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JUBA RIVER VALLEY DEVELOPMENT STUDY

VOL. IV

AGRICULTURE AND LIVESTOCK SECTOR

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CHAPTER 1.

INTRODUCTION

Many different studies have been made for various purposes in the Juba Valley. The area was partially investigated from the soils science aspect in 1960-1961 by experts from the United Nations International Cooperation Administration. Their findings are given in the report: "Inter-River Economic Exploration", which is concerned with the south-central part of the Juba Valley.

Subsequently, in 1968, FAO published a report on soils in Somalia, which also considered the landform and lithological situation (Agriculture and Water, Landform and Soil, Vol. III, Rome, 1968). The report is complete with planimetric maps derived from 1:60,000 (approx.) uncontrolled photomosaics. According to the report, these maps were printed at scales of 1:100,000 and 1:500,000, but they were not made available for the present study. The classification given in the FAO report is essentially the result of careful photointerpretation, after having observed and examined a number of soil profiles along the motorable roads.

Russian technicians have also studied soils in the Juba Valley; their results are reported in "The Juba River Scheme", Section V, Soils, 1965.

Two traverses were made along the Juba Valley in 1975, one in the dry season, April, when the Juba flows were very low and the other in October before the start of the second rainy season (Der). These reconnaissances were run to check on the existing soil map (FAO soil map) so as to ascertain the most serious limitations, with a view to performing the Land Classification for the whole of the valley. Various profiles were examined in certain soils which had evident deficiencies as regards their future irrigation use and soil samples were taken for subsequent analysis.

Climatic factors were also considered, as was the effect these might have on the evolution and involution of soils in this environment. Some erosion was noted, as well ecological effects, as well as the hazards which might derive from the irrational use of the soils in general.

This Report merely gives an outline of the soils in the Valley, of their suscettivity and utilization coefficient for irrigation according to the U.S. Bureau of Reclamation (1), Land Classification Scheme, appropriately adapted to suit this environment. The reader is referred to Vol. III for information on the morphology and geology of the area.

Classification of the lands was based on investigations made along the valley, grouping the series noted in the reports above-mentioned.

This classification was plotted on the 1:60,000 (approx.) planimetric maps which were then reduced to 1:200,000. The following 23 sheets are involved.

Dolow 13 and 14, El Wak 12 and 16, Baardheere 1, 2, 5, 6, 9, 10, 13 and 14, Dif 4, Jilib 1, 2, 5, 6, 9, 10, 13 and 14, Kismayo 1 and 2 (see Fig. 1.I Map Sheet Index). The sheets concerned cover a total of around 70,000 km^2.

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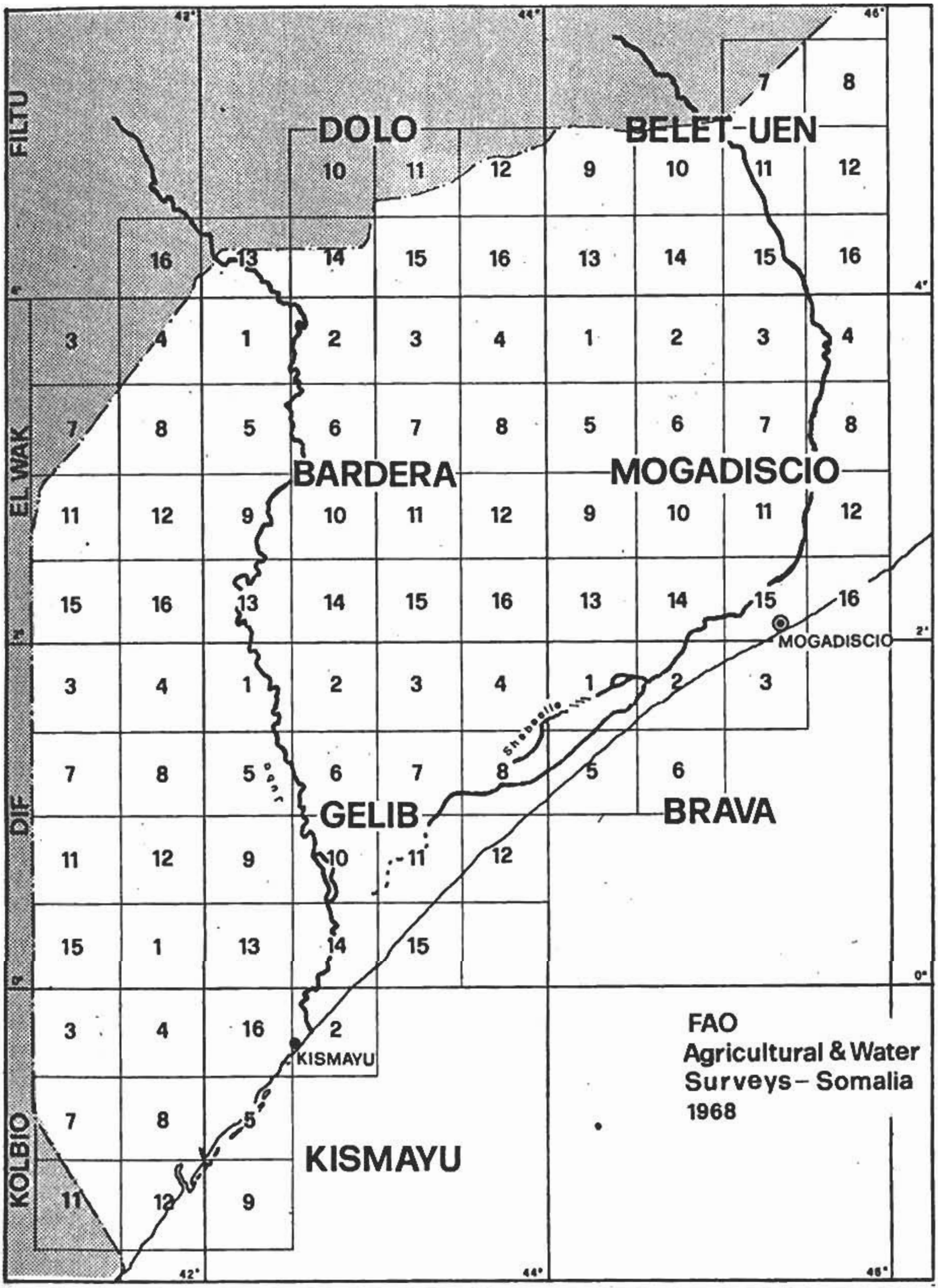
(1) U.S. Dept. of Interior - Bureau of Reclamation Manual, Vol. V - Part II - Land Classification for Irrigation Suitability.



PEDOLOGICAL CARTOGRAPHY : MAP SHEET INDEX

CARTOGRAFIA PEDOLOGICA : INDICE DEI FOGLI

fig. 1 . I

CHAPTER 2.

CLASSIFICATION PARAMETERS

The parameters for the land classification are as follows:

Class 1 - Arable:

Lands that are highly suitable for irrigation farming, being capable of producing sustained and relatively high yields of a wide range of climatically adapted crops at reasonable cost. They are flat lying with gently slopes.

The soils are deep and of medium to fairly fine texture with mellow, open structure allowing easy penetration of roots, air and water and having free drainage yet good available moisture capacity. These soils are free from harmful accumulations of soluble salts or can be readily reclaimed. Both soil and topographic conditions are such that no specific drainage requirements are anticipated, minimum erosion will result from irrigation and land development can be accomplished at relatively low cost. These lands potentially have a relatively high payment capacity.

Class 2 - Arable:

Land suitable for irrigation farming, being measurably lower than Class 1 in productive capacity, adapted to somewhat narrower range of crops, more expensive to prepare for irrigation or more costly to farm. They are not of such high value as lands of Class 1 because of certain correctible or non-correctible limitations. They may have lower available moisture capacity, as indicated by coarse texture or limited soil depth; they may be only slowly permeable to water because of clay layers or compaction in the subsoil; or they also may be moderately saline which may limit productivity or involve moderate costs for leaching. Topographic limitations include uneven surface requiring moderate costs for levelling, short slopes requiring shorter length of irrigation runs, or steeper slopes necessitating special care and greater costs to irrigate and prevent erosion. Drainage may be required at a moderate cost or loose rock or woody vegetation may have to be removed from the surface. The Class 2 lands have intermediate payment capacity.

Class 3 - Arable:

Lands that are moderately suitable for irrigation development but have more extreme deficiencies in the soil, topographic or drainage characteristics than described for Class 2 lands. They may have good topography, but because of inferior soils have restricted crop adaptability, require larger amounts of irrigation water or special irrigation practices, and demand greater fertilization or more intensive soil improvement practices. They may have uneven topography, moderate to high concentration of salines or restricted drainage, susceptible of correction but only at relatively high costs. Generally, greater risk may be involved in farming Class 3 lands than the better classes of land, but under proper management they are expected to have adequate payment capacity.

Class 4 - Limited Arable or Special Use:

Lands with specific deficiencies susceptible of correction at high cost; however, they could be suitable for irrigation because of existing or contemplated cropping with suitable crops. Lands are included in this class only after special economic and engineering studies have shown them to be arable. The deficiencies may be inadequate drainage, excessive salt content requiring extensive leaching, unfavourable position allowing periodic flooding or making water distribution and removal very difficult, rough topography, excessive quantities of loose rock on the surface or in the plough zone, or cover such as trees or bush. Elimination of the deficiencies requires outlays of capital for land development in excess of those for Class 3 but acceptable because of the specific utility anticipated. Class 4 lands may have a diverse range in payment capacity depending on the limitations involved.

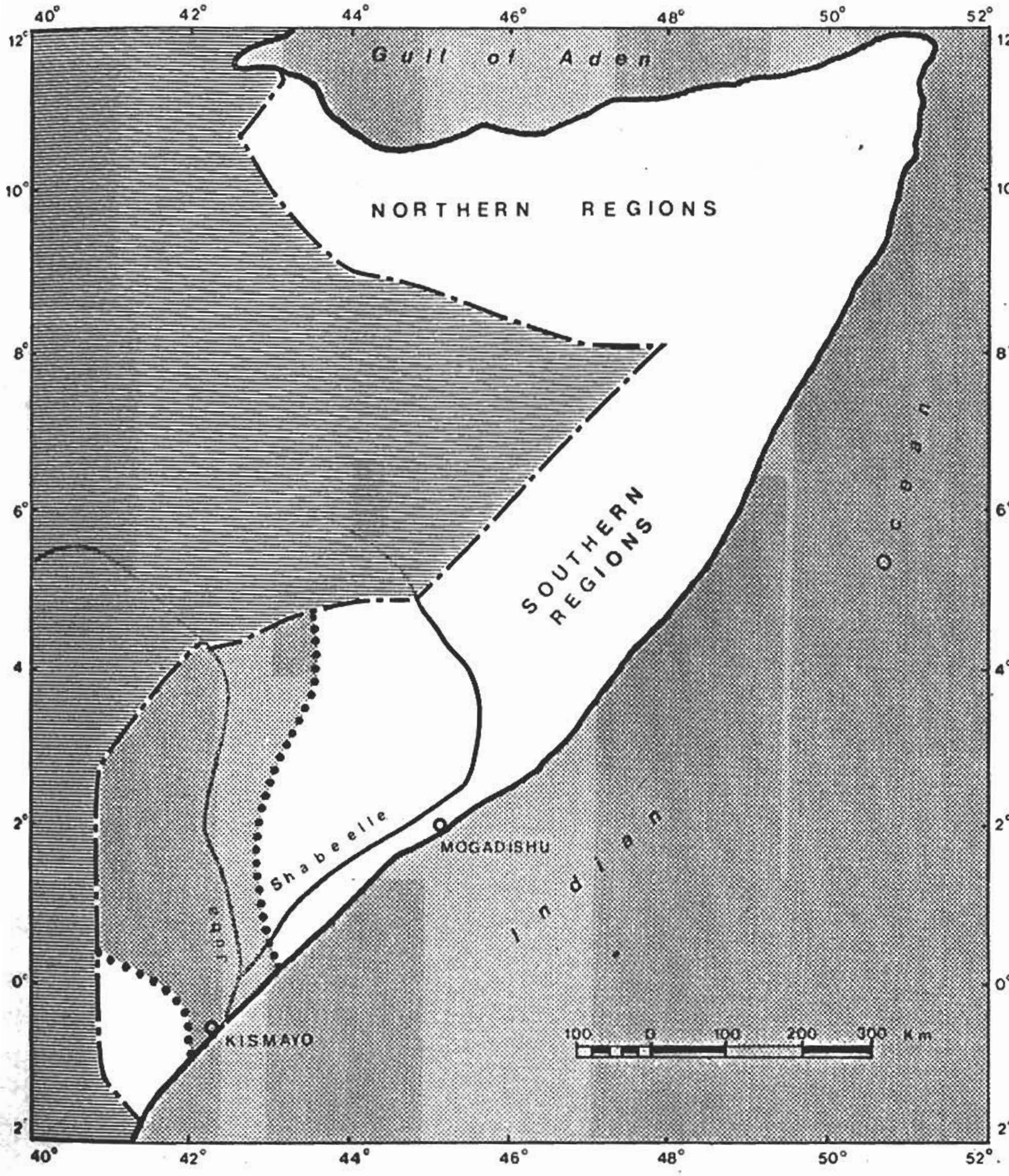
Class 5 - Nonarable:

Lands in this Class are nonarable under existing conditions, but have potential value sufficient to warrant tentative segregation for special study prior to completion of the classification, or they are lands in existing projects whose arability is dependent upon additional scheduled plans for improvement.

They may have a specific soil deficiency such as excessive salinity, very uneven topography, inadequate drainage, or excessive rock or tree cover. In the first instance, the deficiency or deficiencies of the land are of such nature and magnitude that special agronomic, economic or engineering studies are required to provide adequate information, such as extent and location of farm and project drains, or probable payment capacity under the anticipated land use, in order to complete the classification of the lands. The designation of Class 5 is tentative and must be changed to the proper arable Class or Class 6 prior to completion of classification of the Study Area. In all instances, Class 5 lands are segregated only when the conditions existing in the area require consideration of such lands for competent appraisal of development possibilities, such as when an abundant supply of water or shortage of better lands exists, or when problems related to land development, rehabilitation and resettlement are involved.

Class 6 - Nonarable:

Lands in this Class include those considered nonarable under the existing project or the project plans because of failure to meet the minimum requirements for the other Classes of land, arable areas definitely not susceptible to delivery of irrigation water or to provision of project drainage, and Classes 4 and 5 land when the extent of such lands or the detail of the particular investigation does not warrant their segregation. Generally, Class 6 comprises: lands with soils of very coarse or fine texture, or shallow soils over gravel, shale, sandstone, or hardpan, and lands that have inadequate drainage and high concentration of soluble salts or sodium, and lands that are steep, rough or badly eroded. Class 6 lands do not have sufficient payment capacity to warrant consideration for irrigation.



THE PROJECT AREA

L'AREA DI PROGETTO

3.1 CLASSIFICATION FOR IRRIGATION

Irrigable lands in the valley have been classified in the first, second and third class of irrigation suitability.

The only class lands classified are those belonging to the irrigation schemes proposed by Juba River Scheme of 1965.

Class 1 includes a part of the soils derived from recent alluvium deposided by the Juba. They belong to various series and differ from each other in particle size distribution, drainage and erosion hazard. Hence this class includes most of the recent and present-day alluvial soils which are more or less level but which sometimes include gullies of various sizes.

The "Ganana" (FPL.Ga) series occur along the river. This series is derived from the more recent alluvials and is distinguished by a very marked variability in particle size distribution. As this variability does not emerge from the earlier report, attention must be paid to this point during the design phase. Indeed, between Luuq and Dolow the recent alluvium has a sandier texture than that further downstream. This fact naturally influences certain important physical pedo-agronomic characteristics, the main ones being structure, permeability, field capacity, water application rates, watering intervals and numerous technical requirements.

In the past these soils were classified as brown or reddishbrown alluvial soils, with coarse to fine texture. On the basis of the 7th Approximation they should be classed as Inceptisols in the case of the more developed varieties, and as Entisols when they are less well developed.

Also in Class 1 are some soils on recent alluvium in the narrow flood plain formed by old river channels (Flood Plain Meander, Touata - Alexandra and the Sheebeellah), all on recent alluviums and limited to the Lower Juba Region. The percentage of clay and especially the vertical characteristics, such as deep cracking, self-mulching on the surface, slickensides, etc.) are more marked in this series, producing vertical alluvial soils or even Vertisols. The common feature of the whole series is the presence of about 20% of carbonates, a pH around 8, high cation exchange capacity and good chemical fertility. Organic matter tends to disappear when these soils are cultivated or irrigated.

Another common and quite important characteristic for the equatorial environment is the total absence of soluble salts. There is no doubt that the lack of salinity is the most important characteristic for bringing these soils under the plough. This fact has led to their intensive agricultural use, especially for crops with a good payment capacity such as bananas, cotton, sugarcane, etc.

Using proper farming techniques, therefore, these lands can give very good results. However, investigations made would appear to indicate that proper agricultural techniques are not always used, especially as regards hydraulic layout and irrigation. Around Jamaame to the south of Jilib there are many farms where the hydraulic layout is certainly not efficient. Thus water can be seen ponding along the canals, as can natural hydrophylous vegetation in the fields, etc. (see photo No 2). Crop development is therefore no better than fair and the general aspect is typical of hydromorphic areas, with very evident signs of chlorosis. This fact may also be bound up with a shortage of nitrogenous fertilizer.

It is thus apparent that if incorrect farming techniques are used, very rapid and serious involution of the soils on recent alluvium can occur in a few years. It is therefore essential to provide drainage,. particularly on the more clayey soils.

Class 2 includes soils deriving from recent alluvium and from limestone formations. These are known as Alluvial Soil, Grumosols. They have been mapped in the following landforms and series: Flood Plain Level (Jilib Sheet 5), Flood Plain Slackwater Level (Jilib 14), Flood Plain Channel Remnant (Jilib 13 and 14), Flood Plain Wirkoi-Zuaguni series (Jilib 13 and 14) and Mantled Plain Limestone Deep Level Baardheere series (Baardheere 9, 10 and 13; El Wak 16; Dif 4; and Jilib 1 and 2). Also included in Class 2 are the hydromorphic areas and some descek (for example Uamo Descek whose soils may be cultivated, if certain limitations are eliminated).

All the alluvial soils have a fine-sandy to clayey texture, a structure which is often massive in the medium to deep horizons, rather poorish drainage and slight alkalinity at depth.

The most evident use limitations are the high clay content, because of the low permeability, while in some places slight alkalinity, and marked waterlogging even though temporary, is to be observed. This last aspect concerns some of the descek, such as, for example, Uamo Descek, in the Afmadow district, which also collects part of the Juba floodwaters.

The soils are Grumosols (Vertisols in the 7th Approximation). If these soils are used rationally not only can their physical properties be improved, but they are also capable of providing very good yields. At the present time areas are to be seen under sorghum and maize as for example at Andaraf in the Uamo Descek.

Bananas are grown with rather poor results on the Class 2 alluvial soils, partly Grey Brown Grumosols, downstream of Consuma. This is probably due to the natural permeability conditions and to the inefficient state of the farm drainage network. Signs of water ponding in drains are very apparent and the presence of hygrophylous vegetation is all too evident. To sum up, here, in addition to some natural waterlogging, there is also that caused by irrigation and the lack of a proper drainage system.

Some of the farms visited adopt reasonably rational cultivation practices and the crops appear to be in a good state, with no signs of suffering or chlorosis. Good cotton and sesame crops were also observed here.

As stated earlier, these soils normally have quite a high clay content. The clay is of the swelling type, belonging to the montmorillonite group and hence with an expandable lattice. The clay is formed in environments where there are alternating dry and wet spells and where the solution circulating in the soil is high in alkalis or alkaline earths. Thus the physical characteristics are bound up with this particular type of clay, which swells when the moisture content reaches a certain figure. When this occurs permeability drops to virtually nil. Thus, in order to be able to cultivate these soils an efficient drainage network is required.

On the Jurassic limestones there are Grumosols (Brown or Yellow-Brown Grumosols). These are particularly common around Baardheere, from which the series takes its name (Baardheere soil). The physical characteristics are the same as those of the preceding series and so is the general fertility. From what could be ascertained during the field reconnaissance it would appear that the soils on the limestones have a greater erosion hazard than do the others. Indeed, alongside areas of very deep soils it is possible to observe highly eroded soils and even bare rock in outcrop. So when these soils are used for agriculture the necessary precautions must be taken to prevent erosion. The action required in the case of all Class 2 lands can be summarized as follows:

- Hydraulic layout must take due account of the hourly and instantaneous rainfall intensity, so as to avoid erosion wherever possible.

- Activated drainage for the clayier series.

- Periodic control of the SAR in the soil and the irrigation water. The soil should be tilled when mellow.

- As far as possible, the fields should be under vegetation when the rains occur.

- Organic matter should be added to the soil occasionally, possibly green manure.

- Proper and repeated quantities of mineral fertilizers should be added, especially nitrogen.

Class 3 lands cover a more extensive area than the previous two. They fall within the following landforms and series: Mantled Plain Limestone-Deep Level-Luuq (MPLd1-Luuq; sheets DoLow 13 and 14; Baardheere 1 and 2); Mantled Plain Limestone-Deep Level-Niomo (MPLd1-Na; Baardheere 13 and 14; Jilib 1 and 2); Flood Plain Cover - Margherita (FPc-Ma-Jilib 14).

The soils have been classified using the following terms: Reddish Brown Calcic Soil, Reddish Brown Grumosols, Greyish Brown Grumosols and alluvial soils subject to salinization processes.

The Luuq-soil series is represented by Reddish Brown Calcic Soils derived from materials which result from the erosion of limestones and sandstones. These have a medium and coarse texture and good drainage, their moisture retention capacity is low and there is a high erosion hazard. However the soils are very arid, as demonstrated by the lack of vegetation thereon. These facts are of notable importance when considering the layout, irrigation techniques and cropping patterns to be used when bringing the soil into cultivation.

Technical and economic requirements must be harmonised with the need for soil conservation. Sometimes these soils are used to grow durra and the local population consider that they provide good yields. A further particular aspect that must be considered, as regards future farming is the danger of salinization.

According to the 7th Approximation these soils are included in the Aridosols. The Amin-Soil Series, Reddish Brown Grumosols (Chromusterts of the 7th Approximation) have a homogeneous profile. They have a clayey texture, a coarse angular blocky structure, prismatic in depth. Drainage is slow and alkalinity is moderate in the medium-depth horizons (40 to 80 cm) and high in the deeper horizons. The erosion hazard is still high because of the poor drainage of the soils and the type of rainfall regime (during the course of the investigations 120 mm of rainfall was recorded in 45 mins.). In some areas these soils are used to grow sorghum, maize, cotton and sesame. When irrigated they can give good yields, provided a certain amount of care is given to the crops and to the soil, including periodic leaching and the addition of organic matter.

If cultivated constantly and if the danger of sodium build-up is removed, the physical characteristics of these soils could be improved considerably. In fact these, together with alkalinization and poor drainage, are the major limitations of the soils.

The Niamo series formed of Grey Brown Grumosols is common, especially on the Baardheere and Jilib sheets. These soils, too, have a very high percentage of clay, above 60-70%, and salinity is high at depths in excess of 100 cm. Vertical characteristics are very evident and even the physical characteristics are linked to the type of soil. Here again low permeability and the erosion hazard may also be serious in some cases, in view of the difficulty which may be encountered in leaching.

The Margherita series occurs on recent alluviums. These are fine-grained, moderately saline and alkaline and not very well drained soils. In places the amount of alkalis and salts may be toxic for plants and so good leaching will be required when the areas are brought into cultivation. Proper hydraulic layout is also needed.

Class 4 lands are encountered on various geolithological formations and in various topographical situations namely:

- gypsiferous-calcareous formations with deep levelled soils, Reddish Brown Calcic Soil (MPG-dl-DO, Dolow sheets 13 and 14, Baardheere 1 and 2);

- calcareous formations with deep levelled soils, Brown, Dark Brown Solonetz (MPL-dl-Fa, Baardheere sheet, El Wak 12 and 16; Dif 1 and 4; Jilib 1, 5 and 6);

- level marine formations with deep soils, Solonchak (MaPL-AF, MAPL-EL, MaPL-SO, PaPL-Um, MaPLGo, etc.);

- eluvial flats with deep soils, Solonetz often very alkaline (EPdl, Du, EPdl-Re, etc.).

The area occupied by the reddish brown calcic soils, the Solonetz and Solonchak, is very extensive, probably amounting to several million hectares. The reddish brown calcic soils are not very widespread, due to the very arid nature of the climate; they are limited to the upper part of the Juba Valley. The main characteristics are the texture, which ranges from fine to coarse and the low fertility; salt build-up is evident in certain parts and the soil reaction may range from moderately to strongly alkaline. All the soils present serious difficulties for agricultural use, even if irrigation water is available.

Most of the Class 4 soils belong to the Solonetz group, on various substrata, but generally marine sedimentaries. These soils have a fine to very fine texture, while the structure is fine on the surface and moderate at depth; the alkalinity increases with depth and so does the percentage of soluble salts and the SAR, carbonates are always present at a uniform percentage throughout the profile; organic matter is present only in the surface horizon; drainage is normal only in the first centimetres and is impeded or almost impeded at depth.

These basic characters, which cannot always be easily eliminated, pose limitations on their use. At the present time bush grows on these soils. This is sometimes quite dense and sometimes quite sparse depending upon the alkalinity and other erosion phenomena, as it has been possible to see in the field (see Photo No 21-22).

Soil conservation is important here because most of the rangelands in the Valley are on Solonetz soils. Herbaceous vegetation reproduces only where the surface organic horizon has been preserved. If for any reason the topsoil is missing the process of erosion starts and desertification rapidly follows. This situation can be plainly seen in the Juba Valley between Jilib and Umbosi, near Soia in the Ajmadu district at Andaraf and all round the Uamo Descek, from Boole to Saakow and up to Baardheere (see Photos No 23-25).

Erosion is of the sheet type, though gully erosion is sometimes observed (see Photo No 21). The stability of the soil vis-à-vis erosion appears to be inversely proportional to the dryness of the climate.

From what has been said above and from what can be gleaned from the existing documentation it can be deduced that there will be quite a number of technical difficulties involved in bringing the Solonetz soils into cultivation, while only a limited number of crops can be grown on a fairly restricted area of these soils. The remainder should be used for improved pasture and soil conservation measures.

Some of the saline soils are Solonchaks, which are particularly widespread in the lower part of the Juba Valley on particular topographic formations. Salt build-up, due principally to the presence of saline groundwaters, is visible in the surface horizons. The texture is normally clayey, while the structure is crumby, unlike the Solonetz; the horizons of the profile are not well differentiated.

To bring these soils into cultivation it will be necessary to lower the groundwater level and to have large quantities of water available for leaching. Thus use of the Solonetz and Solonchak soils must, of necessity, be limited both because of costs and because it is undesirable to return very saline leaching waters to the Juba as this could damage lands farther downstream.

The results of the Land Classification for Irrigation are given in Table 1. The individual soil units belonging to the various classes are plotted on the accompanying 1:200,000 map.

At the end of this Part are described some typical profiles of Solonetz and Grumosols and results soil tests performed are reported (Tab. 2 and 3). They are shown also pictures of typical situations found in the interested areas.

PROFILES OF SOME TYPICAL SOILS

Solonetz (Between Jilib and Faanoole)

\- Profile No 1

Ten kilometres from Jilib towards Faanoole
Levelled plain - El. 90 m a.s.l. - Not well drained
Lithological substratum: Marine sedimentaries
No erosion - High erosion hazard
Vegetation: Thick bush; good tree cover

0 - 10 cm : Dry colour between dark greyish brown and olive brown (2.5 Y 4/5)
Moist colour olive brown (2.5 Y 4/4)
No skeleton. Texture from sandy clay to clay loam

Evident grains of sand on surface. Angular and subangular blocky structure (self-mulching). Hard when dry. Good organic content. Well interpenetrated by roots. Slow drainage.

10 - 40 cm : Dry colour light brownish grey (2.5 Y 6/2)
Moist colour dark greyish brown (2.5 Y 4.2)
No skeleton. Clay loam. Very coarse prismatic structure. Extremely hard when dry. Evident cracking.
Very slow drainage. Interpenetrated by tree roots.
Clearly defined medium and fine mottles common.

40 - 100 cm : Dry colour light grey (2.5 Y 7/2)
Moist colour light brownish grey (2.5 Y 6/2)
No skeleton. Clay loam. Very coarse prismatic structure. Virtually no pores. Drainage very slow to impeded. Virtually no cracks. Penetrated by a few roots. Abundant concretions and nodules.

100 - 150 cm : Moist colour greyish (2.5 Y 5/2)
Similar to one above but with massive structure and impeded drainage.

Profile No 2

About two kilometres north of previous profile

0 - 7 cm : Dry colour greyish brown (10 YR 5/2)
No skeleton. Clayey. Evident sand grains, probably of eolian origin. Fine, angular blocky structure (self-mulching). Pores from common to abundant. Abundant organic matter. Well interpenetrated by roots. Normal drainage.

7 - 20 cm : Dry colour light brownish grey (2.5 Y 6/2)
Moist colour greyish brown (2.5 Y 5/2)
No skeleton. Clayey. Fine prismatic structure. A few small pores. Very slow drainage. Abundant subhorizontal woody roots. Concretions and nodules common. Evident cracking without slickensides.

20 - 100 cm : Dry colour greyish brown (2.5 Y 5/2)
Moist colour between dark greyish brown and greyish brown (2.5 Y 4.5/2). No skeleton. Clayey. Very coarse prismatic structure, almost massive. Very few pores. Very slow drainage. Penetrated by a few roots. Nodules and concretions common.

Profile No 3

About four kilometres north of Profile No 1

0 - 15 cm : Dry colour between dark greyish brown and greyish brown (2.5 Y 4.5/2). No skeleton. Clayey. Fine, angular blocky structure (self-mulching). Pores common. Drainage normal. Abundant grass roots.

15 - 80 cm : Dry colour between dark greyish brown and olive brown (2.5 Y 4/3). Clayey. Prismatic and coarse blocky structure. Few pores. Very slow drainage. Very evident slickensides.

80 - 140 cm : Moist colour between dark greyish brown and greyish brown (2.5 Y 4.5/2). Coarse prismatic structure. Very few pores. Very slow drainage. Abundant slickensides.

Grumosols

Profile No 6

Near Faanoole

Substratum: Recent River Juba alluvium. Evident traces of successive alluvial deposits.

Drainage moderate. Use: Under sorghum

0 - 10 cm : Moist colour dark brown (10 YR 3/3)
No skeleton. Clayey. Fine, angular blocky structure (self-mulching). Normal drainage. Evident cracks. Well interpenetrated by grass roots.

10 - 40 cm : Moist colour dark brown (10 YR 3/3)
Clayey. Coarse blocky structure. Fine but evident slickensides at bottom of horizon. Evident cracks. Slow drainage.

40 - 120 cm : Moist colour between brown and dark greyish brown (10 YR 4.5/3). Clayey. Coarse prismatic structure. Abundant slickensides of all dimensions. Very slow drainage.

Profile No 7

About three kilometres from Saakow Wen
Substratum: Jurassic limestone
Use: Under durra

0 - 15 cm : Moist colour yellowish (5 YR 5/6)
Clayey. Angular blocky structure. Normal drainage. Horizon often tilled.

15 - 50 cm : Moist colour reddish brown (5 YR 4/4)
Angular blocky structure. Slow drainage. Clayey. Few pores. Few or no roots.

Table 1 - Land classification for irrigation suitability

District	Area classified				
	Total	Class 1^	Class 2^	Class 3^	Class 4^
1 LUUQ - DOLOW	33,670	13,198	-	20,472	-
2 BAARDHEERE - SAAKOW	132,490	5,985	126,505	-	-
3 DOWNSTREAM OF SAAKOW	89,940	6,300	4,225	41,055	(1) 38,360
4 DOWNSTREAM OF DUJUUMA	20,463	4,087	16,376	-	-
5 DUFALACH-AFMADOW	22,918	-	22,918	-	-
6 FAANOOLE-JILIB	34,021	10,770	4,751	-	18,500 (1)
7 TOUTA' ISLAND	15,700	10,900	4,800	-	-
8 BAARDHEERE-JONTE	37,900	10,300	27,600	-	-
9 JAMAAME	28,436	16,414	5,330	6,692	-
10 STATE FARMS	13,734	5,133	46	-	8,555 (1)
11 DESCEK UAMO	18,740	-	18,740	-	-
Total	448,012	83,087	231,291	68,219	65,415
%	100	18.7	51.3	15.3	14.7

(1) The Class 4^lands are included in the district envisaged in ditto "The Juba Irrigation Scheme" - 1965

NOTE: The areas on the Baardheere 14, El Waak 12 and 16, and Dif 4 sheets are not included in this table because they lie farther than 50 km from the river and hence it is considered that the Juba waters cannot be conveyed to them economically by canal.

Table 2 - Characteristics

Profile No.	Prof. cm	Texture S %	Texture L %	Texture A %	p^H	Saturation extract Sal. tot. %	Ca^{++} me/1	Mg^{++} me/1	Na^{+} me/1	SAR	p^F 4.2	p^F 2.5
<u>Solonetz</u>												
Profile 1	0- 10	52.0	12.5	35.5	8.2	0.04	4.81	3.14	1.43	0.7	16.83	28.22
	10- 40	51.0	13.5	35.5	8.3	0.26	1.84	4.10	10.87	35.4	17.14	35.18
	40-100	52.0	8.0	40.0	8.1	0.91	23.15	33.47	1[illegible]4.35	34.7	20.50	35.64
	100-140	53.0	9.0	38.0	7.9	1.02	24.10	32.65	187.83	35.3	18.81	38.50
Profile 2	0- 10	46.0	10.0	44.0	7.9	0.09	16.32	7.15	3.26	0.9	18.01	25.85
	10- 20	46.0	9.0	45.0	8.4	0.10	4.91	4.07	9.35	4.4	21.33	33.13
	20-100	48.0	10.5	41.5	8.3	0.46	4.68	7.81	69.57	27.8	20.57	39.27
Profile 3	0- 20	39.0	10.0	51.0	7.9	0.10	3.04	4.00	12.30	6.5	28.12	41.08
	20- 80	35.5	6.5	58.0	8.4	0.85	4.78	10.69	14.25	41.1	25.65	50.91
	80-140	32.5	40.0	63.5	8.3	1.53	29.69	43.10	210.00	34.8	34.06	52.88
<u>Grumosols</u>												
Profile 6	0- 10	26.0	22.0	58.0	7.7	0.11	83.70	6.66	11.74	3.0	15.20	27.45
	10- 50	11.0	29.0	60.0	7.7	0.46	51.40	24.83	63.91	10.4	28.50	41.32
	50- 80	7.0	28.0	65.0	8.0	0.91	22.46	40.71	125.22	22.3	24.64	43.00
Profile 7	0- 15	55.5	18.5	26.0	7.8	0.02	1.90	0.74	1.78	1.5	20.43	32.92
	15- 50	43.5	26.5	30.0	7.9	0.35	16.87	9.29	53.48	14.8	27.23	42.07

Source : Direct surveys and analyses

Table 3 - Absorption rate (K = mm/min) and volume of water drained (H = m^3/ha) - Constant level of water : 5 cm

Time from start of absorption min	Gallery forest soils Pit 140		Grumosols							
			Pit 12		Pit 128		Pit 127		Pit 255	
	K	H	K	H	K	H	K	H	K	H
5	17.5	875	15.0	750	13.8	690	8.0	400	13.7	685
10	9.1	1880	5.3	1040	7.1	1045	4.0	600	4.0	885
15	6.9	1675	4.3	1255	3.3	1210	1.8	690	2.0	985
20	6.0	1935	3.0	1404	2.7	1345	1.3	755	1.8	1075
60	3.0	2235	2.3	1635	1.2	1465	1.0	845	1.2	1195
80	2.5	2985	1.3	2025	0.7	1675	0.35	950	0.5	1345
90	1.2	3345	0.7	2235	0.7	1795	0.15	995	0.4	1465
120	1.2	3705	0.7	2385	0.2	1855	0.15	1040	0.27	1545
150	1.2	4065	0.45	2520	0.2	1915	0.15	1085	0.05	1570
180	0.8	4305	0.40	2640	0.2	1975	0.13	1180	0.05	1585
210	0.8	4545	0.40	2760	0.2	2035	-	-	0.05	1600
240	0.8	4755	0.40	2880	0.2	2095	-	-	0.05	1615

Source: The Juba River Scheme - Sect. V - Soils, Moscow, 1965

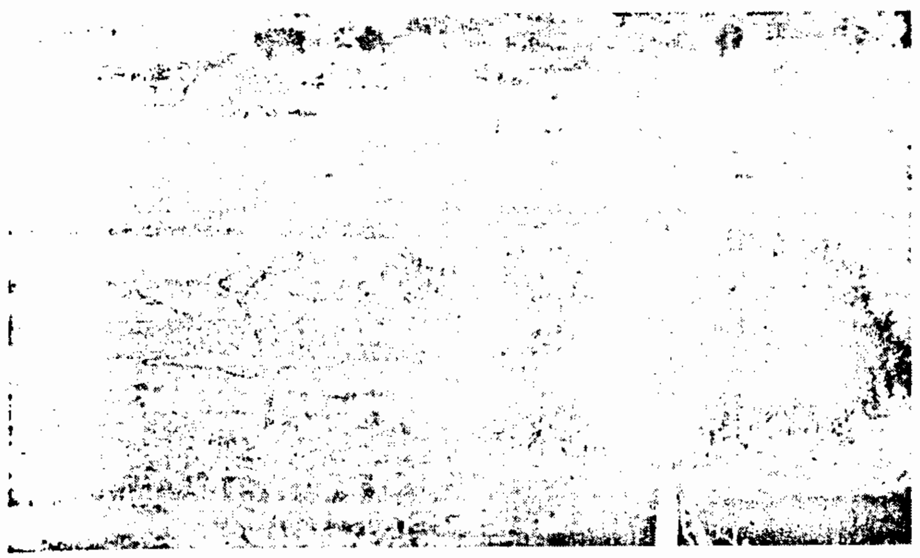


Photo 7 — Solonchak in Lower Juba. Area affected by saline ground waters.
Foto 7 — Solonchak nella bassa Valle del Giuba. L'area è interessata da una falda salata.

Photo 8 — Reddish-brown calcic soil on gypsiferous formation between Luuq and Dolow. It will be difficult to bring these soils under the plough because of their salt content, low field capacity and marked erosion hazard.
Foto 8 — Suolo bruno-rossastro calcico, sulla formazione gessosa, tra Luuq e Dolow. La messa a coltura di questi suoli comporta delle difficoltà: percentuali in sali, bassa capacità di campo, forte pericolo di erosione.

Photo 9 — Detail of Solonetz profile between Jilib and Faanoole. Note coarse structure.
Foto 9 — Particolare del profilo del Solonetz tra Jilib e Faanoole. Notare la struttura grossolana.

Photo 10 — Solonetz north of Dujuuma.
Foto 10 — Solonetz, a nord di Dujuuma.

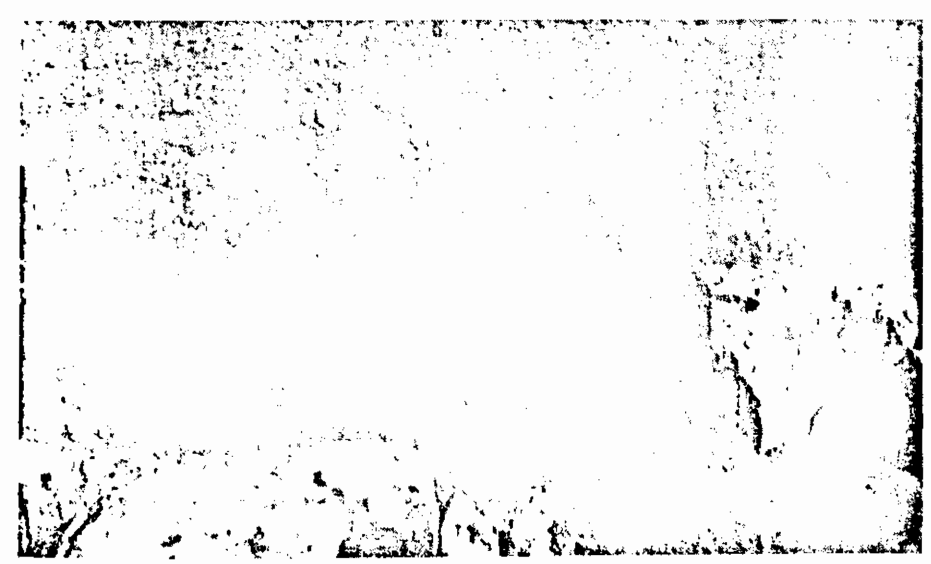


Foto 11 — Terra Rossa sui calcari a nord di Kismayo.
Photo 11 — Terra Rossa on limestone north of Kismayo.

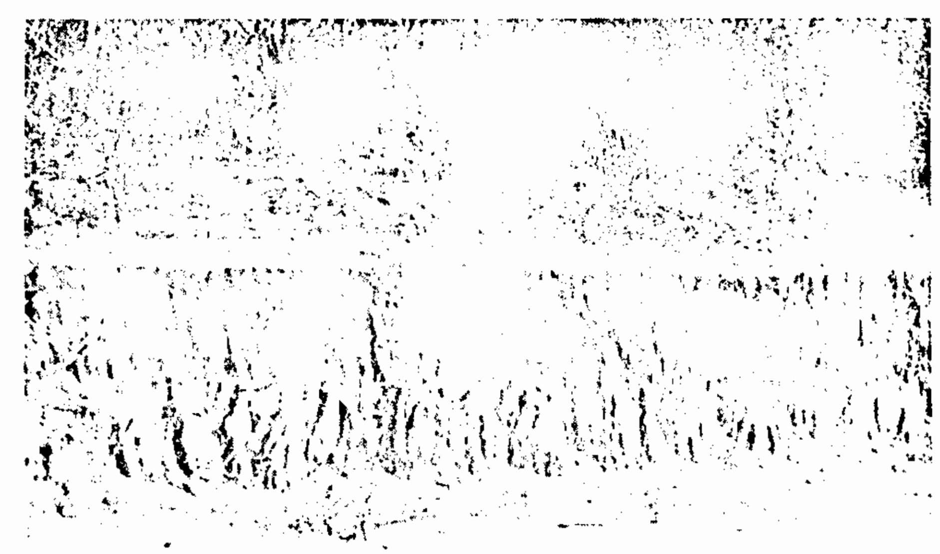


Photo 12 — Dune covered by Terra Rossa.
Foto 12 — Duna ricoperta da Terra Rossa.

Photo 1 — Umboi: Grumosols. Detail of « Kanana » layout for sowing sorghum, sesame and cotton. April 1975.
Foto 1 — Umboi: Grumosols. Particolare della sistemazione a « Kanana » per la semina del sorgo, sesamo e cotone. Aprile 1975.

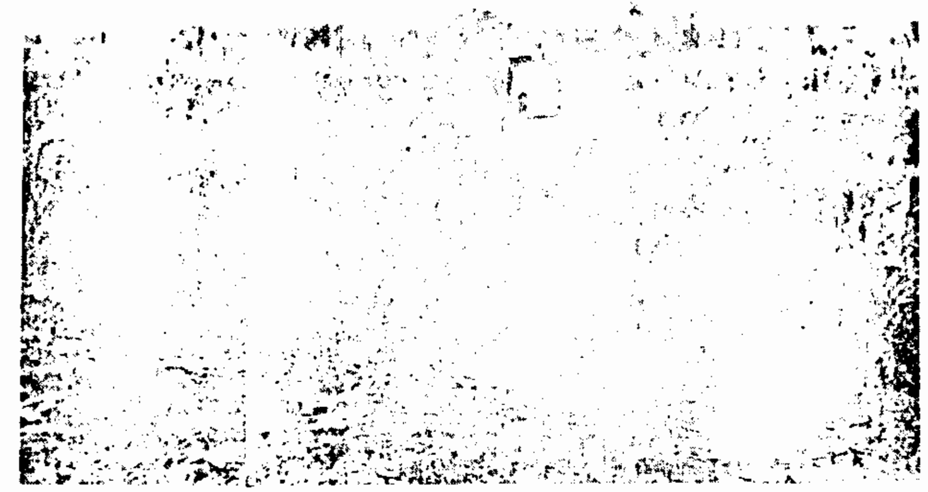


Photo 2 — Umboi:Grumosols - Sesame and sorghum crops. Same area as photo 1. October 1975.
Foto 2 — Umboi: Grumosols - Coltura di sesamo e sorgo. La zona è la stessa della foto precedente. Ottobre 1975.

Photo 3 — Luuq: Alluvial Soils - Sowing in drills. October 1975.
Foto 3 — Luuq: Alluvial Soils - La semina viene effettuata a buchette. Ottobre 1975.

Photo 4 — View of vegetation in the desceks between Andaraf and Afmadow. October 1975.
Foto 4 — Altro aspetto della vegetazione nei descek, tra Andaraf e Afmadow. Ottobre 1975.

Photo 5 — Soybeans: Solonetz — Permeability is no more than moderate.
Foto 5 — Soia: Solonetz — La permeabilità è sempre modesta.

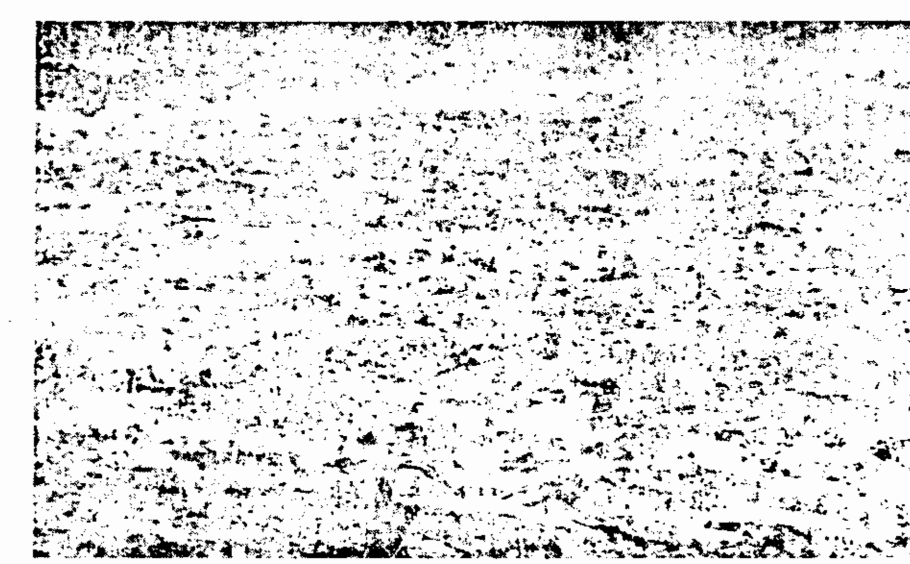


Photo 6 — Soils on gypsiferous formations — Note salt deposits on surface.
Foto 6 — Suoli sulle formazioni gessose — Notare gli accumuli di sale in superficie.

Photo 13 — El Mao Depression. This area has no external drainage, so the soils are hydromorphic and saline, which greatly restricts their use.
Foto 13 — *Depressione di El Mao — La zona manca di rete di scarico. I suoli presentano pertanto una notevole limitazione d'uso per l'idromorfia e per la percentuale di sali.*

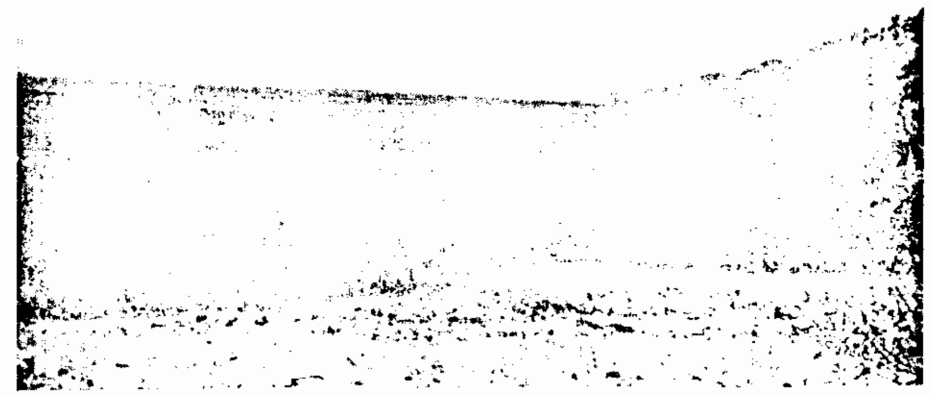


Photo 14 — El Mao seen from the air.
Foto 14 — *El Mao — Vista dall'alto.*

Photo 15 — Wood to the south of Faanoole. The vegetation is in equilibrium with the environment. If it is cleared without taking other appropriate measures, there will be rapid soil erosion.
Foto 15 — *Boscaglia a sud di Faanoole. La vegetazione è in equilibrio con l'ambiente. L'eliminazione della vegetazione senza opportuni interventi determina una rapida degradazione dei suoli.*

Photo 16 — Mogambo Bridge in the Lower Juba, with twelve gates for diverting water to irrigate the Descek Uamo. This structure was built many years ago and is now virtually abandoned.
Foto 16 — *Ponte di Mogambo, nella bassa Valle del Giuba, con 12 paratoie per la derivazione delle acque per irrigare il Descek Uamo. Questa opera, costruita molti anni fa, è oggi praticamente abbandonata.*

Photo 17 — Detail of above photo 16.
Foto 17 — *Particolare della foto precedente.*

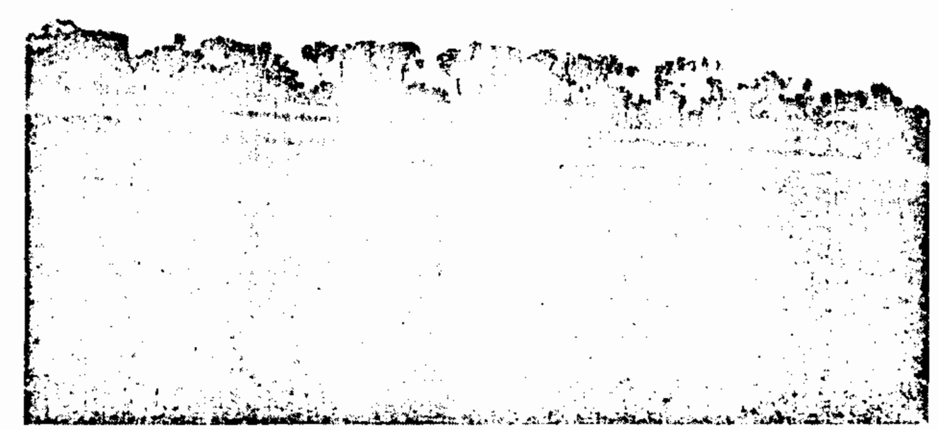


Photo 18 — Rice paddy layout. Rice must be considered as the main crop for leaching Class IV lands. October 1975.
Foto 18 — *Sistemazione per la risaia. Questa deve essere considerata la coltura principale per poter lisciviare i sali dei suoli della IV classe. Ottobre 1975.*

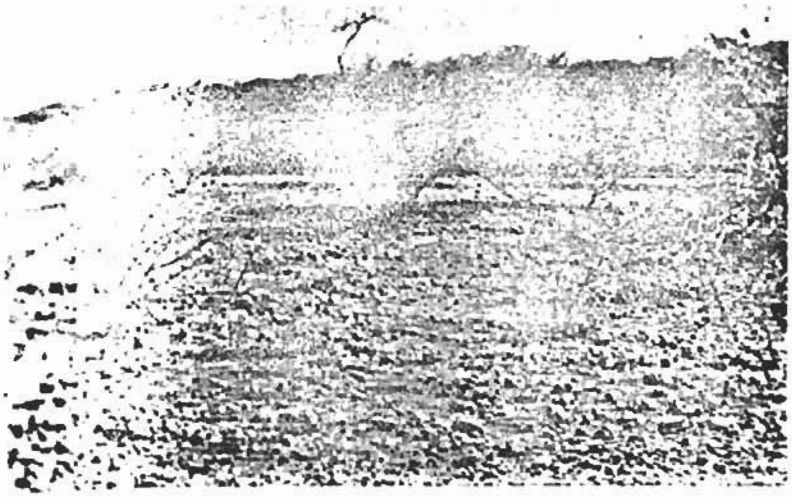


Photo 25

Sheet and rill erosion on volcanic soils in northern Somalia.

