	268.0	208.2
1955	0	0	0	0	0	0	86.0	8.6	224.0	201.3	50.0	40.0	76.5	73.4	0	7.4	0	0	0	7.4	0	0	0	0	436.5	338.5
1956	0	0	0	0	0	0.2	0	14.2	60.0	83.5	42.0	139.1	0	8.1	0	0	0	0.4	0	0	40.0	0	0	8.8	142.0	253.5
1957	0	0	0	0	0	0	82.0	1.5	116.0	0	74.0	0.8	72.0	51.5	11.0	0	0	0	0	0	43.0	0	38.0	0	437.0	53.8
1958	14.0	0	0	0	0	0	121.0	39.4	57.0	68.9	41.0	44.5	-	1.6	-	5.3	-	0	-	0	-	0	-	0	-	179.7
AV	2.0	1.0	2.5	1.3	5.3	1.5	59.7	22.8	99.3	74.7	78.5	98.6	67.9	54.7	24.1	19.0	31.6	14.0	26.5	6.3	18.8	5.5	18.3	3.0	414.2	294.8
YRS	13	12	13	12	11	12	12	12	13	12	13	12	11	12	10	11	11	11	11	11	12	10	12	10	10	11

Table 2-5

Mean Monthly Data of Dew Point Temperature, Vapor Pressure and Relative Humidity

(Yonte and Alessandra)

Month	Dew Point Temp. °C		Vapor Press. mm	Relative Humidity, %	
	Yonte[1]	Aless.[2]	Aless.[2]	Yonte[1]	Aless.[2]
	1954-58	1954-58	1932-39 1953	1953-58	1931-39 1953-58
Jan	23.8	21.6	18.7	75	68
Feb	23.5	21.4	18.6	75	67
Mar	24.5	21.9	19.2	76	66
Apr	25.4	23.4	20.6	77	72
May	24.7	23.3	20.9	79	78
Jun	23.5	21.9	19.4	81	78
Jul	22.9	20.9	18.2	81	77
Aug	22.7	20.7	17.7	79	75
Sep	23.2	20.7	17.9	78	72
Oct	23.8	21.7	18.7	77	73
Nov	24.1	22.5	20.4	75	76
Dec	22.0	22.4	19.6	76	74
MEAN	23.8	21.9	19.2	77	73

[1]Mean of observations at hours 9 and 18 local time

[2]Hours of observation not stated

Source: Contributo alla Climatologia della Somalia, A. Fantoli, Rome, 1963.

D. Water

2.16 Climatic studies within the potential project area confirm the impossibility of depending on natural precipitation for year-round or even dependable seasonal cultivation. Likewise, data from the two wells in the general vicinity show very low yields of chemically suitable water. The Juba River is the only possible source of irrigation water of acceptable chemical concentrations.

1.17 The Juba is Somalia's largest river, with an annual mean runoff about twice that of the second largest river, the Shabelli. It dries up only once every 15-20 years. Its drainage area is about 275,000 square kilometers, of which 98,000 are in Somalia and the rest in Ethiopia. Overall gradient from the proposed Bardera dam site is 20 cm/km, compared to 11.7 cm/km through the project site. River discharges at Giamama/Kamsuma average 5300 million cubic meters annually (Table 2-6) but flows vary a great deal form year to year. The seasonal and monthly distributions are such that the irrigation requirements of the existing banana plantations are not fully met during January, February and March of nearly every year. Water would therefore not be available to provide a full supply for a year-round growing season on new irrigation projects.

2.18 Regulation of the river has already been projected and involves early construction of dams and reservoirs at Saco and Bardera. The Saco reservoir scheduled for completion in 1979 will not have sufficient regulating capacity to supply water to the Moganbo area (6260 ha).

TABLE 2-6

Monthly Runoff of Juba River at Giamama and Kamsuma

(million cubic meters)

GIAMAMA

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
1951	308	96	30	679	1027	761	436	740	621	933	1005	780	7416
1952	225	24	8	75	566	362	241	569	845	1070	862	240	5117
1953	17	6	6	18	461	228	559	911	498	535	820	292	4351
1954	44	6	6	444	547	425	596	1057	993	1191	537	338	6184
1955	46	27	7	37	314	34	134	461	680	894	582	208	3424
1956	65	25	9	97	630	397	371	700	838	987	871	270	5260
1957	49	14	151	200	793	777	537	695	467	446	767	535	5431
1958	123	78	89	15	388	273	629	1087	972	978	899	396	5927
1959	270	19	7	7	454	500	551	601	693	836	1049	421	5408
1960	103	192	699	212	7	392	462	395	579	562	849	787	5239
1961	157	23	26	270	708	448	569	1022	937	864	1169	1100	7293
1962	365	111	18	136	535	151	271	428	663	985	878	403	4944
1963	34	6	13	393	1143	555	420	443	470	477	459	727	5140
1964	290	94	24	158	322	306	284	604	604	992	780	303	4761
1965	361	82	33	20	148	67	94	187	297	791	1146	659	3885
1966	174	57	-	-	-	-	-	-	-	-	-	-	-

KAMSUMA

1972	-	-	-	-	-	-	-	-	726	845	1122	590	-
1973	197	81	37	21	145	275	312	735	873	1049	767	288	4780
1974	105	45	26	307	322	519	460	530	755	601	482	178	4330
1975	70	29	8	50	385	401	461	879	860	842	690	275	4950
MEAN	160	53	66	174	494	382	410	669	704	836	828	463	5239

Sources: 1951 to June 1965: Agricultural and Water Survey of Somalia, Vol. II, Lockwood Survey Corporation Ltd., for FAO, 1966.

July 1965 to February 1966: files of Department of Hydrology, Ministry of Agriculture, Somalia.

September 1972 to December 1975: Planning and Design Study for the Juba Sugar Project, Appendix XV, Booker-McConnell Ltd., June 1976.

Table 2-7

Estimated Monthly Releases from Bardere Reservoir

Units - 10^6 m^3

Year	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
1951	372	339	375	548	620	632	654	659	632	1065	1106	622	7674
52	372	351	375	332	372	456	415	394	674	633	407	404	5185
53	372	339	375	342	372	456	415	443	380	482	467	404	4847
54	372	339	375	360	372	456	415	718	669	675	482	404	5637
55	372	339	375	347	372	456	415	399	381	482	467	404	4809
56	372	358	399	412	442	456	445	453	402	482	467	404	5092
57	372	339	375	373	399	456	415	394	380	482	467	404	4856
58	372	339	375	365	391	456	415	394	380	482	467	404	4840
59	372	339	375	342	372	456	415	394	380	538	1177	404	5564
1960	372	351	653	324	372	456	415	410	380	482	467	404	5086
61	372	339	375	334	372	516	680	686	643	1046	1602	1022	7987
62	372	339	375	329	372	456	415	394	368	482	461	404	4773
63	372	339	375	347	524	618	480	538	368	482	467	404	5314
64	372	351	375	350	372	456	415	394	380	482	467	404	4818
65	372	339	375	353	375	456	415	431	463	496	467	404	4946
66	383	356	410	420	455	456	447	458	435	482	467	404	5173
Total	5963	5496	6337	5878	6604	7694	7271	7559	7315	9273	9911	7300	86,601
Mean	372.7	343.5	396.1	367.4	412.7	480.9	454.4	472.4	457.2	579.6	619.4	456.3	5,412.6
Mean cms	139.2	142.0	147.9	141.7	154.1	185.5	169.7	176.4	176.4	216.4	239.0	170.4	171.6

The larger Bardera reservoir, sited 440 km upstream from the Moganbo area, should have ample capacity to assure full regulation of river flows for the irrigation of this and other projects (Table 2-7). Somali Government officials have stated that the Bardera dam will be constructed and in operation by the end of 1984, before the Moganbo project enters full production.

E. Agriculture

2.19 The economy of Somalia is heavily dependent on its agricultural sector which accounts for 80% of total employment, over 85% of total commodity export earnings and at least 80% of GNP. It has been estimated that about 12-13% of total land area (8 million hectares) is arable while about 55% is suitable only for grazing. Livestock and related activities provide the livelihood of 50 to 70% of the total population; only 20% of the country's population can be considered settled or semi-settled farmers. Apart from commercially produced bananas (20% of exports) and sugar cane, agricultural crops production is mainly for subsistence. Food, especially cereals and vegetable oils, make up over one-fifth of national imports.

Crops

2.20 Only 700,000 hectares of the country's arable land is actually under cultivation at the present time: 650,000 hectares are rainfed or under uncontrolled irrigation and about 37,000 are under controlled irrigation. All land belongs to the state but is allocated according to traditional practices unless otherwise ceded by government.

2.21 Sorghum is the main crop, followed by maize and sesame - 800,000 ha, 170,000 ha and 70,000 ha respectively, in two seasons. Sorghum is grown in the drier areas while maize is the main crop in the wetter regions of Lower Juba and Benadir. The varieties are generally local, low-yielding ones and cultural practices are poor. Very few if any agricultural inputs are used. Pests, diseases and birds take a heavy toll of harvests as traditional control is not fully effective. National yields per hectare are 500 kg sorghum, 900 kg maize and 300 kg sesame. Some cotton and wheat are grown under rainfed conditions but their contribution to the national production is insignificant.

2.22 About 37,000 ha have been developed for irrigation: 27,000 in the Shabelli Valley which is nearer the major population poles; 8500 ha in the Juba Valley, and 1500 ha in Northwest Somalia. Commercial banana and sugar plantations account for 15,000 hectares of these areas, while the Agricultural Crash Program's food farms account for over 4000 ha. The performance of the latter has been poor due to inexperience at both management and field levels. Very little inputs are used on the project farms and production often does not meet the needs of the volunteer workers. Otherwise, irrigation is generally accompanied by better cultural methods, especially on the banana plantations where some food crops such as maize and sesame are grown as a rotation with the bananas. Irrigated crops give considerably higher yields than those grown under rainfed conditions, eg. 3-4 tons/ha for rice, 4-5 tons/ha for maize, and 1.5 tons/ha for cotton.

2.23 Cultivated area in the Juba valley has been estimated by Technital to be 93,500 hectares, including 8500 under controlled irrigation. About 5500 ha of the latter are the commercial banana plantations south from Kamsuma to Kismayu. The major rainfed crops are maize and sorghum, a little cotton, sesame, groundnuts, pulses and some vegetables, grown in mixed fields, mainly for subsistence. Yields are low due to low yield varieties and poor cultivation practices. Cultivated areas and yield levels are shown in Table 2-8:

TABLE 2-8

Irrigated and Rainfed Crops in Lower Juba

	Flood Irrigated		Rainfed	
Crop	Area ha	Yield/ha kg	Area ha	Yield/ha kg
Sorghum	700	800	700	350
Maize	950	900	21,430	400
Rice	280	2000	-	-
Cotton	50	700	3,800	430
Sesame	90	600	5,000	220
Groundnut	40	1200	-	-

Source: Juba Development Program, Technital, 1976

Crop Processing

2.24 The food processing industry of Somalia is largely based on small and inefficient local mills which do not meet national demands. There are three oil extraction mills in Mogadishu and the Government has provided for the construction of two modern mills with a combined annual capacity of 4800 tons to provide a ready processing capacity for increased oilseeds production in the Lower Shabelli and Lower Juba regions. Grains are milled in small local plants. Somalia has six small cotton gins and one large one belonging to Somaltex. There are also two small plants for processing and canning tomatoes and fruits.

Livestock

2.25 Livestock is the principal source of livelihood of 50 to 70 per cent of the population of the Democratic Republic of Somalia, and livestock production (meat, hides, skins, etc.) accounts for almost 70 per cent of national exports. Several estimates have indicated that the population of livestock in Somalia is in the order of 3 million cattle, 2.5 million camels and 14 million sheep and goats. The wetter south (Lower Juba) has the bulk of the cattle population while the dry central regions and the north have the majority of the camels, sheep and goats. Annual offtakes are 7-10% for cattle, 30-35% for sheep and goats and 5% for camels. Offtake is higher in the rainy seasons when the animals are heavier and mortalities are lower.

2.26 Nomadic husbandry accounts for virtually all the national livestock industry. About 55% of Somalia's area

is usable only as grazing land. Natural fodder production varies considerably with rainfall but has been estimated at 13 million tons per year (UNDP/FAO), corresponding to about 6 million tons TDN. The most productive rangelands may not be the most favorable for livestock husbandry due to the tsetse fly infestation, lack of water points, etc. Little cultivation of fodder is practiced and crop residues are not utilized. Possible forage crops include fodder maize, sudan grass, elephant grass, sorghum vulgaris, alfalfa, berseem and many others. The agricultural crops residues that could be used as cattle feed include bran, straw, stalks or stover from grains such as maize, sorghum, rice, sesame and wheat, maize cobs, banana stems, cotton seed, groundnut cakes, etc.

2.27 Pests and diseases are a limiting factor in livestock production in Somalia and represent a serious restriction on live animal exports to countries free of such diseases. Present evidence shows that there is little danger in exporting chilled or frozen meats. Animal health services have improved considerably over the past few years. Rinderpest has been brought under control (1972-75 campaign) and vaccination programs are continuing to consolidate control. Trypanosomiasis is spread by the tsetse flies that abound in the bushes within 10 km of the Shabelli and Juba rivers. Land clearing for irrigation along with river-regulation works that eliminate flooding should remove the natural habitat of the flies. Contagious bovine pleuropneumonia is enzootic among the pastoral herds of Somalia and it is difficult to eradicate because of the failure to detect carriers. The indigenous cattle are quite resistant

to foot-and-mouth disease; endoparasites are no problem except in younger animals and tick-borne diseases can readily be controlled by dipping.

2.28 The very irregular rainfall pattern in Somalia results in constant movement of herds so stock rates may be excessive in good pasturages while lower quality ranges are not fully utilized. Overgrazing may result in desertification of highly productive rangelands as overstocking during rains inhibits pasture growth, encourages the growth of trees and shrubs and facilitates surface erosion. Uncontrolled range usage can lead to deterioration remediable only by introduction of conservation techniques. This has been recognized and several range conservation programs are under way (Trans-Juba, UNDP/FAO, etc.).

2.29 Boran and Suroq are the major cattle breeds in the Lower Juba region. Both are dual purpose breeds in Somalia and represent most of the national beef production. Their fattening capacity compares favorably with beef breeds when they are provided adequate food. Average weights are about 320 and 260 kg/head for Boran males and females, and 380 and 280 kg/head for Suroq males and females.

2.30 Estimates of the cattle population and distribution by age and sex in the project area are given in Tables 2-9 and 2-10. The high percentage of female stock, as shown in the second of these tables, is largely because the breeding stock gets preference for food and water, especially during dry periods. The export of females is prohibited by law and their domestic slaughter is also discouraged. Male cattle, especially bulls under two years, account for 15-25% of the total cattle population in Lower Juba. Those over two years are sold or slaughtered for domestic consumption. Only about 1% are steers.

TABLE 2-9

Livestock Population
in the Lower Juba Area, 1975

District	Camels	Cattle	Sheep	Goats
Kismayu	49,603	60,420	6,299	33,410
Gelib	74,866	175,353	11,473	51,580
Badada	17,291	167,840	7,365	22,601
Afmadu	150,266	579,271	48,154	35,525
Giamama	4,589	532,722	8,181	34,765
Total	296,615	1,515,605	81,472	177,872

Source: Department of Statistics, Kismayu, July 1976

TABLE 2-10

Distribution of Cattle by Age and Sex
in the Lower Juba Area

District	Males			Females		
	% < 2 years	> 2 years	Total	%< 2 years	> 2 years	Total
Afmadu	8.9	6.4	15.3	26.1	58.1	84.7
Kismayu	13.0	5.0	19.0*	20.0	61.0	81.0
Giamama	20.0	4.0	25.0*	21.0	54.0	75.0

n.b. Steers account for 1% of total male population

Source: Central Statistical Department, Ministry of Planning and Coordination, Mogadishu, 1976

2.31 Infrastructural facilities in the Lower Juba region that would help promote intensification of cattle production include:

(a) Kismayu holding ground, 20,000 ha with a carrying capacity of 2500 head slaughter cattle or 15,000 head per year;
(b) Gelib holding ground, 23,000 ha of which 20,000 ha are allocated as a holding ground and 3000 are for quarantine purposes;
(c) A third holding facility is to be established in the Trans-Juba project area at Afmadu.

2.32 Kismayu Port, the third port after Berbera and Mogadishu, was completed in 1968 and has two deep water berths. The main exports from Kismayu are bananas. Ninety per cent of live animals are exported from Berbera port, while meat and meat products exports are concentrated at Kismayu. Some live animals are exported and Kismayu port has adquate facilities for increased live animal and carcass meat exports. Expansion of this port would help increase the potential offtake of live animals, carcass meat and processed meat that will be in excess after development of livestock projects in the Lower Juba area.

Meat Processing

2.33 The municipal abattoirs that slaughter animals for consumption in the urban areas are obsolete and unhygienic. The government-owned Kismayu Meat Factory has a yearly capacity of 60,000 head and is producing canned meats for export. A privately owned abattoir in Mogadishu is also slaughtering for export.

2.34 The increase in exports of meat rather than live animals would provide raw materials for a wide variety of by-products. The hides and skins and leather economy of Somalia is not utilizing the full potential through poor quality of treatment and inefficient procurement. Innards from the factories are sold on the local markets -- currently a more economic solution than processing -- and blood and offal are usually dumped. It is estimated that about 300 tons of blood meal for animal feed supplements could be produced per year by the two major abattoirs at their present levels of operation.

F. Agricultural Institutions

2.35 The agricultural sector is served institutionally by government ministries, government bodies, cooperatives and credit agencies. Responsibilities are divided among many organizations that are often excessively removed from sister organizations. At the agency level, the Ministry of Agriculture's Agricultural Development Corporation (ADC) is primarily engaged in marketing. The Livestock Development Agency (LDA) under the Ministry of Livestock, Forestry and Range, is responsible for coordinating and promoting livestock development and the marketing and export of livestock and livestock products.

Agricultural Development Corporation (ADC)

2.36 ADC is an autonomous agency of the Ministry of Agriculture created in 1971 with monopoly powers for the import, export, storage and national distribution of sorghum and maize, Somalia's major food staples. ADC's authority

has since been extended to rice, cotton and oilseeds. The Agency's marketing responsibilities include grain storage for regular trade and for buffer stocks. The ADC now employs over 400 persons in a total of about 150 collecting stations. In the Lower Juba Valley there are sixty ADC collecting points and storage for about 30,000 tons of grain.

