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RAINFED AGRICULTURE
IN THE
JUBA VALLEY

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RAINFED AGRICULTURE IN THE JUBA VALLEY

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1 Introduction

1.1 Objectives of the Study

Since 1982, the Ministry of Juba Valley Development (MJVD) has been carrying out various programmes for the collection and processing of data on the agricultural sector of the Juba Valley. Such information is required for the elaboration of an overall development plan (masterplan) for the Juba Valley Region. There is still a lack of information on rainfed agriculture. So far, hardly any information has been available on this sub-sector in the Juba Valley. Three questions are of major interest for future development planning:

- Can rainfed agriculture be efficiently improved?
- What are the possibilities for and impacts of including present rainfed areas in irrigated perimeters?
- Can migration of rainfed farmers towards the future irrigated areas be expected?

It is the purpose of this study to contribute to finding answers to the above questions. Additional information to help answer these questions is expected from other ongoing studies, such as the Soil and Land Classification Study (1) and the Environmental and Social Impacts Study (2). It will be up to the envisaged masterplanning to draw definite conclusions from all the subsequently available sources of information as to the future role of the present rainfed areas and the farmers involved.

Within the framework of this study emphasis is laid upon the analysis of the following aspects:

- location and extent of areas presently under rainfed agriculture in the Juba Valley Region
- land tenure, farm structure and farm families involved
- crops, cropping patterns and crop production
- agricultural practices
- labour situation
- farm incomes
- constraints and proposed improvements to rainfed agriculture.

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1) carried out by BUREC/USAID, to be completed by end of 1986.
2) carried out by ARD/USAID, to be completed by September 1988.

1.2 Location and Delineation of the Study Area

The Study Area lies downstream of the site for the Bardheere Dam, on both sides of the river in the districts of Bardheere (Gedo Region), Saakow, Bu'aale and Jilib (Middle Juba Region) and Jamaame and Kismayo (Lower Juba Region).

About half of the rainfed land in the Study Area (49 per cent) is concentrated in Bardheere District. The Dhoobley area lies north of the town of Bardheere, extending along the left bank of the river between Doxiilow and Hureen. On the opposite side of the river the rainfed areas are located around Shimborooley, Sarinley and Buulo Caddey.

The main proportion of rainfed agriculture in the Bardheere District, however, is concentrated in an area which extends from Bardheere about 15 km to the east, to the Busley and Shiidoole area, and to the south-east and south of Bardheere to the areas of Aminaay, Toorey, Korkamaarey, down to Barta Fanye and Qotiiley. South-west of Bardheere the area of Hilo Shiid is included. Further downstream, rainfed agriculture is practised east of Caanoole and in the adjacent southern areas of Barow Diinle and Gaguure which lie at the border between the Bardheere and Saakow Districts. Opposite to this area, on the other side of the river, there are rainfed areas around Waaba and Qasalow.

Another isolated area in the Bardheere District is situated about 30 km east of Bardheere where it extends in the north-east to south-west direction over a distance of about 20 km.

About 30 per cent of the rainfed area in the Juba Region is located in Saakow District. In this district the rainfed land lies along the river between Buulo Caddey in the north and the town of Saakow in the south. Another area extends along the road from Barka Mumin Dorow to Banada and from there north to the area of Galgalonley. The main area for rainfed agriculture in Saakow, however, is that part of the district which lies in the north-east direction from the town of Saakow, starting a few kilometres outside the town and extending over more than 40 km. It covers the areas of Hoodoy, Qeed Cajuuso, Labi Buul, Finka Weera, Qurdhuuba, Gaduudey, Golooley, Bagaadey and Goomir.

In Bu'aale District, where only 2 per cent of the rainfed land in the Juba Region is found, the rainfed fields are concentrated around the town of Bu'aale next to both river banks.

In the district of Jilib the Study Area was limited to those rainfed areas which extend along the river downstream of Fanoole. They are scattered mainly along the right side of the Juba River, west of the Little Juba in the north and inside and around the project area of the Juba Sugar Project

in the lower part of the district. The land under rainfed agriculture in Jilib District is also only about 2 per cent of the total. The Homboy area has not been included in the Study Area.

In Jamaame District 16 per cent of the rainfed land in the Juba Region is located. On the right side of the river there are scattered small areas beginning south of the Juba Sugar Project, near the river and around the Mogambo Project down to Buurkoy. On the left bank of the river there is a rainfed area east of Kamsuma.

The main rainfed area in this district is the area south of Jamaame, beginning at Bangeeni. From there the area extends down to Miirey, Jannaale and Thurdo. In the east and south-east the borders of the area are the sand dunes of Biilaq, Dema, Galad Ley and Naffa Quur.

The small rainfed areas of Kismayo District, representing only about 1 per cent of the total, are located on the right side of the river between Buulo Guduud and Good Weyn.

In Figure 1 locations of the main areas of rainfed agriculture in the Juba Valley are shown.

1.3 Approach

Investigations were based on the interpretation of aerial photographs, mosaics and on field surveys. Photo-interpretation was carried out first in order to determine the location and extent of the rainfed farming areas in the districts of Bardheere, Saakow and Bu'aale. The 1:50,000 scale photo-mosaics were used to delineate and planimetre the rainfed areas in these districts. For the identification of the rainfed areas in the districts of Jilib, Jamaame and Saakow, the existing photo-interpretations and maps of the "Deshek Study" (1) could be used.

Further interpretation of 1:30,000 scale aerial photos was carried out for selected rainfed areas in the districts of Bardheere, Saakow and Bu'aale, in order to determine the portions of the different land use categories (bush land, fallow and cultivated land) on the identified farm land (2). Selection of areas was done by following the concept that each of the identified farming systems (3) should be represented and the analysis of these areas should allow conclusions to be drawn which would be valid for the total farm area in the districts mentioned. Differentiation of land use categories in the districts of Jilib, Jamaame and Kismayo was based on the

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1) Ministry of Juba Valley Development/GTZ/AHT: Deshek and Small- and Medium-Scale Agriculture in the Juba Valley. Mogadishu 1984.
2) For definitions of different land use categories refer to Chapter 3.2.1..
3) Farming systems are described in Chapter 4.

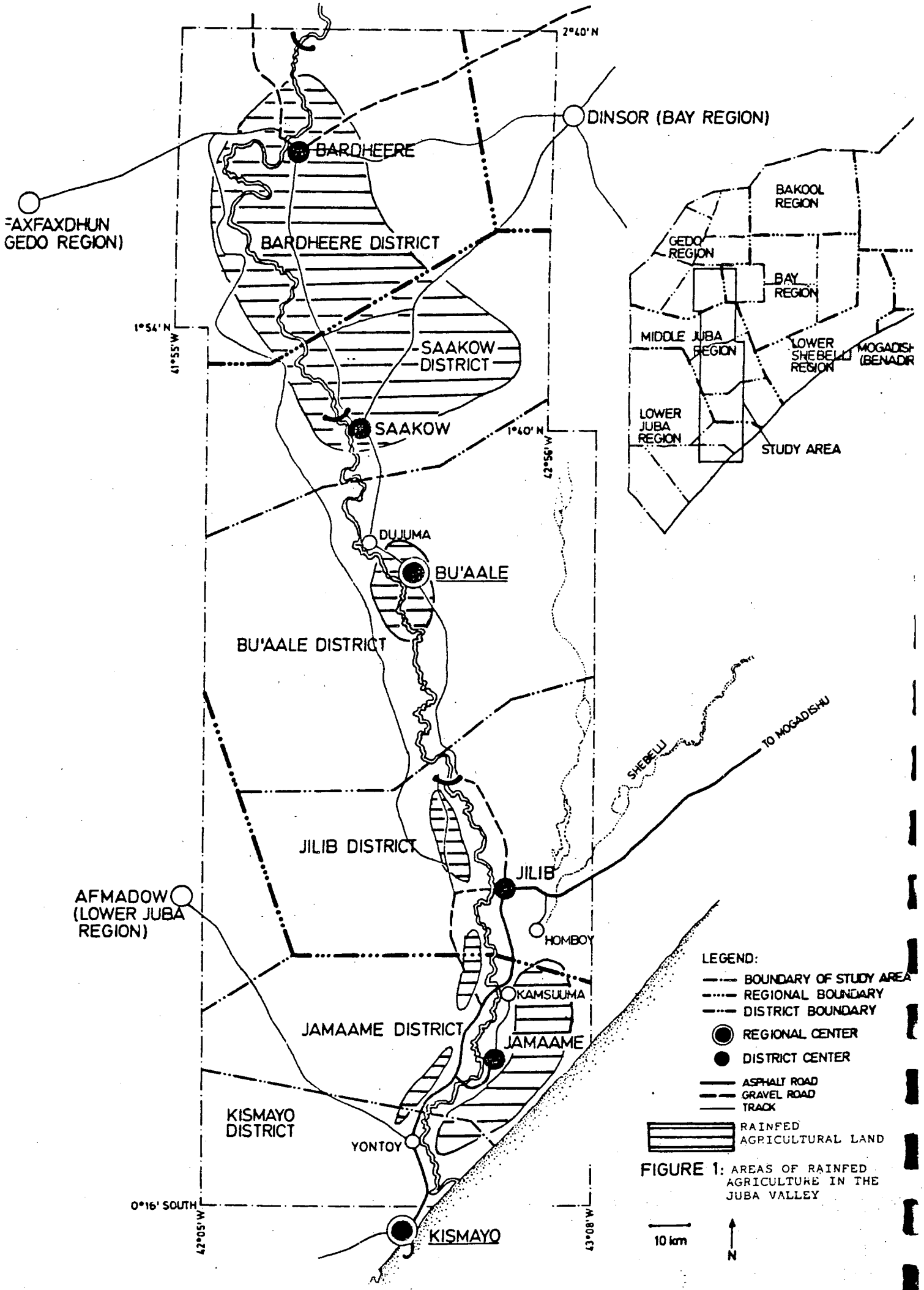

FIGURE 1: AREAS OF RAINFED AGRICULTURE IN THE JUBA VALLEY

interpretation of the "Deshek Study". This interpretation was made in a distinct way by distinguishing three degrees of land use intensities (1). For unutilized land, no differentiation was made between bush land and fallow land. During the field visits some adjustments were made as to the land use intensities given on the land use maps of the "Deshek Study".

Photo-interpretation of 1:30,000 scale photos was also applied for determination of farm sizes. For various villages which were thought to be typical for larger areas and for the different farming systems, the borders of the farm land were determined exactly according to the indications given by the village authorities and then drawn on the photographs. By planimetring the area and questioning a number of farmers from each village, average farm sizes could be calculated. A distribution of farm sizes was then assessed according to the additional information received with regard to numbers or percentages of farmers belonging to different farm sizes.

Secondly, a field survey was carried out in order to verify the results from photo-interpretation and to make interviews, farm visits and visits to the offices of the Agricultural Coordinators from the Ministry of Agriculture in the districts.

Two types of interview were carried out. The first type took the form of questioning village authorities such as the religious leader (sheikh), village headman or members of village committees. They were asked questions with regard to:

- land ownership
- number of farm families
- farm sizes
- role of livestock
- relationships to nomads
- degree of sedentarisation
- labour situation
- attitudes towards irrigated agriculture
- problems of and constraints to rainfed agriculture.

The authorities of those villages selected for determination of farm sizes (as mentioned above) were invited to give such interviews and as many more as possible from the villages passed were also consulted.

For the second type of interview, questionnaires were used containing questions specifically for rainfed farmers on the following aspects:

- farm and family size
- agricultural production
- farming practices

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1) high intensity: over 90 per cent cultivated; moderate intensity: 50 to 90 per cent cultivated; low intensity: less than 50 per cent cultivated

- livestock
- transport, storage and marketing
- farm income
- farm labour

As many farmers as time would allow were asked in all parts of the Study Area.

In order to verify some of the answers given by the farmers interviewed and to get additional information on possible yields, planting distances, harvesting and storage methods etc., farm visits were undertaken to the fields of the farmers interviewed and to many other fields while travelling through the rainfed areas.

In addition, information on farm sizes, number of registered farmers and general information related to rainfed agriculture in the districts was obtained from the Agricultural Coordinators from the Ministry of Agriculture.

2. Climate

The major part of the Juba Valley has an arid climate, i.e. throughout the year monthly potential evaporation exceeds monthly rainfall. The average annual rainfall is about 400 mm. In the north, represented by Luuq, this value is even lower at only 300 mm. Only the area around Jilib, represented by the stations Mareerey and Alessandria, can be characterized as semi-arid: average annual rainfall total is 700 mm and during the months April and May monthly rainfall exceeds monthly potential evaporation.

Although annual totals over the remainder of the Juba Valley do not vary much, considerable differences occur in distribution. Each of the rainfall station, from which data are contained in this report, shows its own specific rainfall pattern.

Traditionally, in the Juba Valley is divided into four seasons:

- Jilaal, from December to April, usually dry
- Gu, from April to June, a wet season
- Xagaa, from June to September, a mainly dry season with sometimes isolated showers
- Der, from September to December, a wet season.

The beginning and end of the seasons may be fixed calendar dates, (as with seasons in Europe). However, for the agricultural production it is more appropriate to think in terms of climatological seasons, whose beginning and end may vary from year to year.

At Jamaame, close to the sea, the rainfall pattern is most reliable during Xagaa, though this season does not bring the highest amount. Rains in Der are unreliable, occurring sometimes in September, sometimes in October. Agriculturally significant rainfall occurs only in the continuous period from April to July.

At Mareerey, a little bit further inland, rainfall in June and July is still significant but both Gu and Der seasons are much more pronounced than in Jamaame. The months with agriculturally significant rainfall are April to July and October to November. The median rainfall in April, May and November exceeds 100 mm/month.

At Bardheere, rainfall during the season of Xagaa is insignificant. The rainfall pattern of Der is similar to the pattern of Gu. The periods, during which rainfall can be expected with some reliability, are from the beginning of April to the middle of May and from middle of October to the middle of December. The shortness of the rainy seasons explains why rainfed agriculture in the middle and upper Juba Valley quite often fails.

At Luuq, in the upper Juba Valley, the periods during which rainfall can be expected in Gu and Der are still shorter than at Bardheere. There are hardly any rains during Xagaa, nor during Jilaal as is sometimes the case in the upper parts of the catchment in Ethiopia in Jilaal. At Luuq, hardly any rainfed agriculture is possible. Further north, towards Doloow, it becomes even drier (almost semi-desert climate).

Direct measurements of evaporation are only available for Mareerey. The mean annual total amounts to 3,000 mm. This amount is considerably higher than the figures obtained through the application of one of the Penman formulae, used in previous studies.

The most probable explanation for this difference is that the data used for the Penman calculations have been wrong or at least inaccurate. An important factor in evaporation is wind speed. Due to poor maintenance of instruments, often too low windspeeds are measured. Furthermore, at Mareerey it has been observed that average wind speeds during the day (when the sun is strong and thus the larger portion of evaporation takes place) are up to five times as high as during the night. Working with mean monthly figures, not distinguishing between day and night, must therefore result in too low evaporation values.

The Jamaame area, which is closer to the sea than Mareerey, may have an annual potential evaporation of less than 3,000 mm. On the other hand, the larger part of the Valley, from Kaytooy onwards to Doloow at the border, is hotter and drier than the Mareerey area and will therefore have a potential evaporation that exceeds 3,000 mm per year.

At Mareerey it has been observed (and this phenomenon will be valid for the whole Juba Valley), that the highest values of potential evaporation occur at the end of Jilaal season (February, March). With no effective rainfall, water requirements for irrigated agriculture will be at their maximum during this period. Lowest values in potential evaporation occur in May, when rainfall is high and sunshine is least. The mean monthly total rainfall data for the stations at Luuq, Bardhèere, Alessandria, Mareerey and Jamaame are shown in Figures 1-4, APPENDIX C. Figure 5 of APPENDIX C shows the daily total Pan Evaporation at Mareerey in 1983.

3. Land Tenure

3.1 Land Ownership

There are two different systems on which land ownership is based in Somalia, the codified land use rights and the traditional land tenure system.

Officially, since 1975, when the Land Reform Law No. 73 came into force, all land has been state owned and the Government is entitled to grant concessions to individuals or groups which give them the right to land use under the following conditions:

- The size of a private holding is limited to a maximum of 30 hectares for irrigated land and 60 hectares for rainfed land.
- The Ministry of Agriculture (MOA) may allocate any area of land at its discretion to state farms, enterprises and cooperatives.
- All land is registered by MOA.
- The validity of the lease is 50 years and it can be extended.
- Private holdings can be inherited.
- The leaseholder must develop the land within two years or the lease will be reallocated by the Government.
- The leaseholder is not allowed to rent, sell or subdivide the land.

It can generally be said that the directions of the law in practice are of little importance in the Juba Valley. They have only been applied to a very limited extent in the areas of irrigated agriculture. In the rainfed areas, however, the prevailing land tenure practice is still based on the traditional system.

According to the traditional rights, the community of each of the main villages (beel) lays claim to a certain area, the delineations of which may have been fixed a long time ago.

This land is distributed between the main village and a number of sub-villages. The community land includes common land and private land(1).

Common land is either unused waste land or bush and rangeland which is commonly used by the populations of the main village and the sub-villages. The main uses of this piece of common land are grazing, the extraction of fuel wood, construction materials, wood for tools and utensils, the collection of honey, fibres and resins and for hunting. Nomads are also allowed to enter this area and use it in the same way as the village people. In general it is assessed that in the whole Study Area the common land still has considerable cultivation potential thus providing a reserve for future expansion of the community.

The private land which is distributed amongst the village population consists of the housing area and farm land, both of which are regarded as private property. The farm land is not normally used completely for crop cultivation. Part of it is left fallow and another part is bush land which is used as graying ground by the families' animals. The owners of private land have an almost unlimited right to dispose of it as they wish. They may use it themselves or they can lease it to other farmers from the village or from outside. Farmers are even allowed to sell their land. Inheritance of land and other properties is regulated according to the Islamic religion.

Purchasing, selling and leasing of private land as well as the distribution of common land to private persons are controlled by the local authorities such as village headmen and village committees or the religious leaders (sheikhs). They become involved when a farmer of the village needs to expand his farm or if his son marries and wants to establish his own farm, or if a neighbour leases part of his land for a limited time or sells it. In such cases the village authorities deal with the contractual aspects and charge the corresponding fees.

But also persons from outside the village community can acquire land on the basis of lease or property. Such people, who are generally nomads, wishing to settle permanently or temporarily, may ask either the village authorities for a piece of common land or a farmer for the lease or purchase of a part of his private land. In both cases the contracts are handled by the authorities. Settlers from outside have the same land use rights as the village people, as long as they cultivate it. If, however, they stop cultivating the land for a consecutive number of years (2), the land use right is abolished and returns to the original owners, either the village community or the farmer.