Foto 25

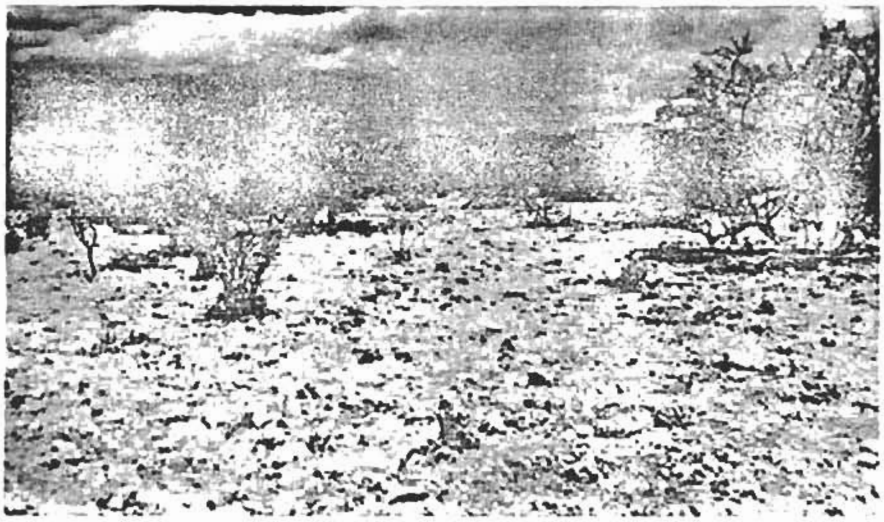
Erosione diffusa ed intensa sui suoli derivati dalle formazioni vulcaniche, nel nord della Somalia.

Photo 26

[illegible] rill erosion on soils derived from soft [illegible]. Land use and the rainfall and runoff [illegible] mainly responsible for the erosion.

Foto 26

[illegible] diffusa ed intensa sui suoli derivati dai [illegible]. L'uso del suolo ed il regime idrome- [illegible] i principali responsabili della degra- [illegible]



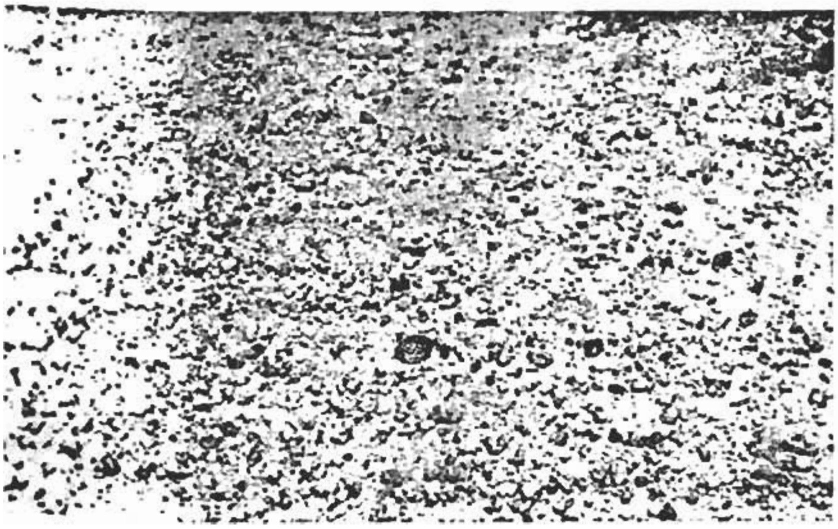


Photo 27

Sheet erosion on soils derived from conglomerates. Once this stage has been reached, it would appear difficult to get the environment back to normal.

Foto 27

Erosione diffusa sui suoli derivati dai conglomerati. Arrivati a questo stadio appare difficile il ripristino dell'ambiente naturale.

3.2 USE CRITERIA AND IRRIGATION METHODS

3.2.1 Erosion Control

It is apparent that environmental conditions favour wind and water erosion: sometimes quite serious. Eolian erosion is more pronounced on the sandy formations and is widespread over the other formations as well. Water erosion is very marked and widespread throughout the Valley. This is probably one of the Somalia's most serious problems. Erosion has caused and can still cause serious irreversible damage over enormous areas, resulting in a gradual breakdown of the entire environment.

Because of the limited availability of suitable soils and because of the high costs involved in their utilization, it is apparent that future use must be so tailored as to avoid any kind of erosion. Therefore, the best approach is to use only part of the lands available, the coefficient of utilization decreasing from Class 1 to Class 4. Indeed not even all the Class 1 lands can be used for agriculture. The Forest Gallery growing along the banks of the River Juba must be touched only to a minimum extent. Soil and vegetation both play a very important part in the stability of the land surface and they help satisfy many general ecological requirements. The erosion hazard is more serious on Class 2 lands and becomes increasingly more so with Class 3 and Class 4. Hence it is felt that not more than 70-90% of Class 1 lands should be used, 50-60% of Class 2, 30% of Class 3 and 10-20% of Class 4.

The rangeland and the tree and bush cover on the areas not utilized for agriculture could be improved by controlled grazing and other measures.

3.2.2 Tilling

For Class 1 lands and for part of those in Class 2 (Reddish Brown Calcic Soils) there would not seem to be much difficulty as regards tilling, while there will be problems for the clayey lands of Class 2 and Class 3 (Grumosols). The tilling difficulties increase when, in addition to a high clay content, salinity and alkalinity are high as well. It must also be pointed out that permeability decreases markedly with irrigation, both because of dispersion and because of the often high percentage of sediment in the water.

In all cases these lands must be tilled at a moisture content which favours maximum break-up of the clods, while total dehydration after tilling should favour a better structure. The tilling depth should increase progressively over the years.

Better results will be obtained when reclaiming and bringing these lands into cultivation if fertilizers are applied, alkalinity is corrected, salts are leached out, etc.

3.2.3 Irrigation

From what has been seen, it would appear that the best method of irrigation, especially for the clayey soils (Grumosols and Solonetz) will be low pressure sprinkler type. The drawbacks with such a system could be the amount of wind during the daylight hours and, in some instances, the amount of suspended solids in the water from the Juba. These limitations do not exist or are much less marked during the nighttime hours or if well waters are used. Observations made along the Juba Valley and especially along the Sheebeeli Valley reveal the importance of studying river waters from this aspect too, since the diversion canals are often blocked by clay and silt transported and deposited by the waters.

There are also problems as regards soil permeability and water application rates. These differ quite considerably from one soil to another, as shown by the observations made during the rainy period on the irrigated farms and by the results reported in "The Juba Valley River Scheme, Section V, - Soil", Moscow, 1965.

Regarding variability of soil permeability, for example, that of the recent alluvial soils (Gallery soils) is 100% greater than that of the Solonetz. Permeability also decreases with time on all soils and becomes virtually nil on the more saline ones. Thus these values will have to be checked, especially after certain basic action has been taken to improve soil structure and permeability (layout, leaching, tilling, etc.).

On the orchard lands (grapefruit) it is suggested that the trickle system of irrigation be adopted, as this can certainly give very good results whether the water to be used for irrigation be depurated of solid content.

3.2.4 Drainage and leaching

The problem of drainage in environments such as these is certainly an important one when lands are being brought into cultivation, especially under irrigation. Good drainage improves the soil characteristics and results in improved yields. On the contrary, absence of drainage results in a worsening of soil characteristics, such as permeability and structure and the effects on yields are disastrous. Very evident examples of this can be observed in the Lower Valley of the Juba, particularly on the banana plantations.

Thus all the advantages of irrigation tend to disappear unless efficient drainage systems are installed to carry away surface and subsurface waters. Only in this way is it possible to control permeability and the amount of salts that can be leached out. It has been noticed that most of the soils have a high salt content, which must be eliminated through drainage and leaching. The possibilities of subsurface drainage (tile drains) must not be neglected in this regard. This should prevent the rise of possibly saline groundwaters and favour the rapid disposal of leaching waters. The leaching methods adopted and the choice of the best techniques are of particular importance for the development of these lands.

CHAPTER 4.

SURVEYS, EXPERIMENTATION AND TRIALS

The evaluation of the lands as regards irrigation use naturally necessitates observation and examination of numerous environmental aspects: physical, geographic, agronomic, ecological and socio-economic at the right degree of detail. The climate also has a very marked influence on the soil and on the plants (natural and cultivated) as well as on erosion.

The Solonetz, Grumosols (Vertisols) the Reddish Brown Calcic Soils etc. clearly illustrate the influence of climate on pedogenesis, as does the serious erosion which wreaks irreparable damage where the natural equilibrium is upset. Hence it is felt that not all the arable soils should be completely irrigated, but only a proportion thereof, depending upon their irrigation suitability.

It is thus apparent that the following is required:

a. Soil Map

A 1:20,000 aero-photogrammetric survey must be made of the whole Juba Valley and one at 1:10,000 of the future irrigation districts. Semi-detailed soil surveys, plus detailed surveys in areas which will be used shortly, are also needed.

After the soil map has been drawn up it will be possible to prepare maps showing "Land Evaluation" with special reference to "Land Classification for Irrigation Use", "Land Capability", etc. A "Soil Map" and a "Land Classification Map" at a suitable scale which brings out all the soil and land characteristics are essential for valley development plans. The report which will accompany the maps will deal with the following points: depth, permeability (to water and air), root penetration capabilities, water resources, present erosion and erosion hazards, salinity, hydromorphic characteristics, factors due to human presence, etc.

b. Experimentation and trials

There is little information available on bringing these lands into cultivation, and even this is fragmentary and limited to soils derived from the recent alluvium of the Lower Juba Valley; in other words the area which has been longest settled.

For most of the soils it will be possible to derive pointers from work done in other countries with similar environments, however, this must be checked by trials run in the field.

These will have to cover the following points, bearing in mind the information and observations made: tilling, fertilization, improvement of physical characteristics (drainage and structure), activation of drainage layout techniques, irrigation techniques, control of irrigation waters, quantification of erosion in various areas, salt balance in soil, etc.

Particular care will have to be paid to the control of the Juba waters, especially as regards flows coming from fields which are leached, so as to avoid the salt content of the waters gradually reaching higher percentages.

As regards climate, it will be essential to set up a number of meteorological stations equipped with self-recording devices which can operate for a long time without attention. Micro-climates are of the greatest importance especially as regards growth and yields of certain vegetable species, so these will have to be studied, since there are no data available on this aspect at present. A study of winds is also of particular importance, both for the effect they can have on crops and for the choice of irrigation systems and type of installations.

P A R T II

AGRICULTURE AND LIVESTOCK SITUATION IN THE VALLEY

CHAPTER 1.

LAND USE

GENERAL

The Juba Valley covers an area of around 170,000 km^2, or something like a quarter of Somalia as a whole. Administratively it falls within four regions, Jubbada Hoose, Gedo, Bay and Bakool. However, from the economic aspect the Valley must be considered as limited to the first two of these, as the other two regions gravitate around Mogadishu and the northern Somalia, a situation that is likely to continue.

It is thought that the Juba Valley, considered in terms of the traditional administrative boundaries of Lower and Upper Juba, may contribute something like 17% of the Gross National Product. The smallness of this figure is explained by the fact that non-agricultural activities account for such a small share (10%) compared with agriculture (26%).

The Valley has about a quarter of the country's population, the figure being estimated at 780,000.

Let us now consider the two regions of Jubbada Hoose and Gedo; these account for a mere 10% of the country's GNP, and contain 12% of the population. However, these two regions differ from one another both as regards population and economy. Jubbada Hoose, with its 236,000 inhabitants, has a population density of 4.3 per km^2, while Gedo, with its 150,000, has 2.9. The GDP of Jubbada Hoose (So Sh 100 million) gives a per-capita income of a little over So Sh 400, which is four times the So Sh 100 of the Gedo Region (GDP of barely So Sh 15 million). This derives from the fact that agricultural activity in Jubbada Hoose is largely inserted in the market economy, especially trade with abroad (bananas and meat). This has provided the necessary support for development of the commercial sector and modern industrial enterprises (meat-packing and packaging materials). Because of the amount of bananas and canned meat shipped out through Kismayo, this is Somalia's leading port as regards tonnage and its second in terms of value.

In the Gedo Region, instead, the only agricultural products inserted in the market economy are cereals and - solely in the Baardheere area - onions, which are supplied to most of the towns in the country.

AGRICULTURE: CHARACTERISTICS AND DISTRIBUTION

Traditionally the agricultural peoples in the Juba Valley cultivate the areas along the river and around the depressions (deschek) which collect runoff and the waters from the Gu and Der floods.

Another part of the population considers agriculture as a sideline to herding, which necessitates part of the labour force remaining far from the villages for long periods. In this kind of society, agriculture is limited to the production of crops for domestic consumption; it is only in the best years that sufficient food is grown to enable the excess to be marketed.

Traditional farms (shambas) are never larger than four hectares. They are worked individually by the families concerned. The amount of land actually tilled depends essentially on the rainfall trends, and insufficient food may be grown because of the irregularity of the rains. Diversification of products is obtained by interplanting rather than by crop rotation.

Maize is the main crop in the first season (Gu), followed by cotton, sesame, beans and a few interplanted vegetables. Maize is also the main crop in the second season (Der), with sesame and sorghum.

This kind of agriculture is designed essentially to satisfy the basic needs of the local peoples. However, over the years another type of agriculture, based on controlled irrigation has come into being in some areas. This concentrates on cash crops for export, the essential ones being rice, cotton, citrus and - in pride of place - bananas.

There are no statistics with the right degree of breakdown with which to draw in an exact picture of the farming situation in the Study Area. According to FAO figures (1), some 70,000 ha were cultivated in 1963-1964 (see Fig.1.II), three main systems being adopted, namely:

Rainfed farming	on 27,882 ha (approx.)
Flooded land farming	on 39,650 ha (approx.)
Controlled irrigation farming	on 2,080 ha (approx.)

The situation with regard to the future irrigation districts is given in Table 1.

Table 1 - Cultivated areas (1963-1964)

Areas relative to future irrigation districts	Rainfed ha	Flooded ha	Irrigated ha	Total ha
1 Luuq - Dolow	1,740	-	-	1,740
2 Baardheere - Saakow	24,400	-	-	24,400
3 Downstream of Saakow	1,090	2,970	-	4,060
4 Downstream of Dujuuma	-	4,140	-	4,140
5 Dufalach - Afmadow	-	-	-	-
6 Faanoole - Jilib	-	4,455	-	4,455
7 Toutà Island	97	6,370	-	6,467
8 Baardheere - Ionte	510	5,600	700	6,810
9 Jamaame	45	9,215	1,380	10,640
10 State farms	-	400	-	400
11 Descek Uamo	-	6,500	-	6,500
Total	27,882	39,650	2,080	69,612

It is apparent from Table 1 that rainfed farming is practised mainly in the Upper Juba, flood-farming from Saakow downstream, and irrigated farming along the lower course of the river.

Rainfed farming is pursued in the areas where rainfall is lowest. It concentrates mainly on the production of sorghum, maize, sesame and groundnuts. Yields are low even in years with good rainfall and the results are always uncertain. Virtually the whole of the production is consumed by the farming family.

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(1) See: "Land use" map 1:200,000 (Dwg IV, II, 1.1)

Photo 19 — Detail of irrigation canal along the Shebeli. Note amount of deposited silt. This fact may constitute a limitation for sprinkler irrigation systems that draw water directly from the river.
Foto 19 — Particolare di un canale per l'irrigazione lungo lo Shebeli. Notare la carica solida sedimentata. Questo fatto può costituire una limitazione per gli impianti di irrigazione a pioggia con acque prelevate direttamente dal fiume.

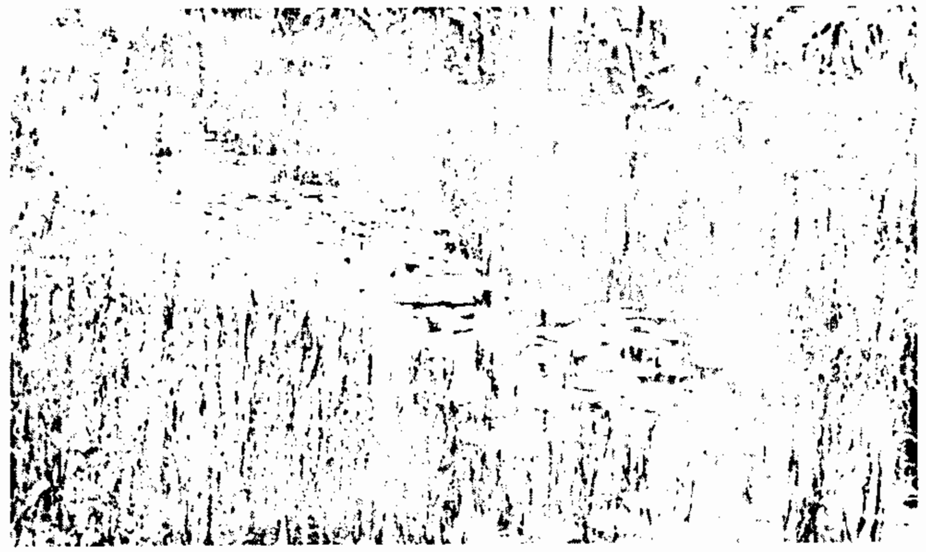

Photo 20 — Lower Juba Valley. Hydraulic-agricultural layouts here are not always efficient. Damage to crops (mainly bananas) and soils is considerable. October 1975.
Foto 20 — Bassa Valle del Giuba. Le sistemazioni idraulico-agrarie non sempre sono efficienti. I danni alle colture, principalmente banani, ed al suolo sono rilevanti. Ottobre 1975.

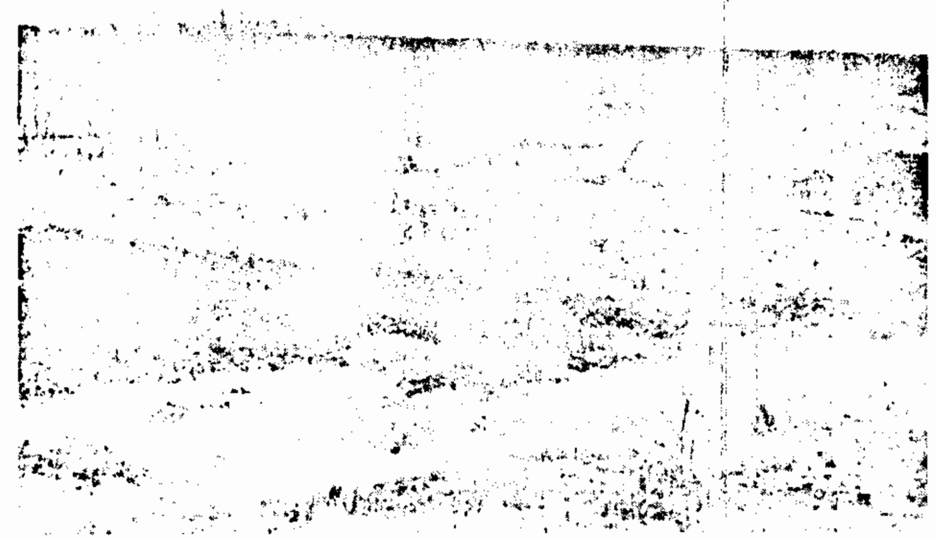

Photo 21 — Example of gully and sheet erosion in the Upper Juba Valley. April 1975.
Foto 21 — Esempio di erosione incanalata e diffusa nell'alta Valle del Giuba. Aprile 1975.

Photo 22 — Example of erosion.
Foto 22 — Esempio di erosione.

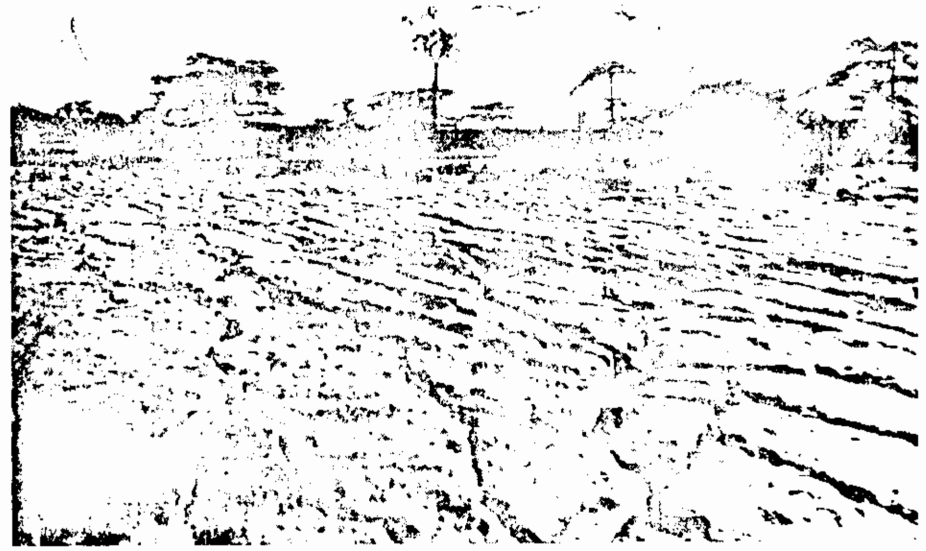

Photo 23 — Example of catastrophic erosion. NW Somalia.
Foto 23 — Esempio di erosione catastrofica. Somalia N-O.

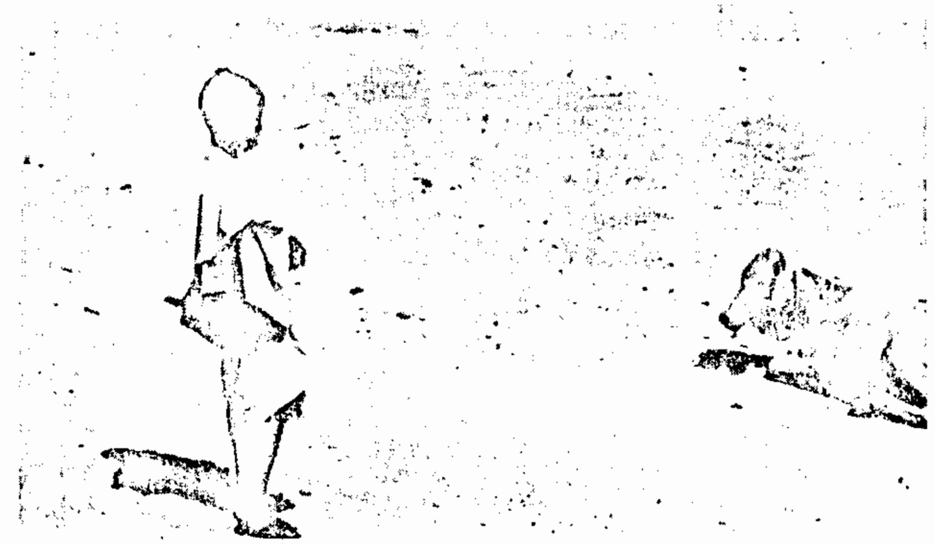

Photo 24 — Sheet erosion around Descek Uamo.
Foto 24 — Erosione diffusa nei bordi del Descek Uamo.

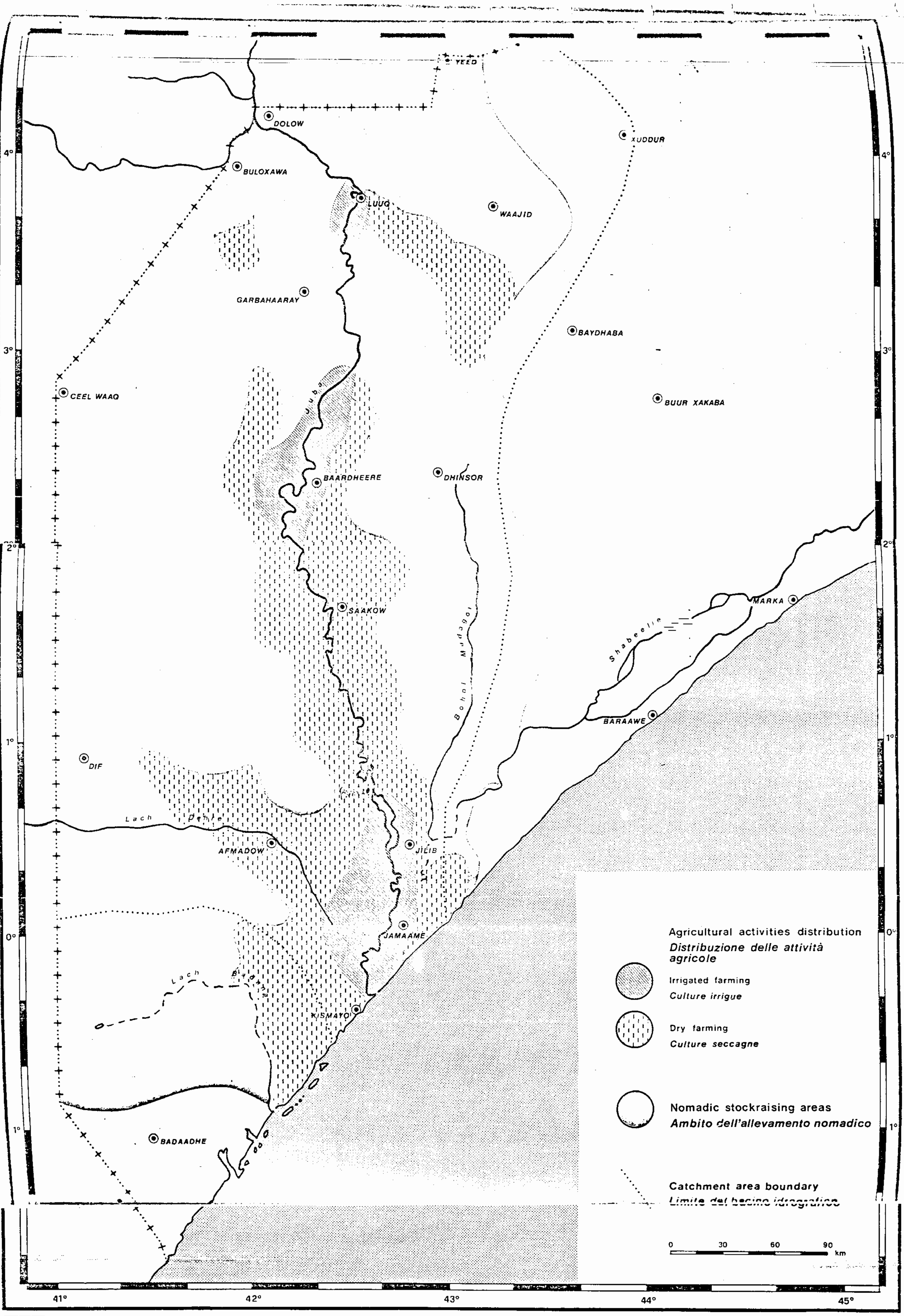

fig. 1. II

LAND USE

UTILIZZAZIONE DEL TERRITORIO

The lower-lying lands, where sufficient moisture is stored in the soils during the wet seasons to permit the growing of seasonal crops such as cotton, maize, sesame and groundnuts, are cultivated all along the river. The inflow of water prior to sowing is favoured by the construction of small ditches and ridges, though these in no way enable the inflow and outflow to be controlled. Consequently, it is inevitable that the land may receive too much or too little water, and it ensues that the yields obtained are more or less the same as those from dry-farmed areas in years with average rainfall.

Controlled irrigation, with water being pumped onto the lands, was started to permit development of banana-growing, this crop being sufficiently valuable to repay the investment needed to buy and install pumps and roughly level the plantations. In the last fifteen years, irrigation has also been extended to other crops, but only grapefruit has given economically viable results. The return from seasonal crops has not been sufficient to repay irrigation expenses, unless grown as a sideline on banana plantations. The one exception is rice, but its introduction is recent and as yet it is not widely grown in the Study Area.

On the basis of preliminary statistical data and other information collected directly for the 1975 Gu season, the areas presently cropped, the yields and total productions are estimated as shown in Tables 2 to 7.

Inspection of these data indicates that there has been an expansion in the areas cropped during the last ten years, especially under irrigation.

Table 2 - Lower Juba irrigated crops (ha)

Crop	Gu	Der	Total
Bananas	-	-	5,025
Grapefruit	-	-	80
Dwarf coconut	-	-	25
Maize and sorghum	950	700	1,650
Upland rice	100	180	280
Cotton	50	-	50
Vegetables and pulses	40	120	160
Oil seeds	40	90	130
Tobacco	30	-	30
Total	1,210	1,090	7,430

Table 3 - Upper Juba irrigated crops (ha)

Crop	Gu	Der	Total
Bananas	-	-	30
Grapefruit	-	-	3
Maize and sorghum	630	200	830
Onions	350	420	770
Tobacco	80	-	80
Vegetables and grain pulses	130	-	130
Oilseeds (groundnuts + sesame)	-	240	240
Total	1,190	860	2,083

Table 4 - Lower Juba irrigated crop yields and productions

Crop	Area harvested	Yield ql/ha	Production ql
Bananas	5,025 (1)	184	925,000 (2)
Grapefruit	80	120	9,600
Coconut	25	6	150
Maize	950	9	8,550
Sorghum	700	8	5,600
Rice	280	20	5,600
Cotton	50	7	350
Pulses	120	10	1,200
Vegetables	40	20	800
Groundnuts	40	12	480
Sesame	90	6	540
Tobacco	30	10	300
Total	7,430	-	-

(1) Only 3,995 ha in production
(2) In 1974 70% of the production was exported (647,510 ql)

Table 5 - Upper Juba irrigated crop yields and productions

Crop	Area harvested	Yield ql/ha	Production ql
Bananas	30	120	3,600
Citrus	3	50	150
Maize	400	9	3,600
Sorghum	430	8	3,440
Onions	770	120	92,400
Tobacco	80	-	-
Vegetables and pulses	130	10	1,300
Groundnuts	80	12	960
Sesame	160	9	1,440
Total	2,083	-	-

Table 6 - Lower Juba rainfed crop yields, productions and areas (1)

Crop	Area (ha)	Yield (ql/ha)	Production (ql)
Maize	21,430	4.0	85,720
Sorghum	700	3.5	2,450
Cotton	3,800	4.3	16,340
Sesame	5,000	2.2	11,000
Pulses	3,638	4.5	15,400
Total	34,568	-	-

(1) Districts of Jilib, Jamaame and part of Afmadow

Table 7 - Upper Juba rainfed crop yields, productions and areas

Crop	Area (ha)	Yield (ql/ha)	Production (ql)
a. Gedo Region (Luuq, Saakow, Garbahaaray & Baardheere dists.)			
- Maize	4,050	4.4	17,820
- Sorghum	42,600	4.2	178,920
- Cotton	2,770	1.7	4,709
- Pulses	400	5.0	2,000
- Sesame	600	4.0	2,400
	(50,420)		
b. Bay Region			
- Maize	1,230	5.7	7,011
- Sorghum	75,750	4.0	303,000
- Cotton	2,050	1.0	2,050
- Pulses + Sesame	2,870	-	-
	(81,900)		
c. Bakool Region			
- Maize	1,000	4.0	4,000
- Sorghum	14,600	2.3	33,580
- Cotton	1,100	4.2	4,620
- Pulses + Sesame	100	-	-
	(16,800)		
Total Upper Juba (a+b+c)			
- Maize	6,280		28,831
- Sorghum	132,950		515,500
- Cotton	5,920		11,379
- Pulses + Sesame	3,970	-	-
	149,120		

1.3 TECHNICAL LIMITS OF PRESENT AGRICULTURE

Table 8 sets forth the average yields that are presently obtained. These confirm what has already been said and generally agreed. They especially highlight the unacceptably low productivity of annual irrigated crops, which explains why such crops are not common either in the Study Area or in the country as a whole.

This is not an unusual fact, but it is complete contrast with the growing development of agricultural activity, even in Somalia. The reason for the situation is readily apparent, being the completely inadequate lack of control of the waters and the backward state of the other means of production. Indeed, it is evident that the local traditional farmer can attain the level of production permitted by the means he has available, but the same cannot be said about the plantations, which are the only farm enterprises that can practice controlled irrigation.

Table 8 - Average yields (ql/ha)

Crop	Rainfed farming	Flood-fed farming	Irrigated farming
Maize	2 - 4	4 - 7	10 - 12
Sorghum	2 - 3	3 - 4	-
Sesame	1.5 - 3	2 - 5	5
Groundnuts	3 - 5	7 - 10	8 - 12
Rice (paddy)	-	-	20 - 50
Upland rice	-	?	18 - 20
Cotton	1 - 3	2 - 4	15 - 20
Pulses	2 - 3	3 - 5	4 - 8
Tomatoes	-	?	20 - 30
Bananas	-	-	180
Sugar cane	-	-	700 (1, 2, 3)
Grapefruit	-	-	120

(1) Yearly production in a 14-18 month cycle at Johar (Shebeli)
(2) Yearly production on the Shebeli
(3) Average yield of industrial sugar is around 10-10.5% and that of polarized sugar 19-20%.

It has been generally found that one of the features of controlled irrigation here is the use of excessive quantities of water, which cannot be properly disposed of, owing to the inadequate drainage system. This feature is evident particularly for perennial crops whose yields gradually fall. The Shebeli Valley contains several examples of this: the build up of salt in the water exacerbates the adverse effects of the excess of moisture in the soil, sometimes very markedly.

These phenomena are less evident with seasonal crops, because the lands are watered fewer times over the year and the soils enjoy a period of fallow. However, with these crops the failure to introduce modern technical inputs is even more serious and of decisive importance; indeed, it is such as to prejudice the development of the country. One point in this regard to which attention must be drawn is the failure to use selected seeds; this leads to many delusions. It cannot be expected that seeds that are selected naturally under marginal farming conditions can produce more than is permitted by the intrinsic limits of their genetic constitution.

The same can be said with regard to banana-growing. At the moment, the plantations are composed of non-homogeneous "genetic populations", where there are streams of different productive potentials (1).

Large state-financed irrigation projects alter the terms of the economic problem for the farmer, saving him the cost of investments. However, unless the present production limits are exceeded, the economy of the Project as a whole will be jeopardized and it will be impossible to attain the planned investments. The present yields must not be considered acceptable in a development area; thus a general renewal of current agricultural techniques is required.

Tables 9 and 10 indicate present irrigation water consumption, as derived from the meteorological data for Baardheere and Jamaame Stations.

(1) Reliable information based on recent studies concerning the botanical and variety aspects indicate the possibility of achieving a substantial increase in yields (by 50 to 100%) if more productive clones are used.

Table 9 - Lower Juba : Present reconstructed irrigation consumption (in m^3)

Crops	Irrigated area (ha)		J	F	M	A	M	J	J	A	S	O	N	D
Banana tree	5,025		8,999,775	8,271,150	9,045,000	5,909,400	4,009,950	4,512.450	5,120,475	7,326,450	6,828,975	7,542,525	8,629.900	8,999,775
Grapefruit	80		93,120	85,600	93,600	44,400	13,680	24,720	34,000	69,120	61,840	70,640	89,200	93,120
Dwarf coconut	25		38,050	34,975	38,250	22,750	13,225	16,125	19,100	30,075	27,700	30,900	36,475	38,050
	Gu	Der												
Maize + Sorghum(1)	950	700	133,175	-	-	108,062	439,731	912,750	635,075	142,856	96,950	757,050	1,021,300	932,225
Upland rice	100	100	36,270	-	-	12,487	54,162	73,000	74,284	16,100	26,797	208,530	277,920	253,890
Cotton		50	-	-	-	4,025	11,417	19,650	25,500	41,517	5,350	-	-	
Vegetables + Pulses Oil seeds	80	210	32,917	-	-	6,440	18,270	31,440	35,700	9,490	22,470	178,421	252,210	230,419
Tobacco	30	-	-	-	-	3,078	11,550	16,830	17,822	4,192	-	-	-	
Need to plants			9,933,307	8,391,725	9,176,850	6,110,642	4,571,985	5,606,965	5,961,956	7,639,800	7,070,082	8,788,066	10,300,005	10,547,479
Need to scheme (efficiency 0.5)			18,666,614	16,783,450	18,353700	12221,284	9,143,970	11,213930	11,923,912	15,279600	14,140,164	17,576132	20.600010	21,094.958
Continous flow (m^3/sec.)			6.96	6.94	6.85	4.7	3.40	4.32	4.45	5.70	5.45	6.56	7.94	7.87
Peak flow for 24 hours l/sec/ha													1.30	

N.B. - Climatic data at Jamaame station

(1) - Need of maize

Table 10 - Upper Juba - Present reconstructed irrigation consumption (in m^3)

Products	Cultivated area ha	J	F	M	A	M	J	J	A	S	O	N	D
Bananas	30	54,810	50,970	57,240	25,890	38,520	51,660	51,630	52,200	51,720	36,150	32,940	45,480
Citrus fruit	3	3,021	2,802	3,147	141	1,380	2,841	2,338	2,871	2,844	1,140	948	2,118
Maize and Sorghum	630 200	255,850	33,975		46,541	556,762	922,320	806,479	116,471		20,950	131,250	231,200
Vegetables (onios)	770	537,180	436,957	70,140	13;956	225,094	421,750	421,750	373,012	52,719	34,387	212,047	409,920
Tobacco	80				4,000	66,096	110,240	99,144	11,136				
Vegetables and pulses	130					95,550	156,650	414,219	19,792				
Oil seeds (sesame and groundnut)	240	306,960	285,360	-	-	-	-	-	-	-	-	17,310	204,960
Need to plant		1,157,821	810,064	130,527	90,528	983,402	1,665,461	1,796,060	575,482	107,283	92,627	394,495	893,678
Need to district (efficiency 0.5)		2,315,642	1,620,128	261,054	181,056	1,966,804	3,330,922	3,592,124	1,150,964	214,566	185,254	788,990	1,787,356
Continuous flow (m^3/sec.)		0.86	0.67	0.1	0.07	0.73	1.28	1,34	0.43	0.08	0.07	0.3	0.67
Peak flow for 24 hours in l/sec/ha		-	-	-	-	-	-	1.10	-	-	-	-	-

N.B. - Climatic data of Baardheere station

CHAPTER 2.

LIVESTOCK

ESTIMATE OF LIVESTOCK NUMBER

An initial census of population and livestock was made in Somalia in early 1975. As soon as the figures are published, accurate, up-to-date data will be available on the livestock situation in the Juba Valley.

However, whilst awaiting these statistics it was considered advisable to refer to the estimates made for the Agricultural and Water Surveys performed in 1964 on behalf of FAO (13) for what were then called the Upper Juba, Lower Juba, Benadir and Hiran regions, also embracing the present study area. These estimates are based on a sample count made from low-flying aircraft towards the end of "Gu" (the main rainy season) which occurs between June and early July.

This period was selected to estimate the number of livestock as then the animals are most widely spread out over the country, beause after the rains the herds move away from the rangelands nearest to the waterpoints and go towards areas where grazing and water are available after the rains in natural and man-made depressions.

More recent estimates of livestock numbers are available in the following literature (16), (17), (20) and (33), but these do not permit an appreciation of the number of species raised in the various natural regions, as they refer to Somalia as a whole. Moreover, they are not based on counts but on indirect assessments.

Data on livestock numbers for the Juba Valley in 1964 can be obtained by extrapolating figures from the FAO report mentioned above (13);

Cattle	1,000,000
Sheep	150,000
Goats	750,000
Camels	500,000

As more than 10 years have elapsed since these estimates were made, it will be necessary to use them with due caution. Various events which may have modified the number of the head of livestock in one way or another over the last decade are as follows:

- the amount of veterinary work which has been done, especially treatment to counter Trypanosomiasis and the JP 15 campaign for the eradication of rinderpest, in operation since 1969;

- the droughts of 1964-65, 1968-69 and especially the recent long drought of 1973-74.

Fortunately the damage caused during the last drought was not severe in the centre-south part of the Juba Valley where most of the cattle are to be found because of the rangelands and watering facilities.

Serious losses occurred, however, in the northern regions of Bakool and Gedo (32), where, because of natural conditions, camel, sheep and goats are raised rather than cattle. Another important factor is that livestock losses during drought periods normally occur among old and weak animals and among very young ones which the mothers have been unable to feed. In view of this, it should be relatively easy to build up the herds again fairly rapidly as soon as grazing and watering conditions return to normal.

Regarding the distribution of the various species in the Study Area, on the basis of the FAO estimates (13) confirmed by field investigations, the following points may be made:

- About 80% of the cattle in the Juba Valley are in the central and southern regions (Buur, Eluviated Plain, Lac Dera, Marine and Dudumali Plain). These regions have the highest concentration of cattle, even when Somalia as a whole is considered, while the number of sheep and goats (20% of the total in the valley) and of camels (40%) is relatively limited. In the case of the nomadic herders in the lower Juba, cattle are used instead of camels as beasts of burden.

- On the dry plateau lands of the northern regions of the Juba Valley, (Mandera - Ceel Waaq Uplands, Upper Juba Valley, part of the Central Uplands and of the Faafadun Plain) sheep and goats are most common (approximately 80% of the total number in the study area and something about 50% of the livestock in these regions) and camels (approximately 60% of the total and about 30% of the livestock of the zone). These regions are not well adapted to cattle-raising because of the poor forage availability and the low rainfall, together with unfavourable terrain conditions.

- Comparing the estimates of the Agricultural Water Surveys (13) made in 1964 with an earlier estimate for 1952, it is apparent that in the Upper and Lower Juba, Benadir and Hiran, there is an upward trend in the number of cattle (+64%) and a decrease in camels (-38%) and sheep and goats (-38%).

As there are no data available yet on the last livestock census, for the purpose of the cattle-raising project in the study area, an estimated figure of 1,200,000 head will be adopted. This seems to be the most common estimate amongst those who have been concerned with livestock matters over the past ten years.

2.2 NOMADIC AND SETTLED STOCKRAISING

At the present time, stockraising in the Juba Valley is practised by nomads and by farmers following time-honoured methods. Extrapolating the estimates of the Agricultural and Water Surveys Report (13) for 1964, it is evident that stockraising in the Juba Valley is almost exclusively a nomadic occupation, indeed, herders accounted for 70% of the cattle, 85% of the sheep and goats and 80% of the camels.

The following results emerge from an analysis on the amount of nomadic stockraising in various natural regions of the study area:

- The percentage of cattle raised by nomads compared with that raised by farmers increases as we go from the arid plateau lands of the northern part (in Mandera - Ceel Waaq, Upper Juba Valley, part of the Faafadun Plain and of the Central Uplands, only 25% of the cattle are raised by nomads, the remaining 75% being raised in the dry farmed areas around Baydhaba where more water and forage are available towards the central regions (80% of cattle raised by nomads and the ramaining 20% by farmers in the agricultural areas between Baardheere and Dujuuma) and the coastal area (90% of the livestock raised by nomads, there being little agriculture in this area, while the no-have huge herds of cattle which find more ideal conditions as regards forage and watering points).

- The percentage of camels raised by the nomads also increases going from the highlands (75%) to the coastal regions (95%), but in any case in view of the way that camels adapt to nomadic life, they are generally raised by the herders for their milk and for a small amount of meat and also as draft animals. In so far as the farmers are concerned, the animals are, instead, used mainly for transport.

- Sheep and goats are also well-adapted to a nomadic existence and it is found that the nomads always raise considerably more of these animals than the farmers. In this case, the percentage varies little from one natural region to the other, being in the 85 - 90% range. Sheep and goats normally constitute the main means of subsistence for the women and the children of the nomadic families.

2.2.1 Livestock Raised by Farmers

As has been seen, stockraising in the Juba Valley is mainly nomadic, however, the following points may be made with regard to livestock raised by the farmers.

- This form of stockraising falls between true nomadic herding and settled stockraising, in as much as at night the animals are closed in pens known as "zeribe" near the farmhouse "mundul" in the village; during the day, throughout the rainy season, they feed on the fallow lands and the bush, and in the dry season, after the harvest, they are fed on crop residues or allowed to graze the maize or sorghum stalks which have been left in the fields.

- A particular form of stockraising is to be observed in some urban areas to satisfy the milk demand. Here cows are kept in the town while in milk and at the end of lactation they are sent back to the herders once again. During the period they are kept in town they are sheltered from the sun beneath plants grown between the houses and are fed on forage brought in from the surrounding areas, often supplemented by byproducts of cereal processing (maize and sorghum middlings) and oil seeds.

- The FAO Survey (13) indicated that the proportion of farmers who kept livestock varied from 100% in the Upper Juba Valley to 37% in the Shebeli Flood Plain. This shows that the raising of livestock by the farmers depends largely upon the presence or absence of the tsetse fly.

- The FAO Survey (13) also indicated that on average the farmers kept around 12 head of cattle. Few farmers had any sheep, the average being 1 per family. Some 10 - 20% kept goats, the average being 4 head per family, but this does not reflect the true situation since goats are raised in herds of 20 - 100. The average number of camels per family was around 3. The farmers generally use the camels for transport, since milk and meat come mainly from the cattle.

- It was observed that the farmers mainly raised Surco cattle, and it would seem that the preference for these animals derives from the assumed higher fat content of the milk, which the farmers use to make "subag" (a semifluid kind of butter-ghee) which is a basic part of their diet.

- In general the cattle raised by the farmers were found to be in considerably worse condition than those raised by the herders, especially those encountered between Kismayo and Afmadow.

2.2.2 Nomadic Herding

This is the main form of stockraising in the Juba Valley. It is justified by the climatic conditions of the area and by the fact that the tsetse fly is to be found near the river. Climatic conditions are characterised by very irregular rainfall accompanied by high moisture losses through evaporation because of the high temperatures and persistent monsoon winds. The rains fall mainly in two seasons. The average annual figure is between 200-300 mm in the northern part of the valley and at a maximum probably reaches about 550 mm in the central and southern parts, (see Table 11).

This situation controls the development of rangelands and amply justifies the nomadic type of stockraising practised here to ensure best use of natural resources. Indeed, the irregular nature of the rains means that the rangelands do not develop regularly and properly in the same place one year after another, while the alternation of dry seasons ("gilal" and "hagai") and rainy seasons ("gu" and "der") means that herds must be constantly on the move to seek new pastures and watering points, their movements being determined by the rainfall trends.

The practice of this form of nomadic herding over the centuries has resulted in the development of a technique that is particularly well-suited to making best use of the natural environment and which has resulted in the selection of animals with genetic characteristics well adapted to local ecological conditions.

The nomadic herder moves his livestock in separate herds of cattle, camels, sheep and goats (the former, as has been seen, predominate in the centre-south of the study area, where more water and rangelands are available, while camels and goats predominate in the difficult conditions on the dry plateaux in the north of the valley). Naturally the herders take due account of the different requirements and autonomy of the species as regards grazing and water. Goats and camels can also graze the vegetation of trees and bushes which, it might be added, often has a higher nutritive value (good protein content) and hence provides a more uniform source of food over the course of the year than does herbaceous vegetation (14). This explains why it is possible to see camels and goats in good condition at any time of the year.

As regards watering, the requirements of the various species differ. Cattle must drink at least every two days; camels can go without water for as long as fifteen days and drink water with a salt content which would be intolerable to cattle; this means that they have a different degree of autonomy when moving from place to place and a wider range over which to graze around the water points.

The composition of the numerous herds of cattle seen mainly between Kismayo, Afmadow and Cogane was homogeneous as regards categories of livestock; in almost all cases calves less than one year old; fully grown cows accompanied by a few bulls and males and females in the course of growth were pastured separately. The search for grazing and water is the nomadic herder's

Table 11 - Rainfall Regime (from Agricultural and Water Surveys - Somalia F.A.O. Rome 1968)

Station	Rainy Seasons	Seasonal mean mm	% probability of having a rainfall of mm								Annual mean mm
			60	120	180	240	300	360	420	480	
Luuq	Mar-May	180	89	74	53	31	-	-	-	-	300
	Oct-Dec	99	66	41	31	6	-	-	-	-	
Dolow	Apr-May	118	-	-	-	-		-	-	-	186
	Oct-Dec	54	-	-	-	-	-	-	-	-	
Xudur	Apr-May	182	-	-	-	-	-	-	-	-	336
	Oct-Dec	148	-	-	-	-	-	-	-	-	
Baardheere	Mar-May	174	83	67	48	29	-	-	-	-	378
	Oct-Dec	170	79	64	47	31	-	-	-	-	
Baydhaba	Mar-May	306	96	91	82	68	58	34	20	-	557
	Sep-Dec	196	87	73	58	34	17	-	-	-	
Dhinsor	Mar-Jly	200	-	-	-	-	-	-	-	-	451
	Apr-May	142	-	-	-	-	-	-	-	-	
	Oct-Dec	148	-	-	-	-	-	-	-	-	
Afmadow	Mar-May	230	99	92	74	45	19	5	-	-	543
	Oct-Dec	245	86	76	64	51	38	26	16	9	
Jonte	Apr-Jly	343	-	99	95	84	66	43	22	9	497
	Aug-Dec	144	Monthly mean about 29 mm								
Jamaame	Apr-Jly	292	-	-	-	-	-	-	-	-	434
	Oct-Dec	180	Monthly mean about 23 mm								
Jilib	Apr-Jly	288	-	-	-	-	-	-	-	-	522
	Oct-Dec	180	-	-	-	-	-	-	-	-	
Kismayu	May-Jly	208	92	80	60	38	19	7	-	-	391

main concern and in point of fact, the condition of his livestock depends mainly upon these two factors. The herders also observe animal husbandry practices which often have a very rational basis and stem from careful and long observation of the real situation.

Not all of them castrate the male animals, but, if this is done, the operation is performed on very young calves and on 3 - 4 year old males so as not to interrupt growth.

When twin births of different sex occur, the female is eliminated, evidently because if has been found that these females are often sterile (free-martins). Some herders eliminate the first calf borne by cows if this calf happens to be a male. It seems that in this way, the cows adapt better to milking, not being affected by the presence of a calf to whom they must give milk. If instead, the first calf is a female, the herder prefers to keep it because he places more value on the contribution the animal can make towards increasing his herd than on the need for milk for his own consumption. Sterile cows are eliminated from the herd. The herder pays careful attention to the regularity with which the cows get with calf, something which is conditioned mainly by good availability of forage and water. It would seem that the herders are capable of removing ovarian cysts from cows which do not get with calf. The womenfolk of the family de-tick the animals by hand.

In short, most of the animal husbandry practices used by the herder are the result of centuries of accumulated experience and observation. The herder is a pragmatic person, this aspect of his character being essential to life in such difficult environmental conditions. As such, he has shown himself to be open to new ideas, provided that these give good results. This is demonstrated by the fact that the anti-trypasonomiasis treatment has so quickly found acceptance amongst stockraisers. Indeed, it would seem that the injections are often given directly by the herders themselves, who obtain the necessary serum from the veterinary centres.

Under no circumstances should the abilities of the nomadic herders be undervalued. Their thorough understanding of their animals and the environment in which they live are amply attested to by the almost surprising results they attain under such difficult ecological conditions.

The most serious negative aspect of nomadic herding is the danger of excessive stocking rates. Put in other terms, this means irrational use of rangelands, because the animals are concentrated in certain areas, while others, which are classed as difficult, are under-utilized for reasons which are described elsewhere. This may not only accentuate the seasonal and annual variations of the amount of food available to the animals, it can also cause very serious erosion and desertification of the rangelands. In point of fact, to ensure proper development of vegetation, the land must be allowed to rest when grass is in a vegetative phase, i.e. during the rains, especially at the beginning and end of this season. If instead there are too many animals on the rangelands during these periods, the growing cycle is interfered with, especially in the case of the perennial herbaceous species, both at the moment when the grass throws up new shoots from the reserves accumulated in the roots and during the period when the plant should be building up new reserves for subsequent sprouting. This interference compromises future forage production and permits the varied growth of trees and shrubs at the expense of the grasslands, facilitating surface erosion by wind and, in the hilly regions, by runoff as well.

Excessive stocking rates occur on the best rangelands with watering facilities when there is no relationship between animal ownership and use of the range, in other words, when the grazing can be used indiscriminately by everyone without any control to ensure the best possible use is made of the productive potential of the rangelands.

2.2.3 Seasonal Movements of Livestock

Nomadic movements are dictated mainly by climatic factors, in other words, by the availability and distribution of rainfall and hence of grazing and water over the course of the year. Other factors may also influence the choice of rangelands, such as, for example, the need for forage with a higher mineral-salt content, or the presence of the tsetse fly or other insects which are harmful to the stock.

The size and the direction of the movements vary from region to region and may change from year to year, depending on the difference in rainfall and hence in the development of rangelands (see Fig. 2.II).

During the dry season, animals are concentrated near permanent water points and watering stations prepared specifically along the river by cutting the gallery forest and destroying bush to try to control the spread of the tsetse fly.

During the rainy season, cattle herds are distributed more evenly over the territory due to the greater number of watering points following the formation of ponds in natural and man-made depressions during the rains.

There are no precise details regarding nomadic movement in the Juba Valley, but from information received it would appear that the main lines of cattle movement during the dry seasons are as follows:

- In the Lower Juba mainly near the river, near Jilib, near the Beles Qoogami, Afmadow and Kismayo wells, near the descek and the laks which cross the southern part of the territory.

- In the centre and northern regions along the Juba (especially near the Salagle waterpoints on the right bank of the river) and around Busar.

During the rainy season, the herds of cattle are less concentrated. Those on the right bank of the Juba move towards the rangelands between Afmadow and Jilib and even further north and they probably thrust westwards beyond the border, while nomads on the left of the river tend to move towards Dhinsoor and the Upper Juba, moving away from the tsetse fly infested areas. In this season, in the northernmost regions, the herds tend to move away from the river and go northwestwards towards up-country rangelands.