2.37 ADC buying and reselling prices are fixed by decision of the SRSP Politburo and the Council of Ministers. Table 2-11 shows ADC commodity farmgate prices for the past six years and for 1977 for crops planned for inclusion in the project.

TABLE 2-11

ADC Commodity Prices 1971-1977

(SoSh. per ton farmgate)

	1971	1972	1973	1974	1975	1976	1977
Maize	400	450	450	500	550	600	750
Rice	-	-	1400	2500	2500	2500	3500
Sesame	1500	1550	1550	1800	2000	2000	2400
Cotton*	1267	1267	1267	1267	1867	1867	2533
Pulses	-	-	-	-	-	2000	2500

* Two-thirds grade I and one-third grade II

Source: Government of Somalia

2.38 ADC's grain trading operations appear to be successful in financial terms though it is difficult to assess

this on the basis of existing accountancy procedures. The Agency's most critical problem is without doubt linked to manpower and staff shortages and inadequacies. In spite of difficulties, ADC has proven able to carry out its responsibilities successfully and the impact of the agency on the economy of Somalia in the past five years has been considerable.

ONAT

2.39 ONAT, the tractor hire service, was established in 1964. It rents tractors with drivers on an hourly basis to both private and government entities. Hire charges are not economic and the service is both under-equipped and under-manned. About 200 tractors were purchased recently but the Ministry of Agriculture estimates that 2115 would be needed by 1979. In the past, many small farmers could not afford even the current low rates because of lack of credit sources. Recently, a new credit policy has been adopted to make money available for this purpose. In addition to tractors for hire, ONAT supplies other agricultural inputs such as fertilizer, herbicides, pesticides, etc.

Department of Plant Protection and Locust Control

2.40 This department's two major projects are the development of a system to control Quelea birds (with UNDP assistance) and the establishement of a plant pathology laboratory and six mobile units. A plant quarantine station at Afgoi is also planned. Experimental work is under way on pest protection for cotton, maize and sorghum. The department lacks qualified personnel and high priority is given to postgraduate training in this field. The

1974-78 Plan allocates SoSh. 20,159,800 for strengthening plant protection services.

Department of Agricultural Cooperatives

2.41 This department was created in 1974 to implement a SoSh. 48 million cooperative development program. Again, shortage of experienced staff is a continuing problem. There is no cooperative tradition in Somalia so development of a sufficient training capacity will take time. Unless organized along state farm principles, they are likely to bring low distributable incomes and the members will be discouraged.

Agricultural Research Institute (ARI)

2.42 The Agricultural Research Institute (ARI) is responsible for all agricultural research in Somalia. Its main station is the Central Agricultural Research Station (CARS) located at Afgoi. It was established in 1965 with U.S. AID assistance. It has 400 ha of irrigable land at Afgoi on the Shabelli River and 40 ha at Gelib on the Lower Juba River. Rainfed lands at its disposal include 40 ha at Bonka (Upper Juba) and 80 ha in Northwest Somalia (Tug Wajaleh and Aborein). Its major agronomic research work concerns the development of improved varieties and cultural methods for maize, rice, sorghum, wheat, millet groundnuts, sesame, sunflower, cotton, sugar cane and fodder. Its laboratories run analyses of soils, water, plant tissues, evapotranspiration and soil salinity. Its entomological service carries out research on pests and diseases and control measures. Progress has been made in introducing some new crops, such as rice, but the Government feels that no major results have been achieved in

resolving agronomic problems regarding maize and sorghum. The only crop research activity contemplated under the current Development Plan is a 6-year UNDP/FAO project (1973-79) to train research personnel, establish and conduct applied research, and to experiment with modern cropping technology with better soil and water management methods and conservation. The project is financed by UNDP (SoSh 11,567,430) and Government (SoSh 8,511,090).

2.43 CARS also maintains liaison with research staff at the Paddy Rice and Virginia Tobacco Experimental station at Jowhar. Research work is being carried out by twelve graduates, assisted by qualified technicians and skilled workers. The agency disseminates extension information through the Agricultural Extension Service. CARS does no research on livestock.

Agricultural Extension

2.44 Extension is carried out by the various technical ministries and is especially complicated due to the predominantly nomadic nature of the agricultural population. With regard to crops, the service is still in the early stages of development, chronically under-staffed and unable to extend much knowledge to farmers due to the weakness of research. A UNDP/FAO project (1972-75) reorganized and upgraded the staff, established work programs and initiated training courses for both staff and farmers. Five farmer training centers (Bonka, Genale, Aborein, Giamama, Jowhar) have an annual capacity for 1500 trainees. Two courses per year are given, timed to coincide with the growing seasons. A tractor-driving course is offered at Genale to train

drivers for ONAT, government and private farms. Apart from the critical shortage of skilled and experienced personnel, the service suffers from lack of liaison among the various agencies in charge of research and extension.

Livestock Development Agency (LDA)

2.45 LDA was established in 1966 as an autonomous agency to coordinate livestock development and promote the marketing and export of livestock and livestock products. The Agency initially concentrated on building holding grounds and marketing activities along the Shabelli and Juba Rivers, particularly near Kismayu and Mogadishu, to hold export stock before quarantine and to collect and hold cattle for the Kismayu Meat Factory. In 1967, LDA became responsible for all port veterinary work, the issue of health certificates and the collection of livestock inspection fees. It also took over a project for the establishment of 42 parasite treatment centers and began trading in drugs in 1969. Also, in 1969, LDA became active in the supply of slaughter cattle to the Kismayu Meat Factory and in the export of livestock. When this factory began operating at near capacity, LDA began to show a profit.

2.46 Following the takeover of its livestock development activity by the new Department of Animal Production Development in 1974, LDA's charter empowers it to control and regulate the purchase, possession, movement, sale, import and export of all livestock, poultry and related products. In addition to marketing, price policy-making and purchasing for distribution to urban centers or export, LDA is now

directly engaged in production. The Trans-Juba Livestock Development Program is the largest program in progress. Others include an immature cattle holding project in the north and the Hargeisa slaughterhouse and cold storage plant.

3. EXISTING PROGRAMS

A. Juba Valley Development Program

3.01 Studied initially in 1963-64, then updated in 1972-73 and again in 1976, this progam presents the long term planning objectives for the Juba River Valley covering a total of 98,000 square kilometers in South Somalia. The development aims include full utilization of available labor force, better standard of living through redistribution of increased wealth and incomes, and maximum contribution to net exports as well as import substitution. Human, land and water resources were studied and economic analyses were made taking account of both domestic and foreign markets. The potential arable land resources of the valley have been estimated at over 450,000 hectares, including 221,500 hectares of irrigable land, making this one of the country's most important development poles. The following eleven irrigation districts were determined with regard to potential for irrigation and to ease of future management and development:

Juba Valley Development Program
Identified Irrigable Districts

Agricultural District	Area (ha)
Lugh - Dolo	16,400
Bardera - Saco	47,350
Saco	26,600
Dujuma	11,100
Dufalac - Afmadu	7,800
Fanole - Gelib	26,400
Touta Island	13,300
Bardera - Yonte	32,200
Giamama	20,050
State Farm	10,300
Descek Wamo	10,000
	221,500

Proposals are to put 43,000 ha under perennial crops and the remainder under seasonal crops, in particular maize, sorghum, rice, wheat, oil seeds, cotton, banana, sugarcane, pulses, vegetables and alfalfa.

3.02 It is projected that Juba Valley production in the year 2010 will cover the whole of domestic demand for rice, fruit and tobacco, most of the demand for sugar and vegetable oils and two-thirds of the demand for cereals. It would provide 100% of meat exports, over 90% of rice exports and over 55% of grapefruit exports of the country. Foreseen production levels are presented in Table 3-1.

TABLE 3-1

Juba Valley Development Program

Foreseen Production Levels at Full Development

	Production Year 2010 (000 Tons)
Cereals	700
Oilseeds	103
Vegetables	277
Grain pulses	63
Sugar	200
Cotton	20
Minor textiles	17
Tobacco	12
Bananas	512
Fruits	33
Meat (eq. standard carcass weight)	35

3.03 Projects already identified include the following, some of which are already under way:

1. Rice growing at Gelib
2. Cotton, sesame, groundnuts, maize and pulses at Fanole

3. Banana plantations in the lower valley and at Kalanji (Pilot Farm)
4. Resettlement project at Dujuma
5. Bardera dam and reservoir
6. Saco dam and reservoir
7. Sugar cane plantations and associated mill
8. Cotton pilot farm at Giamama
9. Trans-Juba Livestock Project and Gelib Multi-purpose Ranch

Funding under the 1974-78 Development Plan is SoSh 740 million out of a total planned investment of SoSh 3.86 billion.

B. Trans-Juba Livestock Development Project

3.04 The main objective of the Trans-Juba Livestock Development Project is to increase Somalia's beef exports and foreign exchange earnings by establishing a marketing infrastructure, disease control services and a system for fattening immature cattle (formerly sold in Kenya). The project covers the 170,000 square kilometers between the Juba River and the Kenya border in the south. Its components include improved market infrastructures, three production ranches, an irrigated fodder farm with a feedlot, veterinary facilities and training.

3.05 The project is organized and administered through a new department known as the Project Development and Training Unit, attached to the Livestock Development Agency (LDA). The veterinary facilities created by the project would be operated by Government through the Department of Animal Health. The consultants of the project would assist the State Planning Commission in the identification and preparation of further projects for increasing livestock production in the Juba area. Total annual output at full production

would be 81,000 heads, increasing meat exports (canned and chilled) by 5000 tons per year. The estimated cost of development is SoSh 80.35 million, with a foreign exchange component of 43%.

3.06 This project, given financial aid by the World Bank, is under LDA control, and was started in 1974. Little has been achieved beyond the planning and surveying stages. It is also noted that some 45% of the funding is to be used for a sophisticated irrigated farm of 1500 ha to produce fodder for fattening cattle.

C. Multipurpose Cattle Ranch at Gelib

3.07 This project will complement the EEC project for livestock development at Gelib, the Trans-Juba Livestock Development Project and the Agricultural Development Project located in the vicinity of the proposed Fanole Dam. The major aims are:

(i) To test the productive capacities in both milk and meat of indigenous breeds of cattle and to maintain these types in adquate numbers and improve them by selection;

(ii) To improve cattle quality through fattening on adequate feeds and thus increase the sales of cattle in foreign markets.

3.08 The project would be located in an area of 1500 ha on the east bank of the Juba River, opposite Gelib town. The area is shrub and tree steppe suitable for ranching. The ranch would serve as a demonstration center for improved animal husbandry practices as well as for the production of superior types of animals through selection. The project would start with an initial stock of 3025 head of cattle purchased from local stockowners. An additional 4100 head

would be purchased in the next two years. The operation of the ranch thereafter would be based on the animals produced on the ranch itself. It is also hoped that the project will assist local agricultural communities by supplying milk and organic fertilizers. Fixed capital outlay has been estimated at SoSh 963,800.

3.09 This project has not been implemented but its proposals seem very sound and it should be given high priority. However, it should not be production-oriented, but rather should emphasize setting up a fact-finding center for the entire Juba region. The project has not given enough stress to investigations into increased forage production.

4. THE PROJECT

A. General Description

4.01 The area surveyed covered about 10,000 hectares on the west banks of the Juba River between Moganbo and Koban villages. The site is populated by about 500 households in six small villages and scattered dwellings. The total cultivated area is estimated at 1000-15000 hectares in the lighter bush areas with farm sizes of 2-3 hectares. Virtually all of the easily cleared areas appear to have been occupied. Land is offically state-owned but is still being allocated according to traditional practices in the absence of other regulation. All activity is subsistence agriculture in scattered mixed plots situated near the dwellings. The methods of cultivation are primitive and based exclusively on family labor. The main crop is maize, with some sesame intercropped in the wetter lowlands and some tobacco. The latter crops, however, are insignificant, and maize may be considered the only crop. Little or no land preparation is done before sedding at the start of the rains. No fertilization or pest control is practiced and yields are low, at about 400 kg per hectare for maize. Actual production fluctuates a great deal depending on the annual rainfall pattern. Yields are slightly higher for crops planted in the desckes (depressions) that act as flood relief for the Juba when in flood, and are more than double on nearby irrigated lands where maize and other crops are rotated on the banana plantations. The survey team noted severe moisture stress in blooming maize in August 1976. Pests and disease attacks were especially severe, with losses that could amount to over 50% of the crop.

4.02 The foregoing confirms that agricultural production in the project area is at a low level. Moisture availability is the most serious limiting factor on production while poor cultural practices, and particularly the lack of pest control, further reduce yields. Improved cultural practices, including fertilizer use and proper pest control, would increase yields but would not eliminate the primary obstacle to higher and more dependable production, i.e. the irregularity of water supplies. The full potential of the project area can be exploited only through irrigation, mechanization, especially in land clearing and preparation, fertilizer use and proper pest control. This is not feasible under the present cropping pattern based on small scattered farms. The establishment of a state farm would permit mechanization and would permit the concentration of experienced farm managers and technicians who would guide and train laborers in accomplishing the correct procedures for higher production.

4.03 The value of existing production was calculated on the basis of one crop of maize per year on 1200 hectares, or 20% of the total net project area of 6260 ha. Sesame and tobacco were not included as they are insignificant amounts. Assuming an average yield of 400 kg per hectare, the existing production of the farms of the project area would be 480 tons per year. No opportunity costs or inputs have been considered since family labor is the sole input at present. Taking the ADC fixed price of SoSh 75 per quintal as a basis, the value of existing production has been estimated at SoSh 360,000.

4.04 Several irrigation projects in the valley near the Moganbo project area are under construction. The Touta Island sugar plantation of about 6000 ha is located

upstream, above Kamsuma. The Fanole Project of 8000 ha is in an advanced stage of construction. There is a state farm for growing about 2400 ha of cotton near Giamama. A state banana plantation of about 3000 ha is in an advanced stage of planning. The 1500 ha farm in connection with the Trans-Juba Livestock Development Project is nearing the construction stage.

B. Rationale for the Project

4.05 Under present conditions Somalia does not produce sufficient food for its people. The value of imports of basic foodstuffs continues to rise at the same time as the balance of payments deficit increases. Increased production of basic commodities for national consumption along with a continuing export of livestock products and bananas should improve the financial condition of the country.

4.06 It is the avowed policy of the Government to increase production of goods basic to the needs of its people, up to the time when it may become nearly self sufficient. Since the Juba River Valley will have an ample year round supply of water when regulated, and an abundance of arable land, irrigation here will go a long way toward meeting the needs. The Government has given high priority to development of viable irrigation projects.

4.07 By-products from crops produced under irrigation are excellent feed for fattening cattle. Fattened cattle may be exported at a higher price, either live or as carcasses, and may become more competitive on world markets. This would further improve Somalia's world economic position.

4.08 There is a shortage of people trained in modern, highly productive, mechanized, irrigated agricultural practices. The state farm concept should make maximum utilization of those who are trained and should lead to the training of agricultural laborers. The Government has proposed a farming practice which will use machinery to do those things that can be done better by machinery and to use labor for those things done equally well or better manually.

4.09 The Moganbo Irrigation Project is planned for intensive production of food and fiber crops, with an added return from fattened cattle through a feedlot operation. To the extent practicable, the crop rotation includes nirtrogen-fixing crops, which will supply fodder. It is further planned to use manure from the feedlot both as fertilizer and to add humus to soils. Ultimately, chemical fertilizers will be provided as required to reach maximum production. National target crops to be produced are rice, maize, sesame and cotton. Others are clover and legumes.

4.10 To encourage permanent settlements and a low rate of turnover of employees, plans include five new villages so located that laborers will not have to walk more than three kilometers to their work site.

4.11 Since the project is planned for maximum production, management should be organized along the lines of an efficient profit-making operation, with a minimum of non-productive overhead. Expatriate advisors are planned to assure the proper orientation from the beginning. The indigenous staff would have full responsibility for the success of the state farm. The staff would have some

assurance of job stability and, conversely, the Government needs some guarantee that the employees will stay on the job for a reasonable period of time. The success of the project will hinge on the quality of management it receives.

4.12 The field soil survey commenced on July 12th, 1976, and field work ended September 8th, 1976. Several meetings with government officials and soil specialists at the Afgoi soil testing laboratory were held from the 8th to the 17th of September and the Soils Scientist made short field trips to the Mogadishu region.

4.13 The mapping of different land forms and soil types was based on interpretations of air photographs, supported by field traverses and site investigations. The soil map "Gelib 14," and aerial photographs and mosaics, in scales 1:100,000 and 1:30,000, respectively, were available. The field traverses utilized every available type of trails, dikes (man-made levees) and cut-lines of previous survey works. Seventeen new cut-lines were also made during this field work. They included some 150 km of east-west cut-lines (at intervals of 750 to 1000 meters) and a few north-south lines.

4.14 Soil observations and examinations were made using auger bores to a depth of 130 cm. A total of 81 bores were examined and soil samples were collected for laboratory analysis. Twenty-five soil pits were also dug two meters deep in selected localities. The location of all bores and soil pits were marked on tracing paper matched to the aerial photographs, then marked on the soil map of the project area (1:15,000).

4.15 At each profile site, comprehensive descriptions were made of surface relief, vegetation, depth of horizons or layers, hand texture, structure, color according to the Musell color charts, consistency, salts, carbonates, gypsum, mottles, root and pore size and distribution, reaction with dilute HCl, and the pH, using field kit reagents and a color chart.

4.16 Soil samples were collected from the soil surface and at different depths in the soil profile to determine variations in texture, color, structure and/or salt content. A total of 483 samples were collected, labelled and sent to Afgoi soil laboratory for analyses. The following tests and methods were used:

(a) Particle-size distribution: determined using the hydrometer methods. The texture class was determined using the texture triangle, and the saturation percentages were used to identify soil textural classes.

(b) $CaCO_3$ equivalent percentages: The samples were reacted with excess HCl and back titrated with NaOH.

(c) Organic matter percentages, by measuring organic carbon content: The samples were treated with excess potassium dichromate and sulphuric acid, digested with heat and back titrated with ferrous sulphate (% organic matter = % organic carbon x 1.72).

(d) Available potassium (ammonium acetate extractable potassium = soluble plus exchangeable potassium): A 10-gram sample was shaken with a 100-ml ammonium acetate solution. The extracted potassium was determined by the flame method.

(e) Available phosphorus (sodium bicarbonate extractable phosphorus): A 5-gram sample was shaken with sodium bicarbonate solution. Phosphorus was determined colorimetrically in the filtrate.

