DEMOCRATIC REPUBLIC

OF

SOMALIA

MOGANBO IRRIGATION PROJECT

FEASIBILITY STUDY

APPENDICES VOLUME 2

PART III: IRRIGATION AND DRAINAGE

PART IV: INFRASTRUCTURES

PART V: AGRICULTURAL CROPS

PART VI: LIVESTOCK SECTOR

Prepared for the:

State Planning Commission
and
Kuwait Fund for Arab Economic Development

Tippetts-Abbett-McCarthy-Stratton - New York

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SOMALIA

MOGANBO IRRIGATION PROJECT

APPENDICES, VOLUME 2

PART III

IRRIGATION AND DRAINAGE

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SOMALIA
MOGANBO IRRIGATION PROJECT

APPENDICES, VOLUME 2 PART III

IRRIGATION AND DRAINAGE

I GENERAL

1 The Moganbo Irrigation Project would involve the development of 6,943 hectares of river bottom lands on the right (west) bank of the Lower Juba River, 18 kilometers south of Kamsuma and roughly parallel to the paved Kismayu-Gelib road. The project site is bounded to the north and west by a production ranch and feedlot of the Trans-Juba Livestock Project, and to the east and south by about 5,000 hectares of commercial banana plantations. The land is laced with many old river channels and is, for the most part, unoccupied by any economic activity other than small scattered subsistence farms (2-3 ha in size) and occasional use by nomadic herdsmen. Weeds, bushes and trees cover the entire

project area, with variable density depending on moisture availability.

2 Natural precipitation in the area is low and irregular and cannot be relied upon for dependable crop production. Groundwater resources of adequate quality have not been found, so the Juba River would be the only feasible source of irrigation water. The river has an annual runoff ample enough if regulated to supply the Moganbo and other projects (see WD I, Climate and Water Resources). Chemical content and sediment concentrations are medium to low and very low most of the year. High values have been observed only during early Gu season floods and are due to a flushing action that would be eliminated with the regulation to be afforded by the Saco and Bardera dam and reservoir projects (1979 and 1984, respectively).

Storm Rainfall

3 There is no record of tropical cyclones occurring in southern Somalia. Probability analyses of storm rainfall occurrences indicate that drainage systems, culverts, etc., should be designed to control surface runoff corresponding to a 10-year return period, i.e. 98mm/one day; 110mm/2days and 116mm/3 days.

Existing and Planned Irrigation

4 Little use has been made of the waters of the Juba. Initial focus of development efforts on the Shabelli, Somalia's second largest river, were probably motivated by the following factors: (i) the Juba formed the border with Kenya; (ii) irrigation by diversion is less feasible: pumping is required; (iii) the Juba is relatively far from Mogadishu, the capital city; and (iv) the infrastructural base for development was lacking. Thus, less than 20% of the Juba's irrigation potential has been exploited and only 4% of this is under controlled irrigation.

Table III-1

Actual and Potential Irrigation in Somalia[1]

(hectares)

	Juba	Shabelli	North Region	Total
Total potential	150,000	80,000	5,000	235,000
Irrigated	27,000	70,800	2,200	100,000
Controlled	6,000*	26,900	1,500	34,400
Flood	21,000	43,900	700	65,600

*Technital's report to the EEC, The Juba Valley Development Program, indicates that 8,500 hectares are under controlled irrigation in the Juba Valley.

[1]Source: Somalia, Recent Economic Developments and Current Prospects, August 1975, IBRD.

5 The Juba has few tributaries, all of them small, in its lower reach, so water must be diverted from the main stream involving high water conveyance costs and precluding small-scale irrigated farming. Cultivation using flood irrigation is practiced in the slack water depressions (desceks) that serve as flood relief to the Juba. Prior to independence, Italian farmers introduced pumped irrigation for the cultivation of bananas (mainly) and other crops. The semi-portable, diesel-powered, horizontal pumps, usually of standard manufacture, are installed on the river banks and are generally unprotected by any type of shelter. Water is pumped into stilling basins before conveyance to the fields.

6 Proposals for large-scale use of water from the Juba were first made by USAID in 1961, and subsequent studies covering a total of 150,000 hectares were conducted by FAO and Selchozpromexport. The Juba Valley Development Program is the end result of this work. Drawn up in 1963-64, updated in 1972-73 and again in 1976 by Technital of Rome (EEC sponsored), the program includes the irrigation of 221,500 hectares[1] by 2010, and

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[1] Differences between these and FAO/IBRD estimates may be due to the inclusion of lower land classes to be put under rice cultivation.

assistance to dry-land farming in the surrounding areas, and an important livestock development component. The irrigable areas have been grouped into eleven agricultural districts and a number of projects have been identified, some of which are already under way[1](Table III-2).

Floods

7 A detailed analysis of the Juba River's hydrology is given in WD-I-Climate and Water Resources. The most damaging floods occur during the Der season (Sept.-Nov.) when rainfall is heaviest in the Ethiopian highlands. Flood peaks are regulated only by the natural flood relief depressions and old river channels (about 30,000 hectares in all). Flood control weirs at Bulo Yag, for example, now divert flood waters off into such areas on the proposed Moganbo project site. Construction of the dams and reservoirs at Saco and Bardera should ensure full regulation of river flows. Fanole dam and the Kaliakoko head works will also help in securing better control of flood waters. The only flood hazard to the Project would then be the flood control weirs at Bulo Yag so priority must be given to the construction of a

[1]See Working Document IV - Crops

TABLE III-2

SOMALIA

MOGANBO IRRIGATION PROJECT

JUBA VALLEY DEVELOPMENT PROGRAM

A. Irrigable area by district

District	Irrigable Area	District	Irrigable Area
1. Lugh-Dolo	16,400	7. Tuta Island	13,300
2. Bardera-Saco	47,350	8. Bardera-Yare	32,200
3. Saco	26,600	9. Giamama	20,050
4. Dujuma	11,100	10. State Farm	10,300
5. Dufala-Afmadu	7,800	11. Deseck Wamo	10,000
6. Fanole-Gelib	26,400		
		Total:	221,500

B. Identified Projects to Date

Project	Approx. Surface	Crops	Status
Fanole	8000ha	Cotton, oil seeds	Under way
Yonte Phase I	5000ha	Sugar cane	Under way
Yonte Phase II	5000ha	Sugar cane	Expansion
Gelib	-	Rice	-
Giamama	10000ha	Cotton	Planned
Kalanji	250ha	Bananas	Planned
Faboule	-	Cotton, oil seeds	Planned

Source: Juba Valley Development Program, Summary, Sept. 1976; and on-site investigations

main interceptor drain along the north border of the project site. This structure may also be called upon, at a later date, to carry off excess and waste waters from the irrigation and livestock projects on higher land to the north.

II- IRRIGATION WATER REQUIREMENTS

8 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 the 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.

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.

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.

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 per cent. 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.

9 The equation for monthly requirements is as follows:

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

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, derived with reference to alfalfa;

p = percentage of daytime hours of period examined;

t = mean temperature in degrees centigrade

E = irrigation efficiency assumed to be 60 per cent

F = Blaney-Criddle consumptive use factor for alfalfa.

10 The climatic data used in computing plant consumptive use and water requirements are given in Table III-3. Table III-4 shows the monthly consumptive use factors developed by Blaney and Criddle as well as the empirical factor (F). Table III-5 shows the selected crop rotation by areas, and Table III-6 gives the solutions of the formula, exclusive of the factor for efficiency (E). Finally, Table III-7 gives net water requirements per month for the various crops.

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TABLE III-3

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 III-4

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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 III - 5

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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

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TABLE III-6

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

≡ 1.0 l/sec/ha

* See crop rotation plan

TABLE III - 7

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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.

11 An efficiency coefficient of 60% was applied, giving the total monthly and annual net project water requirements presented in Table III-8. All project works have been designed to meet these requirements.

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TABLE III-8

MONTHLY AND ANNUAL DIVERSION REQUIREMENTS

Units: $m^3 \times 10^3$

Month	MAIZE	SESAME	RICE	CLOVER	LEGUMES	COTTON	TOTAL
Jan		2 612	3 729	2 007		2 177	10 525
Feb							
Mar							
Apr	2 100			411	3 818		6 329
May	2 722			513	3 717		6 952
Jun	3 378			797	3 644		7 819
Jul	3 022			926	2 813		6 761
Aug						2 011	2 011
Sep			2 185		2 308	2 308	6 801
Oct		1 979	2 849	529	3 260	3 260	11 877
Nov		2 683	3 274	1 493	3 098	3 098	13 646
Dec		3 468	3 998	1 713	2 600	2 600	14 379
Total:	11,222	10,742	16,035	8,389	25,258	15,454	87,100

5.4 m^3/s continuous

III- LAND PREPARATION

12 Vegetation type and density on the project site are determined mainly by moisture availabilities. In general, root structures are shallow and extend over relatively wide areas. The land must be cleared and grubbed to permit mechanical tilling operations. There are termite hills on the area, up to as many as 15 per hectare in certain parts. They range from less than 50 cm to 5-or-more meters in height, and can measure up to 15 meters in diameter. Wherever they are present, land preparation costs will be higher.

13 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. Field observations and investigations in the area indicate that cut and fill would amount to an average 1500 cubic meters per hectare. 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.

IV - PROJECT FEATURES

14 The major features of the project include: the irrigation system; drainage system; land development; roads; villages; feedlot, and purchase of machinery and equipment. The irrigation and drainage systems are described below.

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

16 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, 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 6.0m 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 m long and the bottom of the intake channel should be 18 m wide.

17 With the natural ground surface at 10.5 m and occasionally subject to flooding, the deck of the pumping plant has been set at 13.5 m. The structure should be 18 m long and 3.5 m wide. Provision has been made for 7 pumps of 1 cms 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 cms capacity, with two standbys. Although the larger pumps would operate at lower efficiency in meeting diverse demand, the saving in capital cost appears to outweigh increased 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. As 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 is required for bowls or propellers.

18 A power station is planned to provide energy for the pumping plant and 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 (est. 250 kw), a power plant of 1000 kw capacity was considered appropriate. The maximum pumping load of 540 kw will be during November and December. 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 (none). To meet the headquarters village demand when no pumps are operating requires a 250 kw set. To allow down time for repairs and considering the diversity of load, a plant with one 500 kw unit and two 250 kw units was chosen.

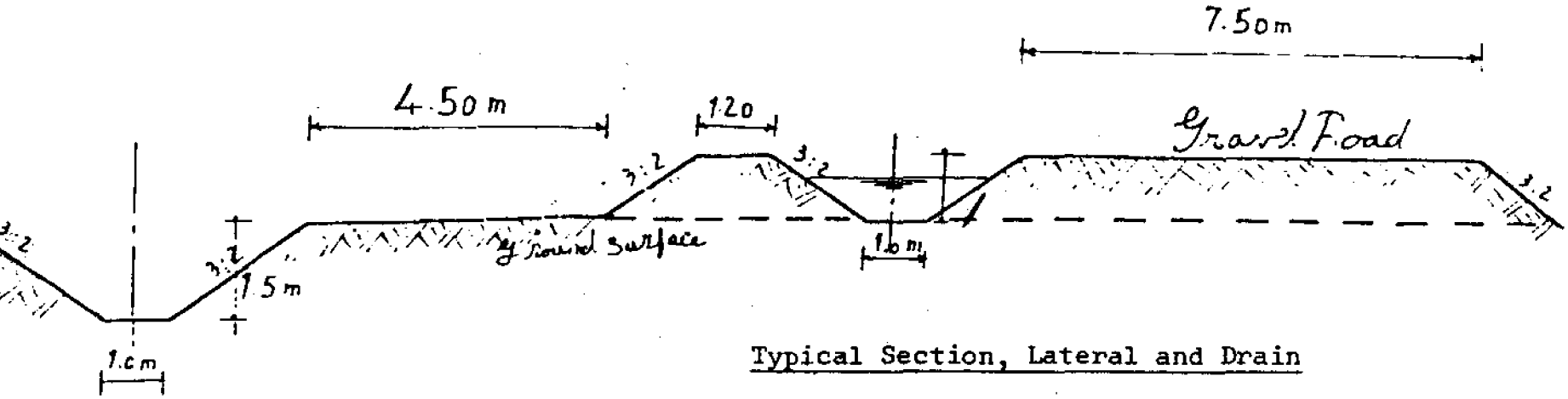
19 The main canal, with an initial capacity of 5.6 cms would be 9.94 kms long. It would have a bottom width, at the end of the transition from the pumping station, of 3.6 m and a water depth of 1.22 m. Allowance has been made for .7 m freeboard. In order to reach a delivery water surface elevation of 11.83 m at the beginning of Lateral H, the water surface at the pumping plant should be 12.33 m msl. The ground surface at the pumping plant is 10.5 m and at the division structure (sta. 1+080) is 10 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.

20 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 an initial W.S. elevation of 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, 10 m. From this point to sta. 5+710 the canal will have a bottom width of 3 m, water depth of 1.17 m and freeboard of .6 m. Its capacity should be 3.4 cms. The ground surface at sta. 5+710 is 8.9 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 9.3 m.

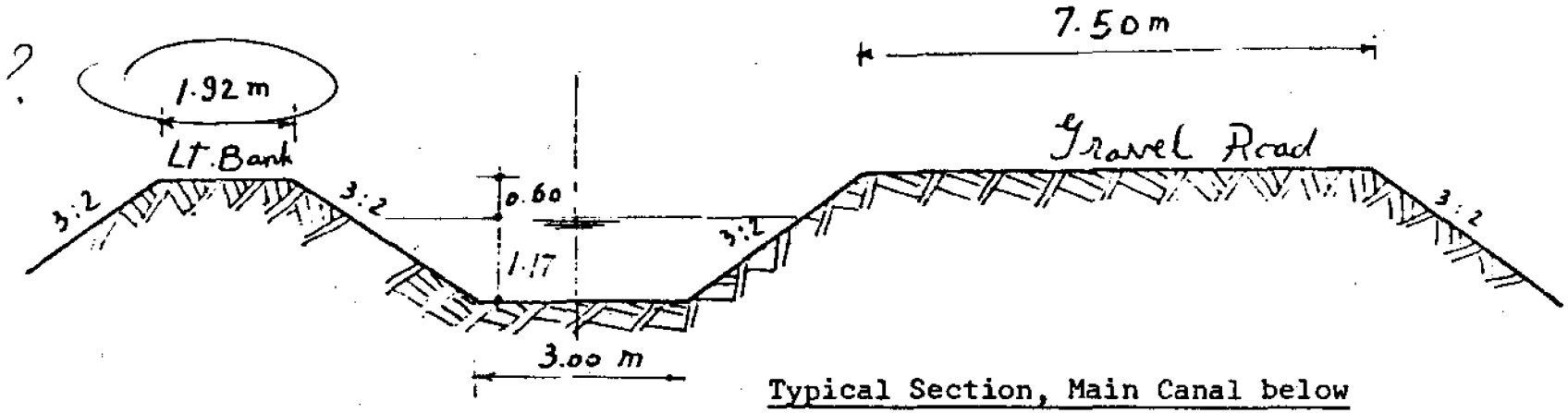
21 The continuation of the main canal to its end at sta. 9+940, will have a bottom width of 2.4 m, water depth of 1.04 m, and freeboard of 0.58 m. Its capacity should be 2.2 cms. It will start in partial cut and will be in 0.54m cut at its end. The right bank will be widened to 7.5 m to provide a two-directional road. At sta. 9+940, the canal bifurcates into Lateral F and G.

22 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.

23 Check structures should be provided at the turnout to Lateral E and about every kilometer along the canal



Typical Section, Lateral and Drain



Typical Section, Main Canal below Station 1+080

III-20a

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

below sta. 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.

24 It is estimated that main canal construction should include: 10,000 m^3 required excavation; 231,400 m^3 of burrow excavation and 209,800 m^3 of compacted embankment. Structural concrete for the main canal is estimated to total 1600 m^3.

25 The lateral system should serve about 41115 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:

Lateral	B-C	1.59 cms
	E	0.89 cms
	F	0.78 cms
	G	0.86 cms
	H	0.84 cms

The banks of the laterals are planned to be compacted embankment with a 7.5 m 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 (Fig. III-1).

26 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 227,200 m^3. 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.

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

The main drain would be 23.1 km 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 regualted by Bardera and Saco dams, 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 tertiary drains to be executed after land preparation. Experience with similar soils shows that subsurface drainage will ultimately be necessary. At the present stage, 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 needed.

28 The origianl plans for the project contemplated emptying the main drainage system into the river near Sunguni. Since the anticipated releases form 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.

29 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.

30 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% 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.

The field costs for the irrigation system, drainage system and land development are shown in Table 8a.

TABLE 8a

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 8a , 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

V. Costs

A. Capital Costs

31 The total cost of the irrigation and drainage system, amounting to SoSh. 105,157,000, is broken down by features in Table III-8. ← €1500/ha net.

28 The main canal, pumping plant, power plant, main and secondary drains, and lateral "H" were estimated on the basis of computed quantities. The cost of clearing, leveling and tertiary ditches were estimated on a unit price per hectare based on experience elsewhere. Secondary canals were also estimated on a unit price per hectare based on experience. Where possible, the construction of drains has been planned concurrently with laterals (secondary canals) so that drainage excavation may be used in lateral embankments.

32 In any new irrigation project, it is not possible to accurately estimate the need for future drains. In view of the type of soils of this project site, the crop rotation and the amount of water to be applied, an estimate for future drainage is included.

It is quite likely that the construction of these drains should not start before the tenth year of the project when the need becomes evident and should thereafter be completed by the fifteenth year.

33. Pumps and motors, generating equipment and electrical equipment should be purchased by the Government under competitive bidding. During the design phase of the project, pumps, motors and generating equipment should be ordered and be in the process of purchase while design proceeds.

Table III-8b

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 (irr.)	2,257.4	255.7	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		
Land Development	45,551.5	18,220.6	27,330.6
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

Work Scheduling

34 The scheduling of funds requirements for construction of the irrigation system is shown in Table III-9. It has been estimated that the design and preparation of tender documents would require about 18 months from the time that funds first become available for construction. About one-half of the SoSh. 7,081,300 estimated cost for engineering and supervision will be required during this period. The remaining allowance for supervision of the construction work should be spread over the six-year construction period and future drains works.

35 In scheduling construction, attention was given to assuring that the work required to provide 400 ha of land for irrigation will be terminated at the end of the first construction year. Programming of works for the two following years has been done with a view to completing all systems construction work, except lateral "H", the remaining land development and future drains, during the course of the third construction year.

36 The floodway channel near Bulo Yag has been used in the past to relieve flooding conditions downstream on the Juba River. Until Saco and Bardera dams

are built to control floods, this floodway should remain operable. Funds are provided in the estimate to rehabilitate the control gates. Construction plans include the building of the first section of the main drain and lateral B-C so that water from the floodway can be by-passed when necessary along the western side of the project without damage to systems or structures on the site or elsewhere in the area. Lateral "H" would have to cross the floodway and has been scheduled for construction in Year VII, i.e. the last year of active construction. It is expected that Bardera dam will be in operation then and the lateral can be in fill rather than siphoned under the floodway. At this time, the gates to Bulo Yag floodway may be permanently closed.

Machinery

37 The total project cost would include the initial capital cost of purchasing the operation and maintenance equipment itemized in Table III-10. This cost, SoSh. 1,105,800 is scheduled for Project Year III and would bring the total project cost to SoSh. 106,263,100.

38 To facilitate communications between the central water dispatcher and the water guards, provision is made for a radio communication system. This system should have one fixed station at headquarters, a fixed station in each of the four workers' villages and seven mobile units.

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MOGANBO IRRIGATION PROJECT

Table III-9

Schedule of Expenditures for the
Irrigation Systems (incl. Machineries)

PROJECT YEAR	EXPENDITURE 000 SoSh.
I	2,559.0
II	19,641.0
III	13,847.1
IV	15,266.8
V	11,773,4
VI	15,942.7
VII	13,555.5
Future Drains (Years X to XV)	13,678.2
TOTAL	106,263.1

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MOGANBO IRRIGATION PROJECT

Table III-10

Maintenance Equipment

Item	Units: 1000 SoSh. Total	Local	Foreign
Radio communications system	50.4	5.0	45.4
Tractor,D-6 or equiv., dozer	113.4	11.4	102.0
Tractor, rubber-tired, 50hp	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 20%:	10.8	1.0	9.8
Subtotal:	1005.3	100.4	904.9
Administrative Costs 10%:	100.5	10.0	90.5
Total:	1105.8	110.4	995.4

*Excluding those of trucks and tractors, costed in capital costs

It should also be used for communication between the Farm Manager and the various village managers.

Machinery and equipment replacements have been foreseen in years IX,XV,XXI and XXVII at a cost of SoSH. 1,005,300 each year.

B - Operation and Maintenance Costs

39 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.

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

39 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 III-10. Since the system will be, at least partly, in operation all year except February, proper scheduling of maintenance work is essential.

40 This same maintenance organization should also maintain the road system.

41 The pumping plant and power plant would be in close proximity to each other in the headquarters village. It is estimated that four operators could handle the joint operation and maintenance of the installations. The drain pumping plant near Sanguni would need two operators.

42 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 III-11 lists the personnel required to handle the operation and maintenance division at full development, including salaries. Table III-12 shows the buildup of personnel during the early years of development.

43 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 help train pumping and power plant operators need be available only two months of Year III.

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Table III-11

Personnel Requirements

	No.	Annual Salary 000 SoSh	Total Annual cost 000 SoSh
Irrigation System Manager	1	18	18
Clerk typist	1	10	10
Water Dispatcher	1	12	12
Foremen	4	12	48
Water Guards	4	10	40
Mechanics	4	10	40
Equipment Operators	2	6	12
Truck Drivers	2	6	12
Electrician	1	10	10
Laborers	16	3	48
Pump and Power Plant Operators	6	10	60
Total personnel costs - Irrigation and Drainage systems			310
- Expatriate -			
System Mgr Adviser	1	315	315
Master Mechanic	1	315	315
Pumping and Power Plant Adviser	1/6	315	53

Table III-12

SOMALIA

MOGANBO IRRIGATION PROJECT

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

Summary

Annual operation and maintenance costs for the irrigation and drainage system, including personnel for machinery maintenance, are listed in Table III-13. The breakdown by year of development is given in Table III-14.