The movements of camels cover a wider range, passing from pastures in the southern part of the country during the dry seasons to the up-country rangelands during the rains; the distance covered may exceed 300 km.

2.3 CHARACTERISTICS OF CATTLE RAISED IN THE JUBA VALLEY

The cattle raised in Somalia owe their existence, generally, to their ability to resist drought and live under near-starvation conditions. Consequently, growth is slow, the animals mature late, and in the more difficult areas there are long intervals between calvings. There are 4 main breeds of cattle in Somalia: Boran (Avai or Lo'Addei), Surco (or Giddu), Dauara (or Garre) and Gasara (or Abgal). These are all humped-back cattle.

They are not really true breeds but populations, often mixed in various ways and distinguished by a marked variability of characteristics. Boran and Surco cattle are found in the Juba Valley.

The Boran are shorthorned mesomorphs. They are generally white and have a good conformation; they are raised mainly for meat because they have a slight skeletal structure and a good mass of muscular material. The height to the withers is 120 - 125 cm and the average weight is indicated as being 320 kg for males and 260 kg for females (10), (28), (32). In the Lower Juba, where forage is readily available, the author has seen herds of cows in a very good state of development with individuals weighing certainly more than 300 kg.

The fact that the Boran is a good meat producer is underlined by the results obtained in Kenya, where properly fed grade animals can weigh as much as 500 - 600 kg and even as much as 900 kg.

In Somalia, during 100-day fattening tests using 3-4 year old Boran males having an initial weight of 200 - 250 kg, daily increases averaging 900-1,040 gr have been achieved on the feedlot at km 7 from Mogadishu. The animals were fed on molasses, maize bran, maize stalks and a mixture of meat-bone, fish-and blood-meal.

The Surco longhorn mesomorphs are heavy-built, red and white animals measuring 120 - 125 cm at the withers.

The males weigh 340 kg, the females 280 kg (10), (28) and (32). The farmers on the left bank of the Juba, between Baardheere and Dujuuma, seem to favour this breed of cattle, though it is often apparent that the herds have been mixed with various other cattle populations. The farmers like the Surco breed because of the butter production they can obtain. This is a fundamental item in the local diet.

The basic features of nomadic cattle-raising in the study area can be summarized as follows:

age at 1st calving	4 1/2 - 5 yrs
fertility rate of the herd	0.60
calf mortality - 1 year old	35-40% per year
calf mortality - 1-2 years old	15-20% per year
calf mortality - 2-3 years old	5% per year
calf mortality - 3 years old	1% per year
duration of lactation	5-8 months
milk available	300-500 litres/year
weight increase	0.180-0.250 kg/day

Of course, these parameters are only indicative. They represent the average performance with nomadic stockraising and should change markedly when the seasonal trend and hence the availability of water and grazing moves away from the average.

Two-year old Dauara males having an initial weight of 180 kg fattened for 100 days on the Experimental Feedlot at km 7 from Mogadishu gained weight at 885 - 905 g/day, to 268 kg when slaughtered (52% carcase, 38% meat, 9% bone and 3.5% fat) (4).

By way of comparison it should be noted that according to the manager of the Mogadishu meat-packing concern, the average slaughter weight of cattle bought directly from the herders in 1974 was 190 - 200 kg (meat yield 25%, fat yield 0.7%).

2.4 OTHER SPECIES RAISED

2.4.1 Sheep and goats

Sheep and goats constitute the main form of sustenance for the transhumant herders. They are meat and milk animals, the wool yield being negligible.

The distinguishing feature is their ability to live in very difficult surroundings on a small amount of food. They are often complementary to the cattle, in that they browse plants that cows do not like.

The sheep are of the "black head" variety typical of Somalia. They are found all over the country, but the main concentration is in the north. The skin produced by these sheep is considered one of the best in the world.

There are Mudugh goats, with two sub-breeds - Abgal (small) and Ogaden (medium-sized white animals) - and Bimal goats, also with two sub-breeds - Gazze and Tunni. These are found especially on the right bank of the Shebeli in the Doi area and the coastal areas.

The average weight of the full-grown female sheep is 30 - 35 kg, while the males weigh 35 to 40 kg. The first lambing occurs at about 20 months, though the range may cover 16 to 28 months. The gestation period is 145 days and in general there is eight months between lambings, though the period may be as short as six months or as long as twelve. The ewes generally lamb six times, though the range is from four to eight. They continue to lamb up to between five and eight years of age. The lactation period is 4 to 5 months, some 50 kg of milk being produced, most of which is taken by the lambs.

Goats and camels constitute the sole source of meat and milk for the nomadic families which live in areas where the grazing is so poor and water is so scarce that other animals cannot survive.

Goats are raised with sheep in other areas where conditions are better, the proportions varying from herd to herd. The average live weight of fully-grown animals is 30 to 35 kg, though it may range from 25 to 40 kg depending on the nutritional value of the various rangelands. The live weight of the males is slightly greater than that of the females. Goats generally produce their first young at 18 months, though age may range from as low as 16 to as high as 24 months. The gestation period is 145 days and the interval between births can range from 6 to 12 months, with an average of 8. The number of times a she-goat produces young and her productive career are about the same as for the sheep discussed above. The lactation period is 5 to 6 months and milk production runs at about 70 kg, almost all of which is taken by the young.

2.1.2 Camels

There are five main breeds of camel in Somalia: Cangial, Gazze, Elai (in equatorial Somalia and Lower and Middle Juba) - this is the largest camel with males weighing up to 800 kg and females up to 650 kg -, Mudugh (a small animal) and the Benadir, which is the true Somali camel and also the commonest.

Camels are raised particularly for meat and milk and rarely for agricultural work. The nomads also use them as beasts of burden. Camels are essential for the survival of the nomads. Their milk constitutes the basic food of the nomadic families, so the she-camels are carefully tended and killed only at an advanced age. She-camels come on heat periodically, and the males are also subject to periodicity in this respect, so the mating can only occur when the two periods coincide. The females generally come on heat for the first time at 4 to 5 years of age and the gestation period is 12 - 13 months. The whole of the milk supply is reserved for the young camels during the first months of life. It is difficult to estimate the milk yield, as production is not regular; the animals may even be milked several times a day, depending on the family's needs. However, it probably ranges from 3 to 12 litres per day for a period of 8 to 10 months. The full-grown he-camel weighs from 500 to 600 kg and the she-camel slightly less. The meat yield is fairly good, ranging from a minimum of 45% to a maximum of 66%.

CHAPTER 3.

RANGELANDS

3.1 GENERAL

The rangelands of the study area consist mainly of an association of trees, bushes and scrub. The different ecological formations vary as regards density, height and composition, as do the pedological, topographic, rainfall and anthropic conditions. The main formation has been defined as "steppe with trees and bushes" (13), in which the dominant vegetation is woody, composed of small trees and deciduous spiny bushes. Herbaceous vegetation grows among the bushes. The density of the bush varies from very thick to sparse. There are a few scattered trees, and it is rare that their foliage meets. The bushes, too, are normally quite separate. The average height and density of trees and bushes varies with the aridity of the climate and the type of soil. Herbaceous vegetation is composed almost exclusively of graminaceous species. These grow to a height of 20 - 60 cm and the average density is low. Grass is often thicker near the base of the bushes and thins out on moving away from that point.

In another ecological formation which is equally common (scrubland), bushes are the main kind of vegetation, and there are only a few scattered trees. In this case, most of the vegetation is woody with trunks that ramify at ground level. The height of the bushes varies from 1 - 3 m.

In the northern part of the Juba Valley, the vegetation is characterized by a scarsity of perennial graminaceae, by a lack of trees (found virtually exclusively in stream beds) and by the lack of height of the bush and scrub. These areas, where the terrain is often very rugged, show evident signs of violent surface erosion as the result of runoff of waters which are not retained, and do not infiltrate, owing to the lack of vegetation. Here the country side is dominated by the colour of the bare, rocky soil which shows through the thin cover of low scrub. Some of the commonest trees and bushes in the rangelands of the study area are: Acacia spp., Commiphora spp., Dobera glabra, Grewia tenax, Cordia gharaf, Terminalia spp., Combretum spp., Euphorbia spp., Sansevieria spp., and Maurea Somalensis.

Among the leguminoseae: Indigofera spp., Crotalaria spp. and Clitoria. In the case of the graminaceae, we have: Aristida spp., Andropogon spp., Bothriochloa insculpta, Chrysopogon ancherii, Cenchrus ciliaris, Chloris spp., Cynodon dactylon, Dactyloctenium aegyptium, Enteropogon spp., Eragrostis spp., Echinochloa spp., Hyparrehnia dissoluta, Pennisetum spp., Panicum spp., Sporobolus spp., Tetrapogon spp., etc.

Dense abundant vegetation can be seen along the banks of the river especially to the south of Baardheere where there are discontinuous stretches of gallery forest running some 30 - 50 m from the river banks. There are formations of Hyphaene and examples of Ficus Mimuspos degani, Afzelia, Thrichilia, Garcinia ferrandi, Pittosporum abysinnicum, Sorindeia somalensis, etc.

Where the gallery forests have been destroyed, the banks of the river and the surrounding lands subject to flooding are covered by such plants as Panicum, Sacharum aegyptiacum and Sorghum vulgara. These zones could be good potential grazing but they are avoided by the herders (except during the most serious droughts) because of the presence of the tsetse fly.

The nomads normally go to the river with their cattle only at given points where drinking sites have been cleared by destroying the vegetation. These sites are known as "hillo".

Table 12 - Rangeland productivity and stocking rate (derived from data in the Report : Agricultural and Water Surveys - Somalia, FAO 1968)

Natural Region (1)	Productive area (1) km^2	Annual forage production(2) ton/km^2	Stocking Rate potential ha/AU(3) (A)	Stocking Rate surveyed ha/AU (4) (B)	Increased stocking rate possible (B/A)	Remarks
Mandera - El Wak Upland	20,622	13.9	26	51	2	Erosion
Upper Juba Valley	1,656	20.9	17	49	3	
Central Upland	62,362	20.0	18	45	2.5	Many animals raised by farmers in the Baidoa subregion; erosion elsewhere
Bur	16,507	30.9	12	14	1	
Eluviated Plain	18,199	59.9	6	16	2.5	Tsetse near the Juba; thick forest to west
Marine Plain	16,360	48.1	7	19	3	Tsetse and very thick bush
Lower Juba-Shebelle Flood Pl	2,040	79.3	5	476	95	Tsetse and very thick bush
Faafadun Plain	13,159	39.8	9	476	53	Lack of water and perhaps presence of ectoparasites
Lack Dera Plain	11,125	74.9	5	9	2	
Dudumali Plain	2,344	72.2	5	6	1	
Coastal Dune	8,848	28.7	13	18	1.5	Desertification,wandering dunes

(1) Only natural regions touched by the Juba Valley are listed:the productive area indicated refers to the whole natural region and not just to the part within the Juba Valley.

(2) Expressed in dry forage determined by sampling on land within the individual ecological formations identified and measured by means of interpretation of 1:60,000 air photos. Production was surveyed in one of the two annual growing seasons in 1963-1964.

(3) The calculation are based on consumption of 3,600 kg of dry forage per A.U. per year.

(4) The number of cattle is that estimated by the flights recorded in the FAO document to which the other assessments refer. The counts were done at the end of the main rainy season ("gu") in 1964.

3.2 RANGELAND PRODUCTIVITY AND STOCKING RATES

The productivity of the rangelands is closely bound up with the rainfall regime. Table 11 shows the distribution of the rains (mostly 10 year means) and the percentage probability. The data are for rainfall stations in the study area.

The only indications available on rangeland productivity and the potential stocking rate for the area are those given in the "Agricultural and Water Surveys - Somalia" published by FAO (13). During the course of this survey in 1963-1964, the productivity of the individual ecological formations identified was determined by sampling. The ecological formations were classified by interpreting the 1:60,000 airphotos flown in 1960 by the RAF. The production of forage and the potential stocking rate was calculated for each natural region. The stocking rate at the time of the FAO survey was also indicated. By comparing these two values, the theoretical possibility of increasing the amount of livestock in the individual natural regions was worked out. The results of these investigations are summarized in Table 12 and have been used to indicate the potential stocking rate in the various natural regions on Fig.3.II. In order to correctly assess the values indicated, the following points should be kept in mind:

- Only forage production was estimated, neglecting the tree and shrub vegetation which is the preferred grazing of camels and goats. Thus, the estimates refer solely to cattle, which in any case are the animals that will make the greatest contribution to the development of Somali livestock.

- Forage production was determined in only one of the two growing seasons. The estimates made were not corrected to obtain annual production, it being preferred, instead, to consider that forage production in the second rainy season would be equal to that which should not be grazed in order to guarantee rational rangeland use, without compromising further development of the vegetation and soil conservation. A more precise evaluation of forage production would have required more detailed sampling and this would have had to be repeated at least in two of the annual rainy seasons and possibly in more than one year, in order to avoid estimating errors due to anomalous rainfall trends.

- According to one author who has been concerned with Somali rangelands (34), these estimates of stocking rates are excessively optimistic because in making them it was supposed that all the available forage was consumed. According to this author it would have been wiser to consider that about half the available forage is lost by being crushed underfoot and in various other ways. On the other hand, the estimates in the FAO report (13) are based on a consumption of 3,600 kg of dry substance per AU per year. According to the results of some test-work done on zebu in Africa (29) this figure should be considered excessive (being equivalent to a daily consumption of dry matter running at 3.5% of the live weight, with a live weight of 280 kg) and could well be reduced to 2,600 kg (daily consumption of dry matter, running at 2.5% of the live weight of a 280 kg animal).

To sum up, as the author of the FAO report (13) states, these figures must be considered as providing pointers rather than precise statistical evaluations of the productive potential of the rangelands. They permit a useful

Table 13 - Estimate of number of head of cattle in 1964 and possible increase thereof (Agricultural and water surveys FAO 1964).

	EXISTING NUMBER OF CATTLE	POSSIBLE INCREASE	
DUDUMALI PLAIN 2,344 Km²	58,712	10,326	5 ha/AU
LOW JUBA-SHEB FLOD PL 2040 Km²	1,000	63,056	
LAC DERA PLAIN 11,128 Km²	186,881	142,882	
ELUVIATED PLAIN 10,198 Km²	164,037	264,606	8-10 ha/AU
MARINE PLAIN 16,360 Km²	122,088	190,410	
FAAFADUN PLAIN 13,150 Km²	4,340	204,082	
BUR 16,807 Km²	188,067	36,888	11-15 ha/AU
COASTAL DUNE 8,648 Km²	72,109	28,756	
UPPER JUBA VALLEY 1,656 Km²	4,835	8,910	16-20 ha/AU
CENTRAL UPLANDS 62,362 Km²	199,741	288,198	
MALDERA-EL WAK 20.622 Km²	87,716	88,705	20 ha/AU
TOTAL AREA 173,222 Km²	EXISTING NUMBER OF CATTLE 1,038,074	POSSIBLE INCREASE 1,305 532	

comparison to be made of the different natural regions.

Table 13 was drawn up to facilitate identification of the natural regions on which attention should be concentrated since, once existing natural limitations have been removed, increases in the stocking rates here are to be expected. It was apparent from the Table that the natural regions where rangeland development schemes would appear to be the most promising, are the Lower Juba and the Shebeli Flood Plain and the Faafadun Plain.

The main limiting factor at the present time in the Lower Juba and the Shebeli Flood Plain is the presence of the tsetse fly. There is also very thick bush here which would require costly clearing. At the present, these lands are used only during the dry season, because of the water in the Juba River. This would constitute an area suitable for a livestock project integrated with agriculture if irrigated farming is developed here in the future.

In the Faafadun Plain, which is also interesting because of the huge area involved, (13,159 km^2), the limiting factors are linked to the lack of waterpoints and, it would seem, also to the presence of a tabanidae ("bal") which is damaging to animals, particularly to camels which it infects with tripanosomiasis.

The north and north-west part is not so interesting, because it tends to be dry. In any case, this is an area of relatively open rangeland, where, at the end of the "hagai" dry season (beginning of October to the beginning of the "der" rains), there is much herbaceous vegetation which is already dry and has not been grazed. Careful examination should be made of this area to gain a better understanding of the limiting factors.

In the Marine Plain, the limiting factors are the tsetse fly and the presence of thick bush over 80% of the area which reduces the rangeland potential. This natural region is utilised particularly up to the rains, especially the western fringes.

The Lac Dera natural region consists mainly of grassy clearings with trees (Acacia tortilis is frequent). Here, the vegetation is relatively open and the kind of countryside is not commonly found in other parts of Somalia, where it is reminiscent of African Natural Parks. This formation alternates with "steppes with trees and bushes". In general these are the rangelands which cannot be used to the full in areas which are short of water. The sandy nature of the soil means that the collection and conservation of rainwater in depressions is no more than transient.

A wildlife expert working on the UNDP project "Strengthening of Forestry and Wildlife Management" (1) has identified an area of about 3,300 km^2 in the southernmost part of this natural region for establishing Somalia's first National Park. Grazing on this area would be prohibited (Vol.V, Fig.4.I).

The Dudumali Plain is a good rangeland region but it seems to be sufficiently used already. The western areas of the Buur and the Eluviated Plain appear to lend themselves to a considerable increase in the number of animals they could carry. The main limiting factor is water availability. To avoid this shortcoming, 40 artificial basins have been constructed in these areas to collect 20,000 m^3 of rainwater each ("uar"). This work forms part of a pilot project financed by the European Development Fund for livestock improvement (see Fig.4.II).

Other limiting factors are the tsetse fly in the Eluviated Plain near the Juba and the presence of very thick bush in parts of the area.

The rangeland situation in the northern parts of the Juba Valley and in the Coastal Dune calls for schemes aimed mainly at arresting the violent erosion and desertification which is occurring because of the excessive number of animals which these lands carry at certain times, especially those near water points. Other factors causing erosion are runoff (in the rugged areas of the north) and wind (wandering dunes which have sprung up after the vegetative cover has been stripped in the coastal area).

3.3 PRESENT EVOLUTION OF RANGELAND VEGETATION

Many reports have been written on the vegetation and rangelands in Somalia. These show that serious and difficult-to-reverse erosion is occurring, often as a result of excessive and irrational grazing (3), (15), (18), (19), (30) and (39). Most of these reports refer to the northern regions of Somalia, where the equilibrium between vegetation and animals is more precarious because of the more severe climatic conditions. These reports are generally based on indirect testimony and do not quantify the magnitude of the phenomenon, there having been no continuous controls.

The only precise indication on the evolution of vegetation in the Somali bush comes from a recent report by L.R.N. Strange (35), a range management expert, working on behalf of UNDP, who has run a course at the Veterinary School in Mogadishu. In 1974, he was commissioned by the Rangeland Service of the Ministry of Livestock, Wildlife, Forestry and Rangelands to evaluate conditions on the Uar Mahan Ranch. This is a small 3,800 ha ranch which was set up in 1956, between Afgooye and Uanle Uen in the natural region called the Shebeli Flood Plain in the FAO report (13). Though this region does not come within our area of study, the points made apply also to conditions on some rangelands in the Juba Valley. For the "Shebeli Flood Plain", the FAO report (13) estimated a potential stocking rate equal to that for the "Lower Juba and Shebeli Flood Plain", i.e. the highest stocking rate for the whole of the Juba Valley.

Vegetation consists of low shrub with trees here and there and a graminaceous herbaceous cover which is seriously overgrazed. There have been many changes in the productive guidelines and management forms of the Uar Mahan ranch since it was set up. Though the ranch is divided into 10 fenced areas, until 1974 no rational grazing criteria were applied. All that was done was to move the animals to the areas where grass was available. The stocking rate ascertained by Strange was considered excessive (7.2 ha per AU). Indeed, when the animals had used all the grazing within the ranch it was necessary to send them outside to find pasture. This "outside" grazing became particularly important during low rainfall years. Strange was able to assess the effect this type of management had on the vegetation, by comparing the conditions he found with those described 16 years before on a detailed vegetation map of Uar Mahan (30). The results of his comparison are as follows:

Variations in grass - bush - tree relations					
Open grassland		Bush grassland		Trees, bush and grassland	
1958 %	1974 %	1958 %	1974 %	1958 %	1974 %
32	0	56	49	12	51

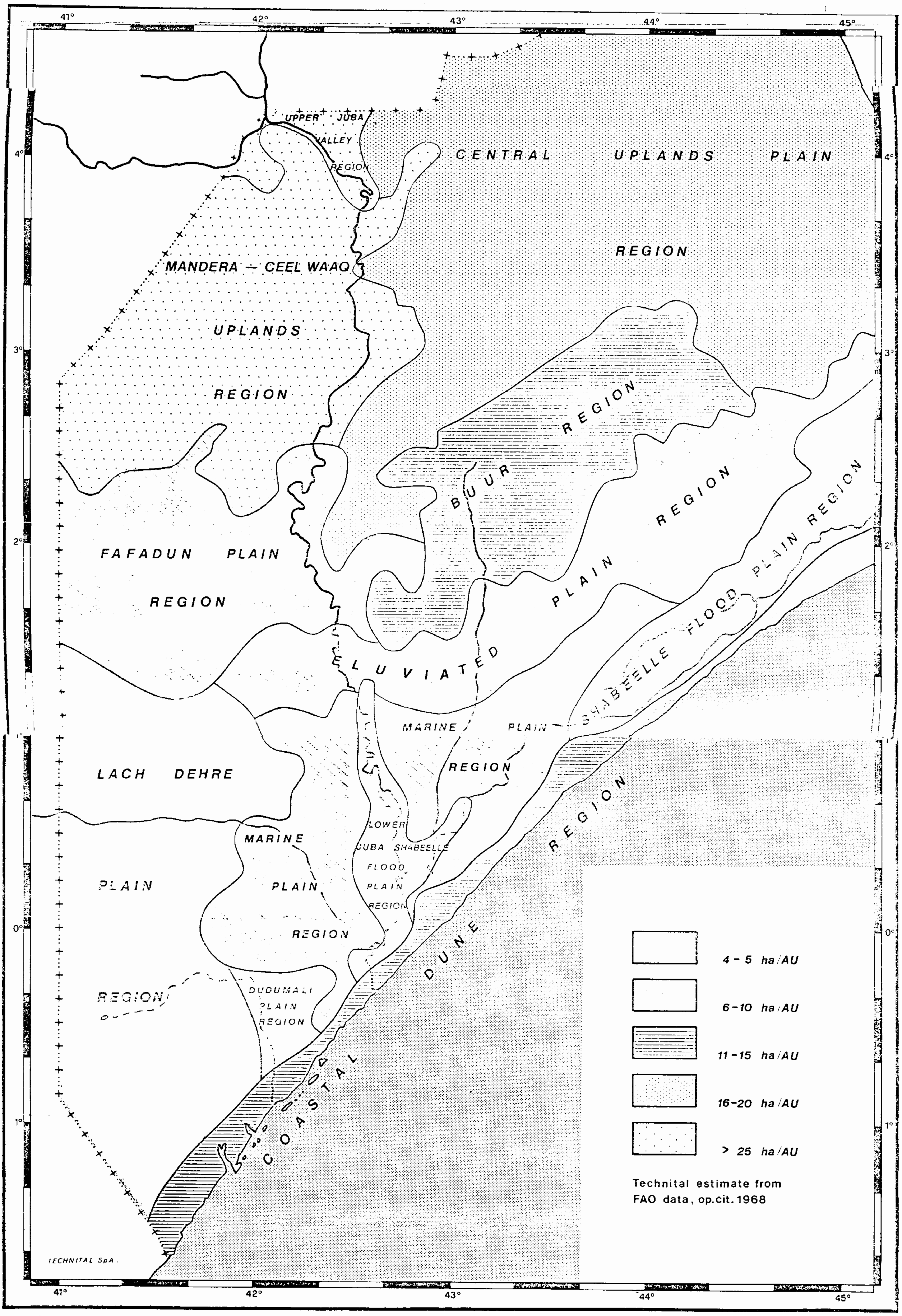

fig. 3. II

POTENTIAL STOCKING RATE

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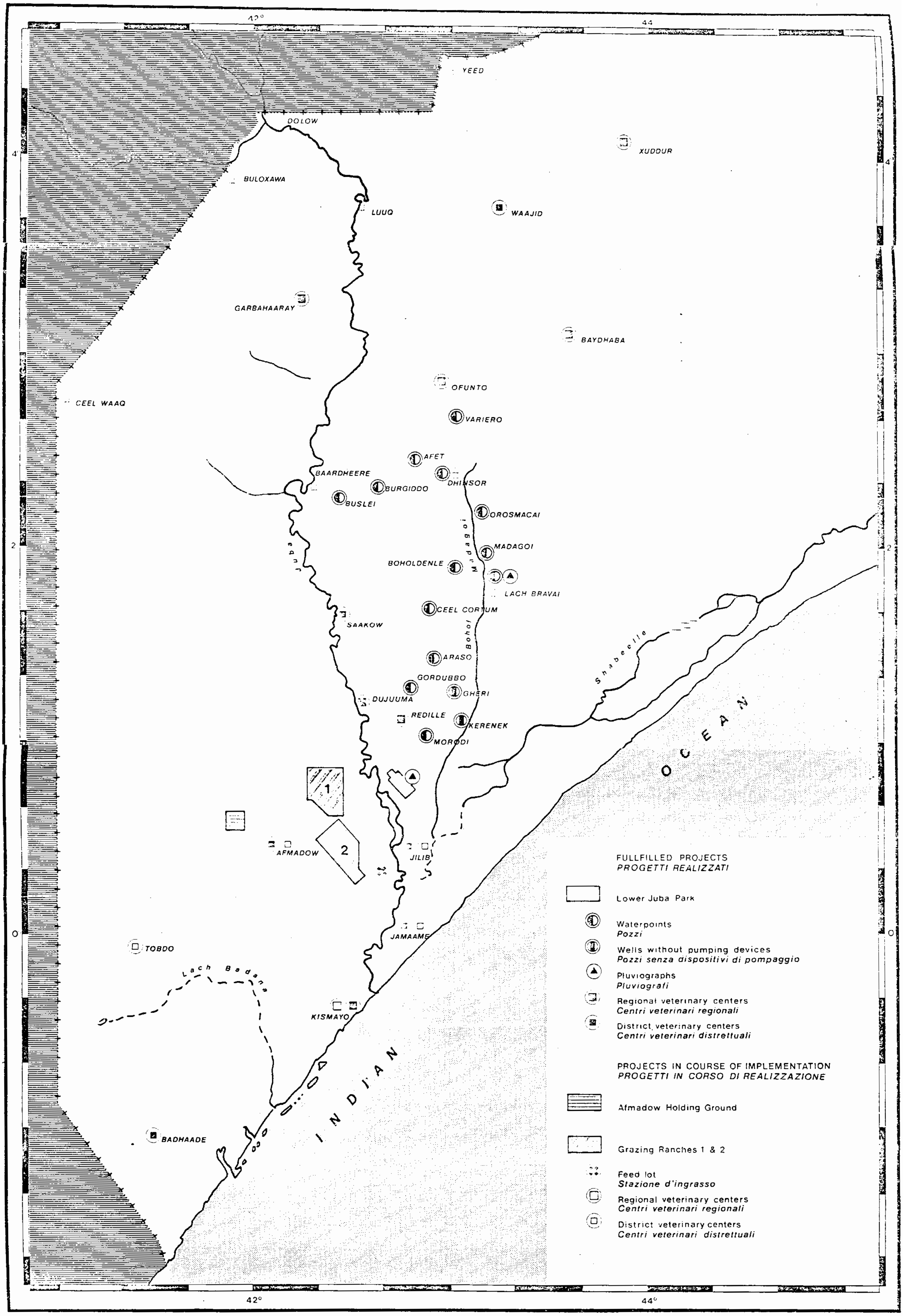

fig. 4.11 FULLFILLED & ON-GOING PROJECTS — PROGETTI REALIZZATI ED IN CORSO

In sixteen years the open grassland had disappeared almost complete-y, even though originally it covered 1/3 of the area, while bushes and trees ad come to occupy first place. The most prominent bushes found were Acacia ubica (which is not grazed by any kind of animal) and Grewia tenax. In the ase of this last species, it was possible to estimate, on the basis of the omparison of earlier-known data, that in 4 years it had reached a height of 50 - 160 cm, at an average growth rate of 40 cm per year despite the above-round part of the vegetation being grazed by animals during the dry season. fter having duly considered these trends, the recommendation was made that ıe ranch should be cleared of bush every 5 years by burning or by other ıans.

In short, 16 years of improper and uncontrolled range management, ıry similar to that which is becoming increasingly common amongst the no-:dic farmers, has led to a marked deterioration in the grazing lands which n only be restored by introducing proper techniques for their use.

Eleven years have passed since rangeland conditions were evaluated the Agricultural and Water Surveys (13). If matters evolve as quickly as dicated by Strange's survey, it would certainly be advisable to make a new, re detailed evaluation of the situation, at least in those regions which e more promising from the livestock development aspect and in those where e risks of erosion and deterioration are greatest. This evaluation of range-ıd characteristics and of the potential number of animals which can be rried should be completed by studies to ascertain in detail the movements, ıits and the techniques followed by the nomadic herders in these areas, so to establish what should be done to achieve a correct policy of rangeland ıagement.

Remote - sensing (5), (25), (36) and (38) would appear to be the most mising technique for this kind of investigation. The indications provided satellite (e.g. the ERTS-1: Earth Resources Technology Satellite of the A) which surveys the situation every few weeks, should permit detailed and tinuous observation of vegetation conditions and the distribution of sur-e waters at a relatively reasonable cost. They should also provide indi-t indications on the seasonal movements of the herds. The UNDP experts king in Somalia with the Rangeland Service of the Ministry of Livestock planning to use these satellite pictures, which would appear to provide ry useful tool for planning rangeland policy.

WATER RESOURCES

One of the factors which has the most effect on the development of stock in the study area is water availability. The watering points in the Valley consist of natural depressions, "uar", "berkeds", "descek", "lak", s and the Juba River.

Water collects in the natural depressions ("ballehs") during the y season, providing temporary watering points which rapidly dry up when dry season begins. The "uar" are artificial basins, generally hand-dug, ı have a system of ditches to channel the rainwater in. These have the function as "ballehs" and like the latter, they suffer from very high ration losses and also require regular maintenance to keep the conveyance ditches in good order and prevent the basin becoming filled with silt.

During the fifties, a start was made on mechanized construction of "uar". Between 1959 and 1961, nine 5,500 m^3 basins were built near Afmadow during a US AID project. In 1963, a further fourteen of the same size were built on the Baydhaba Plain. Immediately after construction, these "uar" were a great help to the surrounding areas, but later, when they were inspected during the course of the FAO Agricultural and Water Surveys (13), many were found unserviceable, having become silted-up through lack of adequate maintenance.

Recently, forty 20,000 m^3 "uar" were built in a pilot area between the Juba and the Shebeli in the framework of project 215.016.24, financed by the EDF, to improve animal health. Each of these "uar" has a pumpdriven motor to carry the water from the large 20,000 m^3 basin to a small 50 m^3 distribution basin. From here, the water is pumped by hand to eight drinking troughs. Each drinking trough has an area of about 180 m^2 and is surrounded by a steel pole fence. There are houses for two guards near each "uar". The bottom of some of the "uars" has been waterproofed by means of PVC sheets. 18 of these "uar" were inspected after the 1974 "der" rains (7). This inspection showed that only five were filled to a satisfactory level (from 4 - 6 m), while five were completely dry. The fact that these "uars" were not full was attributed to the poor rainfall in some cases, while in others, it was due to the permeable nature of the soil in which they had been dug or to the poor layout and maintenance of the conveyance ditches. Many of the steel fences had been removed because they had broken the legs of camels.

The uncontrolled use of "uar", or of any other waterpoint for that matter, can cause very marked deterioration in the state of the rangelands thereabouts, due to the excessive number of animals. In fact, there exists the danger that, attracted by a sure source of water, the herders may tend to concentrate more stock on the rangelands around the "uar" immediately after the rains than they would otherwise do. This interferes with the growing cycle of the herbaceous plants during the delicate stage when they are throwing up shoots and building up reserves for the next growing season.

The Trans Juba Livestock Project of the World Bank provides for the construction of about 30 "uar" in the centre south part of the Trans Juba area. These are to be laid out along 800 km of stock trails (40). "Berkeds" are underground concrete cisterns for the collection of water. These are common in the north of Somalia and in the study area in the Hoddur district.

"Descek" are natural depressions which are fed with torrential waters or with floodwaters from the Juba during the rainy season. Following regular rainfall, they constitute a secure watering point during the dry season. Most of them are found in the southernmost part of the study area and near the Juba river (e.g. Uamo Descek).

"Lak" are shallow, natural drainage systems which channel rainwater towards closed basins or towards the Juba or directly into the sea. The most extensive of these are Lak Bissig, Lak Dera, Lak Badana and Lak Bushbush which contain water throughout the year.

During the rains the "laks" fill up but flow is slow due to the low gradient and thick vegetation in the bed. Most of this water is lost through evaporation, infiltration and transpiration. The "lak" too are found mainly in the southern part of the study area, in the natural regions of the Lak Dera Plain, Dudumali Plain and in the western part of the Marine Plain.

Open wells are normally hand-dug in depressions or in the beds of dry rivers. In this latter case, they usually have to be rebuilt twice a year. Sometimes numerous hand-dug wells are concentrated in a radius of a few metres to tap a single, shallow, local aquifer.

The sinking of these wells began in the early fifties. Since then, according to the Mineral and Groundwater Survey (37), some 700 have been drilled throughout Somalia, but in 1972 only 200 - 250 were in use. The remainder were not equipped either because they were dry or the water was too saline or because the pumps, motors, pipes and filters, etc. were no longer serviceable.

In most drilled wells, the depth to water is in excess of 30 m and therefore submersible pumps and powerful motors must be used. Furthermore, the wells have to be properly maintained.

The discharge from these wells is generally in the 2 - 5 m^3/h range (36). It is reported (37), that many of these boreholes should be deepened because they barely reach groundwater level. This means that they are not very efficient and quickly dry up if there is any slight fall in groundwater level.

Very often when a drilled well is brought into use and produces water of a drinkable quality, houses spring up in the vicinity and the families of nomadic herders tend to settle there.

Finally, the Juba itself constitutes an abundant source of water. However, since for much of its course the environs are infested with tsetse fly, livestock is usually only watered at the river when the temporary watering points in the rangelands farther away from the river dry up.

"Hillos" are areas along the banks of the river where the gallery forest has been cleared to allow stock to be watered with less risk of catching trypanosomiasis.

The quality of groundwater is often poor due to an excess of salts. When the salt content exceeds 7 g/l it is considered that the water is no longer suitable for cattle, but only for camels, though it will be tolerated by goats and sheep. When it exceeds 10 g/l it is considered marginal even for camels, while when over 15 g/l it is unsuitable for all livestock.

Table 14 reports the waterpoint inventory for each district of the study area, based on the indications given in the 1973 report by the Hendrikson Group (20).

As regards the number and the sites of wells, information for that report derives from the Mineral and Groundwater Survey (37), while for the surface watering points the data were derived from preliminary investigations for the population and livestock censuses. It can be seen from the Table that only 18% of the watering points in the study area are wells while 43.2% are temporary waterpoints such as "uar" (40%) and "balleh" (3.2%). The district with the greatest number of watering points is Baydhaba (26% of the total) but many of these are "uar" (236).

The density of waterpoints expressed as the number per 10,000 km^2 is shown on Fig.5.II, the reference area for these indications is the "planning square" used in the report by the Hendrikson Group (20) namely squares with sides approximately 110.3 km in length and having a total area of 12,200 km^2. These areas are bounded geographically by parallel lines set one degree of latitude and one degree of longitude apart. It is apparent from the map that there is a marked lack of waterpoints (less than 40 per 10,000 km^2) in all parts of Trans Juba which do not touch the river.

Table 14 - Waterpoint inventory

District	Wells	Ballehs	Berkeds	Uars	Hillos	Waterpoints Total	Waterpoints as %
Hoddur	30	-	48	28	-	106	10.8
Baidoa	20	-	-	236	-	236	26.1
Dhinsor	16	-	-	61	-	77	7.9
Luuq	34	2	-	1	50	87	8.9
Baardheere	20	-	-	27	71	118	12.1
Afmadow	4	-	-	23	-	27	2.8
Jilib	10	6	-	1	118	135	13.8
Jamaame	32	5	-	1	83	121	12.4
Kismayo	13	18	2	13	5	51	5.2
Total	179	31	50	391	327	978	100
as %	18.3	3.2	5.1	40.0	33.4	100	

Source : Hendrikson (20) - 1973

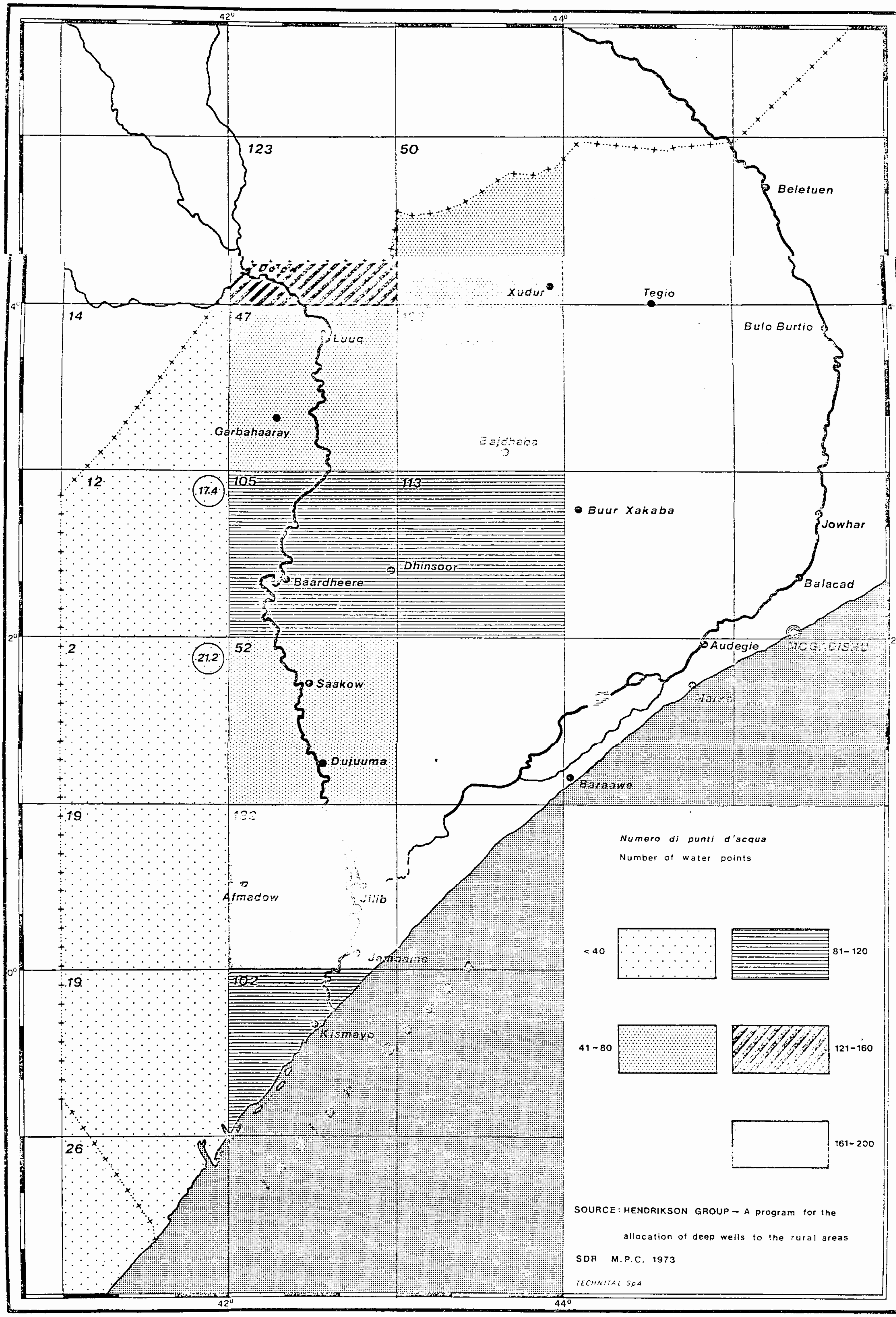

fig.5 . II

NUMBER OF WATERPOINTS

NUMERO DI PUNTI D'ACQUA

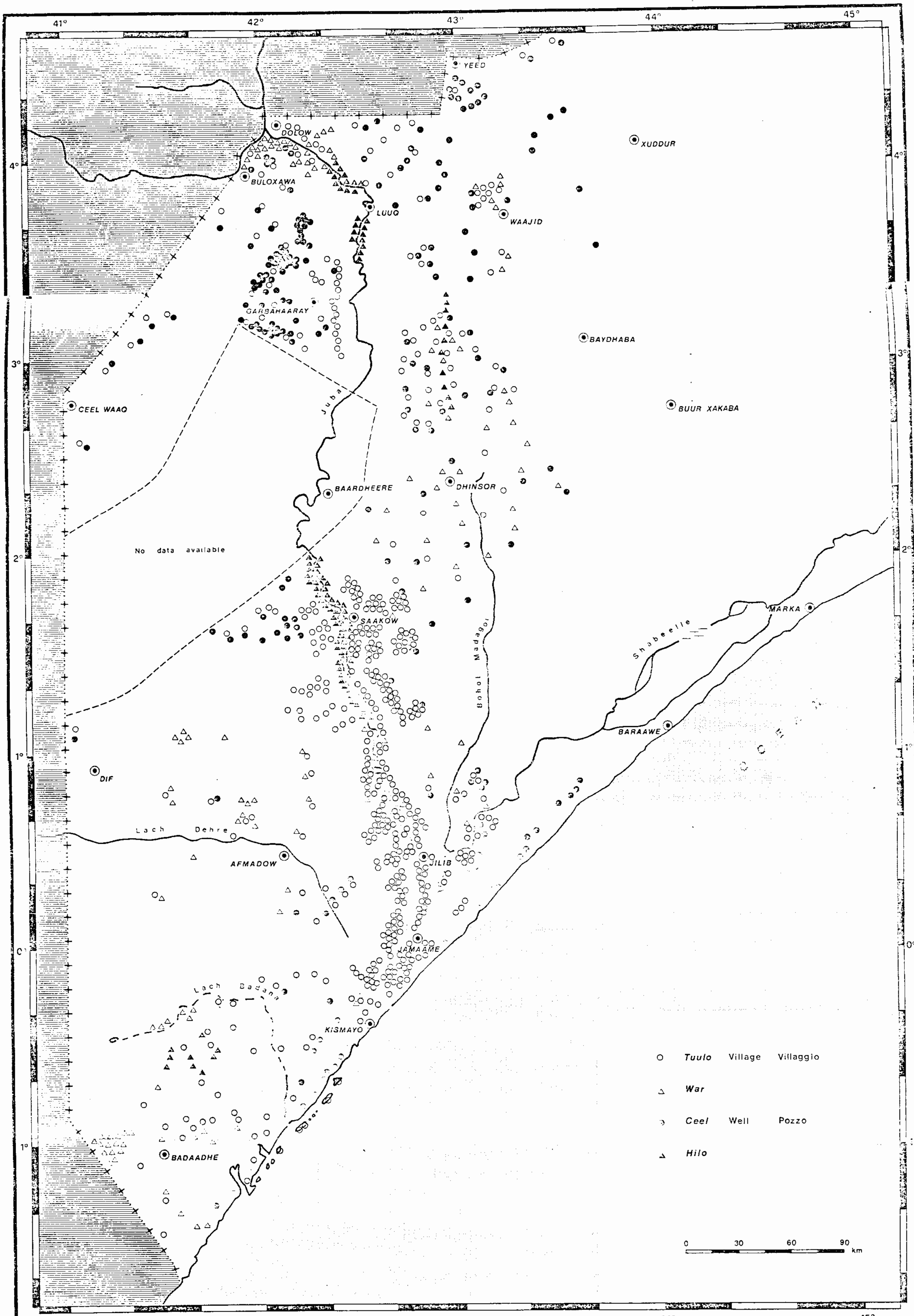

fig. 6.II

VILLAGES & WATERPOINTS

VILLAGGI E PUNTI D'ACQUA

It should be pointed out that the area around Faafadun, i.e. "planning squares" 21.2 and 17.4 of Fig.5.II, have the lowest absolute density of waterpoints, 2 and 12 respectively per 10,000 km^2.

Fig.6.II reports in detail the waterpoints, confirming the distribution shown on Fig.5.II, the report by the Hendrikson Group (20) also indicates where the availability of permanent waterpoints is less than the average for the whole of the country.

There are few waterpoints in the Baydhaba area and most of these are "Uar" which dry up with the advent of the dry season.

Most of the "balleh" (87%), around half the wells (56%), 31% of the "hillo" and 22% of the "uar" are located outside towns (20).

The FAO Agricultural and Water Surveys Report (13) provides a series of indications regarding the possibility and advisability of constructing "uar" in the individual natural regions. It is recommended that "uar" should not be built in the following regions:

- Lower Juba and the Shebeli Flood Plain, since they would be superfluous here because of the good availability of watering points along the river.
- Dudumali Plain, Eluviated Plain and Buur Region, because the soil here is excessively permeable.
- Mandera - Ceel Waaq, because of the low productivity of the rangelands and the difficulty of identifying suitable soils.
- Central Uplands, at least for the moment, because most of the region can only support a very small number of animals, except perhaps the Baydhaba Plain, where however there are already many "uar" and well construction is possible.

The construction of "uar" is recommended instead in the following regions:

- Lak Dera and the western part of the Marine Plain. This region is considered as having first priority for the construction of "uar" because of the good potential of the rangelands, relatively certain rains and proximity to the markets
- The eastern part of the Marine Plain. The use of the southernmost areas with easy access to river waters is not advised but it is considered that "uar" should be constructed on the northern borders of this region so that they could also serve the Eluviated Plain where soil conditions are not suitable for the construction of such basins.
- Faafadun Plain. The construction of "uar" should be envisaged in the southern part of the region which borders on the best rangelands. For the remaining part of the region it would appear preferable to construct wells.

The Mineral and Groundwater Survey (37) was the first national survey of Somalia's groundwaters. In the case of the study area, the Report states that the "Border Cretaceous Belt" (the region along the border with Ethiopia and Kenya from the village of Fer-Fer to the northeast up to Ceel Waaq to the west) has highly mineralized water of unsatisfactory quality, while good quality water is found at a depth of 150 m or more in the Lower Juba Plain.

The Report underlines, however, that so far Somalia's water resources have only been studied on a preliminary basis and that lacking a drilling campaign on a national scale they cannot be quantitatively evaluated.

In the conclusions of this Report a water resource drilling programme is proposed. In the Upper Juba area this programme provides for the drilling of 9 wells (some of which would be at Tigieglo, Yet, Bulo Hawa, Faafadun and Siglo) to make water available for livestock and for nomadic settlements. The Report indicates that the aquifer here will probably be between 3 - 40 m thick, with depth to water of 30 - 40 m, water quality between 1.5 - 4 TDS gr/l and a discharge ranging from 3 - 5 to 15 - 20 m^3/h. It suggests that the drilling depth should be 150 - 250 m. Finally the Mineral and Groundwater Survey (37) suggests that water legislation be revised.

As regards water-use by the herds, it should be emphasized that the waterpoint policy cannot be considered in isolation from the rangeland - use policy, and it is essential to set up an organization, without delay, responsible for both.

3.5 USE OF BYPRODUCTS

In the study area, only stockraising of the traditional type is practised. The use of crop by-products is limited to maize and sorghum stubble which the animals graze directly during the dry season in some cases, while in others it is collected and distributed to the animals that are kept in towns during their lactation period. In this latter instance, the animals' diet is sometimes supplemented by byproducts from the milling of cereal (middlings) and the processing of oil seeds (cake).

Trials have been run on the use of byproducts in the intensive fattening phase. These were performed on the experimental feedlot with about 60 head of cattle at the veterinary centre at km 7 from Mogadishu. The feedlot consists of two fenced enclosures which face onto a feed trough.

Shade is provided by an open-sided shed with a palm frond thatch which runs through the centre of the paddocks. Each beast has a total area of about 25 m^2, as well as 66 cm of feed trough, 10 cm of watering trough and 2.5 m^2 of covered area (4).

The feedlot was built during a UNDP project in 1972, the object being to run trials on the use of byproducts available in Somalia and to determine the growth parameters of local stock, while permitting the training of staff at the veterinary school. The feedlot was constructed entirely of locally available materials in order to keep costs low and to provide an example which can be readily emulated.

So far trials have been run with rations composed of: molasses (up to 4 kg per head per day) maize bran, rice straw, sesame and groundnut cake, fishmeal, meatmeal, bonemeal and blood. In 100-day fattening tests, average growth rates of 800 - 1,040 g/day have been obtained, depending on the breed, age and the initial weight of the animals fattened. These results indicate the advisability of fattening stock on the abundant byproducts that will be available when the various irrigation projects are implemented in the Juba Valley.

When the production volumes are sufficiently high, consideration might will be given to the use of byproducts from the canning of vegetables (tomatoes, peas, etc.) and from the production of fruit juices (pawpaw, citrus, etc.).

CHAPTER 4.

ON-GOING PROJECTS AND PROGRAMMES

4.1 PROGRAMMES OF THE 1974-78 FIVE-YEAR PLAN

The importance of the Juba Valley and the Shebeli Valley for the attainment of Somalia's economic development aims is clearly recognized in the Five-Year Plan. Indeed, the main financial appropriations are for the development of farming and stockraising in these two regions, the sums involved being So Sh 740 and So Sh 85 million, respectively, against a bare So Sh 50 million for the rest of the country.

In detail, the Five-Year Plan provides for the following projects in the Juba Valley (1):

a. Development of rice-growing with controlled irrigation
b. Setting up of the Faanoole Irrigation District (part)
c. Development of banana-growing
d. Development of sugar cane-growing
e. Development of cotton-growing
f. Development of livestock in Trans Juba.

- Rice-growing Project

The implementation of the Project depends on the studies to be performed in the framework of the Jowhar Project for the Jubbada Hoose area. For this reason it has been decided to draw up a short-term programme (1974-1977) which should enable about one quarter of the country's rice consumption (8,000 tons of polished rice, equal to 12,000 tons of paddy) to be provided from this source.

This plan covers 1,200 ha in the Jubbada Hoose region (500 ha in the Jilib District and 700 in the Jamaame District) and 2,800 ha in the Shabeellada Hoose and Dhexe regions (Jowhar, Afgooye, Shalambood, Jaanale and Baraawe Districts). In general, it is envisaged that crop rotation will be practised, maize and sesame being grown in the Der season and rice in the Gu season.

Water will be provided by a variable number of irrigation installations.

- Faanoole Irrigation Project

It represents the first stage of the Juba Development Program, according to the 1964 project "Juba River Scheme" that foresees the setting up of state farms with a net irrigated area equal to 8,300 ha to be later extented to 20,000 ha.

The project is divided into four stages corresponding to the progressive extension of the irrigated area. Irrigation works should be completed in 7 years time. The final cropping pattern is based on cotton, sesame, groundnut, maize and vegetables.

- Banana development project

Works of the first two pilot farms of Golwein and Kalanji are under way. According to the 1974-1978 program, private owned plantations are also

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(1) Partly affecting the Shebeli Valley too.

planned to be extended from the present 8,900 ha up to 10,000 ha.

The two pilot farms of Golwein and Kalanji have an important role in this context. In fact, as stressed by the 1974-78 program, the main constraints to the development of Somali banana production consist in the low yields per hectare and the inadequate cultivation techniques.

Therefore the main task of the pilot farms shall be the adoption and experimentation of modern technologies in order to bring the Somali banana production at the same level of more advanced countries.

According to this assumption, which is supported by the National Banana Board, exports of banana are expected to triplicate by limiting the expansion of new plantations to some 2,000 ha additional to the existing cropped area and by increasing yields up to an average 400 quintals per hectare. Finally it must be mentioned the plan of moving the cultivation of banana from the Shalambood area (4,200 ha) towards the Lower Juba Valley.

- Sugar cane plantation

The target of the project is the production of about 500,000 tons of sugar cane on a net cultivable area of 5,125 ha.

The expected yield per ha (100 t) is indeed very high, at least for Somalia and it should be achieved by the adoption of modern techniques and the introduction of improved varieties. The project foresees also the setting up of an new sugar mill having a capacity of 50,000 tons per year and employing 541 persons for 288 working days.

It must be noted that implementation of the new plantation will create a certain competition in the use of water during the "Jilal" season between the plant and the existing banana plantations. Furthermore, the expected production of sugar (50,000 t) at the beginning would be higher than the domestic demand.

The surplus production therefore shall have to be exported, but this does not represent a serious hindrance as Saudi Arabia, the Arab Republic of Yemen and the People Democratic Republic of Yemen import large quantities of sugar (180,000 t in 1972).