(f) pH was determined in a saturated soil paste extract using a pH meter with glass electrode.

(g) Electrical conductivity (EC_e): A saturated soil paste-extract was measured with a Solu-Bridge (conductivity cell).

(h) Soluble cations and anions were measured in the prepared extract as follows:
- Sodium and potassium, by flame photometry;
- Calcium and magnesium, titrated with versine (EDTA), using a buffer solution pH 9.5 and suitable indicators;
- Chlorine, titrated by silver nitrate solution;
- Carbonate and bicarbonate ions were neutralized by sulphuric acid;
- Sulphate ions: the difference between total cations and other determined ions;
- Sodium adsorption rate: calculated from concentrations of Na, Ca and Mg in the saturation extract ($SAR = Na/[Ca+Mg/2]^{\frac{1}{2}}$).

4.17 The soils of the Moganbo project area are developed in the very complex landforms of the southern region of the Lower Juba River flood plain. The old and recent deposition of Juba River sediments in this area were reworked during late stages of formation. The overflow during high flood seasons finds its way through and over some parts of the complicated landforms near Moganbo and Bulo Yag. The flood plain meander contains abandoned channel courses, levees and oxbows. Flood plain slackwater lowlands, known locally as "desceks," are commonly found adjacent to flood plain levee bodies. All these types of landforms are intermixed and vary in size in the project area.

4.18 Ant mounds are common in the project area, especially on medium textured soils (loams). These mounds, in many sizes and heights, up to 5 meters in height and 15 meters in diameter, are found in relatively large parts of the surveyed project area and represent one of the obstacles to development. They must be levelled before irrigated agriculture development can proceed.

4.19 All soil profiles are deep and well drained except where ponded water stands for prolonged periods in the desceks. Investigations to a depth of two meters did not encounter any watertable in the project area. A dry well seven meters deep was encountered on the southern part of the project area (the N cut-line).

4.20 Stony subsoils were encountered in the southern part of the project area (Profiles of Pits 10, 23, and Bore 76). Gravels are commonly present even in fine-textured soil materials. These stony subsoils and the presence of gravel may indicate several flooding and erosional cycles during the land formation period in the Juba flood plain. These, along with the presence of large bodies of coarse-textured surface material as well as stratified soil material, reflect the large variation of the flood and flow pattern of the Juba River.

4.21 Sediments carried by the Juba River are calcareous. Table 4-1 shows calcium carbonate equivalents, texture, and organic matter for samples from a representative test pit.

TABLE 4-1

Typical Analysis Showing

Calcium Carbonate Equivalents, Texture, Organic Matter[1]

(Field Survey, July 12 - Sept. 8, 1976)

Sample Depth cm	$CaCO_3$ equiv %	Sat. %	Sand %	Silt %	Clay %	Tex-ture	Org. M %	Av. P ppm	Av. K meq/L 100gm
2 - 20	23	40	22	56	22	L	1.1	3.0	0.4
70	24	48	22	60	18	CL	0.8	0.5	0.3
110	23	52	26	58	16	C	0.6	2.8	0.3
150	18	48	26	56	18	CL	0.8	2.8	0.2
175	15	52	23	65	14	C	0.1	2.0	0.2
200	15	40	22	60	18	L	0.3	1.8	0.2

[1] Total samples 106 (25 pits, 81 bores)

4.22 As shown in Table 4-2, only four samples had pH values less than 7.0. Over one-half of the samples were neutral to base and 45% were in the range of base to alkali. Only 1.5% were above 8.3 and in the alkaline range. No surface alkali spots were observed.

TABLE 4-2

pH of Saturated Soil Paste Extracts, Classes and Distribution

pH	Class	Samples from Pits	Bores	Total	%
		138	344	482	100
< 7	Slightly acid	1	3	4	0.8*
7-7.7	Neutral to base	61	193	254	52.7
7.8-8.3	Base to alkali	71	146	217	45.0**
> 8.3	Alkali	5	2	7	1.5**

* Surface samples
** Subsoil samples

4.23 The salt hazard in the project area is relatively low, as may be seen in Table 4-3. Of a total of 480 samples tested, 65.2% indicated no salt hazard and only 20.4% showed a high to very high hazard.

TABLE 4-3

Electrical Conductivity of Saturated Soil Paste Extracts, Classes and Distribution

EC_e mmhos/cm	Class	Samples from Pits	Bores	Total	%
		136	344	480	100
< 2	No salt hazard	75*	238*	313	65.2*
2-3.9	Low salt hazard	10	26	36	7.5
4-7.9	Medium salt hazard	8**	25	33	6.9**
8-16	High salt hazard	25**	33	58	12.1**
> 16	Very high hazard	18**	22	40	8.3**

* Surface samples ** Subsoil samples

4.24 Almost three-fourths of the 422 samples tested showed a sodium absorption ratio of less than 10, which would indicate no sodium hazard. Table 4-4 shows that 15.2% of the samples had a very high hazard, over 25.

TABLE 4-4

Calculated Sodium Adsorption Ratio Values, Classes and Distribution

SAR	Class	Samples from Pits	Bores	Total	%
		138	284	422	100
< 10	No Na hazard	90	233	313	74.2
10-15	Low Na hazard	7	14	31	4.9
15-25	High Na hazard	11	13	24	5.7*
> 25	Very high Na hazard	30	34	64	15.2*

* Subsoil samples

4.25 Weathering of sandy materials releases enough free iron oxides to form cemented sandy material near the soil surface. The subsoils of these lands are usually cemented by leached (illuviated) secondary carbonates which make them calcareous and sometimes of medium salinity. This type of soil formation, along with the common saline or saline-alkali subsoils, especially of fine-textured material, reflects the leaching capacity of the semi-arid climate of the project area. The low content of organic matter suggests the need for the application of organic fertilizers (manure).

4.26 Based on saturation percentages, the soils generally fall in a textural class of silt loam to clay loam, with 41% of the samples falling in the latter class (Table 4-5).

Experience in the area showed that the chemicals in the soil cause a flocculation of the silt particals which made a mechanical analysis meaningless. The use of the saturation percentage is believed to give a true picture of the texture.

TABLE 4-5

Saturation Percentages and
Soil Textural Classes Distribution

Sat. %	Texture	Samples from Pits	Bores	Total	%
		138	342	480	100
< 28	Loamy sand (LS)	4	9	13	2.7
28-35	Sandy loam (SL)	14	9	23	4.8
36-42	Loam (L)	29	70	99	20.6
43-50	Silt loam to clay loam (S+L to CL)	65	132	197	41.0
51-60	Clay (C)	22	93	115	24.0
> 60	Heavy clay (HC)	4	29	33	6.9

4.27 A set of standards was adopted to evaluate the soils in relative economic classes. These standards apply only to the soils of the Moganbo Irrigation Project, and are summarized in Table 4-6. Of the more than 10,000 hectares covered by the field survey, a gross area of 6,943 ha was finally considered to be irrigable, based on the canal system layout. The various classes of irrigable land, by Blocks, are shown in Table 4-7. Some small isolated spots of Class I soils may exist, but the degree of survey carried out was not conducive to their identification. It should be noted that 824 ha of Class IV lands have been included. These soils are interspersed with better land and, although the cost of leveling would be high, their

Table 4-6
SOMALIA

MOGANBO IRRIGATION PROJECT

Land Classification Standards

Soils	Class I	Class II	Class III	Class IV	Class V
Elec. Cond.	Less than 2	2.0 to 3.9	4 to 7.9	8 to 16	Coarse Textured
S.A.R.	Under 10	10 to 15	10 to 15	15 to 25	
pH	6.5 to 7.5	7 to 7.7	7 to 8	7.7 to 8.3	
Drainage					
Surface	Excellent	Good	Moderate	Adequate	Free draining
Permeability	Moderate	Moderate	Low	Low	"
Sub-surface	None required	Moderate spacing	Close spacing	Very close spacing	"
Topography					
Slope	Less than 1% Uniform	Under 2%	Under 3%	Over 3%	Over 3%
Undulations	None	Gentle, some ant hills	Moderate	Old river channels	Moderate
Leveling	None	Light	Medium	Heavy	Expensive to serve

inclusion is considered an asset to the project. The Class V land (131 ha) would be difficult to serve but its addition to the project is desirable because the area is small and the cost of service would not affect the feasibility of the project.

TABLE 4-7

Project Land Classification:
Irrigable Soils
(hectares)

Block	Class I	II	III	IV	V	Total
A	-	-	564	72	-	636
B	-	179	396	51	-	626
C	-	662	36	137	131	966
D	-	686	609	55	-	1350
E	-	154	471	260	-	885
F	-	598	112	70	-	780
G	-	94	628	136	-	858
H	-	497	302	43	-	842
Total		2870	3118	824	131	6943*

*Note: Estimated project cropped land (6260 ha) was determined by subtracting 683 ha from the total irrigable area, as allowance for roads and infrastructural rights of way, villages, etc.

C. Crops

4.28 The selection of crops was based on considerations of (i) soils suitability; (ii) national food needs and import substitution, and (iii) maintenance of soil fertility. Maize, rice and sesame are major national target food crops. Cotton is a major import item, though Somalia used to be a major exporter. Pulses are an important source of plant

protein widely consumed in the country, and they are nitrogen fixers. Clover is also a valuable nitrogen fixing crop and can be used to feed cattle that produce manure to enrich soils in organic matter.

4.29 The recommended cultivars are the following:

Maize:	Double crossed US 13 (widely adaptable); Asgrow 100 (enveloping husk resists bird attack)
Rice:	Dawn and Saturn are adapted to Somalia; IR 22 and IR 8 may prove adapted and are reportedly bird resistant
Cotton:	Acala S-J-1 and Cooker 201 are early maturing, perhaps reducing bollworm attack
Sesame:	New high-yielding, low-shattering California varieties may prove adapted
Forage:	Berseem
Pulses:	Cowpeas, broad beans

4.30 Two crop rotations have been established, the first based on rice rotating with clover and maize on the heavier soils, and the second a three-year pattern based on cotton rotating with maize, legumes and sesame on the lighter soils.

Crop Rotation No. 1 (Blocks A, B, C, H)

Season:	A	B
Gu	Maize	Clover
Der	Clover	Rice
	B	A
Gu	Clover	Maize
Der	Rice	Clover
	A	B
Gu	Maize	Clover
Der	Clover	Rice

Table 4-8

Annual Crop Rotation at Full Development
(hectares)

Crop	Season Gu	Der	Total
Maize	2,405	-	2,405
Sesame	-	1,450	1,450
Rice	-	955	955
Clover	955	955	1,910
Legumes	2,900	1,450	4,350
Cotton	-	1,450	1,450
Total	6,260	6,260	12,520

The growing of maize only in Gu and cotton only in Der makes it possible to schedule manual labor requirements for weeding and harvesting evenly throughout the year.

4.31 Rice would be grown during the Der season since experience on the Paddy Rice and Virginia Tobacco Experimental Station at Jowhar has shown that Quelea bird attacks are heaviest in Gu. If the IR variety reportedly resistant to bird attacks proves adapted, rice could be double-cropped and maize production reduced accordingly.

Crop Rotation No. 2 (Blocks D, E, F, G)

Season	A	B	C
Gu	Pulses	Maize	Pulses
Der	Cotton	Pulses	Sesame
	B	C	A
Gu	Maize	Pulses	Pulses
Der	Pulses	Sesame	Cotton
	C	A	B
Gu	Pulses	Pulses	Maize
Der	Sesame	Cotton	Pulses

4.32 The three-year pattern shown above would help to hold down pest population buildups on cotton. The annual crop rotation at full development is shown in Table 4-8.

4.33 During the design stage, an expatriate agronomist and a soil scientist should be employed to review the planned cropping pattern based on more detailed soil analyses and the latest information on adaptable cultivars. During the construction and development period, various cultivars should be tried to determine those most suitable to the area.

D. Water Requirements and Supply

4.34 The amount of irrigation water needed at a given time is equal to the amount needed to bring the soils of the root zone of the specific crop to field capacity plus that needed to wet subsequent soil layers down to the maximum depth of root penetration without causing logging. Knowledge of effective plant water needs is essential in establishing crop rotations, selecting varieties with long or short cycles, etc. In the absence of reliable information on crop water use under local conditions, it has been considered advisable to assess the irrigation water requirements of the proposed crops by applying the Blaney-Criddle method for calculating plant consumptive use. The climatic conditions of the Juba Valley in fact resemble somewhat those initially used to develop this formula. Though lacking in finesse with regard to the causative agents determining evapotranspiration rates of crop cover, the method has the advantage of widespread use and gives data on coefficients for crops in various stages of growth and maturity. Account was taken of useful rainfall, calculated on the basis of precipitation quantity, timing and duration, physical soil properties, ground slope, topography, etc. Finally, the net requirements were increased to compensate for losses in ditches and canals, evaporation, deep percolation, watering inefficiencies and a leaching factor to remove excess salts from the root zone.

4.35 Recognizing the need for leaching of salts to prevent a toxic buildup in the soil, provision is made for 10% of the field delivery going into deep percolation. This should apply to all crops except paddy rice. For rice, the consumptive use factor "K" has been increased to allow for

excessive percolation and evaporation.

4.36 The method of irrigation contemplated varies with the crop. In general, maize, cotton, sesame and legumes will be furrow irrigated. Rice will be irrigated by ponding and clover will be flood irrigated. Watering inefficiencies and normal irrigation waste were considered to be 15% of the field delivery. This is based on the fact that a systematic training program under a single farm management will result in high operating efficiency. The cost of pumping the irrigation water supply is a further inducement to strive for high irrigating efficiency.

4.37 Canal and lateral losses and operating waste have been estimated at 20% of the pumped water supply. Again, since this is planned to be a well coordinated farm operation based on a pumped water supply, operating wastes should not exceed five percent. The allowance of 15% for canal and lateral losses may be considered low, except for the fact that most of the canal and all of the laterals are made of compacted embankment. The soils of the area are normally of low permeability and their compaction in embankments should further reduce their permeability and, hence, water losses.

4.38 The equation for monthly requirements is:

$$U = EKF = EK \left\{ \frac{p\ (45.7\ t + 813)}{100} \right\}$$

Where:

U = monthly requirements, in mm, of a crop at any period;

K = consumptive use coefficient for the crop at a specific period of growth;

(cont)

p = percentage of daytime hours of the period examined;

t = mean temperature in degrees centigrade;

E = irrigation efficiency 60%

F = Blaney-Criddle consumptive use factor.

4.39 The climatic data used in computing plant consumptive use and water requirements are given in Table 4-9. Table 4-10 shows the monthly consumptive use factors developed by Blaney and Criddle as well as the empirical factor (F). Table 4-11 shows the selected crop rotation by areas, and Table 4-12 gives the solutions of the formula, exclusive of the factor for efficiency (E). Finally, Table 4-13 gives net water requirements per month for the various crops.

4.40 The project overall efficiency coefficient as explained in paragraphs 4.35, 4.36 and 4.37 is 60%. When applying this to the net water reqirement (Table 4-13) and the cropped areas (Table 4-11), the monthly diversion requirement (pumping load) shown in Table 4-14 results.

4.41 By giving priority to the Fanole Project (8000 ha), Touta Island Sugar Project (6000 ha), the State Banana Farm (3000 ha), Trans-Juba livestock farm (1500 ha), Giamama cotton plantation (2400 ha) and existing banana plantations, approximately 27 cubic meters per second of water are required for these users. Relating this demand and the demand shown in Table 4-14 to the monthly runoff of the Juba River (Table 2-6), it is evident that there will be some water shortages during January and April of some years. The Saco dam is scheduled for completion in 1979. It is understood that it will not necessarily help the Moganbo Project but will give an assured supply to the projects noted above. Bardera dam has been scheduled for completion in 1984. Water releases from Bardera dam and reservoir (Table 2-7)

TABLE 4-9

CLIMATIC DATA FOR DETERMINATION OF
CONSUMPTIVE USE AND WATER REQUIREMENTS

	MONTHLY		
Month	Mean Temp. t(°C)	% of Annual Daytime P (hrs)	Average Rainfall (mm)
Jan	28.6	8.50	2.0
Feb	28.9	7.73	2.5
Mar	29.0	8.49	5.3
Apr	29.4	8.22	59.7
May	28.5	8.49	99.3
Jun	27.1	8.22	78.4
Jul	26.4	8.50	67.9
Aug	26.1	8.49	24.0
Sep	26.8	8.21	31.6
Oct	27.7	8.49	26.5
Nov	28.0	8.22	18.5
Dec	28.4	8.50	18.3

TABLE 4-10

MONTHLY CONSUMPTIVE USE FACTORS,

BLANEY-CRIDDLE METHOD

MONTH	0.457 t	F=p[0.457t+8.13]	CONSUMPTIVE USE FACTORS, K					
			MAIZE	SESAME	RICE	CLOVER	LEGUMES	COTTON
Jan	13.07	180.20		0.60	1.30	0.70		0.50
Feb	13.21	164.96						
Mar	13.25	181.52						
Apr	13.44	177.31	0.60			0.45	0.75	
May	13.02	178.72	0.85			0.65	0.90	
Jun	12.39	168.67	0.90			0.70	0.85	
Jul	12.07	171.70	0.80			0.70	0.70	
Aug	11.93	170.31						0.60
Sep	12.25	167.32			1.00		0.75	0.75
Oct	12.66	176.51		0.65	1.15	0.45	0.90	0.90
Nov	12.80	172.05		0.75	1.30	0.65	0.85	0.85
Dec	12.98	179.44		0.90	1.50	0.70	0.70	0.70
Total		2088.71						

TABLE 4-11

CROP ROTATION BY AREAS

The net project area of 6,260 hectares was divided into eight sub-areas for crop rotation purposes. Proposed crop distribution and rotation is shown in the Table. It should be noted that the cropping pattern results in a total cropped area of 12,520 ha each year. The general boundaries of these cropping areas are shown on Drawing No. 1 in WD-V-Crops.

	Maize		Sesame		Rice		Clover		Legumes		Cotton		
	Gu	Der	Gu	Der	Gu	Der	Gu	Der	Gu	Der	Gu	Der	Total
1. A	285	-	-	-	-	285	285	285	-	-	-	-	1140
2. D	405	-	-	405	-	-	-	-	810	405	-	405	2430
3. F	230	-	-	230	-	-	-	-	460	230	-	230	1380
Total:	920	-	-	635	-	285	285	285	1270	635	-	635	4950
4. B	290	-	-	-	-	290	290	290	-	-	-	-	1160
5. C	292	-	-	292	-	-	-	-	584	292	-	292	1752
Total:	582	-	-	292	-	290	290	290	584	292	-	292	2912
6. E	266	-	-	266	-	-	-	-	532	266	-	266	1596
7. G	257	-	-	257	-	-	-	-	514	257	-	257	1542
8. H	380	-	-	-	-	380	380	380	-	-	-	-	1520
TOTAL:	2405	-	-	1450	-	955	955	955	2900	1450	-	1450	12,520

TABLE 4-12

MONTHLY CONSUMPTIVE USE

OF PROPOSED CROPS* (mm.)