SOMALIA

MOGANBO IRRIGATION PROJECT

Table III-13

Summary of Annual Operation

and Maintenance Costs at Full Development

	000 SoSh.
Personnel	310.0
Fuel, maintenance and repair of equipment	179.4
2 Tractors (4000 hrs/yr @ SoSh 17/hr) 1 Dragline (1200 hrs/yr @ 17/hr) 2 Trucks (24,000 km/yr @ 1.1/km) 3 Land Rovers (48,000 km/yr @0.9/km) 4 Motorcycles (48,000 km/yr @0.3/km) 1 Scraper (1000 hrs/yr @ 17/hr)	
Fuel for Power Plant (495,000 liters)	545.6
Fuel for Drain Pump	105.6
Maintenance of Pumping and Power Plants	71.4
Total	1,212.0

Table III-14

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MOGANBO IRRIGATION PROJECT

Breakdown of Annual Operating Cost

by Year of Development

	III	IV	V	VI	VII	VIII - 30
1. Fuel, Maintenance, Repairs	11.4	27.9	63.2	89.7	123.6	179.4
(2) Tractors (4000 hr)[1]	4.3	10.6	19.2	34.0	52.1	68.0
(1) Dragline (1200 hr)[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 (48000 km/yr)[5]	0.9	2.2	4.4	7.2	11.0	14.4
(1) Scraper (1000 hr)[6]	0.4	1.1	2.1	3.5	5.4	7.0
2. Fuel for Power Plant[7]	34.9	84.7	167.6	272.7	410.0	545.6
3. Fuel for Drain Pumping Plant[8]	6.8	16.3	32.2	52.8	80.9	105.6
4. Maintenance for Pumping and Power plant	4.4	10.7	21.8	35.7	54.7	71.4
Total:	57.5	139.6	284.8	450.9	669.2	902.0

(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, 496,000 x 1.1 = 545,600 SoSh in Year VIII

(8) No. liters diesel 60hp x 0.2 liters/hp-hr x 2000 hr/yr x SoSh 1.1/liter = 105,6000 SoSh, Year VIII

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MOGANBO IRRIGATION PROJECT

APPENDICES, VOLUME 2

PART IV

INFRASTRUCTURES

SOMALIA

MOGANBO IRRIGATION PROJECT

APPENDICES, VOLUME 2 PART IV

INFRASTRUCTURES

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FIGURES

TABLES

SOMALIA

MOGANBO IRRIGATION PROJECT

APPENDICES, VOLUME 2 PART IV

INFRASTRUCTURES

Introduction

1 An outline policy for the improvement of transport conditions in the vast territory of Somalia with its sparse and predominantly nomadic population and its different geographical zones, each of which has a distinct pattern of domestic and foreign trade, is a subject requiring special attention. Any evaluation of an appropriate scale of public investment depends on changing circumstances, and a balance must be struck with other (e.g. social) requirements involving investment that is not directly renumerative (administration of agricultural services, education, health) and public investment in other infrastructure projects (rural and urban water supplies).

2 A transportation system in any country serves at least two purposes: one is to move goods cheaply and another is to open up new areas and bring in new resources. High priorities are justified for the connection of productive land areas with local markets, or with ports, with a view to facilitating movement of livestock and crops and to bring equipment or goods to where they are needed. The rate as well as the amount of development will determine the amounts of road building necessary. A system of priorities can be set up so that the facilities that earn the most will be built first. Irrigation areas would take first consideration in this respect, because tonnages will increase as soon as the first crops are produced.

3 The general guidelines adopted in the present approach are given below. The transport and communications sector was taken as an instrument for formulating a set of economic projections, which were then used to establish targets for the following sectors of the economy:

(i) Agricultural crops sector: The transport system must permit the shipping of agricultural products during both the rainy and dry seasons and provide for the delivery of agricultural inputs and mechanical equipment to farm units.

(ii) Livestock sector: The main transport characteristics necessary are an easy access to the main markets and export centers, and flexible distribution throughout the region.

(iii) Housing sector: Villages should be so located as to require only a reasonable walking distance for workers to travel to their work site.

I TRANSPORTATION

A - Existing State

Institutions

4 The main responsibilities of this sector are assumed by four Ministries: the Ministry of Public Works; the Ministry of Transport; the Ministry of Fisheries and Maritime Transport, and the Ministry

of the Interior, which is responsible for road traffic control and regional coordination. Some public agencies are also connected with road transport, e.g. the National Agency for Foreign Trade (ENC) and the Agricultural Development Corporation (ADC), which are involved in marketing.

Somalia

5 The main features of the transport sector in Somalia are:

(i) A road network which functions fairly well following extensive development during the 1971-73 Plan, but which is subject to improvement;

(ii) An air transport system which is still in its initial stages, but has good prospects;

(iii) A sea transport system wherein coastal shipping is almost nonexistent, and

(iv) No railroad or inland waterway transportation.

6 Tables IV-1, -2, -3 and -4 provide an outline of sea and air movements. As will be noted, the latter almost exclusively concerns passenger traffic. Less than 0.1% of the country's foreign trade is shipped by air.

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MOGANBO IRRIGATION PROJECT

Table IV-1

Somali Airline Traffic

	1972	1973
Passengers (no.)	27,524	30,355
Passenger kms	17,732,233	19,522,645
Tons of freight	380	388
Tons-kms	316,186	281,295

Table IV-2

Traffic at Mogadishu Airport

	1972	
	Arrivals	Departures
Passengers	10,400	9,700
Freight (tons)	940	260

SOMALIA

MOGANBO IRRIGATION PROJECT

Table IV-3

Passenger and Freight Movements

at Main Somali Seaports

(Average of 1970, 1971 and 1972)

	Berbera	Mogadishu	Merka	Kismayu	Total
Freight loaded 1000 tons	165	25	48	79	317
Freight unloaded, 1000 tons	84	199	9	31	322
Passengers embarking	1798	52	73	131	2054
Passengers disembarking	2139	54	57	128	2378

Table IV-4

Movements in 1973 and 1974

at Kismayu Port

(tons)

	1973	1974
Imports	36,985	38,140
Banana exports	66,028	69,264
Other exports	22,695	5,176
Total exports	88,723	74,440
Shipping movements	173	126

Review of Government Transport Policy

7 The Government of Somalia is using transportation as a tool for development, with a view to opening up new areas, promoting goods and people movements throughout the country, and establishing efficient and reliable communications both within Somalia and with the rest of the world. Official transport fares are kept at a rate valid throughout the country while the prices of gasoline and diesel oil are maintained at reasonable levels.

8 It is the Government's opinion that the bulk of internal goods transport should be done by private road hauliers and that goods and passenger flows should be kept separate. The transportation of government goods is controlled; government has succeeded in enforcing the established procedure by allocating contracts through the Ministry of Transport but it has been unsuccessful in enforcing the tariff laws. Attempts to exercise some control on the transportation of private goods by establishing a nationwide trucker cooperative have not been successful.

9 The existing primary road network is largely focused on the main towns with a particular

concentration on Mogadishu. There are few all-weather roads of intermediate or secondary level and the feeder road network is made up largely of dirt tracks passable during the dry seasons only. Large areas of Somalia therefore have very poor links with other parts of the country.

10 The 1971-73 Development Plan placed great emphasis on the construction of communications and transport infrastructures. Construction began on the Belet Wein - Bura arterial highway and on the Hargeisa-Berbera road. The Afgoi - Baidoa road and resurfacing of the Jowhar-Buto-Burti roads were completed. Many feeder roads were built through self-help action. Finally, the construction of Kismayu airport and works on Mogadishu Harbor were started.

11 The 1974-78 Plan foresees the building of 1711 kilometers of paved roads and the improvement of some 140 kilometers. Projects include a major north-south link between Mogadishu and Bosasso through the northern regions, which should contribute a great deal to ease of movement between north and south Somalia. The Plan also envisages an

MOGANBO IRRIGATION PROJECT

Investments Made or Planned in the Communications Sector
During Various Development Plans (in millions So. Sh.)

Plan	Road Construction Investment Pl*	Ac*	Port Construction Investment Pl	Ac	Airport Construction Investment Pl	Ac	Total Investment Pl	Ac	Communications Investment as % of total Plan Investment
1963-67	210	--	146	--	54	--	410	--	30.7
1968-70	197	132	145	40	12	1.3	354	173.3	53.9
1971-73	195	72.5	76	32	21	16	292	120.5	35.3
1974-78	686	--	133	--	28	--	847	--	24.5

*Pl, planned; Ac, actual

TABLE IV - 6

ROAD CONSTRUCTION IN SOMALIA (km)

Year	Asphalted	All-weather Non-asphalted	Dry Weather	Total
1963	600	2400	9000	12000
1968	860	3000	11000	14860
1971	915	4000	12000	16915
1974	1500	4000	13000	18500

intensive program of feeder roads construction with a view to gaining maximum returns from the large investments in roads development. Table IV-5 summarizes the investment situation in the transport and communications sector as conceived in the various National Plans made since 1963, while Table IV-6 indicates the lengths of roads completed at the end of the various Plan periods.

Juba Valley

12 The roads situation in the Juba Region reflects the relative isolation that the region has experienced in the past. There are very few stretches of roads of international standard, whether paved or well graveled (coral surfacing), and there are no roads of intermediate standard. The 1974-78 Plan provides for the construction of the Gelib-Golwein road, while the paved Arara-Giamama-Kamsuma road and Kismayu Airport, inherited from the previous Development Plan, have already been completed.

Major Roads (Figure IV-1)

13 The principal road links gravitate towards Kismayu. The three major arterial roads of the region are the following:

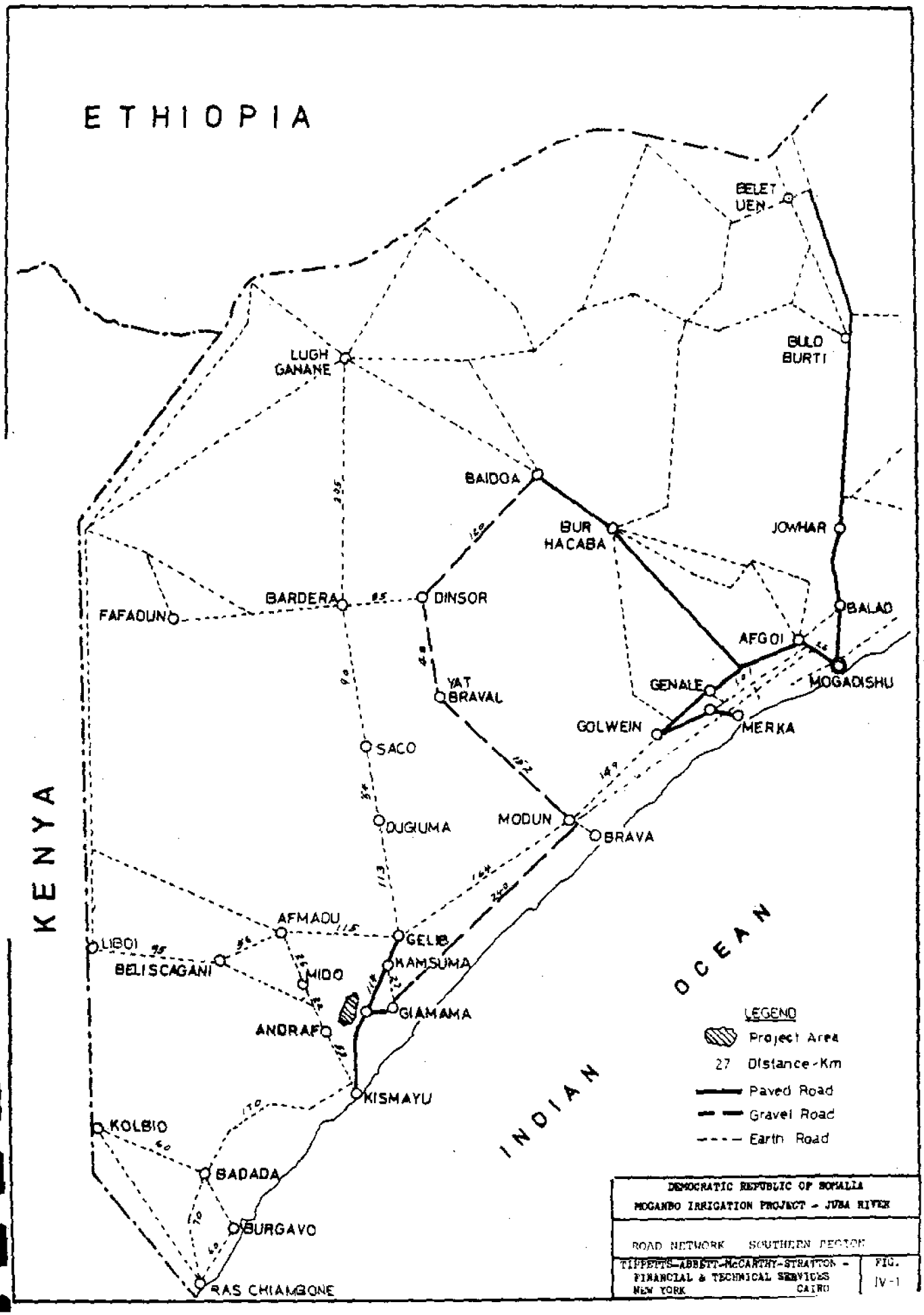
(a) Kismayu-Gelib, which is asphalted up to the fork where one road, actually a track, proceeds to Bardera and beyond to Lugh and Dinsor, while the other passes through Shabelli flood plain to Mogadishu, the latter generally not usable during wet seasons;

(b) Kismayu-Afmadu-Liboi (Kenya Border);

(c) Kismayu-Badada-Ras Chiamboni (Kenya Border on the coast).

These are the basic elements of the network. They are linked by a network of feeder roads -- no more than tracks -- which provide access to the areas crossed by the main roads, generally in the dry season only.

14 The Mogadishu-Gelib-Kismayu-Afmadu-Liboi route is by far the most important route from the point of view of international communication, as it can be considered as an adjunct to the Trans-Africa Highway. Since there are no settlements of any importance in the hinterland of Kismayu, the function of the major arterial system is to carry the scanty, long-distance traffic from Kismayu to destinations in Kenya, Ethiopia, or the northwest part of Somalia. One of the more important secondary


ETHIOPIA
KENYA
INDIAN OCEAN
BELET UEN
BULO BURTI
LUGH GANANE
BAIDOA
BUR HACABA
JOWHAR
BALAD
MOGADISHU
BARDERA
DINSOR
FAFADUN
AFGOI
YAT BRAVAL
GENALE
GOLWEIN
MERKA
SACO
DUGIUMA
MODUN
BRAVA
AFMADU
GELIB
LIBOI
BELISCAGANI
KAMSUMA
MIDO
GIAMAMA
ANDRAFI
KISMAYU
KOLBIO
BADADA
BURGAVO
RAS CHIAMBONE
LEGEND
Project Area
27 Distance-Km
Paved Road
Gravel Road
Earth Road
DEMOCRATIC REPUBLIC OF SOMALIA
MOGAMBO IRRIGATION PROJECT - JUBA RIVER
ROAD NETWORK SOUTHERN REGION
TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES NEW YORK CAIRO
FIG. IV-1

roads is the Arara-Giamama-Kamsuma road which serves for the export of bananas from the areas on the left bank of the Juba River.

15 The Gelib-Bardera road is very important because it carries agricultural products (bananas and sesame seed) from the irrigated lands on the two banks of the Juba River, both in the lower reaches near Kismayu and further upstream in the region of Bardera, to the port of embarkation at Kismayu. The Bardera-Dinsor route (90 km) is a track connecting the high and middle Juba Valley with Baidoa and Mogadishu and is also of primary importance.

Road Characteristics

16 The pavement structure of all the roads, except the Kismayu-Gelib link (about 120 km) and between Arara and Giamama (13 km) are earth roads, 6 to 7 meters wide. In general, both the primary and secondary roads are devoid of all structures. In many places, the road surface lies in a shallow trough below the level of the natural ground, and becomes a veritable watercourse in the rainy season. Under the present circumstances, in fact, all the inspected roads are normally closed to traffic for

periods which vary from two weeks to three months during the wet seasons. Table IV-7 gives the main characteristics of the road network in south Somalia.

B - Proposed Improvements, Juba Valley

17 For better understanding, detailed data are needed on the following points:

(i) Population: A demographic study on the future features of population aggregations and social structures, and forecasts of future population structures and occupations in the whole area relevant to the project;

(ii) Settlement structure: A study of a distribution model of the population in urban centers of various dimensions; study of town planning models for the creation of urban settlements as a function of the future population aggregations; temporary and final housing types;

(iii) Regional planning: Covering the location of urban centers and the definition of their areas of influence; land-use destination; definition of functional poles; general infrastructures planning.

TABLE IV - 7

SOMALIA

MOGANBO IRRIGATION PROJECT

SOUTHERN REGION ROAD NETWORK, MAIN LINKS AND SPECIFICATIONS

Link Name	Construction			Condition[1]	km Length	Average speed (Km/h)	Travel time (hours)
	Paved	Coral	Earth				
Bardera - Dinsor	-	-	X	poor	90	30	3.00
Bardera - Gelib	-	-	X	poor	290	30	9.67
Dinsor - Yat Braval	-	X	-	good	48	60	0.80
Kismayu - Gelib	X	-	-	good	115	80	1.44
Arara - Giamama	X	-	-	good	13	80	0.16
Giamama - Kamsuma	-	-	X	fair	25	40	0.63
Afmadu - Beles Gogani	-	-	X	poor	56	30	1.87
Kismayu - Lac Badana	-	-	X	poor	79	30	2.63
Lac Badana - Badada	-	-	X	poor	93	30	3.10
Dinsor - Baydhaba	-	X	-	good	120	60	2.00
Giamama - Brava	-	-	X	poor	340	30	11.33
Gelib - Modun	-	-	X	fair	163	40	4.10
Kismayu - Sunguni	-	-	X	poor	75	30	2.50
Andraf - Bulogadud	-	-	X	fair	30	40	0.75

[1]Note: "poor": cannot be used at all times; "good": all-weather road; "fair": cannot be used at all times, but better than "poor."

18 Generally, the following should be taken into consideration:

(i) The development of administrative control of the country, the creation of new wells and the extension of health care, have all brought about the need for a faster and more manageable road transport system than the existing one, consisting of a network of tracks but which is gradually expanding. Under present conditions, it can be said that roads play a marginal role in the lives of nomadic peoples, who continue to travel extensively, according to their economic necessities. It seems fair to predict that, in the near future, nomads will adapt to the extending road network. They will find it easier to trade their goods in the towns along the roads, and will probably tend to market more animals with better results than with the present system.

(ii) In the traditional sector of agricultural activities and trade, transportation will play a greater role than ever before. Somalia is still lacking in road construction and is lagging behind many countries at a similar level of development.

(iii) Air transport is still in its infancy in terms of traffic volume. Few people are able to travel exclusively by plane. Air transport is still a tool for accessibility only, but might have a greater share in the development of Somalia in the future when its capacity is extended.

(iv) Maritime transport, for domestic communications, is used mainly to supply the people along the coast with the basic necessities. Service is irregular and coastal shipping is actually almost nonexistent.

19 The establishment of new agricultural zones such as those of the Trans-Juba Livestock Development Project, the Multi-purpose Cattle Ranch at Gelib, the Juba Sugar Project and the Fanole Irrigation Project, will create new centers that will start a "push-and-pull" action in the area under the influence of the new activities. It is therefore necessary to reconstruct the existing road network of the area and to increase the level of service of these roads. Table IV-8 shows which links should be reconstructed or otherwise improved.

SOMALIA

MOGANBO IRRIGATION PROJECT

Table IV-8

Road Construction for Future Needs

Link Name	Length km	Present road condition	Future road condition
Kismayu - Andraf	53	Poor earth	Good paved
Andraf - Mido	22	" "	" "
Mido - Afmadu	26	" "	" "
Afmadu - Gelib	115	" "	" "
Gelib - Modun	164	" "	" "
Modun - Gulwein	149	" "	" "
Merka - Brava	125	" "	" "
Brava - Giamama	240	" coral	" "
Giamama - Kamsuma	27	" earth	" "
Kismayu - Kamsuma	76	Good paved	" "
Brava - Yat Braval	152	Good coral	" "
Yat Braval - Dinsor	48	" "	" "
Dinsor - Baidoa	120	" "	" "
Ras Chiamboni - Badada	70	Poor earth	" coral
Ras Chiamboni - Burgavo	60	" "	" "
Badada - Kismayu	170	" "	" "
Afmadu - Beliscagani	56	" "	" "
Beliscagani - Leboi	95	" "	" "
Gelib - Bardera	257	" "	" "

C - Project Roads

20 The proposed project site is located on the right bank of the Juba River. It is about 15 km long, about 5.5 km wide, and oriented roughly north-south. The adjacent villages are Koban on the south and Moganbo and Bulo Yag on the north. The area would comprise four villages plus a central, or headquarters village.

Road Planning Concepts

21 In the proposed study, the fundamental concepts for the project roads were considered on the basis of the following points:

(i) A relatively high speed paved road joining the headquarters village with two worker villages and with the paved highway from Kismayu to Gelib: this would ensure the transportation of crops and movement of livestock rapidly to markets and shipping ports as well as facilitate interior movement and communications.

(ii) In order to have the best use of rights-of-way, it is planned to use the water delivery side of canals as road surfaces by widening the bank to 6 meters. Roads should also be within

drain rights-of-way. This helps to minimize the area used for roads and would provide accessibility to all parts of the site

(iii) The cropped areas of the project would be reached by earth roads of 3 meters width.

(iv) In general, all service roads in the project area are planned to be coral surfaced. The high speed road joining the headquarters village with villages II and III would have a paved surface.

(v) The study shows also that it is economical to use the existing flood dike as a base for the high speed road. It would be a service road through Blocks F and D.

(vi) Ring roads were planned on the circumference of the villages, linking them with either the high speed road or with the service road network. This would ensure a good system of transportation for laborers within the area and outside of it.