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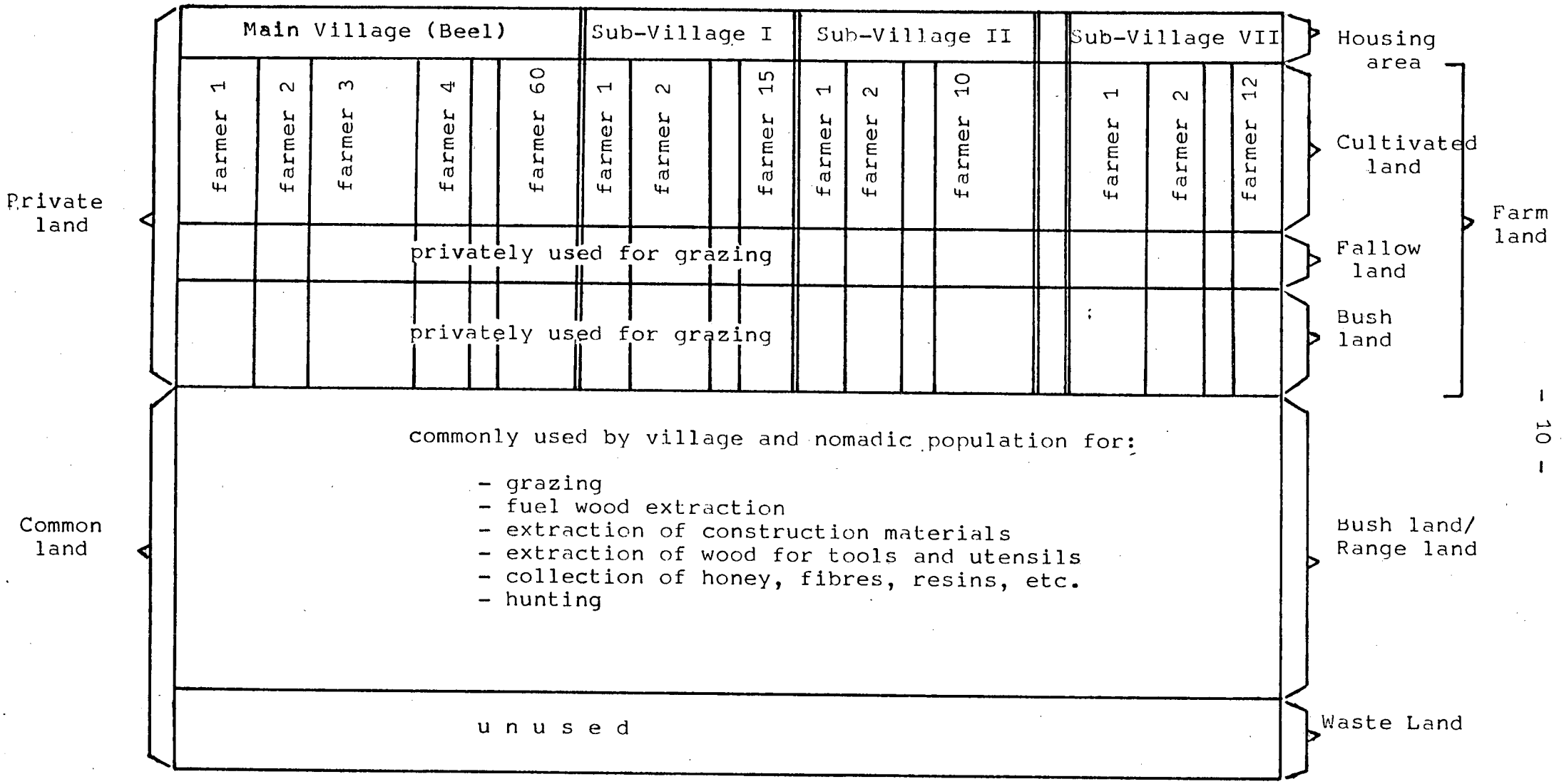
1) Figure 2 shows schematically the distribution of community land.
2) The numbers indicated differ from 3 to 10 years, the latter being the one which was mentioned most frequently.

Figure 2 : Distribution of Land belonging to a Village Community



Source : Own investigations

3.2 Total Farm Land in the Study Area

3.2.1 Definitions

In this report different terms are used for the areas connected to rainfed agriculture. To get a clear understanding of the meaning of these terms, they have been defined and are explained in the following sub-chapters.

3.2.1.1 Farm Land

Farm land is defined as the area which a farmer and his family claim to possess. The land title has been either registered by the Ministry of Agriculture, given by village authorities, or has been inherited. For more details, the above Chapter 3.1 is referred to. The farm land consists in general of bush land, fallow land and cultivated land.

3.2.1.2 Bush Land

Bush land is that proportion of the farm land which is not used for rainfed agricultural production, but is used to keep animals for parts of the year or all-year-round.

3.2.1.3 Cultivated Land

The farm land, reduced by the proportion of bush land, is defined as the cultivated land. This cultivated land consists of the area actually used for rainfed crop production together with the land used as fallow land. The fallow land can have been bound into a crop rotation system, but also may not be cultivated for a certain period, due to lack of manpower.

3.2.1.4 Cropped Area

The cropped area is that proportion of the cultivated land which is either annually or seasonally used to grow crops under rainfed conditions.

3.2.2 Total Farm Land in the Study Area

The methodological approach of the determination of the total farm land in the Study Area used for rainfed production has been described in Chapter 1.3. The total farm land per district is presented in Table 1 of APPENDIX A. A summary of this table is given below.

Table 1 : Rainfed Farm Land in the Study Area

District	Total Rainfed Farm Land in hectares	Percentage of Total Rainfed Farm Land
Bardheere	58,350	49.3
Saakow	35,250	29.8
Bu'aale	2,050	1.7
Jilib	2,450	2.1
Jamaame	19,100	16.1
Kismayo	1,200	1.0
Total	113,400	100.0

Source: Own compilation and Table 1 of APPENDIX A.

From this table it can be noted that the total, rainfed farm land in the Study Area comes to around 118,500 hectares. The main areas are found in Bardheere, Saakow and Jamaame Districts whereas Kismayo District has the smallest area.

3.2.3 Bush, Fallow and Actual Cultivated Land

In order to derive the amount of cultivated land from the total farm land in the Study Area, the following procedure for the various Districts was followed:

- Bardheere District: the area for a total of 9 selected villages was interpreted on the 1:30,000 scale aerial photos. The area belonging to the 9 selected villages (1) represented 19 per cent (10,940 ha) of the total farm land in the Bardheere District (58,350 ha). The interpretation existed of the determination of the bush, fallow and actual cultivated area. The areas determined were then planimetred and calculated.

- Saakow/Bu'aale Districts: the same procedure was followed as described for the Bardheere District. The area belonging to four selected villages (1), represents 23 per cent (7,750 ha) of the total farm land in the Saakow/Bu'aale Districts (35,250 ha). By planimetreing the total farm land, the bush land, the fallow land and the area actually under cultivation were calculated.

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1) The villages in the Bardheere District are: Mantaniaha, Sarinley, Aminaay, Xanaale, Tobaaco, Baarow Diinle, Gargelis, Garaska Shabada and Hilo Shiid.
The villages in the Saakow/Bu'aale Districts are Buulo Batuulo, Gurmeyso, Barka Mumin Dorow and Qeed Cajuuso.

- Jilib, Jamaame and Kismayo Districts: the total farm land for rainfed production was planimetred and mapped in the course of the Study on Desheks, Small and Medium-Scale Irrigated Agriculture in the Juba Valley. Simultaneously the degree of utilization of the rainfed areas had been assessed and this information also incorporated in the maps. During the present field investigations these assessments were verified and more precisely determined for the various areas.

The results of the photo interpretation showed that:

- In Bardheere District an average of 17 per cent of the total farm land is bush land. This figure varies greatly between the selected villages. Whereas in the farm land belonging to the village of Xanaale only 7 per cent of the area was identified as bush land, the farm land of the village of Mantaniaha showed 24 per cent of bush land.

- In Saakow/Bu'aale Districts, an average of 22 per cent of the farm land was classified as bush land. This percentage varied for the farm land of the village Barka Mumin Dorow (8 per cent bush land)to 37 per cent bush land for the village of Gurmeyso.

In addition part of the cultivated land is left fallow. Fallow land is normally not included in a crop rotation system for the usual reason of allowing the land which has been used for a long time to regenerate, but for the following reasons:

- a farmer may have died and the land is not used by his successors or relatives

- it may have happened that several consecutive dry seasons occurred. Some settled farmers have subsequently left the land and gone with their animals to grazing places

- the farmer has stopped cultivating his land because he is a nomad and he leaves the fields to move on with his animals.

The areas identified as fallow land were:

- Bardheere District: an average of 13 per cent of the total farm land, varying between 3 per cent around the village of Baarow Diinle and 30 per cent around the village of Sharinley. This high percentage of fallow land for Sharinley village was due to severe locust attacks for the past three years. This discouraged a large number of farmers from growing crops. This was the only case noted in the field study where locust attacks were the reason why farmers abandoned their fields.

Table 2 Land-Use Classification in the Study Area

District	Total farm land in ha	Bush Land in ha	Fallow Land in ha	Unutilized land in ha	Area under actual crop production in ha	Area under actual crop production in per cent of total farm land
Bardheere	58,350	9,920	7,586	17,506	40,844	70.0
Saakow	35,250	7,755	4,230	11,985	23,265	66.0
Bu'aale	2,050	451	246	697	1,353	66.0
Jilib	2,450	-	-	1,925	525	21.4
Jamaame	19,100	-	-	9,810	9,290	48.6
Kismayo	1,200	-	-	1,080	120	10.0
Total	118,400	18,126	12,062	43,003	75,397	63.7

Source: Own Calculations and Tables 1-4 of APPENDIX A

- Saakow/Bu'aale Districts: an average of 12 per cent of the total farm land, varying between 8 per cent in the village of Gurmeyso to 15 per cent around the village of Barka Mumin Dorow.

From these identifications it can be noted that the areas actually used for crop production would come to 70 per cent of the total farm land in Bardheere District and 66 per cent for the farm land in Saakow/Bu'aale Districts.

For the Jilib, Jamaame and Kismayo Districts the area used for actual cultivation was calculated by using the land utilization as shown on the available maps. Bush land and fallow land were not identified on these maps. The calculation of the areas under cultivation in these districts is shown in detail in Tables 2-4 of APPENDIX A. The results of the calculation of bush land, fallow land and land used for actual crop production is summarized in Table 2.

From Table 2 it can be noted that out of the 118,400 ha farm land in the Study Area around 75,500 ha are used for rainfed crop production.

3.3 Size of Farm Holdings and their Distribution

3.3.1 Introduction

As mentioned previously in Chapter 1.3, information on farm sizes has been obtained by determining the size of village land through photo-interpretation and asking the village authorities for the number of farm families belonging to the villages, by questioning the local people about farm size distribution and by evaluating the statistics of the Agricultural Coordinators in the districts.

3.3.2 Bardheere District

Since in this district only a very small percentage of farmers is registered by the Ministry of Agriculture, the assessment of farm sizes for the different areas was based mainly on the interpretation of aerial photographs and interviews with local authorities as has been described in Chapter 1.3.

The results of these investigations are shown in detail in Table 5 of APPENDIX A. For a total number of 21 villages a total farm area of over 27,000 hectares could be allocated. This area represents 53 per cent of the whole farm land in the Bardheere District. The land belongs to about 3,200 farm families which gives an average of nearly 9 hectares per farm. The indications as to the number of farm families given by the

village authorities may not be accurate in every case and are sometimes rather doubtful. However, due to the high coverage of the area during the investigations, the result is considered to be fairly reliable. Information regarding the number and/or percentage of farms in the villages belonging to the different categories of farm sizes was obtained for nine villages thought to be typical for the district. Here also some information which was received in the villages seems to be questionable. But on the whole, the distribution of farm sizes shown in Table 3 which is based on figures regarding a farm area of over 11,000 hectares (20 per cent of the total farm land) gives a correct picture of the actual situation.

Table 3: Distribution of Farm Sizes in Bardheere District

Farm Sizes in ha	per cent
1 - 5	33
5 - 10	27
10 - 15	21
15 - 20	9
20 - 50	8
50	2

Source : Table 5, APPENDIX A

It is not possible to draw general conclusions from the information available as to differences in farm sizes between the different "Farming Systems" in the Bardheere District, as described in Chapter 4. For example, it seems that in the areas of mixed irrigated and rainfed agriculture the portion of irrigated land is too small when compared with the total farm land, to influence the average farm size figures. It has however been observed that when farmers have irrigated and rainfed land, the rainfed part of the farm is much smaller than the calculated overall average of nine hectares. For the remaining rainfed areas it was found that the semi-settled farmers generally cultivate less land than the permanently settled nomads and the traditional crop cultivators. This is mainly due to the fact that the semi-settled families are smaller than the others, or that only parts of nomads' families settle. As a rule it can be said that an average of one hectare of cultivated land is required per family member. Since there is no shortage of land it is possible to draw approximate conclusions as to the numbers of population involved and the size of farmers' families, according to the amount land cultivated in the rainfed area.

3.3.3 Saakow/Bu'aale Districts

Ninety per cent (31,800 hectares) of a total rainfed farm area of about 35,000 hectares in Saakow District are registered at the Ministry of Agriculture's office. Registration includes information about the distribution of farm sizes in 33 of the most important villages in the district. This is shown in Table 6 of APPENDIX A, in which the information was completed by photo-interpretation and interviews as described in Chapter 1.3.

The following Table 4 summarizes the percentage figures corresponding to each farm size category in the villages of Saakow mentioned in Table 6, APPENDIX A.

Table 4: Distribution of Farm Sizes in Saakow District

Farm Size in ha	per cent
1 - 5	39
5 - 10	32
10 - 15	13
15 - 20	6
20 - 50	9
50	1

Source : Table 6, APPENDIX A

The land under consideration belongs to nearly 3,300 farm families giving an area of almost 10 hectares per farm. Unlike in Bardheere District, a clear difference in farm sizes can be seen amongst the farmers from those villages where mixed, irrigated (in Saakow mainly deshek) and rainfed agriculture is practised. The rainfed area of the farms is only five hectares on average.

Also no difference has been observed in average farm sizes between the two farming systems which are described in Chapter 4 as "Traditional Rainfed System" and "Settled Nomads' System". The overall average of farm sizes in these two groups is over 11 hectares. For the "Semi-Settled Nomads' System", however, a smaller farm size of on average 7.5 hectares was again found. As in Bardheere District, the farm sizes coincide with the number of family members. Where rainfed farming is predominant, an average of one hectare is required

for each family member. Where farm sizes are smaller, either the family sizes are smaller (as in areas of semi-settled nomads' families) or additional land is cultivated under irrigated conditions (as in the mixed deshek/rainfed villages).

Table 6, APPENDIX A also shows the distribution of about 1,200 hectares of rainfed land between the different farm size categories in the Bu'aale District. This area represents nearly 60 per cent of the total farm land identified as being under r infed conditions in the district. The relatively high figure of 13 hectares for the average farm is influenced by 25 recently established large farms of up to 50 hectares each, which are not typical for the rainfed agricultural sub-sector in the Juba Region. They belong mostly to newcomers to the area who have applied for land in order to speculate.

Table 5 shows that, disregarding the untypical farms, the bulk of farms are grouped into the category of 1-5 hectares. This coincides with the field observations which have revealed that the whole Bu'aale District is an area of nomadic movement rather than of crop production, the latter only being carried out sporadically. Table 5 shows the farm size distribution of Bu'aale District.

Table 5: Distribution of Farm Sizes in Bu'aale District

Farm Size in ha	per cent
1 - 5	37
5 - 10	19
10 - 15	13
15 - 20	6
20 - 50	25
50	-

Source : Table 6, APPENDIX A

3.3.4 Jilib, Jamaame and Kismayo Districts

In Jilib District only 25 farmers with 234 hectares of farm land are registered at the Ministry of Agriculture. The area represents 10 per cent of the identified farm land in the district cultivated under rainfed conditions (1). The average farm size is nine hectares which is the same as in the rainfed areas upstream. No differentiation of farmers belonging to the different farming systems as described in Chapter 4 could be observed. They are all in the same category of "Traditional Rainfed" farmers. The distribution of farms between the farm sizes is shown in Table 6.

Table 6: Distribution of Farm Sizes in Jilib District

Farm size in ha	per cent
1 - 5	48
5 - 10	24
10 - 15	24
15 - 20	-
20 - 50	-
50	4

Source : Table 7, APPENDIX A

A total of 27,500 hectares of farm land from the Jamaame and Kismayo Districts are registered in the Jamaame office of the Ministry of Agriculture. This represents 75 per cent of the total of 36,500 hectares of rainfed, deshek and irrigated land on small and medium-scale farms.

However, in most cases the registered land has not been clearly classified into one of the categories of rainfed, deshek or irrigated land. Out of the total registered land only about 3,400 hectares could be clearly identified as rainfed land, distributed over about 1,400 farms. This area represents 17 per cent of the total rainfed area in both districts. This results in an average farm size of 2.4 hectares which is only about one quarter of the average farm size in the remaining rainfed areas in the Juba Valley. From Table 7 it can be seen

1) Not included in the Homboy area.

that 98 per cent of the registered farms belong to the category of the one to five hectare farm size. From the field investigations and the information received from the local authorities in the two districts it was found that almost all the smallholder farmers belong to the category of "Mixed Deshek and Rainfed" farmers. That means that most of the farmers, even those who live up to 10 or 12 kilometres away from the river, cultivate (in addition to their plot of rainfed land) part of their farms in a deshek. This part may be of a similar size to the rainfed part or even bigger. According to the "Deshek Study" (1) the average deshek land belonging to one farm is around two hectares.

Apart from the "mixed" type of farm there are a relatively small number of pure rainfed farms, the average farm size of which is estimated to be around five to seven hectares.

Table 7: Distribution of Farm Sizes in Jamaame and Kismayo Districts

Farm Size in ha	per cent
1 - 5	98
5 - 10	1.2
10 - 15	0.5
15 - 20	0.3
20 - 50	0.5
50	-

Source : Table 7, APPENDIX A

1) MJVD/GTZ/AHT, Deshek and Small and Medium-Scale Irrigated Agriculture in the Juba Valley.

4. Farming Systems

4.1 Introduction

The survey on rainfed agriculture shows that this sub-sector is not as uniform as it seemed to be. There are different types of farmers involved in rainfed farming. In order to distinguish between different groups of farmers and their different economic systems, the term "farming system" is used. In principle the systems identified belong to two main socio-economic groups; namely the traditionally sedentary cultivators who have settled along the river and the traditionally nomadic pastoralists.

There have always been economic relations between the farmers at the river and the nomads. This system was based on the fact that the nomads had to approach the river during the dry seasons to find water and food for their animals and for themselves. In the course of time a system of exchange of goods has developed, following the nomads' regular movement patterns and by means of which agriculturalists provide the nomadic families with staple food, mainly sorghum and maize, as well as articles for daily use. The nomads in return supply the sedentary farmers with meat, milk and butter (ghee). This kind of relationship is still functioning very well as far as can be judged from the impressions obtained during the field surveys.

Apart from such traditional relations between the two systems of sedentary cultivators and nomadic pastoralists, a process of development and integration of both systems has taken place and is still continuing. This process consists of two components:

- expansion of the areas of cultivation from the river into the areas of nomadic migration

- sedentarisation of nomads in areas adjacent to the traditionally cultivated areas.

As a result, different farming systems of rainfed agriculture have been formed, founded on the original socio-economic systems of sedentary agriculture and nomadic livestock keeping. The following four farming systems have been identified:

- mixed irrigated/rainfed system
- traditional rainfed system
- settled nomads' system
- semi-settled nomads' system.

These systems differ with regard to the following criteria:

- degree of sedentarisation
- settlement pattern
- relationships with nomads
- importance of livestock keeping.

In the following, a short characterisation and description of the location of each of the farming systems will be given.

4.2 Mixed Irrigated/Rainfed System (System I)

This system prevails in the cultivated areas along the river in all districts of the Study Area with the exception of Bu'aale where only systems II and IV are found. The farmers of System I belong to that population group which started immigrating into the Juba Region over one hundred years ago. They originated from Kenya and Tansania, first coming to the Lower Juba reaches and later moving on to settle further upstream as well. After settling they remained at their newly founded villages unlike the original nomadic population of that region. Many of these villages were founded around one hundred years ago from which time on the settlement structure remained almost unchanged. These farmers have always traditionally been cultivators. After they came to the Juba Valley, they first cultivated the fertile land next to the river and later on, as the population increased, they also cultivated rainfed land. Nowadays, many farmers of this area have both rainfed and irrigated land. Most of the irrigated land is under uncontrolled irrigation lying in the depressions near the river which are locally called "desheks". A small portion of land is also irrigated by pumps. Irrigated farming is normally the economic fundament of this type of farm. Rainfed farming is practised in addition because the irrigated farm area is not sufficient and also because the deshek crops are frequently destroyed by floods caused by rains and river water. Thus rainfed farming constitutes an element for reducing the risk which is connected with deshek cultivation. On the other hand it can be said that irrigated cropping reduces the risk of the farm family which exists for rainfed farming because of the erratic rainfalls in the region. The rainfed area of the average farm in this system is generally smaller when compared with the farms of the other systems. On average they possess five to seven hectares of rainfed land. Most of the farmers in the mixed Irrigated/rainfed system also keep animals. However, the importance of livestock keeping is low. This is an important criteria in distinguishing this farming system from the others, in particular the nomadic systems III and IV. In the nomadic systems livestock still constitutes an important economic factor besides crop cultivation. It can be seen as an investment for securing the food supply of the family in times of drought and during crop failures. As mentioned above, compensation for risk in system I is striven for by combining rainfed and irrigated crop cultivation.