Month	Maize	Sesame	Rice	Clover	Legumes	Cotton
Jan		108.1	234.3	126.1		90.1
Feb						
Mar						
Apr	106.4			79.8	133.0	
May	151.9			116.2	160.9	
Jun	151.8			118.1	143.4	
Jul	137.4			120.2	120.2	
Aug						102.2
Sep			167.3		125.5	125.5
Oct		105.9	203.0	79.4	158.9	158.9
Nov		129.0	223.7	111.8	146.2	146.2
Dec		161.5	269.2	125.6	125.6	125.6
TOTAL	547.5	504.5	1097.5	877.2	1274.6	748.5

* See crop rotation plan

TABLE 4-13

MONTHLY NET IRRIGATION WATER
REQUIREMENTS OF PROPOSED CROPS (mm.)

MONTH	Monthly Average Rainfall in mm.	Effective Rainfall in mm.	NET WATER REQUIREMENTS (mm)					
			MAIZE	SESAME	RICE	CLOVER	LEGUMES	COTTON
Jan	2.0	0		108.1	234.4	126.1		90.1
Feb	2.5	0						
Mar	5.3	4.0						
Apr	59.7	54.0	52.4			25.8	79.0	
May	99.3	84.0	67.9			32.2	76.9	
Jun	78.5	68.0	83.8			50.1	75.4	
Jul	67.9	62.0	75.4			58.2	58.2	
Aug	24.1	19.0						83.2
Sep	31.6	30.0			137.3		95.5	95.5
Oct	26.5	24.0		81.9	179.0	55.4	134.9	134.9
Nov	18.8	18.0		111.0	205.7	93.8	128.2	128.2
Dec	18.3	18.0		143.5	251.2	107.6	107.6	107.6
TOTAL	434.5	381.0	279.5	444.5	1007.5	549.2	755.7	639.5

Note: It is recommended that a pre-planting application of up to 200 mm be made; the amounts should not exceed the maximum post-planting irrigation on which canal design has been based.

will amply provide a full water supply under the ultimate Juba Valley development. There should be a surplus sufficient to maintain an adequate flow below the Moganbo project to greatly dilute any drainage water from the project.

TABLE 4-14

Monthly and Annual Diversion Requirements

($m^3 \times 10^3$)

Month	MAIZE	SESAME	RICE	CLOVER	LEGUMES	COTTON	TOTAL
Jan		2612	3729	2007		2177	10525
Feb	-	-	-	-	-	-	-
Mar	-	-	-	-	-	-	-
Apr	2100	-	-	411	3818	-	6329
May	2722	-	-	513	3717	-	6952
Jun	3378	-	-	797	3644	-	7819
Jul	3022	-	-	926	2813	-	6761
Aug	-	-	-	-	-	2011	2011
Sep	-	-	2185	-	2308	2308	6801
Oct	-	1979	2849	529	3260	3260	11877
Nov	-	2683	3274	1493	3098	3098	13646
Dec	-	3468	3998	1713	2600	2600	14379
	11,222	10,742	16,035	8,389	25,258	15,454	87,100

E. PROJECT FEATURES

4.42 The major features of the project include: the irrigation system; the drainage system; land development; roads; villages; feedlot, and purchase of machinery and equipment.

4.43 The irrigation system to serve 6260 ha includes a pumping plant, power station, main canal, and laterals. The initial main canal capacity was based on the average flow for the maximum month (December) plus 5 per cent for operating waste.

4.44 The pumping plant is to be located near the south (downstream) side of the Bulo Yag floodway. For protection of the plant and to provide some silt settlement space, the plant was located 100 meters from the river. A sediment bed load skimming weir is provided at the river. The river bottom is at about elevation 5.95 meters above mean sea level, and the crest of the weir would be at 7.0 m. It is estimated that the low water level of the river, after Bardera dam is built, would be elevation 7.5 m. This is based on an estimated flow of 35 m^3/sec after all upstream land (150,000 ha) is under development. Gates with a sill elevation of 6.0 should be provided for operation prior to completion of Bardera dam. Similarly, temporary openings should be provided in the pumping plant structure for this interim period. The weir should be 18 meters long and the bottom of the intake channel should be 18 meters wide.

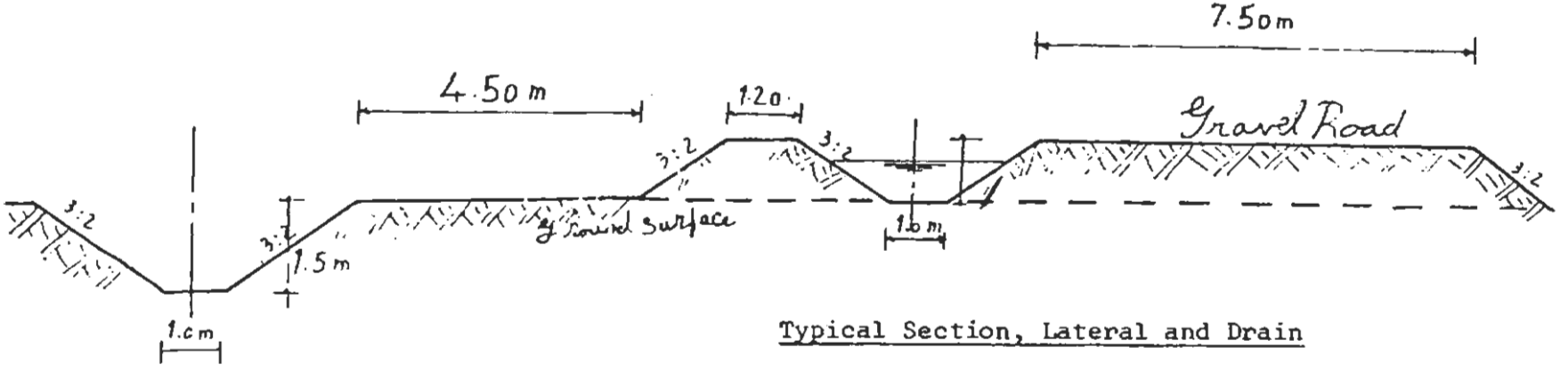
4.45 With the natural ground surface at 10.50 m and occasionally subject to flooding, the deck of the pumping plant has been set at 13.50 m. The structure should be 18 meters long and 3.5 meters wide. Provision has been made for 7 pumps with 1 c.m.s. capacity. One pump would be a standby. Because of the diversity of water demand from month to month, consideration was given to 14 pumps of 0.5 c.m.s. capacity, with two standby. Although the larger pumps would operate at lower efficiency in meeting the diverse demand, the saving in capital cost appeared to outweigh any increase in annual cost. Pumps should be standard industrial propeller type with 90 kw electric motors, direct drive, as prime movers. Starting should be Y/D and is estimated to require 200 kw for each motor. Since precaution is taken to prevent any bed load coming into the pump chamber and since the suspended material is not severely abrasive, no special alloy would be required for the pump bowls or propellers.

4.46 A power station is planned to provide energy for the pumping plant and the headquarters village. Based on the pumping load (max. 650 Kw, i.e. 5 pumps in operation plus starting power for a sixth) and the demand for the headquarters village (estimated at 250 Kw), a power plant of 1000 Kw capacity was considered necessary. The maximum pumping load of 540 Kw will be during the months of November and December; the month of October should require 5 pumps (450 Kw) and January, 4 (360 Kw). Other months should require only 3 pumps, except for August (1) and February and March (0). To meet the headquarters village demand when no pumps are working would require a 250 Kw generating set. To allow "downtime" for repairs and considering the diversity of load, a plant with one 500 Kw unit and two 250 Kw units was chosen. (See Figure 4-2)

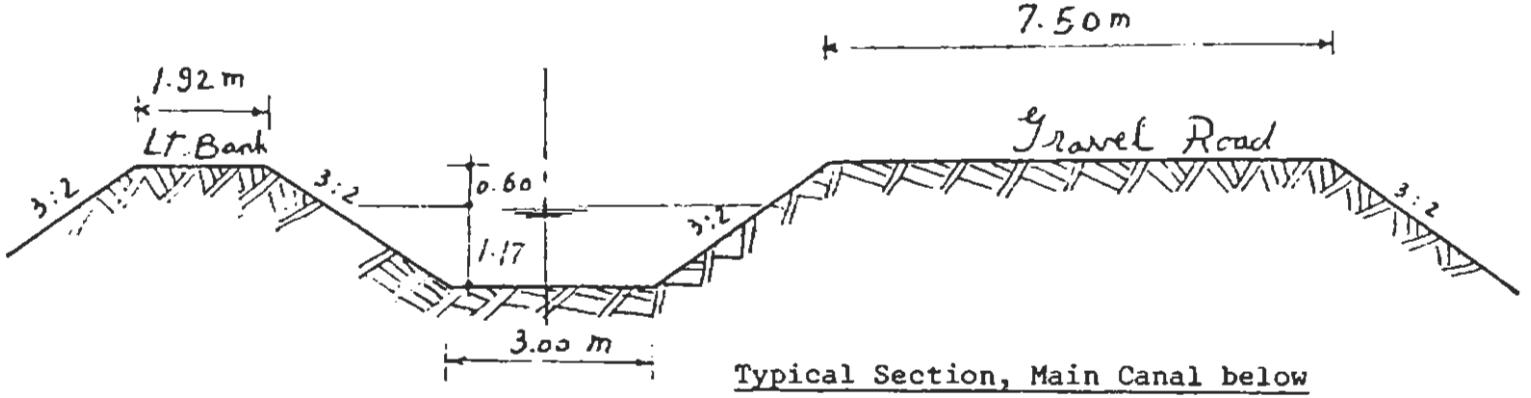
4.47 The main canal, with an initial capacity of 5.60 c.m.s. would be 9.94 kms long. It would have a bottom width, at the end of the transition from the pumping station, of 3.60 meters and a water depth of 1.22 m. An allowance has been made for 0.70 m freeboard. In order to reach a delivery water surface elevation of 11.83 m at the beginning of Lateral H, the water surface at the pumping plant should be 12.33 m m.s.l. The ground surface at the pumping plant is 10.5 m and at the division structure (sta. 1+080) is 10.0 m. The canal would be in fill up to the division structure as would the structure. The left bank would be widened to 7.5 m to permit a two-direction gravel road.

4.48 At the division structure (Sta. 1+080), Lateral H would commence with an initial water surface elevation of 11.83 m. Lateral B-C would have a initial W.S. elevation 11.15 m, as would the continuation of the main canal The invert of the main canal below the drop should be at natural ground level of 10.0 m. From this point to station 5+710, the canal will have a bottom width of 3.0 m, water depth of 1.17 m and freeboard of 0.60 m. Its capacity should be 3.40 c.m.s. The ground surface at station 5+710 is 8.90 m, making 0.47 m cut at this point. The right bank should be enlarged to 7.5 m to permit a two-direction gravel road. Lateral E would take off on the right side at this station, with an initial S.W. elevation of 9.30 m.

4.49 The continuation of the main canal to its end at station 9+940, will have a bottom width of 2.4 m, water depth of 1.04 m, and freeboard of 0.58 m. Its capacity should be 2.20 c.m.s. It will start in partial cut and will be in 0.54 m cut at its end. The right bank will be widened to 7.5 m to provide a two-directional road. At station 9+940, the canal bifurcates into Lateral F and G.



Typical Section, Lateral and Drain



Typical Section, Main Canal below Station 1+080

DEMOCRATIC REPUBLIC OF SOMALIA MOGANBO IRRIGATION PROJECT - JUBA RIVER	
TYPICAL SECTIONS-CANALS AND DRAINS	
TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES NEW YORK CAIRO	FIG. 2

4.50 A wasteway will be incorporated into the division structure at sta. 1+080 and water will be wasted into the main drain. Wasteways should also be provided at the beginning of Drain A and Drain B, above the lateral turnouts.

4.50 Check structures should be provided at the turnout to Laterals E and about every kilometer along the canal below station 1+080, making a total of eight. There would be about 14 tertiary turnouts from the main canal in this reach. An estimated eleven bridges should be provided for ready access to areas on either side of the canal.

4.52 It is estimated that main canal construction should include: 10,000 m^3 required excavation; 231,4000 m^3 of burrow excavation and 209,8000 m^3 of compacted embankment. Structural concrete for the main canal is estimated to total 1600 m^3.

4.53 The lateral system should serve about 4,115 ha, the balance of the project lands being served directly from the main canal. Capacities of the various laterals were estimated on the basis of one liter per second per hectare served. The capacities of the various laterals are:

B-C	1.59 c.m.s.
E	0.89 c.m.s.
F	0.78 c.m.s.
G	0.86 c.m.s.
H	0.84 c.m.s.

The banks of the laterals are planned to be compacted embankment with a 7.5 meter two-directional road on the "low" or delivery side. In each case, except for lateral H, there is a drain planned to parallel the laterals on their

"high" side. The drains are separated from the laterals a sufficient distance to allow a percolation slope of 7:1 from the lateral water surface to the drain. (See Fig. 4-2)

4.54 The estimated embankment and borrow excavation was based on a computation for lateral B-C serving an area of 1592 ha expanded to the system to serve 4115 ha. The total excavation to provide 378,000 m^3 of embankment (434,700 m^3) was reduced by the amount of parallel drain excavation (157,500 m^3) to give a net borrow excavation of 277,200 m^3.

4.55 It is estimated there should be 54 turnouts from laterals; 16 check structures; 8 wasteways, and 25 bridges across laterals in addition to the bridges in the transportation network. The total structural concrete in the lateral system was estimated by comparison with systems built in other countries and totalled 1600 m^3.

4.56 Drains provided for this project will not only serve as drainage outlets but will also carry surface runoff made up of farm waste and excess rainfall. All canal wasteways will empty into the drainage system and it may also be required to carry drainage and waste from the Trans-Juba Livestock Development Project farm and the sugar plantation, both located on higher ground to the north of the Moganbo project.

4.57 The main drain would be 23.1 kms long, beginning near Bulo Yag village and running along the project's northern,then western border to the discharge point near Sunguni village to the south. Until the Juba River is regulated by Bardera Dam and Saco Dam, the Bulo Yag floodway would empty into the main drain when in use. The building of Lateral B-C should serve as a training dike to keep

water from the Moganbo project lands. Main drain bottom widths would be 1 m between stations 0+000 and 5+620, 2 m between stations 5+620 and 10+060, 3 m between stations 10+060 and 14+460, and 4 m between stations 14+460 and 23+100. Both main and secondary drains would have a minimum depth of 1.5 meters. Provision has been made to use drain excavation for lateral embankment and for road embankments where roads parallel the drains. About 29.2 kms of secondary drains have been planned and a cost allowance has been made for the tertiary drains to be executed after land preparation. Experience with soils of the type on the project site shows that subsurface drainage will ultimately be necessary. At the present stage of investigations, however, it is not possible to predict their number or location. Provision has been made in the cost estimates for funds to build future drains as and when needed.

4.58 The original plans for the project contemplated emptying the main drainage system into the river near Sunguni. Since the anticipated releases from Bardera Dam, even during normal low water periods, should be sufficient to dilute the chemicals in the drain discharge, it was believed there would be no serious change in the chemical quality of the river water. The Government of Somalia has recently adopted a policy that no drain water shall be discharged into flowing streams. Early in the project design phase, investigations should be made to locate a depression where project drainage water may be discharged.

4.59 Main and secondary drains should require about 450,000 m^3 of excavation. As previously stated, about 157,500 m^3 of drain excavation can be used in constructing

lateral embankments. An allowance of SoSh 1600 per ha for 6260 ha has been made to cover the cost of future subsurface drains if and when they are required.

4.60 Land development, including clearing, land leveling and smoothing, and construction of tertiary ditches, was estimated on the basis of field examination, discussion with local contractors, and comparison with similar work in other regions. It was estimated from field observation that about 60 per cent of the gross project area (4166 ha) would require some form of clearing and grubbing. Likewise, technical people in the field estimated the cost of land leveling and smoothing for the different land classes. The cost of tertiary ditches, including small structures, was estimated on the basis of similar work in other countries.

4.61 Earth-moving operations using heavy equipment (e.g. scrapers) must be kept to a minimum to avoid disturbing the more fertile top soils. Removed earth would be used to build up canals. Fine grading would be carried out to give the land proper gradient for efficient irrigation, and should be repeated periodically as part of general system maintenance operations. The biggest risk in land preparation is that too much top soil may be removed making deep plowing necessary to bring the soils to adequate tilth and increasing the fertilizer requirements. Any such operations should be done following the advice of soils scientists.

4.62 The field costs for the irrigation system, drainage system and land development are shown in Table 4-15.

TABLE 4-15

Field Cost of Construction Features

Item	Unit	Quantity	SoSh Unit Cost	Field Cost 000 SoSh.
Main Canal, 9.94 km				
Required Excavation	m^3	10,000	8.45	84.5
Borrow Excavation	m^3	231,400	8.45	1,955.3
Compacted Embankment	m^3	209,800	6.30	1,321.7
Concrete in Structures	m^3	1,600	1480.50	2,368.8
Misc. Earthwork	m^3	105,400	7.56	796.8
Misc. metal, pipe, etc.	LS	-	-	490.0
Subtotal				7,017.1
Laterals, 35.6 km				
Borrow Excavation	m^3	227,200	8.45	2,342.3
Compacted Embankment	m^3	378,000	6.30	2,381.4
Concrete in Structures	m^3	1,600	1480.50	2,368.8
Misc. metal work, gates	LS	-	-	143.0
Subtotal				7,235.5
Pumping Plant, 6 c.m.s.				
Excavation, Intake Channel	m^3	12,750	7.94	101.2
Concrete in Structures	m^3	391.3	1480.50	579.3
Purchase of Pumps & Motors	Ea	7	186,430	1,305.0
Installation of Pumps and Electrical Equipment	LS	-	-	217.9
Subtotal				2,257.4

...../

TABLE 4-15, cont.