22 Attached Figure IV-7* shows a plan for the preliminary layout of the service road system.

* Sleeve at end of volume

Construction Phasing

23 The construction of the project would be phased as follows:

Project Year II	covering	400	ha	in	Block	A
Project Year III	"	570	"	"	"	A-B
Project Year IV	"	940	"	"	"	B and C
Project Year V	"	1215	"	"	"	D and E
Project Year VI	"	1665	"	"	"	F and G
Project Year VII	"	1470	"	"	"	G and H

According to this plan, construction of the corresponding road network and other infrastructure would be tied to the construction of the irrigation system.

Construction Methods and Materials

Recommended Standards

24 A total of 98 kilometers of coral-surfaced roads have been planned to give access to all parts of the project area. The roadways would be 6 meters wide with 0.75 meter shoulders. They would be constructed of graded crushed coral. The construction of this type of road does not present any particular problems in flat areas where the construction work consists of clearing and grubbing, grading, compaction and digging of lateral interception channels that will also provide material for a low embankment on which to place the surfacing. In addition to the surfaced road system, earth stretches would be provided along the sides of the planting areas to give sull access to all parts of the project area. They should be passable for most of the year except after heavy rain storms, so regular maintenance would be essential to prevent the formation of deep ruts.

Design Criteria

25 A number of design criteria, such as minimum curve radii, sight distances, grades, etc. have been determined. The design criteria include horizontal alignment and vertical profile according to established standards while construction criteria refer to bearing capacities, equivalent thickness, and choice of pavement structure. Table IV-9 shows a preliminary proposal for roads design, with the main criteria such as design speed, minimum radius and maximum grade in percentage.

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MOGANBO IRRIGATION PROJECT

Table IV-9

Preliminary Road Design Proposal

Description	Coral Road
Road width (in meters)	6.00
Shoulders width (meters)	0.75
Design speed (km/hr)	50
Minimum radius (meters)	80
Maximum grade (%)	7%
Pavement surface	crushed coral

Surfacing Characteristics

26 The choice of surfacing, i.e. coral road, has been based on technical and economic considerations. The composition of the surface should be designed to meet the technical demands at the lowest possible cost. Consequently, for the base course, two different gradings of the granular material (to be obtained almost exclusively by crushing coral) may be used with maximum particle sizes of 60 mm. For the sub-base course, in those areas where natural materials have little or no plasticity and have an appreciable gravel fraction (CNR of about 10), it is proposed to improve the grading of the materials by adding crushed coral from quarries, graded to supply the missing fraction. A hydraulic binder of lime should be used to stabilize road crossing sils and silty clays with a variable sand fraction (CBR of 5).

Table IV-10

Unit Cost Estimates and

Schedules for Roads Construction

Item	Estimated Cost So. Sh.
1) Clearing: Clearing, grubbing and removal of stones, trees and shrubs an a width of 10 meters	5.00 per m^2
2) Grade Preparation: Leveling, shaping, rolling, compacting, building area 10m wide to 85% modified Proctor density	10.00 per m^2
3) Embankment:	
a) Common embankment fill construction including shaping, compacting to 95% modified Proctor density	7.00 per m^2
b) Select embankment fill construction (sub-base) including shaping and compacting to 95% modified Proctor density	20.00 per m^3
4) Rock Excavation	
a) Small quantity rock excavation, including blasting for roadway and ditch disposal	30.00 per m^3
b) Large quantity rock excavation, including blasting for roadway and disposal as road fill	25.00 per m^3

Table 10, page 2

Item	Estimated Cost So. Sh.
5) Ditch Excavation: Ditch excavation for special ditches to intercept or carry away drainage water	10.00 per m^3
6) Dike construction: Dike construction including the building of spurs and embankments to intercept or divert drainage water	9.00 per m^3
7) Stabilized base course: Stabilization of 10 to 15 cm (sub-base in lime)	145.00 per m^3
8) Crushed stone base course: Crushed stone base course including the processing of gravel, transporting, spreading and compacting on select embankment fill	125.00 per m^3
[9] [On basis of 30 cm thickness, estimated cost is 118 per m^3]	
10) Culvert installations: These items cover the furnishing, transporting and placing of corrugated metal pipes and preparation and pouring of concrete for reinforced concrete slabs and culverts:	

Table 10 page 3

Item	Estimated Cost So.Sh.
10), cont. Culvert installations	
.....	
(a) Corrugated metal pipes with diameters 1 to 2 m:	
1 m dia.	140.00 per m
2 m dia.	350.00 per m
(b) Concrete slab and box culverts	762.00 per m^3 concrete
11) Rip-rap: Rip-rap for stream protection at culverts and bridges along slopes and diversion dikes	36.00 per m^3
12) Submergible bridges: The hand-laid rock, sand bedding, crushed stone, and grouting to build the tug crossings	150.00 per m^3
13) Concrete bridges: Foundation and superstructures of concrete bridge structures:	
(a) Simple-span, reinforced concrete slabs, spans up to 10m	1130.00 per m^2 deck surface
(b) Simple span beam and slab reinforced concrete bridges with spans up to 20m	1355.00 per m^2 deck surface
(c) Long span bridges over 20m span length	1570 per m^2 deck surface

Table 10 page 3

Item	Estimated Cost So.Sh.
14) Preliminary and General Items	
(a) Contractors' camp facilities	
(b) Camp operation	
(c) Contractors' move-in and move-out of project	
15) Engineering Costs	
(a) Engineering design and supervision fee	
(b) Resident engineer and staff payroll and overhead allowance	
(c) Resident engineer and staff travel and expenses	
(d) Housing accommodation for resident engineer and staff	
(e) Office accommodation for resident engineer and staff	
(f) Laboratory for engineers	
(g) Food services for resident engineer and staff	
(h) Vehicle for resident engineer and staff	
(i) Vehicle operator for resident engineer and staff	
The estimate used to cover these Engineering items and an allowance to cover contingencies is 23% of the estimated construction cost.	

29 From the above Unit Cost Estimates, a rough estimate of costs for a completed road can be presented as follows:

Table IV-11

Unit Road Costs

	SoSh.
(a) Coral roads 6m wide with 0.75m shoulder width	100/meter
(b) Village roads (streets), constructed from components:	
i) earth filling 30 cm thick	13/m^2
ii) hardcore base stone 20 cm thick	25/m^2
iii) coarse aggregate and fine	12/m^2
Total cost/m^2	50/m^2

The village roads (or streets) should occupy about 3% of the total village area.

Note: The survey team found deposits of materials suitable for road building purposes under one meter overburden on the project site. These may be large enough for the needs of the project and would reduce road-building costs.

Maintenance

30 Routine and periodic maintenance should be carried out to keep the project network serviceable. The maintenance operations have been described as follows:

> Routine maintenance would concern patching, main surface reshaping, mowing and roadside care, while periodic maintenance would involve some improvement works about every 5-6 years.

II PROJECT VILLAGES

Introduction

31 In addition to the system of transportation facilities which are provided for people and goods within the project area and with other areas, it is necessary to plan for other infrastructures which are needed to ensure the successful implementation and subsequent operation of any plan for irrigated agricultural development. As a matter of fact, the economies of rural areas grow slowly; they depend mainly on agricultural production, and climatic conditions and topography are the main factors affecting crop quantity and quality. Rural life, in general, is static; this is reflected in the traditional living conditions and existing services. Furthermore, the demographic structures of rural areas differ from those of urban areas. In developing countries, land reclamation is one of the vital approaches towards a dynamic development of these economies as it provides food to answer both human and animal needs. Whenever new social patterns must be created or encouraged, comprehensive planning

is necessary to create a healthy environment in which development programs may succeed and bring maximum benefits to a country.

32. The population structure of the project area is described in Working Document IX, along with a listing of the existing social infrastructures. These cannot be expected to answer project requirements, so account must be taken of the need to build and operate schools, clinics and mosques for the project villages.

33. The Moganbo Irrigation Project would require about 2533 laborers, machinery operators and staff to operate properly. It is recommended that four small worker settlements as well as an administrative or headquarters village be built to accomodate them. The maximum distance between the central place of each village would not be more than 3 km from any working area assigned to that village.

34 It is estimated that a total of 10,000 to 15,000 inhabitants would live in the proposed four villages plus the headquarters village. On this basis, the following village plan has been established.

Table IV- 12

Project Village Plan

Village	Area (ha)	No. of Inhabitants
Headquarters	90	1500
Village I	70	2300
Village II	75	2300
Village III	64	2000
Village IV	62	2700
		10,800

35 Housing would be provided through the project but other infrastructure including five mosques, five schools, a hospital and four clinics should be provided by the appropriate national agency. A rough estimate of cost for these facilities is SoSh. 6,920,000. They would not all be required in one year but could be scheduled for completion along with the completion of each of the five villages.

A - Village Design

Planning Criteria

36 Environment has a great impact on social structures and villages are very sensitive organs that must be studied and planned with special care. The most important factors to be considered in village

planning on the project area are:

(a) Physical factors, such as topography, soil conditions and canals used as roads to and from the village and other places of interest;

(b) Cultural and social factors, i.e. the traditions and social ways of living that have shaped deep family relations within villages, and types of life-styles;

(c) Economic factors, i.e. the need to cultivate every bit of good land, which has led to the building of houses that were often small, insufficient, or less than commodious, and

(d) Security factors, such as freedom from floods, theft and cattle poisoning, whose importance are clearly reflected in the round shape of the villages and in the narrow street patterns.

37 The plan of the project villages, their shape and building materials, were determined using the following basic considerations:

1. The shape of the land, its levels, dimensions and directions;

2. The relationship of the project area with the neighboring agricultural land and the limits of its area;

3. The relationship of the project area with the main roads, public transportation and communications;

4. The direction of prevailing winds;

5. The rainy seasons, their duration and amounts;

6. The characteristics of the site, its soils, degree of drainage and absorption of water;

7. Temperature and humidity characteristics;

8. Population numbers and relationships with the surrounding areas and districts;

9. The planned capacity of the village(s);

10. Drinking water resources from canals or artesian wells or cisterns, etc.;

11. The attitudes of the farmers regarding animal wealth and attitude toward services offered at centers, or by extension;

12. The characteristics of the building materials and methods of construction; available local materials in the area, the resistance of these materials to insects, climatic conditions, etc.

Description of villages

38 Based on estimated total personnel (staff, operators and labor) requirements for the project, which amounts to 2533 people, the headquarters village and four workers' villages have been planned as follows:

Headquarters Village

39 The headquarters village would be located beside the intake of the main canal and near the power plant and pumping station (attached Figure IV-7). In addition to necessary housing it would include project offices, a central hospital, post office and police station. Other project facilities include a central warehouse for seed, fertilizer, equipment, spare parts and general stores. A project machinery maintenance shop and fuel storage facility would also be provided in the headquarters village. Since training of personnel is vital to efficient management and crop production, a training center should also be located in the headquarters village. This would be the only village provided with full utilities including electricity and telephone in addition to running water and sewers. Communications between this and other villages would be by radio.

Housing

40 Four types of housing have been planned to satisfy all requirements and these would be provided through the project.

(i) Type A: A first-class dwelling composed of sleeping quarters, reception, living space, kitchen, bathroom and front and back yard, as in Figure IV-3. Only six of these units should be built and they should all be in the headquarters village.

(ii) Type B: This type of house should be provided to the skilled staff at the headquarters village, to each of the village managers and to the feedlot manager, veterinary and animal husbandry experts in Village V. These houses would have three rooms, a kitchen and bathroom (Figure IV-4).

(iii) Type C: These houses would be for foremen and other key personnel. They would have two rooms, a kitchen and a bathroom (Figure IV-5). About 190 of these houses would be required in the various villages.

(iv) Type D: The dwellings for the labor force would consist of two rooms, a cattle shed, a courtyard and a storeroom. They would be built in groups of

20 units each (Figure IV-6). About 1880 of these houses would be required.

41 Each village would be supplied with fresh clean running water, sanitary facilities and drainage. Local building materials should be used insofar as is possible in terms of durability and economy. The breakdown of housing needs by village is shown in Table IV-13.

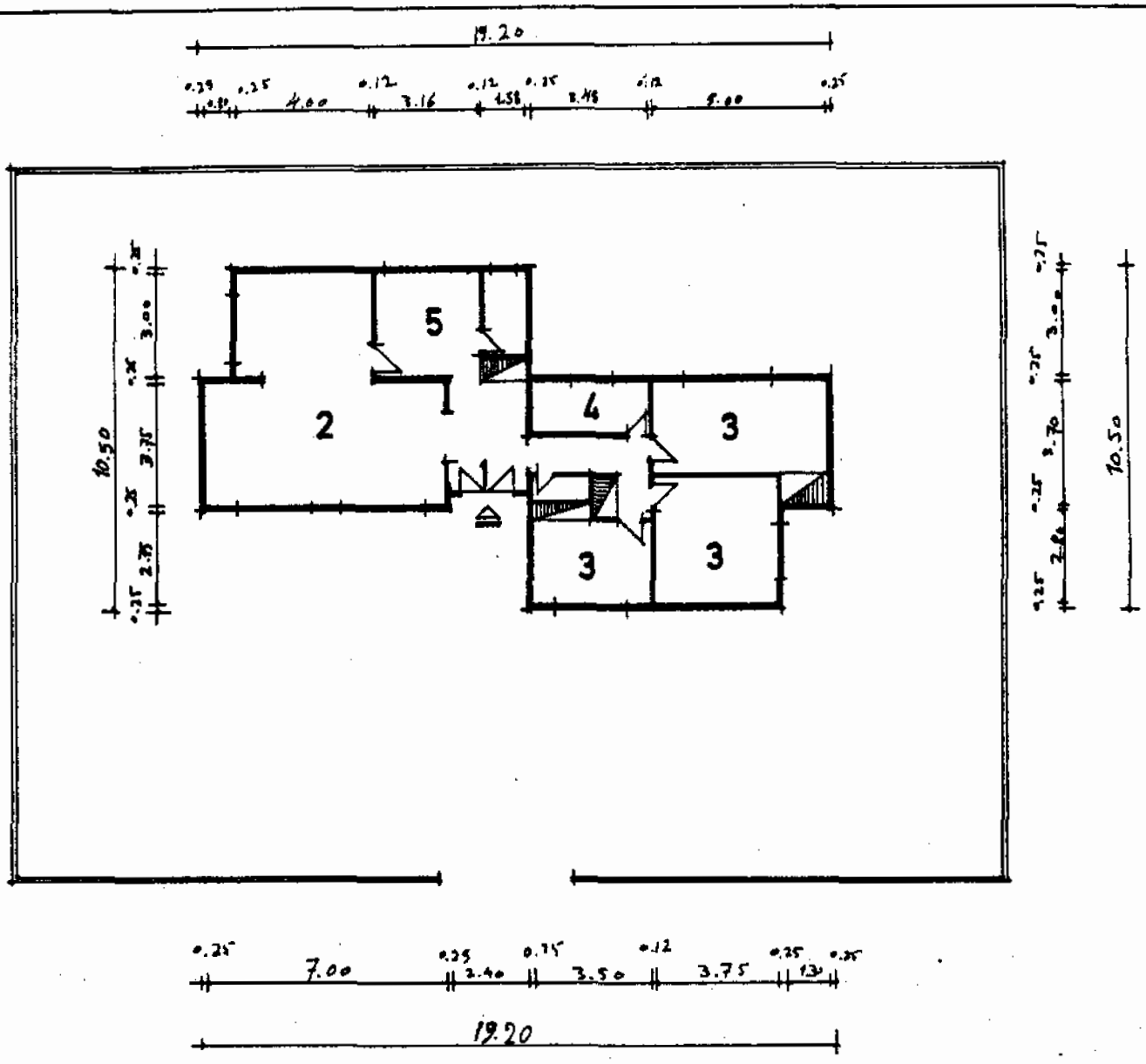
Table IV-13

Village Housing Requirements

	Type A	Type B	Type C	Type D	Total Population
Headquarters Village	6	3	50	225	1500
Village I	-	1	35	412	2300
Village II	-	1	35	413	2300
Village III	-	1	35	345	2000
Village IV	-	3	35	488	2700
Total:	6	9	190	1883	10,800

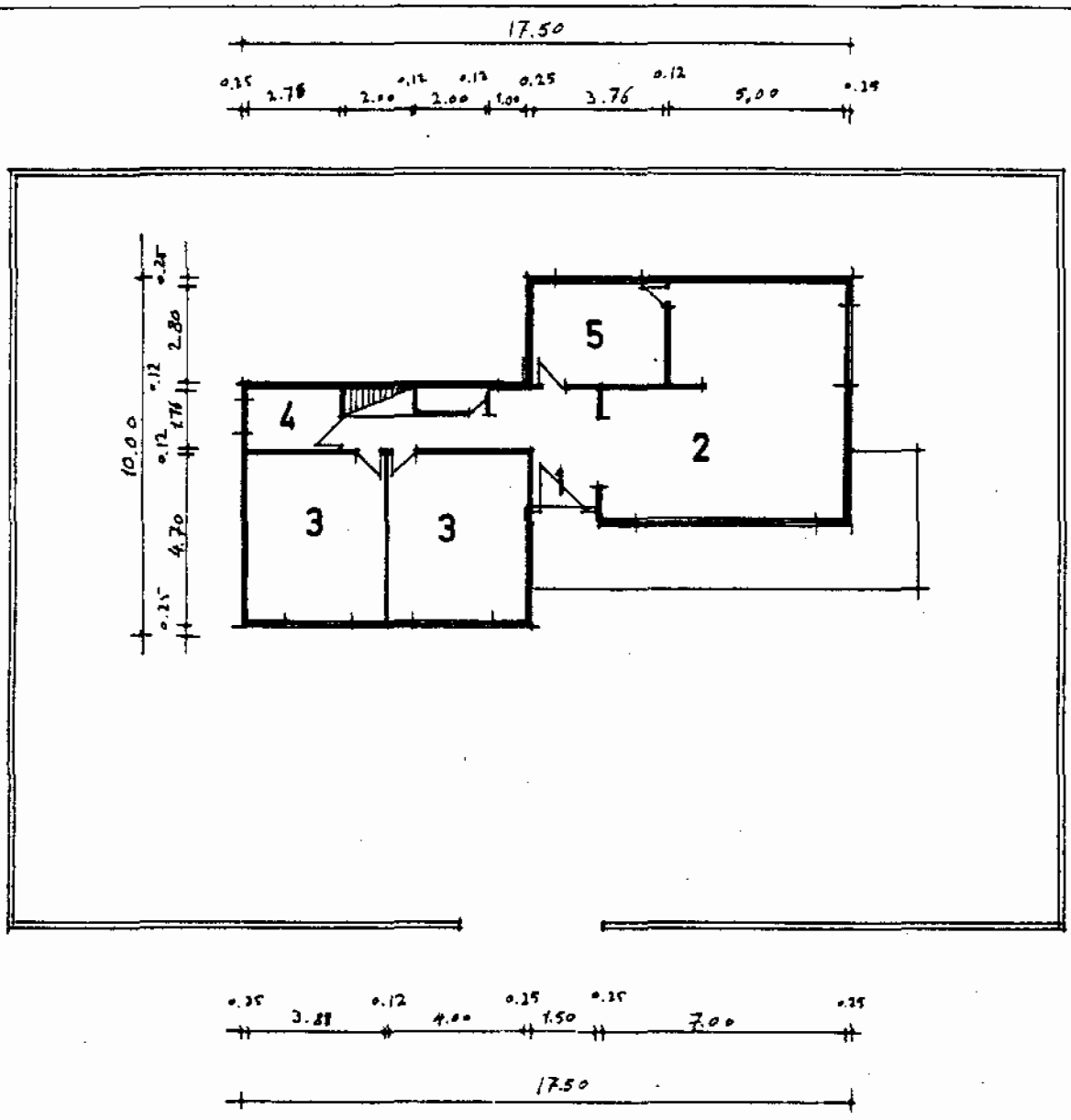
Crop Storage Facilities

42 Each village would have an enclosed and covered storage area where field production may be assembled and stored until shipped to its destination.