- Project for the development of cotton production

This project is in line with the Government policy of reducing the deficit of the commercial balance, by partially reducing the importation of cotton, cotton tops and maize, by checking the price rise and by creating new employment outlets both in the agricultural and industrial sectors. This project foresees the setting up of a Cotton State Farm in the Jamaame area. According to the expected cropping pattern 2,400 ha will grow cotton, 1,600 ha will grow maize, while the remaining 800 ha will be under fallow.

The project includes also a cotton ginnery equipped with a crusher; the by-products of cotton seeds can be utilized for animal feeds.

In addition to the above-mentioned agricultural development projects, the program envisages two other important projects in the livestock sector: Trans-Juba Livestock Development Project, and Multi-purpose Cattle Ranch-Jilib.

The first one foresees the creation of two cattle ranching schemes (farms) of 80,000 ha each; one irrigated farm (1,200 ha) growing fodder plants and a feed lot with a capacity of 5,200 head of cattle; five permanent cattle markets (Tabda, Maskati, Jilib, Luuq and Busar) and a new farm near Afmadow (20,000 ha).

The project foresees also the creation of water points along the 1,000 km of existing roads; a campaign against diseases; and the training for skilled personnel to ensure the project management.

The potential production of the Trans-Juba Project will be approximately 50,000 head of cattle per year half of which to be sold after fattening (210 to 300 kg LW) either as live cattle or as beef cattle to the Kismayo meat processing plant for the production of canned meat.

The other half, consisting in quality beef cattle, should be fattened up to 300 - 370 kg LW, by using first quality fodder produced in the irrigated farm.

The second project foresees the creation of a pilot cattle center over an area of 1,500 ha for the improvement of breeding techniques and the production of improved breeds by means of crossings.

It shall also be used for trials and experiments in order to improve the yields of milk and meat of the indigenous breeds so as to make possible the export of beef at higher prices.

In the framework of the 1974-1978 FYDP, the establishment of these project confirms the determination of the Somali Government to assign a leading role to the Juba Valley in the efforts of reaching the target of an independent domestic food production and of increasing exports.

The analysis of the investment shows that in the project area will be concentrated about 68% of total investments in the agricultural sector and 57% of total investments in the livestock sector.

4.2 THE 1975 JUBA VALLEY EMERGENCY PROGRAM

The 1975 emergency program for the resettlement of the drought-striken populations foresees the settlement of 40,000 people in the Juba Valley, of which 30,000 in the Dujuuma district and 10,000 in the Halba district.

In connection with the tragic loss of cattle that heavily affects the trade balance, the Somaly Government has defined some livestock schemes for the development of cattle and poultry meat production.

The two schemes, to be located in Dujuuma and Halba, shall have the following characteristics:

	Area (ha)	Manpower	Cattle ranching		Poultry farms	
			no.	thousand of So.Sh.	laying hens (no)	thousand of So.Sh.
Dujuuma	18,000	6,000	4,250	6,251	15,000	6,081
Halba	6,000	2,000	1,418	2,084	5,000	2,027

The program foresees also the setting up of two semi-mechanized farms for the production of forage. Each farm should employ 400 persons with an investment cost of 24 millions of So. Sh.

On the whole, the investment costs shall be approximately 145 millions So.Sh., of which 107.8 for the Dujuuma cattle scheme and 37 for the Halba one.

The investment breakdown shows the following percentages:

- 24% for land levelling (earth moving works);
- 12% for agricultural machinery and equipment;
- 40% for services (schools, health centers, housing, drinking water supply, etc.);
- 4% for running costs;
- 20% for the supply of food and clothing.

The two above mentioned programs should be reviewed in the light of the proposals included in the present report. If the construction of hydraulic works at Luuq and Saakow will start in 1976, the 8,000 manpower units available could be used for such works, lasting for about 18 months, and possibly for the construction of some roads.

This outlook is also justified by the fact that, by pooling together the planned costs of 145 million So. Sh., and the costs for hydraulic works at Luuq and Saakow, better capital returns could be obtained by developing productions more convenient from the view-point of profitability, employment absorption and livestock development.

P A R T III

THE MEASURES IN THE AGRICULTURAL SECTOR

CHAPTER 1.

POSSIBLE CROPS

1.1 MAIN CLIMATIC CONDITIONS

There are some slight differences in the climatic aspects of the lower, middle and upper reaches of the Juba Valley. The data available derive from several series of records that in some cases are incomplete and which cover different periods. Table 1 lists the meteorological stations to which reference is made. The characteristics of these stations are as follows:

- Luuq: Arid steppe climate

The available data concern temperature (means, means of minima and maxima, daily range, absolute monthly and annual minima and maxima, relative humidity, cloud cover, winds, etc.). The mean temperatures are available for the years 1923-1939 and 1953-1963. The monthly means never fall below 28 °C. Raingauge data are available for the 1922-1940 and 1953-1965 periods. The rains are concentrated in the months of March, April and May, and October and November. Rainfall is nil in the other months, except for sporadic falls.

- Baardheere: Continental steppe climate

The available data on temperature cover 1915, 1922-1939, 1943-1950 and 1953-1958. The monthly means never drop below 26 °C. Rainfall data are available for the 1915, 1922-1940 and 1943-1965 periods. Rainfall is concentrated in April-May and October, November and December.

- Alessandra

Temperature data are available for the 1923, 1930-1939 and 1953-1958 periods. The monthly means never drop below 25 °C. Rainfall data are available for the 1922-1923, 1930-1939 and 1953-1960 periods. Rainfall is concentrated in April, May, June and July, and in October, November and December. Data on the number of hours of sunshine are available for the 1934-1939 and 1953-1958 periods.

- Jamaame: Littoral steppe climate

Temperature data are available for the 1931-1936 period. Rainfall data are available for the 1929-1937 and 1953-1958 periods. Mean monthly temperatures are above 26 °C. Rainfall is concentrated in April, May, June, July, August, September and October.

Climatic data of interest to agriculture are detailed in Tables 1 to 19 of Appendix A.

1.2 ECOLOGICALLY POSSIBLE CROPS

The main characteristics of each of the crops indicated in Table 2 are detailed in Appendix B, which also gives the results of trials run in Somalia and other information needed to justify the choice of crops, the cultural techniques to be adopted, the growing periods and the probable yields.

Table 1 - Irrigation districts and climatic stations of reference

District		Station
1.	Luuq - Dolow	Luuq Gannane
2.	Baardheere - Saakow	Baardheere
3.	Downstream of Saakow	Baardheere
4.	Downstream of Dujuuma	Alessandra
5.	Dufalach - Afmadow	Alessandra
6.	Faanoole - Jilib	Alessandra
7.	Touta Island	Alessandra
8.	Baardheere - Ionte	Jamaame
9.	Jamaame	Jamaame
10.	State Farms	Alessandra
11.	Descek Uamo	Alessandra

The basic reasons for the choices made are given briefly below, with breakdown by crop type. Then in Chapter 4 the crops are grouped into cropping patterns, on the basis of the system of farming involved.

Appendix E details an adequate programme of research and trials to be implemented gradually at Afgooye and at the envisaged Juba Experimental Station.

The questions posed when selecting crops to be grown in the Valley are as follows:

a. Will they help reduce imports of food and agro-industrial products (textiles, ropes, sacks, etc.).

b. Will they have an export market so as to increase the country's foreign exchange earnings in order to cover some of the Valley development costs involved in the purchase of capital goods (machinery and equipment), technical inputs (fertilizers and pest-control chemicals) and various financial outgoings.

c. Will they have an alternative market, i.e. can they be placed both on the domestic or foreign market, depending on the current economic situation.

Crops selected on the basis of this approach include:

- Those with virtually unlimited possibilities of expansion in terms of area (cereals, oilseeds, etc.).
- Those with limited, but nevertheless considerable possibilities (bananas, tobacco, sugar cane etc.).
- Those with limited expansion possibilities (various fruits, vegetables, etc.).

Crops selected include those already widely grown in Somalia, plants which have been introduced for trials but which are not yet cultivated extensively, and plants to be introduced for the first time. The various plants recommended for the Juba Valley are indicated in Table 2, where they are set out according to the various market possibilities (domestic and export), development possibilities, etc. The crops are classed under the main headings: cereals, oilseeds, textile plants, sugar-producing plants, stimulants, pulses, vegetables, starchy plants, forage plants, green manure plants and fruits.

Cereals

Somalia imports large quantities of cereals (maize, sorghum, rice and wheat), yet for all these species there are varieties and/or ecotypes suited to conditions in the Juba Valley. The possibilities of expansion for these crops are very good. Rice and wheat also have a good export market in the Arabian Peninsula, which could probably absorb any surplus production. Maize and sorghum are already widely cultivated in Somalia and in the Juba Valley.

Trials have been run with wheat in the Shebeli Valley; results are quite promising.

Oilseeds

Fair amounts of oilseeds are already grown in Somalia as a whole and in the Juba Valley, especially sesame and groundnuts. However, production does not cover the country's vegetable oil needs.

There are also good possibilities of growing safflower, soybeans, and sunflower. Oilseed byproducts make very good feed for animals and soybeans, especially, have a good export market (Europe).

Castor oil seeds could also be more widely grown in Somalia for export.

Cotton, too, should be considered among the oilseeds (though here it is listed with the textile plants), since its seeds provide an edible oil and its byproducts can be used for livestock feed.

The coconut must also be classed among the oilseeds; there are already quite a number of dwarf-palm plantations in the Lower Juba. However, productivity is not such as to recommend large-scale development.

Vegetables

Climatic conditions are favourable for the cultivation of various types of vegetable in Somalia, despite the fact that the country inports considerable amounts. Expansion of vegetable-growing along the Juba would not only cover imports and enable home consumption to be boosted, it would also provide a surplus for export to the Arabian Peninsula.

Somalia could also grow out-of-season crops for Europe (November-March), which could be exported at favourable prices.

In addition to marketing fresh vegetables, it would also be possible to build up a canning and frozen foods industry whose production could be placed in Arabia, the Middle East and Europe.

The vegetables with the best development possibilities are tomatoes, onions, potatoes, melons, water-melons, marrows, sweet peppers, lettuces, cabbages, artichokes and carrots.

Pulses

The various pulses that could be grown in Somalia (Dolichos, spp. etc.) could play an important role in improving the country's general diet, which is short of essential amino-acids, thus pushing consumption to such items as meat, eggs, and dairy produce.

Pulses are also of some importance for improving soil fertility.

Fruits

After meat and animals on the hoof, bananas are the county's main foreign-exchange earner. This crop grows well in the Juba Valley (where it is already cultivated on 5,500 ha), especially in comparison with conditions in the Shebeli Valley.

In the on-going re-organization and development plan, the National Banana Agency envisages the concentration of this fruit in the Juba Valley. It also provides for marked improvements in cultural techniques and marketing procedures. It is possible to think in terms of some 12,000-13,000 ha of banana plantations along the Juba Valley in the future.

Grapefruit

It grows well in the Juba Valley, however arrangements are now well under way for growing the fruit on about 1,300 ha in the Shebeli Valley. This will cover most of the share of the world market that Somalia might hope to carve out for itself and so there are but limited possibilities for expanding the crop in the Juba Valley.

There are many other kinds of fruit already grown in Somalia or which could be introduced, that will find good conditions for development. However, the world market is not such as to permit any great expansion. The fruits we have in mind here are citrus (limes and oranges), avocados, pineapples, cashews, pawpaw, mangoes, guavas and many others.

Textile plants

Large quantities of cotton goods are imported and there is a growing demand for sacks and cordage. Not only would the production of cotton and hard fibres (jute, kenaf, San Hemp, etc.) help reduce imports, it would also help develop a domestic textile industry.

Cotton is already widely grown in Somalia, though other fibre plants that have been introduced experimentally on various occasions in the past have never come to be cultivated extensively.

Sugar Producing Plants

The Johar plantation cannot cover the domestic demand for sugar, so large quantities have to be imported. Sugar cane should grow well in the Juba Valley and production could be expanded to meet the whole of the Somali demand and to permit some exports to the Arabian Peninsula.

Stimulants

Tobacco should grow well in the Juba Valley and it should be possible to cultivate sufficient to meet domestic demand and to provide a surplus for export.

Starchy Plants

The starch plants that could be grown in the Valley are cassava, sweet potatoes and potatoes. Cultivation of these could be developed to cover human and livestock feeding requirements and to supply a starch-extraction industry whose products could be exported.

Forage Plants

The development of the livestock sector (particularly cattle-raising) will entail the cultivation of forage for hay and for grazing. It should be possible to grow numerous species under irrigation, the most important being Guinea grass, Rhodes grass, Elephant grass, Sudan grass, alfalfa (lucern) and many others.

Green Manure Plants

Green manure plants will have to be grown to improve the physico-chemical properties of the soils. There are many suitable species, the most adaptable being Vigna spp., Dolichos spp. and Crotalaria spp.

Table 2 - Ecologically possible crops

Crop	Market			Diffusion		
	A	B	C	D	E	FA
CEREALS						
Wheat	x			x		
Maize	x			x		
Rice			x		x	
Sorghum	x			x	x	
OILSEEDS						
Groundnuts	x		x			
Safflower			x		x	
Coconut						
Castor oil		x			x	x
Sesame	x		x			
Soybean			x		x	
TEXTILE PLANTS						
San hemp	x				x	
Cotton	x			x		
Jute	x				x	
Kenaf	x				x	
SUGAR PRODUCING PLS.						
Sugar cane			x	x		
STIMULANTS						
Tobacco			x	x		
PULSES	x			x		

Crop	Market			Diffusion		
	A	B	C	D	E	FA
VEGETABLES						
Garlic			x	x		x
Bamhia			x		x	x
Carrots			x		x	x
Gabbages			x		x	x
Onions			x	x		x
Water-melons			x		x	x
Fresh beans						
Lettuce			x		x	x
Egg-plants						
Melons			x		x	x
Sweet peppers			x		x	x
Tomatoes			x		x	x
Vegetable marrows			x		x	x
STARCHY PLANTS						
Sweet potatoes	x				x	
Potatoes	x				x	
Cassava			x		x	x
FORAGE PLANTS						
Elephant grass	x				x	
Alfalfa	x				x	
Rhodes grass	x				x	
Sudan grass	x				x	
GREEN MANURE PLANTS						
Miscellaneous						

Table 2 - Ecologically possible crops (Cont'd)

Crops	Market			Diffusion		
	A	B	C	D	E	FA
FRUITS						
Cashew		x			x	
Pineapple		x			x	
Avocado		x		x		x
Banana		x		x		
Pawpaw and others					x	x
Grapefruit		x		x		

KEY

A. Crops with good development possibilities and a good domestic market

B. Crops mainly with export market

C. Crops with alternative markets - domestic or export

D. Crops already widely grown in Somalia

E. Crops now being tried or to be introduced

F. Crops grown marginally and with possibilities of development limited to small areas

CHAPTER 2.

CULTURAL TECHNIQUES

The basic parameters regarding the cultural techniques recommended for the crops selected for the various cropping patterns are set forth in adequate detail in Appendixes B, C and D. Here only the essential points are summarized.

2.1 GROWING SEASONS AND SOWING PERIODS

Crops grown in the Valley at the present time follow the trends of the rains, i.e. they are grown in Gu being sown in April and in Der being sown in October.

It is thought that the traditional growing seasons will continue to be respected, especially as regards Gu, for the following reasons:

- The monthly streamflow of the river is at its lowest in February and March and is also fairly low in January.
- The first flood wave occurs in April and the second in October, while flows in the interim are fairly high and regular.
- Even when the waters are regulated there will still be a period when availability is poor (February, March and early April) when the supplies will have to be reserved especially for the perennial crops.

There exist better possibilities for flexibility in Der, as it will be easier to meet the crop water requirement by irrigation.

Traditional experience and analysis of temperature and rainfall data show that it is not possible to rely on the rains to ensure germination and regular growth of herbaceous crops before April (first decade). From that time on, the availability of irrigation water, too, permits sowing without excessive risks. Thus the Gu sowing period must be taken as April 10th onwards. Extension of the sowing season into May and perhaps to June depends essentially on organizational factors and on the cropping pattern adopted.

Sowing for the Der season permits more flexibility and can be performed from July to the end of October, thanks to the abundance of irrigation water available. Der is followed by the Gilal season when crops that need a dry climate at the end of their growing period (cotton, rice, soybeans,etc.) can be brought to maturity.

Table 3 indicates the growing periods for each of the crops examined.

2.2 CULTURAL OPERATIONS

Ploughing

Ploughing will be performed in the period between the two cropping seasons. The depth to which the soil will be tilled and the kind of plough used will depend on the type of soil involved and the requirements of the various crops. For ploughing it will be necessary to use crawler tractors rated at 70 - 90 HP, at least. The operation should be performed, if possible, in mellow soil, irrigating the land, if necessary, before tilling.

Harrowing, grubbing and presowing fertilization

These three operations must precede sowing. When the fertilizer is being distributed it can be dug in by light cross harrowing, which will also serve to rid the soil of the larger plant debris that still remains there.

The three operations can well be performed simultaneously by means of a 60 - 70 HP wheeled tractor complete with the three combined implements.

Furrowing

For some crops it is necessary to prepare furrows in which the plant material is placed. Furrows are also prepared for the irrigation of all the crops. In some cases the same implement is used to ridge-up the seedlings.

Fertilization

Fertilization is needed to conserve soil fertility and to maintain the high yields. Fertilizers consist in mineral fertilizers, organic fertilizers and fallow or green manure.

Mineral fertilizers

At the moment no results are available of conclusive trials with mineral fertilizers in the Valley. It is possible to suggest average fertilizer formulae on the basis of present knowledge of the soils, crops and trials run at the Central Agricultural Research Station, Afgooye and Bonka Farmers Training Centre, and in other countries where conditions are similar. However, the formulae will have to be adjusted and corrected after appropriate trials.

The formulae suggested initially for the Valley contain mainly nitrogen and phosphorus. For the time being the application of potash would be limited to crops that are particularly sensitive to the application of this element (bananas, tobacco and sugar cane) as the amount present in the soils is considered sufficient for the other crops.

Fertilizer formulae and quantities of seeds recommended are listed in Table 4.

Organic fertilizers

Tests with organic fertilizers have been run at Bonka Farmers Training Centre, fairly good results being obtained with the use of 125 ql/ha (Table 5). On the whole, the yield of sorghum was more than double that on the control plot, which received no fertilizer.

Unfortunately it is not always possible and economic to use organic fertilizer, the bulk of which will consist of crop residues that are buried before the next crop is sown. But it is likely that many byproducts that might be dug in (straw, maize and sorghum cobs, oil-seed byproducts) will be put to better and easier use as animal feedstuffs. Hence the need for a careful technical and economic assessment of the situation.

Table 3 - Growing period

Crop	Average number of days
CEREALS	
Wheat	90 - 140
Maize	80 - 135
Paddy rice	120
Rainfed rice	120
Sorghum	80 - 150
VEGETABLES	
Garlic	100 - 120
Artichokes	Multi-annual
Carrots	65 - 90
Cabbages	70 - 80
Gherkins	65 - 70
Onions	110 - 130
Water melons	90 - 120
Lettuces	60 - 90
Melons	90 - 150
Potatoes	
Sweet peppers	125 - 150
Tomatoes	70 - 80
Radishes	25 - 30
Vegetables marrows	100 - 120
PULSES	100 - 130
STARCHY PLANTS	
Sweet potatoes	
Cassava	300 - 360
TEXTILE PLANTS	
San hemp	100
Cotton	150 - 190
Jute	90
Kenaf	150 - 180
Ramia	Multi-annual
OILSEEDS	
Groundnuts	90 - 150
Safflower	110 - 150
Sunflower	120 - 150
Castor oil	90 - 250
Sesame	40 - 90
Soybeans	40 - 90

?

Cont'd Table 3

Crop	Average number of day
SACCARIFEROUS	
Sugar cane	Multi-annual
STIMULANTS	
Tobacco	120
FORAGE PLANTS	
Elephant grass	Multi-annual
Alfalfa	Multi-annual
Rhodes grass (chloris gaiana)	Multi-annual
Sudan grass	Multi-annual
FRUITS	
Cashews	Multi-annual
Pineapples	Multi-annual
Avocado	Multi-annual
Coconut	Multi-annual
Bananas	Multi-annual

Table 4 - Mineral fertilizers and sowing density - Quantity of active ingredient (kg/ha) and quantity of seeds per crop (kg/ha)

Crop	FERTILIZER				SEEDS	
	Nø.		P_2O_5		Kg/ha	
	Range	Recommended value	Range (1)	Recommended value (1)	Range	Recommended value (1)
Wheat	60-100	75	80-120	90	90-180	150
Maize (grain)	45- 90	50	50-100	80	15- 25	20
Paddy rice	20-100	50	50-100	50	90-150	100
Rainfed rice	40- 60	50	30- 60	50	140-200	160
Sorghum	35- 45	40	35- 65	40	4- 20	10
Sorghum (forage)	-	-	-	-	10- 30	15
Garlic	40- 70	40	100-150	120	800-1000	9,000 x
Artichokes	70-100	80	80-100	100		12,500 x
Carrots	100-200	150	100-130	100		3,300
Cabbages	80-120	80	50-100	60		0,200
Gherkins	40- 60	50	60- 80	70		3,000
Onions	40- 70	50	80-100	90		3,300
Water melons	40- 60	50	80-100	80		2,600
Lettuces	30- 50	30	80-100	90		1,300
Melons	50-100	70	50-100	70		2,600
Potatoes					30-40,000 x	40,000 x
Sweet peppers	80-100	90	80-100	90		3,800
Tomatoes	30- 50	40	100-150	110	2- 9	2,600
Vegetable marrows	40- 60	50	80-100	90		2,600
Pulses	40- 70	50	60-100	80	40- 90	70-
Sweet potatoes	30- 40	40	60- 70	70	12-15,000x	14,000 x
Cassava	45- 90	50	25- 65	60	10-15,000x	13,000 x
San hemp	35- 65	50	60- 80	70	40- 50	40
Cotton	35- 85	40	55- 85	50	40- 80	40
Jute	60- 90	80	20- 45	40	8- 12	10
Kenaf	35- 65	50	30- 60	40	20- 35	25
Ramia	55-.80	60	60- 80	70	25-30,000x	30,000 x
Groundnuts	20- 45	25	50-100	50	60-120	170
Safflower	20- 50	30	15- 30	20	8- 15	10
Sunflower	40- 80	50	50-100	80	5- 15	15
Castor oil	20- 45	40	50- 90	70	10- 15	15
Sesame	20- 45	30	15- 25	15	5- 20	12
Soybeans	0- 45	30	35- 80	45	20- 60	25
Sugar cane xx	35-160	50	60-120	70	20-25,000	22,000

cont.d Table 4

Crop	Fertilizer N. Range	Fertilizer N. Recommended	P_2O_5 Range (1)	P_2O_5 Recommended value (1)	Seeds Kg/ha Range	Seeds Kg/ha Recommended value (1)
Tobacco xx	50-130	80	30- 90	60	0.02-0.04	0.03
Elephant grass	7- 15	10	25- 45	30		40-42,000x
Alfalfa	0- 20	10	-	60	15- 30	20
Rhodes grass	7- 13	10	25- 40	30	2.5-3.5	3,000
Sudan grass					10- 20	15
Cashews					150-200	150
Pineapples	300-400	300	150-200	150	45-75,000x	45,000 x
Citrus						100-125 x
. on plainting	-		250	250		
. year. 1	9- 45	30	-	-		
. year 2	20	20	-	-		
. year 3 - 5	20	20	22- 25	25		
. year 6	10- 30	20	6- 12	10		
Avocado	20-50	30	10- 25	15	100-160	100-125 x
Bananas xx	100-150	120	60- 90	70	800-3,000x	2,500 x
Coconut	20- 40	30	25- 50	40	100-150	100-125 x

x Number of cuttings, rooted cuttings, bulbs, etc per ha

xx Sugar cane 50 Kg/ha of K_2O
Tobacco 150 Kg/ha of K_2O
Bananas 60 Kg/ha of K_2O

(1) Average values recommended to start with; considered suitable for the various edaphic conditions in the Juba Valley Districts.

Note: Values related to fertilizer doses and seed rates may be slightly underestimated but they correspond to values closely linked to the production results indicated in the Report.
They are similar to those applied in other African countries in similar conditions. Due account has also been taken of the experimentation results in Somalia, although they are not fully significant, in assuming the above indicated values.

Table 5 - Organic fertilizers

Season	Yield on fertilized plot	Yield on control plot	Increased yield %
GU 1967	28.4 ql/ha	12.7 ql/ha	124 %
DER 1967	11.8 "	4.4 "	168 %
GU 1968	37.7 "	14.4 "	162 %
DER 1968	24.2 "	8.7 "	178 %
GU 1969	24.2 "	12.5 "	95 %
DER 1969	19.8 "	6.6 "	200 %
Average of 6 trials	24.4 ql/ha	9.9 ql/ha	146 % increase

Source : IBRD, Agricultural Sector Project Identification Report, App. 12, 1973

Fallow - Green manure

It is normal practice in the Valley to apply green manure and to leave the land fallow. However, this practice has a considerable cost in terms of lost crop production. Thus, here again trials will have to be run which take account of soil fertility and the economic aspect, in order to decide on the best cultural practice.

Trials were run at Bonka Farmers Training Centre to compare the pattern of fallow-crop and crop-crop. Though the resulting data are not definitive they are fairly interesting: the practice of continuous cropping gave better results than did that of having a fallow period. It is not easy to explain the reason for this, though it might be that the ploughing in of crop residues was better as regards improvement of soil fertility than was fallowing. But it may also be that the effect of fallowing on fertility is manifest only on the long term.

The other problem is the economics of using green manure or of fallowing. Trials on green manure compared with fallowing were run at Bonka Farmers Training Centre during Gu. The crop grown during Der was sorghum. Green manure gave a 35% higher yield than did fallowing.

Season	Yield with green manure (ql/ha)	Control plot yield (ql/ha)	Percent increase
1967 Der	7.1	5.3	34
1968 Der	6.8	4.8	42
1969 Der	8.3	6.4	30
Average	7.4	5.5	35

Source: IBRD, Agricultural Sector, op.cit.

The green manure crops can be used to feed livestock for one or two cuts and then ploughed in, thus reducing the cost of this practice.

However, the problem still remains of whether green manuring is really worthwhile on the short term. Only the suggested trials will indicate the merits and demerits of the alternatives: fallow/crop, green manure/crop or actually crop/crop. Until then, the practice of ploughed fallow is recommended. This involves ploughing and irrigating the fallow land and then ploughing in the natural plant growth which occurs. This solution is cheaper than green manuring.

Sowing

Sowing is done by hand or by machine, depending on the crop. The sowing (or transplanting) period follows the first decade in April (Gu) and also embraces the months of August, September and October (Der). The seeds (or seedlings) should be treated to prevent attack by parasites that live in the soil.

The varieties of seed to be used must be selected mainly on the basis of the results of trials run or to be run. In the case of crops not already grown in the area, it will be necessary to seek varieties coming from environments that are ecologically similar to those in the Valley and then to acclimatize them.

Sowing and planting distances

Little work has yet been done in Somalia on sowing and planting distances and the results so far to hand are not very indicative. So it will be as well to refer to layouts already adopted in Somalia or in other countries where conditions are similar to those in the Juba Valley (Table 6).

Weed control and weeding

Provision has been made for the use of weed-killer chemicals; however, trials should be performed on their use in the specific conditions in the Valley. Meanwhile, in the short and medium term it will be advisable to depend on manual weeding, not least to ensure that there is no transport of active residual chemicals in the drainage waters, which could result in the gradual pollution of the Juba, thus damaging the downstream Districts.

Pest control treatments

Infestation by insects (coleopters and lepidopters) and nematodes, together with fungus and bacteria infestations can markedly reduce crop yields. Pest-control treatments are therefore essential to obtain high production. For the large schemes it is considered that spraying from the air would be the best and cheapest solution. For the family farms, instead, treatment should be given by manual sprayers or dusters.

The treatments needed for the various crops or groups of crops are as follows:

- Treatment of seeds with insecticides that are ingested (DDT, Lindane, etc.).
- Preventive treatment against coleopters and lepidopters (DDT and Lindane).
- Therapeutic treatment against lepidopter and coleopter larva in fruits and other parts of plants (Sevin, Rogor and phosphoric esters).
- Treatment against soil nematodes (especially for bananas).
- Treatment against fungus (e.g. cercospora) by spraying with activated mineral oils and fungicides (Zineb, Ziram, etc.).

The number of treatments will depend on the degree of infestation and on the economics of the treatments. As far as possible, treatments should be preventive. Thus seed dressing and one or two DDT or Lindane treatments against coleopterans and lepidopters will be of primary importance (1 - 2 phosphoric-ester based). At least 7 or 8 treatments will be necessary for cotton.

Bird control

Attack by birds can cause great damage to crops whose seeds are exposed (sorghum, rice, wheat, soybeans, sunflowers, pulses, vegetables, etc.).

Table 6 - Sowing and planning distances (in m)
(Average values advised for first trials in Juba Valley Districts)

Maize grains	0.60x0.40
Sorghum	0.60x0.30
Wheat	0.15-0.35 between rows
Paddy rice	0.20-0.30 m between rows
Rainfed rice	0.25-0.35 m between rows
Cassava	1.00x1.00 / 1.00x0.80
Sweet potatoes	0.90x0.30
Potatoes	0.50x0.30
Melons	0.50x1.80
Water melons	3.00x3.00
Onions	0.30x0.15
Garlic	0.40x0.10
Tomatoes	0.90x0.50
Vegetables marrows	1.50x1.00
Sweet peppers	0.40x0.60
Artichokes	1.00x0.80
Lettuces	0.30x0.30
Carrots	0.10x0.30
Radishes	0.10x0.15
Cabbages	0.90x0.80
Gherkins	1.00x0.40
Lentils	0.35 between rows
Beans	0.50 between rows
Cotton	0.75x0.85-0.90x0.35-70x30
Jute	0.10x0.10
Kenaf	0.60x0.10
San hemp	0.15 between rows
Ramia	1.00x0.40
Groundnuts	0.40x0.15
Sesame	0.60x0.20
Safflower	0.60x0.30
Soybeans	0.50x0.20
Castor oil	1.00x0.75
Sunflower	0.80x0.40
Sugar cane	double rows m 1.50x0.30
Tobacco	1.20x0.60/1.00x/0.45/0.90/0.90/0.80x0.80
Alfalfa	0.10-0.15 between rows
Elephant grass	0.90x0.30
Sudan grass	0.70x0.30
Rhodes grass	0.90 between rows
Coconut	9.00x9.00
Avocado	10.00x10.00 / 8.00x8.00
Grapefruit	10.00x10.00 /10.00x8.00 / 9.00x9.00
Bananas	2.00x2.00
Pineapples	double rows 0.90x0.60x0.30
Cashews	8.00x8.00

However, trials have not yet been run in Somalia on this aspect and it is not possible to plan scientific measures to combat attack. The only solution to the problem, as things stand, is to utilize the available labour, especially the women and children for continuous surveillance of the crops, so that they can disturb the birds. Varieties of cereals (rice, sorghum and wheat), whose seeds are genetically resistant to being stripped, might also be introduced.

2.3 MECHANIZATION AND MANPOWER REQUIREMENTS

The general line for the development of agriculture is to opt for labour-intensive cultural operations. Provision is made in this Project for the adoption of different levels of mechanization involving diverse use of labour.

a. Mechanized crops

These are crops grown mainly on the State Farms and in production cooperatives. The following operations would be mechanized.

- Ploughing
- Harrowing and grubbing
- Sowing
- Furrowing
- Pest-control treatments (aerial spraying)
- Transport
- Threshing and the like
- Combine harvesting (in some cases).

Other operations, such as hoeing, weeding and harvesting (requiring a lot of labour) are expressly envisaged as being done by hand.

b. Semimechanized crops

These are field crops grown on the Family Farms, where only ploughing and harrowing are mechanized (plus threashing and transport, where necessary).
The data concerning the individual operations are set forth in Appendix C.

c. Annual crops

These include vegetables and pulses when grown on small plots on Family Farms. Here no mechanization would be used at all.

In the three different levels of mechanization, an estimate has been made of the distribution of the various operations and the relevant machine and labour requirements during the growing period of each crop.
It is considered that deep ploughing will be done between two successive crops, in relation to the productive system and organizational requirements.
The manpower needs and number of machine hours needed per hectare of land are set forth in Annex C.

Table 7–Potential evaporation – Calculated by various formulae for various meteorological stations

Station / Formula / Month	Alessandra			Baardheere		Jamaame		Luuq–Gannane	
	Blaney - Criddle	Thornthwaite	Turc	Blaney - Criddle	Thornthwaite	Blaney - Criddle	Thornthwaite	Blaney - Criddle	Thornthwaite
January	180.0	158.1	164.1	182.7	165.4	179.1	158.1	187.0	171.4
February	164.6	145.7	160.7	169.9	155.1	164.6	145.7	174.4	161.0
March	181.7	161.2	172.7	190.8	177.8	180.0	158.1	196.5	182.3
April	172.4	149.5	140.7	181.3	166.6	177.3	160.6	186.9	174.4
May	178.3	153.9	133.9	183.0	161.2	179.1	158.1	187.7	171.7
June	165.8	136.3	117.2	172.2	145.4	168.3	141.4	179.7	163.8
July	168.1	119.6	121.0	172.1	140.4	169.8	121.2	181.2	156.9
August	168.9	124.8	135.4	174.0	140.4	169.8	124.8	180.0	155.4
September	165.8	136.3	148.1	172.4	149.5	167.5	141.4	177.5	160.6
October	174.9	149.8	141.1	183.4	161.2	176.6	149.8	180.4	159.6
November	171.6	149.5	129.3	173.8	156.5	171.6	149.5	177.4	160.4
December	178.3	153.9	144.3	180.0	161.2	179.1	158.1	183.3	168.3
Annual value in mm	2,070.6	1,738.6	1,708.5	2,135.6	1,880.7	2,082.8	1,766.8	2,192.0	1,985.8

2.4 CROP WATER REQUIREMENTS

Numerous formulae have been worked out for calculating potential evapotranspiration based on the relationship between evapotranspiration and climatic elements. Not all of these can be used in Somalia, either because of the special physical and climatic environment or because of the limited amount of data available. The formulae most commonly used for irrigation projects are as follows:

a. Blaney and Criddle Formula

This was worked out by the authors in the dry climates in the western part of the USA. The formula is one of the most widely used. It provides for correction of the theoretical calculations based on climatic characteristics with empirical coefficients that take account of the nature of the plant.

b. Thornthwaite Formula

This is an exclusively climatic formula. It was worked out by the author on the basis of experiments run in wet environments in the central and eastern parts of the USA. It is based on the exponential relation existing between the ETP and the mean monthly temperature, appropriately corrected for latitude.

c. Turc Formula

This formula has been used in various parts of the world. It can be considered both theoretical and practical. It can only be used at Alessandra, as the required data are missing elsewhere.

Theoretical evapotranspiration values obtained by the Blaney and Criddle, Thornthwaite and Turc formulae (the last only for Alessandra) are reported in Table 7.

It has been considered advisable to use the Blaney and Criddle formula for calculating consumptive use of water by plants in this Project, because:

- Climatic conditions in the Valley resemble those in the area where the formula was developed.

- A series of empirical crop coefficients is available with which to make a better estimate of water consumption. The K values used to correct the ETP as a function of crop are set forth in Table 8. In view of the hot, dry climate involved, the upper limits of the values indicated by Blaney and Criddle have been adopted. missing

By reference to the potential ETP and the K coefficients, consumptive use of water by the various crops in each district and for the whole year has been calculated (Appendix A).

The distribution of rain is interesting, especially for evaluating its effectiveness in agriculture. The data on rainy days, derived by A. Fantoli are given in Appendix A. Effective rainfall constitutes that part which is really available to satisfy the consumptive use requirements of the crops.

There are not enough meteorological data available to apply any of the various formulae being worked out by authors in different parts of the world. It has therefore been decided to adopt a nil value in those months when rainfall frequency is low, as there is every likelihood that it will not rain at all. Instead, the rainfall recorded in the "rainy" months has been adopted, "as is" since losses by percolation and runoff are taken to be nil.

The effective rainfall figures adopted are given in Appendix A.

Starting from the gross water requirement per plant per month, the effective rainfall has been deducted to arrive at the irrigation water requirement at the plant for each crop over the course of the year. The data for the various stations are set forth in Tables 9, 10, 11 and 12.

2.5 PROBABLE YIELDS

At the moment crop yields are generally medium low to low owing to:

- Lack or insufficiency of water
- Rudimentary nature of cultural techniques
- Lack or insufficiency of fertilization
- Varieties not always suited to environment
- Insufficient control of vegetable and animal pests.

It is to be expected that with the introduction of irrigation, better varieties, fertilization, appropriate cultural techniques and proper pest control measures, the yields will rise considerably.

Future yields of crops presently grown in Somalia and those it is intended to introduce or which are now being introduced have been estimated on the basis of results obtained with improved crops in similar environments in other parts of the world. The probable yields are set forth in Table 13.

Three periods are considered in the estimates:

- A first or initial period, when yields will not be very high because the lands will only recently have been put under the plough, and cultural and organizational techniques and procedures are still being worked out (Years 1 to 5).

- An intermediate or second period, when conditions are beginning to settle down and higher yields should be possible (Year 5 to 10).

- A final period when things are running smoothly and the potential of the soil and the varieties grown is fully exploited (after Year 10).

The values indicated are averages for the whole Project Area. Of course, depending on the prevailing soil and climatic conditions in each District yields will differ for any given crop. It is considered that the differences will fall within a range of ± 10%.

Table 9 - Monthly crop water needs (mm) - Station : Alessandra

Crop \ Month	J	F	M	A	M	J	J	A	S	O	N	D
CEREALS												
- Maize	153.0	139.9	154.4	8.1	40.3	86.9	90.4	143.5	140.9	74.2	86.2	103.3
- Sorghum	144.0	131.7	145.4	0.5	31.4	78.6	82.0	135.1	132.6	65.4	77.6	94.4
- Wheat	144.0	131.7	145.4	0.5	31.4	78.6	82.0	135.1	132.6	65.4	77.7	94.4
- Paddy rice	198.0	181.1	199.9	51.2	84.9	128.4	132.4	185.8	182.4	117.9	129.1	147.9
- Upland rice	162.0	148.1	163.5	16.8	49.3	95.2	98.8	152.0	149.2	82.9	94.7	112.3
OILSEEDS	126.0	115.2	127.2	-17.7	13.6	62.1	65.2	118.2	116.1	47.9	60.4	76.6
TEXTILE PLANTS	126.0	115.2	127.2	-17.7	13.6	62.1	65.2	118.2	116.1	47.9	60.4	76.6
FRUIT-BEARING CROPS												
- Banana	180.0	164.4	181.7	34.0	67.1	111.8	115.6	168.9	165.8	100.4	111.9	130.1
- Grapefruit & pineapple	117.0	107.0	118.1	-26.3	4.7	53.8	56.8	109.8	107.8	39.2	51.8	67.7
- Avocado & citrus fruits (excluding grapefruit)	99.0	90.5	99.9	-43.6	-13.1	37.2	39.9	92.9	91.2	21.7	34.7	49.9
- Coconut	153.0	139.9	154.4	8.1	40.3	86.9	90.4	143.6	140.9	74.2	86.2	103.3
PULSES	126.0	115.2	127.2	-17.7	13.6	62.1	65.2	118.2	116.1	47.9	60.4	76.6
VEGETABLES	126.0	115.2	127.2	-17.7	13.6	62.1	65.2	118.2	116.1	47.9	60.4	76.6
STARCHY PLANTS	126.0	115.2	127.2	-17.7	13.6	62.1	65.2	118.2	116.1	47.9	60.4	76.6
FORAGE PLANTS	162.0	148.1	163.5	16.8	49.3	95.2	98.8	152.0	149.2	82.9	94.7	112.3
SUGAR CANE	162.0	148.1	163.5	16.8	49.3	95.2	98.8	152.0	149.2	82.9	94.7	112.3
TOBACCO	144.0	131.7	145.4	0.5	31.4	78.6	82.0	135.1	132.6	65.4	77.6	94.4

Table 10 - Monthly crop water needs (mm) - Station : Jamaama

Crop \ Month	J	F	M	A	M	J	J	A	S	O	N	D
CEREALS												
- Maize	152.2	139.9	153.0	91.0	52.9	64.5	76.4	120.3	110.8	123.6	145.9	152.2
- Sorghum	143.3	131.7	144.0	82.1	44.0	56.1	67.9	111.8	102.4	114.8	137.3	143.3
- Wheat	143.3	131.7	144.0	82.1	44.0	56.1	67.9	111.8	102.4	114.8	137.3	143.3
- Paddy rice	197.0	181.1	198.0	135.3	97.7	106.6	118.9	162.8	152.6	167.8	188.8	197.0
- Upland rice	161.2	148.1	162.0	99.9	61.9	73.0	84.9	128.8	119.1	132.4	154.4	161.2
OILSEEDS	125.4	115.2	126.0	64.4	26.1	39.3	51.0	94.9	85.6	97.1	120.1	125.4
TEXTILE PLANTS	125.4	115.2	116.0	64.4	26.1	39.3	51.0	94.9	85.6	97.1	120.1	125.4
FRUIT-BEARING CROPS												
- Banana	179.1	164.6	180.0	117.6	79.8	89.8	101.9	145.8	135.9	150.1	171.6	179.1
- Grapefruit & pineapple	116.4	107.0	117.0	55.5	17.1	30.9	42.5	86.4	77.3	88.3	111.5	116.4
- Avocado & citrus fruits (excluding grapefruit)	98.5	90.5	99.0	37.8	- 0.8	14.1	25.5	69.4	60.5	70.6	94.4	98.5
- Coconut	152.2	139.9	153.0	91.0	52.9	64.5	76.4	120.3	110.8	123.6	145.9	152.2
PULSES	125.4	115.2	126.0	64.4	26.1	39.9	51.0	94.9	85.6	97.1	120.1	125.4
VEGETABLES	125.4	115.2	126.0	64.4	26.1	39.9	51.0	94.9	85.6	97.1	120.1	125.4
STARCHY PLANTS	125.4	115.2	126.0	64.4	26.1	39.9	51.0	94.9	85.6	97.1	120.1	125.4
FORAGE PLANTS	161.2	148.1	162.0	99.9	61.9	73.0	84.9	128.8	119.1	132.4	154.4	161.2
SUGAR CANE	161.2	128.1	162.0	99.9	61.9	73.0	84.9	128.8	119.1	132.4	154.4	161.2
TOBACCO	143.3	131.7	144.0	82.1	44.0	56.1	67.9	111.8	102.4	114.8	137.3	143.3

Table 11 - Monthly crop water needs (mm) - Station : Baardheere

Crop / Month	J	F	M	A	M	J	J	A	S	O	N	D
CEREALS												
-Maize	155.3	144.4	162.2	59.1	101.0	146.4	146.3	147.9	146.6	93.0	83.7	124.6
-Sorghum	146.2	135.9	152.2	50.0	91.8	137.8	137.7	189.2	137.9	83.8	75.0	115.6
-Wheat	146.2	135.9	152.2	50.0	91.8	137.8	137.8	189.2	137.9	83.8	75.0	115.6
-Paddy rice	201.0	186.9	209.9	104.4	146.7	189.4	189.3	191.4	189.6	138.8	127.2	169.6
-Upland rice	164.4	152.9	171.7	68.2	110.1	155.0	154.9	156.6	155.2	102.2	92.4	133.6
OILSEEDS	127.9	118.9	133.6	31.9	73.5	120.5	120.5	121.8	120.7	65.5	57.7	97.6
TEXTILE PLANTS	127.9	118.9	133.6	31.9	73.5	120.5	120.5	121.8	120.7	65.5	57.7	97.6
FRUIT-BEARING CROPS												
-Banana	182.7	169.9	190.8	86.3	128.4	172.2	172.1	174.0	172.4	120.5	109.8	151.6
-Grapefruit & pineapple	118.8	110.4	124.0	22.8	64.3	111.9	111.9	113.1	112.0	56.3	49.0	88.6
-Avocado & citrus fruits (excluding grapefruit)	100.7	93.4	104.9	4.7	46.0	94.7	94.6	95.7	94.8	38.0	31.6	70.6
-Coconut	155.3	144.4	162.2	59.1	100.9	146.4	146.3	147.9	146.5	93.0	83.7	124.6
PULSES	127.9	118.9	133.6	31.9	73.5	120.5	120.5	121.8	120.7	65.5	57.7	97.6
VEGETABLES	127.9	118.9	133.6	31.9	73.5	120.5	120.5	121.8	120.7	65.5	57.7	97.6
STARCHY PLANTS	127.9	118.9	133.6	31.9	73.5	120.5	120.5	121.8	120.8	65.5	57.7	97.6
FORAGE PLANTS	164.4	152.9	171.7	68.2	110.1	155.0	154.9	156.6	155.2	102.2	92.4	133.6
SUGAR CANE	164.4	152.9	171.7	68.2	110.1	155.0	154.9	156.6	155.2	102.2	92.4	133.6
TOBACCO	146.2	135.9	152.6	50.0	91.8	137.8	137.7	139.2	137.9	83.8	75.0	115.6

Table 12 - Monthly crop water needs (mm) - Station : Luuq Ganane

Crop \ Month	J	F	M	A	M	J	J	A	S	O	N	D
CEREALS												
-Maize	158.9	148.2	138.7	45.1	120.8	152.7	154.0	153.0	150.9	107.6	93.0	155.8
-Sorghum	149.6	139.5	128.9	35.7	111.5	143.8	134.0	144.0	142.0	98.6	84.1	146.6
-Wheat	149.6	139.5	128.9	35.7	111.5	143.8	134.0	144.0	142.0	98.6	84.1	146.6
-Paddy rice	205.7	191.8	187.8	91.8	167.8	197.7	199.3	198.0	195.2	152.7	137.3	201.6
-Upland rice	168.3	157.0	148.5	54.4	130.2	161.7	163.1	162.0	159.7	116.7	101.9	165.0
OILSEEDS	130.9	122.1	109.2	17.0	92.7	126.0	126.8	126.0	124.2	80,6	66,4	128,3
TEXTILE PLANTS	130.9	122.1	109.2	17.0	92.7	126.0	126.8	126,0	124.2	80.6	66.4	128.3
FRUIT-BEARING CROPS												
-Banana	187.0	174.4	168.2	73.1	149.0	179.7	181.2	180.0	177.5	134.7	119.6	183.3
-Grapefruit & pineapple	121.5	113.4	99.4	7.7	83.3	116.8	117.8	117.0	115.4	71.5	57.5	119.1
-Avocado & citrus fruits (excluding grapefruit)	102.8	95.6	75.8	11.2	64.5	98.8	99.7	99.0	97.6	53.5	39.8	100.8
-Coconut	158.9	148.2	138.7	45.1	120.8	152.7	154.0	153.0	150.9	107.6	93.0	155.8
PULSES	130.9	122.1	109.2	17.0	92.7	126.0	126.8	126.0	142.2	80,6	66.4	128.3
VEGETABLES	130.9	122.1	109.2	17.0	92.7	126.0	126.8	126.0	142.2	80.6	66.4	128.3
STARCHY PLANTS	130.9	122.1	109.2	17.0	92.7	126.0	126.8	126.0	142.2	80.6	66.4	128.3
FORAGE PLANTS	168.3	157.0	148.5	54.4	130.2	161.7	163.1	162.0	157.7	116.7	101.9	165.0
SUGAR CANE	168.3	157.0	148.4	54.4	130.2	161.7	163.1	162.0	157.7	116.7	101.9	165.0
TOBACCO	149.6	139.5	128.9	35.7	111.5	143.8	145.0	144.0	142.0	98.6	84.1	146.6

Table 13 - Probable yields (ql/ha)

Crops	1st period	2nd period	Final period
CEREALS			
Wheat	15	20	30
Maize-silo (green parts)	300	400	500
Maize (grain)	25	40	55
Maize-cob mash	75	100	120
Sorghum	20	24	30
Paddy rice	20	30	40
Rainfed rice	15	20	25
OILSEEDS			
Groundnuts (in shells)	10	12	15
Safflower seeds	8	10	15
Safflower dry flowers	0,1	1,1	1,2
Sunflower	8	10	12
Castor oil	8	10	15
Sesame	6,5	8	10
Soybeans	10	12	15
TEXTILE PLANTS			
San hemp	12	15	20
Cotton (bolls)	12	15	18
Jute (fibre)	12	15	20
Kenaf (fibre)	12	15	20
Ramia	12	15	20
SUGAR-PRODUCING PLANTS			
Sugar cane (1st year)	800	800	1,000
STIMULANTS			
Tobacco (dry leaves)	10	12	15

Crops	1st period	2nd period	Final period
GRAIN PULSES	12,5	15	20
VEGETABLES	125	145	180
STARCHY PLANTS			
Sweet potatoes (green tubers)	200	300	400
Cassava (ripe roots)	200	300	400
FORAGE PLANTS			
Elephant grass (green 8 cuts)	800	1,000	1,200
Alfalfa (hay 10-12 cuts)	180	220	250
Rhodes grass (green 8 cuts)	600	800	1,000
Sudan grass (green 3 cuts)	600	800	1,000
FRUITS			
Cashews (nuts)	2	4	8
Pineapples	150	200	250
Avocado	200	200	300
Bananas	300	300	400
Coconuts	3	3	5
Grapefruit	200	200	300

CHAPTER 3.

THE IRRIGATION DISTRICTS

NOTE

In evaluating the irrigated areas it must be pointed out that the Dujuuma District area has been defined on the basis of the availability of the lands pedologically classified, applying the low utilization coefficients indicated in paragraph 3.2.1, Part I, Vol. IV.

On the other hand it has been recognized the necessity of using part of this District for the realization of a national park. Owing to the level of first approximation of the study it has not been considered opportune to change the irrigated area to be destined to a park and that to be destined to agriculture and eventual variations of utilization coefficient.

3.1 GENERAL

Eleven Districts have been blocked out down the Juba, on the basis of an evaluation of the potential of the lands suitable for irrigation and geographic location (see Fig.1.III). The size and shape of the Districts varies. They contain a gross irrigable area of about 234,000 ha of Class I, II and III lands and 31,000 ha of Class IV (see Table 14).

This number also includes the districts identified previously in the 1965 "Juba River Irrigation Scheme", as far as geographic location and area are concerned. However, as indicated ahead, the assessments are different as regards land classification, cropping patterns and crop calendars, yields and irrigation water consumption.

Table 14 sets forth the basic data on the Districts identified. It should be recalled that part of the lands included in District 6 should not be irrigated or should be used only through high overall and unit investments. The same holds good for some lands in District 2. Thus it is considered cautiously that around 220,000 ha of the 265,000 just indicated can be developed over the next thirty years, provided that flow control is ensured on the Juba by the dams and reservoirs described elsewhere.

In District 1 (Luuq-Dolow) upstream of Baardheere Dam, irrigation will be bound up with the seasonal availability of river water. Thus there should be no multi-year crops in the cropping patterns there.

However, taking the Districts as a whole, 95% of them will eventually be served by waters controlled by the Baardheere and Saakow Dams, so the cropping patterns there can include both perennial and multi-annual crops. Irrigation water should be available in the required quantities nine years out of ten.

3.2 THE DISTRICTS

District 1: Luuq - Dolow (see Table 15)

This starts immediately downstream of Dolow and runs for about 70 km along the Juba, mainly on the right of the river. Its maximum width is about 8 kilometres and its minimum about 2. The gross irrigated area is 19,250 ha and the net area 16,400 ha.

All the irrigation water will have to be pumped, because it would be inadvisable to build a dam on the river until clear-cut bilateral agreement has been reached with Ethiopia.

District 2: Baardheere - Saakow (see Table 16)

This is the largest District, with a gross area of 57,000 ha and a net area of 47,350. It extends for about 70 km, some 60% of it being on the right of the Juba, where it reaches a maximum width of about 20 km, and 40% on the left where it is 12 km at its widest point.

The whole of the District has to be reclaimed. It is envisaged that about 50% of the area will have to be irrigated by pumped waters.

District 3: Downstream of Saakow (see Table 17)

This District runs for about 56 km, two thirds on the right of the river and one third on the left. The maximum widths are 20 and 10 km respectively. The gross irrigated area is 32,900 ha and the net area 26,600.

The whole of the District has to be reclaimed. Some 10% of the land will have to be irrigated with pumped waters.

Twenty-eight percent of the area, namely 7,650 ha, consists of Class IV lands.

District 4: Downstream of Dujuuma (see Table 18)

This District is about 60 km long. It stretches on both sides of the river, being a maximum of 6 km wide in all and an average of 4 km. The gross irrigated area is 13,070 ha and the net 11,100.

Some 30% of the lands will be irrigated by pumped waters.

District 5: Dufalach - Afmadow (see Table 19)

This District starts about 1 km from Afmadow and extends towards the Juba for about 60 km in a NNE direction, being a maximum of 13 km or so from the river. The maximum width is 8 km and the mean 4. The gross area is 9,165 ha and the net 7,800.