4.3 Traditional Rainfed System (System II)

This system was identified in Bardheere District where it extends between Korkamaarey in the north and Barta Fanye in the south and between Xanyaale and Kukale in the west and Tobaako in the east.

In Saakow District the area between Golooley in the north, Marmarka in the south and west and Goomir in the east belongs to system II.

In Jamaame District this system includes all the identified rainfed land on the right side of the river beginning south of the Juba Sugar Project and ending in the area of Yontooy.

System II has developed from the socio-economic system of the immigrated cultivators. Descendants of those farm families who first came to settle along the river have moved away in search of new land for cultivation. They settled down permanently in villages of the areas described above and concentrated on rainfed farming. The settlements are of the same type as those in the villages near the river. The families do not normally have any close relationships with the nomads. Like the farmers at the river they only exchange sorghum, maize and articles of daily use for meat, camel milk and butter.

The importance of livestock for the farmers in System II is similar to that of the mixed irrigated/rainfed farmers. Some cows, goats and sheep are kept for the supply of milk and occasionally meat. Basically, however, this group of farmers rely heavily on rainfed agriculture. Unlike the other three farming systems, where the risk of rainfed farming is compensated to a certain degree by either irrigated farming or bigger livestock herds, these purely rainfed farmers have no other economic activities which would allow compensation for risk.

4.4 Settled Nomads' System (System III)

villages where the population is of nomadic origin were found all over the Study Area. However, although some of them are even situated near to the river, it can generally be said that most of the nomadic settlements lie in the rainfed areas far away from the river.

The population of these villages constitutes the sedentary part of the nomadic society which remains permanently settled. No differences were observed with regard to house types or the layout of villages.

The main differences between the farmers of this system and the first two systems described above lie in the close relationships which the former maintain with the nomadic society

and the economic importance of livestock keeping. Livestock keeping is the second main component of this economic system. Apart from a few cows and some sheep and goats for milk and meat supply and one or two animals for transport, which are kept in and around the village, such farmers maintain larger herds of cattle and camels. These herds are normally looked after by farmers' relatives.

Relationships of this kind between the nomadic and the sedentary parts of a family can be seen as an economic reinsurance system advantageous to both groups. The farmers benefit because in case of crop failure they can rely on their animals to be sold and used for consumption. In return, the rainfed farms of the sedentary part of their families constitute a permanent source of staple food and goods for daily use for the nomads. The average farm size is around 10 hectares, mainly used for sorghum growing.

4.5 Semi-Settled Nomads' System (System IV)

This system is mainly found in the Bardheere and Saakow Districts in the areas close to the villages of the permanently settled nomads. The farmers of this group carry out rainfed farming on a temporary basis. They come as single families or in small groups to the villages where they personally have relatives or which belong to their tribe, asking for land to be cultivated. Normally they will get a piece of land at the border of the cultivated land, something which is no problem because there is still enough unused cultivable land. There they build nomadic-style huts (agal) either jointly with other families thus forming a little village or each one separately on his own farm. After a few cropping seasons most of these farmers again return to nomadic life. Thus it quite often happens that nomadic villages and farms in such areas are established and abandoned frequently at irregular intervals. During their sedentary phase, these principally nomadic people keep up their relationships with the herdsmen who look after their livestock herds, these being maintained at full size. Food production on their comparatively small farms (average six hectares) consists mainly fo sorghum growing which is used for consumption by themselves and by the pastoralist part of the family.

5. Agricultural Production

5.1 Introduction

This Chapter deals with topics on the agricultural production under rainfed conditions, such as crops grown, cropping patterns, cropping intensities, crop rotations, agricultural practices, the total crop production and sedentary livestock and pastoralism. For case of reference the presentation in this report is done by districts. However for certain districts the descriptions have been combined as the information on agricultural production was found to be similar. This was the case in the districts of Saakow/Bu'aale and in Jilib/Jamaame/Kismayo Districts. The district of Bardheere was found to be the only one where the information gathered during the field trips was applicable only to that district.

5.2 Present Crop Cultivation

There are four climatic seasons to be distinguished:

- Jilaal	21st December	-	20th March
- Gu	21st March	-	20th June
- Xagaa	21st June	-	20th September
- Der	21st September	-	20th December

Gu and Der seasons are the rainy seasons, whereas Xagaa and Jilaal are called "dry" seasons. However during the Xagaa precipitation occurs in the districts of Jilib/Jamaame and Kismayo.

Crop cultivation in Bardheere and Saakow/Bu'aale Districts takes place in Gu and Der seasons. However, as far as the cultivation of sorghum in these districts is concerned, this crop is not always planted in Der season. In many cases ratoon cropping is practised (boqon dhow) which means that after a successful Gu season, the sorghum plants are left on the field for regrowth during the following Der season. From farmers' information it was assumed that this system is applied when the total production of the Gu season is sufficient to cover the food and cash requirements of the farmer's family and his relatives.

If Gu production does not meet such requirements (e.g. low rainfall in the preceding Gu season), sorghum is replanted in Der season. Farmers stated that on average the ratoon cropping of sorghum is practised in two out of five years. It has been taken that around 10 per cent of the farmers in Bardheere District and 70 per cent of the farmers in the districts of Saakow/Bu'aale practise such ratoon cropping of sorghum.

Crop cultivation in the districts of Jilib, Jamaame, Kismayo takes place mainly in the Gu season. In Der season crops are not grown, due to insufficient rainfall.

Although the crops are mainly grown in Gu season, some crops e.g. sesame is planted with maize 6-8 weeks after the maize has been sown. Thus the sesame will benefit from the last Gu rains and will continue to grow on Xagaa rains. Therefore the agricultural seasons do not necessarily coincide with the climatic seasons as mentioned at the beginning of this Chapter. Even at the time of the field trip, most crops were still growing in Xagaa season as the Gu planted crops had been destroyed by floods of the river Juba.

In the northern part of Jilib District it was noted that crops are cultivated under rainfed conditions in Gu and Der seasons. However, as the total rainfed area in Jilib District is comparatively small (see Table 2) and the area where this is practised is even smaller, further calculations and description of such agricultural practices have been omitted. Agricultural practices in Jilib District are regarded as being the same as those in Jamaame and Kismayo Districts. The distinction between the areas where one crop per year and where two crops are grown was found to be the northern boundary of the Mareerey Sugar Estate at the latitude of the township of Jilib.

The main crops grown in the districts are:

- Bardheere District:
  - Gu and Der seasons: maize, sorghum, sesame and some small amounts of beans. In a few cases farmers revealed that some groundnuts were cultivated. Whereas maize, sorghum and sesame are cultivated in pure stands, beans and groundnuts are mainly interplanted with maize and sorghum.

- Saakow/Bu'aale Districts:
  - Gu season: maize, sorghum, sesame and beans, whereby the latter crop is interplanted with maize or sorghum.
  - Der season: maize, sorghum and sesame.

- Jilib/Jamaame/Kismayo Districts:
  - Gu/Xagaa seasons: maize, sesame, cotton,beans and groundnuts. Maize and sesame can be planted as pure crops, but also a wide range of intercropping is practised e.g. sesame and maize, sesame, maize and beans, cotton and beans, maize and beans, sesame and groundnuts.

Maize, sorghum and beans are mainly used to supply the farmer's family and to a certain extent his relatives, with staple food.

On one occasion in the village of Hilo Shiid in Bardheere District, farmers mentioned that maize was harvested at a green stage for direct consumption. This was done to bridge the gap of available staple foods which occurs before the Der crops have been harvested.

Sesame, groundnuts and cotton are sold and supply the farmers with necessary cash.

5.3 Crop Varieties

The crop varieties found in the Study Area are:

- maize:
  Mixed local varieties with white and yellow dented seeds are cultivated. They mature in all districts after around 90 days. Then potential yield was estimated at 4-5 t per ha.

- sorghum:
  A mixture of local red and white, long stemmed varieties are cultivated. It matures after around 90 days. Its potential yield is estimated at 3t per ha.

- sesame:
  Five different varieties of sesame are grown in the Study Area. They are:
  . four locule, white seeded Labo Doon
  . eight locule, white seeded Labo Doon
  . four locule, reddish brown seeded Labo Doon
  . four locule, black seeded Labo Doon
  . eight locule, black seeded Labo Doon.
  These varieties are grown mixed and mature in around 90 days in Bardheere and Saakow/Bu'aale Districts and 95 days in Jilib/Jamaame/Kismayo Districts. Their potential is around 0.8 t per ha.

- cotton:
  A medium staple variety, Acala 4-42, is being cultivated in the Study Area. It matures under rainfed conditions in around 150 days. Its potential could not be ascertained due to lack of information.

- groundnuts:
  Local bunch type varieties of groundnuts are cultivated. They are distinguished according to the size of the seeds in large-local and small-local varieties. They are harvested in Bardheere and Saakow/Bu'aale Districts after a growth period of around 60 days; in Jilib/Jamaame/Kismayo Districts they are harvested after 120 days.

- beans:
  A running type of local beans with red seeds is cultivated. After 60 days in Bardheere and Saakow/Bu'aale Districts and 80 days in Jilib/Jamaame/Kismayo Districts the beans are harvested.

5.4 Cropping Pattern, Cropping Intensity and Crop Rotation in the Study Area

5.4.1 Introduction

Within the scope of this Study, cropping pattern, cropping intensity and crop rotation are defined as follows:

- cropping pattern is the sequence of crops grown under rainfed conditions
- cropping intensity denotes the proportion of land planted during a year
- crop rotation is the sequence of crops grown on the same piece of land over a period of one year.

5.4.2 Bardheere District

Based on the information received during the field investigations, cropping patterns according to the four different farming systems (see Chapter 4) have been worked out. They are shown in Table 8.

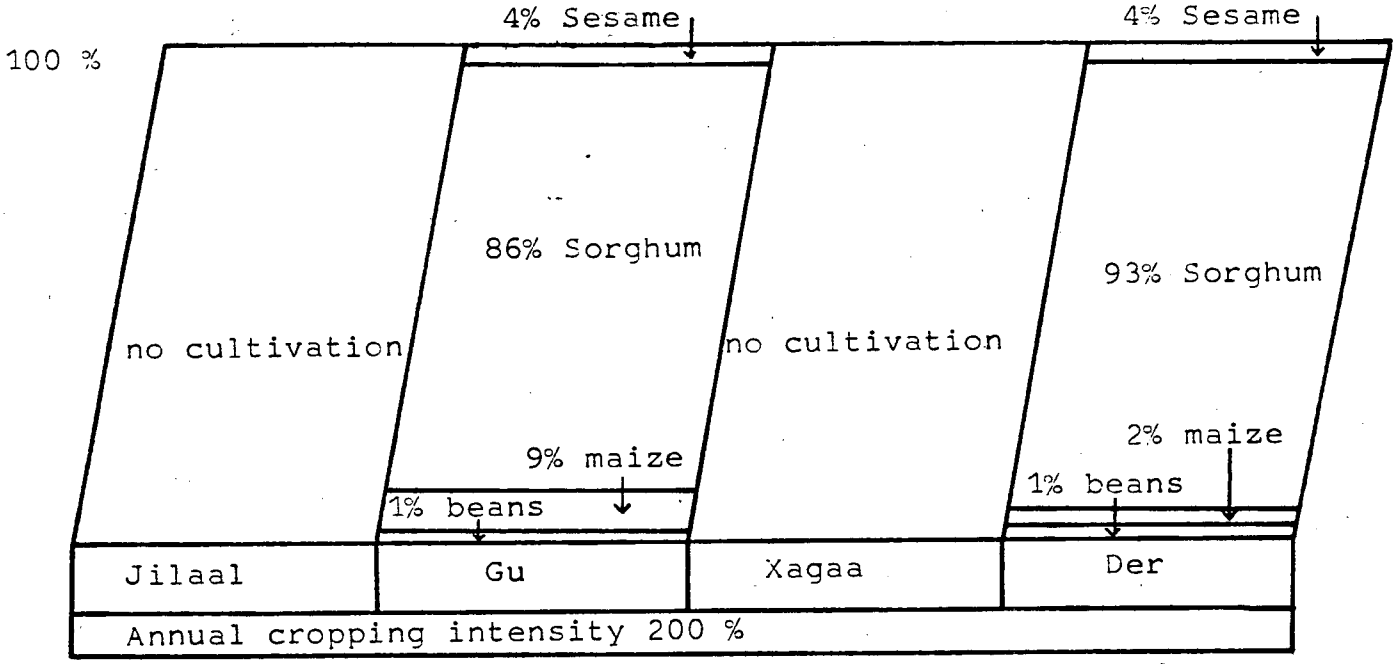
Table 8: Bardheere District: Cropping Patterns According to Farming Systems

Crops	Farming System							
	I	II	III	IV	I	II	III	IV
	Gu Season				Der Season			
	in per cent of area cultivated							
maize	13	11	4	4	3	-	-	4
sorghum	77	84	96	92	85	100	100	92
sesame	8	1	-	2	10	-	-	2
groundnuts	1	-	-	-	1	-	-	-
beans	1	4	-	2	1	-	-	2
Total in per cent	100	100	100	100	100	100	100	100

Source : Own Calculations

The average cropping pattern for the district and the cropping intensity for the area under actual cultivation is shown in Figure 3.

Figure 3: Bardheere District: Cropping Pattern and Cropping Intensity for Land Actually Under Cultivation



Source : Own Calculations

From Table 8 and Figure 3 it can be noticed that:

- The main crop cultivated in Gu and Der seasons is sorghum.
- The proportion of sorghum increases from Gu to Der season at the cost of maize. This is done in connection with the more uncertain rainfall and rainfall distribution in Der season. Sorghum can tolerate the uncertain and erratic rainfall better than maize can.
- In farm system II and III only sorghum is grown in Der season.
- The proportion of land cultivated with beans and sesame is the same for both seasons.
- The area cultivated with groundnuts is too small to be further considered.
- The annual cropping intensity is 200 per cent.

A crop rotation on the farm holdings was not noted. The fallow land is not incorporated into the crop cultivation, but is left until sufficient labour is found to cultivate the fallow land as well.

The areas cultivated with each crop are determined by the staple food and cash requirements of the farmers as well as by the weather conditions in the prevailing season.

5.4.3 Saakow/Bu'aale Districts

Cropping patterns in these districts have been defined according to the farming systems as shown in Table 9.

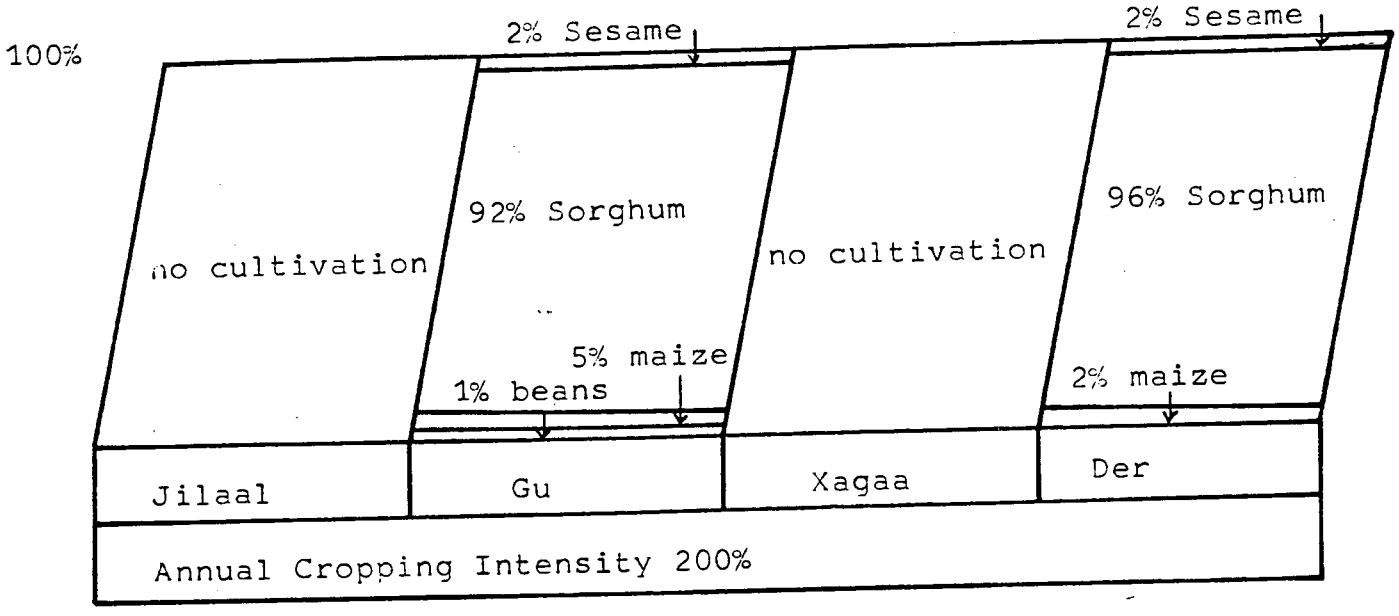
Table 9: Saakow/Bu'aale Districts: Cropping Patterns According to Farming Systems

Crops	Farming System					
	I	II	III/IV	I	II	III/IV
	Gu Season			Der Season		
	In per cent of area cultivated					
Maize	-	3	7	-	-	3
Sorghum	85	85	93	90	95	97
Sesame	15	9	-	10	3	-
Beans	-	3	-	-	2	-
Total in per cent	100	100	100	100	100	100

Source: Own Calculations

The average cropping pattern for the districts and the cropping intensity are shown in Figure 4.

Figure 4: Saakow/Bu'aale Districts: Cropping Pattern and Cropping Intensity for Land Actually Under Cultivation



Source: Own Calculations

From Table 9 and Figure 4 it can be noted that:

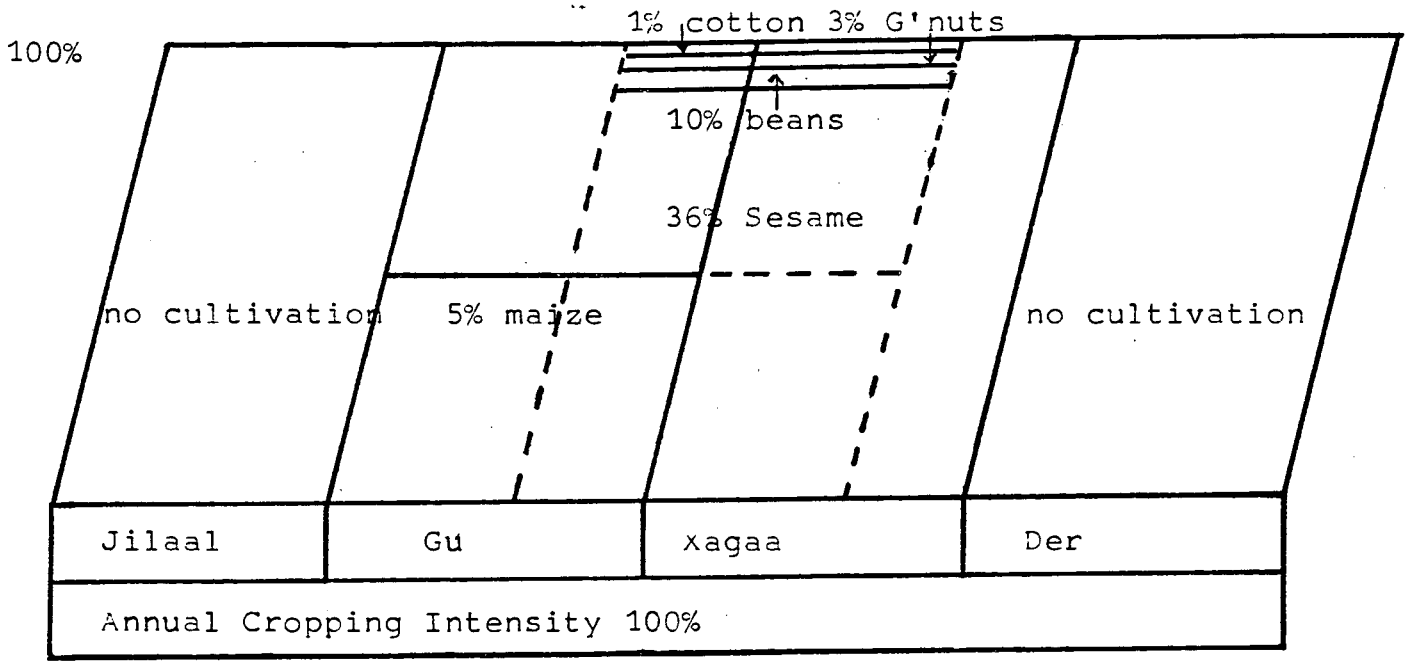
- The main crop grown in Gu and Der season is sorghum.
- The sorghum component is raised in Der season on average from 92 per cent to 96 per cent at the cost of the maize component. This again, as mentioned for Bardheere District is due to the ability of sorghum to endure small amounts of erratic rainfall better than maize.
- In System I maize is not cultivated in Gu and Der season, as this crop is grown in Desheks, where water is more readily available.
- In both seasons on average 2 per cent of the area is planted with sesame.
- The annual cropping intensity is 200 per cent.