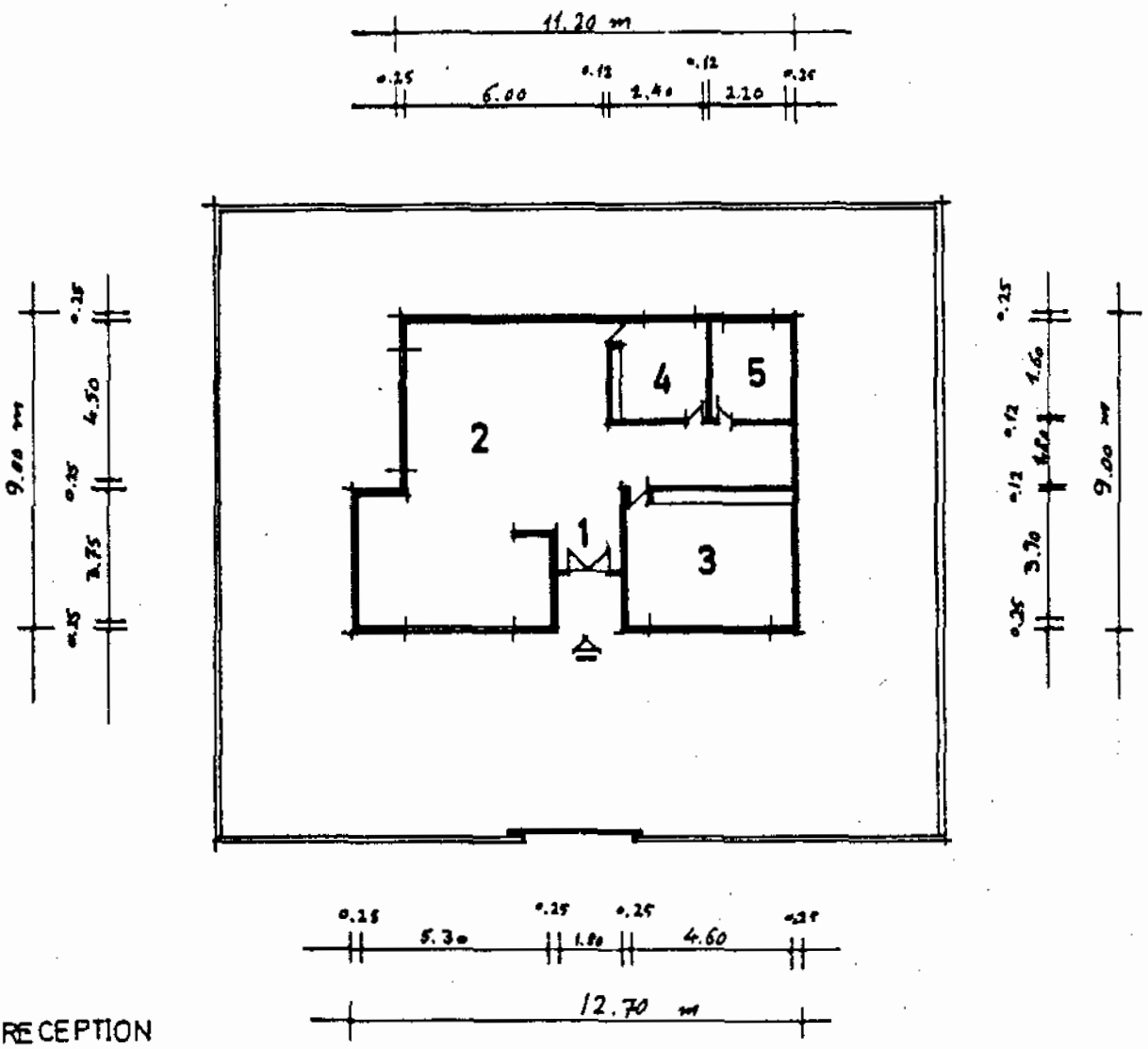
1. ENTRANCE
2. RECEPTION
3. BED ROOM
4. BATH ROOM
5. KITCHEN

DEMOCRATIC REPUBLIC OF SOMALIA MOGANBO IRRIGATION PROJECT - JUBA RIVER	
HOUSE : TYPE-A	
TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES	FIG. IV-3



1. ENTRANCE.
2. RECEPTION
3. BED ROOM
4. BATH ROOM
5. KITCHEN.

DEMOCRATIC REPUBLIC OF SOMALIA MOGANBO IRRIGATION PROJECT - JUBA RIVER	
HOUSE: TYPE B	
TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES NEW YORK CAIRO	FIG. IV-4



1 RECEPTION

2 LIVING ROOM

3 BED ROOM

4 KITCHEN

5 BATH ROOM

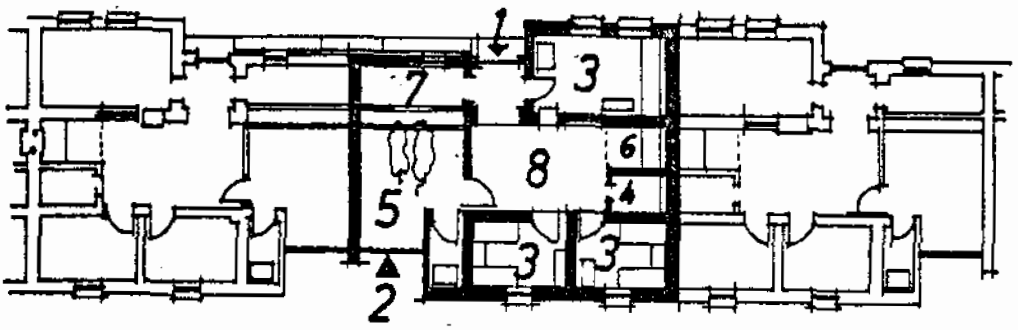
DEMOCRATIC REPUBLIC OF SOMALIA

MOGANBO IRRIGATION PROJECT - JUBA RIVER

HOUSE: TYPE C

TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES
NEW YORK CAIRO

FIG. IV - 5



1 ENTRANCE OF THE CLEAN PART

2 ENTRANCE OF UNCLEAN PART

3 ROOMS

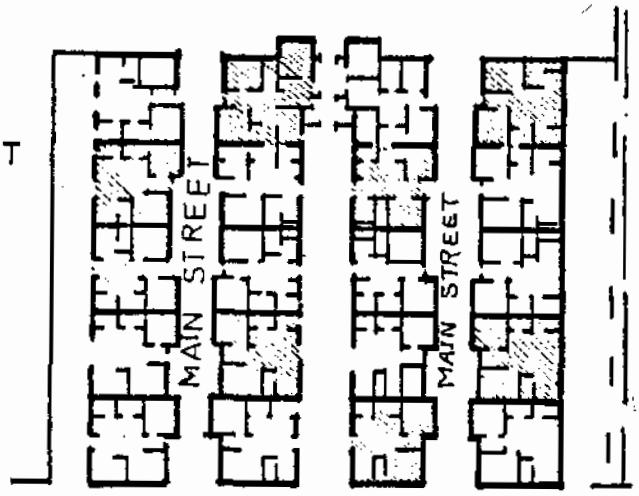
4 STORE

5 CATTLE PEN

6 LATRINE

7 CHOPPED STRAW

8 COURTYARD



ONE CLUSTER OF 20 UNITS
FOR 20 FAMILIES

DEMOCRATIC REPUBLIC OF SOMALIA MOGANBO IRRIGATION PROJECT - JUBA RIVER	
WORKER HOUSING: TYPE D	
TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES NEW YORK CAIRO	FIG. IV-6

B - Social Services

43 In addition to housing, each village should have a mosque, a nurse's station, a primary school and a social center to be provided and operated by the appropriate national authority. The elementary schools would accomodate children of both sexes, be well oriented and centrally located, be constructed of sound materials and adequately equipped. The nurses' stations in the worker villages should deal with emergency needs, mother and child care and vaccinations.

44 Since the mosque is generally the cultural and social center of the village, it must be located near the center of the village overlooking the largest open space. It should contain a small public library. It should be built of good materials in a dignified style, and be provided with a fresh water supply.

C - Unit Building Costs

45 Table IV-14 shows the unit building costs for farm buildings, housing and social infrastructure. For estimating purposes, the unit costs, include contingencies (15%), engineering and supervision (8%) and overhead and administration (10%).

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Table IV-14

Unit Building Costs

Type A house	375,700	SoSh.
Type B house	205,000	"
Type C house	82,000	"
Type D house	1,360	"
Hospital (HQ)	1,230,000	" (1)
Nurses's station (Workers)	410,000	" (1)
Mosque (HQ)	410,000	" (1)
Mosque (Workers)	275,000	" (1)
School (HQ)	680,000	" (1)
School (Workers)	410,000	" (1)
HQ Warehouse	1,250,000	"
Workers village store	410,000	"
Machine shop (HQ)	1,250,000	"

(1) To be provided by appropriate national agency

46 Costs summaries, and by years of construction are described in Part IV hereafter.

III CONSTRUCTION SCHEDULE

47 Building of the infrastructure is closely associated with the development of the project. Work on these villages should start in Project Year II and continue as follows:

Project Year II, complete:

Headquarters Village: six type-A houses; three type-B houses; 10 type-C houses, and 50 type-D houses; streets, water supply and sewer.

Village IV: the three type-B houses; 10 type-C houses, and 50 type-D houses; streets and water supply.

Project Year III, complete:

Headquarters Village: 40 type-C houses and 100 type-D houses; machine shop and warehouse.

Village IV, no activity;

Village I, complete construction

Project Year IV, complete:

Headquarters Village, complete construction;

Village IV: add 50 type-D houses;

Village II: complete construction

Project Year V, complete:

Village III: complete construction

Project Year VI, complete:

Village IV: complete construction

IV COSTS

A. Capital Costs

48 Costs for the construction of the project roads and infrastructure are summarized in the following Tables IV-15 and IV-16. These costs include 15 per cent for contingencies, eight per cent for engineering and supervision, and ten per cent for overhead and administration.

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Table IV-15

Estimated Cost of Road System

by Construction Years

	Length km	Road type	Cost 10^6 SoSh.
Project Year II	43.75	Coral	5.98
Project Year III	19.40	Coral	2.65
Project Year IV	34.70	Coral	4.74
Total:	97.85		13.37

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Table IV-16

Estimated Cost of Infrastructures

Item	No.	Total, 10^6 SoSh. Amount	Local	Foreign
Type A House	6	2.25	1.13	1.12
Type B House	9	1.84	0.92	0.92
Type C House	190	15.58	7.79	7.79
Type D House	1880	2.56	1.28	1.28
Streets, sanitary	5	7.76	3.88	3.88
Office Bldg (furn.)	1	0.41	0.25	0.16
H.Q. Warehouse	1	1.25	0.63	0.62
Machine Shop (equip'd)	1	1.25	0.50	0.75
Village Storehouses	4	1.64	0.82	0.82
		34.54	17.19	17.35

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MOGANBO IRRIGATION PROJECT

APPENDICES, VOLUME 2

PART V

AGRICULTURAL CROPS

SOMALIA

MOGANBO IRRIGATION PROJECT

APPENDICES, VOLUME 2 PART V

AGRICULTURAL CROPS

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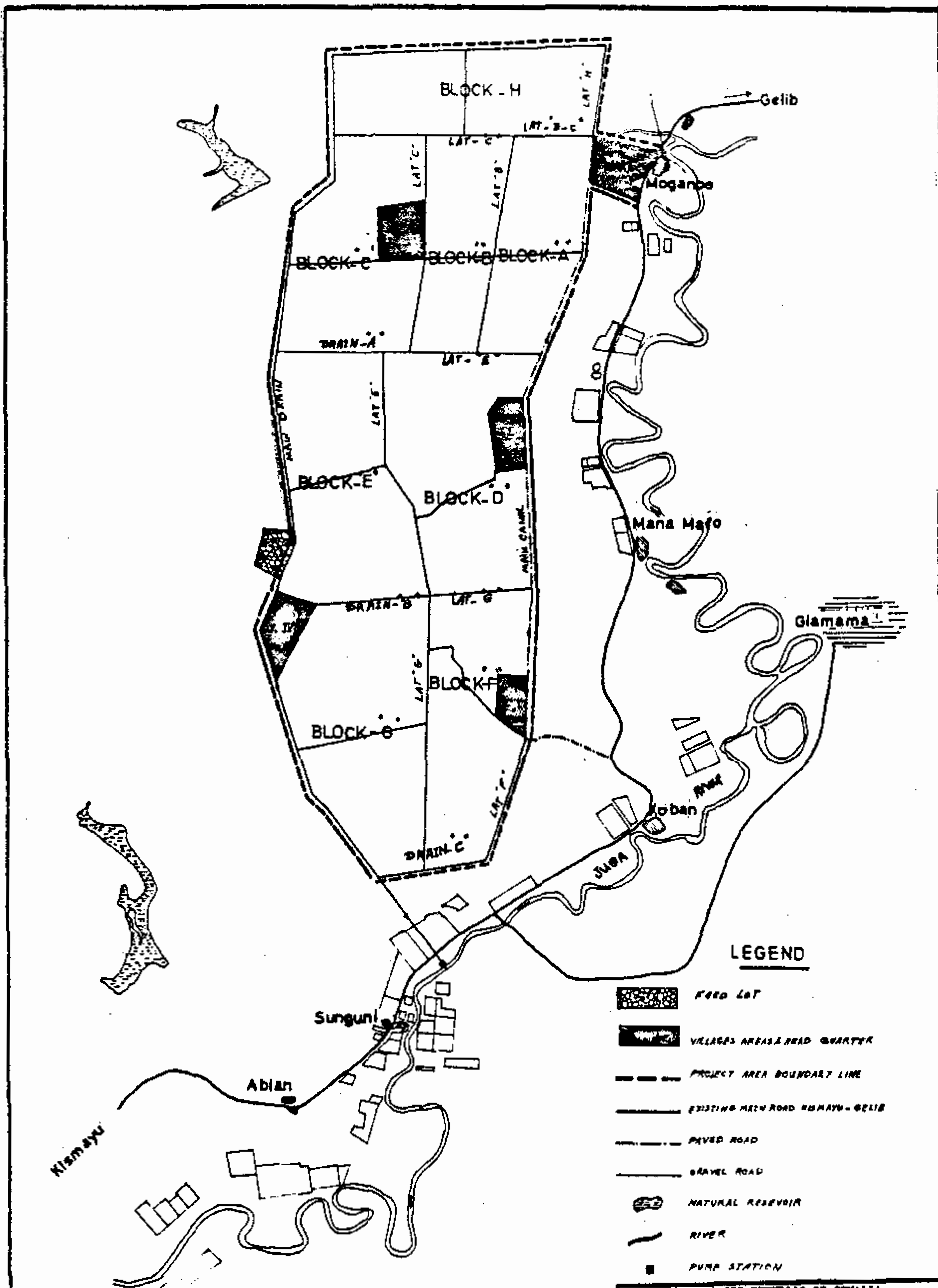

DEMOCRATIC REPUBLIC OF SOMALIA
MOGAMBO IRRIGATION PROJECT - JUBA RIVER

GENERAL PROJECT LAYOUT

TIPPETTS-ABBETT-McCARTHY-STRATTON - FINANCIAL & TECHNICAL SERVICES
NEW YORK CAIRO

FIG. V - 1

SOMALIA

MOGANBO IRRIGATION PROJECT

WORKING DOCUMENT V

AGRICULTURAL CROPS

Introduction

1 Agricultural production in Somalia is heavily dependent on the weather, especially rainfall, which is both low and irregular. About 12-13%, or 8 million hectares, of the national territory can be considered arable. Only 700,000[1] hectares or 9% are cultivated or in fallow; less than 50,000 hectares of these are under controlled irrigation and therefore free of the main constraint on agricultural production. Bananas and sugar cane are the only crops grown commercially under irrigation on a large scale. All other crops, such as maize and sorghum (the two main staple grains), sesame, groundnuts and pulses (legumes), etc. are grown under rainfed conditions or non-controlled (flood) irrigation, mainly for subsistence.

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[1] Ministry of Agriculture, Statistics, 1975

Food imports rank second only to imports of manufactured goods. Government planning goals place high priority on the development of agricultural crops production. The aim is to achieve self-sufficiency in food production as well as supply associated industries, and perhaps produce a surplus for export.

2 The strategy established for attaining these objectives is outlined in the 1974-78 Development Plan. The essential role of irrigation is recognized as the only means of assuring a reliable supply of moisture necessary for dependable year-round cropping. Emphasis is also placed on the part which state farms can play in development by permitting both the cultivation of large areas under irrigation, using mechanization and appropriate agricultural inputs such as fertilizers and pest control, and the concentration of available managerial and technical resources which are in extremely short supply.

3 The proposed Moganbo Irrigation Project has been prepared in this context. Maize, sesame, rice and pulses would be produced for human consumption,

mainly as import substitution crops, and cotton would be grown to replace current imports of lint for the national textile industry. Cotton seed could be used as a source of edible oil or an animal feed additive. A feedlot component geared towards export has been added to supply badly needed organic matter for enriching project soils. The fattening ration would be composed basically of forages grown to enrich the soil in nitrogen and of crop residues from the farm. Such integration of the project components, both within the sphere of the project itself and with the aims and needs of the country as a whole, is designed to secure maximum benefits from the land development effort to which the Moganbo Irrigation Project would contribute.

I EXISTING PRODUCTION

A - Rainfed Crops

4 The majority of Somalia's agricultural crops are grown under rainfed conditions with all the attendant problems found in a country where rainfall is both low and irregular. The main field crops are sorghum, maize and sesame, which the Ministry of Agriculture has estimated are grown on 55, 24 and 10%, respectively, of total cropped land (1975). Other crops grown on limited areas are wheat, cotton, groundnuts, rice, pulses, fruits and some vegetables. Crops are planted at the start of the Gu or Der rainy seasons (April and September, respectively). Intercropping is widely practiced. Agricultural methods are primitive and varieties are generally low-yield, local ones. Land preparation is minimal and there is very little or no fertilizer use or pest control. Somewhat better and more reliable crops are grown in the flood plain depressions (desceks) of the rivers in the south and on bunded lands in the northwest.

Sorghum (Sorghum vulgaris)

5 Sorghum is the main cereal crop and the basic staple food. There are two varieties, red and white, the latter being preferred. Somalia is considered self sufficient in sorghum in "normal" years when moisture requirements are met. Total area has been estimated to be about 800,000 hectares (two crops per year). Cultivation is largely confined to the rain-fed drier areas of Somalia, i.e. Upper Juba and parts of Hargeisa and Burao regions. The national mean crop area is 5.6 hectares. Cultivation practices are rudimentary and land preparation is generally limited to clearing and burning with little or no grubbing. Borers are the principal pests. No pest control or fertilization is practiced. Harvesting is done by hand. Stalks are left in the fields to be eaten by livestock or may be sold to village livestock owners. Yields are variable. The following table, compiled on the basis of the FAO Production Yearbook (1961-65) and the data elaborated by Technital for the Juba Valley Development Project for EEC (1972-75) shows a national yield varying between 500 and 650 kg per hectare. The mean national yield is nearer 400-450 kg/ha. Variety trials at Bonka (Baidoa) have given yields of 2.7 T/ha with good cultural practices.

Table V-1

Sorghum Harvested Area and Production

Year	Harvested Area (1000 ha)	Production (1000 M.T.)	T / ha
1961-65*	194	104	.536
1972**	282	165	.585
1973**	254	163	.642
1974**	260	160	.615
1975**	400	200(est.)	.500

Sources:

*FAO Production Yearbook; **Juba Valley Development Project, Technital SpA for EEC, 1976.

Maize (Zea mays)

6 Maize is the second grain crop after sorghum. Somalia is considered self sufficient in maize production in "normal" years. Maize yields are higher and it has a better market value than sorghum but it is more dependent on a fairly reliable rainfall, which is unpredictable in Somalia. It is grown in the wetter areas, mainly in the south near the coast, in Lower Juba, Benadir and Herai regions. Estimates of cultivated area are about 170,000 hectares. The national mean crop area is 1.79 hectares. The local varieties are low yielding and cultivation practices are rudimentary like those described for sorghum.

Several borer insects attack maize, the most important being Sesamia cretica and Sitolioga cerealella. Lack of suitable varieties, poor land preparation and little or no fertilization or pest control, result in low yields. Yields between 300 and 1000 kg per hectare, depending mainly on moisture availabilities, are recorded. Average national yield is reportedly slightly under 1000 kg/ha. The mean yield is 600 kg/ha. Experimental work has indicated a high response to varietal introduction and use of nitrogen and irrigation. Yields over 5.7 Tons per hectare have been obtained under field trials at Afgoi. The maize production in Somalia is shown in the following table.

Table V-2

Maize Harvested Area and Production

Year	Harvested Area (1000 ha)	Production (1000 M.T.)	T / ha
1961-65	106	102	.962
1972	157	153	.975
1973	166	164	.988
1974	170	165	.971
1975	170	165	.971

Sources: Idem.

Sesame (Sesamum indicum)

7 Sesame is the third field crop of Somalia after sorghum and maize. It is also the main oilseed crop, used to make a cooking oil which is preferred to other, less expensive vegetable oils. Cropped area reportedly increased a great deal since 1970 and is currently estimated at 70,000 hectares.[1] Yields vary from 250 to 300 kg per hectare from most plantings, to 500 kg/ha in descek farming and up to 1000-1200 kg under irrigation. The crop thrives on heavy soils capable of retaining moisture and an increasing portion is being irrigated. Farms are smaller than for maize and sorghum, land preparation is minimal, the local varieties yield poorly, and crops suffer greatly from pest and disease attacks, especially Antigastra catalaunis (Pyralid of sesame) and Fusarium oxysporium (wilt), though sesame is not susceptible to bird attacks. Experimental work has shown good response when improved varieties are introduced along with better cultivation practices. The economic returns on sesame tend to be lower than for groundnuts, Somalia's second oilseed crop, but farmers seem to find the harvesting task for sesame more manageable.

[1]Ministry of Agriculture, Statistics 1975.

Table V-3

Sesame Harvested Area and Production

Year	Harvested Area (ha)	Production (Tons)	Yield/ha (Tons)
1960*	30,000	8,600	.290
1961*	10,000	4,500	.450
1962*	15,000	4,500	.300
1972**	25,000	17,350	.694[?]
1975***	70,000	26,000	.380

*FAO, Report to the Govt. of Somalia No. 2088, 1965
**FAO, Country Development Brief-Somalia, 1973
***Ministry of Agriculture, Statistics, 1975

Rice

8 Some upland rice is grown. Total area was estimated to be about 410 hectares for all Somalia in 1974, with a yield of about 250 kg/ha. All proposed development of rice production is based on irrigation.

Cotton (Gossypium)

9 Cotton has been grown in Somalia for centuries, mainly the short-staple varieties. Many varieties have been introduced since the start of this century and line selections have been made on some that are

adapted to local conditions. However, it is doubtful whether any true varieties still remain as discrete crops. Commercial production for export was started early in the colonial period but later abandoned for economic reasons. Cropped area rose to a record 25,000 hectares in the early and late 1950's, then fell drastically and Somalia began importing lint for its national textile factory, Somaltex. The cultivated area has recently been estimated at 2000-3000 hectares, about two-thirds of which is rainfed, with yields of 200-300 kg per hectare. Farm sizes range from .02 ha in the Shabelli flood plain to 3.82 ha in the Upper Juba. Cultural practices are poor and crops suffer very heavily from pest and disease attacks. About 17 harmful insects have been identified but the following are the most harmful:

1. Pectinophera gossypiella (pink bollworm)
2. Earias biplaga (Spring bollworm)
3. Diparopsis castanea (Red bollworm)
4. Dysdercus cardinalis (Red cotton bug)
5. Oxycarenus hyalinipinnis (Black cotton bug)
6. Aphis gossypu (Cotton aphis)
7. Empoasea fasialis (Cotton passid)

Cotton is usually planted in the Gu season and farmers commonly left the plants in the field through the Der season to get a second crop. This practice has now been prohibited, which should help to reduce pest population buildups. The major diseases are Fusarium oxysporium (wilt), and Xanthomonas matirecarum (bacterial wilt). Production varies considerably, partly as a result of weather fluctuations, but also due to the farmers' responses to prices. Since 1970 the cultivation and ginning of cotton has been regulated by ADC, which is also the sole buying agent. Current domestic production has been estimated at 800 Tons per year, far below the requirements of the national textile factory. Cotton is one of the major target crops under the current Plan and the Government has set up a cotton seed multiplication center near Afgoi that should supply enough seeds for 3000 hectares. Better varieties and the introduction of improved cultural practices, irrigation, fertilizer use and especially pest control, should raise yields considerably.