Some areas need less clearing than other, but the remainder of the District all needs reclamation works. It is envisaged that water will have to be pumped to irrigate 5% of the lands, to resolve local problems which would otherwise lead to the overall scheme having to be much costlier.

District 6: Faanoole - Jilib (see Table 20)

This runs for 22 km on the right of the Juba, where it is 14 km wide. On the left it occurs as two separate areas where rice appears to be the only possible crop. The gross and net areas are 28,700 and 26,400 ha, respectively.

The whole District has to be reclaimed. Pumped irrigation will be necessary on about 5% of the land.

The District contains 14,800 ha of Class IV lands, i.e. about 50% of the irrigable area.

District 7: Touta Island (see Table 21)

About 70% of the area is enclosed by two arms of the river, while the remainder is on the right bank. The total length is 42 km and the average width is 6. Gross and net areas are 15,700 and 13,000 ha, respectively.

The whole District has to be reclaimed. Irrigation waters will have to be pumped onto about 5% of the lands.

District 8: Baardheere - Ionte (see Table 22)

The whole District lies on the right of the Juba. It is 70 km long and an average of 7 km wide. Gross and net areas are 37,900 and 32,200 ha, respectively.

Here, too, the whole District has to be reclaimed. Pumping is envisaged for 5% of the area.

District 9: Jamaame (see Table 23)

This District lies entirely on the left of the Juba. It is 30 km long and an average of 8 km wide. Gross and net areas are 26,810 and 20,050 ha. Reclamation works required and pumped irrigation are as for District 8.

District 10: State Farm (see Table 24)

This District lies downstream of Jilib. It is 22 km long and 12 km wide at the maximum (6 km on average). Gross and net areas are 12,300 and 10,300 ha.

Preliminary work has already been done and it is now a matter of building the irrigation and drainage works, especially for the Class IV lands. Here, too, some 5% of the lands will have to be pump irrigated. Sixty percent of the gross irrigated area (7,700 ha) is Class IV.

District 11: Deschek Uamo (see Table 25)

This extends for about 70 km, starting 14 km SSE of Afmadow. Its maximum width is 4 km and its average is 2. Gross and net irrigated areas are 11,800 and 10,000 ha. Pumped waters will be needed to irrigate at least 15% of the District.

Table 14 - Irrigation Districts : Land Classification; Gross and Net Irrigable Areas

DISTRICT	Land class (ha)					Area served by irrigation network (ha)					Net irrigable area (ha)				
	Total	cl. 1	cl. 2	cl. 3	cl. 4	Total	cl. 1	cl. 2	cl. 3	cl. 4	Total	cl. 1	cl. 2	cl. 3	cl. 4
Luuq - Dolow	33,670	13,198	-	20,472	-	19,250	9,250	-	10,000	-	16,400	7,900	-	8,500	-
Baardheere - Saakow	132,490	5,985	126,505	-	-	57,000	4,200	52,800	-	-	47,350	3,550	43,800	-	-
Downstream of Saakow (1)	89,940	6,300	4,225	41,055	38,360	32,900	4,740	2,510	18,000	7,650	26,600	4,000	2,100	14,000	6,500
Downstream of Dujuuma	20,463	4,087	16,376	-	-	13,070	3,270	9,800	-	-	11,100	2,800	8,300	-	-
Dufalach - Afmadow	22,918	-	22,918	-	-	9,165	-	9,165	-	-	7,800	-	7,800	-	-
Faanoole - Jilib (2)	34,021	10,770	4,751	-	18,500	28,700	8,690	4,410	-	15,600	26,400	7,420	4,180	-	14,800
Touta Island (2)	15,700	10,900	4,800	-	-	15,700	10,900	4,800	-	-	13,300	9,250	4,050	-	-
Baardheere - Ionte (2)	37,900	10,300	27,600	-	-	37,900	10,300	27,600	-	-	(3)32,200	8,750	23,450	-	-
Jamaame (2)	28,436	16,414	5,330	6,692	-	26,810	16,370	5,000	5,440	-	(3)20,050	12,200	3,750	4,100	-
State Farms (2)	13,734	5,133	46	-	8,555	12,300	4,600	-	-	7,700	10,300	3,900	-	-	6,400
Descek Uamo	18,740	-	18,740	-	-	11,800	-	11,800	-	-	10,000	-	10,000	-	-
Total	448,012	83,087	231,291	68,219	65,415	264,595	72,320	127,885	33,440	30,950	221,500	59,770	107,430	26,600	27,700

(1) In "Juba River Scheme - Moscow 1965" indicated as "Dujuuma District"
(2) In "Juba River Scheme - Moscow 1965" indicated with same name, but areas, locations and land classes do not coincide
(3) Including areas presently under bananas (5,025 ha) and forage (1,200 ha)

Table 15 - District 1 - Luuq - Dolow

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
a. Family Farms			
- Class 1 lands	8,356	5,850	5,000
- Class 2 lands	-	-	-
- Class 3 lands	-	-	-
Sub total	8,356	5,850	5,000
b. Large Schemes			
- Class 1 lands	4,842	3,400	2,900
- Class 2 lands	-	-	-
- Class 3 lands	20,472	10,000	8,500
Sub Total	25,314	13,400	11,400
Total	33,670	19,250	16,400
%	100	57.1	48.7

Table 16 - District 2 - Baardheere - Saakow

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
a. Family Farms			
- Class 1 lands	5,400	3,800	3,200
- Class 2 lands	-	-	-
- Class 3 lands	-	-	-
Sub total	5,400	3,800	3,200
b. Large Schemes			
- Class 1 lands	585	400	350
- Class 2 lands	126,505	53,800	43,800
- Class 3 lands	-	-	-
Sub total	127,090	53,200	44,150
Total	132,490	57,000	47,350
%	100	43.0	35.7

Table 17 - District 3 - Downstream of Saakow

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
a. Family Farms			
- Class 1 lands	3,200	2,240	1,900
- Class 2 lands	2,967	1,460	1,200
- Class 3 lands	-	-	-
Sub total	6,127	3,700	3,100
b. Large Schemes			
- Class 1 lands	3,100	2,500	2,100
- Class 2 lands	1,298	1,050	900
- Class 3 lands	41,055	18,000	14,000
- Class 4 lands (1)	38,360	7,650	6,500
Sub total	83,813	29,200	23,500
Total	89,940	32,900	26,600
%	100	36.5	29.5

(1) Destined to rice cultivation

Table 18 - District 4 - Downstream of Dujuuma

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
a. Family Farms			
- Class 1 lands	4,087	3,200	2,800
- Class 2 lands	16,376	9,800	8,300
- Class 3 lands	-	-	-
Sub total	20,463	13,070	11,100
b. Large Schemes			
- Class 1 lands	-	-	-
- Class 2 lands	-	-	-
- Class 3 lands	-	-	-
Sub total	-	-	-
Total	20,463	13,070	11,100
%	100	63	54

Table 19 - District 5 - Dufalach - Afmadow

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
Large Schemes			
- Class 1 lands	-	-	-
- Class 2 lands	22,918	9,165	7,800
- Class 3 lands	-	-	-
Total	22,918	9,165	7,800
%	100	39	34

Table 20 - District 6 - Faanoole - Jilib

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
a. Family Farms			
- Class 1 lands	2,184	1,800	1,520
- Class 2 lands	388	300	280
- Class 3 lands	-	-	-
Sub total	2,572	2,100	1,800
b. Large Schemes			
- Class 1 lands	8,586	6,900	5,900
- Class 2 lands	4,363	4,100	3,900
- Class 3 lands	-	-	-
- Class 4 lands (1)	18,500	15,600	14,800
Sub total	31,449	26,600	24,600
Total	34,021	28,700	26,400
%	100	84	78

(1) Mainly destined to rice cultivation.

Table 21 - District 7 - Touta Island

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
Large Schemes			
- Class 1 lands	10,900	10,900	9,250
- Class 2 lands	4,800	4,800	4,050
- Class 3 lands	-	-	-
Total	15,700	15,700	13,300
%	-	100	85

N.B. The geographic area corresponds to that defined in the "Juba River Scheme" project, Moscow, 1965.

Table 22 - District 8 - Baardheere - Ionte

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
Large Schemes			
- Class 1 lands	10,300	10,300	8,750
- Class 2 lands	27,600	27,600	23,450
- Class 3 lands	-	-	-
Total	37,900	37,900	32,200
%	-	100	85

N.B. The geographic area corresponds to that defined in the "Juba River Scheme" project, Moscow, 1965.

Table 23 - District 9 - Jamaame

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
Large Schemes			
- Class 1 lands	16,414	16,370	12,200
- Class 2 lands	5,330	5,000	3,750
- Class 3 lands	6,692	5,440	4,100
Total	28,436	26,810	20,050
%	100	94	70

N.B. Areas according to the "Juba River Scheme" project, Moscow, 1965.

Table 24- District 10 - State Farms

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
Large Schemes			
- Class 1 lands	5,133	4,600	3,900
- Class 2 lands	46	-	-
- Class 3 lands	-	-	-
- Class 4 lands (1)	8,555	7,700	6,400
Total	13,734	12,300	10,300
%	100	90	74

(1) In the "Juba River Scheme" project (Moscow, 1965) these lands are destined to oilseeds and cotton cultivations.

Table 25 - District 11 - Descek Uamo

	Geographic area Ha	Gross irrigated area Ha	Net irrigated area Ha
Large Schemes			
- Class 1 lands	-	-	-
- Class 2 lands	18,740	11,800	10,000
- Class 3 lands	-	-	-
Total	18,740	11,800	10,000
%	100	63.5	53

CHAPTER 4.

After the presentation of the study the Somali Government has given indications about changes in the proposed cropping patterns to account for decisions taken when the study was on the way of completion.

Anyway it has not been deemed opportune to change the whole analysis here performed. The proposed cropping patterns deserve their indicative value.

The whole set of changes have been accounted for in the short - and medium - terms development plan.

CROPPING PATTERNS

4.1 PRODUCTION GUIDELINES

On the basis of the general directives for the development of the sector and forecasts of domestic and export requirements (see Vol II Parts I and II), and taking account of the possible alternatives, the guidelines to be followed in the short and medium term are as follows:

a. Increase and stabilize cereal production: sorghum, maize and rice, to meet domestic demand and reduce imports.

b. Increase meat production (especially beef) to maintain and boost present exports while expanding and improving the existing livestock population.

c. Raise the quantity and quality of banana production to maintain and boost exports.

d. Increase production of sugar and cotton so as to completely replace imports.

e. Increase oilseed production to supply domestic market which presently has to import vegetable oils.

These lines frame the general picture for long-term agricultural development strategy, though they may be modified to suit particular needs which may emerge during the period considered (1976-2000).

The aims indicated above can be achieved by:

- developing technically-advanced irrigated agriculture in the districts outlined earlier, so as to produce commodities for export and to substitute imports, while progressively improving availability of feed for livestock (crop byproducts and forage);

- improving rainfed agriculture in the Valley - after having set up the Districts - mainly around the fringes of the irrigated areas or between these, where there exists an adequate infrastructure that can at least meet part of the local needs.

4.2 POSSIBLE CROPPING PATTERNS

Within the established framework, the cropping patterns for each irrigation District have been dictated essentially by soil and climatic conditions, it being assumed that sufficient water will be available for the crops in all Districts downstream of Baardheere, as and when required.

Thus, apart from the multi-annual crops, for which specific conditions must be respected to obtain the best results, there is nothing which restricts the cultivation of the other crops to a given District.

For Districts 6 - 10, the cropping patterns recommended differ from those in the Selchozpromexport Scheme. This is because of changed prospects on the domestic and foreign markets, a different assessment of the potential of the lands, and a prudent appreciation of irrigation consumption and processing costs involved in attaining the production aims.

However, the cropping patterns envisaged in the schemes already planned or being implemented as per the ongoing Five-Year Plan have been incorporated in this Project. But it must be pointed out that in this case the success of some of the schemes, particularly those for banana and sugar production will depend largely on the timely construction of the Saakow flow regulation works, while awaiting the building of the Baardheere Dam at a later date.

Irrigated farming is not common in Somalia today, so the estimates of possible yields have been based on an appreciation of average bio-climatic conditions, referring also to trials and results obtained in other parts of Somalia and countries with comparable conditions. It has been assumed that there will be a gradual elimination of the adverse hydropedological conditions through improvement of the physical and chemical soil conditions and the adoption of appropriate cultural techniques.

The cropping patterns indicated essentially reflect the role each crop or group of crops has or may have in the economy of the Valley and Somalia as a whole. Export crops have been included in the cropping patterns to the extent that they can be marketed without major problems. Among the seasonal crops, particular emphasis has been given to cereals and oil seeds. Textile plants, vegetables and pulses have been assigned a role that, it is considered, reflects their expansion possibilities in Somalia.

Within the context of the different groups, the role assumed by the various species has been emphasized only in the case of cereals. In the case of the other groups (e.g. oilseeds) the species are considered to be mutually competitive. The choice of one species or another will depend on the productivity (in the Valley) of the varieties available and on organizational demands.

For the time being, some groups (e.g. starchy plants) have been left out of the cropping patterns. It will be possible to define their role more clearly after trials to assess their competitiveness with the other crops introduced during the present planning phase.

For the mechanized farms it has been felt necessary to introduce fallow for 25% of the year (15% Gu and 10% Der), while the figure for family farms is 20% (10% Gu and 10% Der). In special cases, the amount of fallow has been either increased or decreased. The practice of resting the land has been considered essential in this first stage, when the soils are being brought under the plough for the first time. It is very important, since it enables the peak demand for machinery and manpower to be reduced, especially for the Der sowing and for harvesting. As the years go by, the soils will have been tilled more frequently and the general organization will have improved; it will then be possible to reduce the amount of fallow.

Irrigation conditions in the Valley permit very considerable elasticity as regards rotation. By and large the principle has been adopted of concentrating in Der the crops with a long growing period and those that require a dry spell in the last part of their cycle.

The total net arable and irrigable area is 221,500 ha, 43,075 of which under perennial crops and 178,425 under rotated crops (Table 26). It is possible to grow two crops a year on nearly all these lands. Thus cropping intensity (ratio of harvested to arable areas) exceeds 1.6 : 1, with but limited variations from District to District, except for Jamaame which has a large amount of land under perennial crops.

Table 27 indicates the breakdown of areas by crop and District, according to the basic cropping pattern.

Table 26 - Net arable areas. Perennial and rotated crops (ha)

District	Net irrigated area Ha	Perennial crops				Total rotated areas
		Bananas	Citrus and other	Sugar cane	Total	
Luuq - Dolow	16,400	-	-	-	-	16,400
Baardheere - Saakow	47,350	-	100	6,375	6,475	40,825
Downstream Saakow	26,600	-	-	-	-	26,600
Downstream Dujuuma	11,100	-	-	-	-	11,100
Dufalach - Afmadow	7,800	-	-	-	-	7,800
Faanoole - Jilib	26,400	-	50	-	50	26,350
Touta Island	13,300	2,000	600	-	2,600	10,700
Baardheere - Ionte	32,200 (1)	5,525 (2)	200	6,375	12,100	20,100
Jamaame	20,050 (3)	8,500 (3)	200	6,375	15,075	4,975
State Farm	10,300	-	-	-	-	10,300
Descek Uamo	10,000	-	400	6,375	6,775	3,225
Total	221,500	16,025	1,550	25,500	43,075	178,425

(1) Including areas presently under bananas (1,525 ha) and those envisaged for forage in the Trans Juba Project (1,200 ha)

(2) Including 1,525 ha bananas

(3) Including areas presently under bananas (3,500 ha)

Table 27 - Breakdown of areas by crop and district (in ha) according to basic cropping pattern (a)

Crop \ District	1° Luuq Dolow	2° Baardheere Saakow	3° Down-stream of Saakow	4° Down-stream of Dujuuma	5° Dufalach Afmadow	6° Faanoole Jilib	7° Touta Island	8° Baardheere Ionte	9° Jamaame	10° State Farms	11° Uamo	Total ha	Total %
CEREALS	13,300	38,140	37,730	8,850	4,730	27,210	8,500	14,525	3.600	5,150	3.680	(165,415)	46.5
Maize	4,500	17,800	1,085	3,900	4,730	6,450	4,600	7,925	3,600	5,150	-	59.740	-
Sorghum	4,600	14,000	775	2,750	-	5,400	3,900	6,600	-	-	-	38,025	-
Paddy rice	-	1,900	35,250	-	-	15,000	-	-	-	-	-	52,150	-
Rainfed rice	-	-	-	2,200	-	360	-	-	-	-	3,680	6,240	-
Wheat	4,200	4.440	620	-	-	-	-	-	-	-	-	9,260	-
OILSEEDS	10,800	21,160	2,480	8,900	6,240	9,020	5,350	9,440	-	5,850	-	(79,240)	22.2
TEXTILE PLANTS -												(19,660)	5.5
Cotton	1,100	1,900	-	-	780	730	1,300	-	2.400	3,900	-	12,110	-
Minor textile plants	1,100	2,850	-	-	-	1.090	-	2,510	-	-	-	7.550	-
FRUITS												(17,575)	4.9
Bananas	-	-	-	-	-	-	-	5,525	8.500	-	-	16,025	-
Others	-	100	-	-	-	50	-	200	200	-	400	1,550	-
SUGAR CANE	-	6,375	-	-	-	-	-	6,375	6,375	-	6,375	(25.500)	7.2
TOBACCO	-	1,900	-	-	-	1,460	1,000	1,900	1,170	-	-	(7,430)	2.1
PULSES	2,200	3,180	6,185	1,230	1,300	5,780	2,130	3,800	-	3,130	1,550	(30,485)	8.5
VEGETABLES	500	2,540	310	1,000	600	910	500	900	1,290	-	615	(9,165)	2.6
FORAGE												(1,800)	0.5
Maize	-	-	-	-	-	-	-	1,200	-	-	-	1,200	-
Alfalfa, Rhodes etc.	-	-	-	-	-	-	-	600	-	-	-	600	-
Total ha	29,000	78,145	46,705	19,980	13,650	46,250	21,380	46,975	23,535	18,030	12,620	356,270	100.-
Net irrigable area ha	16,400	47,350	26,600	11,100	7,800	26,400	13,300	(1) 32,200	(2) 20,050	10,300	10,000	(3) 221,500	-
Croppint intensity	1.77	1.65	1.76	1.80	1.75	1.77	1.60	1.46	1.17	1.75	1.26	1.61	-

(a) Indicated as Alternative E in Vol. III, Part III Table 1 concerning irrigation water requirements.
(1) Including area already under bananas (1,525 ha) - (2) Including area already under bananas (3,500 ha) and forage in the Trans Juba Project - (3) Including areas indicated in notes (1) and (2).

..3 PRODUCTIVE ORGANIZATION

Following the criteria laid down by the Somali Authorities, the future productive organization will hinge around State Farms, Production Cooperatives and Family Farms, grouped into service and marketing cooperatives.

The number and areas of the various organizational types are set forth in Table 28. The figures were arrived at by technical and organizational assessments that take account of the Family Farms that already exist and those that will presumably have to be created in some of the new Districts to promote and facilitate settlement or resettlement of the farming families which, in some cases, will have to be moved from the farms they now cultivate.

The size of the Family Farms is dictated essentially by the average workforce available and the cropping pattern adopted.

The size of the large enterprises will vary depending on the cropping pattern, the cropping intensity and the amount of mechanization. It is expected that around 65 to 70 largely independent production units will be needed; these will be equipped with all the necessary mechanical implements and be staffed by skilled personnel.

The Family Farms (see Tables 15 - 18 and 20) will be set up on the lands already occupied or on those which cannot be readily grouped into large units.

Table 28 - Production organization

Districs	Family Farms		State Farms or cooperatives	
Luuq Dolow	1,925	5,000	3	11,400
Baardheere - Saakow	1,350	3,200	15	44,150
Downstream Saakow	1,145	3,100	8	23,500
Downstream Dujuuma	4,430	11,100	-	-
Dufalach - Afmadow	-	-	3	7,800.
Faanoole - Jilib	625	1,800	9	24,600
Touta Island	-	-	5	13,300
Baardheere - Ionte	-	-	12	32,200
Jamaame	-	-	8	20,050
State Farms (1)	-	-	2	10,300
Descek Uamo	-	-	2	10,000
Total	9,475	24,200	67	197,300

(1) Project in progress - 1975

CHAPTER 5.

IRRIGATION

5.1 BASIC PARAMETERS

It is possible to distinguish three groups of crops as far as irrigation layout is concerned:

- Rice, forage and wheat — Border irrigation
- Pulses, maize, sorghum and sugarcane — Furrow irrigation
- Bananas and citrus — Basin or Border irrigation

Until the fruits are up to a given standard of development they can be irrigated by furrows that carry the water to small basins prepared around the plants. Of course, the border layout will have to be prepared when it is necessary to irrigate the whole area.

The suggested irrigation schemes and the criteria to be followed in sizing the irrigation plots are described farther ahead.

It is a fact that with continuous distribution 24 hours a day efficiency is highest, distribution losses are lower and the canals are not so costly, since they can be smaller than those needed if water were distributed in a shorter period. However, there is very little flexibility in a system designed to function 24 hours a day, and some crops, generally seasonal forage crops, do not take well to being irrigated in the hottest part of the day.

Taking account of these contrasting factors, i.e. the advantages of continuous distribution and the needs of the various crops and irrigation requirements, the resulting solutions are as indicated below:

District	% area of crops irrig. by day	Cont. disch. l/s/ha	Useful hours	Effective discharge l/s/ha
9 Jamaame	over 50	0.9	24	0.9
3 Downstream Saakow	" 50	0.8	24	0.9
8 Baardheere - Ionte	40	0.8	24	0.8
7 Touta Island	25	0.5	16	0.8
2 Baardheere - Saakow	20	0.8	16	1.2
1 Luuq - Dolow	-	0.8	16	1.2
4 Downstream Dujuuma	-	0.4	16	0.6
5 Dufalach - Afmadow	-	0.8	16	1.2
6 Faanoole - Jilib	-	0.5	16	0.7
10 State Farm	-	0.4	16	0.6
11 Deschek Uamo	" 50	0.8	24	0.8

Water application rates calculated by reference to the available soils data range from a minimum of 5 m^3/ha/cm for sandy soils to 12 m^3/ha/cm for clayey soils. These figures rise to 6.70 m^3 and 17 m^3, assuming a field efficiency of 70%.

In the main growing period of the crops it is considered that irrigation should reach a depth of 100 cm, so the figures become 670 and 1,700 m^3/gross hectare, of which 500 and 1,200 are available for plants, permitting irrigation intervals of 8 and 20 days, when evapotranspiration is around 6 mm/day.

The minimum water flow available on the field must therefore be:

$$\left(\frac{670,000}{7 \times 16 \times 3,600}\right) = 1.7 \text{ l/s/ha} \qquad \text{and} \qquad \left(\frac{1,700,000}{15 \times 16 \times 3,600}\right) = 1 \text{ l/s/ha}$$

respectively, considering 16 hours of irrigation per day and the irrigation intervals indicated. Thus, in the case of the 3 ha Family Farms the minimum water flow must be 5 l/s.

The intake rate of the sandy soils is 25 mm/hour, so they can absorb 250 m^3/h/ha, equal to 70 l/s and 100 l/s, at a 70% efficiency (1).

The intake rate of the clayey soils is 10 mm/h and hence these can absorb 100 m^3/h equal to 27 l/s and 40 l/s, at a 70% efficiency. These are the maximum water flow rates theoretically possible at any watering point (2).

In the case of border irrigation, a discharge of between 2 and 5 l/s per metre width of border will be used, depending on the ground slope and soil texture, while with furrow irrigation the discharge per furrow will vary according to the same parameters and the length of the furrow.

The water may be applied to the field by plastic siphons whose diameter is matched to the desired discharges (0.5 to 6 or 7 l/s) thus avoiding having to break the laterals each time.

As will be appreciated, it is not possible to give anything more than general indications at this stage and to illustrate the approach adopted for the problems concerned. Only at the Final Design stage will it be possible to indicate the definitive water flows and the irrigation times, distributions, etc., as then the shape, dimensions, slope and soil of each plot will be known. All these factors have a bearing on the distribution and management of the water in a very decisive manner and must be taken into account in order to ensure hydraulic schemes that are as homogeneous as possible.

As regards the irrigation of rice, it is necessary to emphasize that the availability of water and the lack of better-quality soils that may be served by the irrigation systems under study, point to the advisability of developing 10,000 ha of Class IV lands, including them in District No 6 (Faanoole-Jilib).

As these are solonetz, they cannot but be reclaimed by growing paddy rice on them continuously for five years, and thereafter by alternating the main crop with other cereals, forage and pulses, as soon as the leaching has rendered the soils fit for such crops by having reduced the salinity to supportable values (30 mmhos). Considering the purpose of the reclamation and the value of the production from the rice, the crop will be grown following the most modern practices, which call for direct sowing, flooding of the ground, an intermediate drain-off at the end of tillering to permit weeding and top dressing, then a second flooding, discharging the water near harvest time. If a track-type combine harvester is used to gather in the crop, it may be possible to grow another in Der. Thus provision has been made for watering rates in line with this type of cultivation, at 17,000 m^3/ha per season.

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(1) Silt + clay less than 35%

(2) Silt + clay equal to 50%

Rice is also envisaged in District No 3 (Downstream of Saakow). In this case, provision is made for transplanting after the seedlings have been in the nursery for two months. This practice results in a 90% saving in water for two months in each growing period, but a lot of labour is needed for the transplanting, at least in present conditions. Consequently smaller volumes of water are envisaged for the crop here than in the case discussed above. However, these lands are to be brought under the plough in the final stages of the Project. This should preferably be done block by block, rotating crops on the first before starting cultivation on the following ones.

This being the case, we have selected the indicated solution, as this permits a considerable quantity of water to be reserved for this area, sufficient for any solution. This ensures the maximum degree of flexibility.

In any event, these lands are to be cultivated last. Being suitable for growing rice, they will probably be used for this purpose, rather than using other lands reclaimed earlier and by this time growing rotated crops, thus leaving a further volume of water available which can be used in the District in question. The extension of the transplanted rice may also be controlled by the need to utilize the labour force or the possibility of applying mechanized methods, as the case may be.

5.2 IRRIGATION WATER REQUIREMENTS

The gross irrigation requirements at the intake, net of effective rainfall, has been estimated by applying the parameters calculated in Para 5.1 and on the basis of the cropping patterns adopted for each District (see Table 27).

Table 29 sets forth the relevant data not only for the general cropping patterns selected (Table 27) but also the requirements in the case of four alternatives, based on the introduction in Districts 2 and 5 of 25,000 ha of multiannual forage, to replace cereals and oilseeds. Table 29 bis summarizes the general monthly and annual overall data for the possible general cropping pattern alternatives, allowing for the introduction of multiannual forage on 25,000 ha in Districts 2 and 5 and the reduction of the rice crop in District 6.

Consumption was determined by the Blaney and Criddle formula, introducing the climatic data for Ionte in the case of the Lower Juba and that for Baardheere-Luuq where the upper Juba is concerned. The higher K values were adopted. Irrigation efficiency was taken to average 0.60 at the field turnouts for all crops except rice, since it is probable that in the first instance irrigation will be by surface flooding. In determining consumption, account was also taken of the real consumption at the present time, though this figure will, of course, be improved upon as time goes by. The requirements thus determined do not include the water needed for leaching saline and alkaline soils, which must be determined separately by reference to the crop calendars and the specific characteristics of the soils.

Losses by evaporation from large bodies of water and seepage from conveyance canals have not been included, since these can be controlled or eliminated by lining the conveyance canals or using large diameter pipes.

Table29 - Crops monthly and yearly water needs ($10^3 m^3$)

District		Area (ha)		Pluriannual crops (ha)	J	F	M	A	M	J	J	A	S	O	N	D	Year total per district
		gross irrigated	net irrigated														
Luuq - Dolow		19,250	16,400	-	2,300	-	-	900	22,150	33,100	25,750	6,600	7.800	25,850	17,750	19,350	161,550
Baardheere-Saakow	A	57,000	47,350	6,475	19,720	13,590	15,250	9.450	55,520	93,725	62,115	23,325	30,245	54,320	51,005	51,045	485,310
	B	(57,000)	(47,350)	(26,475)	63.850	55,810	62.645	26,890	67,660	103,415	89,125	61,570	62,980	63,310	58,835	72,260	788,350
Downstream of Saakow		32.900	26,600	-	650	-	-	8,410	47,600	68,500	53,650	61,600	27,200	104,400	80,000	37,000	489,010
Downstream of Dujuuma		13,070	11,100	-	2,200	-	-	100	3,500	12,000	10,150	2,200	2,600	8,500	11,750	11.400	64,400
Dufalach-Afmadow	A	9,165	7,800	-	1,700	-	-	70	2,700	9,000	7,600	1,700	1,950	6,400	8,850	8,550	48,520
	B	-	-	(5,000)	10,750	9,400	10,500	4,500	11,450	17,500	15,150	10,400	10,600	10,650	9.950	12,200	(133,000)
Famoole-Jilib	A	-	(16,400)	50	2,850	80	90	80	5,300	17,500	15,500	6,000	11,950	12,950	16,500	13,300	101,600
	B	28,700	26,400	36	2,850	80	23,090	36,380	54,300	53,000	27,500	50,000	46,950	59,850	52,800	26,000	(432,800)
Touta Island		15,700	13.300	2.600	9.800	6,600	7,250	11,850	19,850	15,350	14,650	10,100	10,050	11,950	15,500	16,700	149,600
Baardheere - Ionte		37,900	32,200(1)	12,100	33,700	32,750	35,800	25,300	24,000	31,100	34,800	33,700	31,300	57,400	72,200	69,100	481,150
Jamaame		26,810	20,050(2)	15,075	46,500	39,400	43,100	28,000	20,400	24,150	26,800	36,650	35,250	43,150	50,450	49,500	443,350
State Farms		12,300	10,300	-	4.850	-	-	70	3,050	9,600	9,500	6,600	10,700	8,200	9,650	9,150	71,370
Descek Uamo		11,800	10,000	6,775	1,850	60	70	70	3,250	10,900	9,450	3,800	7,300	7,500	9,450	8,100	61,800

(1) Including the areas already cultivated with banana tree (ha 1,525) - (2) Including the areas already cultivated with banana tree (ha 3,500) and those envisaged for forages by the Trans Juba Project (ha 1,200)

Table 29/bis - Total gross irrigation needs ($10^6 \times m^3$) in the final phase, according to the various alternatives of general cultivation systems

Alternative \ Months	A	M	J	J	A	S	O	N	D	J	F	M	Annual total	Remarcks
Alternative A	86	219	344	290	197	183	352	354	304	130	95	105	2.658	
Alternative B	107	233	355	315	243	222	363	363	329	184	146	162	3.022	with forages (ha 20,000) in district 2
Alternative C	112	242	364	323	252	231	367	364	333	192	156	172	3.108	with forages (ha 25,000) in districts 2 and 5
Alternative D*	142	277	379	316	280	253	401	388	331	179	144	195	3.285	with forages in districts 2 and 5
Alternative E = Basic cultivation system (see Tab. 28)	122	265	380	302	241	218	399	390	316	130	95	128	2.986	

These losses have, however, been considered in the design of the hydraulic works.

During an advanced stage of implementation of the proposed scheme, it is envisaged that sprinkler and also trickle irrigation will be introduced for suitable soils and specific crops. This will produce a big reduction in unit and overall water consumption. Definitive decisions in this regard can be taken only at the Final Design stage, when sufficient soil surveys have been made and trials have been run.

5.3 IRRIGATION AND DRAINAGE LAYOUTS

For each of the eleven Districts, provision is made for intake works, main conveyance canals, secondary and tertiary canals, all in earth and complete with the required control structures, calculated for the discharges and water flows indicated earlier.

The irrigation networks can feed laterals that will supply water to the individual irrigation units, i.e. to the smallest plots to be irrigated independently, being devoted to a single crop. The areas of these plots will vary markedly, from a minimum of 0.5 ha on 3-ha Family Farms growing six different crops to a maximum of about 100 ha on the State Farms.

Here it is only possible to give general indications and to suggest typical schemes (indicated in Figs 2 and 3.III), as it is obvious that in practice the size of the individual plots will depend on the topography and hence on earth movements, which, when needed, should be kept to a minimum. Considerations of this type will also indicate whether it will be necessary to level the land at different elevations.

The irrigation systems also include the pumping stations envisaged for irrigation of the whole of the Luuq-Dolow District, part of the Baardheere-Saakow District, Downstream of Saakow, Downstream of Dujuuma and the Deschek Uamo, or simply to economically meet local situations on limited areas that would not otherwise be irrigable, as will occur in the other Districts too.

LEGEND Fig.2 & 3 III *LEGENDA*

rural & field roads
strade rurali

bridge
ponte

windbreak
frangivento

secondary canal
canale secondario

tertiary canal
canale terziario

field canal
canaletta

tertiary drain
drenaggio terziario

field drain (open drain)
drenaggio superficiale

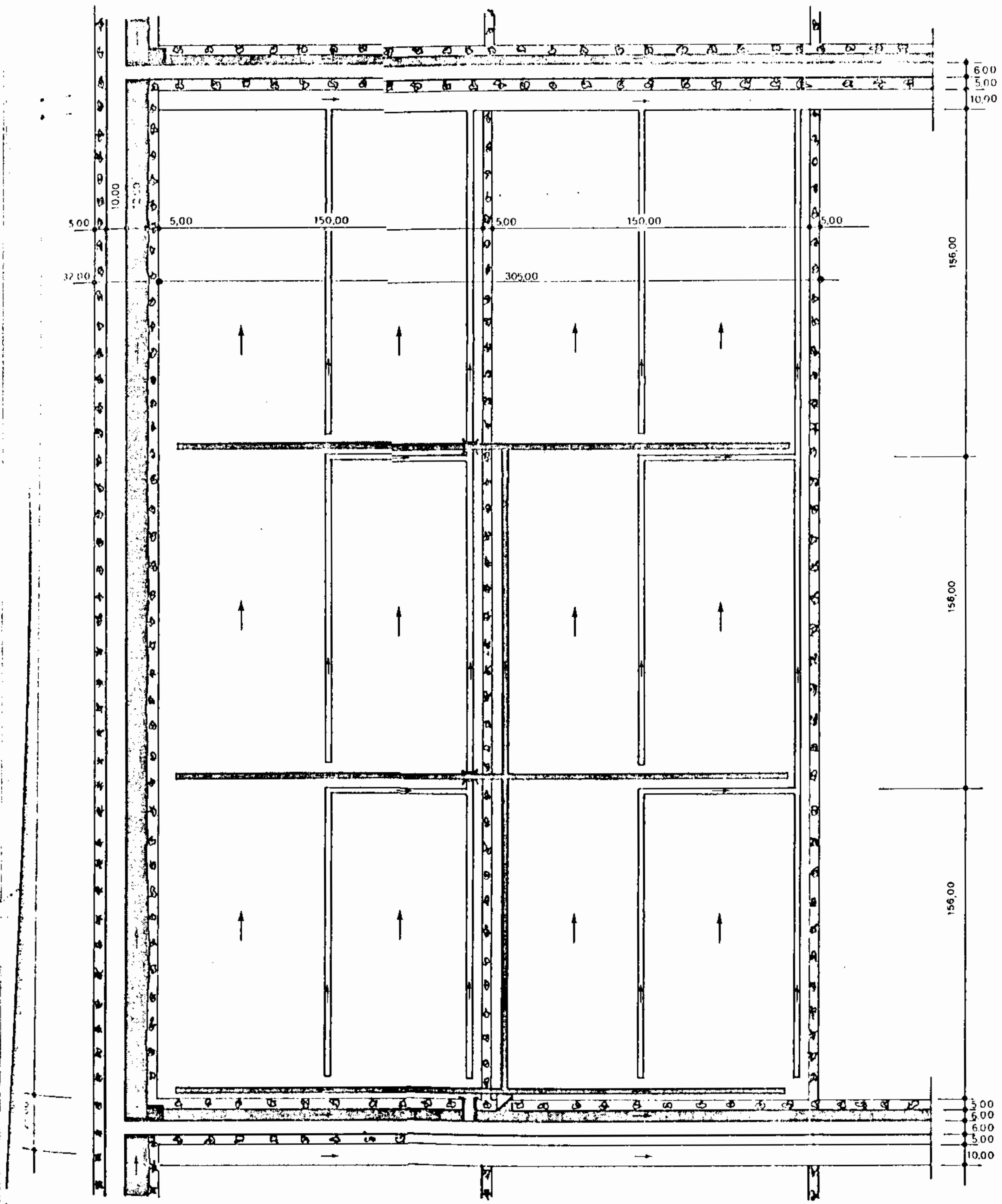
field drain (tile drain)
drenaggio profondo

intake for tertiary canal
presa per canale terziario

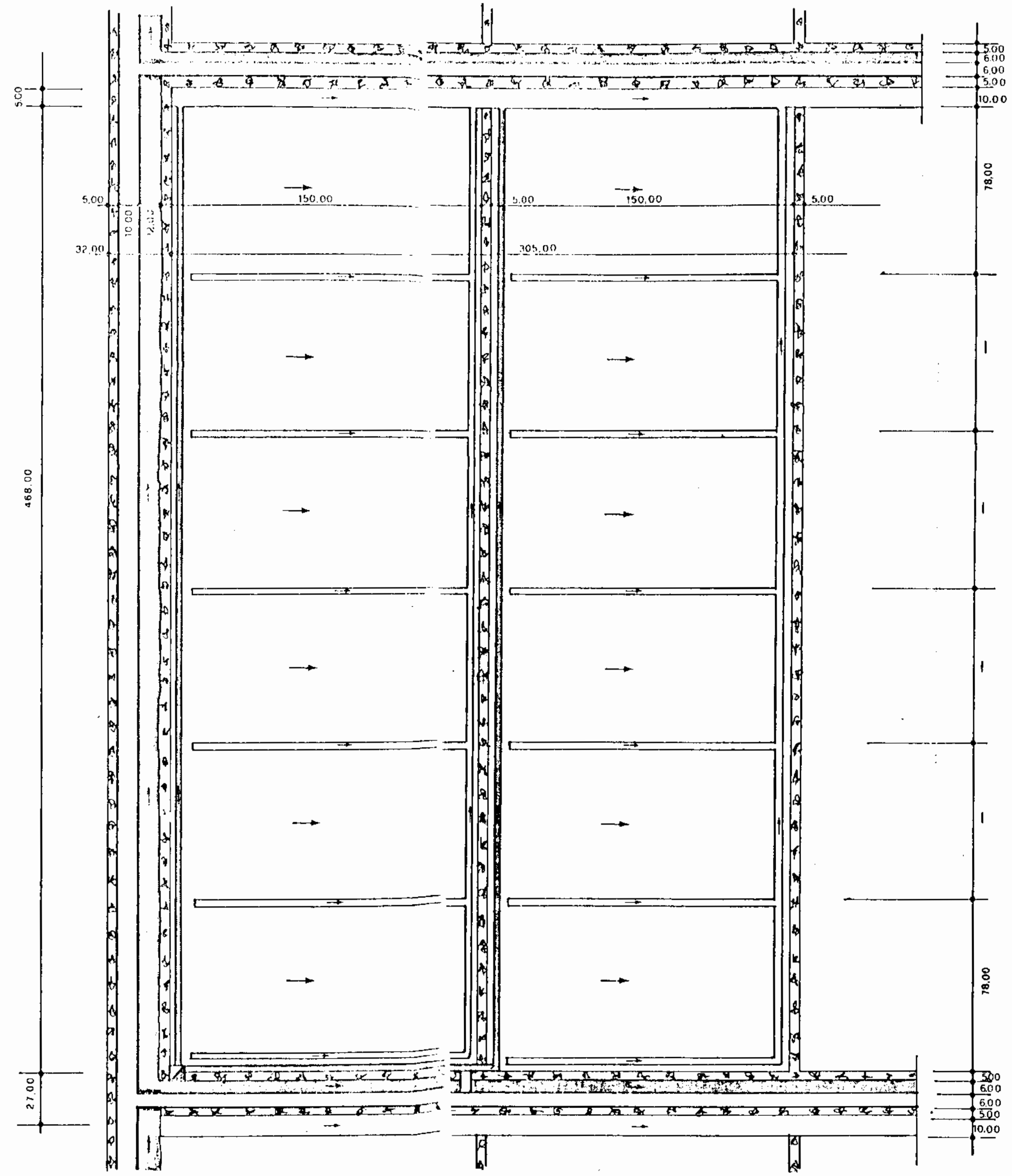
intake for irrigation unit
presa per unità irrigua

culvert
tombino

slope levelling direction
pendenza del livellamento



drainage with open drains
drenaggio superficiale



drainage with open drains
drenaggio superficiale

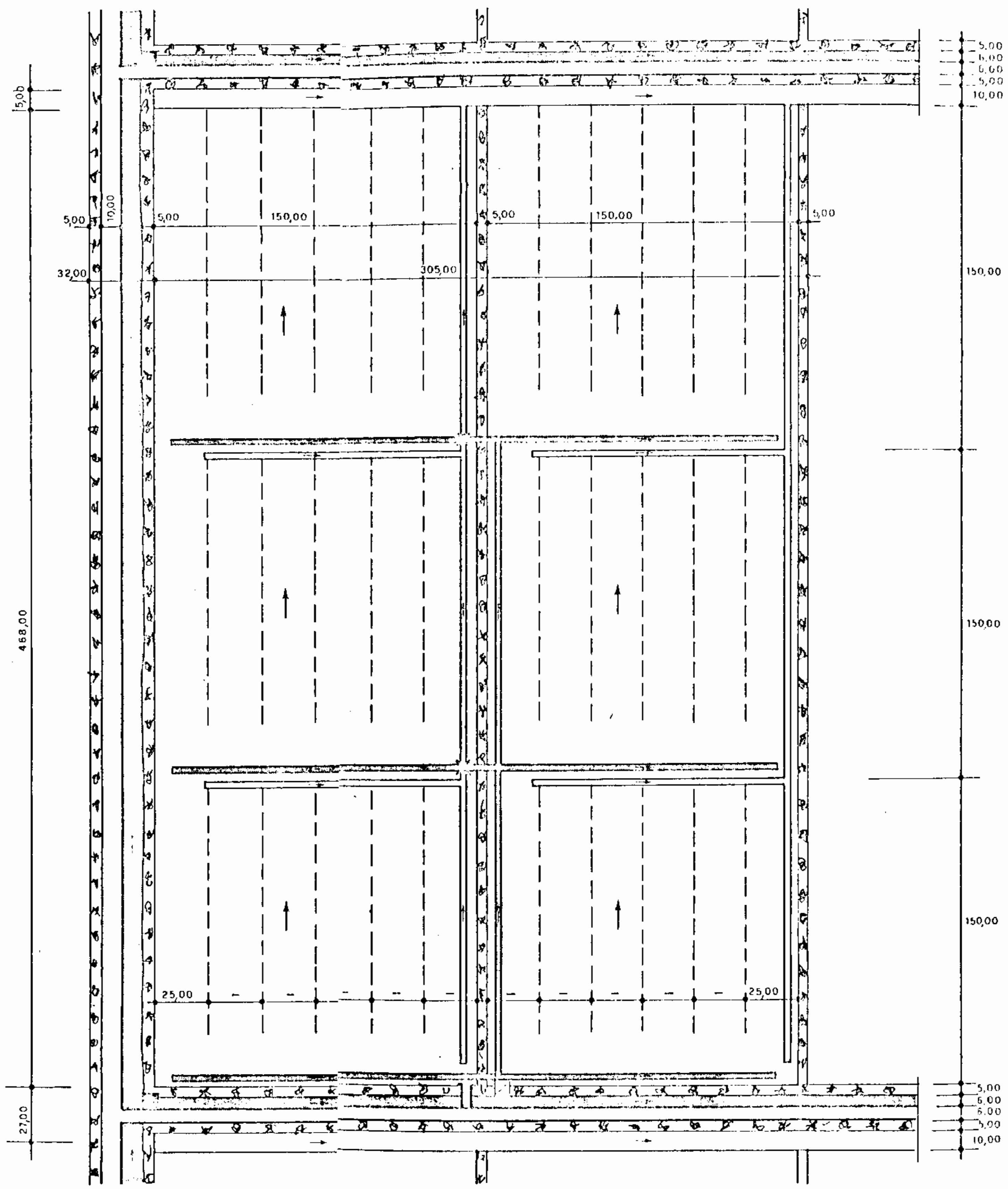
TYPICAL IRRIGATION UNITS

UNITA IRRIGUE TIPICHE

fig. 2.III

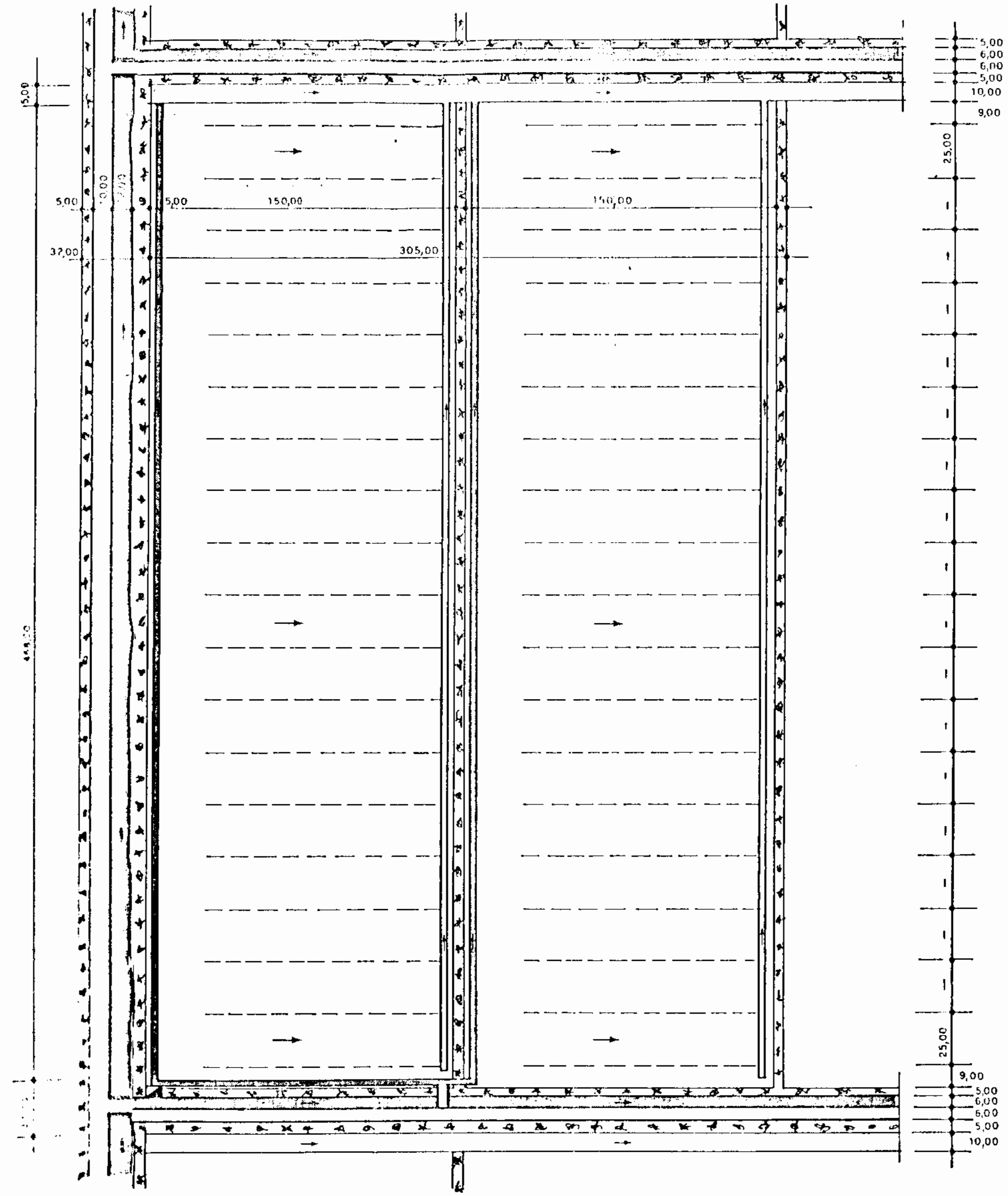
TYPICAL IRRIGATION UNITS

UNITA IRRIGUE TIPICHE



drainage with tile drains

drenaggio profondo con tubazione a giunto aperto



drainage with tile drains

drenaggio profondo con tubazione a giunto aperto

fig. 3.III

CHAPTER 6.

LAND RECLAMATION WORKS

The land reclamation works to be performed are outlined below:

Bush clearing

Care should be taken here to avoid clearing areas of bush which may be of importance from the ecological aspect (especially the gallery forest). Thus this operation must be limited to eliminating formations inside the Districts and to creating narrow cleared strips along the river so as to be able to irrigate all the better lands. As things are at present, the crawler bulldozer is the best piece of equipment for doing this job. The average cost is estimated to be So Sh 500/ha.

Grubbing or uprooting

Grubbing or uprooting completes the above operation, the soil being cleared of all the roots that would impede normal tilling. A 100 HP crawler tractor with tow chain and single tooth ripper, plus two workmen with axes and motorsaws, would constitute the minimum operational unit to be used. The average cost is estimated to be So Sh 300/ha.

Stone clearing

This operation is required in some cases before the Class II and III lands can be used in their entirety. A crawler tractor fitted with front racket is the best piece of plant for this job. Of course, the stones that are lifted will have to be carted away on trucks. The operation will be required only on limited areas. The estimated average cost is So Sh 300/ha.

Rough or preliminary levelling

Rough levelling is always needed so that the fields can subsequently be economically laid out and used. For this job it is advisable to use heavy earth-moving equipment (such as scrapers) which permits the economic movement of large quantities of earth over considerable distances. Even if the ground is sufficiently flat to start with, if tree clearance has been performed it will have to be levelled again afterwards. The cost of this operation varies depending on the landform. It has been put at an average of So Sh 1,300-3,000/ha.

Grading or final levelling

This operation is required to complete the rough levelling and to render the lands more suitable for irrigation. If large trailed scrapers are used for the job it is possible to prepare an average of 1 ha/hour. Thus with very limited expenditure it is possible to avoid big losses of water and crop damage owing to poor distribution of irrigation water on the field. Though this job certainly has to be done before the land is irrigated, it should also be repeated periodically to maintain the desired irrigation efficiency of the Project. This operation is performed on the whole of the area, the average cost being estimated at So Sh 300/ha.

Deep ploughing

Theoretically this is the last of the preliminary operations, however, in practice it is sometimes better to do it before the grading. Its scope is to clear the soil of the last pieces of root, to facilitate aeration and ensure penetration of water and crop roots.

When there has been a considerable amount of earthmoving, deep ploughing is essential when the topsoil has been removed. Moreover, it sometimes needs to be repeated to help the soils reacquire a certain amount of tilth in a relatively short time. This is the reason why a cost of So Sh 500/ha has been considered, which would otherwise be excessive. When deep ploughing is being done, attention must be paid to the advice of the soil scientist. In soils which are not heavy and uniform at depth the ripper is the best tool, or at least the cheapest one. Fine-textured soils generally call for use of the mouldboard plough, provided this is utilized in such a manner as to obtain better aeration. But sight must not be lost of the nature of the deeper soil horizons, since when these are brought to the surface they may either improve or worsen the arable layer. If the latter is the case, then the ripper must be used instead of the mouldboard.

In Class IV lands, deep ploughing will start with very shallow ploughing that will gradually be extended in depth as the years go by and the water table is lowered and the salinity has been brought to acceptable levels by leaching and corrective treatments.

Windbreaks and roads

All the Districts will be surrounded by a 10-m wide windbreak (perimeter windbreak), while secondary and tertiary windbreaks may be planted around the farms and along the roads. The purpose of the windbreaks is to protect the crops from the advserse effects of the winds, especially hot winds, and to provide a supply of timber that is lacking in Somalia. They will also supply shade and at the same time will help bring about an oasis effect which will reduce water consumption by about 20%.

Each District is connected by main roads to the regional road network, while the network of internal roads will enable the machinery to be moved where it is needed for working the fields and to transport out production.

Irrigation and drainage networks

All the Districts will have networks for the conveyance and distribution of irrigation waters and the removal of drainage waters. These will be designed to suit the pedological and topographic characteristics of each individual District and the relevant productive organization. As regards drainage in the Districts where Class IV lands are to be irrigated, tile drains will be used to ensure effective control of the vertical movement of the waters and, consequently, of the salt.

The reclamation costs for the various Districts, including contingencies and engineering are given in Tables 30 to 41.

Table 30 - Recapitulation of costs - Irrigation development (in '000 So.Sh.)