Item	Unit	Quantity	SoSh Unit Cost	Field Cost 000 SoSh
Power Plant, 1000 Kw				
Structure	LS	-	-	34.7
Generating Equipment	LS	-	-	1,617.2
Fuel Storage Tank	liter	250,000	0.68	170.1
Installation	LS	-	-	75.6
Subtotal				1,897.6
Bulo Yag Floodway Repair	LS	-	-	157.5
Drains				
Main Drain, Excavation	m^3	294,460	6.30	1,855.1
Secondary Drain, Excavation	m^3	155,540	6.30	979.9
Future Drains	ha	6260	1600	10,019.5
Subtotal				12,854.5
Land Development				
Clearing	ha	4,166	1227	5,110.6
Land Leveling & Smoothing				
Class II	ha	2,870	3900	11,193.0
Class III	ha	3,118	4400	13,719.0
Class IV and V	ha	995	5940	5,669.4
Tertiary Ditches	ha	6260	1575	9,859.5
Subtotal				45,551.5
TOTAL				76,971.1

4.63 Table 4-16 is a summary of the total costs for the irrigation and land development features including contingencies (15%), engineering and supervision (8%) and administration and overhead (10%).

TABLE 4-16

Cost Estimate: Irrigation and Drainage System

000 SOSh

Item	Total	Local	Foreign
Main Canal	7,017.1	2,175.3	4,841.8
Laterals	7,235.5	2,532.4	4,703.1
Pumping Plant (Irrigation)	2,257.4	225.7	2,031.7
Power Plant	1,897.6	189.8	1,707.8
Drains	12,854.5	3,856.3	8,998.2
(Future Drains)	[10,019.5]		
Bulo Yag Floodway	157.5	31.5	126.0
Land Development	45,551.5	18,220.6	27,330.9
Subtotal:	76,971.1	27,231.6	49,739.5
Contingencies 15%	11,545.7	4,084.7	7,461.0
Subtotal:	88,516.8	31,316.3	57,200.5
Eng. & Super.8%	7,081.3	2,505.2	4,576.1
Subtotal:	95,598.1	33,821.5	61,776.6
Admin. & Overhead 10%	9,559.8	3,382.1	6,177.7
TOTAL:	105,157.9	37,203.6	67,954.3

4.64 A road system 98 km long to facilitate the production and marketing of crops is included. The general layout is shown in Figure 1. Where possible, canal and lateral banks have been widened to provide a 6 meter, coral roadway, with 0.75 meter shoulders. Similarly, the waste from drain excavation has been used to provide a built-up roadway. Road materials have usually come from sources near Kismayu. During soil surveys, some gravels suitable for road construction were located at a depth of one meter below ground surface. More detailed investigations will reveal the available quantities of these materials.

4.65 The proposed crop rotation, the livestock feedlot and the management structure call for the employment of 2533 people. It is further estimated that these activities will result in a project population of 10,800. A headquarters village and four workers' villages have been planned so that no worker would need to travel more than three kilometers to his work. The headquarters staff would include management staff, maintenance personnel and power and pumping plant operators. The villages have been located so that they occupy a minimum of irrigable land and still serve their purpose. Each village will have fresh, clean running water. The headquarters village will have septic tanks for type A and type B houses. Villages are shown on the project map (Figure 1).

4.66 The project should include furnished housing for its permanent employees. The Farm Manager and his immediate staff, including expatriates, would be provided a first class house (type A) composed of sleeping quarters, reception, living space, kitchen, bathroom and front and back yard. Type B houses of slightly lower level should be

provided for Village Managers, Feedlot Manager, Veterinarian, Animal Husbandry Expert, and other skilled staff. A third house, type C, would be provided for foremen and other key personnel. An estimated 1880 houses of type D will be provided for laborers. The latter should be built of local materials in the manner of existing dwellings in the villages in the area.

4.67 In addition to the housing, each village except the headquarters village will have a storage area, part of it covered. This temporary storage would be needed to hold harvested crops until a commercial hauler can take them to the buyer. The headquarters village should have a warehouse for seed, fertilizer, pesticides, herbicides and equipment spare parts. There should also be a machinery maintenance shop to be used to service all project machinery. Certain facilities such as a mosque, clinic, primary school and social center in each village should be provided by the appropriate government agencies at no cost to the project. Table 4-17 shows the housing requirements, streets, land area and population of each of the villages.

TABLE 4-17

Housing Requirements, Streets, Land Area and Population of Villages

House Type	Total	VILLAGE H.Q.	I	II	III	IV[1]
A	6	6	-	-	-	-
B	9	1	1	1	1	3
C	190	50	35	35	35	35
D	1880	225	412	413	345	485
Village area, ha	361	90	70	75	64	62
Village streets, km	21.66	5.4	4.2	4.5	3.84	3.72
Population	10,800	1,500	2,300	2,300	2,000	2,700

[1] Includes personnel to operate and maintain the feedlot

4.68 The capital cost of roads and villages including contingencies (15%), engineering and supervision (8%) and administration and overhead (10%), is shown in Table 4-18.

TABLE 4-18

Breakdown of Capital Cost of Roads and Villages

Item	Total	Local	Foreign
Roads, 98 km	13,370	10,696	2,674
Villages			
Type A Houses	2,250	1,125	1,125
Type B Houses	1,840	920	920
Type C Houses	15,580	7,790	7,790
Type D Houses	2,560	1,280	1,280
Streets and Sanitation	7,760	3,880	3,880
Office Building	410	250	160
Warehouse	1,250	625	625
Machine Shop	1,250	500	750
Storage Areas	1,640	820	820
Subtotal	34,540	17,190	17,350
TOTAL	47,910	27,886	20,024

4.69 The feedlot is located west of the main drain near the southern boundary of the project and adjacent to Village IV. It is designed to finish 15,000 head of cattle every 5 months or 30,000 head per year. An area of 0.2 ha per 100 animals would allow space for internal roads, work corrals, food storage and animal pens. The lot would have sun shade for cattle, water troughs, feed bunks, fences, and dipping facilities for controlling ectoparasites. Buildings would include: sheds for concentrates, crop residues, feed mill and tractors and vehicles; veterinary laboratory, and molasses tanks.

4.70 The estimated cost of the feedlot, including contingencies (15%), engineering and supervision (8%) and administration and overhead (10%) is shown in Table 4-19.

TABLE 4-19

Capital Cost: Feedlot Facilities and Machinery (000SoSh)

Item	Total	Local	Foreign
Sheds for concentrates and crop residues (3)	75	38	37
Shed for feed mill	50	25	25
Shed for tractors, vehicles	25	13	12
Veterinary laboratory	20	6	14
Molasses tanks (2)	50	15	35
Feed troughs, 9000 meters	225	113	112
Cattle shelters, 30,000 m^2	90	45	45
Water troughs, 750 m	75	38	37
Concrete pads, 18,000 m^2	360	108	252
Fences, 21 km	180	54	126
Scales (5)	100	50	50
Cattle Squeezers (5)	25	13	12
Water reservoirs, 600,000 ltrs	140	42	98
Cattle dip, with yards	40	20	20
TOTAL	1,455	580	875

4.71 Machinery and equipment costs include those for maintenance of the irrigation system, operation of the feedlot and farming, and are shown in Tables 4-20, 4-21 and 4-22.

TABLE 4-20

Irrigation System: Maintenance Equipment

Item	Total	Local	000 SoSh Foreign
Radio communication system	50.4	5.0	45.4
Tractor, D6 or equiv., dozer	113.4	11.4	102.0
Tractor, rubber-tired, 50 HP	50.4	5.0	45.4
Motor grader, 56 HP	126.0	12.6	114.4
V-ditcher	15.7	1.6	14.1
Carry-all scraper, $7.5m^3$	31.5	3.1	28.4
Dragline, $0.6m^3$ 120 HP	189.0	18.9	170.1
Mower, tractor-mounted	18.9	1.9	17.0
Weed burner and sprayer	18.9	1.9	17.0
Trucks, 2-ton (2)	126.0	12.6	114.4
Land Rover pickup (2)	50.4	5.0	45.4
Land Rover station wagon (1)	31.5	3.2	28.3
Motorcycles (4)	37.8	3.8	34.8
Concrete mixer, 1-sack, wheeled	12.6	1.3	11.3
Pump, 5 cm discharge pipe	6.3	0.6	5.7
Small hand tools	25.2	2.5	22.7
Subtotal:	904.0	90.4	813.6
Contingencies 10%:	90.4	9.0	81.4
Subtotal:	994.4	99.4	895.0
Spare parts	10.8	1.0	9.8
Subtotal:	1005.2	100.4	904.8
Administration Costs 10%:	100.5	10.0	90.5
Total:	1105.7	110.4	995.3

TABLE 4-21

Feedlot Operating Machinery[1]

Item	Total	SoSh 000 Local	SoSh 000 Foreign
Feed mill with pelleting machine	419	42	377
Green chop loader (2)	93	9	84
Two-wheeled trailers (10)	141	14	127
Two-wheeled molasses tankers (5)	87	9	78
Trucks, 10 ton (5)	1,596	160	1,436
Subtotal	2,336	234	2,102

[1] Includes contingencies, spare parts and aministrative costs

Table 4-22

CAPITAL COSTS: FARM MACHINERIES

000 SoSh.

Item	No.	Total	Local Currency	Foreign Exchange
4-wheel drive Tractor, 90-100 HP	50	4080	408.0	3672.0
Wheel Tractor, 65 HP	70	4160	416.0	3744.0
3-furrow mounted moldboard plow	33	300	30.0	270.0
Mounted (20-)disc harrow	17	233	23.3	209.7
3/4-furrow mounted nidger	22	200	20.0	180.0
Land leveler, trailed wheel tractor	7	289	28.9	260.1
Tractor-mounted fertilizer spreader	11	67	6.7	60.3
Row tractor	28	212	21.2	190.8
Pesticide sprayers, tractor trailed ← inappropriate for rice	33	549	54.9	494.1
Row planters	22	466	46.6	419.3
Seed drill	11	135	13.5	121.5
Ditcher	7	42	4.2	37.8
Comines	7	1649	164.9	1484.1
Baler	7	148	14.8	133.2
Mower (1.6m)	10	45	4.5	40.5
Trucks (8-10 ton)	22	6035	603.5	5431.5
Trailer	22	266	26.6	239.4
Cottonseed delinter	3	34	3.4	30.6
Organic manure spreader	11	660	66.0	594.0
Subtotal:		19570	1957.0	17613.0
Contingencies 10%:		1957	195.7	1761.3
Subtotal:		21527	2152.7	19374.3
Spare Parts[1]:		1446	430.3	1015.7
Subtotal:		22973	2583.0	20390.0

[1] Excluding tractor and truck spare parts

4.72 The total project investment cost is summarized in Table 4-23, below.

Table 4-23

Summary of Project Investment Costs

	SoSh. Million			U.S.$ Million			For. Exch.
	Local	Foreign	Total	Local	Foreign	Total	%
Irrigation & Drainage	37.204	67.954	105.158	5.905	10.787	16.692	65
Roads	10.696	2.674	13.370	1.698	0.424	2.122	20
Villages	17.190	17.350	34.540	2.729	2.754	5.483	50
Feedlot	0.580	0.875	1.455	0.092	0.139	0.231	61
Machinery & Equipment							
Crops	2.583	20.390	22.973	0.410	3.237	3.647	89
Feedlot	0.234	2.102	2.336	0.036	0.334	0.370	90
System	0.110	0.996	1.106	0.018	0.158	0.176	90
Total:	68.597	112.344	180.938	10.888	17.833	28.721	62

F. Phasing of Construction and Development

4.73 Plans for construction of the project are associated with plans for crop production. Construction of the irrigation system, land development and infrastructure is timed to have new land areas ready for production as shown in Table 4-24. It is estimated that design should require about 18 months after funds become available and a consultant has been selected for the engineering and supervision work. This contemplates that both the irrigation and drainage system and the infrastructure be designed by one consultant. It is also planned that all work be in one contract so that there may be no conflict between the building of the irrigation system and the building of the infrastructure. It is further intended that work be put out to international tender. In order to assure quality and perhaps some saving in cost, it is intended that pumps and motors, generating sets, electrical equipment, and operation and maintenance equipment be furnished by the government under international tender and installed by the contractor. This will permit the ordering to be done in Year I (design year). Delivery could be scheduled for the middle of Year II, except for operation and maintenance equipment which could be ordered in Year II and received in Year III.

4.74 Construction of the irrigation and drainage system and infrastructure should meet the following schedule:

Year I

1. Detailed studies and design of system
2. Order pumps and motors, generating equipment and electrical equipment

Year II

1. Excavate intake to pumping plant
2. Build skimming weir
3. Pumping plant
4. Transition from pumping plant to main canal
5. Main canal sta. 0+000 to 5+710
6. Division structure at sta. 1+080
7. Install first two pumps
8. Power plant, including installation of one 250 Kw generator and electrical equipment
9. Install fuel storage tank
10. Repair gates at Bulo Yag floodway
11. Lateral B-C to sta. 1+980
12. Main drain to sta. 5+620
13. Lateral E
14. Secondary drain A
15. Clear and level first 400 ha in Block A and build farm ditches (tertiary canals)
16. Coral road along main canal, 15 km.
17. Coral roads in Blocks A, B, C, 28.70 km
18. Headquarters village streets, water supply, septic tanks, 6 type-A houses, 3 type-B, 10 type-C and 50 tyep-D houses
19. Village IV streets, water supply, 3 type-B houses, 10 type-C and 50 type-D
20. Order operation and maintenance equipment

Year III

1. Main canal sta. 5+710 to 9+940
2. Complete laterals B and C
3. Complete installation of pumps (5)
4. Complete installation of power plant equipment (1-250 Kw and 1-500 Kw generator set)
5. Main drain sta. 5+620 to 23+100
6. Secondary drains beside Lateral B and Lateral C
7. Clear and level 570 ha in Block A and B and build farm ditches
8. Coral roads for Blocks D and E, 19.4 km
9. Headquarters village: 40 type-C houses, 100 type-D; machine shop, warehouse
10. Village I: one type-B house; 35 type-C, 412 type-D; streets, water supply; storage yard

Year IV

1. Laterals E, F and G
2. Secondary drains B and C
3. Secondary drains along Laterals E and G
4. Clear and level 940 ha in Blocks B and C and build farm ditches
5. Coral roads for Blocks F, G and H, 34.7 km
6. Headquarters village: 75 type-D houses
7. Village II: one type-B house, 35 type-C, 413 type-D; streets, water supply, storage yard

Year V

1. Clear and level 1215 ha in Blocks D and E and build farm ditches
2. Village III: one type-B house, 35 type-C, 345 type-D; streets, water supply, storage yard

Year VI

1. Clear and level 1665 ha in Blocks F and G and build farm ditches
2. Village IV: 25 type-C houses, 385 type-D

Year VII

1. Lateral H
2. Clear and level 1470 ha in Blocks G and H and build farm ditches

Table 4-24

Cropped Area by Years

Project Year	New Land ha	Cumulative Total ha	Location by Blocks
III	400	400	A
IV	570	970	A and B
V	940	1910	B and C
VI	1215	3125	D and E
VII	1665	4790	F and G
VIII	1470	6260	G and H

4.75 The investment cost of the project may be scheduled by project years as shown in Table 4-25:

Table 4-25

Investment, Including Machinery,

by Project Years

000SoSh

Project Year	Canal Drainage	Roads	Villages	Feedlot	Crops	Total
I	2,559.0	-	-	-	-	2,559.0
II	19,641.0	5,980.0	8,400.0	-	-	34,021.0
III	13,847.0	2,650.0	11,800.0	1,347.0	5,007.5	34,651.5
IV	15,266.8	4,740.0	5,750.0	607.0	4,112.0	30,475.8
V	11,773.4	-	5,630.0	659.0	4,892.0	22,954.4
VI	15,942.7	-	2,960.0	607.0	4,489.5	23,999.2
VII	13,555.5	-	-	571.0	4,472.0	18,598.5
Future[1]	13,678.2	-	-	-	-	13,678.2
Total	106,263.6	13,370.0	34,540.0	3,791.0	22,973.0	180,937.6

[1]Estimated requirement for drains to be constructed when needed after project construction is completed.

H. Operation and Maintenance

4.76 Proper operation and maintenance of the irrigation and drainage system will be vital to the success of the project. Water deliveries should be made at the time and place required by the various village managers who must evaluate crop needs. The system should be operated in such a way as to permit no delays which may cause moisture stress or crop loss.

4.77 An operating staff consisting of a foreman and four water guards will be adequate to handle deliveries of water.

4.78 Maintenance of the irrigation system would require a foreman, four equipment and truck operators and sixteen laborers. Equipment requirements would be as shown in Table 4-20. Since the system will be, at least partly, in operation all year except February and March, proper scheduling of maintenance work is essential. It is anticipated that all road maintenance should be performed by the irrigation systems operation and maintenance organization with their equipment. Villages would be under the immediate supervision of the village managers and their maintenance should be handled by the same laborers as are working on crop production. Therefore, no separate items of maintenance have been charged for roads or villages.

4.79 The pumping plant and power plant would be in close proximity to each other in the headquarters village. It is estimated that six operators could handle the joint operation and maintenance of the installations.

Table 4-26

IRRIGATION AND DRAINAGE

BUILDUP OF PERSONNEL

Project Year Units: 10^6 SoSh.

	II		III		IV		V		VI		VII		VIII-30	
	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.	No.	Amt.
Irrigation System Mgr	1/2	9	1	18	1	18	1	18	1	18	1	18	1	18
Clerk Typist	-	-	1	10	1	10	1	10	1	10	1	10	1	10
Water Dispatcher	-	-	1	12	1	12	1	12	1	12	1	12	1	12
Foremen	-	-	1	12	1	12	1	12	2	24	3	36	4	48
Water Guards	-	-	1	10	1	10	1	10	2	20	3	30	4	40
Mechanics	-	-	1	10	1	10	1	10	2	20	3	30	4	40
Equipment Operators	-	-	1	6	1	6	1	6	2	12	2	12	2	12
Truck Drivers	-	-	1	6	1	6	1	6	2	12	2	12	2	12
Electrician	-	-	1	10	1	10	1	10	1	10	1	10	1	10
Laborers	-	-	2	6	2	12	6	18	10	30	13	39	18	48
Pump and Power Plant Operators	-	-	1	10	2	20	3	30	4	40	6	60	6	60
- Expatriates -														
System Mgr Advisor	1/2	158	1	315	1	315	1/2	158						
Master Mechanic			1	315	1	315	1	315						
Pump and Power Plant Advisor			1/6	53										
Total	1	167	7	793		756		615		280		269	++	310

4.80 In order to reduce possible duplication, all machinery and equipment in the project area, including farm equipment, should be maintained in a central workshop. This shop would be in the headquarters village and under the direct supervision of the irrigation system manager. The shop would be manned by a foreman, four mechanics and an electrician. Minor repairs to farm machinery could be made by the mechanic-dispatcher of the farm equipment pool, and it would be his responsibility to send equipment to the central maintenance shop for major work. The foreman would be responsible for all repair work and for maintaining an adequate stock of spare parts. Major mechanical work on the pumping and power plants would be done by the pool of mechanics in cooperation with the electrician. Table 4-26 shows the buildup of personnel during the early years of development.