Wheat

10 Wheat is grown on a limited area in the Tug Wajaleh plain in the northern region of Somalia. A

state farm on 24,000 hectares was started in 1963 but subsequently abandoned because of administrative difficulties. Only about 3000 ha were grown in 1972-73. Yields varied between 500 and 700 kgs per hectare, due to poor varieties and lack of irrigation. Again, limited work has indicated that some Mexican cultivars when irrigated can give as high a yield as 4.5 tons/ha. Most of Somalia however is not conducive to successful wheat production.

Pulses, including Groundnuts

11 Pulses (legumes) are generally a good source of plant protein, vitamins, minerals and sometimes oil. They have great value in soil improvement, as nitrogen fixing crops, and provide valuable feed for animals. At present some groundnuts and beans are grown as companion crops with maize and sorghum. Under good conditions, yields of 1.5-2.0 tons can be obtained. Groundnuts are the second oilseed crop after sesame. The cultivated area is estimated at about 1000 hectares, and the yield is about one ton unshelled pods per hectare. The crop is scattered on small-size farms. Varietal research goes back to prior to 1940 and for a long time the most widespread

varieties were Khandeish and Spangolo. During the last twenty years, the American (Virginia) and Senegalese (S24-48) varieties were introduced. Legumes are grown in both the Gu and Der seasons; little care is given to land preparation, sowing times or varietal selection, pest control or proper harvesting.

Other Crops

12 A great number of forage crops could be grown under the climatic conditions of Somalia but very little such cultivation is done at the present time. Citrus is being actively promoted. Mango, papaya and coconuts are also grown on a small scale. Finally, tobacco, lemon grass, gram, sunnhemp, finger millet, sisal and a great variety of vegetables are grown on small areas.

Summary

13 The following table (V-4) summarizes the available information on field crops production in Somalia.

Table V-4

Field Crops Production

Crop	Area 1000 ha	Av. Yield Tons/ha
Sorghum	400	.500 -.650
Maize	170	.950 -1.000
Sesame	70	.250-.300
Cotton	3	.200-.300
Rice (upland)	4	.250
Wheat	3	.500-.700
Groundnuts	1	1.000
Pulses (legumes)	n.a.	1.5-2.0

B - Irrigated Crops

14 Bananas, sugar cane, rice and some maize are grown under controlled irrigation. Total surfaces have been estimated at about 37,000 hectares with about 27,000 hectares on the Shabelli River, 8,500 hectares on the Juba[1] and 1,500 hectares in Northwest Somalia. Commercial banana and sugar cane plantations alone account for about 15,000 of these irrigated areas.

[1] Juba Valley Development Program, Technital SpA, 1976

The national irrigation potential has been estimated at 200-300,000 hectares. Irrigation is the major concept of the agricultural development strategy as defined in the 1974-78 Plan. It would permit year-round cropping and ensure adequate moisture throughout the growing cycle. Yields of irrigated field crops are far higher than those of rainfed crops and better cultural practices generally characterize the irrigated farms.

Banana (Musa cavendishii)

15 Bananas are the main commercial crop in Somalia, contributing about 20% to national export earnings. The local variety is a dwarf, fast maturing, good yield type with good flavor and is relatively disease free. A new variety introduced from west Africa in the 1960's is similar in type but slightly taller and the fruit skin is thicker, giving fewer problems in packing and shipping. Total cultivated area was 9,800 hectares at the end of 1975, 55% in the Lower Juba valley and 45% in the Shabelli region. Statistics cover exports only. Exported yields were 19 tons/ha in 1970, corresponding to an estimated total yield of about 25-30 tons/ha (30% rejected). They dropped to 14 tons/ha in 1974 due to the drought. Bananas do best on the reddish brown loams of the river flood plains which absorb

water readily. Land is well prepared and kept free of weeds as plants develop. Watering and pruning are practiced as needed. Harvesting begins one year after planting and the plants produce 4-5 years before the land is fallowed or planted with a field crop (maize or sesame). Demonstration farms are under construction at Kalanji (Lower Juba) and Golwein (Lower Shabelli). About 150 hectares had been established by the end of 1974. The Plan objective is to expand areas in the private sector to 10,000 hectares and exports to 150,000 tons by 1978.

Sugar Cane (Saccharum officinarum)

16 Sugar cane is Somalia's only commercial crop apart from bananas. The Jowhar plantation was set up in 1926 by an Italian firm and is now operated by a Government enterprise, SNAI. The initial 7000 hectares have been reduced to 5000 due to salinization of the soils, reducing national production from 46,800 tons in 1969 to 31,300 tons in 1974. Current yields of under 6 tons/ha are far less than the 10 tons/ha achieved ten years ago. The problems are agronomic and technical, but also managerial. The soils are progressively exhausted through repeated cultivation and planting material is poor. Recent

management changes are expected to remedy many problems and improve production. The importation of new varieties from Cuba is contemplated and construction has begun on an 8000 hectare farm, with associated sugar mill, on Touta Island in the Lower Juba.

Rice

17 Rice is a major staple food that Somalia imports. About 3000 hectares are grown under irrigation, yielding from 3 to 4 tons per hectare per season. Crops suffer heavily from bird attacks, especially in the Gu season. Research carried out during the 1960's showed satisfactory results and rice is one of the most important crops to be developed under the 1974-78 Plan. A great number of cultivars have been developed in other parts of the world that are resistant to disease, pest attacks and bird attacks as well.

Maize and Sesame

18 Maize and sesame are grown on about 4000 hectares of irrigated lands. Little information is available on production as they are grown mainly as a rotation crop on the banana plantations.

C - Existing Agricultural Development Projects

Agricultural Crash Programs

19 The Agricultural Crash Program is run by a semi-autonomous agency with the executive authority located in the Presidency. Its aims include employment generation, instilling a spirit of national purpose and promoting the development of agriculture in particular and of rural areas in general. Ten farms with a total of 7550 hectares, including 4050 ha under irrigation, and providing employment to 6000 people, have been set up. To date, the program appears to have met with more success in respect of its social rather than its output objectives, and must be supported by budget subsidies from government. Yields are considerably below the national levels and production often does not suffice to sustain the volunteers. Poor performances can be traced to a serious lack of experience and training, both at headquarters and on the farms, insufficient leveling work and poor cultural practices. In fact, no fertilizers, improved seeds or pest control are used and damage to crops is serious and widespread. The current development plan foresees a doubling

of surfaces and number of volunteer workers and the objectives are self-sufficiency, focus on commodities in short supply in the country and increased outputs per unit area. Funding is set at SoSh. 112.5 million.

Integrated Agricultural Development

20 This project will be jointly financed by Government and the International Bank for Reconstruction and Development. An area of 30,000 hectares in the Northwest Region would be developed for the cultivation of sorghum, oil seeds, legumes and fodder, and a pilot farm of 1000 hectares for wheat would be established in Tug-Wajaleh plain northwest of Hargeisa. Existing vegetable and fruit farms would be improved and fifty new ones established. Funds under the current plan are set at SoSh. 44,320,000.

Irrigation, Shabelli River

21 The current development plan (1974-78) envisages two major irrigation projects on the Shabelli River, one at Afgoi-Mordinle under ADB (African Development Bank) financing, and the other

at Balad, financed by the Democratic Republic of Korea. The former has been projected on the basis of a UNDP-financed pilot farm project and would involve the development of 3000 hectares for the cultivation of cotton, sesame, groundnuts and rice/maize. The second project was defined on the basis of FAO's Agricultural and Water Survey and subsequent feasibility studies. A total of 10,000 hectares would be irrigated for the cultivation of rice, cotton, groundnuts, sesame and fodder. Funding for the Afgoi-Mordinle project amounts to SoSh. 19.9 million, and for the Balad project, SoSh. 160 million.

Rice Production Program

22 This program, carried out by the Agricultural Crash Program, Afgoi-Mordinle Irrigation Development Project and progressive agricultural cooperatives and plantation owners, would involve the planting of 4000 hectares to rice, with management under a special technical unit of the Ministry of Agriculture.

Juba Valley Development Program

23 Studied initially in 1963-64, then updated in 1972-73 and again in 1976, this program presents the long-term planning objectives for the whole 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 or 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. It is proposed to put 43,000 ha of these districts' irrigable lands under perennial crops and the remainder under seasonal crops, in particular maize, sorghum, rice, wheat, oil seeds, cotton, banana, sugar cane, pulses, vegetables and alfalfa.

Table V-5

Juba Valley

Identified Irrigable Districts*

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

24 It is projected that Juba Valley production in 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 below.

*Juba Valley Development Program, Summary based on Technital SpA report to EEC, 1976.

Table V-6

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

25 Projects for the Juba Valley already identified include the following, some of which are already under way.

Rice growing at Gelib;

Cotton, sesame, groundnuts, maize, pulses at Fanole;

Banana plantations in the lower valley and at Kalanji (pilot farm)

Resettlement project at Dujuma

Bardera dam and reservoir

Saco dam and reservoir

Sugar cane plantations and associated sugar mill

Cotton pilot farm at Giamama

Trans-Juba Livestock Project and Gelib Multi-purpose Ranch

*Idem.

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

Fanole Irrigation Project

26 This project is the first stage of the Juba River development scheme. It consists of

(i) the construction of a diversion dam;

(ii) the generation of 5000 kwh hydroelectricity;

(iii) the establishment of a state farm of 8199 ha.

During the first stage of the project, a 1954-hectare cotton farm would be established. The second stage of land development would involve the entry into production of the oil-crop farm totaling 1656 ha. In the third stage, the project would be put into crop rotation. The Class III lands of the cotton and oil crop farms would be developed in stage IV. The project would grow cotton, sesame, groundnuts, maize and legumes. In addition, a small herd of 475 cows and 25 bulls would be raised on the farm and fed with the fodder crops produced by the project for the purpose of determining their growth in terms of dairy and beef yields. Implementation of this project has been started but is lagging.

Juba Sugar Project

27 This project aims mainly at covering Somalia's deficit in sugar. The project, located on Touta Island on the Juba, has two components:

(i) A sugar cane plantation covering a gross area of 8000 ha with a net cultivated area of 6856 ha. In order to obtain reasonable yields, modern cultivation techniques would be employed and better sugar cane varieties would be introduced. The average yield is expected to be 99 tons per hectare. The agricultural potentialities of the soils and the water resources of this zone were examined in the Agricultural and Water Survey of Somalia during 1961-67.[1]

(ii) A new sugar factory with 50,000 tons capacity.

The original proposal of the project foresaw a production of 50,000 ton/year sugar and 13,630 tons/year molasses. Additionally, sugar cane tops (100,000 T/yr) and bagasse (150,000 T/yr) could be produced as by-products of the project's sugar industry. A new proposal has been submitted recently to double the production of the original project.[2] Implementation

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[1] Agricultural and Water Survey of Somalia, FAO, 1967.

[2] The Juba Sugar Project, Booker-McConnell, June 1976.

of this project is beginning in the near future. It should be strongly recommended that the by-products of the sugar factory be utilized to feed the livestock in the area.

Giamama Cotton Project

28 This would be a state farm project for growing cotton in rotation with other crops on a total area of 2,400 hectares. A ginnery and an oil mill are planned and by-products would be used for livestock feed.

II GOVERNMENT SERVICES TO FARMERS

29 The agricultural sector is served by federal government ministries, quasi-state bodies and increasingly, by cooperatives. The Ministry of Agriculture and the Ministry of Livestock, Forestry and Range are the principal institutions involved. Each has a number of autonomous agencies, some of which have related tasks but are nonetheless separate. This situation leads to inefficiencies and re-organization would be desirable.

30 The agencies most involved in the control of or provision of services to agricultural activities are the Agricultural Development Corporation (ADC), the Tractor Hire Service (ONAT), the Department of Plant Protection and Locust Control, and the Department of Agricultural Cooperatives.

Agricultural Development Corporation (ADC)

31 The Agricultural Development Corporation (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. With the exception of two farms at Shalambod on the Shabelli (100 ha), and in the Lower Juba (250 ha), ADC is not directly engaged in production. A major function within the agency's marketing responsibility is grain storage, both for regular trade requirements and as buffer stocks. The ADC now employs over 400 persons in a total of about 150 collecting stations. The commodities are transported to 25 centers with an overall stockpiling capacity of approximately one million quintals (100,000 tons). There are sixty ADC collecting points and storage for about 30,000 tons of grain in the Lower Juba Valley.[1]

32 ADC buying and reselling prices are fixed by decision of the SRSP Politburo and the Council of Minister. At the outset of operations, prices were fairly high to encourage production but they are now inadequate. Farmers are entitled to keep 100 kg of food grains per family member for self-consumption; surpluses must be sold to ADC. It is noted that the

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[1] Juba Valley Development Program, Summary based on Technital SpA Study, September 1976

self-consumption allocation would provide less than 1200 calories per day.

33 ADC's grain trading operations appear to be successful in financial terms although 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. It needs staff experienced and qualified in planning, marketing statistics and book-keeping to establish effective control procedures in order to ensure that current losses due to various inefficiencies or shortcomings are not significantly increased. It needs to improve the compilation of production and consumption statistics and projections for the country as a whole and for the various regions.

34 In spite of these difficulties, ADC has proven able to carry out its assigned responsibilities successfully and its impact on the economy of Somalia in the past five years has been considerable. Table V-7 shows ADC's commodity prices over the past five years. Detailed information on ADC, the market situation and prices by crop is given in Annex IX on Markets and Prices.

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SOMALIA

MOGANBO IRRIGATION PROJECT

Table V-7

ADC Commodity Prices 1971-77

SoSh. per Ton, Farmgate

	1971	1972	1973	1974	1975	1976	1977
Maize	400	450	450	500	550	600	750
Sorghum	350	400	400	450	550	600	-
Rice	-	-	1400	2500	2500	2500	3500
Sesame	1500	1550	1550	1800	2000	2000	2400
Groundnuts	1000	1000	1000	1000	1000	1000	1000
Cotton 2/3 Grade I + 1/3 Grade II	1267	1267	1267	1267	1867	1867	2533
Cotton Seed	200	200	200	200	200	200	200

Department of Plant Protection and Locust Control

36 This department's two major projects are the development of a system to control Quelea birds (with UNDP assistance) and the establishment of a plant pathology laboratory and six mobile units. A plant quarantine station at Afgoi is also planned. Experimental work is under way on the protection of cotton, maize and sorghum from pests. The department suffers from a shortage of qualified personnel, so high priority is given to postgraduate training in this field. The 1974-78 Plan allocates SoSh. 20,159,800 for strengthening the plant protection services. The separation of this department from the extension service is an example of the disadvantages of the present institutional set-up.

Department of Agricultural Cooperatives

37 This department was created in 1974 to implement a SoSh. 48 million cooperative development program. Again, shortage of experienced staff is a continuing problem; as there is no cooperative tradition in Somalia the development of a sufficient training capacity will take time. The number of cooperatives in 1974 was 40. The 1974-78 Plan contemplates the creation of 1050 group farming units,

150 multi-purpose cooperatives and 75 production cooperatives. Unless organized along state farm principles, these are likely to bring low distributable incomes and discourage the participants.

Agricultural Research Institute (ARI)

38 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 the Somalia Government (SoSh 8,511,090).

39 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

41 Extension is carried out by the various technical ministries and is especially complicated due to the predominantly nomadic nature of the agricultural population, including livestock owners. Regarding crops, the service is still in the early stages of development, chronically understaffed and unable to extend much knowledge to farmers due to the weakness of research. A UNDP/FAO project, 1972 to 1975, reorganized and upgraded the staff of the service, established work programs and initiated training programs for both staff and farmers. Five farmer training centers (Bonka, Genale, Aborein, Giamama, Jowhar) are in operation with an annual capacity of 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 and government farms. The most serious problem faced by the service, apart from the critical shortage of skilled and experienced people, is the lack of liaison among the various agencies in charge of research and extension. This should be remedied through reorganization of the institutional situation of the agricultural sector.

III EXISTING STATE IN THE PROJECT AREA

A - The Juba Valley*

42 The proposed Moganbo Irrigation Project would be located in the Lower Juba Valley. Dryland farming and some inundation farming are the predominant forms of land usage. Cultivated area in the valley was estimated at about 93,500 hectares, including 85,000 rainfed and 8,500 under controlled irrigation. About 5500 hectares of the latter are the commercial banana plantations along both sides of the Juba River from Kamsuma to Kismayu. Livestock is a minor activity in the immediate vicinity of the river. With the exception of the banana plantations, existing agriculture is for subsistence, and based on small, scattered family holdings.

43 As in Somalia in general, the main crops are maize, sorghum, a little cotton, sesame, groundnuts, pulses and some vegetables, grown in mixed fields. Although slightly higher than elsewhere in Somalia, thanks to the Juba floods, yields are low and unstable, partly due to moisture stress and partly because of the

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*Juba Valley Development Program, Summary based on Technital SpA study, Sept. 1976.

extremely rudimentary cultivation methods that prevail. The most extensive cultivated areas are near Bardera and Saco and especially below Fanole, where rainfall is relatively high.

44 In 1963, FAO carried out a survey of livestock and crop production in Southern Somalia.[1] The results for the Lower Juba and Shabelli flood plain showed an average cropped area of 7.87 hectares per farm, over half of which was under maize, with significant areas under sesame, cotton and other crops (mainly beans and groundnuts) grown as vegetables. Average yields were: maize, 403 kg/ha; sesame 296 kg/ha; cotton, 200 kg/ha. It was estimated that each farm produced about 2000 kgs of cereals. Table V-6 shows the estimated areas under cultivation by crop, rainfed or irrigated, and corresponding yields. These data were obtained from the Technital report on proposed development in the Juba Valley and clearly show the positive effects of a better water supply on yields.

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[1] Agricultural and Water Surveys - Somalia, Vol. IV, Livestock and Crop Production, FAO, Rome, 1968.

Table V-8

Irrigated and Rainfed Crops in Lower Juba

Crop	Flood Irrigated Area,ha	Yield/ha kg	Rainfed 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

45 Analysis of water resources in the Juba Valley* showed that the Juba River when regulated will have ample water to supply more than 150,000 hectares of irrigable lands. Climate is no obstacle to year-round irrigated agricultural activity, as temperatures do not vary a great deal and there are few serious storms. The vast potential of the valley has been recognized by the Government and the focus of future development action will be placed here. The Juba Valley Development Program described in Paragraph I-C sets down the development aims for the area.

*Juba Valley Development Program, Summary based on Technital SpA study, Sept. 1976; and Working Document No. 1 - Climate and Water Resources.

B - The Project Site

46 The site that was surveyed covered an area of about 10,000 hectares on the west banks of the Juba River between Moganbo and Koban villages.

Existing Situation

47 The site is populated by about 500 households in six small villages and scattered dwellings. The total cultivated area is estimated at 1000-1500 hectares in the lighter bush areas with farm sizes ranging between 2 and 3 hectares. Virtually all of the easily cleared areas appear to have been occupied. Land is officially 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 very 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, however, are insignificant, and maize can be considered the only crop. Little or no land preparation is done before seeding at the start of the rains. No fertilization or pest control is practiced and yields are low,

at about 400 kg per hectare of maize. Actual production fluctuates a great deal depending on the annual rainfall pattern. Yields are slightly higher for crops planted in the desceks (depressions) that act as flood relief for the Juba when in flood, and are much higher 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. Pest and disease attacks were especially severe, with losses that could amount to over 50% of the crop.

48 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., 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.

Value of Existing Production

49 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 hectares. (Sesame and tobacco were not included as they occupied insignificant areas.) Assuming an average yield of 400 kg per hectare, the existing production of the farms of the project site 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. 60 per quintal as a basis the value of existing production has been estimated at SoSh. 288,000.

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*ADC -- see Part II, Table V-7

IV THE PROJECT

50 The soils survey showed that a gross area of 6943 hectares are irrigable. A total of 683 hectares were subtracted from this number to allow for roads and canals, villages, etc. The selection of crops was based on consideration of: (107)

(i) soils suitability;

(ii) national food needs and import substitution;

(iii) maintenance of soil fertility.

Over 85% of the soils are loams, silt loam and clay with about one-half being silt loams to clay. All are arable and free of salt hazard. They have low electrical conductivity and low sodium adsorption ratio. The selected crops are maize, clover and rice in one rotation pattern sited on the heavier soils, and seed legumes, cotton, maize and sesame on the lighter soils.

A - Crops Selection and Rotation

Selection Criteria by Crop

Maize

51 Maize is a major staple grain crop in Somalia. It brings higher returns than sorghum but is more

dependent on a fairly reliable water supply. Under irrigation, and proper cultivation practices, maize can yield well over 5.5 tons per hectare. Somalia is self sufficient in cereals (maize and sorghum) in normal or good rainfall years but must import grains to meet national needs in poor years. The 1974-78 plan contemplates increased maize production under irrigation to ensure full, dependable self sufficiency and even to produce a surplus for export.

52 A number of maize strains from Jamaica (Pioneer x 306) gave yields of 6.2 - 6.9 tons in trials conducted in Somalia. Double crossed US13 has proven to be adaptable to a wide variety of environments and Asgrow 100 has an enveloping husk that would make it resistant to bird attacks. Other experimental work under way at Afgoi is giving good results and the final choice of cultivar would depend on such work and the availabilities of seed. Maize growing in the area would require careful pest control.

Rice

53 Somalia is a traditional importer of rice, which is one of its staple cereals. The national potential for rice production is excellent, assuming that sufficient water is available. The heavier

project soils would be suitable. The Dawn and Saturn varieties have been proven adaptable to conditions in Somalia but are susceptible to heavy bird and disease damage. The International Rice Institute has reportedly developed a high-yielding variety that is resistant to bird attacks. IR22 and IR8 could be tried along with Dawn and Saturn.