Districts	Area (1)	Preliminary works	Network for irrigation	and drainage	Connecting roads and farm roads	Perimeter windbreak	Contingencies and direction	Total	Unit cost
Luuq - Dolow	19,250	60,420	50,980	24,700	28,700	11,250	66,950	243,000	12,624
Baardheere - Saakow	57,000	135,436	147,315	87,750	59,250	12,000	168,249	610,000	10,702
Downstream of Saakow	32,900	125,556	73,327	114,460	35,910	9,120	136,182	494,555	15,032
Downstream of Dujuuma	13,070	48,540	32,815	16,991	30,200	5,625	50,979	185,150	14,166
Dufalach - Afmadow	9,165	25,560	22,679	11,960	16,278	4,050	30,600	111,127	12,125
Faanoole - Jilib	28,700	42,336	64,547	81,090	15,300	2,250	78,097	283,620	9,882
Touta Island	15,700	48,830	28,539	20,410	15,310	2,700	44,007	159,796	10,178
Baardheere - Ionte	37,900	116,720	91,230	48,360	31,360	4,275	110,939	402,884	11,160
Jamaame	26,810	84,570	66,573	35,100	24,500	4,050	81,620	296,413	14,729
State Farms	12,300	3,090	30,243	67,990	8,650	1,800	42,467	154,240	12,540
Descek Uamo	11,800	23,380	29,250	15,340	19,440	4,500	34,920	126,830	10,780
Project area	264,595	714,438	637,498	524,151	284,898	61,620	854,010	3,067,615	11,594
	-	23.3	20.8	17.1	9.3	2.0	27.5	100	

(1) Served by the irrigation network (ha)

(2) Relating to gross irrigated area (Sh/ha)

Table 31 - District 1 - Luuq - Dolow

No	Job	Unit		Cost (Sh.So)
1	Tree clearing	Ha	2,000	1,000,000
2	Grubbing	"	2,000	600,000
3	Bush clearing	"	16,000	9,600,000
4	Stone clearing	"	2,000	600,000
5	Deep ploughing	"	17,300	9,500,000
6	Preliminary levelling	"	19,000	34,200,000
7	1st, 2nd and 3rd order irrigation network	"	19,000	46,360,000
8	Drainage network (ditto)	"	19,000	24,700,000
9	Final levelling	"	16,400	4,920,000
10	Connecting roads (5 m/ha)	km	100	20,000,000
11	Farm roads (30 m/ha)	"	570	8,700,000
12	Pumping stations on canals	n° Ha	20 per 19,000	4,620,000
13	Perimeter windbreaks (24 m/ha)	km	480	11,250,000
	Sub Total			176,050,000
14	20% contingencies (1 - 13)			35,210,000
15	15% engineering (1 - 14)			31,689,000
	(±) Rounding			51,000
	Total Sh.So.			243,000,000

Gross irrigated area 19,250 ha
Net irrigated area 26,600 ha

Table 32 - District 2 - Baardheere - Saakow

No	Job	Unit	Cost (Sh.So)
1	Tree clearing	Ha 2,000	1,000,000
2	Bush clearing	" 57,000	39,000,000
3	Grubbing	" 2,000	600,000
4	Stone clearing	" 6,750	2,700,000
5	Preliminary levelling	" 57,000	47,000,000
6	Deep ploughing	" 52,000	28,036,000
7	1st, 2nd and 3rd order irrigation network	" 57,000	140,000,000
8	Drainage networks (ditto)	" 57,000	87,750,000
9	Final levelling	" 47,350	17,100,000
10	Connecting roads (2 m/ha)	km 140	28,000,000
11	Farm roads (35 m/ha)	" 2,000	31,250,000
12	Pumping stations on canals and rivers	n° 25 per Ha 25,000	7,315,000
13	Perimeter windbreaks (8 m/ha)	km 500	12,000,000
	Sub Total		441,751,000
14	20% contingencies (1 - 13)		88,350,000
15	15% engineering (1 - 14)		79,515,000
	(±) Rounding		- 16,000
	Total Sh.So.		609,600,000

Gross irrigated area 57,000 ha
Net irrigated area 47,350 ha

Table 33 - District 3 - Downstream of Saakow

No	Job	Unit		Cost (Sh.So)
1	Tree clearing	Ha	1,120	560,000
2	Bush clearing	"	26,600	15,780,000
3	Grubbing	"	1,120	336,000
4	Stone clearing	-	-	-
5	Preliminary levelling	"	32,900	87,600,000
6	Deep ploughing	"	30,000	13,300,000
7	1st, 2nd and 3rd order irrigation network	"	32,900	71,227,000
8	Drainange networks (ditto).	"	32,900	114,460,000 (1)
9	Final levelling	"	26,600	7,980,000
10	Connecting roads (3 m/ha)	km	112	22,400,000
11	Farm roads (27 m/ha)	"	900	13,510,000
12	Pumping stations on canals and rivers	n° Ha	10 per 5,500	2,100,000
13	Perimeter windbreaks (11 m/ha)	km	380	9,120,000
	Sub Total			358,373,000
14	20% contingencies (1 - 13)			71,675,000
15	15% engineering (1 -14) (±) Rounding			64,507,000 - 5,000
	Total Sh.So.			494,550,000 -

(1) Including buried drainage, irrigation and drainage water pumping stations and leaching on 7,650 Ha of Class 4 lands. This investment will be made only in the stage following the cultivation of these lands under rice.

Gross irrigated area 32,900 ha
Net irrigated area 26,600 ha

Table 34 - District 4 - Downstream Dujuuma

No	Job	Unit		Cost. (Sh.So)
1	Tree clearing	-		-
2	Bush clearing	-		-
3	Grubbing	-		-
4	Stone clearing	-		-
5	Preliminary levelling	Ha	13,070	39,240,000
6	Deep ploughing	"	11,800	6,000,000
7	1st, 2nd and 3rd order irrigation network	"	13,070	31,891,000
8	Drainage networks (ditto)	"	13,070	16,991,000
9	Final levelling	"	11, 100	3,300,000
10	Connecting roads (9 m/ha)	km	120	24,000,000
11	Farm roads (30 m/ha)	"	400	6,200,000
12	Pumping stations	n° Ha 4,000	4 per	924,000
13	Perimeter windbreaks (19 m/ha)	km	250	5, 625, 000
	Sub Total			134, 171, 000
14	20% contingencies			26,834,200
15	15% engineering			24, 150, 000
	(±) Rounding			- 5,000
	Total Sh.So.			185, 150, 000

Gross irrigated area 13,070 ha
Net. irrigated area 11,100 ha

Table 35 - District 5 - Dufalach-Afmadow

No	Job	Unit	Cost (So.Sh.)
1	Tree clearing	-	-
2	Grubbing	-	-
3	Bush clearing	Ha 6,000	2,760,000
4	Stone clearing	-	-
5	Preliminary levelling	" 9,200	16,560,000
6	Deep ploughing	" 8,300	3,900,000
7	1st, 2nd and 3rd order irrigation network	" 9,200	22,448,000
8	Drainage networks (ditto)	" 9,200	11,960,000
9	Final levelling	" 7,800	2,340,000
10	Connecting roads (6 m/ha)	Km 60	12,000,000
11	Farm roads (30 m/ha)	" 276	4,278,000
12	Pumping stations	n° 1 per ha 1,000	231,000
13	Perimeter windbreaks	Km 180	4,050,000
	Sub Total		80,527,000
14	20% contingencies (1 - 13)		16,105,000
15	15% engineering (1 - 14)		14,495,000
	(±) Rounding		+ 23,000
	Total Sh.So.		111,150,000

Gross irrigated area 9,165 ha
Net irrigated area 7,800 ha

Table 36 - District 6 - Faanoole - Jilib

No	Job	Unit		Cost (So.Sh.)
1	Tree clearing	Ha	150	75,000
2	Grubbing	"	150	45,000
3	Bush clearing	"	20,000	11,580,000
4	Stone clearing		-	-
5	Preliminary levelling	"	10,000	9,670,000
6	Deep ploughing	"	25,800	12,900,000
7	1st, 2nd and 3rd order irrigation network	"	28,700	64,316,000
8	Drainage networks (ditto)	"	18,700	81,090,000 (1)
9	Final levelling	"	26,400	8,066,000
10	Connecting roads	Km	30	6,000,000
11	Farm roads (20 m/ha)	"	600	9,300,000
12	Pumping stations	n° Ha 1,000	1 per	231,000
13	Perimeter windbreaks	Km	100	2,250,000
	Sub Total			205,523,000
14	20% contingencies			41,105,000
15	15% engineering			36,994,000
	(±) Rounding			- 22,000
	Total Sh.So.			283,600,000

(1) Including buried drainage, irrigation and drainage water pumping stations and leaching on 15,600 Ha of Class 4 lands.

Gross irrigated area 28,700 ha
Net irrigated area 26,400 ha

Table 37 - District 7 - Touta Island

No	Job	Unit		Cost (So.Sh.)
1	Tree clearing	Ha	200	100,000
2	Grubbing	"	200	60,000
3	Bush clearing	"	15,700	9,420,000
4	Stone clearing		-	-
5	Preliminary levelling	"	15,700	28,260,000
6	Deep ploughing	"	14,000	7,000,000
7	1st, 2nd and 3rd order irrigation network	"	15,700	28,308,000
8	Drainage networks (ditto)	"	15,700	20,410,000
9	Final levelling	"	13,300	3,990,000
10	Connecting roads (2.5 m/ha)	Km	40	8,000,000
11	Farm roads (30 m/ha)	"	470	7,310,000
12	Pumping stations	n° Ha	1 per 1,000	231,000
13	Perimeter windbreaks	Km	110	2,700,000
	Sub Total			115,789,000
14	20% contingencies			23,158,000
15	15% engineering (±) Rounding			20,842,000 + 11,000
	Total Sh.So.			159,800,000

Gross irrigated area 15,700 ha
Net irrigated area 13,300 ha

Table 38 - District 8 - Baardheere - Ionte

No	Job	Unit		Cost (So.Sh.)
1	Tree clearing	Ha	500	175,000
2	Grubbing	"	350	105,000
3	Bush clearing	"	37,900	22,320,000
4	Stone clearing	"	-	-
5	Preliminary levelling	"	37,900	66,960,000
6	Deep ploughing	"	34,000	17,500,000
7	1st, 2nd and 3rd order irrigation network	"	37,900	90,768,000
8	Drainage networks (ditto)	"	37,900	48,360,000
9	Final levelling	"	32,200	9,660,000
10	Connecting roads (2 m/ha)	km	70	14,000,000
11	Farm roads (30 m/ha)	"	1,120	17,360,000
12	Pumping stations	n° Ha	2 per 2,000	462,000
13	Perimeter windbreaks	km	190	4,275,000
	Sub Total			291,945,000
14	20% contingencies			58,389,000
15	15% engineering			52,550,000
	(±) Rounding			+ 16,000
	Total Sh.So.			402,900,000

Gross irrigated area 37,900 ha
Net irrigated area 32,200 ha

Table 39 - District 9 - Jamaame

No	Job	Unit		Cost
1	Tree clearing	Ha	300	150,000
2	Grubbing	"	300	90,000
3	Bush clearing	"	26,000	16,200,000
4	Stone clearing	"	-	-
5	Preliminary levelling	"	26,000	48,600,000
6	Deep ploughing	"	23,500	13,500,000
7	1st, 2nd and 3rd order irrigation network	"	26,000	65,880,000
8	Drainage networks (ditto)	"	26 000	35,100,000
9	Final levelling	"	20 000	6.030 000
10	Connecting roads (2.3 m/ha)	km	60	12,000,000
11	Farm roads (30 m/ha)	"	800	12,500,000
12	Pumping stations	n° 3 per Ha 3 000		693,000
13	Perimeter windbreaks	Km	180	4,050,000
	Sub Total			214,793,000
14	20% contingencies			42,958,000
15	15% engineering			38,662,000
	(±) Rounding			- 13,000
	Total Sh.So.			296,400,000

Gross irrigated area 26,810 ha
Net irrigated area 20,050 ha

Table 40- District 10 - State Farms (completion)

No	Job	Unit	Cost (So.Sh.)
1	Tree clearing	(carried out)	-
2	Grubbing	(carried out)	-
3	Bush clearing	(carried out)	-
4	Stone clearing	(carried out)	-
5	Preliminary levelling	(carried out)	-
6	Deep ploughing	(carried out)	-
7	1st, 2nd and 3rd order irrigation network	Ha 12,300	30,012,000
8	Drainage networks (ditto)	" 12,300	67,990,000 (1)
9	Final levelling	" 10,300	3,090,000
10	Connecting roads (2 m/ha)	Km 25	5,000,000
11	Farm roads (16 m/ha)	Km 200	3,650,000
12	Pumping stations	n° 1 per Ha 1,000	231,000
13	Perimeter windbreaks	Km 80	1,800,000
	Sub Total		111,773,000
14	20% contingencies		22,355,000
15	15% engineering		20,119,000
	(±) Rounding		+ 3,000
	Total Sh.So.		154,250,000

(1) Including buried drainage and leaching of 7,700 ha of Class 4 lands destined to cotton and oil seeds.

Gross irrigated area 12,300 ha
Net irrigated area 10,300 ha

Table 41 - District 11 - Descek Uamo

No.	Job	Unit	Cost (So.Sh.)
1	Tree clearing	-	-
2	Grubbing	-	-
3	Bush clearing	Ha 1,200	720,000
4	Stone clearing	" -	-
5	Preliminary levelling	" 11,800	14,160,000
6	Deep ploughing	" 11,800	5,500,000
7	1st, 2nd and 3rd order irrigation network	" 11,800	28,792,000
8	Drainage networks	" 11,800	15,340,000
9	Final levelling	" 10,000	3,000,000
10	Connecting roads (6 m/ha)	Km 70	14,000,000
11	Farm roads (30 m/ha)	" 354	5,440,000
12	Pumping stations	n° 2 per Ha 2,000	462,000
13	Perimeter windbreaks (16 m/ha)	Km 200	4,500,000
	Sub Total		91,914,000
14	20% contingencies		18,383,000
15	15% engineering		16,544,000
	(±) Rounding		+ 9,000
	Total Sh.So.		**126,850,000**

Gross irrigated area 11,800 ha
Net irrigated area 10,000 ha

CHAPTER 7.

ORGANIZATION AND MANAGEMENT

7.1 ORGANIZATION

With the aim of speeding up the execution of the development actions an apposite Authority or specific organization has been foreseen. Its main functions can be summarized as follows:

- operation and maintenance of land reclamation and irrigation network;
- operation of infrastructures and social services;
- land resources allocation and farming population re-settlement;
- agricultural services for the Family Farms and cooperatives;
- training;
- cooperative promotion and general support to the State Farms;
- input procurement and product marketing;
- relationship with other governmental agencies.

The structure and composition of personnel necessary to the operating are illustrated in Fig. 4.III and Table 42.

To improve a net area of more than 220,000 ha by putting it totally under irrigation, to construct the irrigation works necessary to do this, and subsequently to manage the operations involved will require a complex organization devoted solely to the Project. This organization will have to be to a great extent independent and autonomous in order to make decisions and interventions in a timely and effective manner.

The Engineering Division has its head office at the general headquarters of the Authority located at Baardheere.

Within the overall picture of the plan for land improvements the Engineering Division has these three fundamental tasks:

- planning of the water works to be done;
- supervision of the construction of these works;
- management of the irrigation operations on the land which is gradually brought under irrigation.

These tasks will be carried out by four services:

- the Design Office;
- the Direction of Works Service;
- the Irrigation Management Service;
- the Agronomical Division Service.

The headquarters for theses services will all be located in Baardheere, while in the case of the latter two services (Direction of Works and Irrigation Management) there will be branch offices located in each of the irrigation districts into which the Reclamation Area is subdivided.

7.1.1 The Design Office

This will have the task of determining and directing the planning operations for the works, which will then be entrusted to engineering consultants to carry out the actual drawing up. The technicians of Design Office will define the preliminary schemes and the basic parameters of the projects and then follow up and check on them as they are carried out. The Design Office will be set up immediately and will be closed out at the end of the planning of the works.

7.1.2 Supervision of Works Service

This Service will fulfill a role of primary importance during the initial stages of the overall operation, especially in the immediate setting-up of the primary intervention, when it will be necessary to furnish all the basic elements for the carrying out of the works to the contracting firms within a very limited time schedule.

This Service will have the task of directing and supervising the firms which will be awarded contracts for the construction of the works. The capability and effectiveness of this Service is of utmost importance to ensure that the works are carried out according to the established time schedule, especially since the situation will be such that the construction work of one firm will be subsequent to and complementary to the work of another.

Immediately after one firm has completed the secondary and tertiary network in a given area, other firms will move in and commence the construction of the field works and the levelling.

Any delay in the work of the former will not only affect their time schedule, but will also stall the follow-up work of the other contractors.

The headquarters for the Direction of Works Service will be located in Baardheere, and it will have to provide for the coordination of the work of the various construction firms and furnish the general directives for the carrying out of the works.

The actual application of these directives, however, and the actual supervision of the work as well as the detailed planning for the works themselves will be handled by the field offices located at the work sites.

These field offices will vary in number during the course of the operations according to the operational planning needs.

7.1.3 The Irrigation Management Service

This Service will have the task of formulating irrigation plans and time schedules, as well as handling the operations and the maintenance of the various works. This Service, working in close contact with the Services of the Agronomical Division, will fulfill these responsibilities through two offices: the Office of Water Management, and the Office of Operations and Maintenance.

The Irrigation Management Service, with its head office in Baardheere, will have sole control of all the works having to do with irrigation and water disposal.

The two offices subsidiary to the Irrigation Management Service, as has been said, are:

a. The Office of Water Management: This will establish and determine the various irrigation parameters and the seasonaly distribution within the various zones of the Project Area according to the cultivation plan adopted (watering volumes, irrigation forms, time schedules, turns, etc.).

Fig. 4-III - Organization Chart of the Project Authority of Management or Organization

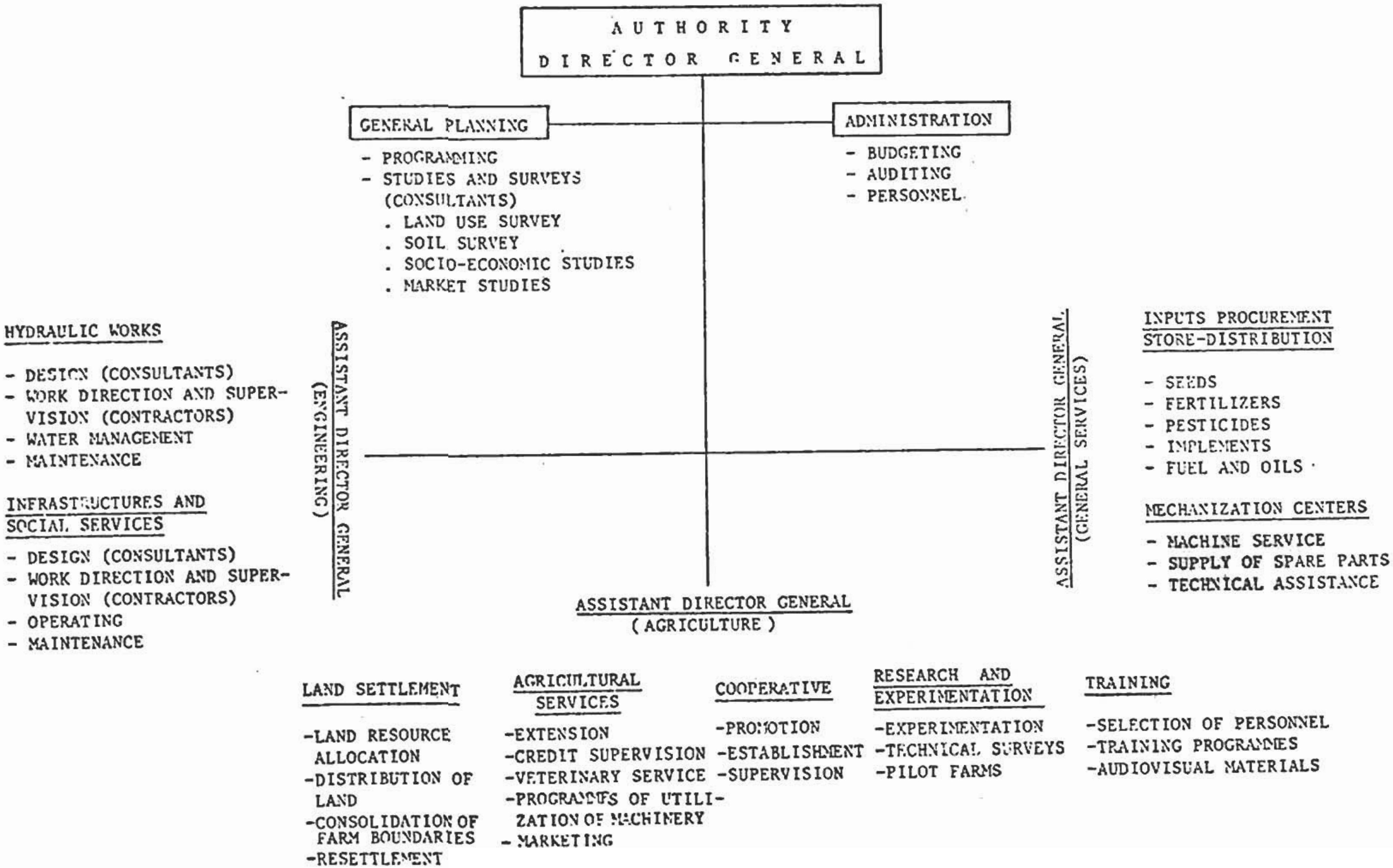


Table 42 - Project Authority Staff

Years / Personnel	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
Managerial Staff	4	4	4	5	5	6	6	6	6	12
Professional Staff (Graduated)	10	12	16	20	20	31	31	31	31	33
Skilled Technicians	32	42	58	67	77	93	95	108	108	150
Skilled personnel (x)	155	295	474	641	838	1,003	1,120	1,220	1,247	2,000
Total	201	353	552	733	940	1,133	1,252	1,365	1,392	2,195

(x) Tractor drivers, extension agents, water workers

Table 43 - Hydraulic Division Staff, according to Service, Qualifications

Service and Qualifications	At Headquarters			In the Field Offices			Total
	Expatriates	Nationals	Total	Expatriates	Nationals	Total	
Chief Engineers	1	1	2	-	-	-	2
Design Service:							
- Engineers	1	1	2	-	-	-	2
- Skilled Technicians	1	1	2	-	-	-	2
Direction of Works Service:							
- Engineers	1	1	2	5	5	10	12
- Skilled Technicians	1	1	2	-	10	10	12
Irrigations Management Service:							
- Engineers	1	1	2	-	-	-	2
- Skilled Technicians	1	1	2	-	-	-	2
Water Management Office:							
- Engineers	1	1	2	-	-	-	2
- Agronomists	1	1	2	-	-	-	2
- Skilled Technicians	-	2	2	-	-	-	2
Operations and Maintenance Office:							
- Engineers	1	1	2	-	5	5	7
- Skilled Technicians	1	1	2	-	10	10	12
- Water Workers	-	-	-	-	350	350	350

b. The Office for Irrigation Operations and Maintenance: This will have the following duties:

- to set up, on the basis of the data furnished by the Office of Water Management, the operations to be followed throughout the whole canal network in order to effect the irrigation plan; this will be done more or less once a week;
- to perform the necessary operations at the beginning and at the end of each irrigation day;
- to supervise, control and measure the flow during operations;
- to perform the normal manual maintenance work on the canals, equipment, etc.;
- to inform the Mechanization Centers when extraordinary maintenance work requiring the use of machines is necessary;
- to supervise and check on the above-mentioned extraordinary maintenance work.

The Office for Irrigation Operations and Maintenance will have its headquarters at Faanoole, but the actual work will be carried out through subsidiary offices located in the irrigation districts of the Project Area.

There will be about 350 water workers. These men will be entrusted to carry out the specific manoeuvres and make the moment by moment checks on the operations to ensure the smooth running of the network. These will be essentially hand-labourers, capable of handling the routine maintenance tasks. They will all be nationals. This crew of 350 men will be divided up as follows:

- 28 men at the intakes at Baardheere and Saakow Dams and other intakes;
- 22 men along the main canals (one about every 4 km);
- 60 men along the primary canals (about every 4 km);
- 120 men along the secondary canals (about every 4.5 km);
- 120 men along the tertiary canals (about one for each of the tertiary canals served by the same secondary canals).

It ought to be noted that not all of the personnel listed above will be needed at the beginning of operations, but only gradually as the specific needs develop. This is especially the case in regard to the Irrigation Management Service, which theoretically will only require full staff at the end of the foreseen development period. For all staff, however, and especially for the water workers, a period of instruction and training will be necessary; consequently one can reasonably presume a level of employment about double that cited in the preceding pages in order to take into account both the lower initial efficiency as well as the necessary period of instruction.

Table 43 provides a summary of the numbers and types of staff proposed thus for the various organization and management services according to qualifications and nationality.

At this point it would be well to call attention again to the importance of both water management and irrigation operations. These two operations, if well calculated, coordinated and carried out, by experts, can keep to the minimum the possible difficulties owing to deficiencies in the network; for example, a variation in the volume or the distribution of the flow, and the consequent modification of the distribution schedule, by means of appropriate adjustments over the network, can avoid excesses or lacks of water in given zones, thus preventing damage to the crops and consequent lower yields.

7.1.4 Agricultural Services

a. Mechanization Centers. The proposed cropping pattern and techniques define the future utilization of machinery and equipment. Taking into account the average size of the farms in the area, it will be necessary to meet the total machinery requirements in order to be able to assure the expected cropping intensity. For technical and organizational reasons, it is proposed to set up 15 mechanization centers managed directly by the project Authority or by specialized firms on behalf of the Authority.

These centers should be strategically located throughout the area and be equipped with the required staff and machinery. They will also supply technical assistance and spare parts to the small private contractors operating in the area, to cooperatives and State Farms which own their own machinery. In considering the fact that these contractors represent an efficient form of management and utilization of machinery, the Authority should also back up the development of this category of operators in view of adapting their working capacity to the area requirements. Adequate credit policies have proven to be critical to the accomplishment of this purpose on other occasions. The mechanical equipment of the centers will be gradually reduced in the future, while the centers will maintain the other above-mentioned functions.

The mechanization centers will also be equipped with machinery necessary for the maintenance of the new irrigation and drainage networks as these latter are completed.

b. Implementation of land distribution and consolidation of farm boundaries. The distribution of the land is not yet completed in the area:

- the designation of lands according to various uses (strictly agricultural, infrastructures, other uses) from time to time has not been done according to an overall plan of reference;
- a large part of the land already distributed for agricultural use is used from the farmers only on a temporary basis.

It is necessary, therefore, that the Authority in collaboration with other competent government agencies, provide a general plan for land resources allocation which will take into account anticipated development of the various economic sectors within the territory and of the necessary building up of infrastructures and services. For the areas allocated for agricultural uses there will have to be a designation of those portions to be occupied by State Farms, experimental stations, etc.; to the extent possible it will be well to respect those lands which have in the past been assigned to local farmers, in order to minimize the problems of re-settlement.

At the same time the Project Authority, ought to provide in a timely manner the appropriate organization for carrying out, according to the time schedule set up in the programme of implementation, the following operations:

- consolidation of farm boundaries with the creation of irrigation, drainage and road networks, both the size and the limits of the existing farms will necessarily be affected. It will be necessary therefore to verify directly, on the land, the modifications which will be brought about, and to proceed with an immediate reconstitution of the farms' boundaries;
- resettlement of families whose land has been allotted for other uses and settlement of additional families on the lands not yet distributed;
- the distribution of long-term rights according to the existing land reform law.

In order to get the farmers of the area to participate actively in the agricultural development project, the consolidation of farm boundaries will precede the cultivation of each successive plot of reclaimed land from the very first year of the project.

During the execution of the works each year a certain amount of land, of the order of a 5 - 6,000 ha, will be temporarily withdrawn from cultivation for the period of time necessary for the completion of the works: the cultivation of these lands will be interrupted both in order to permit the construction of canals and drains and the levelling, and because the water supply will be interrupted. Also in this case it would be advisable that prior of these operations the Project Authority would intervene to arrange agreements with the farmers involved and eventually define certain criteria whereby the latter will receive compensation for loss of production.

c. Inputs supply. The use of fertilizers, pesticides, selected seeds and agricultural machinery is expected to increase considerably in the project area. It is suggested that the Project Authority work together with the other government agencies dealing with production and imports in order to coordinate the distribution of inputs to local farmers. For this purpose it seems necessary to set up storage warehouses corresponding to the agricultural centers of the area.

d. Extension Service. The local farms shall be reorganized, to a certain extent, in order to be able to perform the role assigned to them within the project. From the beginning the farmers will be guaranteed technical and financial assistance and their activities will have to be planned and conducted under the supervision of the project management. The main tasks of this Service will be the following:

- to cover the whole project area with a basic information programme meant to make as many farmers as possible acquainted with the aims of the project, the benefits which will flow from it, and the cooperation required;
- to assist the farmers in the reorganization of their activities after the irrigation and drainage networks are implemented in each district, according to the land development phasing proposed by the programme;
- to assist and train the farmers in the area of land and water management, crop and animal husbandry techniques, marketing, etc.;
- to prepare each year the farm production programme and to secure adequate inputs supply;
- to secure an adequate feed-back of information to the planning unit of the project management, by collecting and transmitting data about population, crops, livestock, work implementation, new requirements, etc.;

- to assist the farmers in preparing credit applications and to supervise the use of funds.

Given the complexity and the importance of the task entrusted to this Service, it is advisable to assign to each extension agent no more than 40-50 families. This corresponds to an average of 1,500 ha equal to 100 irrigation units.

e. Service to Cooperatives. Cooperative organization is one of the productive model envisaged for the project area. At the present time, however, there is no comprehensive experience to be utilized in setting up an appropriate model of cooperative organization and management. As a consequence the project also has to provide an appropriate service aimed at: a) studying and promoting models of cooperatives stuited to the socio-economic realities of the area, and b) providing the necessary assistance to the cooperatives already existing in the area or to be set up in the future. The office of the Project Authority in charge of this Service will conduct its activity in collaboration with the competent Department of the Ministry of Agriculture and with other offices of the project management (extension and training services).

f. Veterinary Service. The tasks assigned to this Service will be the following:

- to assist, advise and train local farmers in animal husbandry techniques;
- to intensify the veterinary coverage of the area, especially in regard to infectious diseases;
- to collaborate with the central veterinary service at Mogadishu in its research concerning disease and parasites.

g. Agricultural Credit Supervision Service. Credit plays an important role in any development plan as an instrument to prompt and guide the farmers' production choices. This tool, however, must be used wisely in order to avoid uneconomical investments and debt situations exceeding the productive capacity of the farms in question.

The main function of the Project Authority in this connection, however, will lie in informing and guiding the farmers in the correct utilization of the funds. Through the offices of the extension service and the service to the cooperatives, the Authority will be able to guarantee the needed information to the Agricultural Credit Bank to assist the farmers in the preparation of credit applications and supervise the use of funds.

h. Research and Experimentation. The present technical knowledge permits a tentative definition of cropping and irrigation techniques. In order to improve this knowledge, it is proposed to set up from the beginning an experimental station. Parallel with the progress of the proposed programme, the station will include successive experimental plots. The principal objects of the experimentation concern:

- correlation of crop results and different kinds of land management, especially irrigation, drainage and leaching on different soils;
- crop husbandry;
- the possibility of reclaiming and cultivating some solonchaks and solonetzic soils.

Simultaneously with the development of the proposed programme, some surveys will have to be carried out throughout the project area:

- soil surveys comprehensive of stratigraphic and hydrological investigations, and land classification. Various types of soil surveys will be carried out in view of identifying and delimiting: a) saline and alkaline soils, b) soils with scarce permeability and c) soils of unfavourable topography. These soil surveys will permit the adoption of suitable solutions for leaching, drainage, levelling and irrigation turns;
- sociological surveys, in order to determine the social feasibility of introducing improved management systems and new inputs, and to suggest the incentives and motivations which will better secure the cooperation of the farmers.

i. Training. In order to attain the objectives of full and efficient cultivation of the entire area of the project in the proposed time limits, it will be necessary to set up a Training Center.

The purpose of the Training Center will be to prepare, by means of short-term courses, Somali agents specialized in the three fundamental sectors: extension, mechanized agriculture and water distribution and control.

The Training Center staff (with the assistance of foreign experts) will prepare the training programme, handle the teaching, and each year update the courses on the basis of the feed-back provided by the extension agents and the farmers.

Various audio-visual aids will be utilized on a large scale, and will be adapted to the actual socio-economic conditions of the population and to the development objectives of the Project. The audio-visual aids will be coupled with practical demonstrations on pilot farms. The foreign and local experts will conduct the courses for a small number of Somali agents who, in turn, will train the extension agents, the tractor drivers and the irrigation and water workers.

On the average each year the Center will prepare 30 extension agents, 100 tractor drivers, 40 water workers and 10 mechanics.

The first step will be the setting up of a Training Center for the training of local personnel of all levels of competence, from experts in agronomy to the farmers directly concerned. This target will be attained by accelerated courses on agricultural subjects using to a great extent the audio-visual methods, the utilization of which will be adapted to the realities and needs of the project. The activity of the Center will consist mainly in promoting the full development of the area according to a realistic and practical concept of modern irrigated farming. Expatriate experts will assist the local personnel in this task.

The Training Center will be managed by the Authority and will be placed under the responsibility of a senior agronomist assisted by the following experts:

- 1 agronomist specialized in irrigation.
- 1 expert in animal husbandry
- 1 agronomist
- 1 expert in agricultural cooperatives and marketing
- 2 instructors specialized in agricultural mechanization
- 1 chief mechanic

- 2 assistant mechanics
- 2 rural sociologists.

The purpose of the Training Center is:

- to train the qualified local staff needed to train, in turn, the agents for the agricultural extension, for tractor use and other machine, for the management of the irrigation network, for cooperative management, etc.;
- to draw up audio-visual courses that are adapted to the objectives of the project and revise them according to arising needs and events.

The senior agronomist will be in charge of organizing courses and selecting the teaching programmes in liaison with the Authority's Technical Services. Furthermore, he will assure the selection of both the Somali instructors and assistants and the agents to be trained for the agricultural extension and other planned services (agricultural mechanization, water management, pilot farms, cooperative management, etc.).

The other experts will draw up the teaching programmes for their respective specialization and deliver the corresponding courses. Moreover, they will revise the content and the presentation of their courses according to the needs of the project and on-going evolution.

The task of the rural sociologists will include:

- a preliminary evaluation of the socio-cultural context so as to permit the elaboration of teaching programmes adapted to the local context;
- participation in the elaboration of teaching programmes for Somali qualified staff of the Training Center and other personnel;
- collaboration in the drawing up of extension programmes which Somali agents will assure to the farmers (audio-visual methods);
- evaluation, for each phase, of the results obtained by the programmes and recommendation of changes made necessary by project requirements;
- collection of the socio-cultural data needed to set up system of cooperatives.

The training provided by the Training Center will, at all levels, be practical and theoretical, and in both methods endeavour will be made to assure a rapid and efficient preparation in improved agricultural practices.

The choice of programmes should be focused on the most urgent needs and on those fields in which knowledge is lacking regarding new agricultural methods and practices.

The expatriate experts at the beginning will hold a course of two months for the Somali instructors on various subjects: crop husbandry, farm mechanization, irrigation, etc.

In a second phase the training will be split in two courses. A group of expatriate personnel assisted by the Somali experts will hold a 6 months course for the extension agents. At the end of the course, the extension agents will be placed under the control of the Extension Service of the Authority and will begin their activity in the field.

The expatriate experts in farm mechanization and water management with the assistance of the local experts, will hold 3 month courses for the local instructor assistants. In turn, at the end of the course, the latter assisted by the expatriate and local experts, will hold 3 months courses for the training of tractor drivers and the water controllers needed for the various phases of implementation of the Project.

The Somali instructors and their assistants constitute the permanent staff of the Center. The selection of the personnel for training courses will be made preferably among the local farmers.

At the same time, the other Somali instructors will train 6 assistants in the use of agricultural machinery and 5 others for water control.

The staff will train the machine operators and water controllers. These skilled workers will be ready and able to work in the project area as soon as the levelling work and construction of the irrigation network are completed.

The expatriate mechanics will train two mechanics, who will train yearly 10 other mechanics (see Tables 44 and 45).

It must also be noted that the number of skilled workers who are trained every year is superior to the actual total requirements of the programme, in view of the selections to be made by the Training Center and possible shortcomings.

The preparation of the audio-visual programmes and the techniques for their use by the agents will be assured by the expatriate experts in collaboration with local staff and the agents themselves.

It is suggested that the Training Center should be provided with a pilot farm to be implemented for an adequate formation of the local personnel. Its purpose will be two fold: a) set up life-size experimental trials of operations that will subsequently have to be undertaken at the level of the whole Project; b) serve as a place where experts of all levels and agents can gain experience, allowing the latter to apply their theoretical knowledge acquired in the Training Center; c) to prepare the documents to be used in drawing up the audio-visual programme necessary for the extension service and d) the pilot farm could be the site of a first experiment in cooperative production and management at full scale.

As previously mentioned, the training programmes will be prepared with the sociologists whose task will continually increase in importance. Moreover, at the end of each phase of operations and training, it will be necessary to be able to check up and evaluate the pertinence of the Training Center's teaching programmes and above all, to be able to assess the degree to which new agricultural ideas and techniques have been assimilated by the peasants.

Furthermore, the impact of the rural sociologists will be determinant in the design of the type of cooperatives to be promoted, especially in planning the optimal size of cooperative units, their operational set ups and their fields of application. These evaluations will be based on direct interviews with the farmers as well as direct contacts with extension service agents and experts, both Somali and expatriate.

Table 44 - Instructors for the Training Center

1.	Expatriate Instructors	No.	12
2.	Local Staff		
	2.a Instructors for :		
	- Extension Service	"	4
	- Machine Operators and water controllers	"	4
	2.b Assistant instructors for :		
	- Machine Operators	"	6/10
	- Water Controllers	"	5
	- Mechanics	"	2

Table 45 - Skilled workers to be prepared by the Training Center

Skilled workers \ Years	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
Extension Agents	20	20	30	30	30	30	30	30	30	30
Water Controllers	20	30	30	35	35	35	35	35	35	35
Machine Operators	40	50	60	80	100	120	140	160	180	200
Mechanics	10	15	20	25	30	50	50	50	50	50

P A R T IV

THE MEASURES IN THE LIVESTOCK SECTOR

CHAPTER 1.

LIVESTOCK PROBLEMS IN THE JUBA VALLEY

The Juba Valley contains Somalia's biggest concentration of cattle (about 1/3 of the national total on about 1/4 of the country's area). The region also has the greatest livestock development potential because of the surface water resources and the quality of rangeland, which could support the highest stocking rate of the entire country.

At the present time, stockraising in the Juba Valley is practised almost entirely by nomads who raise 70% of the cattle, 80% of the camels and 85% of the sheep and goats using traditional methods which take due account of natural conditions. Of course these methods markedly influence the number of head that can be raised and the quality of the stock. Yet, as things now stand, the wide-ranging periodic movements of the herds probably constitute the best way of using the natural resources.

All development programmes for livestock in the Juba Valley will have to take due account of many natural and institutional factors. It will be impossible to change some of these factors (climate, for example) but due account must be taken of them. The livestock development programme for the study area must be tailored to resolve the remaining difficultires.

1.1 NATURAL FACTORS

1.1.1 Climate

The Juba Valley has an arid and semi-arid climate. Rainfall is low (from 186 - 557 mm/year) and rainfall distribution is irregular in space and time. To make matters worse, there are major losses of moisture by evaporation, and drought years tend to occur one after the other.

There is always the possibility that the complete lack of rain or very low rainfall in one of the two rainy seasons may result in the animals being kept in very restricted areas. Development of the rangelands is dependent on the rainfall regime. The stocking rate in the Juba Valley ranges from a maximum of 1 AU to 5 ha in the better parts in the south to 1 AU to 25 ha in the northern areas, where the climate is more difficult.

1.1.2 Water Resources

There is a decided lack of watering points in many parts of the rangelands. There are huge areas where there could be 1 AU to every 5-9 ha (Lak Dera Plain and Faafadun) but which have less than 20 watering points per 10,000 km^2 and for the most part these are only temporary ones. Hence these huge areas remain underutilised, while there is an excessive concentration of stock around the permanent waterpoints. The other matter worthy of mention here is that where more permanent water is available, i.e. on the lands near the River Juba, the tsetse fly is present. If cleared of tsetse, these areas could have a higher stocking rate (1 AU/5ha) than that now prevailing.

1.1.3 Health Situation

All the usual animal diseases - viral, bacterial and parasitic - occur to a greater or lesser extent throughout the project area.

Rinderpest. This once used to cause enormous damage, but it seems that the campaign conducted between 1972 and 1975 - during and after JP 15 (the last phase financed by the German government) - has brought the disease under control, as no outbreaks have been reported since 1973. However precautions must not be relaxed. This point will be taken up again further ahead.

Pleuropneumonia. This disease is still frequent, despite the action taken during JP 15. The fight against this disease will therefore have to continue.

Anthrax and Symptomatic Anthrax. These diseases tend to occur sporadically and not as epidemics. The spores, especially those of the Bacillus Anthracis, can live for a long time in very arid soils and so it will not be easy to eradicate these diseases. However, nowadays, there are excellent low-cost vaccines, which are easy to prepare. With these it is possible to rapidly restrict the extent of the outbreaks when these occur.

Pasteurellosis (haemorragic septicaemia). This is a seasonal disease which tends to attack weak animals; it rarely affects those in good condition. In this case too, there is a very effective, easy to prepare vaccine. The serum is made from samples taken from diseased animals so as to be sure of obtaining the right strain. Some sulphanilamide drugs also provide an effective and relatively cheap form of treatment.

Contagious abortion (Brucellosis). It has not been possible to ascertain exactly what the rate of infection in the Somali herds is. Some samples have been taken, but the number was not sufficient to be really indicative. However, it is likely that the rate is around 15-20% as in other parts of Africa. African stock is usually resistant to this disease which rarely results in abortion as such, but generally takes the form of vaginal discharges and capping of the knee and hock.

Foot and mouth disease. This is not considered a serious disease in Africa. In fact it is rarely fatal except in the case of calves rejected by their mothers affected by a painful udder condition and young and especially fullgrown animals afflicted by sores on their feet which prevent them from making long treks. However, foot and mouth disease is very serious from the economic point of view for countries engaged on intensive stockraising. Furthermore, if it is wished to export fresh meat to Europe, it will be necessary to frame vigorous health regulations to keep in line with those in force in the importing countries.

Blood parasites: Trypanosomiasis (sleeping sickness) and Pyroplasmosis (tick fever). There are many ways of treating these diseases, but most of them have the twofold drawback of being expensive and of providing no more than a temporary cure. Thus animals are liable to become reinfected and treatment must start again. The best method of prophylaxis consists in destroying the vector insects; the tsetse fly in the case of trypanosomiasis and ticks in the case of pyroplasmosis. These problems are dealt with again further ahead (para 2.2.5 and 2.2.6).

Pests of the digestive system. These are numerous and varied. They cause the most serious damage to the herds especially to young animals, because they stunt their growth. A really efficient system of prophylaxis will only be possible when the herders have facilities available to obtain the necessary medicines, with which to treat their own stock regularly.

External pests. Ticks, scabies, and lice: the same remarks apply as for internal pests.

1.2 INSTITUTIONAL FACTORS

1.2.1 Market infrastructure

Improvement of the market infrastructure is essential for the proper development of the livestock sector. There must be markets for young animals and for those ready for slaughter. Slaughtering facilities must be provided, as must proper stock routes. Action along these lines will enable the quantity and especially the quality and hence the value of the livestock to be improved, both for the domestic and the export market.

An efficient market infrastructure, closely coordinated and integrated with the phases of raising, fattening and industrial utilisation of the animals is also a decisive factor in correct range use.

When the right facilities are available it will be possible to reduce the stocking rate on natural pastures, reserving the extensive livestock areas exclusively for breeding animals. In this way too, it is possible to limit the amount of damage which occurs during the recurrent periods of drought, by arranging for the timely removal of animals in excess of the rangeland potential, thus avoiding the danger of jeopardizing future production.

The reader is referred to another section of this report for a more detailed analysis of matters concerning the market infrastructure. It should however be mentioned here that the Somali Development Livestock Agency is actively pursuing this matter and several schemes envisaged in the Trans Juba Livestock Project (40) are now being implemented in the Juba Valley to improve the situation.

1.2.2 Technical Staff and Experimentation

The lack of technical staff for the implementation and management of development projects is a limiting factor which must be borne in mind, since it is likely to hinder progress in this sector and can cause delays in the utilisation of foreign finance.

The shortage is especially marked at managerial level, and the training of managers should go beyond the degree stage to include post-graduate courses. Facilities for this are required. The shortage of middle technical personnel is not so serious, as suitable people can be trained in Somalia.

The large-scale introduction of absolutely new stockraising, forage production and conservation techniques in the Juba area and the country as a whole, will entail an experimental phase to ensure that the techniques are suitable for local conditions.

1.2.3 Use of Rangelands and Waterpoints

With the uncontrolled use of rangelands and waterpoints by the nomadic herds it is impossible to obtain a correct balance between the number of stock raised and the productive potential of the grazing; this leads to underutilisation of some areas and overutilisation of others.

The result is the progressive impoverishment of the rangelands. This manifests itself in different ways, depending on the soil and climatic conditions of the various areas concerned. In some areas, erosion and desertification occurs, in others scrub and trees start to take over and there is insufficient forage for the animals. This situation is not altogether attributable to nomadic practices, which are the result of climatic factors (that cannot be modified) and the irregular distribution of waterpoints (about which something can be done). The main reason for the situation is the growth in human and animal populations, thanks to the efforts made in the health field. However, the overall result is aggravated by the lack of legislation on grazing rights.

Legislation must be passed and an operational structure must be set up to ensure correct use of rangelands and waterpoints.

CHAPTER 2.

OPERATIONAL STRATEGIES

To improve animal production, three main objectives must be attained:

- Improvement of the health situation.
- Improvement of the physical environment (rangelands, availability of water) and of the human element (education of herders).
- Improvement of stock quality and numbers.

In order to attain these objectives, it will be necessary to improve the infrastructure and the services provided by the Ministry of Livestock, Forests, Rangelands and Wildlife by ensuring that sufficient men and materials are available, especially in the field.

These aims were identified during the 1974-1978 Five-Year Plan, and substantial credits were allocated to attain them. A detailed study is made below of the means available to achieve these objectives, efficiency and convenience being considered. This should ensure that the best and most economic methods of approach are selected, so as to avoid any sophisticated programmes whose cost may be quite out of proportion with the practical results to be expected.

2.1 IMPROVEMENT OF THE HEALTH SITUATION

The diseases affecting Somali livestock are known, the therapeutical means exist and so improvement of the health situation depends directly on the veterinary service that can be provided. It is therefore necessary to set up a great number of properly staffed veterinary stations, well-equipped with material, vaccines and medicines. Provision is made for these in the Five-Year Plan and in the Trans-Juba Project and work is proceeding in this direction. Some of the stations are well staffed, such as that at Garbaherre, but the equipment leaves much to be desired in most cases.

It is felt that a good allocation of equipment and personnel would be as follows:

2.1.1 Staff

- In the regional capital there should be a regional veterinary centre or sector under the control of a qualified veterinary surgeon responsible for all matters concerning livestock. He should have one or two assistants and two to four vaccinators, depending on the number of head of stock concerned and the size of the territory.

- In every district there should be a veterinary subsector under the control of an assistant, helped by two or three vaccinators.

- There should be veterinary stations with a vaccinator (not as highly qualified a person as the veterinary assistant) everywhere there is any great concentration of livestock. For instance, instead of having guards at the waterpoints (whose usefulness is difficult to assess) it would be preferable to have vaccinators there who could ensure that the water regulations are observed, while also attending to the health of the stock, educating the herders and obtaining medicines for their cattle (products to combat intestinal worms, ticks and so on, for example).

It is a better policy to distribute staff at numerous points than to have them concentrated merely in the regional or district capitals. The more numerous and frequent the contacts between veterinary service officials and herders, the more efficient the service will be. Such contacts will also greatly facilitate the exchange of information and generate a climate of mutual confidence.

2.1.2 Equipment

Regional Centres. These should have two cross-country vehicles of which at least one should be a Land Rover for use in mass vaccination campaigns; the other could be used for supervision and control missions (and for the sake of economy this could be a Volkswagen or Mehari pick-up). The centres should also have a number of mopeds or bicycles to enable the assistants and vaccinators to get around more easily. There should be refrigerators with a freezer for storing vaccines; these should be kerosene or preferably gas operated. There would also need to be a sufficient supply of such things as syringes and needles. In addition, the centre would need portable iceboxes or small gas operated refrigerators (there are some 9 - 15 litre models on the market which are easily transportable and are very good). In addition, the centres would require simple surgical and medical equipment. There should be a room to be used as a small, unpretentious laboratory in which it would be possible to run diagnostic tests and perform the commonest seriological checks.

District Subsectors. These should have a small pick-up and sufficient mopeds or bicycles to make the staff mobile. A microscope and a refrigerator with a freezer for vaccines would be needed, as would a small supply of materials and medicines to distribute to the vaccinators as required.

Veterinary Stations. These should have a moped or a bicycle for getting around, a small supply of materials and the most common medicines.

2.2 WAYS OF COMBATTING DISEASE

2.2.1 Rinderpest

Because of the good work already done, this disease is now under control and causes no more damage to the herds. However, control does not mean eradication, since the cattle come in contact with wildlife (gazelles, etc.) which are very numerous in some parts of the project area. Furthermore, the recent political events in Ethiopia have certainly slowed down and disrupted veterinary action, so it would be prudent to remain extremely vigilant for at least a few years to come. This does not mean continuing extremely costly operations of the JP 15 type. These are not needed as the objective of disease control has already been attained. It will suffice to maintain and con-

...lidate this control by vaccinating six month to two year old animals every year at the existing veterinary stations or at those shortly to be set up. Without these precautions, within the space of a few years the whole of the Somali livestock population will again be prone to the disease and the minimum chance case may have the most serious consequences.

3.2.2 Pleuropneumonia

Efforts have been made over the last few years to start a campaign (known as JP 28) against Pleuropneumonia, similar to that mounted against rinderpest, project JP 15. However, the international financing organizations continue to hesitate to put up the money, despite the insistence of some, which was made plain during the recent OIE meeting in Paris. A campaign against pleuropneumonia covering the whole of Africa would be extremely costly and it would certainly be a failure. As it is known, the original aim of JP 15 was to eradicate rinderpest, but despite the means made available it was necessary to limit its scope to control of the disease (i.e. to arrest the more immediate effects, but without eliminating the disease altogether), notwithstanding the fact that there was an absolutely innocuous vaccine available which gives immunity for many years. In the case of pleuropneumonia there is also an inoffensive vaccine available, the KH3J strain, but this only ensures short-term immunity (4 or 5 months at a maximum) and the certainty of this immunity is in some cases doubtful.

There are also slightly more efficient vaccines available, but all of them involve some element of danger. The FAO/OIE, OUA experts recommend only two: KH3J and TI-44.

TI-44 seems to be wholly effective for 7 months and may also give immunity up to the 14th month. However, this vaccine causes side reactions, which are sometimes violent and generally numerous. All those who have been working on pleuropneumonia (Orve and Doutre in Dakar, Prevost in Tchad, Lindley in Sudan and then on the Ivory Coast, etc.) have observed such incidents. The final report submitted after an experimental campaign financed by the French Ministry of Cooperation (FAC) in Togo and performed between March 1972 and March 1975 (11) is the most significant in this respect. Let us quote one or two passages therefrom:

- Page 162: Safety tests. The results of these seem to be somewhat disappointing. In fact at Dapango the only reactions were two not very extensive edemas without very serious consequences... but in the southern area (Kara and centre) trials run on comparable animals were discouraging; with 49 control animals there were 29 reactions (equivalent to 20%) 12 of which were not serious... and 17 serious. Of these 17 animals, 15 had very large edemas, which tended to become purulent ulcers except in the case of 5 animals which were treated with the spyramycene dosage recommended by Lindley: this treatment halted the infective process. The 2 most serious cases ended with the death of the animals.

- Page 175: Vaccination with T1 vaccine causes a classical inflammatory reaction at the point of the injection in the case of the most sensitive animals..... The edemas, which are only specific, may clear up by themselves without leaving any trace, or they may become ulcerated, gradually evolving into purulent sores sometimes up to 50 cm in diameter.

Thus it is easy to see why this vaccine is unpopular. In some cases the edema extends over the whole of the side of the animal and eventually causes death.

- Page 190: It can only be hoped that... research workers will be able to find a vaccine which combines the efficiency of T1 with the innocuousness of KH3J.

. . The hesitancy of the international organizations over launching such a costly campaign is understandable while so many technical questions remain unanswered. At the present time a 2-men team of experts is travelling Africa to try to reach a final decision regarding JP 28. However it would seem that instead of being mounted as a general inter-state campaign, as was JP 15, the idea may be to give each state faced with this problem the material means of combatting the disease by its own methods.