A crop rotation on the farm holdings in these districts could not be noted. As for Bardheere District the crops cultivated each season are determined by the climate, the staple food and cash requirements of the farmers' families.

5.4.4 Jilib/Jamaame/Kismayo Districts

Although intercropping is mostly practised in these districts, the proportion of each crop in a farm holding has been calculated based on the information received from the farmers. The result is shown in Figure 5.

Figure 5: Jilib/Jamaame/Kismayo Districts: Cropping Pattern and Cropping Intensity for Land Actually Under Cultivation (1)



Source: Own Calculations.
1) For definitions see Chapter 3.2

From Figure 5 it can be noted that:

- Fallow is not practised in these districts.
- The main crop grown during Gu season is maize as a staple food and cash crop. Sorghum is not cultivated.
- The other crops sesame, beans, groundnuts and cotton are planted in Gu season and ripen in Xagaa season.
- Of these "Xagaa" crops, sesame covers the largest proportion followed by beans and groundnuts. Apart from sesame, which is partly used for cooking purposes (oil), the other part together with beans and groundnuts are cultivated as cash crops.
- The smallest proportion of the area is covered by cotton. This may be due to:
  - the inattractiveness of the government fixed price for the cotton
  - the labour intensive harvest of this crop.
- The cropping intensity is 100 per cent per annum.

As far as a crop rotation system is concerned, farmers revealed that this is not practised. Crops grown and fields allocated are determined by weather conditions (flood occurrences) and market prices.

5.4.5 Total Cropped Land in the Study Area

Based on the definition of cultivated land for Bardheere, Saakow and Bu'aale Districts, the cultivated land per district as shown in Table 2 and the cropping intensities shown in Figures 3-5 ,the cropped land per annum has been calculated. The result is shown in Table 10.

Table 10: Annual Cropped Land in the Study Area (1)

District	Area under actual crop production in ha (2)	Annual cropping intensity in per cent	Annual cropped area in ha
Bardheere	40,844	200	81,688
Saakow	23,265	200	46,530
Bu'aale	1,353	200	2,706
Jilib	525	100	525
Jamaame	9,290	100	9,290
Kismayo	120	100	120
Total	75,397	187	140,859

Source: Own calculations
1) The area for ratoon cropping or sorghum has been regarded as cropped land.
2) Farmland less bush land and fallow land.

From Table 10 it can be noted that the total annual cropped area amounts to around 141,000 ha.

5.5 Agricultural Practices

5.5.1 Introduction

This Chapter gives a description of the current agricultural practises carried out in Bardheere, Saakow/Bu'aale and Jilib/Jamaame and Kismayo Districts. Apart from details on production techniques, the required time for each activity, expressed in man-days, and the related costs are given. These particulars have been transformed from the locally used land measurements and, as in the case of inputs and yields, locally used weights, to hectares and kg and t per ha.

In the Bardheere District the used land measurement is Ta'ab which corresponds with around 1,200 sq.m. In all other districts the land measurement Darab is used, corresponding to around 2,400 sq.m.. By the awarding of tasks to hired labour, a sub-division of the Darab is made. This may be in Saakow/Bu'aale Districts again the Ta'ab (half a Darab) or the Shot, which covers around 400 sq.m. (6 shots to the Darab). In Jilib/Jamaame/Kismayo Districts the Darab is only sub-divided into Shots.

The weights used in the districts are:

1 suus	around 250 gr	1 qt (grain)	100 kg
1 shot	around 60 gr	1 qt (cotton)	30 kg
1 mark	around 125 gr	1 gadiid	around 126 kg

The gadiid weight is used to express the sorghum load one camel carries from the fields to the village. This load consists of four bags of sorghum heads and grains, which equals around 120 kg of pure sorghum grain.

5.5.2 Bardheere District

5.5.2.1 Introduction

The investigations made during the field visit revealed that agricultural practices, independent of the farm systems formed in this district are the same. Quantifiable differences have only been found in the yields in the two growing seasons. A significant difference in yields could not be found between the different farm systems.

5.5.2.2 Soil Preparation

Soil preparatory works are carried out either by hand or by tractor. In one area near the village of Dhoxiilo, animal draught for soil preparation had been in use some time ago.

However this practice was abandoned again due to lack of repair facilities for the implements and the availability of suitable draught oxen.

Information received from the Agricultural Mechanisation Service (ONAT) in Bardheere showed that for the year 1985 around 800 ha of land used for rainfed agriculture had been ploughed. This area represents around 2 per cent of the area under actual cultivation (40,844 ha).

Due to the lack of information on the areas belonging to each of the farming systems within this district, no details can be given on the areas ploughed in each of them. However from observations during the field trip it was apparent that a decrease of plouged rainfed land occurred from System I to System IV. The reasons for this are:

- Farmers belonging to System I order tractors to plough their irrigated land and if the tractor arrives, rainfed land is also ploughed.

- Travel distances of the ONAT tractors increase from System I to System IV. Farmers from a long distance to ONAT tend to order for tractors more seldom than farmers living relatively close to the ONAT station.

- Although ONAT charges one hour's travel time to farmers, longer distances would not be so economical for ONAT, especially in view of the scarce diesel supply.

The soil preparation by hand consists of the following activities:

- cutting up the crop residues from the previous season's crop. This activity requires an average of 2 man-days per hectare, varying between 0.5 and 3 man-days per hectare

- loosening the soil superficially with a short-handled hoe (yambo).
  Also farmers may just plant the new crop between the cut pieces of the old debris without loosening the soil.
  On average 8 man-days are required to prepare 1 hectare of rainfed land. This figure varies between 7 and 11 man-days per hectare, according to the information received

- water retention measures, such as the making of basins, are not carried out in this district.

The average total man-days required for soil preparation would thus come to 10 man-days per hectare. Most of the farmers interviewed stated that soil preparatory work was carried out by themselves, family members and relatives, a few used hired labour. The costs for hired labour were given at So Sh 350 per hour, including travelling time and food for the driver.

5.5.2.3 Sowing

Seeds for the crops grown come from the previous years' crop. In a few cases, at some times, seeds may be borrowed from neighbours or merchants and the same amount returned after the completion of the harvest. Money transactions are not involved. Maize seeds are kept on the cob in trees, to protect them against insect damage. Sorghum,sesame and beans are kept in the farmers' houses.

Although farmers stated that the germination capacity of the seeds was good, observations in the village showed, that at least sorghum seeds were heavily infested with weevils. Protection against such infestations was not undertaken.

The sowing of the Gu crop is carried out after the beginning of the Gu rains. Sowing starts around the 20th May. The Der crops are sown before the onset of the Der rains. Sowing here starts around the 18th October. The sowing method is the traditional one, consisting of hole-making with a long-handled hoe, dropping some seeds into the hole and closing the holes with the feet.

All crops are sown on the flat and mainly in rows. The average planting distances for the various crops were given as follows:

- sorghum 0.80 x 0.80 metres
- maize 0.80 x 0.80 metres
- sesame 0.70 x 0.70 metres
- beans interplanted with maize

The amount of seeds used per crop in each season is shown in Table 11.

Table 11: Bardheere District: Seed Amounts Used Per Crop

Crop	Range of seed amounts in kg per ha	Average seed amount in kg per ha
Sorghum	4 - 24	7
Maize	6 - 12	6
Sesame	4 - 9	6
Beans	3 - 12	4

Source : Own investigations.

Time requirements for sowing the different crops have been given as three man-days per hectare for all crops in the Gu season (wet land planting), varying between 0.5 and 4 man-days per hectare. For Der season two man-days per hectare for all crops was given (dry land planting) varying between 0.5 and 2 man-days.

Due to soil born diseases, bird pests and seed infestations by insects, re-sowing is carried out in order to fill in the gaps. All farmers interviewed stated that for all crops in both seasons re-sowing is carried out twice. Ninety per cent of the questioned farmers mentioned a third re-sowing for maize and sorghum, whereas thirty per cent of the farmers carried out a third re-sowing for sesame. The first re-sowing is done for all crops and in both seasons 3-5 days, the second 5-12 days and the third 9-20 days after the completion of the primary sowing.

The time requirements for re-sowing have been incorporated in the above-mentioned man-day requirements per hectare.

5.5.2.4 Inputs

Inputs in form of improved seeds, agro-chemicals and fertilizers are not available in the district and therefore not used.

5.5.2.5 Crop maintenance

Hand weeding of the crops maize, sorghum, sesame and beans and the thinning of the sesame at the same time as the first weeding is the crop maintenance carried out in this district.

From the information gathered during the field trip it can be noted that:

- 100 per cent of all farmers carry out two weedings for all crops in both seasons
- 50 per cent of the farmers carry out a third weeding for all crops
- an additional 35 per cent of the farmers carry out a third weeding on rare occasions.

The weeding is carried out for both seasons at the following times:

- 1st weeding after 15 days of sowing
- 2nd weeding after 30 days of sowing
- 3rd weeding after 45 days of sowing.

Table 12 shows the time requirements for weeding in man-days and hectares. Farmers mentioned that there were no differences in time requirements in the Gu and Der seasons.

Table 12: Bardheere District: Time Requirements for Weeding

Crop	Average number of man-days per ha			Total man-days per ha
	Number of weedings			
	1	2	3(1)	
sorghum	6	4	2	12
maize	8	4	2	14
sesame	8	4	2	14
beans	4	2	4	10

Source: Own compilation
1) The fact that 50 per cent of the farmers carry out a third weeding has been considered.

Weeding in certain cases is carried out with the aid of hired labour (see also Chapter 7.2.1).

The costs for hired labour were mentioned being as follows:

- 1st weeding for all crops in each season : SoSh 700 per ha
- 2nd weeding for all crops in each season : SoSh 450 per ha
- 3rd weeding for all crops in each season : SoSh 300 per ha

The total average weeding costs would therefore come to SoSh 1,300 per hectare and season.

5.5.2.6 Diseases and Pests

As the harvest had been completed at the time of the field visit, diseases and pests could only be noted from the descriptions given by farmers. According to the farmers' statements, the following diseases and pests occur in their crops:

- sorghum : stalk borer, smut
- maize : stalk borer, maize earworm, army worms
- sesame : leaf spot
- beans : diseases in this crop were not mentioned.

Apart from these diseases and pests the crops are attacked by birds and animals. The hornbill gives the farmers a bad time during sowing when this bird removes the seeds and seedlings. In the maturing period crop damage is done by wild pigs and monkeys. Sorghum is subject to severe quelea attacks. As mentioned in Chapter 3.2.3 the area around the village of Sariinley, east of Bardheere township has been subject to severe locust attacks. But this was the only place where locusts were mentioned. Damage done by domestic or nomadic animals were hardly mentioned.

5.5.2.7 Harvest and Yields

Harvesting the crops is carried out by hand. The methods of harvesting are as follows:

- sorghum : sorghum stalks are cut and heaped with the heads in the fields. There they are left to dry. After some weeks the heads are taken off and stored in underground storages in the fields. The stalks are left as fodder for animals, but also may be used as building material for shelters in the field or living quarters in the village.

- sesame : sesame is harvested as soon as the first leaves turn yellow. At this time, not all seeds are ripe. As the sesame varieties used are shattering ones, the farmer has to decide whether to harvest the sesame at an early stage and lose some seeds due to unripeness or harvest at a late stage and have the disadvantage of losing seeds due to the shattering. The whole sesame plant is pulled out of the soil, stacked and left to dry. Threshing is done in the fields.

- maize : maize cobs are broken from the stalks, gathered and transported to the village. The stalks are left on the field as fodder to own or nomadic animals.

- beans : beans, the crop mainly grown together with maize is harvested successively with the maize. The pods are brought to the farmers' homes, where they are shelled.

The average time needed for harvesting of the various crops was given by the farmers interviewed as follows:

- sorghum : 5 man-days per ha, varying between 2 and 8 man-days per ha. This time involves cutting and heaping the corghum.

- sesame : 6 man-days, varying between 2 and 8 man-days per ha. This time involves pulling and stacking the sesame plants.

- maize : 4 man-days per ha, varying between 3 and 8 man-days per ha.

- beans : unspecified.

The yields achieved, as mentioned by the farmers, varied considerably within and between the Gu and Der seasons. In addition around 10 per cent of the farmers practised ratoon cropping of sorghum in Der season (see Chapter 5.1).
For the calculation of the total average yields per hectare and season, the following considerations have been made:

- three out of five years, good yields are achieved in Gu season. The average yields are then:
  . for sorghum 0.7t per ha
  . for maize 0.8t per ha
  . for sesame 0.4t per ha
  . for beans 0.5t per ha

- two out of five years, medium to low yields are harvested in Gu season, with average for:
  . sorghum 0.4t per ha
  . maize 0.5t per ha
  . sesame 0.2t per ha
  . beans 0.2t per ha

- three out of five years the following average yields are received in Der season
  . sorghum : 0.5t per ha
  . maize : 0.5t per ha
  . sesame : 0.2t per ha
  . beans : 0.1t per ha

- two out of five years small yields are achieved in Der season, due to insufficient rains but yields are around:
  . sorghum : 0.15t per ha
  . maize : 0.15t per ha
  . sesame : 0.10t per ha
  . beans : 0.05t per ha

- in two out of five years ratoon cropping for sorghum is practised, which yields on average 0.3t per ha.

Based on these considerations, the average yields per ha and season have been calculated. The results are shown in Table 13.

Table 13: Bardheere District: Yields

Crop	Average yield in t per hectare		
	Gu Season	Der Season	Gu/Der Season
sorghum	0.58	0.37	0.48
maize	0.68	0.36	0.52
sesame	0.32	0.16	0.24
beans	0.38	0.08	0.23

Source: Own Compilation

5.5.3 Saakow/Bu'aale Districts

5.5.3.1 Introduction

The evaluation of the field survey's results showed that the agricultural techniques applied by the farmers in these two districts were the same. The same goes for the agricultural practices. Marked differences were found for the yields in the Gu and Der seasons, but no significant differences for yields were found between the three different farming systems in these districts.

5.5.3.2 Soil Preparation

Soil preparation in these districts are carried out either by hand or by tractor. Although some years ago, animal traction was used to prepare the soil, this has been abandoned in the meantime, due to lack of functioning implements and the availability of suitable, trained oxen.

Tractor ploughing is carried out from the ONAT station in Bu'aale. Two tractors are occasionally stationed in Saakow, where they serve foremostly Deshek farmers. It has been estimated that around one per cent of the rainfed land under actual cultivation is tractor ploughed each season (around 250 hectares in Saakow District and around 20 hectares in Bu'aale District).

During the field investigation it could be noted that the tractor ploughed areas decrease from the rainfed areas near the Juba River to the more remote rainfed areas east of the river. The reasons for this are the same as explained for Bardheere District in Chapter 5.5.2.2.

Soil preparation by hand consists of:

- Cutting up crop residues left in the field from the last season's crop. This occurs in the case where stalks of maize or sorghum have been left on the field. For this work two man-days per hectare are needed, varying between one and four man-days per hectare. For fields where sesame is grown, only some shrubs and weeds are cut (as the sesame plants are pulled out of the soil and are removed) at times when land is required.

- Loosening the surface soil with a yambo which very often is done simultaneously with cutting-up the debris. Time requirement for this work was given as an average of three man-days per hectare.

- Water retention measures to make better use of the precipitation are not carried out in the rainfed fields.

The average total man-days needed for the preparation of the soil would come to five man-days per hectare. Although most of the soil preparation is carried out by the family members or in groups, some farmers use hired labour. The costs for soil preparation done by hired labour come to SoSh 800 per ha.

Mechanical soil preparation consists of discing the land twice. The working capacity of the tractor is 0.25 hectares per hour (four hours per hectare). The tractor hiring costs are SoSh 350 per hour, including travelling time and food for the driver.

5.5.3.3 Sowing

Seeds of own foregoing crops are mainly used by the farmers of these districts. In a few cases farmers told that sometimes they purchase seeds (e.g. sorghum) from the local market. The price of purchased sorghum was given as SoSh 320 per kg.

Maize seeds are kept on the cob in trees or under the roofs of the houses to prevent them from insect attacks. Sorghum, sesame and bean seeds are kept in bags in the farmers' houses. According to the farmers the germination capacity of the seeds was good. Such a statement however has to be taken sceptically as e.g. the sorghum seeds shown to the field team were heavily infested with weevils. Seed protection was not undertaken by the farmers.

The sowing of Gu crops is done after the beginning of the Gu rains and commences around the middle of May. Der crops are sown before the beginning of the Der rains. Sowing time is around the middle of October. The sowing of the Der crops before the onset of the rains is done to make maximum utilization of the little rainfall in this season. On the other hand,

however, the farmer takes the risk of losing his crop, when the time gap between the first rains and the following ones is too big.

The sowing method is the traditional one, consisting of hole-making, seed dropping and hole closing with the feet. Crops are normally sown in the flat and in rows, to make the weeding easier. The average planting distances for the various crops were as follows:

sorghum and maize : 0.80 x 0.80 metres
sesame : 0.70 x 0.70 metres
beans : interplanted with maize

The seed amounts used per crop in each season are shown in Table 14.

Table 14: Saakow/Bu'aale Districts: Seed Amounts Used Per Crop

Crop	Range of seed amounts in kg per hectare	Average seed amounts in kg per ha
sorghum	6 - 12	9
maize	6 - 12	6
sesame	3 - 8	6
beans (1)	2 - 8	4

Source : Own investigations
1) Only grown in Gu season

Time needed for the sowing was given as two man-days per hectare for all crops in Gu and Der season each. No differences could be noted between wet land and dry land sowing as it was the case for Bardheere District.

Soil born diseases, damage of the sown crops by birds and seed born diseases makes it necessary for the farmers to carry out several resowings. Farmers interviewed stated that all of them carry out resowing of all crops in both seasons twice. Ninety per cent of them do a third resowing. The first re-sowing is done after 5 days, the second 15 and the third 24 days after the completion of the initial sowing. The time requirements for resowing have been included in the above-mentioned man-day requirements per hectare.

5.5.3.4 Inputs

No inputs of any kind are used by the farmers in both districts for rainfed production. In the village of Banaada some agro-chemicals were found to be used to reduce insects in the houses, as it did not help to combat insects in the fields. This chemical was supplied by the Ministry of Agriculture some years ago, but the name had been removed from the box, so its original purpose could not be found out. Since that time no further agro-chemicals could be obtained from the Agricultural Coordinators in the district.