Cotton

54 Cotton used to be grown extensively in Somalia but was discontinued during the 1950's (see Part I-A). Somaltex company began importing lint, mainly from nearby countries, and constitutes a ready market for at least 4000 tons per year. Acala S-J-1 and Cooker 201 give yields of over 2 tons per hectare in Somalia and could be adopted for initial plantings. The choice of these early ripening varieties would help control bollworm damage, and the establishment of a three-year crop rotation would further reduce the buildup of pest populations.

Sesame

55 Somalia imports vegetable cooking oils in relatively large quantities. Sesame is the preferred

oil of the population but it is not produced in sufficient quantities to meet domestic demand. Other oilseeds, eg. groundnuts, sunflower, etc. were not considered for technical reasons: the project soils are not suitable for groundnuts and sunflower would be susceptible to heavy Quelea bird attacks. Possible cultivars could be found among new California high-yielding, non-shattering varieties.

Forage (Trifolium sp., Pennisetum purpurem)

56 Project site soils are lacking in nitrogen and organic matter, a common feature in arid tropical areas. The growing of green manure would fix nitrogen in the soils with resultant savings on expensive chemical fertilizers. If such crops can be used to feed cattle, the latter would produce valuable organic fertilizers. Possible forage crops are: fodder maize; elephant grass; Sudan grass; Guinea grass; alfalfa; Rhodes grass; Erba da Para; Kikiyu; vetch; berseem; Kundug, etc. The most promising with

regard to yield and nutritional value are elephant grass and berseem clover, as well as alfalfa. Elephant grass can give up to 10 cuts a year with a green yield of 80 to 120 tons/ha. Berseem grown on clay soils and provided with irrigation can give 2-4 cuts per year with a green yield of 30 to 60 tons/ha. Alfalfa is another excellent forage crop that would do well in Somalia except that it is a perennial crop that would interfere with crop rotation. Alfalfa should be an excellent forage on dryland areas with fair rainfall. Berseem would be the likely choice in view of the type of soils that are on the project site.

Seed Legumes (Pulses)

57 Seed legumes are also nitrogen fixers and add organic material to soils. They are high protein foods and are widely grown in Somalia, mainly for self consumption. Suitable species for the project area include: Phaseolus sp. (beans); Vigna sp. (cowpeas); Clycini sp. (soyabeans); Arachis sp. (groundnuts); Vicia sp. (broad beans); and Dolichus sp. Cowpeas, broad beans and soya beans would be considered

for the first stages of the project. Experimental research on soyabeans is in the initial stage in Somalia but varieties adapted to high tropical temperatures have been developed in India, Indonesia, Brazil, etc.

Crop Rotation

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

Crop Rotation No. 1

	A	B
Gu	maize	clover
Der	clover	rice

	B	A
Gu	clover	maize
Der	rice	clover

	A	B
Gu	maize	rice
Der	clover	clover

Rice would be grown during the Der season only because experience on the Paddy and Virginia Tobacco Experimental Station at Jowhar has shown that Quelea bird attacks are heaviest in the Gu season.

59 The project would enter partial production on 400 hectares in Block A during Project Year II. Double cropping is assumed so the cropping rotation would be maize followed by clover on 200 hectares and clover followed by rice on the remaining 200 hectares. The same rotation would be applied to the following blocks when developed.

Block	Net Area	Project Year
B	580 ha	III-IV
C	876 ha	IV
H	760 ha	VII
A	170 ha	III

60 The second rotation pattern would be started on Block D in Year V and expanded as follows:

Block	Net Area	Project Year
D	1215 ha	V
E	798 ha	V
F	690 ha	VI
G	771 ha	VI-VII

Crop Rotation No. 2

	Year A	Year B	Year C
Gu	legumes	maize	legumes
Der	cotton	legumes	sesame
	B	C	A
Gu	maize	legumes	legumes
Der	legumes	sesame	cotton
	C	A	B
Gu	legumes	legumes	maize
Der	sesame	cotton	legumes

The three-year pattern thus established would help to hold down pest population buildups on cotton.

61 The net project area of 6,260 hectares was divided into eight blocks for crop rotation purposes. Proposed crop distribution and rotation in shown in Table III-9. 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 Working Document V - Crops.

Table-III-9

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MOGANBO IRRIGATION PROJECT

Crop Rotation by Blocks

	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	280	-	-	-	-	1520
Total:	2405	-	-	1450	-	955	955	955	2900	1450	-	1450	12,520

B - Cultivation Practices

Field Preparation

62 Major field preparation would be carried out during the driest months of the year, i.e. January and February for Gu plantings, and July and August for Der plantings. Following land clearing, grubbing and leveling, the fields would be deep ploughed using moldboard plows drawn by 70-90 hp crawler tractors. About 20-35 tons of manure would be plowed in per hectare to improve soil contents of nitrogen (N), potassium (K) and phosphate (P).* The manure would also add organic matter and improve soil water-holding capacity. Harrowing would be done with disc harrowers; about one-fourth of the necessary nitrogen and phosphate fertilizers would be applied at this time.

63 The necessary manure would be provided by the feedlot integrated with the project. The cattle would be fed a fattening ration composed of clover initially grown to enrich the soils and crop residues. Feedlot capacity and clover cropping have been synchronized in an integrated production cycle that maximizes the benefits of land development.

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*Note: one ton manure - 5 kg N, 5 kg K and 2.5 kg P

Seeding

64 Rice and clover would be grown in level borders but all other crops would be planted in rows. Seed drills and furrowing drills would be required. Row spacing and seeding rates would be determined on the basis of optimal production criteria (mechanized tilling and weeding, spraying, watering, etc.). Gu crops would be sown early in March and Der crops in early September.

Water Applications

65 A pre-planting application would be necessary to wet the soils down to about 50-60 cm. Subsequent watering intervals would be determined empirically as the project operates. Tentatively, one application would be necessary every 10-15 days for maize, sesame, cotton, legumes and clover, while the water level in the rice fields would be maintained. Care would be taken to avoid waterlogging, but it is just as important to avoid moisture stress.

Fertilization

66 In addition to the pre-planting amounts of manure, nitrogen and phosphate fertilizers described

above (Field Preparation), the project soils would benefit from the introduction of clover and seed legumes in the crop rotation. Vicia and Arachis species have a nitrogen fixing ability of 40 kg/ha, while alfalfa fixes 200 kg/ha; these crops would reduce the purchase of chemical fertilizers to a moderate level. Urea would be applied to all crops to supplement nitrogen needs, while super phosphate would be applied to rice, maize, cotton and sesame.

Table V-10

Fertilizers and Seed Rate for Various Crops

Crop	Kg N/ha	Kg P_2O_5/ha	Kg Seed/ha
Rice	60	50	100
Clover	20	30	20
Cotton	50	50	40
Maize	60	50	20
Sesame	30	20	15
Legumes	20	30	25

Weed Control

67 The use of clean seeds and proper plant density should eliminate the necessity to weed clover. Herbicides such as propanil (Stam F34) would be applied

to rice fields to replace tedious hand weeding. A post-emergence solution of 12 liters per 400 liters water per hectare would be applied 3 to 4 weeks after planting. One hand weeding may be necessary just before the rice heads out. Similarly, one herbicide treatment plus one manual weeding operation should suffice for the maize crop. Pre-emergence solutions of 2-4-D at a rate of 1 kg per hectare or Atrazine at 3 kg/ha would be applied. The use of herbicides should reduce the labor requirement for weeding by at least 50%. In the case of cotton, cultivation and manual weeding should suffice and no herbicide should be needed. The same would be true for the sesame and legume crops. The tilling operation would be required 4-6 weeks after planting and the hand weeding before plants finish blooming.

Table V-11
Herbicides

Crop	Planted area/yr	Need/ha	Total annual need
Rice Stam F34	955	12 l.	11,460 liters
Maize (2-4-D or Atrazine)	2405	1 kg 2 kg	2405 kg 7215 kg

Crop Protection

68 Bird damage to rice is a serious problem that can reduce harvests by up to 50% or more, especially in the Gu season. Rice would be planted only in Der and, during the early years of the project, children would be engaged to frighten birds away. The relationship of degrees of maturity and extent of damage would be observed with a view to determining whether earlier or later plantings can avoid harvests at times when the birds are most numerous. All trees or bush around the rice fields would be cleared. It is hoped that the newly developd bird-resistant IRI strains previously referred to will be adaptable to local conditions.

69 Among the selected crops, cotton is the most susceptible to pests, followed by maize. Irrigation is expected to increase the levels of attack but control measures must not be allowed to destroy the natural predators as well. Control will begin with good cultural practices, eg. deep plowing, full elimination of crop residues, seed treatments, use of resistant varieties. For cotton, the crop rotation over three years would lower pest population buildups. Only one or two sprayings would be carried out during the

growing cycle of both maize and cotton. Four liters per hectare of monocrotophos (Novacrone) will take care of most cotton pests (bollworms, seed bugs, etc.). Three liters/ha of Dorsban would also be effective.

Table V-12

Pesticide Requirements

Crop	Liters/ha	Total needs
Cotton		
Novacrone	4	5800 liters
or Dorsban	3	4350 liters

C - Harvesting

70 Rice would be machine harvested to reduce shattering losses. Cotton and maize would be harvested manually as they would otherwise require very special machines. Beans and sesame would be harvested with the same equipment as that used for rice. Cotton would be harvested in December-January, maize in July, rice and sesame in November-December. One-third of the legumes would also be harvested in November-December and the rest in July-August. Clover cuts would be timed to provide a steady supply to the cattle feedlot.

71 Assuming that a laborer can pick about 50 kg per day the crop of about 3200 tons cotton would require around 1000 workers for two months. The maize crop, estimated at about 12,000 tons, may be harvested by the same labor force in about one month's time. Rice and sesame will be grown in the Der season, on about 2500 ha, and would be combined during November and December along with one-third of the legumes (1500 ha).

D - Yields and Production

72 It has been assumed that full yields of project crops would build up over three years time as shown in Table V-14. This allows time for soils improvement, some empirical trials and gives both management and laborers the opportunity to acquire experience. The assumed project yields are conservative to compensate for inevitable inefficiencies during early project years.

Table V-13

Project Production at Full Development

Crop	Area per Year	Yield per ha (Tons)	Total Annual Production (Tons)
Maize	2405	5.0	12,025
Cotton	1450	2.2	3,190
Sesame	1450	1.0	1,450
Rice	955	4.0	3,820
Legumes	4350	1.8	7,830
Clover	1910	40.0	76,400

Table V-14

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MOGANBO IRRIGATION PROJECT

Production Buildup

Project Year	Maize ha	Maize Yield	Cotton ha	Cotton Yield	Sesame ha	Sesame Yield	Rice ha	Rice Yield	Legumes ha	Legumes Yield	Clover ha	Clover 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

Crop By-products

73 The project is designed to be an integrated irrigation project to produce crops and feed animals that will provide necessary organic fertilizer. Clover was thus introduced into the rotation as the main green fodder. It will be grown in the Gu season before rice and in the Der season after maize, and will assure a continuous flow of green fodder throughout the year to the feedlot. Other crop by-products will be available as roughage: rice straw, maize stover, legume forage and sesame stalks. The following table shows the estimated yield of the main by-products at full project development.

Table V-15

By-products of Main Crops

(Tons per hectare)

By-product	Area	Tons/ha
Rice straw	955	7,640
Maize stover	2405	24,050
Cotton seed	1450	2,030
Legume forage	4350	15,660
Sesame stalks	1450	4,350

Labor Requirements

74 The operation of the project has been based on optimum mechanization with a maximum utilization of labor. Cotton and maize harvesting and about 50% of weeding operations would be carried out manually. Land preparation, maintenance of canals, ditches, farm buildings, etc., and the cultivation methods (especially weeding and harvesting), have been scheduled so as to distribute labor requirements fairly evenly throughout the year. About 1400-2000 laborers would be needed at any given time. To encourage permanent settlement about 1800 permanent dwellings have been provided for in the four worker villages directly connected with the Project.

Research

75 It would be out of the scope of the proposed project to carry out any form of varietal or developmental research. This would remain the responsibility of the national research institute at Afgoi, which has a 40-hectare irrigable land allocation at Yonte just south of the project site. Project management would cooperate fully with the research teams at Yonte. They could also invite them to set up trials on the project

site itself and provide the labor and water needed. In this way there will be no repetition of research activity and the project would not draw off research scientists who are in extremely short supply.

V COSTS AND REVENUES

A - Capital Costs

76 The construction costs of the Irrigation Project described herein have been calculated in Working Document III - Irrigation and Drainage, and Working Document IV - Infrastructures. They include the construction and equipment of canals and drainage ditches, land preparation and leveling, buildings including houses and roads. The total cost has been estimated at SoSh. 177,407,900.

77 The costs of machineries for the crop production activities (excluding the livestock component) are listed in Table V-16. Table V-17. shows the distribution of investment outlays by year.

Table V-16

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MOGANBO IRRIGATION PROJECT

Capital Costs - Farm Machineries

Item	No.	000 So. Sh. Total	Local Currency	Foreign Exchange
Heavy duty tractor , 70-90 hp	40	4080.0	408.0	3672.0
Wheel tractor,45-60hp	80	4160.0	416.0	3744.0
3-furrow mounted mold-board plow	33	300.0	30.0	270.0
Mounted(20-)disc harrow	17	233.0	23.3	209.7
3/4-furrow mounted nidger	22	200.0	20.0	180.0
Land leveler, trailed wheel tractor	7	289.0	28.9	260.1
Tractor-mounted fertilizer spreader	11	67.0	6.7	60.3
Reo tractor or mounted steering disc	28	212.0	21.2	190.8
Pesticide sprayers, tractor trailed	33	549.0	54.9	494.1
Row planters	22	466.0	46.6	419.3
Seed drill	11	135.0	13.5	121.5
Ditcher	7	42.0	4.2	37.8
Combines	7	1649.0	164.9	1484.1
Baler	7	148.0	14.8	133.2
Mower (1.6m)	10	45.0	4.5	40.5
Trucks (8-10 ton)	22	6035.0	603.5	5431.5
Trailer	22	266.0	26.6	239.4
Cottonseed delinter	3	34.0	3.4	30.6
Organic manure spreader	11	660.0	66.0	594.0
Subtotal:		19570.0	1957.0	17613.0
Contingencies 10%:		1957.0	195.7	1761.3
Subtotal:		21527.0	2152.7	19374.3
Spare parts[1] :		1446.0	430.3	1015.7
Subtotal:		22973.0	2583.0	20390.0

able V-17

SOMALIA

MOGANBO IRRIGATION PROJECT

Item	Project Year: III No.	III Cost	IV No.	IV Cost	V No.	V Cost	VI No.	VI Cost	VII No.	VII Cost
avy duty tractor, 70-90 hp	8	816.0	8	816.0	8	816.0	8	816.0	8	816.0
eel tractor, 45-60 hp	16	832.0	16	832.0	16	832.0	16	832.0	16	832.0
furrow mounted moldboard plow	7	63.7	7	63.7	7	63.7	7	63.7	5	45.5
unted (20-) disc harrow	4	54.8	3	41.1	3	41.1	3	41.1	4	54.9
4 furrow mounted nidger	5	45.4	4	36.4	5	45.4	4	36.4	4	36.4
nd leveler, trailed wheel tractor	2	82.5	1	41.25	2	82.5	1	41.25	1	41.2
actor-mounted fertilizer spreader	3	18.2	2	12.2	2	12.2	2	12.2	2	12.2
o tractor or mounted steering disc	6	45.5	5	37.7	6	45.5	6	45.6	5	37.7
sticide sprayers, tractor trailed	-	-	-	-	-	-	16	266.2	17	282.8
w planters	5	105.9	4	84.7	5	105.9	4	84.7	4	84.8
ed drill	3	37.0	2	24.5	2	24.5	2	24.5	2	24.5
tcher	2	12.0	1	6.0	2	12.0	1	6.0	1	6.0
mbines	2	471.1	1	235.6	2	471.1	1	235.6	1	235.6
ler	2	42.3	1	21.15	2	42.3	1	21.15	1	21.1
wer	3	13.5	3	13.5	4	18.0	-	-	-	-
ucks (8-10 ton)	5	1371.5	4	1097.3	5	1371.6	4	1097.3	4	1097.3
ailer	5	60.4	4	48.4	5	60.4	4	48.4	4	48.4
ttonseed delinting machine	-	-	-	-	-	-	2	22.7	1	11.3
rganic manure spreader	3	180.0	2	120.0	2	120.0	2	120.0	2	120.0
Subtotal:		4251.8		3531.5		4164.2		3814.8		3807.7
Contingencies 10%		425.2		353.1		416.4		381.5		380.8
Subtotal:		4677.0		3884.6		4580.6		4195.3		4188.5
Spare parts[1] :		330.5		227.4		311.4		283.2		283.5
Subtotal:		5007.5		4112.0		4892.0		4489.5		4472.0

excluding tractor and truck spare parts

B - Operating Costs

78 The operating costs of the irrigation system and infrastructure have been calculated in Working Document III - Irrigation and Drainage and IV - Infrastructures. They would be as follows:

(i) Irrigation, including personnel, fuel costs, maintenance and repair of equipment, pumps and power plants (fuel costs would represent almost half the total annual costs): SoSh 1,212,000.

(ii) Infrastructures, including routine and periodic maintenance: SoSh 481,700/year.

79 Operating costs directly related to crops production concern staff requirements and the procurement of agricultural inputs. These are presented in Tables V-18, V-19 and V-20.

Crops Production Management

80 Production would be the responsibility of the four Village Managers, who are planned to be directly responsible to the Farm Manager. These people are the key to the success of the project. They should have an academic background in agriculture at least

equivalent to that of an agriculture extension agent. By experience, they must be qualified managers capable of supervising an organization of 25 foremen and 500 laborers. This includes scheduling of work such as planting, irrigating, weeding, cultivating and harvesting. In addition, they will have the responsibility of forecasting needs for equipment, seed, fertilizer and pesticides. Management of village operations will be an added responsibility. The Farm Manager will coordinate the activities and requirements of the Village Managers.

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Table V-18

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	12,000	8	80,000
Foremen	12,000	106	1272,000
Equipment operators, Drivers	6,000	160	960,000
Laborers*	3,000	2000	600,000
- 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.

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Table V-19

Agricultural Inputs Needed at Full Production

	Project Year VIII-XXX
Agricultural Inputs	
Plant seed	
Rice	298.9
Berseem	191.0
Cotton	60.3
Maize	90.2
Sesame	54.4
Legumes	217.5
Fertilizers (urea, super phosphates)	
Rice	706.7
Berseem	714.3
Cotton	1006.3
Maize	2020.2
Sesame	474.1
Legumes	2462.1
Insecticide, fungicide	
Cotton	216.0
Maize	101.0
Herbicide	
Rice	240.7
Maize	101.0
Operating cost for tractors, trucks[1]	
Rice	162.3
Berseem	292.2
Cotton	271.2
Maize	449.7
Sesame	271.2
Legumes	739.5
Total:	11140.8

[1]Including fuel, spare parts and maintenance

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Table V-20

Buildup of Agricultural Inputs

Project Year:	III	IV	V	VI	VII	VIII-XXX
Plant seed						
Rice	62.2	151.8	298.9	298.9	298.9	298.9
Berseem	40.0	97.0	191.0	191.0	191.0	191.0
Cotton	-	-	-	16.8	39.9	60.3
Maize	7.5	18.2	35.8	51.0	71.8	90.2
Sesame	-	-	-	15.2	36.0	54.4
Legumes	-	-	-	60.8	144.0	217.5
Fertilizers - urea, super phosphates						
Rice	148.0	358.9	706.7	706.7	706.7	706.7
Berseem	149.6	362.8	714.3	714.3	714.3	714.3
Cotton	-	-	-	281.1	666.2	1006.3
Maize	168.0	407.4	802.2	1142.4	1608.6	2020.2
Sesame	-	-	-	132.4	313.9	474.1
Legumes	-	-	-	787.7	1630.1	2462.1
Insecticide, fungicide						
Cotton	-	-	-	60.4	143.0	216.0
Maize	8.4	20.4	40.1	57.1	80.4	101.0
Herbicide						
Rice	50.4	122.2	240.7	240.7	240.7	240.7
Maize	8.4	20.4	40.1	57.1	80.4	101.0
Operating cost for tractors, trucks[1]						
Rice	34.0	82.5	162.3	162.3	162.3	162.3
Berseem	61.2	148.4	292.2	292.2	292.2	292.2
Cotton	-	-	-	75.7	179.5	271.2
Maize	37.4	90.7	178.7	254.3	358.1	449.7
Sesame	-	-	-	75.7	179.5	271.2
Legumes	-	-	-	206.5	489.6	739.5
Total:	775.5	1880.7	3703.0	5897.2	8626.7	11140.8

[1]Including fuel, spare parts and maintenance

C - Revenues

81 At full development, i.e. in Project Year VII, the total crop production would be as shown in Table V- 21.

Table V-21

Total Crop Production

at Full Development

Crop	Area ha	Ton/ha	Total Production Tons
Rice	995	4.0	3,820
Clover	1910	40.0	76,400
Maize	2405	5.0	12,025
Cotton	1450	2.2	3,190
Sesame	1450	1.0	1,450
Seed legume	4350	1.8	7,830

82 Table V-22 overleaf shows the buildup of revenues during project development.

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APPENDICES, VOLUME 2

PART VI

LIVESTOCK SECTOR

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LIVESTOCK SECTOR

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APPENDICES, VOLUME 2 PART VI

LIVESTOCK SECTOR

I INTRODUCTION

1 Livestock is the principal source of livelihood of 50 to 70 per cent of the population in the Somali Democratic Republic. Livestock production is the backbone of the national economy as it contributes 70 per cent or more to the country's exports (Table VI-1) and thus develops foreign exchange resources which enable Somalia to purchase essential products in world markets. In the past decades, Saudi Arabia, Kuwait, the People's Republic of Yemen and other oil producing states in the area have been the traditional markets for livestock from Somalia.