4.81 In order to assure the success of the project, expatriate technical advisers should be provided for a few years. An adviser to the system manager should be employed for three years commencing with the second half of Project Year II. A master mechanic should be on hand at the beginning of Year III and for a three-year period. An adviser to train pumping and power plant operators need be available only two months of Year III.

4.82 Annual operation and maintenance costs for the irrigation and drainage system, including personnel for machinery maintenance, are broken down by years of development in Table 4-27. The annual operation costs for crop production and livestock production and discussed in Section V, Production.

TABLE 4-27

Breakdown of Annual Operating Costs

by Year of Development

(000 SoSh.)

	Project Year					Full Development
	III	IV	V	VI	VII	VIII-30
1. Personnel	793.0	756.0	615.0	208.0	269.0	310.0
2. Fuel, Maintenance, Repairs	11.4	27.9	63.2	89.7	123.6	179.4
(2) Tractors (4000 hrs)[1]	(4.3)	(10.6)	(19.2)	(34.0)	(52.1)	(68.0)
(1) Dragline (1200 hrs)[2]	(1.3)	(3.2)	(6.3)	(10.2)	(15.6)	(20.4)
(2) Truck (64000 km/yr)[3]	(1.7)	(4.1)	(8.0)	(13.2)	(16.4)	(26.4)
(3) Land Rover(48000 km/yr)[4]	(2.8)	(6.7)	(13.2)	(21.6)	(33.1)	(43.2)
(4) Motorcycles (4800 km/yr)[5]	(0.9)	(2.2)	(4.4)	(7.2)	(11.0)	(14.4)
(1) Scraper (1000 hrs)[6]	(0.4)	(1.1)	(2.1)	(3.5)	(5.4)	(7.0)
3. Fuel for Power Plant[7]	41.7	101.0	199.4	325.5	490.9	651.2
4. Maintenance for Pumping and Power Plants	4.4	10.7	21.8	35.7	54.7	71.4
TOTAL	850.5	895.6	899.8	658.9	938.2	1212.0

(1) at SoSh 17/hr (2) at SoSh 17/hr (3) at SoSh 1.1/km (4) at SoSh 0.9/km (5) at SoSh 0.3/km

(6) at SoSh 17/hr

(7) no. liters x SoSh 1.1 at full production, or 592,000 x 1.1 = 551,200 in Year VIII

5. PRODUCTION

A. Crops

5.01 Crop production has been forecast on the basis of no serious constraints. It is estimated that there will be an adequate water supply, that fertility will be maintained at a high level, that weeds and pests will be efficiently controlled, and that harvesting will be carried out with a minimum of loss through shattering. In general, the yields are conservative and are based on national results under similar conditions. It is assumed that yields in the first two years of production after the land is prepared for irrigation will average about 60 and 75 per cent of yields at full production. Production buildup is shown in Table 5-1.

5.02 Land preparation would be fully mechanized using 100-HP 4-wheel drive dractors, moldboard plows and disc harrowers (Table 5-2). Herbicides would be used to reduce manual weeding by half on maize and rice. Cotton, sesame and pulses would be tilled and manually weeded once. Clover would not require weeding. Maize and cotton would be harvested manually but rice, sesame and beans would be combine harvested.

5.03 About 20-35 tons of manure would be plowed in per hectare at land preparation to improve soil contents of nitrogen, potassium and phosphate (one ton manure equals 5 kg N, 5 kg K and 2.5 kg P). Urea would be applied at harrowing and during the growing period. Crop protection

Table 5-1

Production Buildup

Project	Maize		Cotton		Sesame		Rice		Legumes		Clover	
Year	ha	Yield	ha	Yield	ha	Yield	ha	Yield	ha	Yield	ha	Yield
I	-	-	-	-	-	-	-	-	-	-	-	-
II	200	2.5	-	-	-	-	200	2.5	-	-	400	20
III	200	4.0	-	-	-	-	200	3.0	-	-	400	25
	285	2.5	-	-	-	-	285	2.5	-	-	570	20
IV	200	5.0	-	-	-	-	200	4.0	-	-	400	40
	285	4.0	-	-	-	-	285	3.0	-	-	570	25
	470	2.5	-	-	-	-	470	2.5	-	-	940	20
V	200	5.0	405	1.2	405	0.6	200	4.0	1215	1.2	400	40
	285	5.0	-	-	-	-	285	4.0	-	-	570	40
	470	4.0	-	-	-	-	470	3.0	-	-	940	25
	402	2.5	-	-	-	-	-	-	-	-	-	-
VI	485	5.0	405	1.6	405	0.8	200	4.0	1215	1.5	400	40
	470	5.0	555	1.2	555	0.6	285	4.0	1665	1.2	570	40
	405	4.0	-	-	-	-	470	4.0	-	-	940	40
	555	2.5	-	-	-	-	-	-	-	-	-	-
VII	1360	5.0	405	2.2	405	1.0	955	4.0	1215	1.8	1910	40
	555	4.0	555	1.6	555	0.8	-	-	1665	1.5	-	-
	490	2.5	490	1.2	490	0.6	-	-	1470	1.2	-	-
VIII	1915	5.0	960	2.2	960	1.0	955	4.0	2880	1.8	1910	40
	490	4.0	490	1.6	490	0.8	-	-	1470	1.5	-	-
IX	2405	5.0	1450	2.2	1450	1.0	955	4.0	4350	1.8	1910	40

realistic yields : 3-4 t/ha 1.2-1.5 t/ha 0.6-0.8 t/ha 2-2.5 t/ha

Table 5-2

Unit Machine and Labor Requirements
by Crop per Hectare

Work	Cotton		Maize		Sesame		Rice		Clover		Legumes	
	Hr	Man	Hr	Man	Hr	Man	Hr	Man	Hr	Man	Hr	Man
Manure spreading	.5		.5		.5		.5		.5		.5	
Plowing	2.5	1	2.5	1	2.5	1	2.5	1	2.5	1	2.5	1
Harrowing	1.5	1	1.5	1	1.5	1	1.5	1	1.5	1	1.5	1
Initial fertilizer	.5	1	.5	1	.5	1	.5	1	.5	1	.5	1
Sowing	.5	1	.5	1	.5	1	.5	1	.5	1	.5	1
Furrowing	1.5	1	1.5	1	1.5	1	-	-	-	-	1.5	1
Weeding	.5	19	.5	10	.5	10	.5	21	-	-	-	20
Fertilizing	-	2	-	2	-	1	-	2	-	1	-	-
Irrigating	-	10	-	8	-	4	-	8	-	2	-	4
Bird control	-	-	-	-	-	-	-	20	-	-	-	-
Insect control	.5	1	-	-	-	-	-	-	-	-	-	-
Harvesting or combining (shelling)	-	60	- 1.5	20 4	2.5	2	2.5	2	2	5	2.5	2

NB: Hr = Machinery hours per hectare
Man = Number of mandays per hectare

would be critical to the success of the project as pests and disease attacks will increase under irrigation. Table 5-3 shows the estimated requirement per hectare for fertilizers, herbicides, pesticides and seeds. Quelea birds would be controlled by frightening, which is the traditional method.

Table 5-3

Agricultural Inputs Required per Hectare

Fertilizers	Maize	Rice	Sesame	Cotton	Beans	Clover
N	60 kg	60 kg	30 kg	50 kg	20 kg	20 kg
P_2O_5	50 kg	50 kg	20 kg	50 kg	30 kg	30 kg
Herbicides						
Stam 34		12 ltr				
2-4-D	1 kg					
Pesticides						
Novacrone				4 ltr		
Seeds	20 kg	100 kg	15 kg	50 kg	25 kg	20 kg

5.04 Staff and labor requirements to achieve the production shown in Table 5-1 are listed in Table 5-4.

5.05 Direct crop production costs by years of the project are shown in Table 5-5

Table 5-4

Staff and Labor Requirements

Crops Production Only

	Annual Salary SoSh**	No.	Total Annual Cost
Farm Manager	24,000	1	24,000
Admin. Assistant Manager	18,000	1	18,000
Procurement Officer	15,000	1	15,000
Bookkeeper	15,000	1	15,000
Training Officer	18,000	1	18,000
Training Assistants	15,000	2	30,000
Village Managers	18,000	4	72,000
Clerk Typists	10,000	6	60,000
Foremen	12,000	100	1200,000
Equipment operators, Drivers	6,000	150	900,000
Laborers*	3,000	2000	6,000,000
- Expatriates -			
Advisor to Farm Manager, 5yrs	378,000	1	
Advisor to Training Officer 3 years	315,000	1	
Advisor to Village Managers 3 years	315,000	1	

*Farm operations are such that 1500 to 2000 laborers would be needed at any given time. Housing has been provided for 1880 labor households to encourage permanent settlement.

** Includes insurance and social charges

Table 5-5

Crop Production Operating Costs

by Project Years

(000 SoSh)

Item	III	IV	V	VI	VII	VIII-XXX
Labor and Supervision	776	1,262	1,942	3,284	4,946	6,782
Seeds	100	267	526	634	782	912
Fertilizer	566	1,129	2,223	3,765	5,640	7,384
Insecticides	8	20	40	188	223	317
Herbicides	59	143	281	298	321	342
Machinery	133	322	633	1,067	1,661	2,186
TOTAL	1,552	3,143	5,645	9,166	13,573	17,923

5.06 In addition to the production achieved according to Table 5-1, the project would also produce a number of by-products that might be used as roughage in animal feeds. These are noted in Table 5-6.

Table 5-6

Agricultural Production By-products

By-product	Yield Tons/ha	Hectares	Total Tons
Maize straw	10.0	2,405	24,050
Sesame stalks	3.0	1,450	4,350
Rice straw	8.0	955	7,640
Legumes forage	3.6	4,350	15,660
Cotton seed	1.4	1,450	2,030
Total		12,520	53,730

5.07 It would be out of the scope of this project to carry out varietal or developmental research. However, the project could place the land, labor and inputs required at the disposal of research teams from the Afgoi research station. In this way, there would be no repetition of research activity and the project would not draw off research scientists who are in extremely short supply

B. Livestock

5.08 The production of food crops on the project area should result in a substantial quantity of usable by-products. The crop rotation adopted includes clover to improve the soils. In view of the availability of feed and the availability of cattle on the adjoining rangeland, the benefits of the project may be maximized by the addition of a cattle feedlot. A by-product of the feedlot would be much needed organic matter (manure) for project soils.

5.09 Based on the total cattle population of the project area and discounting the numbers drawn off for exports, municipal abattoirs and other livestock projects already established in the area (Table 5-7), it is estimated that there would be about 44,000 head of cattle available to the project. Since Kismayu meat factory may in the future draw all its requirements from the Moganbo and/or Trans-Juba fattening projects rather than buy from the range, the total reservoir of cattle available to the project or any future programs could possibly be around 100,000 head. Coordination between the Moganbo project and other livestock projects in the Lower Juba area such as the Trans-Juba project and Multi-purpose Gelib ranch would increase the

availabilities of cattle and make possible the full utilization of the cattle potential of the area.

Table 5-7

Estimated Cattle Available to Moganbo Project

	Heads/Year
Estimated cattle population in the Lower Juba Project area	1,515,605
Annual percentage of offtake	10%
Available cattle per year	151,560
Exports of live cattle from Kismayu (1975)*	4,400
Municpal slaughterings in Lower Juba Area*	5,282
Number of cattle required for the Trans-Juba Livestock Project**	30,000
Maximum number of cattle canned in Kismayu Meat Factory*	60,000
Number of cattle required to stock Multi-Purpose Ranch at Gelib (initial stocking only when ranch goes into operation)	7,125
Outflow to Kenya: has ceased	--
NET OFFTAKE	107,307
TOTAL CATTLE AVAILABLE TO MOGANBO PROJECT	44,253

Sources: *LDA, Mogadishu, 1975
**Trans-Juba Livestock Development Project, Phase I

5.10 The proposed annual yield of 30,000 fattened cattle at full development is equal to the finishing of about 15,000 cattle every five months. Cattle would be obtained

at a rate of 750 head per week at liveweights of about 200 kg. They would be fattened to 350 kg in 150 days. The feedlot capacity was based on the potential feed production of the project.

5.11 The proposed feeding ration is based on clover initially grown as a nitrogen fixing crop and crop residues from the Moganbo crop production sector with the concentrate mixture shown in Table 5-8.

Table 5-8

Composition, Proposed Concentrate Mixture[1]

Ingredients (kg)	%	DM	DP	TDN	SoSh.[2]
Maize bran	60	54.0	4.6	43.2	20.0
Crushed maize	20	18.0	1.5	16.6	22.0
Sesame cake	10	9.0	3.8	7.7	13.0
Molasses	7	4.0	0.2	2.5	0.8
Crushed bone meal	2	1.8	0.4	1.4	2.4
Salt	1	0.8	-	-	0.3

[1]DM=dry matter; DP=digestible protein; TDN=total digestible nutrients

[2]Market prices of ingredients are: maize bran, 0.5 SoSh/kg; crushed maize 1.10/kg; sesame case 1.30/kg; molasses 0.12/kg; crushed bone meal 1.20/kg; and salt, 0.3/kg

5.12 The proposed daily ration is as follows:

	DM kg	DP kg	TDN kg
16 kg chopped clover	2.4	0.40	1.8
4 kg hammer-milled maize stover	3.2	0.04	2.0
3 kg pelleted concentrate mixture	2.7	0.30	2.3
Total	8.3	0.74	6.1

5.13 The production of cattle at full development should be about 9980 liveweight tons. This may be translated into 5190 tons of carcass meat.

5.14 Annual operation of the feedlot includes direct management and labor; purchase of feeds that are supplemental to by-product feeds from the project crop production; purchase of cattle; dipping fluid and veterinary requisites; fuel, oil, lubricants and spare parts, and maintenance of feedlot facilities. The Feedlot Manager should be assisted by an expatriate adviser for three years. The personnel requirements of the feedlot are shown in Table 5-9.

5.15 The cost of the feedlot operation, by project years, is shown in Table 5-10.

Table 5-9

Operating Costs: Feedlot Staff
Requirements at Full Development

Staff Requirement	Men/ Year	Annual Salary* SoSh.	Total Annual Cost
Assistant Manager, Feedlot	1	18,000	18,000
Clerk Typist	1	10,000	10,000
Veterinary Assistant	1	15,000	15,000
Animal Husbandry Assistant	1	15,000	15,000
Feedlot Storekeeper	1	12,000	12,000
Livestock Buyers	2	12,000	24,000
Foremen	2	12,000	24,000
Tractor and Vehicle Drivers	6	6,000	36,000
Laborers	205	3,000	615,000
Total Cost, Staff and Labor			769,000
- Expatriate Adviser - (3 years only)	1	315,000	

*Includes insurance and social charges

Table 5-10

Feedlot Annual Operation Costs by Year of Development

(000 SoSh)

Item	Project Year I	II	III	IV	V	VI	VII	VIII
Management and labor	-	-	478	610	254	592	763	769
Animal feed (supplement			925	2774	4624	6473	2248	9248
Cattle purchases			1500	4500	7500	10500	15000	15000
Dipping and Veterinary			30	90	150	210	300	300
Fuel, oil, lubricants, spare parts			13	26	40	53	66	66
Maintenance of feedlot			24	35	50	63	73	73
			2,970	8,035	13,118	17,891	25,450	25,456

5.16 The total cost of production after the project is fully developed is summarized in Table 5-11.

Table 5-11

Summary of Production Costs[1]

	000 SoSh.	000 U.S.$
Crops Production Sector		
A. Irrigation, Drains and Roads		
Personnel	310.0	49.2
O and M systems	902.0	143.2
Machinery Replacements	201.0	31.9
Total	1413.0	224.3
B. Crops Production		
Personnel	6,782.0	1,076.5
Operating Costs	11,141.0	1,768.4
Machinery Replacements	2,950.0	468.3
Total	20,873.0	3,313.2
TOTAL, Crops, Irrigation, Drainage	22,286.0	3,537.5
Livestock Fattening Sector		
Personnel	769.0	122.0
Operating Costs		
Cattle purchases	15,000.0	2,381.0
Other Costs	9,687.0	1,537.6
Machinery Replacements	289.0	45.9
TOTAL, Livestock Fattening Sector	25,745.0	4,086.5
TOTAL PRODUCTION COSTS	48,031.0	7,624.0

[1] n.b. For economic analysis, there has been added SoSh 392,000 for periodic gravel replacement to make the total SoSh 48,423,300.