We have dwelt so long on the Togo campaign because it was the last one to have been performed and, as far as we can understand, a large number of animals were covered simultaneously. The experience underlines the great uncertainty attaching to ways of using T1-44, which gave good results in the Savana regions but was certainly not the solution to the problem in Kara and the Centre. ....

While awaiting an ideal vaccine, the best policy in such cases is to slaughter infected animals. The efficiency of this method is decidedly good...

It is thus advisable to use a combined approach involving vaccination, and the slaughtering of sick animals, as was done in Ethiopia, especially in the Borana, Harrar and Ogaden provinces. There, during the course of the JP 15 operations, the KH3J vaccine was used; this has the advantage of being absolutely innocuous, although it only provides protection against pleuropneumonia for 4 - 6 months.

Without claiming that this method is completely efficient, it is quite certain that in Ethiopia it certainly reduced the incidence of the disease.

2.2.3 Contagious abortion (Brucellosis)

African veterinary services are increasingly tempted to try vaccination, indeed some have been bold enough to insist on general vaccination. But this is to be strongly discouraged. The stockraising methods used do not lend themselves to this approach. The overall pattern of conditions necessary to get good results cannot be attained under these circumstances. There is also the cost factor. Not only is the vaccine itself relatively dear, but the operation entails a series of vaccinations at regular intervals and all the animals must be vaccinated. The experiments run at Fongères in France from 1970 - 1972 show that:

- the best approach is to vaccinate 6-month old animals and then to give a booster dose every year;
- none of the main vaccines is 100% effective, the best are the 45/20 oily vaccines (18% of failures) and B 19 live freeze-dried (29% probability of failure).

Operations on the required scale and with the necessary degree of precision are impossible to perform on large nomadic herds. Another consideration in our case is that the economic impact of the disease on the Somali livestock population (and for that matter on the African livestock population as a whole) is not great and certainly not enough to justify projects of this type.

It is therefore advised that symptomatic prophylaxis be practised. This would consist in eliminating animals which show the most evident signs of contagion: premature abortion, vaginal discharges, build-up of fluid, etc.

2.2.4 Foot and Mouth Disease

While Somali meat continues to be exported as a canned product or as animals on the hoof towards countries on the Arabian peninsula, foot and mouth disease is not a great problem. But things will change, when, thanks to the use of byproducts from cash crops grown under irrigation in the Juba area, the country will be able to produce more meat of interest to the European frozen meat market. Then it will be necessary to comply with the OIE/FAO 1972 recommendations (12) and also those of the Common Market (6). These regulations were framed so as to avoid importing into Europe types of exotic virus that European laboratories are not equipped to tackle.

What types of virus occur in Somalia? The few samples sent to Purbright indicate the presence of Type O and Type A. But many more samples must be taken in order to ensure that other types of virus do not exist. The investigations which have been made in countries bordering on Somalia may serve as a basis for drawing up a draft agreement on how to tackle this disease, should fresh meat be exported to Europe.

In Ethiopia a team of French foot-and-mouth experts at the Debre Zeit laboratory identified types O, A and C as far back as 1968; the last type however was very rare. Seriological studies which have been performed indicate that Ethiopian O and C types are very similar, though not identical, to European types, while the Ethiopian A type viruses are seriologically different from the European A types. Vaccination tests have confirmed this difference. An "A" vaccine prepared at Debre Zeit on the basis of Ethiopian strains offers perfect protection, while "A" vaccines coming from France or from Kenya provide little or no protection.

British research workers in Kenya have discovered different types of SAT. It would be wise to ascertain whether or not these are present in Somalia, especially if there are any buffalo in the region, as these animals are the most dangerous carriers of this type of foot and mouth disease.

2.2.5 Trypanosomiasis (sleeping sickness)

There are three methods of prophylaxis which can be used to combat this disease:

a. Avoidance of the tsetse fly infested areas. This is still virtually impossible for most of the animals in Somalia. During the rainy season, the tsetse fly goes where there is water and arrives far outside its habitual environment, temporarily infesting regions which are normally clear. This is what happens in the case of the "desceks". The lack of permanent watering points means that most of the herds have to go and drink at water courses, which are the preferred habitat of the tsetse fly. The creation of new water points far from the river will improve this situation.

b. Treatment of stock. This is a difficult method to apply to all of the infested stock and will continue to be so until there are enough properly staffed veterinary stations throughout the whole country. Furthermore, the method is costly and, as has been indicated, is purely curative and, at best, provides a few months protection, after which reinfection is possible and the treatment must be repeated.

c. Elimination of tsetse fly. This would be the ideal solution and for many years researchers have been applying themselves to the problem. All the methods discovered so far have had their moment of glory but this has not usually been longlived because the tsetse fly has reappeared again after a short space of time.

The following methods of treatment might be mentioned:

- Spraying powdered insecticides from the air: this method was used well before World War II in South Africa and Zaire (then the Belgian Congo). The immediate results were most marked, but the tsetse fly reappeared.

- Isolation of portions of gallery forest by the total destruction of 2 km stretches of forest along the rivers and treatment of the remaining portions of forest with insecticide. In this case too, the immediate results are excellent but the undergrowth rapidly springs up again and the number of tsetse flies is soon as great as before. The cost of the operation prevents its frequent repetition, especially in view of the precarious results. This method might be efficient if the whole of the area were immediately put under crops. This is precisely what is envisaged in the Juba Valley project with the creation of irrigation districts.

- Spreading insecticide in all the presumed haunts of the tsetse fly, up to a height of 3.50 m. This will certainly kill a lot of flies but there will still remain sufficient to ensure re-infestation.

In Ruanda, two methods have been combined; the clearing of all trees and bushes over a radius of 2 km around stockraising stations and the treatment with Dieldrin and Malathion of all trees up to a height of 3.50 m. Recently it has been observed that the results are very good for the Rubona Station, where there has been no case of trypanosomiasis for 6 years, while the results at the Karama Station are not so good, as several sick animals have been detected. In the case of the Rusumo Station instead, the results have been frankly disappointing. There the tsetse fly reappeared after 18 months and it has not been possible to protect the stock except by treating them twice a year with Verenyl and Anthrycide.

- Genetic warfare, involving the release of irradiated, sterile male flies. This is the most recent discovery and it seems to hold out the best hope of success under certain conditions. The method was used successfully in 1961 on the island of Curaçao, which was cleared of an insect which was causing great damage to the local economy. This is a small island measuring a mere 464 km^2 and there is no possibility of re-infestation. However this would not be the case with the Juba and Shebeli rivers. Even if it were possible to disinfest the whole of the Somali course of these rivers, very little time would pass before the tsetse fly, which infest the banks of the Shebeli in

Ethiopia and also the Doria Canal and Dawa Parma, cross the frontier to reinfest the banks of the river in northern Somalia. The same sort of situation applies also in the south of the country where reinfestation could probably occur rapidly with tsetse flies from the Kenya Wildlife Reserve, which is very close to the Somali border. Something similar occurred in Texas, where the sterile fly method was used with success against the "screw worm" (cochyloma homini vorax) which causes enormous damage to cattle skins; in this case, it has not been possible to prevent resurgence after a few years as a result of flies coming in from Mexico.

However the method has its interesting prospects and numerous research workers are engaged on the problem. There are presently two projects underway in Africa for eliminating tsetse by the irradiated male fly technique. One of these, concerning Glossina morsitans is underway in Tanga, Tanzania; this project is financed by USAID with supplementary technical assistance from the Lang-Ford research laboratory in England and the International Atomic Energy Agency. The second project is at Bobodioulasso in Upper Volta; this is being financed by the French DGRST and implemented by IEMVT of Maisons-Alfort; it concerns Glossina palpalis gambiensis. Some trials have also been run in Chad and Cameroun with irradiated males coming from the IEMVT insectarium at Maisons-Alfort; results have been encouraging.

FAO is particularly interested in the problem of trypanosomiasis. The organization has fathered an ambitious but prudent plan, for which funds have been requested from the UNDP and other international bodies. During the first phase, which will cost about $ 3,000,000, a review will be made of all that has been done so far and the ensuing results will be studied. During the second phase, pilot projects will be set up in order to train teams of experts, while studies will be made of the possibility of developing areas which have been cleared of tsetse; in Kenya, along the Tana River; in Chad along the Chari; along the Niger in the southern part of the river (Nigeria is already taking action along these lines); in Botswana along the delta of the Okavango; in Ethiopia and in Somalia along the course of the Shebeli and the Juba; and in Cameroun in the Adamawa Highlands. It is considered that these projects will take up to 10 years to complete. If the results are positive, other projects will be started. Somalia, too, is interested in this problem and the 1974-1978 Five Year Plan envisages considerable expenditure for combatting the tsetse fly.

This matter has been dealt with at length because it is felt that the results of the efforts exerted in various parts of Africa are still very uncertain and that a research operation of this kind is far too costly for a country like Somalia to launch an ambitious programme on its own. We also feel that while awaiting results of the programmes being run by FAO, USAID and DGRST - organizations with very considerable financial and technical means - it is better to place one's faith in increasing the number of watering points located far from tsetse fly areas, and, if need be, to treat animals which must still use watering points or rangelands where the tsetse fly is present.

This certainly does not mean that Somalia should not participate in a common research project. Yet such participation can amount to no more than operations at selected points, covering a limited range, such as protection of the Park implemented by the European Development Fund at Jilib, where, according to the 1974-1978 Five Year Plan (34), it is planned to set up a breeding centre. Action might also be concentrated on "islands" which are particularly frequented by livestock.

2.2.6 Pyroplasmosis Ticks and other Mites (scabies)

When tackling these problems, it is generally proposed that "dipping tanks" are the answer. What are the results? Thousands of "dipping tanks" have been built in Africa and there are still as many ticks as ever. There may even be more, especially since the younger generation of herders and their wives are not so keen as their forebears used to be on destroying ticks by hand. The reason for the failure of the projects is easy to see. Though the dipping tank is a very valuable asset on a large ranch where the staff see that it is properly used, it is quite another matter when one is built in open country and left for the herders to use at will.

If the dip is to be effective and not dangerous, then the concentration of reagents has to be correct; therefore they have to be controlled, but it often occurs that the guards on these tanks are incapable of making these controls. It may happen that the rains reduce the dip concentration greatly, rendering it no longer effective. On the other hand, wind and heat may cause the water to evaporate and the concentration of chemicals rises making the dip dangerous in some cases. Thus it is necessary to add chemicals regularly and to make frequent checks of concentration. The guards on the tanks cannot do this and so, to protect themselves from the results of their incapacity, many of them ensure that the concentration of the dip is very weak right from the very beginning. Thus the dip is quite useless. A final point is that dipping tanks have to be used frequently if they are to be effective.

A sound campaign against ticks and mites would require the construction of many dips so as to avoid the need for long treks. The goodwill of the herders would also be needed to ensure that they bring in herds to the dips regularly and, in addition, more competent guards would be needed. It is inconceivable that all this can be achieved and that appreciable results can be obtained at an acceptable cost.

Thus simpler methods must be used: methods which any herder can apply. It is considered that equipment, products and instructions for use should be distributed, against payment, to each herder. What kind of equipment would be involved? For herds of any size, a hand pump with or without a pressurizing device, and some kind of a measure (a jam tin cut at the right height) to correspond to the volume of the equipment. In the case of herds of 10 head or less, all that would be needed would be a bucket and a sponge so that the parts preferred by ticks, (the udders, beneath the tail, around the eyes, the ears and the horns) or in the case of scabies the regions affected, can be sponged down regularly. The easiest system for sheep and goats is to use a 200 litre petrol drum in which the solution is prepared and into which the animals are dipped one by one. This would avoid the need to construct dips and hence also the problem of water supply and disposal, and supervision of the installations.

This approach would cost the herders very little, but it would ensure that those who really care about the state of their stock will be able to carry out the necessary treatment without having to undertake a long trek. All that has to be done is to educate the herders to do these jobs, and to organize supplies of insecticides and to distribute suitable measuring devices.

Should it be that, as in the case of the "dipping tanks", many herders are not interested in this problem and the results are not good, at least this approach will have the advantage of having cost the state nothing.

2.3 IMPROVEMENT OF THE ENVIRONMENT

The 1968 FAO study appears to indicate that, despite a relatively low overall potential, the rangelands of the project area could, in theory, carry more animals. They are underused at the present time because of the lack of permanent waterpoints in certain regions in the north and the centre and because of tsetse fly infestation along the banks of the Juba as well as in the south and southwestern regions also. All this means that enormous areas of rangelands cannot be used during certain times of the year, resulting in the great transhumant movements that occur. Notwithstanding everything, the stockraisers, especially the nomads generally utilize the existing natural sources in the best possible manner. Yet there is slow deterioration of the resources along the stock trails and excessive exploitation of the healthy regions or those provided with watering points. Here the soils become eroded and the less appetising types of grazing begin to take over. In other regions the rangelands are underused and are gradually invaded by undergrowth. A final point which should not be forgotten is the often deleterious action of the prairie fires, some of which are started accidentally and some purposely.

To improve this state of affairs it is necessary to open up new waterpoints and to transform into healthy rangelands the immense areas now invaded by scrub and trees and consequently by tsetse fly. There are few ways of doing this and these are very costly. For the moment the classical recommendations for improving rangelands are probably destined to remain inoperative:

- Rotation. For better or worse, this is achieved by transhumance under present conditions.

- Resowing the eroded areas and improvement thereof by introducing new species. These are quite impracticable operations, at least in the northern regions because nothing can be done about the composition of the soil and the landform.

- Fire prevention. The efforts to combat the firing of the rangelands must be based on a perfect knowledge of the various areas: the herders need to be educated and strict surveillance has to be exercised. The search for water necessitates a thorough hydrological study. The many wells with brackish water and the numerous unserviceable "uar" are all proof that improvisation and good will are not enough for an operation of this description to be effective and profitable.

Clearing scrub to reclaim areas of good rangeland (the Lower Juba for example) and at the same time eliminating tsetse from these regions is a long, difficult and costly operation. To be effective, powerful equipment must be used and used carefully if it is not to be dangerous. For instance, though a bulldozer can destroy bush and trees by ripping them out by their roots, it can also destroy the fertile topsoil. A better method may be to use the cutting roller (which cuts and breaks up the branches and roots). This is more rapid than the bulldozer and is not as dangerous to the fertile topsoil. However, destruction of the roots is not as complete and it must be expected that the operation will have to be repeated after a few years.

Though this approach may be feasible on small areas, as in the case of opening a ranch for example, it certainly cannot be advised for very estensive regions. For these there appear to be two possibilities, both of which call for constant control.

- Fire. This must be used right at the very end of the dry season, when leaves and branches are very dry and burn thoroughly (so that the bush has great difficulty in growing again), and when the seeds of herbaceous plants have not as yet received the beneficial water which allows them to germinate (so they have nothing to fear from fire). However this method has the drawback of destroying most of the trees as well.

- Charcoal burners. Under the direction and supervision of forest service officers, charcoal burner cooperatives could be given authority to exploit certain areas which are particularly badly invaded by bush, provided that they also destroy the roots (ripping them up from depth) while leaving untouched the larger bushes and certain useful species.

Thus, in the first instance, efforts should be made to try to arrest the rapid process of deterioration which is occurring and to conserve the present rangeland potential until such time as there is an infrastructure which will permit real lasting improvement to be made. To do this, it will be necessary to initiate a policy for the proper utilization of rangelands and waterpoints.

The unrestricted use of rangeland and waterpoints is in itself damaging. All the herders tend to concentrate in areas where the grazing is best. Consequently these ranges are excessively used and their capacity to carry large numbers of stock decreases rapidly. The same may be said about waterpoints, since the herders' choice always falls on those which are best supplied with water, the result being that the land thereabouts is quickly reduced to desert.

Rules must therefore be drawn up governing land and water-use and bodies must be created whose task will be to ensure that the rangelands and waterpoints are shared equably amongst the users. This body will have to be vested with the authority needed to ensure that its decisions are respected. Control commissions might well be set up which would act under the presidency of the regional political commissars. These commissions would be composed of representatives elected by the various groups of cattle owners, plus the director of the regional Veterinary Centre and officers of the Range Management Service, who would act as technical advisors.

2.3.1 The Physical Environment

Some notes on the use of rangelands and waterpoints are given below.

The problem of range-use is not the same for all types of herds:

- Stock owned by townsfolk such as officials, traders and settled farmers. This presents no real problem. All that needs to be done is to avoid the proliferation of unproductive animals and to set up a system for the rotation of grazing around the villages. Some provision should also be made for the dry season when the animals could be fed on maize and sorghum stalks, groundnut leaves and stems, sesame leaves and stems, beans, etc. The farmers should be encouraged to surround their fields with rows of forage plants such as Pennisetum purpureum, Panicum, Setaria, Digitaria and Aristida, depending on possibilities. In the course of time, sufficient reserves would be built up in this manner to cover the dry season needs.

- Stock owned by farmers and nomadic herders. These herds are forced to move relatively long distances and this situation will have to continue for a considerable time to come. The suggested control commission would be concerned mainly with these herds.

There are no particular problems for watering settled stock, as villages are sited along rivers or, at least, possess one water point.

The watering of nomadic herds is a more complicated matter. During the rainy season water is available virtually everywhere. Some collects in the natural depressions ("balleh") and some in hand-dug wells and in small reservoirs created by low dams and embankments.

During the dry season instead, it is necessary to take the herds to rivers and other natural waterpoints ("hillo", "descek" and "lak") or man-made facilities (a few hand dug wells which tap the aquifer beneath the wadi beds or at other points where the groundwaters occur relatively near the surface).

The number of permanent waterpoints is quite insufficient. This partly explains the reason for transhumance over long distances. It also explains to some extent the irrational use of rangelands which means that some areas near the permanent waterpoints are excessively exploited while enormous stretches of rangeland are under-exploited.

The only solution to enable more and better livestock to be raised in Somalia, by proper utilization of the available rangelands, is to open up numerous waterpoints providing a good supply of water. However, this is far too great a task to be undertaken by the herder and considerable funds will have to be allocated to enable them to be built.

Though this may be a costly solution, it will prove profitable if certain conditions are respected regarding construction and use of the ensuing watering points.

- Conditions to be respected for the construction of watering points

Attention has already been drawn to the fact that improvisation can be dangerous. Proof of this is given by the great number of very costly structures that have been built and never utilized or which have had to be abandoned for a wide variety of reasons. Consequently, preliminary investigations are essential before embarking on any such programme.

- Surface waters ("uar"). The idea here is to improve a depression to collect all runoff either by building a barrier to dam a "thalweg" or the narrow parts of seasonal watercourses.

The following investigations must be performed in both cases:

- Study to ascertain whether the soil is sufficiently impermeable. Assessment of the rangeland potential so as to estimate the number of head to be watered, thus indicating the volume of water to be stored, taking due account of evaporation and siltation.

- Study of how the storage facility will be fed (a topographic survey must be made of the depression, the thickness of the earth dam must be calculated and, if necessary, provision made for a spillway) and of the amount of sediment which will be brought in and deposited; this will indicate how frequently the basin must be cleared out to ensure that there is always a sufficient volume of water in storage.

A study of this type is essential to ensure the long life and the profitability of the structure.

- Shallow and deep aquifers. These are tapped by means of wells or boreholes. Except in very particular cases, the use of boreholes for tapping the shallow aquifer - i.e. down to 40 - 50 m - is not recommended. Boreholes require some mechanical system to raise the water: hand-powered pumps, wind-powered pumps (which will not last long) or motor-powered pumps. Hence the slightest breakdown means that water can no longer be extracted. Consequently, it is felt that boreholes can only be used in largish centres where mechanics are available to make repairs; they should be absolutely avoided in the middle of the open country, where there is no-one to do repairs, when these are needed. Some people may consider that mobile maintenance units could be set up, but unless there is also an efficient radio network serving all points, this system is unlikely to give good results.

In short, boreholes are uselessly costly where relatively low discharges of water are to be provided from shallow depth. It is recommended, instead, that wells be constructed from which water can be drawn by hand or at best by animal power in cases where discharges do not exceed 5 m^3/h and the depth of the water is less than 50 m. In a well 1.20 - 1.40 m in diameter, it is possible to install a headframe with 4-6 pulleys which would enable 4-6 men to raise 8-10 litre containers of water from a maximum depth of 20 m. For greater depths, a camel or an ox could lift 30-40 litre containers; the animals are soon trained to do the job.

In the case of deep aquifers which are very productive, mechanical lifting systems may become profitable under certain conditions. In order to exploit such aquifers, very costly equipment has to be installed and this is certainly not a viable proposition unless very extensive areas have to be provided with water. There is no doubt that this is the system which requires the largest investments, but it is also the best when it is necessary to serve vast areas of waterless rangeland.

A detailed hydrological study is necessary to find sufficiently productive deep aquifers. Such a study is a long and costly affair, but it can still be very profitable, provided that a sufficiently productive permanent aquifer containing usable groundwaters is discovered. In this case, work can be undertaken on a vast scale with the certainty that it will be profitable in the long term. Such a study will ensure that wells are not sunk to tap unsuitable waters or aquifers which have too low a yield. Thus the authorities avoid wasting money on what is in any case an expensive procedure, namely well-drilling. When deep aquifers are tapped, it may sometimes occur that artesian waters are found. In this case the level rises high up the well casing, thus facilitating extraction:

- If the water is completely artesian there are no problems.

- If the water rises within 20 or so metres from the surface, say a maximum of 30 metres, the borehole is the most economical solution. One or two wells are dug 2 or 3 metres below the dynamic water level and are completely lined, a tube is then run from the borehole to feed the hand-dug wells, which are equipped with a head frame and pulleys to enable the water to be drawn by hand or by animal power.

- If the dynamic water level is too far below the surface, then a submersible pump becomes the only solution, but this means that a team of skilled fitters must be available for maintenance. Hence this method is advisable only if it permits rational use of tens of thousand of km^2 of range by hundreds of thousands of cattle, which would not be able to graze there without such a scheme.

This would certainly be the method to choose in the case of the Faafadun Plain and the Eluviated Plain. According to engineers who have sunk exploratory holes for minerals in the Baidhaba region, it is probable that there is a deep aquifer beneath the Eluviated Plain. This idea appears to be borne out by boreholes drilled at Hadwein and Lahele in the south of this area where saline water occurs at 143 m and fresh water at 192.5 m (36). It would be interesting to profit from the mineral exploration work which has been done to prepare a map of this aquifer, should it really exist.

Sight should not be lost of the fact that installations of this kind require an enormous investment which, depending upon the circumstances, can have excellent or catastrophic economic effects. Thus before making any decision on this matter a very thorough study will be absolutely essential.

In calculating profitability, account must be taken of various factors, the most important being, on the one hand, the size of the investment and the cost of running the installations, on the other, the benefits to be derived from the improvement (to be calculated without optimism).

The first step is to make a hydrological study and prepare an accurate groundwater map followed by a sufficient number of discharge tests. If this first phase ends favourably then the following will have to be done:

- Boreholes will have to be sunk carefully.
- Sufficiently large reservoirs will have to be built to ensure that herds can be watered for 2 or 3 days even in case of mechanical breakdown (to allow enough time for repairs).
- A maintenance and repair workshop will have to be installed in a central location so as to minimize the distance travelled when making periodic inspection and repair visits.

- Each pumping station, or at least 1 in 2 pumping stations will have to be equipped with a radiotelephone so that all breakdowns or incidents can immediately be reported.
- The region developed in this manner will have to be organized so as to ensure sagacious utilization of the resources.

If one compares the various possible methods, assuming that the conditions are respected, in other words: that for the wells there is no shallow aquifer with a sufficient discharge; that for the reservoirs there is no other solution for obtaining water; that for the deep boreholes there is a well-endowed deep aquifer which will ensure constant flows, it is apparent that the well solution is by far the most economical (lower investment, practically no maintenance, low operating costs). However, it is impossible to rely on this because if there existed a shallow aquifer with a sufficiently large yield it would have been discovered long ago.

From the economic point of view, "uar" represent an intermediate solution: investments are high, maintenance costs are average, there are no operating costs, at least if pumps are not required. However one drawback is evaporation, while another one may be contamination by animal excreta, in which case by the end of the dry season, the watering points may become more a point of contamination than a source of water.

Though the deep borehole is the most costly solution it is also the safest, when it is possible to utilize large areas of rangeland with a good nutritional potential.

The use of waterpoints must be a profitable proposition

Somalia will have nomads for a long time to come because, until the country has a closely-knit network of permanent waterpoints, general settlement will be impossible. Meanwhile, to economize on natural resources, a very clear distinction must be drawn between dry season and rainy season rangelands.

During the rainy season, grass and water can be found practically everywhere. Vast areas which are quite unusable during the dry season become available as soon as the rains create ponds in natural depressions. The herds must then leave the rangelands near the permanent waterpoints, which being protected in this manner, will be able to get back into good condition before the following dry season.

One point has been noted throughout Africa, namely, when there is a permanent waterpoint, especially when it is a mechanised installation, herders have a tendency to choose the easy solution and remain near that point.

The result is that new grass which springs up with the rains is immediately trodden underfoot by the animals as it tries to grow and no grazing is left for the dry season over a vast area around the waterpoint.

The animals must then seek nutriment over an increasingly large radius, returning to drink only every 2 or 3 days. Thus all the benefits which the new waterpoint could have brought are lost, in other words instead of the animals being able to find food and drink each day without having to move an excessive distance, as the dry season progresses, so they must move further and further away to find grazing.

This is a matter which the control commission proposed in para 2.3 will have to attend to. The policy of leaving the waterpoints when the rains come should be put into practice; indeed, it should be imposed if necessary.

A proper water resources policy should permit the settlement of practically the whole of the country's population over the course of time. The ideal would be to have permanent waterpoints with a dry season discharge of 20 - 25 m^2 every 10 or 20 km. Each waterpoint would thus become the hub of a "pastoral unit" which would be used by a given group of nomads who would eventually come to settle there. The "pastoral unit" would have the following kind of structure:

- Permanent waterpoint, around which a permanent village would spring up, complete with fields growing subsistence crops to the extent possible.
- A dry season rangeland district, calculated on the basis of the yield of the waterpoint and the potential stocking rate of the rangelands; the district should not exceed 8 - 10 km in radius.
- Rainy season waterpoints, "balleh" or "uar". As many of these water points as possible should be built by unsophisticated methods along the outer edge of the dry season rangeland district. The livestock will stay near these waterpoints during the rainy season, (though it might well be that even the long-term presence of herds around one or two of these waterpoints during the rainy season will have adverse consequences).

There would be a vaccinator or range management agent at each of these pastoral units to look after the animals and to supply the herders with medicines to cure intestinal worms and keep down ticks. The person concerned would see to the proper management of the rangelands and would ensure that the area around the permanent waterpoint was evacuated at the end of the dry season, leaving just a few milking cows in the village.

It could well be that grazing might have to be prohibited on a certain portion of the rangelands each year in order to ensure a reserve of food should the rains fail or be only partially effective, as can so very easily happen here. By adopting this approach it would be possible to keep the cattle in good condition throughout the year, while making rational use of the ranges and water. Damage would be prevented to the rangelands and the herds themselves would gradually be built up.

Failure to observe this kind of protective action at Ferlo in Senegal and in the Borun region of Nigeria-where a major network of drilled wells was installed - led to desertification of the land around the boreholes, for a radius of 5 - 10 km and more in some cases within the space of a few years. So here, instead of bringing benefits by boreholes, it happens that animals are not able to drink every day, but only every 2 or 3 days during the dry season, and that, owing to the long treks involved, they grow even thinner than before the development projects were implemented.

It is apparent that if even the minimum amount of authority had been exerted, it would have been very easy to avoid such a disaster. Another point is that if the pumps had been stopped and the distribution of water had been discontinued at the end of the dry season it would have been possible to have achieved substantial savings in operating costs, while at the same time ensuring proper maintenance of the pumps and motors.

2.3.2 The Human Environment

The veterinary service must be dynamic. It must always be on the move, always making contacts with the herders. Only in this way will the service be able to gain their confidence, understand their problems and discover diseases and epidemics in good time. By maintaining close contacts, it will be possible to make the herders very quickly understand the importance of vaccination and of various disease-prevention treatments and get them to adopt more modern productive methods of stockraising...

This is the reason why it is recommended that the veterinary service staff must be in the field, rather than concentrating them in the regional and district capitals. As far as possible the staff should stay on the same site for a good many years, so as to get to know the area, the people and their specific problems thoroughly. Excessively frequent changes of personnel will be counterproductive.

The veterinary assistants and vaccinators should be taught some simple, practical notions of agrostology if this has not already been done, so that they will be in a position to appreciate the nutritive value of rangeland and the ways of preserving its potential. They will thus be able to provide efficient assistance to the Range Management officers whose numbers appear to be far too few.

It is not possible to ascertain exactly how these officers are trained. Advanced training is certainly not necessary for field workers. Young people who have been to small agricultural schools would appear to be ideal, especially if they are taught something about botany, livestock and agrostology. They would automatically do their own apprenticeship and, if they are dynamic and good observers, they should rapidly acquire experience which would make them particularly useful to the herders, on such matters as the protection, conservation and utilization of rangeland.

This commission should be composed of representatives from various groups of herders, and also of herders themselves, who would have a perfect knowledge of the herds, the rangelands and of the waterpoints. Thus the commission should have no particular difficulty in preparing a plan for the equable distribution of rangelands. Members of the commission, presided over by the regional political commissar, should also have sufficient authority to ensure that their decisions are obeyed, enforced if necessary. At the start of transhumance season, each herder would receive a transhumance map attesting to his identity, the number of head of stock and the composition of the herd, the area in which he is authorised to stay and the name of the waterpoint that he must use. In this manner it will be possible to exercise control over transhumance and, if necessary, to take action against those who do not observe the rules.

2.4 LIVESTOCK IMPROVEMENTS

Improvements are possible in livestock quality and numbers.

2.4.1 Livestock Quality

To improve the quality of the stock, the first thing to be done is to improve the entire environment: both physical (health, feeding and watering conditions) and human (education of the herders). These improvements are absolutely essential if the livestock development scheme is to be a success. But there must be no rushing of this stage. Various approaches are possible:

- Selection. This is the first solution to be put into practice. Indeed, it is the only method that can be used while most of the stock are still obliged to trek long distances during transhumance. In the long term, selection will enable local breeds to be upgraded to heavier, more shapely animals without losing their hardiness and specific adaptation to the environment, which are such essential features.

  So it is proposed that small breeding stations be set up near the 11 irrigation districts envisaged in the project. Here, selected Boran cows could be kept and their first male progeny distributed to the herders.

- Crosses. This stage is somewhat further ahead and cannot be tackled until the environmental conditions are well on the way to improvement. It is recommended that crosses only be used in the case of settled herds, i.e. when the herders are in a position to supplement the animals' diet with by-products obtained from around the edge of the irrigation districts. It is quite certain that imported breeding cattle and even their progeny will be more disease prone than local breeds and they will certainly not be able to stand up to completely extensive type of stockraising, even if the animals concerned are already partly adapted, such as the Kenyan "Sahiwal" for example.

- Pure-bred imported animals. Here the environment will condition the success of the operation to an even greater extent than in the case of crosses. Such animals can be kept only in very special conditions, e.g. for milk production. Certainly with the present depressed state of the meat market, the breeding of pure-bred beef cattle is out of the question. In any case, this approach is not recommended for the project area in the immediate future.

A few words must be said on the subject of artificial insemination where cross-breeds and the raising of pure-bred imported cattle are concerned. It would seem that there is a general tendency in Africa to consider AI to be more efficient and easier to apply than it really is. Certainly, the method has been brought to a high point of perfection and can give excellent results. However, it is also a very sophisticated method and involves the use of very delicate, costly material. To be effective, it must be used only by highly competent, skilled personnel and particular precautions must be taken which are quite difficult to attain in Africa.

In countries where AI is commonly applied, and consequently where conditions are ideal for obtaining good results, it has been noted that, where the cows are kept constantly under observation and receive regular injections of hormones to facilitate fertilization, the animals must generally be inseminated twice, and even three times in some cases, in order to obtain results in the 75 - 80% range.

Thus, while the method can be applied for the intensive breeding of dairy cattle on a large scale when the animals are under the constant supervision of veterinary surgeons and expert inseminators, we are of the opinion that it would be better to give much consideration to the whole problem rather than to set up a costly AI service in haste, which may not provide the desired results.

2.4.2 Livestock Numbers

The number of head of stock in a herd depends essentially on the environment and its potential. It has already been seen that there are some obstacles such as the shortage of water and especially the presence of tsetse fly which hinder the complete utilisation of this potential at the present time. Consequently, the number of head of stock can only increase as these various obstacles are gradually eliminated. However, the implementation of the irrigation project will enable the productivity of herds to be improved, perhaps without any increase in the number of animals.

At the present time, because of the prolonged drought over recent years, it is very possible that the herds are still in the restoration stage, namely the number of breeding cows is being built-up again. All the young cows are being kept, as are the old cows which are still capable of calving. Consequently, the productivity of the cows does not exceed 8 - 9%, which means an annual production of around 100,000 head: bulls, young animals and animals at the end of their career. According to estimates made in the project area, on 1,200,000 head, this situation will continue for another 2 or 3 years, after which productivity will return to its normal rate of 11 - 12% or 130,000-140,000 head per year, a good part of which will be young males less than 3 years old.

Until the new structures mentioned in the previous paragraph are created, the situation in the herds will remain unchanged (in other words, the fertility index will remain around 60% and the mortality rate around 35-40% for calves less than 1 year old, 15-20% for animals between 1 and 2 years old, 5% between 2 and 3 years and 1% a year for animals over 3 years old). So it will be necessary to take the following steps:

- Establish new well-equipped veterinary posts or stations and improve the existing facilities.
- Prepare new permanent waterpoints and repair wells and "uar" which are now out of operation.
- Set up specific structures for inculcating and if necessary imposing a proper waterpoint and rangeland use policy.

As the project work gradually gets done and there is an improvement of livestock structures and a progressive increase in irrigated agriculture, the state of the herds will improve and it is reasonable to expect that the following objectives will be attained:

- Towards 1980: fertility index of 65%; death rate: 30% for calves less than 1 year old, 12% for 1 to 2 year old animals, 3% for 2 to 3 year olds and then 1% per annum.
- Towards 1985: fertility index: 70%; death rates respectively: 25%, 10%, 2% and 1% annually.
- Towards 1990: fertility index: 75%, death rates respectively: 25%, 8%, and then 1% annually for calves over 2 years of age.

It is just a question of increasing the productivity of the country's livestock population which, in 20 years, should rise from 10 - 12% to 15 - 16% or even 20% depending upon the hypothesis adopted.

In the first hypothesis (Table 1) it has been considered that sales start from 3 years, an average which takes account of the fact that while some immature males are eliminated, other animals which should have been sold long ago will still remain in the herd.

In the second hypothesis (Table 2) progressive changes in the methods of stockraising are envisaged so that eventually there will be two or even three classes of stockraisers:

1. Stockraisers specializing in the breeding of weaned calves. These will be mainly herders who have only breeding-animals in their herds, mainly young ones, calves less than 1 year old, young store or replacement cattle and a number of bulls in proportion to the number of cows; in other words, these stockraisers would have a greater number of breeding cattle, produce more milk and face less risk of catastrophe in the event of prolonged drought.

2. Stockraisers specializing in fattening calves. The animals would be brought up from a weight of 90 - 100 kg to 300 - 320 kg in a year and a half approximately (a weight increase of 400 gr per day).

3. Stockraisers specialising in fattening cows for slaughter. This would be done in a period of 2 or 3 months, the animals concerned will consist of fattened calves from the fatstockraisers and of beasts at the end of their career and ready for slaughter.

It will only be possible to increase the size of the herds progressively, as new permanent waterpoints are set up (thus permitting the settlement of nomads in "pastoral units", as already mentioned) so that all the natural grazing land available can be properly utilized. Then, according to FAO estimates (13) the number of animals in Somalia could more or less be doubled.

Table 1 - Increase in Livestock population (first hypotesis) ¤

Year and reference	Bulls	Breeding cows	young males				young females				Total size of Somali herd	Outgoing					
			1 year old (1)	1-2 years (1)	2-3 years (1)	3-4 years (1)	1 year old	1-2 years	2-3 years	3-4 years		males		females		Total	%
												young	culled	young	culled		
1975	(Estimate - Breeding herds still in course of reconstruction)											60,000	5,000	-	35,000	100,000	from 8 to 9
1980 Fertility index=60% Death rate=35%-20%-5% and then 1% per annum	24,050	481,000	119,050	84,415	73,160	70,925	119,050	84,415	73,160	70,925	1,200,150	65,214	4,950	-	70,214	140,374	11.69
1985 F.I. = 65% D.R.=30%-12%-3% -1%	21,350	427,000	117,960	91,315	84,200	82,505	117,960	91,315	84,200	82,505	1,200,310	76,185	4,950	-	81,685	162,820	13.85
1990 F.I. = 70% D.R.=25%-10%-2% -1%	19,420	388,400	118,940	96,850	90,380	89,470	118,940	96,850	90,830	89,470	1,200,000	84,497	3,960	4,000	84,497	179,954	14.74
1995 F.I. = 75% D.R.=25-8% and then 1% per annum	18,340	366,870	120,375	99,055	94,460	93,505	120,375	99,055	94,460	93,505	1,200,000	88,568	3,960	10,000	82,568	185,096	15.42

(1) Average annual number - ¤ = Sale of 3 year old males for fattening

Table 2 - Increase in Livestock population (second hypothesis). *

Year and reference	Bulls	Breeding cows	young males				young females				Total size of Somali herd	Outgoing					
			1 year (1)	1-2 years (1)	2-3 years (1)	3-4 years (1)	1 year	1-2 years	2-3 years (1)	3-4 (1)		Males		Females		Total	%
												young	culled	young	culled		
1979	22,050	481,000	119,050	84,415	73,160	70,925	119,050	84,415	73,160	70,925	1,200,000	65,214	4.950	-	70,214	140,374	11.69
1980 F.I. =60% MR.=35-20-5-1%	24,050	481,000	119,050	84,415	73,160	5.000	119.050	84,415	73,160	5,000	1.134,075	131.135	4.950	-	70.214	206,299	17.19
1981	24,050	481,000	119.050	84.415	73.160	5,000	119.050	84.415	73.160	5,000	1.134.075	65.925	4.950	-	70.214	141,089	12.44
1982 to 1984	24,050	481,000	119.050	84.415	73,160	5,000	119.050	84,415	73.160	5,000	1.134.075	65.925	4.950	-	70.214	141.089	12.44
1985 F.I. =65% MR.=30-12-3-1%	22,500	450,000	124.310	84.415	4.500	5.000	124.310	84.415	4,500	5.000	1.043,050	138.374	6.485	-	71.649	216.508	20.75
1986	22,500	450.000	124.310	96.230	4.500	4.455	124.310	96,230	4,500	4.455	1,066,620	68.660	4.455	-	70.214	143.329	13.43
1987	22,500	450,000	124.310	96.230	4.500	4,455	124.310	96.230	4,500	4.455	1,082,200	68.660	4.410	-	70,214	143,294	13.24
1988	22,500	450,000	124,310	96.230	4.500	4.455	124,310	96,230	4,500	4,455	1,098,225	84,240	4,410	-	70,214	158.864	14.46
1989	22,500	450,000	124,310	96,230	4.500	4.455	124.310	96,230	4,500	4.455	1,098,225	84,240	4.410	-	85,635	174.285	15.85
1990 F.I. =70% MR.=25-10-2-1%	22.500	450.000	137,810	4,500	4,500	4.455	137.810	96.230	4.500	4.455	1.033,495	191.960	4.410	-	85,635	282,005	27.28
1991	22.500	450.000	137,810	4.500	4.455	4.455	137.810	112.220	4,455	4.455	1.049,440	107.720	4.410	-	85.635	197.765	18.84
1992	22,500	450,000	137,810	4.500	4.455	4,410	137.810	112,220	4,455	4,410	1.065,895	107.720	4,410	-	85.635	197.765	18.55
1993	22,500	450,000	137,810	4.500	4.455	4.410	137.810	112.220	4,455	4,410	1.082,605	107.720	4.410	-	85.635	197.765	18.67
1994	22,500	450,000	137,810	4.500	4,455	4.410	137.810	112.220	4,455	4,410	1,082,605	107,720	4,410	12,532	90,000	214.662	19.82
1995 F.I.= 75% MR.=25-8-1%	22,500	450,000	147.655	4.500	4.455	4.410	147.655	112.220	4,455	4,410	1,102,295	117,000	4,410	12,532	90,000	223.942	20.31
1996	22,500	450,000	147.655	4.500	4,455	4,410	147,655	121.500	4,455	4,410	1,111,575	117.000	4,410	12,532	90,000	223,942	20.14
1997	22,500	450,000	147.655	4.500	4.455	4,410	147.655	121.500	4,455	4,410	1.122.185	117,000	4,410	12,532	90.000	223.942	19.95
1998	22,500	450,000	147,655	4.500	4.455	4.410	147.655	121.500	4,455	4,410	1.133,205	117,000	4,410	12,532	90,000	223,942	19.76
1999	22,500	450,000	147,655	4,500	4.455	4.410	147,655	121.500	4,455	4,410	1.133,205	117,000	4.410	23,535	90,000	234,945	20.73
2000	22.500	450.000	147.655	4.500	4.455	4.410	147,655	121.500	4.455	4,410	1.133,205	117,000	4,410	23,535	90,000	234,945	20.73

* - Sale of 3-year old males in 1980, 2-year olds in 1985 and 1-year old in 1990

(1) - Average annual number

N.B. If it is not possible to ensure rapid improvement of rangeland and use thereof, the livestock population will have to remain around 1,000,000, namely 400,000 breeding cows instead of 450,000 (1,000,000 head 8 200,000 young intensively raised animals = 1,200,000 head the present total of the Project area) In this case annual production will be 200,000 head, made up of 120,000 young animals and 80,000 animals at the end of their career.

CHAPTER 3.

DESCRIPTION OF PROJECTS

3.1 PROJECTS UNDERWAY

The development of the Juba Valley should permit a big improvement in stockraising in the coming years, both as regards the number of animals raised and the quality thereof. There are three ongoing projects in this region with similar objectives: the Trans Juba Project, the Five Year Plan 1974-1978 and a German project for the Improvement of Veterinary Services in the Lower Juba. All three projects are connected in one way or another to improvement of the operation of the slaughter houses and of the meat canning factory which the Soviet government is helping install at Kismayo.

Before going on to propose out programme of projects, let us rapidly analyse the livestock development projects underway, so that our proposals can be properly viewed in the light of what is being done.

a. Trans Juba Project

The Trans Juba Project concerns only the Lower Juba region and its main object is to improve the supply of meat for the Kismayo canning plant. To this end, 1,900 km^2 of land have been made exclusively available to the Livestock Development Agency. The project envisages:

- The construction of five permanent livestock markets, three large ones at Tabda, Maskati and Jilib and two smaller ones in the northern area at Luuq and Busar.

- The equipping of 1,000 km of stockroutes from the various markets to the holding grounds at Afmadow and Kismayo with resting points every 30 km complete with fenced enclosures and water for the livestock and shelter for the herders.

- The construction of a new 20,000 ha holding ground between Afmadow and Dif to compensate for the smallness of the existing holding ground at Kismayo which, in any case, must be improved by clearing 12,000 ha of bush and creating two new waterpoints.

- The creation of two 80,000 ha stockraising centres (1 head/8ha = 10,000 head/centre). The first of these will be at the Afmadow holding ground, the second at the feedlot to be built. The purpose of these centres or ranches is to avoid the considerable waste involved in slaughtering large quantities of immature animals which are offered on the market. On these ranches, the immature animals will be brought up from 200 kg to 300 kg live weight in a year before being sent to the feedlot for finishing; it is expected that annual production will be 20,000 head.

- The establishment of new veterinary centres for disease control (See Fig. 4.II).

- Possibly the creation of a Disease Free Zone (DFZ) around Kismayo.

It is apparent, even at this point, that the funds available for this Project are insufficient, because of the increase in the price of some materials. Thus it will not be possible to open the Busar and Luuq markets and it will be necessary to make do with only 800 km of stocktrails instead of the 1,000 km envisaged. It would also seem that, because of unforeseen difficulties concerning irrigation, the 1,200 ha feedlot will be abandoned. With the present state of the world meat market there is really no incentive to go ahead with a scheme such as this, though it may be taken up again when the international meat situation improves again.

b. The Five Year Plan, 1974 - 1978

The Plan provides for many points which will facilitate stockraising operations in the framework of the Juba Valley irrigation project and for the intensification of action in the health sector, especially in the Lower and Upper Juba regions, Hiran and Benadir. The particular aim is to create a Disease Free Zone around Kismayo, the port from which meat is exported. The means envisaged are:

- Establishment of new district veterinary centres.
- Construction of six regional diagnostic laboratories.
- Control, treatment and quarantine posts for herds before entering the Disease Free Zone.
- Mobile teams to provide continuous control throughout the DFZ. These teams will work in close cooperation with the nearby veterinary centres.
- Pest-control centres with dips and sprays at each waterpoint or market, plus mobile teams operating from each regional centre.
- Four quarantine stations at the frontier of the DFZ.
- Control of rinderpest.
- Control of tsetse fly.
- Improvement of the central veterinary centre in Mogadishu and of the veterinary assistants' school.
- Project for a pharmaceutical industry.
- Various centres for the raising of cattle, sheep and poultry.
- Artifical insemination centres.
- Multipurpose cattle ranch at Jilib: this project has the following aims:

. improvement of stock by experimentation and selection of local breeds;
. production of milk and beef from local breeds;
. training of the herders in production of "ghee" (a semifluid kind of butter), and in better stockraising techniques.

The Jilib ranch should be built within the Lower Juba holding ground, set up within the framework of EDF project 215.016.24 for improving animal health and the quality of the stock.

c. Veterinary Service (German Project)

We have been assured that the German experts who are now completing the post-JP 15 campaign financed by their government will be moving into the Trans Juba Project area to develop veterinary services there, since this area is to be made a model of what future veterinary services throughout the country should be.

This project, not as yet approved, provides for the setting up of a regional veterinary diagnostic centre at Kismayo by the German Technical Aid programme. The laboratory will make diagnoses and will help strengthen veterinary services in the Lower Juba in close collaboration with the activities envisaged by the Trans Juba Livestock Project (40). The laboratory will be staffed by three veterinary surgeons and two expatriate technicians.

Examination of the various projects underway shows that, as regards the extreme south of the country, everything has been foreseen that is needed for the rapid improvement of stockraising conditions. However certain points may be made:

- Concerning the Five Year Plan. This appears to be very ambitious. Indeed it covers all kinds of schemes, some of which go far beyond the country's possibilities as regards materials, funds and qualified personnel. It even goes beyond the country's actual needs at the moment. There is no doubt that all the things mentioned in the Five Year Plan need doing, but in our opinion some of them can wait quite a long time. It is felt that the Plan does not take sufficient account of present difficulties, especially natural limitations such as climate, reduced rangeland potential, drastic insufficiency of water points, and the great transhumant movements, which will certainly be necessary for many years to come.

  With reference to parasite diseases and the vectors involved, as well as to artificial insemination, the reader is referred to the points made in Paras. 2.2 and 2.4.

  The dangers of trying to push ahead too quickly with overly ambitious projects cannot be too strongly emphasized. Many projects will be a sheer waste of money unless due account is taken of the various difficulties involved, some of which are virtually insurmountable.

- Regarding the Trans Juba project. It is planned to open 30 new waterpoints with big discharges and also large capacity "uar" (5,000 head a day). All these waterpoints are along the stockroutes and thus will have no effect on the possibility of using the rangelands in the Faafadun Plain, for example, during the dry season. Serious consideration will first have to be given to applying the policy outlined in para 2.3.2 because the herders will certainly tend to use them during the rainy season as well, and this will result in the drawbacks which have already been explained.

  It is absolutely necessary to open new markets, but it seems a useless waste of money to construct markets with holding grounds for sellers, holding grounds for buyers, and a space for the auction. Three well-protected enclosures for cattle, sheep and camels, sufficiently large to suit the importance of the market would seem to fill the bill quite adequately and would result in substantial savings.

3.2 THE ALTERNATIVES OF FORAGE AND FEEDSTUFFS PRODUCTION

The agricultural development project for the Juba Valley involves the reclamation of 221,500 ha (net) in eleven irrigation districts on both sides of the river over a period of at least 20 years (see Table 3).

When the reclaimed areas are fully operational, the envisaged crop production will generate an enormous quantity of products and byproducts which can be used for livestock development.

Here only the crops capable of providing byproducts for animal feedstuffs are considered. The fallow lands can be used either as grazing or for the collection of forage, provided that herbicides are not used on the crops.

Table 3 - Irrigation Districts : Net irrigated areas for crop growing

District	Net irrigated area				
	Family Farms		Large Schemes		Total Ha
	No.	Ha	No.	Ha	
Luuq - Dolow	1,925	5,000	3	11,400	16,400
Baardheere - Saakow	1,350	3,200	15	44,150	47,350
Downstream of Saakow	1,145	3,100	8	23,500	26,600
Downstream of Dujuuma	4,430	11,100		-	11,100
Dufalach - Afmadow	-	-	3	7,800	7,800
Faanoole - Jilib	625	1,800	9	24,600	26,400
Baardheere - Ionte	-	-	12	32,200	32,200
Touta Island	-	-	5	13,300	13,300
Jamaame	-	-	8	20,050	20,050
State Farms	-	-	2	10,300	10,300
Descek Uamo	-	-	2	10,000	10,000
Total	9,475	24,200	67	197,300	221,500

Table 4 gives an approximate estimate of the amount of byproducts which will be available per ha when the programme is running normally. In calculating these quantities, it has been assumed that the processing plants will be installed in the centre of the productive area. In point of fact, it is logical to build the sugar mills in the three districts where it is planned to grow 19,000 ha of sugar cane. It is also logical to have a rice mill at Dujuuma, the main rice growing centre; and a cotton ginnery at Jilib or Jamaame, plus oil mills at Baardheere for the northern districts and at Dujuuma, Jilib and Jamaame for the southern districts. In the case of cereals, it will be as well to have a small mill for each district to cover local demand for flour. The rest of the output will be transported to Mogadishu for milling or for export. If, for social reasons, it is decided to build the oil mills at Mogadishu, it will be necessary to make provision for returning a certain quantity of cake to feed livestock in and around the irrigation district.

In order to calculate the nutritional value of the products and byproducts usable, production has been defined on a per ha basis, bearing in mind on the one hand the average envisaged harvest and on the other the percentage of byproducts obtained from the processing plants. Where straw is concerned, it is estimated that usable production will amount to 50 quintals per ha in the case of maize and sorghum, 20 q/ha for rice and wheat and 8 q/ha for pulses (stems and leaves). In the case of rice products, hulls and broken grain, a crop of 20 q/ha and a processing yield of 20% of meal and of broken grains for animal feeds have been assumed. With oil seeds, it has been taken that the average harvest is 10 q/ha and that cake production runs in the region of 35%. For cotton, the figures adopted are an average harvest of 18 q/ha, which, on processing, will give 5.4 q of fibre and 12.6 q of seed, equal to about 2.5 quintals of oil and 5 q of cake. For grasslands the production has been put at 200 q/ha of green grass on fallow lands and 300 q/ha on irrigated pastures.

Coefficients for dry matter (DM), digestible protein (DP) and feed units (FU) have been applied to the foregoing figures in order to obtain the nutritional value per ha of each item of feed or byproduct. In this way, it has been possible to calculate that when the completed project is running normally, the following quantities of feed will be available in the districts:

- 1st Hypothesis. 20,000 ha of irrigated pasture lands in District 2 (Baardheere), providing around 8,700,000 q of dry matter, 362,000 q of digestible protein and 480,000,000 feed units.

- 2nd Hypothesis. No irrigated pasture lands in District 2. In this case, feed availability on site will amount to a little less than 8,000,000 q of dry matter, 292,000 q of digestible protein and nearly 420,000,000 feed units.

Almost 40% of the FU available in the first hypothesis and 50% in the second derive from feeds (cereal straw) which are very poor in digestible protein or completely without any digestible protein at all (molasses). This will influence the livestock development programmes proposed below.