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Table VI-1

Values of Exports in

Somali Democratic Republic (Average 1971-74)

	So.Shs millions	%
Livestock	164.0	56.0
Bananas	68.0	23.3
Meat, meat products	25.0	8.6
Hides, skins	18.0	6.3
Others	17.0	5.8
Total	292.0	100.0

Source: Foreign Trade Returns, Statistics Department, General Directorate of Planning and Coordination, Somalia.

2 Although trade in Somalia's livestock with these importing countries is well established and has a long tradition, there is now an indication that Somalia will face active competition with other livestock producing countries such as Australia, which may constitute a threat to Somalia's status in its traditional markets. There is also no indication that the European community is prepared in the foreseeable future to abandon the restrictive import policies they put into effect in 1974. Also, compared to other meats and fish, the world does not eat much beef. Under these circumstances, the real key to the problem is to improve the quality of beef Somalia now produces in order to maintain the strong foothold it has in its export markets. It is well documented that fattening improves both the liveweight gain and the quality of beef of Somali cattle.[1] The present project aims at establishing a feedlot operation for bulls as an integral part of the Moganbo Irrigation Project in the Lower Juba area. The Lower Juba region has the available infrastructure and large supply of cattle to justify

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[1] FAO/UNDP, Animal By-product Project, Km 7, 1976; personal communication.

the intensification of beef production based on indigenous bulls. Furthermore, in a newly established irrigated project, feedlot fattening of livestock is considered to be an essential component for securing maximum land development benefits. Irrigation projects can also provide some valuable agricultural by-products which can be efficiently utilized as feeds for fattening cattle and thus help in yielding higher returns for the proposed feedlot operation.

II BACKGROUND

A - National Herd in Somalia

3 Due to the lack of reliable basic statistics on population and livestock numbers, only rough approximations and estimates are possible. A census of the number of animals in Somalia was conducted in 1975 and until the results are available, current estimates remain approximate and are to some extent uncertain.

4 Data on the distribution of the livestock population in Somalia are also rough estimates and little is known about the age and sex composition of the national herd. But distribution also depends on climatic conditions; the wetter south has the bulk of the cattle while the dry central regions, together with the north, have the majority of the sheep and goats (Table VI-2). The improvement of range management, water supply and the seasonal movement of animals seem to be the most pressing need for development of livestock in the north. In the south, the water resources are reasonably good and there are tremendous prospects for irrigation. Since cattle are the predominant livestock, cattle-fattening projects based on irrigated fodder production supplemented with agricultural by-products, would be the most feasible strategy for developing and increasing the value of the livestock in the south. A movement in this direction has already been started in the Juba Valley.

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Table VI- 2

Distribution of Livestock in Somalia

1975

Animals	North (millions)	South (millions)	Total
Cattle	0.5	2.5	3.0
Sheep & goats	11.0	3.0	14.0
Camels	1.3	1.2	2.5

Source: Somalia, Recent Economic Development and Current Prospects, Report No. 702-50, IBRD, 1975.

Cattle

5 There are four main types of cattle in Somalia. All are dual-purpose but the Boran (Havai) and Jiddu (Suroq) are most adaptable to gain under feedlot conditions. The Charre (Duara) and Abgal (Gasara) are used primarily for milk production.

6 The Boran is found between the Juba River and the Kenyan border. It is generally white and is considered to be the outstanding beef breed in Africa. However, it is kept as a dual purpose animal in Somalia, with a greater tendency towards meat production since it has a light skeletal structure and good muscular mass. Average weight is 320 kg for males and 260 kg for females. It has shown great response to fattening when given adequate feeds.

7 The Jiddu (Suroq) is the most numerous cattle breed in Somalia. It is an exceptionally good dual-purpose breed and, together with the Boran, forms the basis of meat production in Somalia. Average weight is 380 kg for males and 280 kg for females.

8 The Charre (Duara) cattle are found in the riverine zones of the middle Shabelli region. The Abgal (Gasara) cattle are found east of the Shabelli and range into the low rainfall country of Mudag.

National Livestock Production

9 The annual offtake of livestock in Somalia is profoundly affected by weather conditions and the nomadic nature of husbandry. Sales are higher during the years of abundant rain when grazing conditions are good and mortalities are lower. The reverse is true in drought periods, plus the fact that herdsmen maintain larger herds in drought periods to compensate for mortalities. In addition to weather conditions, the offtake may also be influenced by export prices and/or Government control on the export of calves and female animals following the drought. Data in Table VI-3 give estimates for the annual offtake of cattle, sheep and goats in Somalia.

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Table VI-3

Estimated Annual Offtake of Cattle, Sheep and Goats in Somalia (1975)

	Cattle	Sheep & Goats
Estimated national herd, 1975	3,000,000	14,500,000
Live exports, 1975[1]	40,000	1,536,000
Slaughterings:		
Kismayu meat factory	48,000	---
Sopral meat factory	32,000	---
municipal abbatoirs[2]	70,000	454,000
private (unrecorded)[3]	29,000	3,000,000
Estimated cattle movements		
Outflow to Kenya[3]	40,000	---
Inflow from Kenya, Ethiopia	20,000	300,000
Total offtake from national herd	259,000	5,280,000
Estimated offtake percentage	8.7%	36.5%

[1] LDA estimates and as reported in Hunting & Gunn, 1976

[2] Estimates of IBRD, 1975

[3] As Kenya ceased buying immature bulls in 1975, these figures are higher than anticipated; there is no indication that outflow will continue at a higher rate, especially after operation of the Trans-Juba livestock project.

10 Although an offtake of 9-10% for cattle and 30-35% for sheep appears to be reasonable, proper planning and development strategy can easily double the numbers of livestock and thus the annual offtake could be tripled. In this respect the two most profitable areas for development are improvement of the rangelands and the efficient utilization of the immense amounts of roughage and other by-products available from the irrigated and dryland farms. Table VI-4 demonstrates the spectacular improvement in annual offtake and the the utilization of the national herd through improved herd performance that could be achieved with better range pasture production, nutrition and herd management.

Natural Rangelands

11 Practically all of the land area of Somalia is grazed or browsed by livestock during the major part of each year. About 55 per cent of the land can be considered as prime range and nearly 90 per cent may be considered potential rangeland. There is practically no alternative use that can be made of this land since it will not grow crops; it benefits the national economy only through the livestock it feeds. Nearly two-thirds of the human population of

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Table VI-4 A

Potential Offtake Improvement Through

(A) Improved Range Pasture Production

	Open Range	Semi-open Range	Ranch
Climate	Arid	Arid	Semi-arid
Rangeland	Degenerated	Restored	Cleared scrub-land, improved pasture
Grazing	Uncontrolled	Controlled	Padlock system
Management	Low	Good	High
Drought reserves	No	Yes	Yes
Feed supplementation	No	Little	Strategic
Hectares per animal unit (AU[1])	15	8	4

[1]Animal unit (AU): one dry cow or steer of 300 kg or 6 sheep of 30 kg each

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Table VI-4 B

Potential Offtake Improvement Through

(B) Better Nutrition and Herd Management

	Open Range	Semi-open Range	Ranch
Calving rate, %	60	80	90
Mortalities, %			
- Cows	10	5	3
- Birth to weaning	15	7	5
- Weaning to sale	5	4	2
Age at sale, years	5	4	3
Breeders per 1000 AU[1]	350	295	325
Age at first calving	4-5	3-4	3
Sales/1000 AU[1](annum)	103	197	252
Herd wastage due to unrealized productivity (%)	48.5	26.5	14
Offtake (%)	8[2]	13.5	18
Offtake as unit value of A	100	175	245

[1]Animal Unit (AU): one dry cow or steer of 300 kg or 6 sheep of 30 kg each

[2]The current estimated national cattle offtake

Source: Review of the Livestock and Range Sector, Somalia, K. Kuneman, FAO (SOM/75/009), Mogadishu, 1976.

Somalia are nomads who derive their livelihood almost exclusively from livestock production on the rangelands.

12 Highly productive rangeland is not necessarily the favorable medium for optimal livestock production as a number of limiting factors may hinder their efficient utilization. The Lower Juba and Shabelli flood plain is good rangeland but infested with tsetse fly living in the very thick bush land that would require clearing. These lands are used only during the dry season when water levels in the Juba are lower. Under these circumstances the Lower Juba area can be suitable for livestock projects integrated with irrigated farming.

Forage Production

13 No forage crops are grown on a large scale in Somalia. Some research on alfalfa and Sudan grass is being done at the Agricultural Research Station at Afgoi and the indications are that a variety of these crops might be successfully grown under irrigation.

14 Because of Somalia's extremely variable rainfall pattern, annual or seasonal herbage is unpredictable. This makes the planning of animal feeds utilization very difficult. The efficient utilization of all by-products of animal and plant origin in Somalia can therefore be regarded as complimentary to that of range grazing, and would aid the feeding of livestock at crucial periods. The various by-products can be used for fattening or increasing fertility during normal years or used as survival feeding of range animals during droughts, thus turning a potential loss into a profit. Immense amounts of by-products are available in Somalia but they are not fully utilizable at the present time.

Animal Diseases

15 Foremost among the diseases that can cause heavy mortality in livestock in Somalia are rinderpest, trypanosomiasis, contagious bovine and caprine pleuro-pneumonia, and tick-borne diseases such as anaplasmosis. Somali cattle are resistant to foot and mouth disease.

(a) Rinderpest: This disease used to cause considerable losses, but it appears that the 1972-75 campaign has brought the disease under control, as no outbreaks have been reported since 1973. However it has not been eradicated and precautionary measures should be practiced. Animals should be vaccinated annually between the ages of 6 months and two years, at the existing or future veterinary stations.

(b) Trypanomisasis: This blood disease, known as "sleeping sickness," is found in man and animals and is transmitted by species of Glossina or Tebanidae flies. The trypanosomes produce acute or chronic progressive anemia in infected animals. The transmitter flies (tsetse flies) are found in bushes along the Shabelli and Juba rivers up to ten miles from the river banks. Stock owners take animals to the river for watering at night and before daybreak must reach fly-free ground again.

(c) Tick-borne Pyroplasmosis: The infestation of all species of animals in Somalia by ticks adversely affects their development. Ticks transmit several diseases, such as pryoplasmosis, causing heavy mortality. Dipping must be practiced regularly.

(d) Contagious bovine pleuro-pneumonia: The disease is enzootic in Somalia and affects pastoral herds. It is very difficult to control or eradicate, largely because of the constant failure to detect carriers, or symptomless animals, and the lack of effective vaccines.

16 It should be pointed out that Somalia's animal health services have improved substantially over the last ten years and that health is now less of a constraint to improved livestock production. Trypanosomiasis, a major problem in the Juba and Shabelli river valleys, cannot be satisfactorily overcome until wide-scale bush clearing takes place. This may be partially achieved after establishment of some of the envisaged irrigation schemes.

Deterioration of Rangelands

17 Climatic conditions in Somalia are governed by a very irregular rainfall pattern. The rains come mainly in two seasons, but the irregularity of the rainfall pattern induces a correspondingly irregular development of rangelands and hence an irregular stock rate.

The nomadic nature of animal husbandry invariably causes excessive stock rates on good pasture, while lower quality ranges are not fully utilized.

Technical Staff Shortages

18 The lack of technical staff for the implementation and management of development projects is a limiting factor for efficient livestock production. Skilled manpower shortages are therefore a critical constraint that will continue to hamper the achievement of the objectives of development programs even where finances are available. To overcome this obstacle, training programs in livestock production and range management should be given high priority.

III THE PROJECT AREA

A - Livestock within the Project Area

19 Little detailed information is available on the livestock population of the Lower Juba region. The Ministry of Planning and Coordination conducted a comprehensive livestock census in 1975 but the complete details have not been released. The data in Table VI-5 indicate that this area is a most important cattle raising area. The Boran (Havai) and Jiddu (Suroq) are the main breeds and form the basis of the herds of beef and dairy cattle.

20 Estimates of the distribution of cattle by age and sex in the project area are included in Table VI-6. There is a high percentage of female stock, the main reason being that exports of females are now prohibited by law. Their domestic slaughter is also discouraged. In difficult times, such as droughts, breeding stock (females) get preference for food and water.

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Table VI-5

Livestock Population in Lower Juba Area, 1975

District	Camels	Cattle	Sheep	Goats
Kismayu	49,603	60,420	6,299	33,410
Gelib	74,866	175,352	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	34,756
Total	296,615	1,515,605	81,472	177,872

Source: Department of Statistics, Kismayu, July, 1976.

Table VI-6

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

	MALE			FEMALE		
District	< 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

*Steers account for 1%

Source: Central Statistical Department, Ministry of Planning and Coordination, Mogadishu, 1974.

Male cattle account for 15-25% of the total cattle population, mostly bulls under two years. Those over two years old are either sold or slaughtered for domestic consumption. Almost all male cattle in the Lower Juba are intact and only a small number (1%) are steers.

21 The numbers of cattle that could be available to the project has been determined on the basis of the total population of cattle in the project area (Table VI-5) and the numbers drawn off for export, municipal abattoirs and other livestock projects already established in the area. In the light of the information in Table VI-7, the number of cattle available to the Moganbo Irrigation Project would be around 44,000 head each year. Since Kismayu meat factory may draw all its future requirements from the feedlots of the Moganbo and/or Trans-Juba projects, 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 area (Trans-Juba and Multi-purpose cattle ranch projects) would certainly improve the availabilities

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Table VI-7

Estimated Cattle Available to Moganbo Project

	Heads/Year
Estimated cattle population, Lower Juba project area[1]	1,515,605
Annual percentage of offtake[2]	10%
Available cattle	151,560
Exports, live cattle from Kismayu (1975)[3]	4,400
Municipal slaughterings in Lower Juba[3]	5,282
Maximal cattle canned at Kismayu meat fac.[3]	60,000
Number cattle required for Trans-Juba Livestock Project[4]	30,500
Number cattle required for Multi-purpose cattle ranch, Gelib[2], initial stocking	7,125
Outflow to Kenya[5]	---
Net offtake	107,307
Total cattle available to Moganbo project	44,253

[1]See Table VI-5

[2]See Paragraph 10

[3]LDA, Mogadishu, 1975

[4]See Part B, Projects in the Area

[5]Estimated to be 30,000-40,000 heads/year. However, the Trans-Juba project is expected to reverse the flow to Kenya; also, Kenya ceased buying Somali bulls in 1975.

of cattle and secure the full utilization of cattle potential in this promising area.

B - Important Cattle Projects

22 A number of agricultural programs are now under way in the Lower Juba area, which have a bearing on the proposed feedlot operations of the Moganbo project.

Trans-Juba Livestock Development Project

23 The project covers the area from the Juba River to the border with Kenya. Its main objective 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.

24 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.

25 This project, which was 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. Such a project, considering the very small uplift it will give to the cattle industry, will be working at a very low profit under the present beef price structure. Changing the policy to producing grain for human consumption and using the crop residues for fattening cattle would improve the benefits from irrigation. As Somalia is a grain-importing country, this would also contribute to the saving of considerable foreign exchange.

Multi-purpose Cattle Ranch at Gelib

26 This project, located in the holding ground being developed by the EEC, will complement the Trans-Juba project and the Agricultural Development Project located in the vicinity of the proposed Fanole dam. Its major aims are:

(i) to test the productive capacities in both milk and meat of the indigenous high-potential breeds of

cattle and to maintain these types in adequate numbers and improve them through selection; and (ii) to improve cattle quality through fattening and improved husbandry.

27 This project has not been implemented but its proposals seem very sound and it should be given high priority. 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.

28 The above mentioned projects and proposed irrigation projects for the area, such as the Sugar Cane project on Touta Island and the Fanole scheme for cultivation of cotton, sesame, groundnut, maize and legumes,* indicate that the feedlot operation of the Moganbo project would begin in an area actively involved in the development of cattle and which would contain a wide range of agricultural by-products that can be efficiently utilized in fattening cattle. Co-ordination between the Moganbo project and other projects in the area would be beneficial to all agricultural projects in the Lower Juba region.

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*Working Document V - Agricultural Crops

C - Existing Infrastructural Facilities

29 A number of infrastructural facilities would be of great help in promoting intensification of cattle production, as indicated below.

Holding Grounds

30 The holding ground facilities in the project area are:

(i) the LDA holding ground at Kismayu, capacity 2500 head;

(ii) the EEC ranch at Gelib, 2500 head;

(iii) a holding facility to be established in the Trans-Juba project at Afmadu, which includes two large finishing ranches.

Kismayu Meat Factory

31 The factory was established in 1969 to produce canned meats for export, sausages, rendered fat, tallow, meat, bone and blood meal. The current capacity of the factory is 250 heads per day, or 60,000 head per year. Additional equipment is expected to be installed to expand production capacity to about 120,000 head per year. About 90% of the factory's purchases are bulls and 10% are non-productive cows. The animals

28 The unit prices used in estimating the capital costs of the transportation system have been described in Table IV-10, below.

Kismayu Port

34 Kismayu Port is the third most important port in Somalia, after Berbera and Mogadishu. Completed in 1968, it now has two deep water berths. The main exports are bananas, and a limited number of live animals. Kismayu port has adequate facilities for increased exports of live animals and carcass meat, and its expansion would help to draw off the potential offtake of live animals, carcass meat and processed meat that will be in excess after the development of livestock projects in Lower Juba.

D - Potential Feed Resources in the Area

35 The Lower Juba is one of the most productive forage areas in Somalia. Certain difficulties should be overcome in order to secure a prosperous livestock production development. Flooding, both from the river and from accumulation of runoff during the rainy seasons can be such that cattle must be moved out of the area. Another serious problem is tsetse fly infestation along the river. In many areas the tree and shrub vegetation is very dense and is a hindrance

to cattle movement. To increase the forage productivity of these areas, clearing of the dense vegetation is necessary. The grassland in the region would provide suitable locations for cattle finishing or holding farms. The initiation of a number of irrigation projects in the Lower Juba area would help in clearing dense vegetation and thus help also in the control of the tsetse fly.

36 A summary of the potential by-products in Lower Juba and their nutritive value if used as animal feed, is given in Table VI-8. These are conservative estimates based on areas under cultivation at the present time and those planned for the near future (Fanole, Juba Project, banana farms, etc.).

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MOGANBO IRRIGATION PROJECT

Table VI-8

Summary of Potential By-products
in Lower Juba and Their Nutritional Value
(Excluding the Moganbo Irrigation Project)

By-product	Total production, Tons	TDN %	Total TDN prod., Tons
Banana fruiting stems	110,000	50	55,000
Sorghum & maize stover	100,000	45	45,000
Sorghum & maize bran	1,500	70	1,050
Maize cobs	10,000	50	5,000
Sesame cake	3,000	70	2,100
Sesame stalks	10,000	40	4,000
Cottonseed cake	600	70	420
Rice straw	400	40	160
Sugar cane molasses	26,000	30	7,800
Sugar cane tops	200,000	40	80,000
Sugar cane bagasse	300,000	45	135,000
Total			335,530

E - Marketing of Cattle in the Area

37 A large proportion of cattle marketing is conducted in simple, registered, market places. Nomadic producers tend to bring their animals to the local markets themselves, though some nomadic traders purchase cattle from the North Frontier districts of Kenya and transport them to Kismayu for sale. In general, the majority of cattle transactions in Lower Juba involves only one or two middlemen between producer and purchaser. In the local markets there are small auctions where licensed auctioneers ("braku") work between producer and purchaser for a 2.5% commission.

38 An important development in cattle marketing in the area is that the LDA has controlled and supervised a number of markets where selling is now done on the basis of liveweight in the presence of the producers and the traders. The LDA offers a price of about SoSh. 2.5/kg which varies within very narrow limits and the producer accepts or rejects the price after the animal is weighed and the price is fixed. It is noted that 60% of the LDA total purchases are from traders. This reflects LDA's high fixed prices on a liveweight basis and the demand for heavier animals.

39 Purchasers at non-LDA markets in Lower Juba are mainly retail butchers and private individuals, as large traders and dealers are now relatively unimportant in the area. The meat factory at Kismayu is now buying cattle itself rather than through LDA. This factory is also operating on a fixed-price buying system (2.0 SoSh per kg) which is invariably above the free market level. In general, the price per head is highest in July to November, when cattle quality and weight are best. In the dry season, prices fall because liveweight and quality decline as the availability of grazing is reduced.

40 LDA also controls the export of live animals through Kismayu port. Through LDA control, veterinary standards have been raised to a level acceptable by several major importing countries. The government has set a minimum export price on a per head basis, for the purpose of foreign exchange control (US$ 180.00) for cattle). One consequence of the minimum price policy is that is has prevented the export of immature cattle.

41 It should be said that the marketing conditions of cattle in Lower Juba are improving considerably.

The improvement of marketing arrangements and the holding grounds, existing and planned, of LDA and the Trans-Juba Livestock Development Project will facilitate the export of live animals. Moreover, additional facilities are planned to double the capacity of the Kismayu meat factory to some 120,000 head of cattle per year for canning or processing into chilled and frozen meat.

IV THE PROJECT

A - Feedlot Component

42 The objective of the proposed feedlot operation would be to maximize benefits from land development on the Moganbo Irrigation Project. Project soils are low in organic matter as well as in nitrogen. A suitable forage crop would be included in the crop rotation to add nitrogen and this crop and such crop residues as maize stover or cobs, rice straw, etc. from the project crops would be used to fatten cattle that would in turn produce valuable organic material (manure). The integration of feedlot fattening with the irrigated farming operations would therefore provide the project with valuable soil enricheners and also improve the quality of local beef production for export.

43 The feedlot would be situated to the west of the Kismayu-Gelib paved highway, about 5-6 kilometers from the Juba River on the western edge of the Moganbo Irrigation Project i.e. near Village IV. The site slopes (o.5%) towards the main drain, thereby ensuring

excellent drainage. Feedlot staff and laborers would be housed in nearby Village IV. The feedlot is on the leeside of the village. It would comprise cattle feeding yards, feed stores, tractors and a feed hammer mill with a pelleting machine.