5.5.3.5 Crop Maintenance

Weeding of all crops and thinning of the sesame crop during the first weedingare the crop maintenance activities carried out by the farmers in these two districts. The information given by the farmers interviewed showed that in both seasons

- all farmers carry out two weedings
- 70 per cent of the farmers carry out a third weeding.

The first weeding is carried out eight days, the second 25 days and the third 40 days after the completion of the sowing.

Table 15 shows the time needed for weeding in man-days per ha. Between Gu and Der season there does not appear to be any difference in the time requirement for this work.

Table 15: Saakow/Bu'aale Districts:Time Requirements for Weeding

Crop	Average number of man-days per ha number of weedings			Total man-days per ha
	1	2	3(1)	
sorghum	6	2	1	9
maize	8	3	1	12
sesame	8	3	1	12
beans	5	2	1	8

Source : Own Compilations
1) The fact that 70 per cent of the farmers carry out a third weeding has been considered.

In cases where weeding is carried out with hired labourers (see also Chapter 7) the costs were given as follows:

- 1st weeding for all seasons and all crops SoSh 580 per ha
- 2nd weeding for all seasons and all crops SoSh 400 per ha
- 3rd weeding for all seasons and all crops SoSh 200 per ha

The total average costs for weeding would therefore come to SoSh1,130 per hectare.

5.5.3.6 Diseases and Pests

The diseases and pests described by the farmers in these two districts are the same as for the Bardheere District. To recapitulate they are:

- sorghum : stalk borer, smut
- maize : stalk borer, maize earworm, army worms
- sesame : leaf spot
- beans : no diseases were mentioned
- wild animals and birds, wild pigs, monkeys, quelea, horn bill.

Damage done by nomadic herds was not mentioned.

5.5.3.7 Harvest and Yields

Harvest methods and time requirements for these two districts are the same as described for Bardheere District (see Chapter 5.5.2.7). The yields achieved in these two districts vary between Gu and Der seasons. In addition around 70 per cent of the farmers practise Bogon Dhow in two out of five Der seasons (see Chapter 5.1). Yield differences for the various farming systems however were not significant. For the calculation of the total average yields per hectare, the following considerations have been made:

- three out of five years, good yields are achieved in Gu season. The average yields then are for:
  - sorghum 0.7 t per ha
  - sesame 0.4 t per ha
  - maize 0.7 t per ha
  - beans 0.4 t per ha

- two out of five years, medium to low yields are received in Gu season, with averages for:
  - sorghum 0.4 t per ha
  - maize 0.5 t per ha
  - sesame 0.3 t per ha
  - beans 0.3 t per ha

- three out of five years the following average yields are achieved in Der season:
  - sorghum 0.5 t per ha
  - maize 0.4 t per ha
  - sesame 0.3 t per ha

- two out of five years small yields are harvested in Der season, consisting on average of:
  . sorghum 0.2 t per ha
  . maize 0.2 t per ha
  . sesame 0.1 t per ha

- in two out of 5 years 70 per cent of the farmers practise ratoon cropping of sorghum, harvesting on average 0.3 t per hectare.

Based on this information the average yields per hectare and season have been calculated. The results are shown in Table 16.

Table 16 : Saakow/Bu'aale Districts: Yields

Crop	Average yield in t per ha		
	Gu season	Der season	Gu/Der season
sorghum	0.58	0.37	0.48
maize	0.62	0.32	0.47
sesame	0.36	0.22	0.29
beans	0.36	-	0.36

Source: Own compilation

From this Table it can be noted, that in comparison with the yields achieved in Bardheere District (Table 13) there are hardly great differences in both seasons.

5.5.4 Jilib/Jamaame/Kismayo Districts

5.5.4.1 Introduction

The information received from the farmers during the field trip indicated that for the Jilib, Jamaame and Kismayo Districts the agricultural practices are the same. As already mentioned in Chapter 5.2, agricultural practices deviate north of the township of Jilib. There crops are cultivated in Gu and Der seasons, whereas in the rest of Jilib District, as in the other areas, only one season is used for crop production. But as this area is very small, it was decided not to make a separate description of the agricultural practices there.

5.5.4.2 Soil Preparation

Soil preparatory work is carried out either by hand or by tractor mechanisation. Animal traction is not found in these

districts due to the areas' tsetse infestation. The results of the field investigations revealed that around 40 per cent of the area actually under cultivation in these districts (around 4,000 ha) are ploughed and 60 per cent (around 5,900 ha) are prepared by hand each year.

- soil preparation by hand. Soil preparation by hand in these districts consists of:
  - cleaning the land of the previous season's crop residues. They are gathered, heaped and burned. The time required for this work varies between one and four man-days per hectare, with an average of two man-days per hectare.
  - loosening of soil is done with means of a short-handled hoe (yambo), for which an average time requirement of six man-days per hectare was given. The time requirements varied between two man-days per hectare to 16 man-days per hectare.
  - basin making in rainfed agriculture is not carried out.

The average total man-day requirements for soil preparation would thus come to eight man-days per hectare. Although soil preparation by hand is mainly carried out by the farmers and their relatives, some of them make use of hired labour for this activity. The proportion of the land prepared with hired labour could however not be determined due to the very vague information given by the farmers.

- mechanical soil preparation. Mechanical soil preparation consists of the use of two-wheel-drive tractors with disc-ploughs or disc-harrows. Tractors are hired from the Farm Machinery Services (ONAT), from SOMALTEX, the organisation which deals with the cotton production, from private banana producing farmers and from agricultural cooperatives. The proportion of renting tractors by each group could not be determined, due to lack of information. The working capacity of tractor and plough was given as four hours per hectare (0.25 ha per h). The costs of renting tractors were given as for ONAT SoSh 250 per h; private banana farmers SoSh 450 per h and SOMALTEX SoSh 236 per h.

5.5.4.3 Sowing

Seeds for the crops grown are coming mainly from the previous years' crop, although 20 per cent of the farmers interviewed stated that they purchase seeds at irregular intervals. The seeds are bought from local merchants and from the local market. The seeds of the own harvest are kept in the farmers' houses (sesame, beans, groundnuts) or in trees (maize) or as in the case of cotton, received free of charge from SOMALTEX.

Farmers stated that the seed quality was fair, but observing e.g. the maize harvest in the fields, it seemed that the quality of the maize seed at least has deteriorated due to their use time and time again.

The sowing of maize is carried out after the first Gu rains, around the 20th May. The other crops sesame, beans, groundnuts and cotton are planted 6-8 weeks later. The method used is the traditional one (hole making, seed dropping and hole closing) using a long-handled yambo. All crops are sown on the flat in rows.

The average plant distances were given as follows:

- maize 0.90 x 0.90 metres
- sesame 0.60 x 0.60 metres
- beans and groundnuts 1.80 x 1.80 metres
- cotton 0.90 x 0.90 metres

The amounts of seeds used per crop is shown in Table 17.

Table 17: Jilib/Jamaame/Kismayo Districts: Seed Amounts Used Per Crop

Crop	Range of seed amounts in kg per ha	Average seed amount in kg per ha
maize	6 - 20	12
sesame	3 - 12	9
beans	1 - 4	3
groundnuts (1)	12 - 42	30
cotton	8 - 24	15

Source : Own investigations
1) unshelled

Farmers purchasing seeds mentioned paying the following prices:

- SoSh 30 per kg maize
- SoSh 70 per kg sesame
- SoSh 30 per kg beans

Time requirements for sowing the various crops were given to be:

- 8 man-days per ha for maize and sesame varying from 4-24 man-days per ha
- 7 man-days per ha for beans, groundnuts and cotton ranging from 4-9 man-days per ha.

Although farmers stated that the seed quality they used could be called fair, in average three sowings are carried out to

establish a full field's crop. Under resowing it is understood that gaps in the sown fields, caused by non-germination of the seeds or insects and birds'attacks are filled up.

All farmers stated that six days after the completion of the sowing of maize, the first resowing is carried out. For sesame and cotton this could occur after five days. Around 70 per cent of the farmers carry out a second resowing, which is carried out for maize seven days after the completion of the first resowing and for sesame and cotton six and four days respectively. Thirty per cent of the farmers carry out a third resowing seven days for maize, six days for sesame and four days for cotton after the completion of the second resowing.

The time requirements for the resowings have been incorporated into the above mentioned man-day requirements per hectare.

5.5.4.4 Inputs

Chemical fertilizers are not used in areas where rainfed agriculture is practised. Plant protection is carried out only to a very small extent. Chemicals can be purchased from AFMET. Cotton is sprayed with knapsack sprayers twice per season free of charge. The chemicals used are MUVACRON (100 gr per ha per spraying) and POMAC (2kg per ha per spraying). Cotton growers have access to loans from SOMALTEX, which are charged against the yields. Other credit facilities to rainfed farmers are not available in these districts.

5.5.4.5 Crop Maintenance

Crop maintenance consists of hand weeding and thinning of the sesame and cotton crops. Thinning is done simultaneously with the first weeding. All farmers interviewed stated that they carried out two weedings on the crops maize, sesame and beans and four weedings on groundnuts and cotton; 75 per cent of the farmers questioned carried out a third weeding on maize, sesame and beans.

Weeding is carried out at the following times:

- 1st weeding after the 10th day of sowing
- 2nd weeding after 21 days of sowing
- 3rd weeding after 42 days of sowing
- 4th weeding for cotton and groundnuts only after 110 and 90 days respectively

Table 18 shows the time requirements in man-days and hectares for weeding activities.

Table 18: Jilib/Jamaame/Kismayo Districts: Time Requirements for Weeding

Crop	Average number of man-days per ha				Total man-days per ha
	Number of weedings				
	1	2	3	4	
maize	16	14	8(1)	-	38
sesame	16	14	8(1)	-	38
beans	16	14	8(1)	-	38
groundnuts	16	14	10	7	47
cotton	16	14	10	8	48

Source: Own compilations.
1) The fact that only 75 per cent of the farmers carry out a third weeding for these crops has been considered.

Weeding is mainly carried out with the help of hired labourers. The costs for the weeding were given as follows:

- 1st weeding for all crops : SoSh 2,000 per ha
- 2nd weeding for all crops : SoSh 1,450 per ha
- 3rd weeding for all crops : SoSh 1,050 per ha
- 4th weeding for cotton and groundnuts :SoSh 600 per ha

Considering the average cropping pattern in the districts (see Figure 5), the number of weedings per crop and the costs for each weeding, the average total weeding cost would come to around SoSh 4,275 per ha.

5.5.4.6 Diseases and Pests

As the investigations in these districts were carried out most of the crops had been harvested. Therefore plant diseases occurring in these crops could only be approximated by descriptions of farmers interviewed. According to this information the following diseases and pests may occur:

- maize : stalk borer, maize earworm and aphids
- sesame : leafspot
- cotton : pink, spring and red bollworms and red cotton bugs
- for beans and groundnuts diseases were not mentioned

In addition the crops are subject to damage by rats, monkeys, hippopotami and porcupines. The extent of the damage could

not be assessed, although information from farmers on this subject varied between 10 and 70 per cent. Damage to the crops caused by domesticated animals was not reported.

5.5.4.7 Harvest and Yields

Harvesting of the crops is carried out by hand. The methods of harvesting are as follows:

- maize: maize plants are either pulled out of the soil at the time the first leaves are beginning to dry off, or cobs are broken from the stems which are left on the fields. In the first case the stems with the cobs are piled into heaps and left to dry. After some weeks the cobs are broken from the stems, put into bags and brought to the farmers' houses where the kernels are taken off by hand.

- sesame: sesame is harvested as soon as the first leaves turn yellow. However, at this time not all seeds are mature. By using this method farmers try to avoid losses caused by shattering of the seeds. The whole sesame plant is pulled, gathered and stacked, where they are left for drying. Threshing the sesame is done in the fields.

- cotton: Cotton picking is carried out 2-3 times. The yield is brought to the edge of the fields where it is collected by SOMALTEX and transported to the stores of the ginnery in Jamaame which is presently out of operation.

- beans and groundnuts, as crops mainly intercropped with maize and sesame are harvested during the harvest of maize and sesame. Groundnut and bean pods are taken home for drying and shelling.

The average time needed for harvesting the different crops is as follows:

- maize : 6 man-days per ha, varying between 2 and 12 man-days per ha
- sesame : 10 man-days per ha, varying between 4 and 16 man-days per ha
- cotton : 28 man-days per ha for 3 pickings
- beans and groundnuts : unspecified.

The yields given by the farmers varied considerably. The average yields and their ranges are shown below in Table 19.

Table 19 : Jilib/Jamaame/Kismayo Districts : Yields

Crop	Range of Yields in t per ha	Average Yields in t per ha
maize	0.40 - 2.40	1.20
sesame	0.40 - 0.80	0.60
cotton (bulbs)	0.30 - 0.60	0.40
groundnuts (unshelled)	0.20 - 0.70	0.50
beans	0.20 - 0.80	0.50

Source : Own Calculations

From Table 19 it can be noted that the average yields for maize and sesame are higher than for Bardheere and Saakow/Bu'aale Districts. This might be due to a higher and probably more even rainfall distribution. Yields of groundnuts and beans are about the same as for the other Districts.

5.6 Total Production in the Study Area

The total production in the Study Area has been calculated based upon:

- the areas cropped per season
- the areas allocated to each crop (cropping percentage)
- the average yield per season.

The calculations are shown in Table 20. From this table it can be noted that the total production per annum is in rounded-off figures:

- sorghum	56,400 t
- maize	9,700 t
- sesame	3,300 t
- beans	800 t
- groundnuts	150 t
- cotton	40 t

Table 20 : Total Crop Production Per District

District	Area under actual cultivation in ha Gu	Der	Crops	Cropped area in per cent(1) Gu	Der	Total area cropped in ha	Average Yields in t per ha(2) Gu	Der	Total Yields in t
Bardheere	40,844	40,844	sorghum	86	93	73,111	0.58	0.37	34,427
			maize	9	2	4,493	0.68	0.36	2,794
			sesame	4	4	3,267	0.32	0.16	784
			beans	1	1	817	0.38	0.08	188
Saakow/Bu'aale	24,618	24,618	sorghum	92	96	46,282	0.58	0.37	21,880
			maize	5	2	1,723	0.62	0.32	921
			sesame	2	2	985	0.36	0.22	286
			beans	1	-	246	0.36	-	87
Jilib/Jamaame/ Kismayo	9,935	-	maize	50	-	4,964	1.20	-	5,960
			sesame	36	-	3,577	0.60	-	2,146
			beans	10	-	904	0.50	-	497
			groundnuts	3	-	298	0.50	-	149
			cotton	1	-	99	0.40	-	40
Total	75,397	65,462	-	-	-	140,859	-		-

Source : Own calculations
1) See Figures 3-5 of Chapter 5.4
2) See Tables 13,16,19.

5.7 Transport, Storage and Marketing

5.7.1 Transport

Transport of crops from the fields is carried out by donkey or ox-drawn cart, by camels, lorries, tractor and trailer or even by people.

The use of donkey carts is most common in the whole Study Area. It is estimated that 70 to 80 per cent of the farmers have their own donkey cart which they use for the transport of crops and other goods. In a few cases it was also reported that farmers hire donkey carts from their neighbours. Only a small percentage of farmers use oxen carts instead of donkey carts and the exceptional case would be that people carry their crops back home. In areas where the "Semi-settled Nomads" (1) farming systems prevail and also in the remoter areas of the "Settled Nomads" (2) system the crops are sometimes carried by camels.

Lorries and tractor/trailers are used only by the big farmers to transport their produce from the fields to the village where they live or directly to the market place. The time requirements for transporting the crop from the fields to the villages varied between one and two hours per trip, according to the distances between the fields and the villages. The time mentioned for transportation to the market places was up to six hours.

The transport costs mentioned for the few cases where transport by animals was hired, varied between SoSh 120 and SoSh 600 per ton for a hired donkey cart and between SoSh 40 and SoSh 100 per ton for camel transport. On average, transport by animals costs about SoSh 300 per ton. For the transport of crops by lorries an average cost of SoSh 800 and for transport by tractor/trailer an average cost of SoSh 200 have been calculated.

5.7.2 Storage

Most of the crop production in the whole Study Area is stored in underground stores. Such stores are built either in the fields or in the villages next to the owners' houses. Sesame is stored with the cobs while maize is stored as pure grains. Normally, the crop is stored up to a period of one year. However, it was mentioned many times by the farmers during the field survey, that after seasons of high production and when droughts are expected, the produce of maize and sorghum is kept in underground stores for up to three or five years. Even ten years were mentioned as the maximum period for grain storage.

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1) See Chapter 4. p. 24
2) See Chapter 4. p. 23.

The losses which are mainly caused by beetles, rats and sometimes also by rainwater, are no higher than 5 to 10 per cent on average.

Such a system of cheap and relatively secure storage is essential for the survival of the farmers in the rainfed areas and for the long-term economic stability of the rainfed farming sub-sector as a whole. Underground stores serve as a buffer stock in drought periods. In particular after the main cropping season, the Gu season, the quantities which are stored are normally high enough to enable the farm family to survive until the harvest of the next Gu season. This is because crop cultivation in Der season is most unreliable due to irregular and often low rainfalls. Many farmers keep even more in stock than the quantity which is required to feed the family for one year. This is because the rainfed farmers must also always reckon with the possibility of a drought for a whole year, meaning the loss of two crops.

Storage of sesame and beans is normally done in bags and barrels inside the house, while the seeds are mostly kept in baskets on top of trees in order to prevent them from being eaten by beetles and rats.

5.7.3 Marketing

As has been mentioned before, most farmers bring their produce to the villages where they live by using donkey carts. Here most of that part of the crop which is provided for marketing is also sold. Grains are sold to merchants or to neighbours and sesame is sold to the local sesame mills. In some cases farmers also bring their produce to the central villages (beel) or District Centres in order to achieve higher prices. The bigger farmers who can afford to hire a lorry or tractor/trailer, market their crops in the District or Regional Centres.

According to the information received from the field survey, it is assessed that on average each farmer sells no more than 10 to 15 per cent of his grain crops. About another 10 per cent is given to relatives and the rest is consumed by his family.

Beans are grown exclusively for own consumption and groundnuts are partly sold. Usually all sesame is sold to local enterprises for processing and where cotton is grown, the Somaltex Company buys it at centrally established places.

6. Sedentary Livestock and Pastoralism

6.1 Introduction

During the field survey some attention has also been paid to aspects of livestock and its integration into the farming systems of rainfed agriculture (1). As has been mentioned in Chapter 4, where the rainfed farms have been classified into four different farming systems, most of the rainfed farmers own livestock and relationships exist between crop cultivation and pastoralism which is mainly based on livestock-keeping. In the following, certain aspects of livestock will be considered. Emphasis is laid upon its importance to the rainfed farm enterprises and on the methods by which livestock is kept by the farmers and how livestock is connected to nomadic pastoralism.

6.2 The Importance of Livestock for Rainfed Agriculture

As indicated in Chapter 4, the importance of livestock differs between the farming systems. It is of relatively little importance in the "Mixed Irrigated/Rainfed" (2) System. According to the field investigations on average no more than 2 to 4 cows, 5 to 10 sheep and/or goats and a few chickens are kept by each farm family using this system all along the Juba River. The cows are kept mainly for milk production. For meat production they are of secondary importance. They are slaughtered only when they become too old for further milk production. Instead of beef, people prefer camel or goat meat and lamb or mutton. Their own small herds of goat and sheep together with a few chickens can only provide a limited supply of meat. The diet of these farmers is based mainly on maize, sorghum and milk. It was not found that livestock constitutes a source of cash income anywhere. In the "Traditional Rainfed" (3) farming system the importance of livestock is similar to that of the system described above, although in general the herds were found to be somewhat bigger. The average size of the herd was found to be around 5 to 10 cows and 10 goats. Again milk production for the family is the main purpose of keeping cows. The occasional supply with meat is of minor importance. However, livestock keepint in this farming system certainly has an additional function as a food buffer stock for years of drought, when crop production becomes scarce.