6. ORGANIZATION AND MANAGEMENT

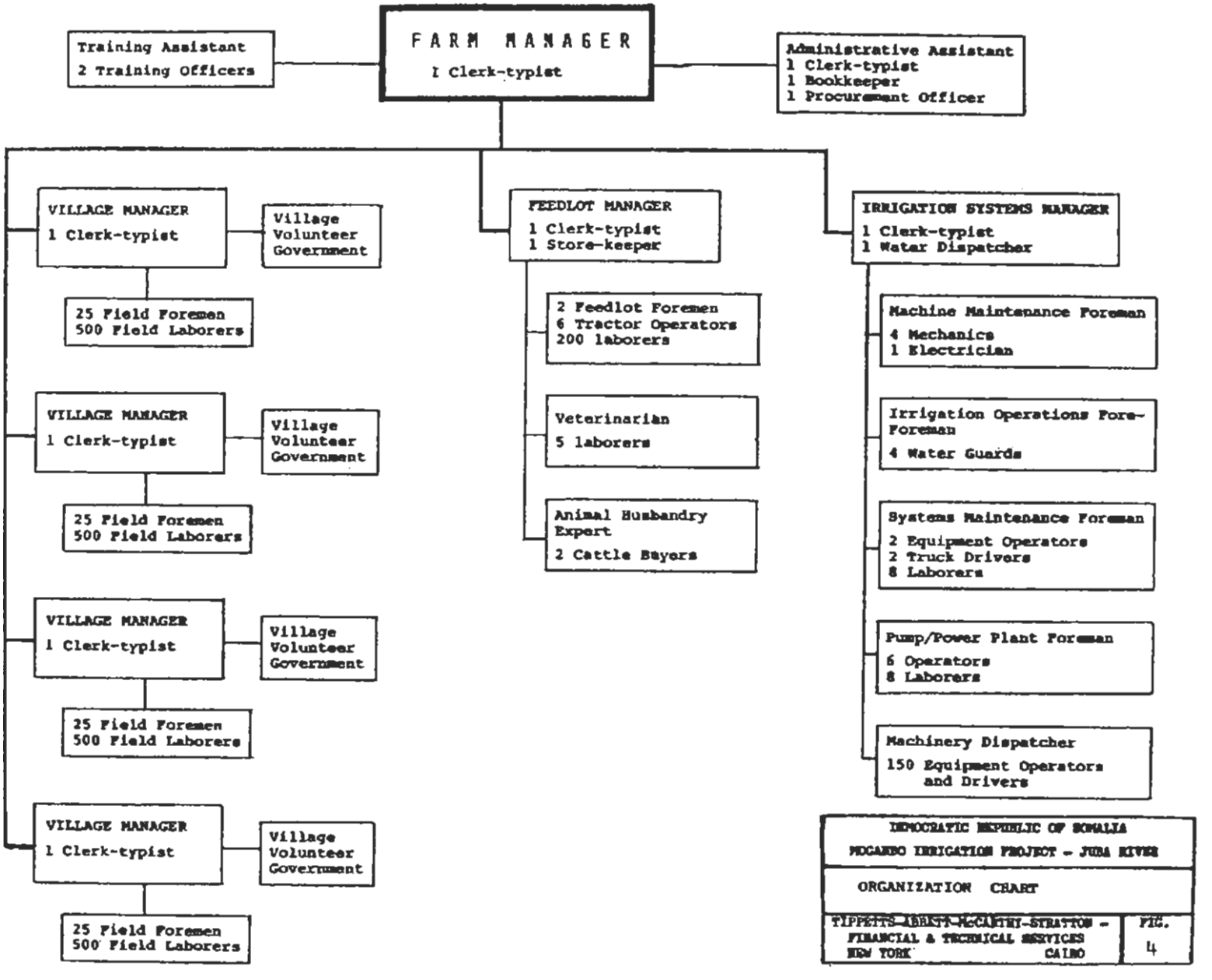
A. Organization

6.01 The project is planned to operate as a State Farm under the direction of a Farm Manager. Although the project should organizationally be placed in the Ministry of Agriculture it should have an autonomous status. The organization structure of the project is based on the principle that machinery shall be used to optimize production, but all work that can be done efficiently by hand labor will be so assigned. Project organization and management has been planned along the lines suitable for a production-oriented, profit-making corporation.

6.02 An organization chart was prepared, taking into account the foregoing principle. Further consideration was given to the distribution of labor by work areas and villages. The areas supervised by Village Managers do not necessarily follow "Block" lines, which were established for irrigation system layout. During the final design of the irrigation system and final village location, the Farm Manager should find it desirable to rearrange the organization for optimum efficiency.

6.03 Although the Village Managers are the titular heads of each village, a volunteer government of the people should be established to regulate and maintain the villages.

6.04 Figure 4 is a suggested organization chart for the State Farm management.


FARM MANAGER
1 Clerk-typist
Training Assistant
2 Training Officers
Administrative Assistant
1 Clerk-typist
1 Bookkeeper
1 Procurement Officer
VILLAGE MANAGER
1 Clerk-typist
Village Volunteer Government
25 Field Foremen
500 Field Laborers
VILLAGE MANAGER
1 Clerk-typist
Village Volunteer Government
25 Field Foremen
500 Field Laborers
VILLAGE MANAGER
1 Clerk-typist
Village Volunteer Government
25 Field Foremen
500 Field Laborers
VILLAGE MANAGER
1 Clerk-typist
Village Volunteer Government
25 Field Foremen
500 Field Laborers
FEEDLOT MANAGER
1 Clerk-typist
1 Store-keeper
2 Feedlot Foremen
6 Tractor Operators
200 laborers
Veterinarian
5 laborers
Animal Husbandry Expert
2 Cattle Buyers
IRRIGATION SYSTEMS MANAGER
1 Clerk-typist
1 Water Dispatcher
Machine Maintenance Foreman
4 Mechanics
1 Electrician
Irrigation Operations Fore-Foreman
4 Water Guards
Systems Maintenance Foreman
2 Equipment Operators
2 Truck Drivers
8 Laborers
Pump/Power Plant Foreman
6 Operators
8 Laborers
Machinery Dispatcher
150 Equipment Operators and Drivers
DEMOCRATIC REPUBLIC OF SOMALIA
MOGAMBO IRRIGATION PROJECT - JUBA RIVER
ORGANIZATION CHART
TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES
NEW YORK CAIRO
FIG. 4

B. Management

6.05 The Manager would have direct responsibility for the successful operation of the project, including the marketing of produce therefrom. He should be trained by education and experience in the details of crop production and must have a sound managerial background. He would be assisted by four village managers, a feedlot manager, and an irrigation systems manager. He should also be assisted by an expatriate adviser in farm management for five years.

6.06 The village managers will each be responsible for crop production on an assigned segment of the project. Their areas of reponsibility would be determined on the basis of a 3-km maximum walking distance from the village which eliminates the need for transport. They should have an educational background at least equivalent to that of an agricultural extension agent and they should have the maturity and ability to schedule the work of 500 laborers through 25 foremen. There should be one expatriate adviser to the village managers who would aid them in developing farming practices suitable to the project area.

6.07 The feedlot manager would be directly responsible to the Farm Manager for the production of fattened cattle from the feedlot. He would work directly with the village managers in providing manure to them from the feedlot. He should have experience in cattle buying, feeding, disease control, and marketing. On occasion it may be necessary to supplement project by-products with feed purchases from outside the project. The project procurement officer would assist when this is necessary. An expatriate expert should be employed for three years to aid the feedlot manager.

6.08 The irrigation system manager would have the responsibility for delivering water to the respective village managers at their demand. He should have an educational and experience background in water management and maintenance of systems. The irrigation system manager would also supervise the central machine workshop for the entire project as well as the maintenance of canals and ditches, roads, pumping and power plant. An expatriate expert should be hired for three years to help the manager develop proper methods of operation. It is also desirable to have an expatriate master mechanic to help in setting up and operating the machinery maintenance shops. Pumping plant operation could be established by an expatriate adviser in two months. This advisor could be provided by the equipment manufacturer.

6.09 Table 6-1 shows the total project personnel requirements by project years. During the early years of the project, the proposed personnel requirements are fairly heavy, to permit training and to allow staff to acquire experience. An assistant manager in charge of training and two training officers have been provided to help teach foremen and laborers optimal production procedures. The management of the project is completed by an assistant manager for administration, a bookkeeper, a procurement officer and a clerk typist.

6.10 Management staff and vital technical personnel should be recruited under contracts for a minimum of 3-5 years in order to provide a certain degree of stability. Many projects in the past have suffered from excessive staff turnover.

Table 6-1

SOMALIA

MOGANDO IRRIGATION PROJECT

Total Personnel Requirements and Costs by Project Years

	AMOUNT	TOTAL		YEAR I		YEAR II		YEAR III		YEAR IV		YEAR V		YEAR VI		YEAR VII		YEAR VIII	
	SALARY	NO	COST	NO	COST	NO	COST	NO	COST	NO	COST	NO	COST	NO	COST	NO	COST	NO	COST
Farm Manager	24	1	24	1	24	1	24	1	24	1	24	1	24	1	24	1	24	1	24
Expatriate Assistant Manager	378	1	378	1	378	1	378	1	378	1	378	1	378	-	-	-	-	-	-
Administrative Assistant Manager	18	1	18	-	-	1	18	1	18	1	18	1	18	1	18	1	18	1	18
Bookkeeper	15	1	15	-	-	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Procurement Officer	15	1	15	-	-	1	15	1	15	1	15	1	15	1	15	1	15	1	15
Training Assistant Manager	18	1	18	-	-	1	18	1	18	1	18	1	18	1	18	1	18	1	18
Training Officer	15	2	30	-	-	-	-	1	15	1	15	1	15	2	30	2	30	2	30
Village Manager	18	4	72	-	-	-	-	1	18	1	18	2	36	2	36	3	54	4	72
Feedlot Manager	18	1	18	-	-	-	-	1	18	1	18	1	18	1	18	1	18	1	18
Feedlot StoreKeeper	12	1	12	-	-	-	-	1	12	1	12	1	12	1	12	1	12	1	12
Irrigation System Manager	18	1	18	-	-	1/2	9	1	18	1	18	1	18	1	18	1	18	1	18
Water Dispatcher	12	1	12	-	-	-	-	1	12	1	12	1	12	1	12	1	12	1	12
Veterinarian	15	1	15	-	-	-	-	1	15	1	15	1	15	1	15	1	15	1	15
Animal Husbandry	15	1	15	-	-	-	-	1	15	1	15	1	15	1	15	1	15	1	15
Foremen	12	106	1272	-	-	-	-	10	120	20	240	40	480	66	792	86	1032	106	1272
Livestock Buyers	12	2	24	-	-	-	-	1	12	1	12	2	24	2	24	2	24	2	24
Mechanics	10	8	80	-	-	-	-	2	20	3	30	4	40	6	60	7	70	8	80
Electrician	10	1	10	-	-	-	-	1	10	1	10	1	10	1	10	1	10	1	10
Water Guards	10	4	40	-	-	-	-	1	10	1	10	1	10	2	20	3	30	4	40
Power and Pumping Plant Operator	10	6	60	-	-	-	-	1	10	2	20	3	30	4	40	6	60	6	60
Equipment Operator and Drivers	6	160	960	1	6	3	18	20	120	40	240	60	360	90	540	120	780	160	960
Laborers	3	2221	6663	-	-	10	30	320	960	500	1500	800	2400	1300	3900	1800	5400	2221	6663
Expatriate Training Assistant	315	1	315	-	-	1/2	158	1	315	1	315	1/2	158	-	-	-	-	-	-
Village Manager Adviser (expatriate)	315	1	315	-	-	1/2	158	1	315	1	315	1/2	158	-	-	-	-	-	-
Feedlot Manager Adviser (expatriate)	315	1	315	-	-	-	-	1	315	1	315	1	315	-	-	-	-	-	-
Irrigation System Mgr. Adviser (expatriate)	315	1	315	-	-	1	315	1	315	1	315	-	-	-	-	-	-	-	-
Master Mechanic (expatriate)	315	1	315	-	-	-	-	1	315	1	315	1	315	-	-	-	-	-	-
Power & Pumping Adviser (expatriate)	315	1/6	53	-	-	1/6	53	-	-	-	-	-	-	-	-	-	-	-	-
Clerk - Typists	10	8	80	-	-	1	10	5	50	5	50	6	60	6	60	7	70	8	80
		TOTAL:		3	408	22 2/3	1219	380	3478	592	4278	935	4969	1492	5692	2058	7740	2533	9391

Note: The total personnel cost for year VIII shown in Table XVII-1 is SoSh. 9,361,000. With the planned crop rotation, it is expected to average SoSh. 7,821,000 per year.

C. Recruitment and Training

6.11 It is recognized that the ultimate success of the project will depend upon the efficiency of the people working there. It is understood that there is a shortage of trained personnel in Somalia, and therefore a training program has been included as a component of the project. A training assistant to the Farm Manager would be aided by two training officers. People to fill the training positions may be recruited from existing training programs in Somalia. They should understand the attitudes, motivation, mentality, values, customs and social life of the laboring people.

6.12 Truck drivers and equipment operators may be recruited from existing training centers. To the extent that the project need cannot be filled from this source, it will be necessary to train them on the job.

6.13 Foremen will require special training. They should be recruited from other projects in Somalia where they will have acquired some familiarity with leadership. They should have experience in farming, either on their own farms or by working actively on a state or private farm. Experience on an irrigated farm would be preferable but there will not be many people with this kind of background. It is expected that foremen will need an indoctrination in project operations and management regulations. Practical training should center on the proper and most efficient methods of planting, fertilizing, irrigating, application of insecticides and herbicides, cultivating, and harvesting. Table 6-2 shows a suggested schedule of distribution of training time.

It is advisable to place foremen under contract for about three years so that full benefit of their training will accrue to the project.

Table 6-2

Suggested Guide for Training Foremen

by Crops and Days

	No. of Days		
	Theory	Field	Total
Introduction to course	3	-	3
Grain crops	3	15	18
Fiber crops	3	15	18
Oil crops	3	12	15
Vegetable crops	3	15	18
Other activities, such as plowing, soil treatment, land leveling techniques, general management	2	35	37
Total	17	92	109

6.14 Laboring personnel should be recruited from among the indigenous farmers and nomads and people brought into the area from other locations. In order to assure maximum production, laborers should be trained in the most efficient method of doing even the most simple task. Much of this training should take place during the day-to-day farming operations, but some formal indoctrination is needed. The training staff should organize a program whereby each laborer is given one or two weeks of intensive training.

D. Incentives

6.15 The primary function of project management is to secure the greatest possible production of the selected crops under the prevailing physical conditions. One way of assuring high production is to provide special incentives to the personnel of the project. A general method might be a distribution of profits over and above a norm. Such distribution may go to all people in proportion to their annual earnings.

6.16 A more specific method applicable to some field workers would consist of a minimum wage, and additional payment on a work unit basis (piece work). Similarly, payment could be made in food products for production over a certain norm.

6.17 Some employees, such as truck and equipment operators, have no standard against which their work can be measured. The awarding of incentive payments should then be a judgment determination by their supervisors, based on guidelines established by the management.

6.18 As an incentive to permanent settlement, housing would be provided in villages and equipped with drinking water and sanitary facilities. Laborers might also be allocated garden plots to be cultivated in their spare time for their own consumption. The project may provide water and certain inputs for such plots.

7. MARKETS AND PRICES

A. Crops

7.01 The anticipated productions of the project at full development are summarized below and compared with nationa production figures for 1975.

Table 7-1

Crop	Cropped Area/yr	Yield/ha tons	Total Annual Prodn. tons	National Production 1975
Rice	955	4.0	3,820	
Maize	2405	5.0	12,025	165,000
Sesame	1450	1.0	1,450	26,000
Cotton	1450	2.2	3,190	1,000
Pulses	4350	1.8	7,830	-
Clover	1910	40.0	76,400	_

7.02 The contribution of the project to national food needs and import substitution is summarized in Table 7-2, showing the production of the project at full development as a percentage of imports and national demand.

7.03 Somalia's balance of trade in agricultural crops has traditionally been negative. The deficit was SoSh. 90.8 million in 1973, worsening to an estimated SoSh. 260-300 million in 1974 and SoSh. 300-350 million in 1975. The Government aims at reducing import levels through substitution of domestic production for imports. Somalia could enter export markets for a number of crops including cereals, especially maize, and sugar, oil crops and fruits.

Table 7-2

Project Production as a Percentage of 1974 Imports, of Estimated 1975 Needs and Projected 1990 Needs

(in 000 tons)

	1975* Demand	1990* Demand	Volume** imports 1974	Project Production	Project Prodn. as % of imports	Project Prodn. as % of national demand 1975	1990
Maize	295.0	494.0	0.7	12.0	-	4	2.5
Rice	26.5	66.9	16.9	3.8	23	14	5.7
Edible oils (40% extraction)	5.7	15.4	2.7	.6	22	10	4
Cotton lint (40% seed cotton prodn)	4.0	6.5	3.5	1.2	34	30	18
Pulses	26.0	49.0	12.1	7.8	64	30	16

*Juba Valley Development Program, Technital for EEC, 1976

**Foreign Trade Returns, Central Directorate of Planning, Mogadishu, 1975

7.04 Somalia is a net importer of cereals -- especially rice -- sugar, and vegetable oils. Imports of wheat, tea and pasta products were drastically reduced in 1973 to ease balance of payment difficulties and further reductions were made in other commodities, including rice and sugar, vegetable oils, etc.

7.05 Somalia's only true export crop is bananas. Other exports are some fresh fruits, incense and myrrh. Table 7-3 shows the import situation for the years 1971 to 1974.

Table 7-3

Volume and Value of Selected Project Crops

(1971 - 1974)

	Maize	Rice	Edible Veg.oil	Cotton	Pulses	
1971						
Volume	27,532	36,171	5,546	53	45	(Tons)
Value	19,844	36,717	15,614	116	63	(SoSh) 000
1972						
Volume	1	26,625	5,914	606	42	"
Value	1	24,343	14,723	2,021	36	
1973						
Volume	2	29,776	2,796	21	16	"
Value	2	40,111	7,892	56	18	
1974						
Volume	1	16,876	2,674	4	12	"
Value	-	53,283	12,769	21	21	

7.06 The sole authorized buyer for maize, rice, oilseeds and cotton is the Agricultural Development Corporation (ADC). Growers are entitled to keep 100 kg grains per person per year for own consumption but this provision reportedly is not enforced. ACD buying and selling prices are fixed by decisions of the SRSP Politburo and the Council of Ministers.

7.07 The marketable maize surpluses purchased by the ADC in 1971 through 1974 are shown below. They indicate a downward trend as a result of the drought which began in late 1973.*

Aug. 1, 1971 - July 31, 1972: 54,500 tons
Aug. 1, 1972 - July 31, 1973: 60,420 tons
Aug. 1, 1973 - July 31, 1974: 18,080 tons

*Source: Somalia, Recent Economic Developments and Current Prospects, IBRD, 1975

7.08 In order to promote the expansion of maize cultivation, the producer price has been steadily increasing. The following table shows the trend of farmgate and retail prices between 1971 and 1976.

Table 7-4

	Farmgate SoSh/quintal	Retail within area SoSh/quintal
1971	40	68
1972	45	73
1973	45	73
1974	50	78
1975	55	83
1976	60	90

Source: ADC

The 1977 farmgate price has recently been set at SoSh 750 per ton.

7.09 Maize is resold to the growers in the areas of production for 90 SoSh/quintal (1976). Imported maize or production from other parts of Somalia is resold at 110 SoSh.

The price per ton for imported maize was about SoSh 960 in 1974, 2100 in 1975(Juba Valley Development Program, Technital for EEC, 1976), and 1490 in the first six months of 1976. This means that imported maize was sold at a subsidized price in 1975 and 1976.