44 Most of the animals available would be bulls and as they usually come off the range in a poor condition they would need a comparatively long feeding period. The bulls would be purchased at an average live weight of 200 kg (2-3 years old) for fattening over a 5-month period (150 days) on rations composed mainly of roughage supplemented with low amounts of concentrates. The roughage portion would consist of freshly cut legume fodders, most probably Berseem, and crop residues (low quality roughage), both from the Moganbo Irrigation Project. The legume green forages would originally be grown in order to improve the soil as a part of the crop rotation but they will also help replace expensive protein supplements and add Vitamin A to the diet of the feedlot cattle. As the feedlot operation would be integrated with the Irrigation project, the legume forages used as feeds are to be considered an intermediate

product and would not be included in the costs of the feedlot operation, as it is considered that their cost will be offset by the value of the manure produced. The ration would be supplemented with such additives as salt, bone meal and molasses, produced in the project area. The manure would be collected from the yards and used to enrich the agricultural soil of the Moganbo project with valuable organic matter.[1]

Feedlot Design

45 The capacityof the feedlot at full development would be 15,000 head finished every five months, or an annual output of 30,000 head. Cattle of 200 kg liveweight would be brought into the feedlot at the average rate of 750 head per week. As the feedlot would depend largely on the agricultural by-products of the Moganbo project, it will not work at full capacity until a ready and regular supply of feeding stuffs from the project is secured. Field development of the Moganbo Irrigation Project will begin with 400 ha in Year II, so the feedlot would start after the first harvest with a capacity of 3000 head per year, reaching full capacity within 5 years, i.e. during Year VII of the Moganbo project. This procedure

[1]Note: 1 Ton manure = 5 kg N, 5 kg K, and 2.5 kg P

has the advantage that it can give the staff "on the job" training while development proceeds, and give both managerial and technical staff the opportunity to gain experience in running a large scale and sophisticated project of this type.

46 It is important to note that the greater the capacity of a feedlot the greater the sophistication and mechanization required; error allowance is reduced to a minimum and hand labor cannot be used as extensively as in small commercial feeding units. To simplify feeding and save on machinery, the cattle in the feedlot would be fed their protein and mineral concentrate mixture in pellets manufactured by a project feed mill with a pelleting machine. The crop residues used as roughage would be hammer milled to fine particle size to reduce labor and storage requirements, in addition to increasing the efficiency of digestion and, in particular, the energy uptake.

Feedlot Characteristics

47 A total allotment of 0.2 hectare per 100 animals on feed would allow space for roads, work corrals, food storage and animal pens.

Lot area per head		14 m^2
Sun shade per head		1.7 - 2.8 m^2
Feeding space per head		56-66 cm.
Watering space per 10 head		30 cm. (troughs 50-61 cm high, 20-30 cm deep)
Water requirements		30-40 litres/day
Feed bunks		
	Throat height	56-61 cm
	Widths	76 cm, top width; 46-50 cm, bottom width
	Neck width	41-56 cm, adjustable to 4 cm increments
Concrete pad behind bunk		1.8 - 3.6 m wide; 10-15 cm thick; 4 cm/m slope minimum (8 cm/m better)
Fences		1.3 - 1.4 m high for feedlot; 1.4 - 1.5 m high for work corrals
Lot slope (away from bunk)		3% to 10%

Each yard would be provided with dipping facilities for controlling ectoparasites.

B - Feedlot Feeds and Feeding Regime

48 Maize, sesame, cotton and rice would be the main food crops of the Moganbo project. The cropping rotation would be based on a yearly cropping of 2405 ha of maize, 1450 ha of sesame, 955 ha of rice and approximately 2000 ha of green forage. The cropping rotation of the Moganbo project was the basis for establishing the feedlot capacity. The crop land would produce fattening fodder for well over 30,000 (net 28,500) head of cattle (Table VI-9).

49 The concentrate mixture for feedlot fattening would be composed mainly of brans and sesame cake, which have high nutritional value and which can be obtained at a low price from the Moganbo project. Availabilities of the same ingredients are also considerably high in Somalia.

50 The feedlot operation depends on obtaining cattle of 200 kg livebody weight to be fattened to

Table VI-9

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MOGANBO IRRIGATION PROJECT

Calculation of Feedlot Capacity

Based on Proposed Forage and Crop Residues

of Moganbo Irrigation Project

Crop	Hectares planted per year	Yield/ha per year Tons	Total Production Tons		Unit req. per head cattle/day	Ration per head x 150 days	Number of Cattle
Berseem	2000	40.0	80,000		16 kg/day	2400 kg	50,000
Maize stover	2400	8.0	19,200	]			
or				]			
Sesame stalks	1500	3.0	4,500	]	4 kg/day	600 kg	52,800
or				]			
Rice straw	1000	8.0	8,000	]			

350 kg in 150 days. According to Morrison's feeding standards, the daily nutritional requirements for fattening cattle are as given in Table VI-10 Table VI-11 gives the proposed daily feed ration for the Moganbo feedlot operation. It will be noted that the present project proposes a higher feed intake than that recommended by Morrison. This is because the bulls would normally be obtained from the nomadic herds in a fairly poor nutritional condition. Furthermore, the daily ration for fattening operations should always be based on the final rather than the initial livebody weight of the animals. It is also suggested that the hammer-milled maize stover (or sesame stalks) be fed together with the chopped green forage. The concentrate mixture would be pelleted and fed with small proportions of the hammer-milled roughage.

Concentrate Mixture

51 Feeding usually accounts for the major part of the operating cost of a feedlot; about 50% of TDN of the feed would be brought in from the outside, i.e. components of the concentrate mixture and other mineral supplements (bone meal and common salt). The balance would be crop residues and green chopped legume fodder

from the Moganbo Irrigation project. The concentrate mixture requirements have been calculated at 3 kg x 150 days x 30,000 head = 13,500 Tons per year (Table VI-12).

Table VI-10

Daily Nutritional Requirements

for Fattening (Morrison)

Weight kg	DM (kg/day)	DP (kg/day)	TDN (kg/day)
200	5.3	0.60	4.3
300	7.4	0.66	5.7
350	8.0	0.73	6.4

Table VI-11

Proposed Daily Feed Ration

Moganbo Feedlot Operations

	DM kg	DP kg	TDN kg
16 kg of chopped Berseem	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 Daily Ration:	8.3	0.74	6.1

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MOGANBO IRRIGATION PROJECT

Table VI-12

Composition of the

Proposed Concentrate Mixture[1]

Ingredients	%	DM	DP	TDN	So.Sh.[2]
Maize bran	60	54.0	4.6	43.2	30.0
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	0.2	2.5	0.8
Crushed bone meal	2	1.8	0.4	1.4	2.4
Salt	1	0.8	-	-	0.3
Total	100	87.6 kg	10.5 kg	71.4 kg	68.5 kg

[1]Note: DM = Dry matter
DP = Digestible protein
TDN = Total digestible nutrients

[2]Market prices of ingredients in So.Sh/kg are 0.50 for maize bran; 1.10 for crushed maize; 1.30 for sesame cake; 0.12 for molasses; 1.20 for crushed bone meal and 0.30 for salt.

V COSTS AND REVENUES

A - Capital Costs

52 The dimensions of the feedlot yards were based on the installations that have proved successful in the feeding trials in Kenya where similar Boran bulls have been fattened. The capital costs for the construction of the facilities are shown in Table VI-13. Machinery costs are listed in Table VI-14.

53 For memory, the housing for the following feedlot staff and labor were costed with Village IV:

For memory (costed with Village IV)

House, Assistant Feedlot Manager (expatriate)	1
House, Advisor to Feedlot Manager	1
House, Veterinary Assistant	1
House, Animal Husbandry Assistant	1
House, Junior Staff	3
Housing, laborers (15 persons/line)	205

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Table VI-13

Capital Costs: Feedlot Housing and Building

	No.	SoSh.	Total SoSh.
Shed for concentrates	1	25,000	25,000
Shed for crop residues	2	25,000	50,000
Shed for the feed mill	1	50,000	50,000
Shed for tractors and vehicles	1	25,000	25,000
Veterinary laboratory, equipped	1	20,000	20,000
Molasses tanks (cement)	2	25,000	50,000
Feed troughs	9000 meters		225,000
Sheds	30,000 meters		90,000
Water troughs	750 meters		75,000
Concrete pads	9000 x 2 meters		360,000
Fences	21 kilometers		180,000
Scales	Five		100,000
Cattle squeezers	Five		25,000
Water reservoirs	4 x 150,000 liters		140,000
Cattle dip, complete with yards			40,000
			1,455,000

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MOGANBO IRRIGATION PROJECT

Table VI-14

Feedlot: Machinery Costs

Machinery	Units	Cost SoSh
Complete feed mill with a pelleting machine		360,000
Green chop loader	(2)	80,000
Two-wheeled trailers	(10)	120,800
Two-wheeled molasses tankers	(5)	75,000
10-Ton trucks	(5)	1,371,500
	Sub-Total:	2,007,300
	Contingencies 10%:	200,700
	Sub-Total:	2,208,000
	Spare parts 20%[1]:	128,000
	Total Machinery:	2,336,000

1) Excluding spare parts for trucks

Phasing

54 Construction of all buildings and sheds and 20% of the labor lines would commence toward the end of the second year of Moganbo Irrigation Project and proceed through Year III. The feedlot would consist of 150 Yards, each with a 100-head capacity. It is therefore proposed that 20% of the yards would be constructed in Years II-III of the Moganbo project and subsequent construction work at the rate of 20% each year. It is proposed also that one cattle squeezer for immobilization, one scale, one water reservoir and one cattle dip be constructed towards the end of Year III (See Table VI-15).

55 It is to be noted that the feedlot operation may benefit from some of the machinery available in the Moganbo Irrigation Project. The feed mill plant would be installed during Year III of the Moganbo project, and other machinery would be supplied at a rate of 20% during the five-year development of the feedlot operation.

Table VI - 15

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MOGANBO IRRIGATION PROJECT

Feedlot - Investment Phasing, in 000 SoSh.

Buildings	Project Year I	II	III	IV	V	VI	VII
Shed for concentrates			25.0	-	-	-	-
Shed for crop residues			50.0	-	-	-	-
Shed for feed mill			50.0	-	-	-	-
Shed for tractors and vehicles			25.0	-	-	-	-
Veterinary laboratory, equipped			20.0	-	-	-	-
Molasses tank			50.0	-	-	-	-
Feed troughs			45.0	45.0	45.0	45.0	45.0
Sheds			18.0	18.0	18.0	18.0	18.0
Water troughs			15.0	15.0	15.0	15.0	15.0
Concrete pads			72.0	72.0	72.0	72.0	72.0
Fences			36.0	36.0	36.0	36.0	36.0
Scales			20.0	20.0	20.0	20.0	20.0
Cattle squeezers			5.0	5.0	5.0	5.0	5.0
Water reservoirs			35.0	35.0	35.0	35.0	-
Cattle dip with yards			8.0	8.0	8.0	8.0	8.0
Total			474.0	254.0	254.0	254.0	219.0

Table VI-15, page 2

- Machineries -	I	II	III	IV	V	VI	VII
Feed mill with pelleter (1)	-	-	360.0	-	-	-	-
Green chop loaders (2)	-	-	40.0	-	40.0	-	-
Two-wheeled trailers (10)	-	-	24.2	24.2	24.2	24.2	24.2
Two-wheeled molasses tankers (5)	-	-	15.0	15.0	15.0	15.0	15.0
10-Ton trucks (5)	-	-	274.3	274.3	274.3	274.3	274.3
Actual machinery costs	-	-	713.5	313.5	353.5	313.5	313.3
Contingencies 10%	-	-	71.3	31.4	35.3	31.3	31.4
Subtotal			784.8	344.9	388.8	344.8	344.7
Spare parts (excluding those for trucks which are included in capital costs for trucks) 20%	-	-	88.0	8.0	16.0	8.0	8.0
Total Machineries	-	-	872.8	352.9	404.8	352.8	352.7

B - Annual Operating Costs

56 The annual operating costs are based on the feedlot operating at full capacity with an output of approximately 30,000 head per year. As the operation would start with 3000 head (Year III of Mòganbo project), the operating cost would be 10% of the total costs described in Table VI-16, thereafter increasing at the rate of 20% annually to the fifth year of the operation, i.e. Year VIII. The annual operating costs are shown in Table VI-16.

57 The feedlot operation would be supervised by an assistant to the Farm Manager, who should have a suitable education and experience background. It is planned to have an expatriate adviser for a period of three years to advise on the proper and most up-to-date techniques in feedlot operations. Other technical staff would consist of a veterinarian and an animal husbandry expert. The total staff requirements are shown in Table VI-18.

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Table VI-16

Annual Operating Costs,

Feedlot at Full Development (Year VIII)

	SoSh.
1. Management and labor (excluding expatriate adviser	735,000
2. Animal feeds procurement	9,247,500
3. Cattle purchases (30,000 head at SoSh. 2.5/kg, 200 kg/head	15,000,000
4. Dipping fluid and veterinary requisites	300,000
5. Maintenance of buildings, machinery and vehicles	73,000
6. Fuel, oil and lubricants and spare parts	66,000
Total operating costs	25,421,500

Table VI-17

SOMALIA

MOGANBO IRRIGATION PROJECT

Feedlot - Annual Operating Costs

by Year of Development

(000 SoSh.)

	Project Year						
	I	II	IIII	VI	V	VI	VII-XXX
Animal feeds	-	-	924.8	2774.3	4623.8	6473.3	9247.5
Cattle purchases	-	-	1500.0	4500.0	7500.0	10500.0	15000.0
Dipping fluid and veterinary requisites	-	-	30.0	90.0	150.0	210.0	300.0
Fuel, oil, lubricants, spare parts	-	-	13.2	26.4	39.6	52.8	66.0
Maintenance of feedlot facilities			24.0	35.0	50.0	63.0	73.0
Subtotal	-	-	2492.0	7425.7	12363.4	17299.1	24686.5

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MOGANBO IRRIGATION PROJECT

Table VI-18

Operating Cost: Feedlot Staff

Requirements at Full Development

Staff Requirement	Men/year	Annual Salary SoSh.	Total Annual Cost
Assistant Manager, feedlot	1	18,000	18,000
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
Tractor and Vehicle Drivers	6	6,000	36,000
Laborers	205	3,000	615,000
Total Cost Staff and Labor			735,000
- Expatriate Adviser - (3 years only)	1	315,000	

Table VI-19

SOMALIA

MOGANBO IRRIGATION PROJECT

Operating Costs

Feedlot Staffing Schedule

000 SoSh.

Project Year:	I	II	III		IV		V		VI		VII		VIII-XXX	
			No.	Cost	No.	Cost	No.	Cost	No.	Cost	No.	Cost	No.	Cost
Staff														
Assistant Feedlot Manager	-	-	1	18	1	18	1	18	1	18	1	18	1	18
Veterinary Ass't	-	-	1	15	1	15	1	15	1	15	1	15	1	15
Animal Husbandry Ass't	-	-	1	15	1	15	1	15	1	15	1	15	1	15
Livestock Buyers	-	-	1	12	1	12	2	24	2	24	2	24	2	24
Tractor and Vehicle Drivers		-	1	6	2	12	3	18	4	24	5	30	6	36
Laborers			21	63	63	189	105	315	150	450	205	615	205	615
Feedlot Storekeeper		-	1	12	1	12	1	12	1	12	1	12	1	12
Feedlot Manager Adviser (expatriate)		-	1	315	1	315	1	315	-	-	-	-	-	-
Total				456		588		732		558		729		735

C - Revenues

Prices

58 Purchase prices for livestock would normally be highest in July through November, when stock quality and weight are at their best. In the dry season, prices would fall because of the decline in quality and weight as the availability of grazing is reduced. In most markets of the Lower Juba area, LDA buys at a set price per kg liveweight. In general, the purchase price has been arbitratily estimated at SoSh. 2.5/kg liveweight. This estimate is comparable with the price currently received by producers selling to Kismayu Meat Factory and to the Km-7 project (SoSh. 2.0 and 2.5/kg respectively).

Sale Prices

59 Sale prices for well-finished cattle have been estimated as follows:

(a) The Government of Somalia has set a minimum export price (280-320 kg animals) at US$ 180.00 per head FOB. This minimum price apparently applies to non-finished cattle. The proposed feedlot would result in at least 6% improvement in the quality of fattened

cattle; thus, the FOB export price for a 350 kg animal would be SoSh. 1200.

(b) Since the Kismayu Meat Factory is not yet purchasing cattle for processing chilled or frozen meat, the price projections are based on sale prices of finished cattle from the Km 7 project at Mogadishu. This operation receives an average price of SoSh. 3.5 per kg fattened steers, or SoSh. 1225 per head at an average weight of 350 kg/head.

Feedlot Income

60 In view of the data in Table VI-21 indicating the buildup of production during the five-year period of development together with expected prices, the feedlot income has been projected as in Table VI-20. The gross annual income of the feedlot operation at full capacity would be SoSh. 34,556,000 This gross income is based on the proposed marketing system whereby 50% of production would be sold for live export and 50% would be sold to Kismayu Meat Factory to be exported as chilled and/or frozen beef.

VI PRODUCTION

61 The feedlot operation would result in an increase in meat production through two main channels:

(a) Improved dressing percentage representing a 5-7% increase over the purchased liveweight on all cattle brought in from the range and resold after fattening. Fattening reportedly increases the dressing percentage of Somali cattle from 46% to 52%, as indicated by the results of the feedlot operation integrated with the "By-product Utilization Project" at Km 7, near Mogadishu (UNDP/Somali Government).

(b) Weight increase on all cattle purchased from the markets and fattened in the feedlot for 150 days (five months). The average weight increase for fully finished cattle destined for export as chilled meat would be 150 kg per head, i.e. 1.0 kg per head per day. This estimate has also been based on results achieved by the project at Km 7, Mogadishu, where similar Boran and Suroq Somali cattle were fattened

on a ration consisting of roughage (crop residues), maize bran, molasses, sesame cake and some meat products. The average liveweight gain on this feed was 1.04 kg/head/day over a period of 120 days on a feed intake of approximately 5.4 kg of dry matter for cattle weighing 180-200 kg, i.e., an intake lower than that proposed for the Moganbo feedlot. Feedlot operations on similar Boran cattle in Kenya have indicated a liveweight gain of 0.9 to 1.2 kg/head/day over a period of 100 days.

62 Most of the incremental meat production would result from increased liveweights, but the improvements in dressing percentage and the quality of meat due to fattening would command a good price difference between buying and selling per kg liveweight. This price difference has been good in the past: the Km-7 project has a purchase price of 2.5 SoSh./kg liveweight, with a selling price at 3.5 SoSh. per kg liveweight, representing a difference of 1.0 SoSh/kg liveweight. Table VI-21 sets out the estimated build-up in total numbers of cattle purchased and the meat production of the proposed feedlot operation over a 5-year development period.

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MOGANBO IRRIGATION PROJECT

Table VI-20

Annual Feedlot Income During the Five-Year Development Period

	Project Year				
	III	IV	V	VI	VII-XXX
A. Total Production					
1. Numbers	2850	8550	14250	19950	28500
B. Sale for Live Export					
1. Numbers	1425	4275	7125	9975	14250
2. Annual Income 000 SoSh.	1,710	5,130	8,550	11,970	17,100
C. Sale for Chilling					
1. Numbers	1425	4275	7125	9975	14250
2. Annual Income 000 SoSh.	1,746	5,237	8,728	12,219	17,456
Total Annual Feedlot Income, 000 SoSh.	3,456	10,367	17,278	24,189	34,556

Notes: i) 50% of production for live export, 50% for processing to chilled or frozen beef;

ii) price of live exports: SoSh. 1200/fattened head

iii) price to factory, SoSh. 1225/fattened head

Table VI - 21

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MOGANBO IRRIGATION PROJECT

Estimated Build-up in Numbers of Cattle Purchased and Meat Production at the Feedlot Operation

	Project Year				
Cattle Purchased	III	IV	V	VI	VII
1. Numbers	3,000	9,000	15,000	21,000	30,000
2. Meat production (Tons)	600	1800	3000	4200	6000
3. Carcass meat (Tons)	276	728	1380	1932	2760
Cattle Sales					
4. Numbers	2,850	8,550	14,250	19,950	28,500
5. Meat production (Tons)	998	2994	4990	6986	9980
6. Carcass meat (Tons)	519	1557	2595	3633	5190
Incremental Meat Production					
7. Liveweight (Tons)	398	1194	1990	2786	3980
8. Carcass meat (Tons)	243	829	1215	1701	2430

Notes: 2. Liveweight of purchased cattle is 200 kg

3. Dressing percentage of purchased cattle is 46%.
4. Losses from young cattle in poor condition purchased from nomads: 5%.
5. Final liveweight feedlot cattle, 350 kg; price 3.5 SoSh/kg, 3500So.Sh./Ton.
6. Dressing percentage of fattened cattle, 52%.
7. First year of feedlot operation is Year III of Moganbo project.

63 It should be pointed out that meat would not be the only important product of the feedlot operation. Cattle manure from the yards would be a significant product. Each bull can produce some 5.0 tons of manure (20% dry matter) over a fattening period of 5-6 months, so one ton of manure (dry matter only) could be collected from the yards per bull per fattening period (150 days) to be used on the Moganbo agricultural plantations. Because the feedlot operation is an integral part of the irrigation project, the cattle manure is considered an intermediate product of the project. It has thus been estimated that the value of this manure would offset the cost of the green fodder and roughage fed to the cattle.

Cost of Production per Ton

64 Costs of production include:

(a) Annual operating overheads, including staff and labor, procurement of veterinary requisites, animal feeds, fuel and lubricants, etc., and
(b) Purchase of cattle for the feedlot. The cost of veterinary treatment is about 10.0 SoSh. per head over the fattening period. (This figure is adopted from the Km-7 project near Mogadishu.)

65 Cattle brought into the feedlot would be purchased at the rate of 2.5 SoSh/kg liveweight; thus one head weighing 200 kg would cost 500 SoSh.

66 With total operating costs at SoSh. 25,421,500 (Table VI-16), and assuming that the feedlot production at full production capacity would be 9980 tons liveweight, the average cost of producing one ton liveweight would be SoSh. 2547. With a carcass meat capacity of 5190 tons per year, the production cost of one ton carcass meat would be SoSh. 4898.

(ii) The establishment of this project would improve the employment situation in the Lower Juba area.