As the possibilities vary greatly from district to district, different lines of action are proposed, depending upon whether family farms or

Table 4 - Availability of by-products according to envisaged crops

By-products and forages	Quin-tals ha	Food value per ha			Without forages in District 2.				With forages in District 2			
		DM (Q)	DP (Q)	FU (Q)	Number of hectares	DM (Q)	DP (Q)	F U	Number of hectares	DM (Q)	DP (Q)	F U
Maize straw	50	43.1	0.172	1,551	50,664	2,183,619	8,714	78,579,864	41,341	1,781,798	7,111	64,119,891
Sorghum straw	50	48.2	0.145	1.542	37,660	1 815,212	5.460	58,071.720	32,637	1.573,103	4,732	50,326,254
Rice and wheat straw	20	18.5	0.184	646	43,962	813,297	8,090	28,399,452	42,516	786,546	7,833	27,465,336
Pulse stems	8	7.36	0.220	353	61,700	454,112	13,574	21,780,100	57,217	421,117	12,587	20,197,401
Maize by-products	8	7.08	0.588	920	50,664	358,559	29,790	46,610,880	41,341	292,694	24,292	38,008,880
Sorghum by-products	6	5.5	0.511	544	37,660	207,130	19,244	20,487,040	32,637	179,503	16,677	17.754,528
Rice by-ptoducts	4	3.41	0.256	345	36,746	125,304	9,407	12,677,370	34,596	117,972	8,857	11.435,620
Wheat by-products	6	5.33	0.613	629	7,216	38,461	4,423	4,538,864	7,920	42,213	4,954	4,981,680
Cotton oil-cake	5	4.7	1.800	526	11,836	55,629	21,305	6,225,736	8,685	40,819	15,633	4,568,310
Oil seeds cake	3.5	3.23	1.450	342	67,644	218,490	98,084	23,134,048	61,142	197,488	88,656	20,910,564
Sugar cane (1)	32	26.65	-	2,665	15,000	399,750	-	39,975,000	15,000	399,750	-	39,975,000
Fallow fodder	200	49.6	2.874	3,026	22,100	1,096,160	63,515	66,874,600	20,100	996,960	57,767	60,822,600
Irrigated grass	300	94.2	5.65	5,934	1,800	169,560	10,170	10,681,200	20,000	1,884,000	113,000	118,680,000
Totale						7,935,283	291,776	418,035,874		8,713,963	361,989	479,746,264

D.M. = Dry matter - D.P. = Digestible protein - F.U. = Forages unit

(1) - Utilizable residuals

large mechanised farming schemes are involved. It will also be necessary to ensure that the health situation, animal husbandry methods and production are first improved.

3.3 SHORT-TERM MEASURES

1976 - 1980. There are few measures planned for this phase. It is envisaged that family farms and large scale schemes will be set up at the same rate over the whole 20-year programme period. However, it will first be necessary to build the dams and construct the huge irrigation facilities, so at least 5 years will be required to establish the basic groundwork.

Where livestock are concerned, the first years will be devoted to experimentation and the preparation of measures to be implemented to ensure success later.

Veterinary Services

Both the Five Year Plan 1974 - 1978 and the Trans Juba Project provide for the improvement of the veterinary services. The action already being taken in this regard should be sufficient for the first years, provided that due heed is paid to the points made earlier. According to the present programme, only towards the tenth year, i.e. after 1985, will it be necessary to set up a specific veterinary service in each district.

Eradication of Tsetse Fly

It is envisaged that family farms will be set up where it is easiest to use water. Thus it is probable that they will be near the banks of rivers, in other words in areas favoured by the tsetse fly. Here it is advisable that the tsetse eradication campaign be started as soon as the areas reserved for future farms have been identified and blocked out. The first thing to do will be to destroy all the bush in the gallery forest, apart from the large trees, and to treat the remaining trees with powdered insecticide. The future farmers could take part in the bush clearing, though heavy machinery should be used for the excavation of irrigation canals and the levelling of the lands for irrigation.

Production of Selected Breeding Stock

The Jilib ranch (Part II para 4.1) should be able to provide a certain number of quality bulls for the first family farms.

Trials

As soon as the first lands are ready for irrigation a small agricultural experimental station will have to be set up, where agronomists will be able to run trials on various kinds of forage. The trials will be run at one single station and will be aimed at ascertaining the most suitable and most productive varieties of forage to be grown and the kind of action to be taken. It is recommended that the following crops be grown:

- Pennisetum purpureum, sorghum soudanense, Panicum maximum, Trypsacum, Setaria sphacelata, Pois d'Angole could well be grown to divide one farm from another and one block of crops from another, since apart from having a fencing function, these species could also provide a good reserve of forage.

- Irrigated pasturelands or forage crops cultivated specifically for cutting.

It would be as well to concentrate the trials on certain species which provide good soil cover, so as to reduce the possibility of erosion caused by the animals trampling the grass underfoot. The following possibilities exist: in the case of graminaceous species, Cynodon dactylon and Polystachium, Pennisetum clandestinum (in the case of mountain pasture), Brachiaria and Paspalum; while where pulses are concerned there are Desmodium, Centrosema, Vicia, Stylosanthes, Pueraria etc. When the trials have been successfully concluded, seeds will have to be grown for sowing the fallow lands and those to be devoted to irrigated pastures.

3.4 MEDIUM-TERM MEASURES

1980 - 1985. The agricultural projects differ from district to district, some provide for the establishment of family farms, while others do not, some will mainly be devoted to monoculture, with the growing of rice for instance at Dujuuma, or will have two main crops, such as in the case of Baardheere-Ionte and Jamaame with bananas and sugarcane. The livestock projects will have to be tailored to suit these differences, though the general scheme will remain the same: stockraising on the open stall system and supplementation of rations on family farms and the creation of pastoral units around the districts.

Certain general measures will be required, such as the setting up of specific veterinary services in each district, the progressive opening of stations for the production of selected breeding stock, centres for raising young animals and feedlots for fattening calves and animals at the end of their productive lives.

Family Farms

The project provides for 2.5 - 3.0 ha family farms. For feeding livestock, each farmer will have available from his land maize straw, sorghum straw and pulse stems and leaves, plus some domestic waste (cereal husks and bean pods). There will also be 3,000 m^2 of stubble which can be grazed or from which forage can be cut, and also the forage provided by the crops used to fence the fields. An average for all the family farms over the course of the years may well be about:

- 11,000 kg of dry matter (DM) theoretically sufficient to raise eleven or twelve 250-kg animal units (AU);
- 4,300 feed units (FU), in other words the energy needed for four AU;
- only 150 kg of digestible protein (DP), a little more than sufficient for 1.5 AU.

Thus the feed available is extremely unbalanced. The

$\frac{DP}{FU} = \frac{150}{4,300} = 3.5\%$, when the absolute minimum should be 5.5%.

The ratio of dry matter to feed unit:

$\frac{DM}{FU} = \frac{11,000}{4,300} = 2.56$, when the tolerable limit should not exceed 1.5 for milking cows and 2 for other animals.

This is because most of the byproducts - namely cereal straw - are poor in nitrogenous matter; thus little of this will be used for feeding stock. The rations will be improved and balanced by the use of cereal by-products such as meal and cattle cake which can be bought locally.

The ideal would be for each farmer to keep 2 milk cows (to provide the family with milk), 1.5 one year old calves, 1 one to two year old calf, and 1 two to three year old calf (stock animal or oxen for slaughter to be sold at a weight of 300 - 350 kg).

The family farms must be set up in Disease Free Zones from the very start. Thus certain precautions must be taken.

To start with no farmer will have the right to maintain more animals on his farm than indicated above. If he has more he will either have to get rid of them or have them cared for by a stockraiser on one of the pastoral units set up around the edge of the district. Before being allowed into the family farm areas, animals will have to undergo a 15 day quarantine period, during which various checks will be made:

- Seriological test to ascertain whether the animal has pleuropneumonia (animals suspected of having this disease will be slaughtered).
- Ring test for cows (eliminating those with a positive reaction).

When each district has its own specific veterinary service it may be possible to concentrate on the question of vaccination against contagious abortion, if it is ascertained that animals are subject to this disease when tested every year.

- Rinderpest vaccinations, pleuropneumonia vaccinations (it is advised that the KH 3J strain be used which can be renewed every 6 months) and vaccination against anthrax.
- Microscopic examination of a fresh blood slide to ascertain animals with trypanosomiasis (treatment of animals suffering from this disease).
- Elimination of ticks (3 sessions during the 15-day quarantine period)
- Treatment against intestinal worms.

Subsequently, the animals must be treated regularly against the following pests:

- Ticks. Not in dipping tanks as the animals must not leave the farm and mobile units would not be viable in this particular case, so the only solution is for the farmer himself to do the job. (See para 2.2.6).

- Internal parasites, particularly nematodes, (liverflukes, paramphistomes, schistosomes) as there is no effective treatment against limnosia, bulimus and planorbis (which spread very rapidly in irrigation districts): two treatments per year.

The best solution for raising the stock is to use the open stall system. As each farmer will have only 3,000 m^2 of fallow pasture available, it will be as well to cut the forage from this rather than graze it, since presence of 5.5 animals (equal to 1 ton of live weight) on such a small piece of land would result in excessive trampling of the grass and would also hinder irrigation work which will be indispensable during the dry season to ensure that the grass grows again. The reaping of a few dozen kg of grass per day is no great job.

Each farm will have a 50 - 60 m^2 fenced enclosure at the centre of which will be a 10 - 12 m^2 shed with the feeding trough. This will give the animals shelter during bad weather and during the hottest hours of the day. Another advantage of this open stall method is that manure can be gathered for the crops.

Apart from fresh grass, the animals will also receive additional food consisting of pulse stems and leaves, domestic waste (cereal meal) and if necessary cake and hulls from nearby processing plants. This food supplement will be calculated for each district on the basis of food availability.

For each group of 20 or 25 farms, there will be a selected bull, kept by one of the farmers, which will be capable of serving 40 or 50 cows in the group.

Pastoral Units

For a variable depth around every district, depending upon the quality of the rangeland, particularly in the rainy season, nomads will be permanently settled in pastoral units. In return for the advantages the herders will receive, they will accept the strict discipline which must be applied for operation of these pastoral units. The camps will be installed 2 or 3 km from the boundaries of the irrigation district, if feasible in an area where it will be possible to cultivate subsistence crops. During the rainy season, the animals will be authorized to graze only beyond this 2 or 3 km limit and will be able to drink at the "balleh" or at small "uar" made by rudimentary methods. Only during the dry season will the animals be able to graze between the line of the camps and the boundary of the irrigation district, drinking at small waterpoints set up along this boundary. The herders will be authorized to cut grass from the fallow fields in any season. After harvesting they will be allowed to reap the straw from cereals and the stems and leaves from groundnuts and other pulses to provide supplementary feed for the dry season.

Animals in these pastoral units will be kept under strict supervision and under the regular care of the veterinary services of each district, since the 8 - 10 km strip of land which they will be able to use will constitute a "cordon sanitaire" around the Disease Free Zones of the family farms.

The herders admitted to these pastoral units will receive a map from the veterinary service officials on which will be marked their identity and the composition of their herd. No animals will be allowed into these pastoral units until they have spent 15 days in quarantine.

Specific Veterinary Services in each District

As far as possible there will be a veterinary surgeon for each district. This is absolutely essential for at least the three largest ones, Baardheere, Dujuuma and Baardheere-Ionte. The veterinary surgeon will have his office at the district centre and will be responsible for the farm livestock and for the pastoral units connected with the district. He will have two veterinary assistants working for him, one on each bank of the river, as well as vaccinators who will be posted along the boundaries of the area (one vaccinator for every 10 km) and also at the quarantine and treatment holding grounds. There will also be range management agents to ensure that the ranges of the pastoral units are properly used; one agent every 20 - 25 km on each bank of the river will be adequate.

Equipment

The equipment will consist in one light cross-country vehicle for the veterinary surgeon, mopeds for the assistants and bicycles for the vaccinators and the range management agents. The centres will be complete with refrigerator, microscopes, vaccines, various medicines, especially for the treatment of trypanosomiasis, liverflukes and intestinal parasites and for the destruction of ticks. Quarantine holding grounds on the borders of the areas will provide health surveillance over the animals before they are admitted to the areas.

Stations for Selected Breeding Stock

24,100 ha are set aside for the establishment of family farms. On the basis of 3 ha per farm there will be 8,033 farmers each with 2 cows, i.e. 16,066 cows in all. Considering that a bull can serve 50-60 cows, 300 bulls will be needed for the family farm area. If it is assumed that a bull is active between the 4th and the 10th year of life, 50 bulls will be required each year for the farms. When the nomads have become settled in the pastoral units and have become used to their new way of life it will be possible to distribute selected bulls to them also, which should thrive on the food and water available.

A station with a herd of 500 breeding animals will be able to supply every year about 125 selected 3-year old bulls. Since all the animals will be kept until they are 3 years old, the size of the herd will be around 1,300 head. Between 500 - 600 ha of irrigated pasture land will suffice for this number of animals.

Baardheere is certainly the most central point and the one best equipped for setting up such a station. It will be organised in the centre of the district, near a veterinary service station. It will be completely fenced and divided into 20 enclosures, 10 for ten herds of 50 cows each with their followers (2 cows per ha), 4 enclosures for weaned calves up to 2 years of age (4-6 head per ha), 3 enclosures for males from 2-3 years old (3-4 head per ha) and 3 enclosures for females from 2-3 years old. Each enclosure will, in turn, be divided into five sections, four of which will be grazed in succession for a period of 1 week, while each year 1/5th of each enclosure will be reaped at the end of the first rainy season to provide a stock of hay and then left to allow the forage to regenerate during the second rainy season.

If cattle are raised on irrigated pastures in this way this should suffice to maintain the herd in good condition. There will be no difficulties if, for example, during a particularly dry year it is necessary to find supplementary feed for the animals.

At the centre of the station there could be an enclosure for the treatment and vaccination of the animals and a tick spray corridor.

Centres for the Raising of Young Animals

As already discussed, it is necessary for the herders to specialize, so that no more than one category ought to deal with the raising of cattle from weaning time until the achievement of 300 - 320 kg in weight. Such centres will require 20,000 ha of irrigated pasture which, it is assumed, will be in the Baardheere district. Centres could also be located along the boundaries of the various districts in order to make use of the products and byproducts of the large farms.

As regards stockraising proper, the operation of the centres can be conceived in 2 ways:

a. Free grazing on irrigated pastures, assuming that it is decided to have such facilities, the pastures could carry 800 - 1,000 kg/ha by regular rotation every 30 days, to ensure an average unit weight increase of 400 gr/day.

The farms would be fenced and divided into enclosures for raising calves from the time they are weaned (8 - 10 months) until they are 18 months old (from 4 - 6 head/ha) and enclosures for the animals from 18 to 30 months old (3 - 4 head/ha). As indicated for the Breeding Stock Stations, each enclosure will be divided into 5 lots, 4 of which will be used for grazing as follows:

Lot 1 will be grazed for one week, then irrigated while the animals are moved to Lot 2. This is grazed for one week and then irrigated while the animals are moved to Lot 3. This, in turn is grazed for one week and irrigated while the animals are returned to Lot 1, when the cycle begins again. Lot 5 will be reaped three or four times during the course of the rainy season to obtain forage, then it will be scarified to aerate the soil and to destroy debris, after which it will be lightly sown a second time to create pasture for the next rainy season. Lot 1 will then be allowed to go fallow.

b. Open stall stockraising. This will be practised near the irrigated pastures, which will be reaped regularly, or on the large mechanised farms where forage will be recovered as hay from the fallow land and as crop byproducts, especially those kinds of straw which are rich in nitrogenous matter, stems of groundnuts and other pulses. The use of the pastures will call for enclosures which allow about 6 - 8 m^2/head for young animals between 8 and 16 months old (80 - 90 kg up to 150 - 160 kg), and 10 m^2/head for the other animals. At the centre of the enclosure, there will be a shed with the feed and watering troughs, and room for the animals to rest. This shed will be a simple strucutre made of locally-available material and having an area calculated to suit the number of animals.

The centres will be organized either on state farms with many thousand head of stock or as small family farms with a few dozen head. The small family farms are to be preferred as they have numerous advantages such as:

- From the social point of view they will provide work for many families.

- No investments will be required apart from those for the purchase of animals. This sum of money could be advanced by a financial organization of the agricultural credit type.
- The families themselves could build the enclosures and the sheds using local materials, they could also collect and build-up the forage reserves.
- Forage could be provided for the stock more simply, since these small farms would be distributed all around the irrigation district.

There could be a cooperative in each district for purchasing and selling animals and also perhaps for supplying byproducts for animal feed (cake, meal, salt, etc.) and medicines to combat worms, ticks, etc.).

Feedlots

There is no need for this kind of centre while the only kind of meat exported is canned meat and few animals on the hoof. However, it may well be that towards 1985 the world meat market will be back to normal and that health conditions in the Juba Valley will have advanced sufficiently to allow frozen meat to be shipped to Europe. In this case feedlots will become indispensable for final fattening of the animals and for producing high quality meat.

3.5 LONG-TERM MEASURES

Most of the major infrastructural works will have been completed by this date and at least half the envisaged agricultural programme will be operative. All the farmers will be on their farms, since they are to have the most easily irrigable land, and about half the pastoral units will be in operation.

Each year the farmers between Dujuuma and Dolow should produce by themselves about 8,000 good-quality 3-year old animals, while the centres raising young animals, bought in the vicinity immediately after weaning, should already be producing between 20 to 25,000 head a year in the same area.

At this stage it will be essential to open up a slaughterhouse and coldstore at Baardheere in order to take the load off the Kismayo unit, which by now will be nearing saturation point. The Baardheere slaughterhouse and cold store will be capable of handling between 15 and 20,000 tons of meat a year, it is estimated, and it will have facilities for recovery and treatment of all products.

CHAPTER 4.

TECHNICAL COEFFICIENTS REGARDING THE PROJECTS

4.1 GENERAL

An evaluation is made here of the animal production on completion of the development programme for the project area for the pastoral units associated with the various districts.

As seen (Table 4), a considerable amount of feed units (FU) comes especially from byproducts poor in digestible protein (DP). It will be necessary to provide concentrates to ensure a balanced diet, at least for the animals raised by the farmers under an intensive farming system.

If, as assumed in para 3.4, each farmer has two milking cows, one and a half calves under one year old, one 1-2 year old calf and one 2-3 year old animal, a balanced ration for the 300 kg cows would ensure production of 4 litres of milk per day over a 200-day period. The farm would also have calves weaned at between 6 and 8 months whose weight gain up to the age of 30-32 months would average 400 gr/day. The average annual feed requirement (Table 5) would be 5,540 FU, 9,258 kg of dry matter (DM) and 540 kg of digestible protein (DP).

The resources offered by various districts vary enormously according to the kind of crops it is planned to grow there. Estimates are given below, district by district, of the animal production it seems reasonable to expect and the way of achieving it.

4.2 LUUQ-DOLOW DISTRICT

From all points of view, this is the least well endowed district. Apart from Dujuuma, this is the district which would have the greatest number of farms proportionate to the total area. It is highly unlikely that there will be any plant processing agricultural produce, except for a few small cereal mills providing flour for the local people.

For the pastoral units, which will be created around this district, the rangelands are the poorest of the whole of the project area. 5,000 ha of the total 16,400 ha are set aside for 1,925 family farms. The availability of byproducts for livestock use is indicat ed in Table 6.

a. Stock raised on family farms

For each farmer to keep a standard herd, it will be necessary to have available:

- Dry matter: 9,258 x 1,925 = 178,216 quintals
- Digestible protein: 540.87 x 1,925 = 10,412 quintals
- FU: 5,540 x 1,925 = 10,664,500

It has already been seen that byproducts from the farms are more than sufficient to cover the dry matter requirements, in fact there is a great excess of this material. But the amounts of digestible protein and FU produced are far too small, there being a shortfall of some 8,000 q of DP and 3,500,000 FU for a balanced diet. It is thought that family refuse - cereal meal, pulse pods, etc. - will amount to around 2 q per family per year. This

Table 5- Annual feed requirements for stock raised on a Family Farm

Class of animal	Daily F U requirement			Daily dry matter requirement		Daily digestible proteine requirem.		Number of days	Annual requirement		
	Daily FU/head	Number of head	Total FU/day	DM/FU	DM kg/day	DP/FU	DP kg/day		F U	DM (kg)	DP (kg)
Breeding cattle	4.2	2	8.4	1.5	12.6	10,5	0.882	365	3,066	4,599	321.93
6-12 month calves	2	1.5	3	1.6	4.8	10	0.300	180	540	864	54.00
12-24 month calves	2.8	1	2.8	1.8	5.4	9	0.252	365	1,022	1,971	91.98
24-30/32 month calves	3.8	1	3.8	2	7.6	8	0.304	240	912	1,824	72.96
Total animals per farm			18		30.4		1.738		5,540	9,258	540.87

Table 6 - By-products available in Luuq-Dolow District

By-product	Total area ha	Family Farms					Large Schemes				
		%	ha	DM (ql)	DP (ql)	FU	%	ha	DM (ql)	DP (ql)	FU
Maize straw	3,267	30.5	1,106	47,669	190	1,715,406	69.5	2,521	108,655	434	3,910,071
Sorghum straw	5,299	30.5	1,595	76,879	232	2,459,490	69.5	3,634	175,159	527	5,603,628
Rice and wheat straw	2,952	30.5	900	16,650	166	581,400	69.5	2,052	37,962	377	1,325,592
Pulse stems	7,623	30.5	2,325	17,112	512	820,725	69.5	5,298	38,993	1,165	1,870,174
Fallow fodder	1,640	30.5	500	24,800	1,437	1,513,000	69.5	1,140	56,544	3,276	3,444,640
Total				183,110	2,537	7,090,021			417,313	5,779	16,154,105

Table 7 - Daily and yearly feed requirements (Typical Family Farm)

Product	Breeding cattle	6-12 month calves (1.5-6 months)	12-24 month calves years	24-30/32 month calves (1-6 to 8 months)	Total	
					kg/day	kg/year
Fresh grass	8 Kg (x2=16 Kg)	5 Kg ($x\frac{1.5}{2}$=3.750)	6 Kg	8 Kg ($x\frac{1}{2}$ m $\frac{2}{3}$)= 5 Kg	30.750	110-120 q.li
Maize and sorghum straw	4 " (x2= 8 ")	1 " ($x\frac{1.5}{2}$=0.750)	2 "	4 " ($x\frac{1}{2}$ m $\frac{2}{3}$)=2.5 "	13.250	45- 50 "
Rice and wheat straw	-	-	2 "	2 " ($x\frac{1}{2}$ m $\frac{2}{3}$)=1.25 "	3.250	12- 15 "
Pulse stems and leaves	1 " (x2= 2 ")	1 " ($x\frac{1.5}{2}$=0.750)	-	-	2.750	10- 11 "
Cake	0.5 (x2= 1 ")	0,250 ($x\frac{1.5}{2}$=0.1875	0.250 "	0,250 ($x\frac{1}{2}$ m $\frac{2}{3}$)=0.150	1.590	6 - 8 "
Sundry cereals	1 (x2= 2 ")	0,250 ($x\frac{1.5}{2}$=0.1875	0.250 "	1 ($x\frac{1}{2}$ m $\frac{2}{3}$)=0.625	3.315	12 - 14 "
Total weight of daily ration	14.5 Kg	7.5 Kg	10.5 Kg	15.250 Kg	50 - 55 Kg	
Dry matter	7.74 Kg	3.45 Kg	5.375 Kg	7.67 Kg		
Digestible protein	0,472 "	0.207 "	0,256 "	0.321 "		
F U	4.42 "	2.250 "	2,92 "	3.95 "		
$\frac{DM}{FU}$ =	1.7 "	1.7 "	1.85 "	1.94 "		
$\frac{DD}{FU}$ =	10.2 "	10.25 "	8,2 "	8.42 "		

would produce for the whole district around 3,500 q of dry matter, 300 q of digestible protein and 350,000 FU.

It would be possible to procure the missing FU and the 8,000 q of protein from nearby large schemes, but it must not be forgotten that the herders on the pastoral units in the vicinity will also require their reserves of forage for the dry season and, in any case, it would be impossible, in this way, to obtain the balanced ration needed for the stockraising method we have in mind.

Thus, unless it is decided to build oil-expressing plants and cereal mills in the Baardheere area, it will be necessary to bring in concentrates from other areas.

Table 7 indicates some examples of balanced rations for the various classes of animals, suitable for the family farms as regards forage and straw. The daily rations required for each farm would be as follows:

- Fresh grass = 30 - 35 kg, which must be obtained by cutting the fallow or the larger graminaceous plants used to fence the enclosures and, if necessary, by thinning the cereals.
- Cereal straw = 15 - 20 kg: there is far more of this material than required.
- Pulse stems and leaves = 2 - 3 kg: production is more than sufficient.
- Cake = 1,590 kg or 6 - 8 q per year.
- Cereal derivatives = 3,315 kg on average or 12 - 14 q per year.

The cereal derivatives could possibly be replaced by grains, of which the farmer will produce around 70 q per year.

Cake and cereal derivatives may be available in the area if oil-expressing plants and cereal mills are set up. Otherwise the local cooperative will have to bring these products from Baardheere to distribute them to the farmers.

b. Pastoral Units

The animals that will be allowed into these units will have available about 40,000 q of dry matter in the form of forage and various kinds of straw, representing some 5,800 q of digestible protein and more than 16,000,000 FU. The average DP content is certainly very low, but this will be a great help in the dry season, particularly in those regions with not very good rangeland potential and which are entirely desert during the dry season at the present time.

The district will extend for about 70 km on both sides of the river, though the rangeland is very poor (209 kg/ha for the Upper Juba Valley, according to the FAO survey of 1968). It is estimated that about 1 animal unit/ha will be a reasonable stocking rate, since most of the rangeland will be utilised only during the rainy season.

Beyond the 70 - 80 km to which the district stretches on both sides of the river, there is a 10 km strip of land covering some 150,000 ha, sufficient to maintain 15,000 animal units of 250 kg each, or about 25,000 head (around 3,750 tons of animals on the hoof).

Leaving aside the farms, the amount of byproducts available in the district amounts to some 1,670 kg of dry matter, 23 kg of DP and 646 FU per animal raised in the surrounding pastoral units.

It may well be that freeranging on fallow land or on the fields after the harvest has been collected will be prohibited because of the risk of ruining irrigation canals. In this case, the owners of the animals will have to come in and cut the forage themselves, especially pulse stems and leaves and wheat straw, the richest source of forage immediately after the harvest.

Reaping of forage on the fallow land may continue during the whole dry season. The forage will be carried from the farms to the pastoral unit by camels.

There are 20,000 tons of forage to be cut in the green state. This is dried on the fields, however, and the weight will drop to about 8,000 tons. In addition, there will be 4,000 tons of pulse stems and leaves and a similar amount of rice or wheat stalks to be collected, making a total of around 16,000 tons. Calculating that each family will have 40 head of stock, it is apparent that each of the 625 families who live on the pastoral units will have to transport 25 tons for 3 or 4 km. This amounts to no more than 30 or 40 trips with five camels and will ensure that there are no worries over feeding the stock during the dry season even if this lasts longer than usual.

It is apparent, however, that this practice will require careful education of the herders, but this will be well worthwile.

4.3 BAARDHEERE-SAAKOW DISTRICT

This is the central point and the most important one. It has 47,350 ha, of which 3,200 are set aside for family farms. A sugar mill, an oil-expressing plant and a number of cereal mills will be built. There are two hypotheses to be considered: one involving the creation of 20,000 ha of irrigated pastures, the other without any such pastures. The food availability for these two hypotheses are given in Tables 8 and 9 respectively.

a. Family farms. Whatever the hypothesis, there will be 3,200 ha for 1,350 family farms, which will have no difficulty in feeding their livestock. Though the forage production of the individual farms will certainly be insufficient, it will be possible to find enough additional feed in the vicinity.

b. Pastoral units. The natural grazing in this region is good (FAO estimate of stocking rate = 595 kg/ha, or a potential of 1 animal unit per 6 ha on the left bank and 398 kg/ha, or 1 animal unit per 9 ha on the right bank). The perimeter of the district exceeds 250 km in length. Allowing a 10 km strip for the pastoral units and taking account of the resources available, with an estimated potential of 1 head per 4 ha on the left bank and 1 head per 6 ha on the right bank, it will be possible to have a total herd of 50,000 cattle, 30,000 on the left bank and 20,000 on the right, in good condition.

c. Stockraising centres for young animals. A brief description has already been given of this kind of centre and mention has already been made of various stockraising possibilities and uses.

Our preference is for a settlement of specialized herders rather than a state farm. Each of the herders would receive 1 to 1.5 ha of land, sufficient to grow subsistence crops for the family and to create enclosures for raising stock on the open stall system. Each fatstock breeder (see para 2.4.2) could raise and deliver some 40 or so animals per year. For this, around 600 - 750 m^2 of land divided into five 120 - 150 m^2 enclosures would be quite adequate. Each enclosure would have shelter for the animals (a simple thatched shed) measuring 6 m x 3 m beneath which would be the feed and watering troughs plus a 1 m tank (or 5 petrol cans) raised around 2 m off the ground, which could be filled by means of a handpump (JAPY type for instance) raising the water from the nearest irrigation canal. The stocks of straw and a store for feed cake and cereal derivatives and grains would be built near the enclosure.

The calves would be bought in groups of 12 - 15 every four months. The breeder would buy 10 - 12 month old beasts (namely, animals that have already been weaned and become used to their new type of feed: a stage during which the growth curve remains virtually stationary). The animals will be sold at about 30 - 32 months when they are up to a weight of 320 - 340 kg. Each breeder will thus have 36 - 45 young animals ranging in age from 10 - 12 months to 22 - 24 months and around 24 - 30 animals in the 30 - 32 months range. The rations for the cattle on each fattening unit are indicated in Table 10. Depending on whether the unit has groups of 12 or 15 head, the daily ration will consist of:

- Fresh grass to be cut in nearby fallow fields 456 or 570 kg
- Maize or sorghum straw 84 - 105 kg } Stocks to be built-up
- Rice or wheat straw 84 - 105 kg } when the reaping is done,
- Molasses 40 - 50 kg 30 - 40 tons each.
- Cereal derivatives or grains 26.5 or 33 kg
- Pulseseed cake 14.4 or 18 kg
- Cottonseed cake 10.8 or 13.5 kg

- 1st Hypothesis

No irrigated pastures, except for 500 - 600 ha to be used by the breeding station. As indicated in Table 8, the district can produce about 225,500 tons of dry matter, 8,735 tons of digestible protein and more than 105,000,000 FU, deriving from:

- Green forage (fallow land)	123,000 tons
- Maize and sorghum straw	161,000 tons
- Rice and wheat straw	12,160 tons
- Pulse stems and leaves (which will be kept for the pastoral units)	1,080 tons
- Molasses	16,000 tons
- Oil seed cake (if the whole of the production from Dujuuma to Dolow is processed at Baardheere)	14,120 tons

In addition, if cotton is ginned in the area, there will also be:

- Cottonseed cake	1,200 tons
- Cereal derivatives	24,600 tons

Taking account of the supplementary needs of the family farms and of those of the pastoral units, there is the possibility of feeding the whole production from 50,000 head raised around the district i.e. about 5,000 weaned calves and 5,000 animals at the end of their career. These 5,000 calves would be raised by 110 breeders who would each take groups of 15 every 4 months, or by 140 breeders who would take 12 animals each.

Table 8 - By-products available in District 2 - Baardheere (without irrigated pastures)

By-product	Total area ha	Family Farms					Large Schemes				
		%	ha	DM (ql)	DP(ql)	FU	%	ha	DM (ql)	DP (ql)	FU
Maize straw	19,349	6.3	1,219	52,238	210	1,890.669	93.7	18,130	781,703	3,118	28,119,630
Sorghum straw	15,049	6.3	949	45,742	137	1,463,358	93.7	14,100	679,620	2,044	21,742,200
Rice and wheat straw	6,450	6.3	361	6,679	67	233,206	93.7	6,089	112,646	1,121	3,933,494
Pulse stems and leaves	15,645	6.3	876	6,447	193	309,228	93.7	14,769	108,700	3,249	5,213,457
Molasses	5,000	-	-	-	-	-	100	5,000	133,250	-	13,325,000
Fallow forage	6,470	5	320	15,872	920	968,320	95	6,150	305,040	17,675	18,609,900
Oilseed cake	41,479	-	-	-	-	-	100	41,479	133,977	60,145	14,185,818
Total				126,978	1,527	4,864,781			2,254,936	87,352	105,136,499

Table 9 - By-products available in District 2 - Baardheere (with irrigated pastures)

By-product	Total area ha	Family Farms					Large Schemes				
		%	ha	DM (ql)	DP (ql)	FU	%	ha	DM (ql .)	DP (ql)	FU
Maize straw	10,026	12.1	1,219	52,238	210	1,890,669	87.9	8,807	379,882	1,515	13,659,657
Sorghum straw	10,026	9.4	949	45,742	137	1,436,458	90.6	9,077	437,511	1,316	13,996,734
Rice and wheat straw	5,004	7.2	361	6,679	67	233,206	92.8	4,643	85,895	854	2,999,378
Pulse stems	11,162	7.9	876	6,447	193	309,228	92.1	10,286	75,704	2,262	3,630,958
Molasses	5,000	-	-	-	-	-	100	5,000	133,250	-	13,325,000
Oilseed cake	34 977	-	-	-	-	-	100	34 977	112 975	50 717	11 962 134
Fallow forage	4,470	7.2	320	15,872	920	968,320	92.8	4,150	205,840	11,927	12,577,900
Cereals derivates	20,000	-	-	-	-	-	100	20,000	1,884,000	113,000	118,680,000
Total				126,978	1,527	4,837,881			3,315,057	181,591	190,531,761

Table 10- Types of ration for young cattle (12 - 32 months)

Product	From 10/12 to 22/24 months				From 22/24 to 30/32 months			
	kg/day	DM (kg)	DP (gr)	FU	kg/day	DM (kg)	DP (gr)	FU
Green forage	6.0	1.688	87.0	0.906	10.0	2.480	145.0	1.510
Rice or wheat straw	1.0	0.920	9.2	0.310	2.0	2.300	18.4	0,620
Maize or Sorghum straw	1.0	0.913	3.4	0.155	2.0	2.300	6.8	0.310
Molasses	0.5	0.416	-	0.500	1.0	0.833	-	1.000
Cereals by-products	0.4	0.368	37.8	0.416	0.4	0.470	32.0	0.400
Pulse-seed cake	0.4	0.368	165.6	0.388	-	-	-	-
Cotton-seed cake	-	-	-	-	0.3	0.284	108.0	0.300
Nutritional value of rations	9.3	3.673	303.0	2.675	15.7	8.667	310.2	4.140
DM / FU		1.74				2.1		
DP / FU			10.9				7.5	

- 2nd Hypothesis (20,000 ha of irrigated pasture)

There is even more feed available in this case amounting to more than 180,000 q of digestible protein and 190,000,000 FU (Table 9).

- Green forage: - from fallow = 83,000 tons = 683,000 tons
  - from irrigated pastures = 600,000 tons
- Maize and sorghum straw = 89,500 tons
- Rice and wheat straw = 9,280 tons
- Pulse stalks and leaves = 8,230 tons
- Molasses = 16,000 tons
- Oilseed cake = 11,250 tons

plus 12,500 tons of cereal derivatives, if cereals are processed in the area.

There are 3 solutions for the use of these 20,000 ha of irrigated pastures (or rather 19,400 ha since the part reserved for the breeding station must be deducted):

- A large state-run complex.
- Numerous small family farms and freerange grazing.
- Numerous small family farms and openstall stockraising.

In the last two cases it will be necessary to distribute the irrigated pastureland in plots of a few hundred square metres on the outer edge of the district.

The freerange solution will obviously involve a large investment on fencing, and range use would be as indicated in para 3.4:

- 4 - 6 head per ha for calves up to 2 years old, 3 - 4 head per ha for those over 2 years old, in other words, a stocking rate of 800 - 1,000 kg live weight per ha.
- Regular rotation on 4 grazing enclosures in succession over a period of 30 days, while a 5th enclosure is left fallow for the collection of forage, and for the regeneration of grazing every 5 years.

This method will require thorough training of the breeders and very strict control will need to be exercised over rotation. It will also involve some trampling down of grass and a loss of nutriment, of the order of 30-40%. However, it does eliminate the need for feeding the animals manually, since they will find all the food they need in the enclosures. Some supplemental minerals in the form of a saltlick and probably some concentrates should more than suffice.

The openstall system of stockraising avoids all the work and expense involved because of the need to fence in the case of ranging. It also eliminates the danger of the grass being trampled underfoot and facilitates periodic irrigation and renewal of the grazing lands every 5 years. By avoiding waste there is a possibility of raising more stock on the same area. But there is also additional work for the family, though cutting some 500-600 kg of grass a day and transporting it a few hundred metres is not an enormous job for two or three people.

With the freerange solution, 15,500 ha of irrigated pasture (namely 20,000 ha minus 600 for the breeding station and 1/5 of the area left fallow each year to allow the grass to grow again) would permit the 500-600 families involved to raise annually:

- With a stocking rate of 800 kg/ha: 25,000 1-2 year old calves, 25,000, 24-32 month calves, and 25,000 animals at the end of their career, in five 70-day periods.
- With stocking rate of 1,000 kg/ha: somewhat more than 30,000 animals of all classes.

In the case of the open stall system, with the rations indicated in Table 10, or with very much lower grass consumption and the use of byproducts, a good part of which would be lost unless used in this manner, it would be possible to obtain the same results on only 6,000 - 7,000 ha.

d. Fattening centres. These centres will enable animals at the end of their career, bought outside the district, to be fattened up before being slaughtered.

- 1st Hypothesis - no irrigated pastures. Here too, as in the case of breeding centres for young animals (para 3.4) it is preferred to count on specialized breeders instead of a state body. Fifty breeders each with a fenced area of 200 - 250 m^2 could fatten 5,000 animals at the end of their career coming from the pastoral units set up around the district. Each of them in succession would handle 5 groups of 20 head every 70 days. The ration would be of the same type as proposed in Table 10 for 12 - 32 month animals, but slightly better, because, in general, these animals would be thinner and would need to be "filled" more rapidly. The ration should be: 10 kg of fresh grass, 4 kg of maize straw or chopped sorghum mixed with 1 kg of molasses, 0.4 kg of cottonseed cake, and 1 kg of cereal derivatives. This ration would contain 8.6 kg of dry matter, 0.384 kg of digestible protein and 4.57 feed units.

$\frac{DM}{FU} = 1.87$ $\frac{DP}{FU} = 8.4$

- 2nd Hypothesis: irrigated pastures. 250 breeders could fatten 25,000 head per year, each looking after 5 successive groups of 20 head. With abundant stocks of fresh grass nearby, a simpler ration would be possible. 12 kg fresh grass, and 6 kg maize or sorghum straw, chopped and mixed with 1 kg of molasses, 0.5 kg DM.

Should irrigated pastures be established, the breeders admitted to the pastoral units nearby could obtain far richer feeding stuffs during the dry season because they would have available all the forage produced and all the stalks and leaves of pulses, around 1,400 tons of digestible protein, for the 50,000 head of cattle which will be raised (28 kg/head).

4.4 DISTRICT DOWNSTREAM OF SAAKOW

The district will measure 26,600 ha, 3,100 of which set aside for 1,145 family farms. This is the main rice growing centre. The guidelines adopted for Luuq-Dolow will be used for this district too. Feed availability is indicated in Table 11.

Table 11 - By-products available in District 3 - Downstream of Saakow

By-product	Total area ha	Family Farms					Large Schemes				
		%	ha	DM (ql)	DP (ql)	F U	%	ha	DM (ql)	DP(ql)	F U
Maize straw	977	100	977	42,108	168	1,515,327	-	-	-	-	-
Sorghum straw -	698	100	698	33,644	101	1,076,316	-	-	-	-	-
Rice or wheat straw	32,238	1.8	580	10,730	107	374,680	98.2	31,658	585,673	5,825	20,451,068
Pulse stems	6,856	30	2,056	15,132	452	725,768	70	4,800	35,328	1,056	1,694,400
Fallow forage	2,660	16.7	444	22,022	1,276	1,343,544	83.3	2,216	109,914	6,369	6,705,616
Rice derivaties (brought in from Baardheere)	36,746	-	-	-	-	-	100	36,746	125,304	9,407	12,677,370
Total				123,636	2,104	3,035,685	-	-	856,219	22,657	41,528,454

a. Family farms

1,145 family farms, each with 2 milking cows, 1.5 calves less than 1 year old, one 1 - 2 year old calf and one 2 - 3 year old calf. The farms will have more or less the same quantity of byproducts available as those at Dolow. Thus in order to feed the animals properly, it will be necessary to provide them with concentrates as well. There are no difficulties as regards cereal derivatives because the rice mill will provide all that is needed. Cake will have to come from Baardheere; around 6,000 quintals will be required. The rations will be as indicated in Table 7.

b. Pastoral Units

The natural rangelands here are of average value. The byproducts recovered from a large mechanised scheme will amount to about 13,500 quintals of digestible protein (of which more than half will consist of very rich products), hay from the fallow lands and pulse stems and leaves. 40,000 head of cattle can be admitted to the pastoral units in the district, and each farm will have about 34 kg of DP available for the bad season.

4.5 DISTRICT DOWNSTREAM OF DUJUUMA

To raise a standard herd, concentrates will have to be distributed to the farmers. There will be no difficulties over cereal derivatives, since the rice mill will be set up nearby. Cake will have to be brought in from Baardheere. Requirements will amount to around 44,600 q of rice derivatives and 25,000 of cattlecake.

All the farm byproducts will be used on the family farms and hence it will not be possible to set up pastoral units around the district (See Table 12).

4.6 FAANOOLE-JILIB DISTRICT

See Table 13. This district covers 13,400 ha, of which 1,800 can be set aside for family farms.

a. Family farms

There will be 25 family farms. So that they can feed their stock properly, it will be necessary to bring in 4,250 quintals of cattlecake from Baardheere-Ionte and 7,560 quintals of rice derivatives from Dujuuma.

b. Pastoral units

As this is the smallest district, only relatively restricted amounts of byproducts can be made available to the herders. Though the quality of the surrounding rangelands is fairly reasonable, it will not be possible to have more than 15,000 head on the pastoral units.

Table 12 - By-products available in District 4 - Downstream of Dujuuma

By-product	Family Farms only			
	Total area ha	DM (ql)	DP (ql)	F U
Maize straw	3,496	150,678	601	5,422,296
Sorghum straw	2,497	120,355	362	3,850,374
Rice or wheat straw	1,998	36,963	367	1,290,708
Pulse stems or leaves	5,615	41,327	1,235	1,982,095
Fallow forage	1,110	55,056	3,190	3,358,860
Total		404,379	5,755	15,904,333

Table 13 - By-products available in District 6 - Faanoole - Jilib

By product	Total area ha	Family Farms					Large Schemes				
		%	ha	DM (ql)	DP(ql)	F U	%	ha	DM (ql)	DP (ql)	F U
Maize straw	4,842	11.5	557	24,007	96	863,907	88.5	4,285	184,683	737	6,646,035
Sorghum straw	4,059	11.5	467	22,509	68	720,114	88.5	3,592	173,134	521	5,538,864
Rice or wheat straw	324	100	324	5,994	60	209,304	-	-	-	-	-
Pulse stems or leaves	5,976	11.5	687	5,056	151	242,511	88.5	5,289	38,927	1,164	1,867,017
Fallow forage	1,340	11.5	155	7,688	445	469,030	88.5	1,186	58,826	3,408	3,588,836
Total		-	-	65,254	820	2,504,866	-	-	455,570	5,830	17,640,752

After the Faanoole - Jilib district comes the Trans Juba Project area of the Livestock Development Agency and the Kismayo slaughterhouse. There are no more family farms. Thus no specific projects will be proposed for the other districts of the Lower Juba. Yet there will still be large quantities of maize and sorghum straw available and without doubt it should be possible to use all or part of the forage from the fallow lands. For the Baardheere-Ionte and Jamaame districts, molasses and cattlecake are readily available.

4.7 BAARDHEERE-IONTE DISTRICT

Here major cash-crops are grown (sugarcane, bananas, oilseeds, cotton and tobacco) plus some cereals for feeding the workers employed in the large schemes and in the processing plants. It is also envisaged that there will be 1,200 ha of irrigated pasture and 600 ha of forage crops. In fact, this is the huge feedlots section of the Trans Juba Project.

However, there will be sufficient other byproducts available to enable several pastoral units to be established. These would involve no more than twenty thousand or so head of cattle, which the owners could feed during the dry season with forage coming from the fallow lands and the possibly pulse stems and leaves, plus some maize and sorghum straw which can be cut and mixed with molasses. (More of this kind of straw will be available than can be used) (See Table 14).

4.8 TOUTA DISTRICT

It is not envisaged using byproducts for possible pastoral units here because of the difficulty of getting them to the breeders. However, as there will be 1,330 ha of fallow and 4,703 ha of land under pulses, the idea could be considered of setting up enclosures in the centre of the island where 3,000, 10 to 20-22 month cattle and 3,000, 20-22 to 30-32 month cattle could be raised using rations indicated in Table 18 (See also Table 15).

4.9 JAMAAME DISTRICT (Lower Juba)

The district will cover 20,050 ha. The points made for the Baardheere-Ionte district are applicable here too (See Table 16).

Tab. 14 - By-products available in District 8 : Baardheere-lonte

By-product	Large Schemes only			
	ha	DM (ql)	DP (ql)	U F
Maize straw	7,229	311,570	1,243	11,212,179
Sorghum straw	5,954	286,983	863	9,181,068
Rice or wheat straw	-	-	-	-
Pulse stems or leaves	8,315	61,198	1,829	2,935,195
Molasses	5,000	133,250	-	13,325,000
Fallow forage	3,780	187,488	10,864	11,438,280
Irrigated grass	1,800	169,560	10,170	10,681,200
Total		1,150,049	24,969	58,772,922

Tab. 15 - By-products available in District 7 : Toutà Island

By-product	Large Schemes only			
	ha	DM (ql)	DP (ql)	U F
Maize straw	4,092	176,366	704	6,346,692
Sorghum straw	3,370	162,434	489	5,196,540
Pulse stems or leaves	4,703	34,614	1,035	1,660,159
Fallow forage	1,330	65,968	3,822	4,024,580
Total		439,382	6,050	17,227,971

Tab. 16 - By-products available in District 9 : Jamaame

By-product	Large Schemes only			
	ha	DM (ql)	DP (ql)	U F
Maize straw	2,417	104,173	416	3,748,767
Sorghum straw	804	38,753	116	1,239,768
Pulse stems and leaves	1,122	8,258	247	396,066
Molasses	5,000	133,250	-	13,325,000
Fallow forage	2,740	135,904	7,875	8,291,200
Oilseed cake	26,165	84,513	37,939	8,948,430
Cotton oil cake	11,836	55,629	21,304	6,225,736
Total		560,480	67,897	42,175,007

Tab. 17 - By-products available in District 10 : State Farms

By-product	Large Schemes only			
	ha	DM (ql)	DP (ql)	U F
Maize straw	4,635	199,768	797	7,188,885
Pulse stems and leaves	5,841	42,990	1,285	2,061,873
Fallow forage	1,030	51,088	2,960	3,116,780
Total		293,846	5,042	12,367,538

Table 18 - Daily rations for fattening cattle

Product, composition and content	Age of cattle	
	Less than 2 yrs old	More than 2 yrs old
Green forage	10.0 kg	15.0 kg
Pulse stems and leaves	2	3
Cattlecake	0.300 kg	0.300 kg
DM	4.6	6.7
DP	0.320	0.420
FU	2.8	4.05
DM/FU	1.64	1.66
DP/FU	11.4	10.37

4.10 DUFALACH-AFMADOW AND DESCEK UAMO DISTRICTS (outside area?)

They are extended over 7,800 and 10,000 ha respectively; both organized in large State Farms. The main crops foreseen are sugar cane, oil seeds, maize, rice and grain pulses.

The by-products availability for animal food is indicated, in total, in Table 19.

Considering that the two districts have no Family Farms, and that they will be exploited during the last phase of realization of the project and that already today they constitute and important source of forage supply for transhumand livestock it is envisaged their utilization in field with permanent livestock.

Table 19 - By-products available in the Districts of Dufalach-Afmadow and Descek Uamo

By-product		Large Schemes			
		Ha	DM (ql)	DP (ql)	F U
Maize stems and leaves	(D)	4,300	203,863	814	7,336,230
Rice stems and leaves	(U)	3,680	68,080	677	2,377,280
Oil seeds cattle cake	(D) (U)	6,240 780			
		7,020	22,675	10,179	2,400,840
Pulses stems and leaves	(D) (U)	1,300 1,550			
		2,850	20,976	627	1,006,050
Sugar cane (residuals)	(U)	5,000	133,250	-	13,325,000
Total		-	448,844	12,297	26,445,600

CHAPTER 5.

STOCKRAISING AND LIVESTOCK PRODUCTION CONNECTED WITH THE IRRIGATION DISTRICTS

The estimates here cover what might reasonably be expected in an area which does not exceed 10 km around the irrigation districts when the irrigation development programme is operating normally.

As envisaged by the time the irrigation districts are at that stage of development, the herds that will have been established in the pastoral units will consist only of breeding stock and of unweaned calves, plus breeding bulls and young store or replacement animals. Soon after weaning the calves will all be sold to breeders specialising in fattening operations, while animals at the end of their career will be sold to breeders also specialising in fattening animals for slaughter.

Consideration is given only to the area between Dolow and Dujuuma, and the districts where it is envisaged setting up family farms and which may be looked upon as the area which will provide cattle for the future Baardheere slaughterhouse.

a. The herd

Though the number of head on the family farms and the pastoral units may remain unchanged, the number of animals raised by breeders specialising in fattening stock will rise from 15,000 to 75,000 if irrigated pastures are established at Baardheere.

b. Production

At the end of the programme the annual production of the settled herds should be around 20% of the total numbers (130,000), half as weaned calves (13,000) and half as animals at the end of their career (13,000).

Without irrigated pastures at Baardheere, only a little more than one third of the production could be properly raised and fattened in the Baardheere district.

With 7,000 ha of irrigated pasture and young animals raised on the free stall system, it would be possible to have an annual production of 25,000 head of 320 - 340 kg young animals plus 25,000 animals fattened at the end of their career. In other words, this would include the whole of the production of the pastoral units thereabouts plus 12,000 head of all classes of animals acquired each year outside the area.

Beyond the bounds of this area there would no longer be molasses or cattlecake available.

Under these conditions the Baardheere slaughterhouse would be handling around 60,000 head per year, equal to some 10,000 tons carcass weight.

At the end of the programme, even without increasing real numbers, the herd in the Project Area will produce around 235,000 head per year, made up of 140,000 young and 95,000 animals at the end of their career. To absorb this production, the Kismayo and the new Baardheere slaughterhouses will have to handle 117,500 head per year, equal to around 20,000 tons carcass weight, as envisaged for the Baardheere slaughterhouses.

Thus, there will be around 60,000 head to be bought each year, from outside the area, made up of 30,000 weaned calves, which will be fattened up to 320 - 340 kg at 30 - 32 months and 30,000 animals at the end of their career, which will be fattened up in 70 days.

To keep these additional animals, it will be necessary to increase the amount of irrigated pastures at Baardheere to 15,000 ha and to bring in from Baardheere-Ionte and Jamaame 15,000 tons of molasses and 10,000 tons of cattlecake. For supplementary feed derivatives, the demand for which will amount to 10,000 tons, local production from Baardheere and Dujuuma should be sufficient.

CHAPTER 6.

CONCLUSIONS

Where livestock is concerned, the agricultural development project in the Juba Valley should lead to the doubling of the productivity of the herd over a period of 20 years. However, to derive full benefit from the agricultural programme, certain preliminary action is necessary, namely:

- Improvement of the animal health situation, by putting the veterinary services into proper shape and ensuring they have sufficient equipment and qualified staff.

- Improvement of the rangelands and the use thereof, by opening new waterpoints and adopting a rational policy for the use of rangeland and water, which should be supervised by regional commissions set up specifically for this purpose and by the range management services.

- Training of stockraisers in improved animal husbandry techniques, progressive settlement of the nomads in pastoral units and the creation of groups of breeders specialising in the intensive raising of young stock and in the fattening of fully-grown animals to produce good quality meat. Agricultural output from the districts along the river will provide the livestock sector with large quantities of byproducts, whose rational use will entail the integration of stockraising and agricultural projects.

- Raising of milking cows by the farmers to cover family milk requirements and the raising of young animals to a weight where they can be profitably slaughtered.

- Creation of pastoral units for the permanent settlement of a certain number of herds, which for many years will have to be fed and watered from the irrigated crop areas.

- Creation of fenced enclosures for the fattening of animals at the end of their career before being sent to slaughter.

- Creation of fenced enclosures for the raising of young animals on the open-stall system with a balanced diet involving the use of agricultural byproducts.

- Establishment of a station for the production of improved breeding animals achieved by selection, as the first step towards upgrading stock quality.

- Construction of a 20,000-ton/year slaughterhouse at Baardheere to produce top quality meat for export, chilled or frozen, and 2nd or 3rd quality meat for canning.

Byproducts from the five districts which will supply the Baardheere slaughterhouse and the creation of 7,000 ha of irrigated pastures at Baardheere will ensure annual production of 25,000 good quality 3-year old animals with a live weight of 330 kg and 25,000 animals at the end of their career fattened on feedlots.

To absorb the production of the whole of the nearby regions and to make full use of the Baardheere slaughterhouse it will be necessary:

- To increase the area of irrigated pasture to 15,000 ha.
- To bring into Baardheere 15,000 tons of molasses and about 7,000 tons of cake from Baardheere-Ionte and Jamaame to feed an additional 25,000 calves and 25,000 animals at the end of their career to be purchased each year.