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1) More detailed information on the livestock sector in the Juba Valley Regions is expected from a survey to be carried out in the near future by MJVD.
2) See Chapter 4. p. 22.
3) See Chapter 4. p. 22.

In the "Settled Nomads" (1) farming system, livestock becomes more important. Part of the farmers' families are generally exclusively occupied in looking after the herds. The herds are composed of up to 20 or 30 camels, between 10 and 40 cows and 10 to 20 sheep and/or goats. Apart from a regular milk supply, the occasional provision of meat and as an insurance against food shortages in drought periods, the importance of livestock lies in the prestige aspect which accompanies the ownership of camels and cows in particular.

For the system of "Semi-settled Nomads" (2) livestock is still the main component of the economy, while rainfed cropping is of secondary importance. It is hard to assess how many head are owned by each family. The indications given by the farmers ranged between 20 and 50 camels and about the same number of cows. Goats and sheep seem to be low in number. The predominant importance of camels is for milk supply and prestige. They are only slaughtered for important social events, if they become too old or have to be killed in case of accident or illness. Cattle are kept for additional milk and some meat and constitute the main source of cash income. In addition, a few donkeys are kept for transport in all four above-mentioned farming systems.

6.3 Methods of Livestock-keeping

The few milk cows, sheep and goats belonging to farmers near the river are looked after by the family members, mainly the children. They graze in the bush and fallow land around the villages and after the cropping seasons they are fed with crop residues, mainly maize stalks. They generally have easy access to river water.

In the areas of "Traditional Rainfed" farming the animals are also kept around the villages and looked after by family members. They find their food in the bush, fallow and range land and on the fields after harvesting. Water is provided by shallow wells or by the river. During the dry season, however, when food supply becomes scarce, the cows are generally taken out of the area to places where food can be found. In this case the animals are looked after in the following ways:

- The herds of the farmers join the nomads and are looked after by family members, hired labour from the village or by hired nomads.
- The herds of various farmers from one village group together and move jointly to the grazing grounds. They may be looked after by family members or hired labour.

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1) See Chapter 4. p. 23.
2) See Chapter 4. p. 24.

Different amounts of remuneration were found for the nomads and hired labour for taking care of the animals. The maximum size of herd one person can look after is about 20 to 30 head. Generally payment is based on such a unit and the period of one month or one year. Payment is in cash and/or kind. Some of the following examples may illustrate the payment systems:

- Bardheere District: for 20 cows per month SoSh 600, or if not paid cash 1 head p.a.
- Bardheere District: for 30 cows 1 cow per year plus food plus clothing, or SoSh 2,000 p.a. plus food and clothing.
- Saakow District: SoSh 15 per month per head plus food and clothing.
- Jamaame District: for 30 head 1 cow per year plus the produce of milk and butter.

In the "Settled Nomads" system a few cows for milk supply and the sheep and goats are kept around the villages and fed as described above. The larger part of the herds however remain permanently with the nomadic part of the farmers' families or with other nomadic clan members. In some cases it was also reported that hired labour is used for looking after the herds which have joined the nomads. Payment for it is similar to that mentioned above. If family members or relatives take care of the farmer's herd, remuneration is in the form of food, mainly sorghum and the permission to use the milk produce.

In case of the "Semi-settled Nomads" system the bulk of the farmers' herds remain with the nomadic part of the family who are provided with sorghum from the farm.

Some additional information on the livestock sector of the rainfed farms are the following market prices for animals:

- camels		
. male	SoSh 10,000	- 15,000
. female	SoSh 15,000	- 20,000
- cows		
. milk producing	SoSh 5,000	- 7,000
. other	SoSh 4,000	- 5,000
- goats	SoSh 600	- 1,500
- sheep	SoSh 300	- 500

7. Agro-Economy

7.1 Selection of Representative Farms for the Study Area

In order to get a better understanding of the economic situation of the farm families involved in rainfed agriculture in the Study Area, representative farm models have been selected and analysed with regard to the situation on labour and income. Despite the large extension of the Study Area (see Chapter 1.2) there are no great differences in the economy of rainfed agriculture between the districts. Therefore it is sufficient to differentiate between three regions:

- region 1 : Bardheere District
- region 2 : Saakow and Bu'aale Districts
- region 3 : Jilib, Jamaame and Kismayo Districts.

No significant differences were found inside the regions between the farming systems as described in Chapter 4. Therefore no differentiation has been made in this respect although it will be mentioned into which farming system each farm model was identified. The cropping patterns are also relatively homogeneous inside each region. Therefore the same cropping patterns were applied for each of the farm models for each region. Differences in farm economy occur mainly as a result of the farm sizes in the regions. Such differences have an effect mainly on the following aspects:

- labour situation; i.e., the use of family labour and hired labour
- mechanization; i.e. the use of tractors for field preparation
- market orientation; i.e. selling of crop surplus
- income, i.e. self-sufficiency or the need to earn additional off-farm income.

The analysis of the farm economy is concentrated on making visible the differences between farm types which are self-sufficient and those which need additional income from other sources.

In the following two chapters 7.2 and 7.3, an analysis is made of the labour situation and the income situation of the selected representative farms. The selection is based on the information on farm sizes given in Chapter 3.3 and on cropping patterns as presented in Chapter 5.4.

The selected representative farm types are:

- Bardheere District
  - 5 ha farm, of which 3.5 ha (70 per cent) are cultivated
  - 10 ha farm, of which 7 ha (70 per cent) are cultivated
  - 15 ha farm, of which 10.5 ha (70 per cent) are cultivated

- Saakow/Bu'aale Districts
  - 5 ha farm, of which 3.3 ha (66 per cent) are cultivated
  - 10 ha farm, of which 6.6 ha (66 per cent) are cultivated
  - 15 ha farm, of which 9.9 ha (66 per cent) are cultivated

- Jilib/Jamaame/Kismayo Districts
  - 2.4 ha farm, of which 1.2 ha (50 per cent) are cultivated
  - 5 ha farm, of which 2.5 ha (50 per cent) are cultivated.

7.2 Labour Situation

7.2.1 Introduction

The two categories of family labour and hired labour are used for the analysis of the labour situation. A third category of labour provided by the "group help system" (1) has been included in the hired labout category because it was not possible to distinguish clearly enough to what extent this system is applied.

Nevertheless, the group help system is very common, particularly in the districts of Bardheere, Saakow and Bu'aale. Further downstream it seems to be of no major importance. Group help is a traditional system of neighbours helping each other. A farmer who is in need of additional farm labour for a limited period in order to carry out activities such as field preparation and weeding, may ask one or more neighbouring farm families for help. There is no remuneration for such work. The farmer only provides some food and tea. It is however expected that everybody asking for help will be ready to help others on other occasions, so that in the long run they all help each other in return.

It was also reported that at times of peak labour demand the family labour from different farms group together and proceed from one farm to another in order to carry out farm work.

It is thought that this system of group help which seems to function well on a traditional basis, would also be a fundament for the development of future farmers' organizations. Such organizations could also be established at village level in order to solve the existing problems of input supply and marketing.

7.2.2 Bardheere District

As has been mentioned in the foregoing Chapter 7.1, three different farm types have been selected from this region of the Study Area for further economic analysis.

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1) Somali : Goob

The first type is a 5 ha farm which belongs, as far as the size is concerned, to the largest group of 33 per cent of farms between 1 and 5 hectares. This type of farm is representative of areas near to the river where the farm family owns an additional part of irrigated land. This farm type is also found in the pure rainfed areas of the "Traditional Rainfed" (1) and "Settled Nomads" (2) systems, where an unmarried man or a small family practises crop cultivation. Finally, the small farm type is found in the "Semi-settled Nomads System" (3), where only part of the nomad's family has settled temporarily while the rest of the family carries on with its nomadic life.

From the field investigations it was found that the family of such a 5 ha farm provides on average 2 Family Labour Units for field work. Considering public and religious holidays and social events, an average of 20 working days per month has been assumed. Thus the monthly availability of family labour is 40 man-days from this type of farm.

According to the results of the photo-interpretation and field survey, the farmers in Bardheere District cultivate only 70 per cent of their farm land (4). Therefore it was assumed that of the 5 ha, 3.5 ha are cultivated. Crop cultivation is carried out in both Gu and Der seasons.

In accordance with the prevailing cropping patterns in the district (5), the cropping patterns of the 5 ha farm model in the Bardheere District would be as follows:

Gu Season :

sorghum	3.00 ha
maize	0.32 ha
sesame	0.14 ha
beans	0.04 ha

Der Season :

sorghum	3.25 ha
maize	0.07 ha
sesame	0.14 ha
beans	0.04 ha

In Table 21 the annual labour demand for the 5 ha rainfed farm in Bardheere District and the degree to which the available family labour is utilised are calculated. For the calculation of labour demands the labour profiles of APPENDIX B, Tables 1 to 8, are used.

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1) See Chapter 4, p. 22.
2) See Chapter 4, p. 23.
3) See Chapter 4, p. 24.
4) See Chapter 3.2.3, Table 2, p. 15.
5) See Chapter 5.4.2, Figure 3, p. 29.

Table 21 Bardheere District : Labour Budget for a 5 ha Farm; 3.5 ha (70 %) cultivated; 200 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
			In Man Days												
Labour Demand															
Sorghum	Gu	3.00	-	-	-	30.0	9.0	30.0	6.0	21.0	-	-	-	-	96.0
Maize	Gu	0.32	-	-	-	3.2	1.0	3.8	0.6	1.9	-	-	-	-	10.5
Sesame	Gu	0.14	-	-	-	1.4	0.4	1.7	0.3	1.1	-	-	-	-	4.9
Beans	Gu	0.04	-	-	-	0.4	0.1	0.2	0.2	0.5	-	-	-	-	1.4
Sorghum	Der	3.25	22.8	-	-	-	-	-	-	-	32.5	9.8	32.5	6.5	104.1
Maize	Der	0.07	0.4	-	-	-	-	-	-	-	0.7	0.1	0.8	0.1	2.1
Sesame	Der	0.14	1.1	-	-	-	-	-	-	-	1.4	0.4	1.7	0.3	4.9
Beans	Der	0.04	0.5	-	-	-	-	-	-	-	0.4	0.1	0.2	0.2	1.4
Total Labour Demand			24.8	-	-	35.0	10.5	35.7	7.1	24.5	35.0	10.4	35.2	7.1	225.3
Hired Labour			-	-	-		-		-	-		-		-	
Family Labour Availability			40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	480.0
Balance			15.2	40.0	40.0	5.0	29.5	4.3	32.9	15.5	5.0	29.6	4.8	32.9	254.7
Percentage of Family Labour Used			62.0	0.0	0.0	88.0	26.0	89.0	19.0	61.0	88.0	26.0	88.0	18.0	47.0

Source : Tables 1 to 8 APPENDIX B

Table 21 shows that the overall utilization of family labour is only 47 per cent. It varies between zero and 89 per cent as a maximum, i.e. the family labour is not fully used even during the months of peak labour demand in both seasons for sowing and weeding.

From the field survey it is known that in many cases the farmers of these small enterprises go to the bigger farms of their village to work as hired labour. Since the small farms do not produce any surplus to be marketed and to provide cash income they satisfy their cash requirements in this way. It was also reported many times during the field investigations that unutilised family labour is used within the group help system where a neighbour who is temporarily short of labour may ask for help (1).

In other cases where the rainfed fields are only an additional part of the total mixed irrigated/rainfed farm, the family labour surplus is used for cultivation of irrigated land.

The second farm type selected as farm model for the Bardheere District is a 10 ha farm. This type represents 27 per cent of farms belonging to the group of 5 to 10 hectares. It is the most common farm type in the district and can be found predominantly in the "Traditional Rainfed" (2) and in the "Settled Nomads"(3) farming systems.

Field investigations revealed that such a 10 ha farm provides on average four Family Labour Units for field work. Thus the monthly availability of family labour is calculated at 80 man-days per month for this type of farm.

As for the 5 ha farm model as described above, it is assumed that of the 10 hectares, 70 per cent, i.e. 7 hectares are cultivated during both Gu and Der seasons. Also the same cropping patterns are applied, so that the cropping patterns of the 10 ha farm model in Bardheere District would be as follows:

Gu Season:

sorghum	6.00 ha
maize	0.64 ha
sesame	0.28 ha
beans	0.08 ha

Der Season:

sorghum	6.50 ha
maize	0.14 ha
sesame	0.28 ha
beans	0.08 ha

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1) See Chapter 7.2.1.
2) See Chapter 4, p.22.
3) See Chapter 4, p.23.

Table 22 Bardheere District: Labour Budget for a 10 ha Farm; 7.0 ha (70 %) cultivated; 200 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
			In Man Days												
Labour Demand															
Sorghum	Gu	6.00	-	-	-	60.0	18.0	60.0	12.0	42.0	-	-	-	-	192.0
Maize	Gu	0.64	-	-	-	6.4	2.0	7.6	1.2	3.8	-	-	-	-	21.0
Sesame	Gu	0.28	-	-	-	2.8	0.8	0.4	0.6	2.2	-	-	-	-	9.6
Beans	Gu	0.08	-	-	-	0.8	0.2	0.5	0.3	1.0	-	-	-	-	2.8
Sorghum	Der	6.50	45.6	-	-	-	-	-	-	-	65.0	19.6	65.0	13.0	208.2
Maize	Der	0.14	0.8	-	-	-	-	-	-	-	1.4	0.2	1.6	0.2	4.2
Sesame	Der	0.28	2.2	-	-	-	-	-	-	-	2.8	0.8	3.4	0.6	9.8
Beans	Der	0.08	1.0	-	-	-	-	-	-	-	0.8	0.2	0.5	0.3	2.8
Total Labour Demand			49.6	-	-	70.0	21.0	71.5	14.1	49.0	70.0	20.8	70.5	14.1	450.6
Hired Labour			-	-	-		-		-	-		-		-	
Family Labour Availability			80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	960.0
Balance			30.4	80.0	80.0	10.0	59.0	8.5	65.9	31.0	10.0	59.2	9.5	65.9	509.4
Percentage of Family Labour Used			62.0	0.0	0.0	88.0	26.0	89.0	18.0	61.0	88.0	26.0	88.0	18.0	47.0

Source : Tables 1 to 8 APPENDIX B

In Table 22 the annual labour demand for the 10 ha rainfed farm in Bardheere District and the degree to which the available family labour is utilized are calculated, based on the labour profiles of APPENDIX B, Tables 1 to 8.

Table 22 shows that for the whole year the utilization of family labour is less than 50 per cent. The highest rates of utilization of family labour are during the months of April and September, when field preparation and sowing are carried out and during June and November the main months for weeding. However, even this type of farm generally never uses more than about 90 per cent. This is the average situation. In practice it was found that occasionally such farms use hired labour mainly for field preparation, sowing and weeding. This is the case when family labour is less than four labour units. More often than using hired labour however, the group help system as described in Chapter 7.2.1 is used when the farmer is in need of additional farm labour due to temporary labour shortage caused by illness, death or any other event. It has also been observed that farmers who own farms of around 10 ha hire tractors for field preparation.

The third farm type which is selected as a farm model from the Bardheere District is a 15 ha farm. This type represents 21 per cent of farms belonging to the group of 10-15 hectares. It is representative of the big farms which rely on the use of hired labour and/or machinery as well as family labour. This farm type was mainly found in areas where the "Traditional Rainfed" (1) farming system prevails.

As in the aforementioned 10 ha farm model, the family size is such that it can provide on average up to four Family Labour Units for field work. This results in a monthly availability of 80 man-days.

For this farm type it is also assumed that 70 per cent of the farm land, i.e. 10.5 hectares are cultivated during the two cropping seasons of Gu and Der. Again the same cropping patterns as for the abovementioned farm models in the Bardheere District are applied. Thus the cropping patterns of the 15 ha farm are as follows:

Gu Season:

sorghum	9.02 ha
maize	0.95 ha
sesame	0.42 ha
beans	0.11 ha

Der Season:

sorghum	9.77 ha
maize	0.21 ha
sesame	0.42 ha
beans	0.11 ha

1) See Chapter 4, p.22.

Table 23 Bardheere District: Labour Budget for a 15 hectare Farm; 10.5 hectare (70 %) cultivated, 200 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
			In Man Days												
Labour Demand															
Sorghum	Gu	9.02	-	-	-	90.2	27.1	90.2	18.0	63.1	-	-	-	-	288.6
Maize	Gu	0.95	-	-	-	9.5	2.9	11.4	1.9	5.7	-	-	-	-	31.4
Sesame	Gu	0.42	-	-	-	4.2	1.3	5.0	0.8	3.4	-	-	-	-	14.7
Beans	Gu	0.11	-	-	-	1.1	0.3	0.7	0.4	1.3	-	-	-	-	3.8
Sorghum	Der	9.77	68.4	-	-	-	-	-	-	-	97.7	29.3	97.7	19.5	312.6
Maize	Der	0.21	1.3	-	-	-	-	-	-	-	2.1	0.4	2.5	0.4	6.7
Sesame	Der	0.42	3.4	-	-	-	-	-	-	-	4.2	1.3	5.0	0.8	14.7
Beans	Der	0.11	1.3	-	-	-	-	-	-	-	1.1	0.2	0.7	0.4	3.7
Total Labour Demand			74.4	-	-	105.0	31.6	107.3	21.1	73.5	105.1	31.2	105.9	21.1	676.2
Hired Labour			-	-	-	25.0	-	27.3	-	-	25.1	-	25.9	-	103.3
Family Labour Availability			80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	960.0
Balance			5.6	80.0	80.0	0.0	48.4	0.0	58.9	6.5	0.0	48.8	0.0	58.9	387.1
Percentage of Family Labour Used			93.0	0.0	0.0	100.0	40.0	100.0	26.0	92.0	100.0	39.0	100.0	26.0	70.0

Source : Tables 1 to 8, APPENDIX B

In Table 23 the annual labour demand for the 15 ha rainfed farm in Bardheere District and the degree to which the available family labour is utilized are calculated, based on the labour profiles of APPENDIX B Tables 1 to 8.

Table 23 shows that the overall utilization of family labour is 70 per cent. In four months of peak labour demand, in April and September for field preparation and for sowing, and in June and November for weeding, additional labour has to be hired. Alternatively machinery has to be hired for field preparation.

7.2.3 Saakow/Bu'aale Districts

For this region also three different farm types have been selected for further economic analysis.

The first type is a 5 ha farm which belongs to the largest group of 39 per cent of farms between 1 and 5 hectares. As in Bardheere District, this farm type is representative for areas near the river where the "Mixed Irrigated/Rainfed" (1) farming system prevails. It is also found in areas of the "Semi-settled Nomads System"(2), where part of a nomadic family has settled temporarily. This farm type is also found elsewhere in both districts, where small families practise crop cultivation.

According to the field survey carried out in that region it is assumed that on average such a 5 ha farm provides 2 Family Labour Units for field work. The monthly availability of family labour is calculated at 40 man-days. Photo-interpretation together with the field survey have revealed that on average 66 per cent of the farm land in that region is cultivated (3). Accordingly, it is assumed that of the 5 ha farm land, only 3.3 ha are cultivated. Crop cultivation is carried out in both Gu and Der seasons.

Based on the average cropping patterns in the region (4), the cropping patterns of the 5 ha farm model in Saakow/Bu'aale would be as follows:

Gu season:

sorghum	3.04 ha
maize	0.17 ha
sesame	0.07 ha
beans	0.03 ha

Der season :

sorghum	3.16 ha
maize	0.07 ha
sesame	0.07 ha

1) See Chapter 4, p.22.
2) See Chapter 4, p.24.
3) See Chapter 3.2.3, Table 2,p.15.
4) See Chapter 5.4.3, Fig. 4, p.31.