7.10 Under normal climatic conditions maize production meets local requirements. However, in periods of drought, the country becomes heavily dependent on outside markets. In 1971, for example, the country had to import 27,532 tons of maize (Foreign Trade Returns, Ministry of Coordination and Planning), and in 1975 about 44,740 tons were imported.

7.11 Taking into consideration demographic growth, betterment of the population's standards of living and the expected substitution effect of maize with rice that will accompany rising living standards, Technital in its report to the EEC has forecasted the national and regional demands for maize for 1975, 1980 and 1990, as shown in Table 7-5.

Table 7-5

Year	Kg Per Capita	Total Demand, Tons Lower Juba	Somalia
1975	98.3	76,600	295,000
1980	104.0	103,400	353,000
1990	112.0	144,000	493,700

7.12 The expected increase in maize production on the project will reach 4% of the total demand in 1990 and will represent 8% of the demand for maize in the Juba Valley.

7.13 Rice is a major staple cereal in Somalia. Since 1975, domestic production must be sold to the ADC who were paying a farmgate price of SoSh 2500/ton for milled rice,

as compared to SoSh 1400/ton in 1973. This was also the price offered in 1976. The retail price to the consumer has been increased from SoSh 3000 in 1975 to SoSh 4000/ton in 1976. The farmgate price was raised to SoSh 3500 per ton early in 1977. The dependency of the country on rice imports has been shown in Table 7-3.

7.14 Although volumes have decreased, the unit values of imports have been rising rapidly, causing a heavy drain on foreign currency resources. In view of the increasingly heavy bill thus paid and of the unreliability of surplus on the world markets, an interim objective of at least partial import subsitution is highly justified in order to help alleviate the deficit in Somalia's balance of trade.

7.15 Technital projects the following national and regional demands for rice in 1980 and 1990 as follows:

Table 7-6

Year	Consumption per capita	Total Demand, Metric tons Lower Juba	Somalia
1975	8.7 kg	6,800	26,500
1980	10.4 kg	10,300	35,300
1990	15.2	19,800	66,900

7.16 The Moganbo project, in full production, could produce 3820 tons of milled rice, representing about 10% of the expected total demand in 1980, and 5.7% of demand in 1990. It would provide 38% of the expected needs of the Lower Juba area in 1980 and about 20% of needs in 1990.

7.17 All oilseed production must be sold to the ADC. The annual amount of sesame purchases varies between 10,000 and 12,000 tons. The ADC's farmgate and retail prices for sesame from 1971 to 1976 are shown in Table 7-7. The farmgate price was raised to SoSh 2400 per ton early in 1977.

Table 7-7

Year	Farmgate SoSh/quintal	Retail SoSh/quintal
1971	150	200
1972	155	200
1973	155	200
1974	180	220
1975	200	270
1976	200	270

Source: ADC

7.18 Technital has presented calculations of the future demand for edible oils for Somalia and for the Lower Juba area. These are shown in Table 7-8 for 1975, 1980 and 1990.

Table 7-8

Year	Per capita kg	Total, tons Lower Juba	Somalia
1975	1.9	1,500	5,700
1980	2.2	2,200	7,500
1990	3.5	4,500	15,400

7.19 When in full production, the Moganbo project plantations will produce 1445 tons of sesame, corresponding to 575 tons of sesame oil (40% extraction rate). This amount represents 4% of the total national demand.

7.20 Somalia has been a net importer of cotton since 1973. Domestic production must be sold to the ADC who resell it at cost to SOMALTEX, the Government-owned textile factory. At full production, the factory requires about 4000 tons of cotton lint annually. Only 800-1000 tons are purchased by ADC at the present time. The price for cotton, two-thirds grade I and one-third grade II, was set at SoSh 2533 per ton early in 1977.

7.21 The Moganbo project, when in full production, will produce an average of 3,200 tons seed cotton or about 1100-1200 tons cotton lint annually, representing 25% of the Somaltex company requirements. It is foreseen that the national demand for cotton lint will reach 7000 tons by the year 2010. This means that Somalia should have to increase its cotton imports.

B. Livestock

7.22 The proposed feedlot to be integrated with the Moganbo irrigation project would finish 28,500 head (net) of cattle per year. Half would be exported live through Kismayu Port and the remainder would be sold to the Kismayu Meat Factory for processing as chilled or frozen meat. Virtually no live export of cattle is being done through the port at the present time although it has the necessary capacity. The higher quality and heavier weights of the project's fattened animals would command premium prices in comparison to existing national live-animal exports.

7.23 Countries of the Arabian Gulf such as Saudi Arabia, Kuwait, and South Yemen have always been the traditional market for exports of live animals from Somalia. Exports

in the past have been made on a haphazard basis due to a number of constraints, the important one being the irregularity of Somalia's supply of good quality cattle. With the improvement of marketing arrangements, including the holding grounds and shipping facilities being created in view of planned development projects, the export of live animals will be greatly facilitated.

7.24 Kismayu Meat Factory has a slaughtering capacity of 60,000 head per year which it is processing into stewed meat and corned beef. Its canning facilities will be doubled under the current development plan to a capacity of 120,000 head per year.

7.25 The export of chilled and frozen beef may become one of the factory's major activities in view of the expected increase in numbers of higher quality fattened cattle form feedlot operations in the Lower Juba area. The Government of Somalia intends to expand the factory's existing cold storage capacity from 360 to 1000 tons.

7.26 The Moganbo feedlot would be able to provide Kismayu Meat Factory with 15,000 head of fattened cattle (equivalent to 2700 tons of carcass meat) annually. Veterinary standards in Somalia have been improved to a level acceptable to several countries in addition to its traditional markets in the Arabian Gulf.

7.27 The Trans-Juba Feedlot would produce about 80,000 head of finished cattle per year for delivery to the Kismayu factory. This leaves a free canning capacity of over 40,000 tons per year. The proposed Moganbo production of 15,000 head or 2700 tons of carcass meat for processing is well under the planned increase in annual capacity of the factory's cold storage facilities.

7.28 At the present time, the factory is buying its animals directly from the range. It is expected that it will turn to the feedlots for its supplies in the future to take advantage of the higher meat quality and heavier weights.

7.29 The LDA is buying animals for export at SoSh 2.5 per kg liveweight, and this has been adopted as the price for cattle purchases for the calculation of feedlot operating costs. The By-Products Utilization Project at Km-7 near Mogadishu is obtaining SoSh 3.5 per kg liveweight for its finished cattle and this has been adopted for the sales price to the Kismayu Meat Factory.

VIII JUSTIFICATION AND BENEFITS

A. Value of Existing Production

8.01 About 20 percent of the project area is cultivated for subsistence by approximately 500 households. Production is rainfed or flood irrigated, no agricultural inputs except family labor area applied, and yields are low. Maize is virtually the only crop with some intercropped sesame and some tobacco. Other crops, such as sorghum, cotton, groundnuts and beans, were not found.

8.02 Assuming a cultivated area of 1200 hectares cropped in maize, with a yield of 400 kg per hectare, the value of existing production was calculated at SoSh 360,000 on the basis of the 1977 farmgate price of SoSh 75 per quintal. No account was taken of sesame or tobacco production as these were insignificant and no opportunity costs were assumed since only family labor was involved.

B. Evaluation of Costs

8.03 The capital costs as estimated elsewhere in this report total SoSh 180,938,000, representing an average cost of SoSh 28,904 per hectare. The costs are broken down by features in Table 8-1.

Table 8-1

Total Costs Breakdown

Capital Investment	Total Cost SoSh millions	Cost per hectare SoSh	Foreign Component SoSh millions	Foreign Component % Total
Land reclamation, leveling, irrigation and drainage	105.158	16.798	67.954	65
Roads	13.370	2.136	2.674	20
Buildings, housing*	35.995	5.750	18.225	51
Machinery, equipment				
- Irrigation systems	1.106	0.177	0.995	90
- Crops production	22.973	3.670	20.390	89
- Feedlot	2.336	0.373	2.103	90
Total Capital Investment	180.938	28.904	112.344	62

*Including feedlot construction, SoShl,455,000

8.04 The total annual operating costs, when the project is in full production, amounts to SoSh 48,423,300. The relative importance of the different cost items in the total annual operating costs is shown in Table 8-2. The cost of cattle purchases represents more than 30% of the total annual project operating costs and the purchase of cattle feed represents close to 20% of the total. The cost of fertilizers represents more than 15% of the total annual operating cost. Labor is another major annual cost item, representing about 10% of the total annual operating cost. The wage bill for for the crop production sector accounts for more than 87%

of the project's total annual wage bill. Finally, Table 7-2 shows that the operation and maintenance costs for machines and equipments, and the average annual replacements costs, are of relative importance, representing about 7% each of the total annual operating cost.

Table 8-2

Summary of Operating Costs

at Full Development

(000 SoSh)

		Cost	Total Cost	% of Total
I	Personnel		7,86I.0	I6.2
	Staff (excl. expatriates)	2,768.0		
	Labor (unskilled)	5,093.0		
	Crops [4,430.0]			
	Livestock [6I5.0]			
	Irrigation [48.0]			
II	Inputs		33,502.2	69.2
	Crops	8,954.7		
	Seeds [9I2.3]			
	Plant protection [658.7]			
	Fertilizers [7,383.7]			
	Livestock	24,547.5		
	Feed purchase [9,247.5]			
	Cattle purchase [I5,000.0]			
	Dipping fluid [300.0]			
III	Operation and Maintenance		3,6I9.I	7.5
	O&M, machinery & equipment	3,I54.I		
	Maintenance			
	Gravel roads	392.0		
	Feedlot facilities	73.0		
IV	Replacements		3,44I.0	7.2
	TOTAL		48,423.3	I00.0

C. Production and Revenues

8.05 The anticipated crop production at full operation, i.e. in Project Year X, is shown in Table 8-3.

8.06 Livestock fattening operations would produce 28,500 head of well finished cattle per year at full production. The buildup of production is as follows.

Project Year	III	2,850 head
	IV	8,550 "
	V	I4,250 "
	VI	I9,950 "
	VII-XXX	28,500 "

8.07 All the crops produced in the Project with the exception of legumes and clover would be marketed through the Agricultural Development Corporation (ADC), the government agency with monopoly buying powers. The prices adopted for the calculations are shown in Table 8-3. The price of legumes is not controlled and they can be sold freely. Clover (berseem) production would not be sold but would be fed to the cattle in the Project's feedlot. The ADC's farmgate prices for 1977 were adopted for maize, cotton, sesame and rice. A conservative average farmgate price of SoSh 2500/ton was assumed for legumes, as beans were retailing for an average price of SoSh. 4.0 per kg (1976). Clover would be taken to the feedlot in exchange for organic fertilizer.

8.08 A selling price of SoSh. 3.5 per kg was adopted for livestock sales on the basis of prices currently obtained by the FAO-UNDP Km-7 By-Products Utilization Project near

Mogadishu. This corresponds to SoSh. I225 per head assuming an average finished weight of 350 kg per animal. The sales for live export were priced at SoSh. I220 per head to allow for export tax.

Table 8-3

Summary of Production, Prices and Revenues at Full Development

	Total Annual Production Tons	Unit Price per ton (per head) SoSh.	Total Annual Revenues 000 SoSh.
Crops			
Rice (955ha; 67% paddy production = milled rice at SoSh. 3500/T)	2,559	3,500	8,957
Seed Cotton (I450 ha) (2/3 Grade I and I/3 Grade II)	3,I90	2,533	8,080
Maize (2405ha)	I2,025	750	9,0I9
Sesame (I450 ha)	I,450	2,400	3,480
Legumes (4350 ha)	7,830	2,500	I9,575
Clover (I9I0 ha)	76,400	-	-
Total Crops			49,111
Feedlot			
Live export	I4,250	I,200	I7,I00
Kismayu Meat Factory	I2,250	I,225	I7,456
Total Feedlot			34,556
Total Project			83,667

8,09 About 59 per cent of the Project's returns are obtained from the crops production sector and 4I per cent from the livestock sector. Legumes bring the highest total return among

the various crops followed by maize, rice, cotton and sesame. As may be seen below, however, the highest gross return per hectare is obtained from rice, followed by cotton and legumes.

	Gross Return per Hectare (rounded off)
Rice	SoSh. 9,380
Cotton	SoSh. 5,570
Legumes	SoSh. 4,500
Maize	SoSh. 3,750
Sesame	SoSh. 2,400

D. Economic Evaluation

8.10 The economic life of the Project was assumed to be 30 years. The calculations carried out show that the Project has a financial rate of return of 15.1 per cent.

8.11 Taking into consideration all of the factors listed below, the economic rate of return was found to 16.2 percent.

1. Taxes and duties paid on fuel and for plant protection materials have been deducted from the costs.
2. The Project's economic benefits from exported or import-substitute commodities were calculated on world import or export prices for 1976. The prices per ton for the various crops were adopted as follows:

	Per Ton
Rice	SoSh. 2I50[I] (milled rice[2])
Maize	SoSh. I070[3]
Cotton	SoSh. I0000[4] (lint cotton)
Cotton Seed	SoSh. 950[5]
Sesame	SoSh. 3780[5]
Legumes	SoSh. I970[6]

8.I2 In the calculations, the opportunity cost of capital in Somalia has been assumed to be between 6 and 8%. Long-term loans to agriculture are given by the Somalia Development Bank (SDB) at 6% per year, to industry at a rate of 6.5% per year and to other sectors at 7.5% per year. The benefit/cost ratio and the net present worth discounted at 6% and 8% are as follows:

	Discounted at 6%	Discounted at 8%
Net Present Worth	SoSh. 178,218,000	SoSh. 110,462,000
Benefit/Cost Ratio	1.296	1.223

With a benefit/cost ratio of more than One, at a discount rate of 8%, the Project can be considered economically viable.

(I) CIF Mogadishu, including handling charges, etc.
(2) Rate of extraction 67%
(3) $I20 per ton, World Bank prospective prices, plus addition of $50 transport charges
(4) Somaltex prices
(5) FOB Sudan Port, plus transport, handling charges (World Bank)
(6) Adjusted for transport and other charges (World Bank)

8.13 Another way of showing project benefits is to show value added. The computation of value added, using operating costs exclusive of labor, and discounted to present worth at 8%, shows a net domestic value added of SoSh. 174,807,000.

Project Revenues and Payback Period

8.14 Table 8-4 shows that during the first six years of the project life, total annual costs will exceed total annual revenues. It is expected that the deficit will be financed through loans. Payback periods for the loans have been calculated using three assumptions. The resulting payback periods are as follows:

a) Assuming a loan payback grace period of six years on interest free loans, loans will be paid back by the eleventh year of project life (Table IX-38 in Part IX of Appendices, Volume 3).

b) Assuming a payback period of six years, during which no interest is paid and the loans bear six per cent interest starting from the sixth year, the loans will be paid back by the twelfth year (Table IX-39, and Table 8-4 herein).

c) Assuming a loan payback period of six years, and that the loans bear six per cent interest capitalized as of project year 1, the loans will be paid back by year 13 of the project life (Table IX-40, Part IX of Appendices Volume 3).

8.15 In order to appraise the value of the project, the sensitivity of the financial rate of return to varying conditions was analyzed. The following is a summary of findings:

	Analysis	Rate of Return
1.	Two year delay in implementation	14.1%
2.	20% increase in construction costs	12.6%
3.	20% increase in production costs	10.9%
4.	Two year delay in planned yield levels	14.0%
5.	Full production achieved one year early	15.8%
6.	10% reduction in construction cost	16.4%
7.	10% increase in crop prices	16.8%
8.	20% increase in production costs, cattle purchases unchanged	12.4%
9.	Combination 20% increase in capital and operating costs and 10% increase in farm prices, with cattle prices unchanged	11.9%
10.	Combination of 20% increase in production costs including cattle purchase, 20% increase in capital costs, and 10% increase in prices received	10.6%

8.16 Some thought was given to an analysis with 20% decrease in farm prices but likelihood of this happening during the period of analysis, without commensurate reductions in production cost, seem somewhat remote. Similarly, to speculate on a 3 or 4 per cent annual increase in crop prices seemed unwarranted.

8.17 The value of the project was also analyzed in terms of the sensitivity of the economic rate of return to varying conditions, summarized below.

Analysis	Rate of Return
1. Assuming 20% increase in production costs	12.4%
2. Assuming two year delay in implementation	14.8%
3. Assuming 20% increase in construction costs	14.3%
4. Assuming 20% increase in construction costs and two year delay in implementation	12.7%

8.18 Even under the most pessimistic assumptions used in the analyses, the Moganbo Project is viable and beneficial to Somalia. Non-monetary benefits derived from a step toward national self-sufficiency in food and fiber and the general well-being of the people add to the project's viability.

TABLE 8-4

SOMALIA

MOGANBO IRRIGATION PROJECT

Payback Period (Assuming No Interest During Grace Period) 000 SoSh.

Year	Amount of loan to recover deficit	Total Deficit	Interest at end of year at 6%	Surplus	Net Deficit
1	3967				
2	35298				
3	34791				
4	28876				
5	16991				
6	10302				
Subtotal	129225				
7		129225	7753	5512	131466
8		131466	7888	31867	107487
9		107487	6449	33493	80443
10		80443	4826	37162	48107
11		48107	2886	22703	28290
12		28290	1697	36683	(6696)

IX FUTURE ACTIONS AND OUTSTANDING ISSUES

9.01 There are a number of matters not previously mentioned, which should be considered after funds become available for the project and during the design period. These are discussed in the following paragraphs.

(1) There are banana plantations between the eastern project boundary and the Kismayu-Gelib highway. Some consideration should be given to integrating these into the project with a view to reducing the cost of production and improving yield. Since banana exports are a source of foreign exchange for the country, such an integration may further improve the national foreign currency situation.

(2) Since the Trans-Juba Livestock Development Project farm borders on the project on the north and has as its purpose the production of feed and the feeding of livestock, some consideration may be given to its integration (1500 hectares) into the project. There might result a saving in operation and management costs. Food production in addition to by-products should increase the net benefit from this area.

(3) The possibility and feasibility of serving the project area from a river diversion near Kaliakoko should be studied in some detail. The diversion to a canal running west of the project area was proposed in the Juba Valley Development Program, but details are not available. Such a diversion may be considered if it would result in an overall net saving to the project. With the general gradient of the valley being quite low, there is a question whether the lands of the project may be serviced by such a canal.

(4) The success of the project will depend on the quality of management and the ability to train subordinate staff and workers. Some training programs in Somalia have been reasonably successful and some have not. This matter should have intensive study and a training program outline should be made during the design stage. Management must be by native Somalis, but there is need for help from expatriate advisers.