Table 24 Saakow/Bu'aale Districts: Labour Budget for a 5 ha Farm; 3.3 ha (66 %) cultivated; 200 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
			In Man Days												
Labour Demand															
Sorghum	Gu	3.04	-	-	-	15.2	6.1	24.3	3.0	21.3	-	-	-	-	69.9
Maize	Gu	0.17	-	-	-	0.9	0.3	1.9	0.2	1.0	-	-	-	-	4.3
Sesame	Gu	0.07	-	-	-	0.3	0.1	0.8	0.1	0.6	-	-	-	-	1.9
Beans	Gu	0.03	-	-	-	0.2	0.1	0.2	0.1	0.4	-	-	-	-	1.0
Sorghum	Der	3.16	22.1	-	-	-	-	-	-	-	15.8	6.3	25.3	3.2	72.7
Maize	Der	0.07	0.4	-	-	-	-	-	-	-	0.4	0.1	0.8	0.1	1.8
Sesame	Der	0.07	0.6	-	-	-	-	-	-	-	0.3	0.1	0.8	0.1	1.9
Beans	Der			-	-	-	-	-	-	-					
Total Labour Demand			23.1	-	-	16.6	6.6	27.2	3.4	23.3	16.5	6.5	26.9	3.4	153.5
Hired Labour			-	-	-		-		-	-		-		-	
Family Labour Availability			40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	480.0
Balance			16.9	40.0	40.0	23.4	33.4	12.8	36.6	16.7	23.5	33.5	13.1	36.6	326.5
Percentage of Family Labour Used			58.0	0.0	0.0	42.0	17.0	68.0	9.0	58.0	41.0	16.0	67.0	9.0	32.0

Source : Tables 18 to 24 APPENDIX B

In Table 24, the annual labour demand for the 5 ha rainfed farm in Saakow/Bu'aale Districts and the degree of utilization of family labour is calculated.

For the calculation of labour demands the labour profiles of APPENDIX B, Tables 18 to 24 are used. Table 24 shows that the utilization of family labour is only 32 per cent considering the whole year. The monthly percentages vary between zero and a maximum of 68 per cent.

As in Bardheere District, the surplus of family labour may be used for earning cash income as hired labour on neighbouring farms. Or, in the case of a mixed irrigated/rainfed farm, the remaining farm labour is used for irrigated crop cultivation. But as in Bardheere it was also quite often mentioned during the field survey that the family members of farms having a certain amount of spare labour are asked by neighbours for help within the framework of group help systems as described in Chapter 7.2.1.

The second farm type selected as farm model for the districts of Saakow and Bu'aale is a 10 ha farm. This type represents the group of 32 per cent of farms belonging to the category of 5 to 10 hectares. It is the most common farm type in the region and can be found in both the "Traditional Rainfed"(1) and the "Settled Nomads"(2) farming systems.

According to the field survey the provision of family labour for this farm type is four Family Labour Units on average. The monthly labour availability is calculated at 80 man-days. For this farm model it is also assumed that 66 per cent of the farm land, i.e. 6.6 ha, are cultivated. Crop cultivation is carried out during Gu and Der seasons. The cropping patterns applied are the same as for the aforementioned 5 ha farm in the region, so that the cropping patterns of the 10 ha farm in Saakow/Bu'aale Districts are as follows:

Gu Season:

sorghum	6.07 ha
maize	0.33 ha
sesame	0.13 ha
beans	0.07 ha

Der Season:

sorghum	6.34 ha
maize	0.13 ha
sesame	0.13 ha

1) See Chapter 4, p.22
2) See Chapter 4, p.23

In Table 25 the annual labour demand for the 10 ha rainfed farm in Saakow/Bu'aale Districts and the degree of utilization of family labour are calculated. Calculations are based on the labour profiles of APPENDIX B, Tables 18 to 24.

Table 25 shows that the overall utilization of family labour is only 32 per cent. In times of peak labour demand, no more than 70 per cent of the available family labour is required.

From the field survey it is known that the situation described in Table 25 reflects the real situation of that farm type in the region to a high degree. Most of these enterprises have sufficient family labour to cope with the requirements and occasionally surplus labour may be hired out in order to earn additional cash income. A small percentage of no more than 10 to 15 per cent of the farms belonging to this group may also need to hire labour during months of peak demand, when the family labour is reduced for specific reasons such as illness, death, marriage or emigration.

There is practically no use of tractors instead of hand labour for field preparation in the district of Saakow. In Bu'aale however, the use of tractors is quite common. Due to the relatively small area of rainfed land in this district, the importance of this fact is low when compared to the total.

The third farm type which has been selected as farm model for the districts of Saakow and Bu'aale is a 15 ha farm. This type represents 13 per cent of farms belonging to the category of 10-15 hectares of size. It is representative for the big farms which make full use of family labour during peak times and which, besides family labour, also rely on the use of hired labour to a limited extent. A small number in Bu'aale District also use machinery for field preparation.
This farm type was found mainly in areas where the "Traditional Rainfed" (1) farming system prevails.

The family size of this type is the same as for the 10 ha farm type, so that the provision of family labour comes on average to about four Family Labour Units. This results in a monthly availability of 80 man-days. Again it is assumed that this farm type cultivates no more than 66 per cent on average, giving a size of 9.9 ha of cultivated land. Crop cultivation is also carried out in Gu and Der seasons.

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1) See Chapter 4, p.22.

Table 25 Saakow/Bu'aale Districts : Labour Budget for a 10 ha Farm; 6.6 ha(66 %) cultivated; 200 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
			In Man Days												
Labour Demand															
Sorghum	Gu	6.07	-	-	-	30.4	12.1	48.6	6.1	42.5	-	-	-	-	139.7
maize	Gu	0.33	-	-	-	1.7	0.7	3.6	0.3	2.0	-	-	-	-	8.3
Sesame	Gu	0.13	-	-	-	0.5	0.3	2.9	0.1	1.0	-	-	-	-	4.8
Beans	Gu	0.07	-	-	-	0.4	0.1	0.5	0.1	0.8	-	-	-	-	1.9
Sorghum	Der	6.34	44.4	-	-	-	-	-	-	-	31.7	12.7	50.7	6.3	145.8
maize	Der	0.13	0.8	-	-	-	-	-	-	-	0.7	0.3	1.4	0.1	3.3
Sesame	Der	0.13	1.0	-	-	-	-	-	-	-	0.5	0.3	1.4	0.1	3.3
Beans	Der			-	-	-	-	-	-	-					
Total Labour Demand			46.2	-	-	33.0	13.2	55.6	6.6	46.3	32.9	13.3	53.5	6.5	307.1
Hired Labour			-	-	-		-		-	-		-		-	
Family Labour Availability			80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	960.0
Balance			33.8	80.0	80.0	47.0	66.8	24.4	73.4	33.7	47.1	66.7	26.5	73.5	652.9
Percentage of Family Labour Used			58.0	0.0	0.0	41.0	17.0	70.0	8.0	58.0	41.0	17.0	67.0	8.0	32.0

Source : Tables 18 to 24 APPENDIX B

Table 26 Saakow/Bu'aale Districts: Labour Budget for a 15 ha Farm, 9.9 ha (66 %) cultivated; 200 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
							In Man Days								
Labour Demand															
Sorghum	Gu	9.10	-	-	-	45.5	18.2	72.8	9.1	63.7	-	-	-	-	209.3
Maize	Gu	0.50	-	-	-	2.5	1.0	5.5	0.5	3.0	-	-	-	-	12.5
Sesame	Gu	0.20	-	-	-	0.8	0.4	2.2	0.2	1.6	-	-	-	-	5.2
Beans	Gu	0.10	-	-	-	0.5	0.2	0.7	0.1	1.2	-	-	-	-	2.7
Sorghum	Der	9.50	66.5	-	-	-	-	-	-	-	47.5	19.0	76.0	9.5	218.5
Maize	Der	0.20	1.2	-	-	-	-	-	-	-	1.0	0.4	2.2	0.2	5.0
Sesame	Der	0.20	1.6	-	-	-	-	-	-	-	0.8	0.4	2.2	0.2	5.2
Beans	Der			-	-	-	-	-	-	-					
Total Labour Demand			69.3	-	-	49.3	19.8	81.2	9.9	69.5	49.3	19.8	80.4	9.9	458.4
Hired Labour			-	-	-		-	1.2	-	-		-	0.4	-	1.6
Family Labour Availability			80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	960.0
Balance			10.7	80.0	80.0	30.7	60.2	0.0	70.1	10.5	30.7	60.2	0.0	70.1	503.2
Percentage of Family Labour Used			87.0	0.0	0.0	62.0	25.0	100.0	12.0	87.0	62.0	25.0	100.0	12.0	48.0

Source : Tables 18to 24 APPENDIX B

The same cropping patterns as for the two other farm types in the region are applied, giving the following cropping patterns for the 15 ha farm in Saakow/Bu'aale Districts:

Gu Season

sorghum	9.10 ha
maize	0.50 ha
sesame	0.20 ha
beans	0.10 ha

Der Season

sorghum	9.50 ha
maize	0.20 ha
sesame	0.20 ha

In Table 26 the annual labour demand for the 15 ha rainfed farm in Saakow/Bu'aale Districts and the degree of utilization of family labour are calculated. Calculations are based on the labour profiles of APPENDIX B, Tables 18 to 24.

Table 26 shows that the overall utilization of family labour is less than 50 per cent. Family labour is only fully used in periods of peak demand and there is some demand for hired labour. Observations in the field have shown that in general the demand for hired labour of this farm type is somewhat higher than is reflected in Table 26. It is estimated that around 20 per cent of the farms hire labour during times of field preparation and weeding. Instead of hiring labour against payment it was reported many times in the districts, that such farms fill their temporary labour gaps by asking neighbours for help within the framework of the group help system, as described in Chapter 7.2.1.

7.2.4 Jilib/Jamaame/Kismayo Districts

Two different farm types have been selected for further economic analysis for this region. The first one is a 1.4 ha farm which represents the average farm size in Jamaame District where the highest concentration of rainfed land in the lower reaches of the Juba Valley is found. This farm type is representative for 98 per cent of the farms of that district, which belong to the category of 1 to 5 hectares. Most of these farms are of the "Mixed Irrigated/ Rainfed"(1) farming system. That means, that most farmers own, in addition to their rainfed fields farm land which is located in the desheks. These desheks are not only located next to the river but are also found all over the district of Jamaame, even near the sand dunes of the coastal areas. According

1) See Chapter 4, p.22.

to the "Deshek Study" the average size of deshek land owned by a farmer is around 2 ha.

As a result of the field survey it is estimated that this farm type provides on average 1 Family Labour Unit for the field work in rainfed farming. The monthly availability of family labour is calculated at 20 man-days.

From the photo-interpretation which has been carried out within the context of the "Deshek Study", and from an additional field survey which was undertaken for this study, it appeared that on average only about 50 per cent of the farm land is cultivated. The rest is bush land or fallow(1). Accordingly, it is assumed that of the 2.4 ha farm land only 1.2 ha are cultivated.

Crop cultivation is carried out in the Gu and in the following Xagaa seasons. Based on the average cropping patterns in the region (2), the cropping patterns of the 2.4 ha farm model in Jilib/Jamaame/Kismayo Districts would be as follows:

Gu Season :

maize	0.60 ha

Gu / Xagaa Season :

sesame	0.43 ha
beans	0.12 ha
ground nuts	0.04 ha
cotton	0.01 ha

In Table 27 the annual labour demand for the 2.4 ha rainfed farm in the Jilib/Jamaame/Kismayo region and the degree of utilization of family labour is calculated. For the calculation of labour demands the labour profiles of APPENDIX B, Tables 30 to 34 are used.

Table 27 shows that for the whole year the utilization of the available family labour is only 32 per cent. The monthly percentages vary between zero and 100 per cent. Only in periods of peak labour demand, in June and August, is the family labour fully used. In all the remaining months less than 50 per cent is utilized. From the field investigations it is known that many farms in the region do not even use their family labour to the extent shown in Table 27. About 40 per cent of the cropped land in Jamaame District is ploughed by tractors and many farmers use hired labour for weeding. This means that the surplus of family labour of

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1) See Chapter 3.7.3, Table 2, p.15.
2) See Chapter 5.4.4, Figure 5, p. 32.

Table 27 Jilib/Jamaame/Kismayo Districts : Labour budget for a 2.4 ha Farm, 1.2 ha (50%) cultivated; 100 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
							In Man Days								
Labour Demand															
Maize	Gu	0.60	-	-	-	4.8	4.8	18.0	4.8	4.8	-	-	-	-	37.2
Sesame	Gu/Xagaa	0.43	-	-	-	-	-	3.4	3.4	12.9	3.4	5.2	-	-	28.3
Beans	Gu/Xagaa	0.12	-	-	-	-	-	1.0	0.8	3.6	1.0	1.4	-	-	7.8
G'nuts	Gu/Xagaa	0.04	-	-	-	-	-	0.3	0.3	1.2	0.4	0.3	1.1	-	3.6
Cotton	Gu/Xagaa	0.01	-	-	-	-	-	0.1	0.3	0.1	-	0.1	0.3	-	0.9
				-	-	-	-	-	-	-					
				-	-	-	-	-	-	-					
				-	-	-	-	-	-	-					
Total Labour Demand			-	-	-	4.8	4.8	22.8	9.6	22.6	4.8	7.0	1.4	-	77.8
Hired Labour			-	-	-	-	-	2.8	-	2.6	-	-	-	-	5.4
Family Labour Availability			20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	240.0
Balance			20.0	20.0	20.0	15.2	15.2	0.0	10.4	0.0	15.2	13.0	18.6	20.0	167.6
Percentage of Family Labour Used			0.0	0.0	0.0	24.0	24.0	100.0	48.0	100.0	24.0	35.0	7.0	0.0	32.0

Source : Tables 30 to 34 APPENDIX B

the farm type under consideration is even higher in reality than calculated in Table 27. It is estimated that most of the labour surplus is utilized in the deshek part of the farms.

Many farms may also use their labour surplus for earning additional cash income as hired labour on neighbouring farms.

The second farm type selected as farm model for the districts of Jilib, Jamaame and Kismayo is representative for only a small portion of farms which have 5 ha or more.

The provision of family labour of this farm type has been estimated at 2 Family Labour Units resulting in a monthly labour availability of 40 man-days. For this farm model it is also assumed that 50 per cent of the farm land, i.e. 2.5 ha are cultivated. Crop cultivation is carried out during the Gu and Xagaa seasons.

The cropping patterns applied are the same as for the aforementioned 2.4 ha farm in the region, so that the cropping patterns of the 5 ha farm in Jilib/Jamaame/Kismayo Districts are as follows:

Gu season : maize 1.25 ha

Gu/Xagaa season :

sesame	0.90 ha
beans	0.25 ha
g'nuts	0.08 ha
cotton	0.03 ha

Table 28 shows the calculations for the labour demand for the 5 ha rainfed farm in the Jilib/Jamaame/Kismayo region and the degree of utilization of family labour. For the calculation of labour demands the labour profiles of APPENDIX B, Tables 30 to 34 are used.

Table 28 shows that for the whole year the utilization of family labour is only 42 per cent. The monthly percentages vary between zero and 100 per cent. During the months of June and August additional labour has to be hired. From the field investigations it is assessed that in reality more hired labour is used than shown in Table 28. Also field preparation is generally carried out by hired tractors, so that the labour surplus is in general even higher than calculated.
It is assumed that part of the labour surplus is used on the deshek part of the farm.

Table 28 Jilib/Jamaame/Kismayo Districts; Labour Budget for a 5 ha Farm, 2.5 ha(50%) cultivated; 100 % Cropping Intensity

Labour Demand/ Supply	Season	Cultivated area in ha	J	F	M	A	M	J	J	A	S	O	N	D	Total
			In Man Days												
Labour Demand															
Maize	Gu	1.25	-	-	-	10.0	10.0	75.0	10.0	10.0	-	-	-	-	115.0
Sesame	Gu/Xagaa	0.90	-	-	-	-	-	7.2	7.2	27.0	7.2	10.8	-	-	59.4
Beans	Gu/Xagaa	0.25	-	-	-	-	-	2.0	1.8	7.5	2.0	3.0	-	-	16.3
G'nuts	Gu/Xagaa	0.08	-	-	-	-	-	0.6	0.6	2.4	0.8	0.6	2.2	-	7.2
Cotton	Gu/Xagaa	0.03	-	-	-	-	-	0.2	0.9	0.3	-	0.2	0.9	-	2.5
	Der			-	-	-	-	-	-	-					
	Der			-	-	-	-	-	-	-					
	Der			-	-	-	-	-	-	-					
Total Labour Demand			-	-	-	10.0	10.0	85.0	20.5	47.2	10.0	14.6	3.1	-	200.4
Hired Labour			-	-	-		-	45.0	-	7.2		-		-	52.2
Family Labour Availability			40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	480.0
Balance			40.0	40.0	40.0	30.0	30.0	0.0	19.5	0.0	30.0	25.4	36.9	40.0	331.8
Percentage of Family Labour Used			0.0	0.0	0.0	25.0	25.0	100.0	51.0	100.0	25.0	37.0	8.0	0.0	42.0

Source : Tables30 to 34 APPENDIX B

7.3 Farm Income

7.3.1 Introduction

The analysis of farm income is limited to that income which is generated by crop cultivation under rainfed conditions. In cases like the mixed irrigated/rainfed farms, the income from the irrigated part of the farm was not taken into consideration. Also other sources of farm income, such as livestock, bee-keeping, earnings from work as hired labour etc. have not been included in the calculations. The reason for this is only partly insufficient information. On the other hand it was seen as the predominant purpose of this study to concentrate on finding out the economic strength of rainfed farming. In order to facilitate the comparisons between different farm types and farming regions, it has therefore been decided to analyse purely the rainfed farming aspects.

Five main figures have been of major interest, the gross margin per ha and man-day of family labour, the net farm income per farm and man-day of family labour and the management income. The total net farm income of the farms was calculated by deducting the total production costs from the gross output. Family labour was not costed.

The net income of a family labour man-day was calculated by dividing the total net farm income by the amount of family labour man-days used according to the requirements calculated in the labour profiles and farm budgets of APPENDIX B.

The management income was calculated by costing the used family labour man-days at the rate which is paid on average for hired labour in the region.

7.3.2 Bardheere District

The calculations of the farm models for the Bardheere District, as selected in Chapter 7.1, are based on the crop budgets of APPENDIX B, Tables 9 to 17.

The following Table 29 summarizes the gross margins which have been calculated in the crop budgets.

Table 29 Bardheere District : Gross Margins

Group	Gross Margin in SoSh per year per ha	per Man-day family labour
Sorghum		
- Use of family labour only	4,958	155
- Use of hired and family labour	3,758	188
- Use of machinery, hired and family labour	2,708	271
Maize		
- Use of family labour only	6,951	211
- Use of hired and family labour	5,551	242
- Use of machinery, hired and family labour	4,501	500
Sesame		
- Use of family labour only	13,999	400
- Use of hired and family labour	12,599	600
Beans		
- Use of family labour only	8,095	231

Source : Own calculations

Table 30 shows the farm model of a 5 ha farm in Bardheere District. The net farm income is about SoSh 36,000. The income per man-day is SoSh 161 which is 61 per cent more than the average daily rate paid for hired labour in the district. By costing the family labour used at the average daily rate for hired labour of SoSh 100, the annual management income is only approximately SoSh 13,700.

Since the level of production of this farm type is so low, there is no cash income from sorghum, maize or beans. Some cash income is earned from sesame alone. Additional cash requirements have to be satisfied from other sources. If this farm has no other income from deshek or irrigation cultivation or from livestock, additional income will be gained from work as hired labour on other farms. In many cases, however, a farmer who owns such a farm has other incomes from the deshek or irrigated land belonging to him or from his livestock herd.

Table 30 Bardheere District: Farm Model, 5 ha Farm

Item	Unit	Crops Sorghum	Maize	Sesame	Beans	Total
1. Farm Size	ha					5.00
- Cultivated Area	ha					3.50
- Unused	ha					1.50
- Cropped Area (1)	ha	6.25	0.39	0.28	0.08	7.00
2. Inflows						
Output						
- Total production	kg	3,000	203	67	18	
- Losses (2)	kg	150	10	3	1	
- Net Production	kg	2,850	193	64	17	
- Farmgate Price	SoSh/kg	11	14	60	36	
- Gross Output	SoSh	31,350	2,697	3,830	612	38,489
3. Outflows						
Variable Costs						
- Seeds	SoSh	481	33	101	12	627
- Packing Material	SoSh	1,500	94	10	3	1,607
- Field Operation, Labour	SoSh					
- Field Operation, Machinery	SoSh					
- Tax	SoSh	31	2	1	-	34
Subtotal	SoSh	2,012	129	112	15	2,268
4. Net Farm Income						
- Total per Farm	SoSh	29,338	2,568	3,718	597	36,221
- Total per Family Labour Man-Day	SoSh					161
5. Adjustment for Family Labour (3)	SoSh	20,000	1,290	980	280	22,550
6. Investment and Management Income	SoSh					13,671

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 100 per man-day

Table 31 Bardheere District Farm Model, 10 ha Farm

Item	Unit	Crops Sorghum	Maize	Sesame	Beans	Total
1. Farm Size	ha					10.00
- Cultivated Area	ha					7.00
- Unused	ha					3.00
- Cropped Area (1)	ha	12.50	0.78	0.56	0.16	14.00
2. Inflows						
Output						
- Total production	kg	6,000	406	134	37	
- Losses (2)	kg	300	20	7	2	
- Net Production	kg	5,700	385	128	35	
- Farmgate Price	SoSh/kg	11	14	60	36	
- Gross Output	SoSh	62,700	5,394	7,661	1,259	77,014
3. Outflows						
Variable Costs						
- Seeds	SoSh	963	66	202	23	1,254
- Packing Material	SoSh	2,952	187	20	6	3,165
- Field Operation, Labour	SoSh	15,000	1,092	784	-	16,876
- Field Operation, Machinery	SoSh					
- Tax	SoSh	63	4	3	1	71
Subtotal	SoSh	18,978	1,349	1,009	30	21,366
4. Net Farm Income						
- Total per Farm	SoSh	43,722	4,045	6,652	1,229	55,648
- Total per Family Labour Man-Day	SoSh					586
5. Adjustment for Family Labour (3)	SoSh	25,000	1,482	1,176	560	28,218
6. Investment and Management Income	SoSh					27,430

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 100 per man-day

Table 32 Bardheere District: Farm Model, 15 hectare Farm

Item	Unit	Crops Sorghum	Maize	Sesame	Beans	Total
1. Farm Size	ha					15.00
- Cultivated Area	ha					10.50
- Unused	ha					4.50
- Cropped Area (1)	ha	18.79	1.16	0.84	0.22	21.00
2. Inflows						
Output						
- Total production	kg	9,019	603	202	51	
- Losses (2)	kg	451	30	10	3	
- Net Production	kg	8,568	573	192	48	
- Farmgate Price	SoSh/kg	11	14	60	36	
- Gross Output	SoSh	94,251	8,023	11,520	1,731	115,525
3. Outflows						
Variable Costs						
- Seeds	SoSh	1,447	97	302	32	1,878
- Packing Material	SoSh	4,510	278	30	8	4,826
- Field Operation, Labour	SoSh	22,548	1,624	1,176	-	25,348
- Field Operation, Machinery	SoSh	19,730	1,218	-	-	20,948
- Tax	SoSh	94	6	4	1	105
Subtotal	SoSh	48,329	3,223	1,512	41	53,105
4. Net Farm Income						
- Total per Farm	SoSh	45,922	4,800	10,008	1,690	62,420
- Total per Family Labour Man-Day	SoSh					279
5. Adjustment for Family Labour (3)	SoSh	18,790	1,044	1,764	770	22,368
6. Investment and Management Income	SoSh					40,052

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 100 per man-day

In Table 31 a 10 ha farm model from Bardheere District has been calculated. The net farm income is about SoSh 56,000 and the income per man-day family labour reaches almost SoSh 590. After adjusting the net farm income by costing family labour at the rate of SoSh 100 for hired labour, the income is still over SoSh 27,000.

It is estimated that this farm type is self-sufficient with regard to food production. Cash requirement may be met by selling sesame and some grains.

7.3.3 Saakow/Bu'aale Districts

The calculations of the farm models for the districts of Saakow and Bu'aale, as selected in Chapter 7.1, are based on the crop budgets of APPENDIX B, Tables 25 to 29.

The following Table 33 summarizes the gross margins which have been calculated in the crop budgets.

Table 33 Saakow/Bu'aale Districts : Gross Margins

Crop	Gross Margin in SoSh per year per ha	per Man-day family labour
Sorghum		
- Use of family labour only	4,936	215
- Use of hired and family labour	3,806	272
Maize		
- Use of family labour only	6,251	284
Sesame		
- Use of family labour only	16,993	739
Beans		
- Use of family labour only	12, 685	470

Source : Own Calculations

In Table 34 the income situation of a 15 ha farm model in Bardheere District is calculated. It is shown that the net farm income exceeds SoSh 62,000. The income per man-day of family labour is around SoSh 280. The management income is SoSh 40,000.

It is suggested that this farm type is completely self-sufficient and can satisfy both food and cash requirements from its own production.

Table 34 shows the income situation of a 5 ha farm model in Saakow/Bu'aale Districts. The net farm income is SoSh 33,000 and the income per man-day of family labour SoSh 217. The management income is low, not reaching SoSh 14,000 p.a. This farm type is in the same situation as the 5 ha farm model of Bardheere District. It needs additional income either from deshek farming, from livestock or from work as hired labour on another farm.

In Table 35 a 10 ha farm model from the districts of Saakow and Bu'aale is calculated. The net farm income is about SoSh 66,000 and the income for one man-day of family labour is SoSh 217. This farm type is in general self-sufficient and can provide both food and cash requirements.

Table 36 shows the income situation of a 15 ha farm model in Saakow/Bu'aale Districts. The net farm income is almost SoSh 78,000 and the family labour income is So Sh 271 per man-day. The management income is about SoSh 42,000.

This farm type is, like the 15 ha farm type in Bardheere, fully self-sufficient.

Table 34 Saakow Bu'aale Districts : Farm Model, 5 ha Farm

Item	Unit	Crops Sorghum	Maize	Sesame	Beans	Total
1. Farm Size	ha					5.00
- Cultivated Area	ha					3.30
- Unused	ha					1.70
- Cropped Area (1)	ha	6.20	0.24	0.14	0.03	6.60
2. Inflows						
Output						
- Total production	kg	2,976	113	41	11	
- Losses (2)	kg	149	6	2	1	
- Net Production	kg	2,827	107	39	10	
- Farmgate Price	SoSh/kg	11	14	60	36	
- Gross Output	SoSh	31,099	1,500	2,314	369	35,282
3. Outflows						
Variable Costs						
- Seeds	SoSh	614	20	50	6	690
- Packing Material	SoSh	1,488	58	6	2	1,554
- Field Operation, Labour	SoSh					
- Field Operation, Machinery	SoSh					
- Tax	SoSh	31	1	1	-	33
Subtotal	SoSh	2,133	79	57	8	2,277
4. Net Farm Income						
- Total per Farm	SoSh	28,966	1,421	2,257	361	33,005
- Total per Family Labour Man-Day	SoSh					217
5. Adjustment for Family Labour (3)	SoSh	18,018	630	378	126	19,152
6. Investment and Management Income	SoSh					13,853

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 126 per man-day

Table 35 Saakow/Bu'aale Districts : Farm Model, 10 ha Farm

Item	Unit	Crops Sorghum	Maize	Sesame	Beans	Total
1. Farm Size	ha					10.00
- Cultivated Area	ha					6.60
- Unused	ha					3.40
- Cropped Area (1)	ha	12.41	0.46	0.26	0.07	13.20
2. Inflows						
Output						
- Total production	kg	5,957	216	75	25	
- Losses (2)	kg	298	11	4	1	
- Net Production	kg	5,659	205	71	24	
- Farmgate Price	SoSh/kg	11	14	60	36	
- Gross Output	SoSh	62,249	2,875	4,260	864	70,248
3. Outflows						
Variable Costs						
- Seeds	SoSh	1,229	39	94	15	1,377
- Packing Material	SoSh	2,978	110	11	4	3,103
- Field Operation, Labour	SoSh					
- Field Operation, Machinery	SoSh					
- Tax	SoSh	62	2	1	-	65
Subtotal	SoSh	4,269	151	106	19	4,545
4. Net Farm Income						
- Total per Farm	SoSh	57,980	2,724	4,154	845	65,703
- Total per Family Labour Man-Day	SoSh					217
5. Adjustment for Family Labour (3)	SoSh	35,910	1,260	756	252	38,178
6. Investment and Management Income	SoSh					27,525

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 126 per man-day

Table 36 Saakow/Bu'aale Districts : Farm Model, 15 ha Farm

Item	Unit	Crops Sorghum	Maize	Sesame	Beans	Total
1. Farm Size	ha					15.00
- Cultivated Area	ha					9.90
- Unused	ha					5.10
- Cropped Area (1)	ha	18.60	0.70	0.40	0.10	19.80
2. Inflows						
Output						
- Total production	kg	8,928	329	116	36	
- Losses (2)	kg	446	16	6	2	
- Net Production	kg	8,482	313	110	34	
- Farmgate Price	SoSh/kg	11	14			
- Gross Output	SoSh	93,298	4,376	6,612	1,224	105,510
3. Outflows						
Variable Costs						
- Seeds	SoSh	1,841	59	144	22	2,066
- Packing Material	SoSh	4,464	168	17	5	4,654
- Field Operation, Labour	SoSh	21,018	-	-	-	21,018
- Field Operation, Machinery	SoSh					
- Tax	SoSh	93	4	2	1	100
Subtotal	SoSh	27,416	231	163	28	27,838
4. Net Farm Income						
- Total per Farm	SoSh	65,882	4,145	6,449	1,196	77,672
- Total per Family Labour Man-Day	SoSh					271
5. Adjustment for Family Labour (3)	SoSh	32,760	1,890	1,134	378	36,162
6. Investment and Management Income	SoSh					41,510

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 126 per man-day

7.3.4 Jilib/Jamaame/Kismayo Districts

The calculations of the farm models for the districts of Jilib, Jamaame and Kismayo are based on the crop budgets of APPENDIX B, Tables 35 to 43.

The following Table 37 contains a summary of the gross margins which have been calculated in the crop budgets.

Table 37 Jilib/Jamaame/Kismayo Districts: Gross Margins

Crop	Gross Margin in SoSh per year per ha	per Man-day family labour
Maize		
- Use of family labour only	16,087	259
- Use of hired and family labour	12,787	533
- Use of machinery, hired and family labour	9,787	612
Sesame		
- Use of family labour only	35,365	536
- Use of hired and family labour	30,865	1,102
- Use of machinery, hired and family labour	29,065	1,453
Cotton		
- Use of machinery and family labour	6,853	46
Groundnuts		
- Use of family labour only	21,067	237
Beans		
- Use of family labour only	17,812	274

Source : Own Calculations

Table 38 Jilib/Jamaame/Kismayo Districts: Farm Model, 2.4 ha Farm

Item	Unit	Crops Maize	Sesame	Beans	G'nuts	Cotton	Total
1. Farm Size	ha						2.40
- Cultivated Area	ha						1.20
- Unused	ha						1.20
- Cropped Area (1)	ha	0.60	0.43	0.12	0.04	0.01	1.20
2. Inflows							
Output							
- Total production	kg	720	258	60	20	4	
- Losses (2)	kg	36	13	3	1	0.2	
- Net Production	kg	684	245	57	19	3.8	
- Farmgate Price	SoSh/kg	14	60	36	45	20	
- Gross Output	SoSh	9,576	14,706	2,052	855	76	27,265
3. Outflows							
Variable Costs							
- Seeds	SoSh	101	232	13	54	-	400
- Packing Material	SoSh	324	39	9	3	2	377
- Field Operation, Labour	SoSh						
- Field Operation, Machinery	SoSh						
- Tax	SoSh	3	2	1	-	-	6
Subtotal	SoSh	428	273	23	57	2	783
4. Net Farm Income							
- Total per Farm	SoSh	9,148	14,433	2,029	798	74	26,482
- Total per Family Labour Man-Day	SoSh						340
5. Adjustment for Family Labour (3)	SoSh	4,366	3,304	944	472	175	9,261
6. Investment and Management Income	SoSh						17,221

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 118 per man-day

Table 38 shows the income situation of a 2.4 ha farm model from the districts of Jilib, Jamaame and Kismayo. The net farm income is about SoSh 27,000, the income of family labour SoSh 340 per man-day and the management income is about SoSh 12,000.

These small farms rely heavily on additional income, which in this region is either received from additional deshek land or from work as hired labour. The opportunities for going as hired labour in the lower reaches of the Juba Valley are manifold. Farmers can either go to other rainfed or deshek farms in the area or they find jobs on the banana plantations along with other adult family members or their children. In addition, job opportunities are provided by the large projects such as the Fanoole Project, the Juba Sugar Project and the Mogambo Project.

Table 39 shows a 5 ha farm model from the region of Jilib/Jamaame and Kismayo. Here the incomes are higher: SoSh 42,000 net farm income, So Sh 642 income per man-day family labour and SoSh 34,000 management income. But still this farm type also needs additional income which can be gained from deshek fields belonging to the same farm or from salaries earned as hired labour from the different sources in the region as described above.

Table 39 Jilib/Jamaame/Kismayo Districts: Farm Model, 5 ha Farm

Item	Unit	Crops Maize	Sesame	Beans	G'nuts	Cotton	Total
1. Farm Size	ha						
- Cultivated Area	ha						5.00
- Unused	ha						2.50
- Cropped Area (1)	ha	1.25	0.90	0.25	0.08	0.03	2.50
2. Inflows							
Output							
- Total production	kg	1,500	450	125	40	12	
- Losses (2)	kg	75	27	6	2	1	
- Net Production	kg	1,425	513	119	38	11	
- Farmgate Price	SoSh/kg	14	60	36	45	20	
- Gross Output	SoSh	19,950	30,780	4,275	1,710	220	56,935
3. Outflows							
Variable Costs							
- Seeds	SoSh	210	486	27	108	-	831
- Packing Material	SoSh	675	81	19	6	6	787
- Field Operation, Labour	SoSh	5,625	4,050	-	-	-	9,675
- Field Operation, Machinery	SoSh	2,250	1,620	-	-	28	3,898
- Tax	SoSh	6	5	1	-	-	12
Subtotal	SoSh	8,766	6,242	47	114	34	15,203
4. Net Farm Income							
- Total per Farm	SoSh	11,184	24,538	4,228	1,596	186	41,732
- Total per Family Labour Man-Day	SoSh	(20)	(18)	(16)	(7)	(4)	642
5. Adjustment for Family Labour (3)	SoSh	2,360	2,124	1,888	826	472	7,670
6. Investment and Management Income	SoSh						34,062

Source : Own Calculations

1) 200 per cent annual cropping intensity
2) 5 per cent
3) Family labour requirement costed at SoSh 118 per man-day

8. Constraints

8.1 Introduction

Based on the evaluation of the present situation, together with the needs expressed by the farmers in the course of the field visit the following main groups of constraints could be identified:

- constraints in agricultural production
- constraints in agricultural service.

The difficulties in the present agricultural production methods were found to be similar in Gardheere, Saakow/Bu'aale Districts on the one hand and on the other hand similar for Jilib, Jamaame/ Kismayo Districts. Slight differences were found between these two main areas.

As far as constraints in the performance of agricultural services is concerned, they were found to be basically the same.

8.2 Constraints in Agricultural Production

The constraints found in the whole Study Area are:

- technical constraints, such as
  - insufficient machinery and equipment
  - untimely deployment of machinery and equipment
  - absence of draught animals
  - lack of implements for animal draught
  - lack of a programme for training draught animals

- production constraints
  - insufficient and erratic rainfall
  - non-existence of methods to use rainfall in a better way (water retention measures)
  - inadequate production techniques
    - improper or non.existing soil preparation
    - insufficient seed amounts
    - inadequate sowing techniques
  - poor seed quality
  - lack of improved seeds
  - lack of farm inputs i.e. means for seed treatment and for pest and disease control
  - non-availability of control of quelea and locust attacks

For the three southern districts flood hazards are an important constraint to receiving adequate yields. Flood hazards occasionally may occur when the Juba River overflows its embankments. However more regularly the rainfed areas are flooded from rainwater coming from adjacent higher areas.

8.3 Institutional Constraints

Various, mainly governmental institutions provide services to the agricultural sector in the Juba Region. These are, for example marketing, machinery hire, agricultural extension, input and credit supply and promotion of farmers' organizations. The following Table 40 shows that with the exception of marketing, the agricultural service sector in the Juba Valley is weak.

Table 40 Portion of Farmers served in the Juba Valley

Service	Estimated percentage of farmers served
Marketing	90
Machinery Hire	15
Agricultural Extension	10
Input Supply	10
Agricultural Credit	2 - 3
Promotion of Farmers' Organizations	0

Marketing

Most of the farmers in the rainfed sub-sector in the Juba Valley can market their produce under reasonable conditions. This is due to the extended station network of the Agricultural Development Corporation (ADC) which had the monopoly of grain (mainly sorghum and maize) marketing until 1982 and the increasing involvement of private businessmen in marketing. In the last three years,since liberalization of grain marketing, the private sector has been competing with ADC. ADC maintain stores in the districts of Bardheere, Saakow, Bu'aale, Jilib, Jamaame and Kismayo with a storage capacity of about 50,000 tons.

Machinery Service

Farm machinery service for the rainfed farms is provided by the Farm Machinery and Agricultural Service Organization (ONAT) and Somaltex. ONAT maintains agencies and workshops in Bardheere, Bu'aale, Jilib and Jamaame. The main activities consist of bush clearing, land levelling, ploughing and harrowing for private farmers.

ONAT is not able by a long way to meet the present demand for machinery services in the Juba Region. The main problems consist of lack of machinery, spare parts and fuel, the non-availability of qualified technical staff and poor administration.

Somaltex can serve only a small number of farmers involved in cotton growing. Their machinery service is functioning well.

Agricultural Extension

Extension work for farmers in the Juba Valley is carried out by the Agricultural Farm Management and Extension Training Project (AFMET) and Somaltex.

AFMET has initiated its programme in the Juba Valley in 1982. Since then agencies have been established in Yontooy, Jilib, Bu'aale, Saakow and Bardheere. However, they were only poorly staffed and equipped so that after an initial phase, during which extension work was carried out to some extent, the activities of the extension service stopped almost completely in 1985. Extension work for the small number of cotton growers is well organized.

Input Supply

The institutions responsible for the provision of agricultural inputs are the Ministry of Agriculture (MOA), the Agricultural Farm Management and Extension Training Project (AFMET), and Somaltex.

The responsibilities of the MOA's Plant Protection and Locust Control Department have temporarily been taken over by AFMET which should also have organized the supply of other farm inputs such as fertilizers, implements etc. However, due to AFMET's decline in the Juba Region and shortcomings of the MOA's organization and funds, the supply of farm inputs is limited to a small group and cotton growers.

Credit Supply

The existing sources of farm credit for the farmers in the Juba Valley are the Somali Development Bank (SDB), and Somaltex. SDB has a branch in Kismayo which extends medium-term loans to only a very limited number of bigger farmers. The small group of cotton growers in Lower Juba receives crop loans free of interest from Somaltex for financing pesticides, farm labour and tractor hire. The majority of farmers in the Juba Region however, have no access to institutional credit sources.

Promotion of Farmers' Organizations

After the establishment of the Cooperative Law in 1973 a large number of agricultural cooperatives were created in the Juba Valley. Financial, technical and administrative support was given by the Union of Agricultural Cooperatives (UAC). In 1983 a total number of 98 cooperatives with over

10,000 members were registered. However, after an initial boom the support from UAC diminished and finally stopped altogether, with the effect that in 1985 there were only a few cooperatives operating according to the defined aims.

8.4 Other Constraints

Apart from the abovementioned technical, organizational and institutional constraints, there are other constraints which influence the production of crops under rainfed conditions. Such constraints are found in the physical conditions of the farmers, their families and relatives. A healthy physical constitution is a pre-requisite for executing successful agricultural production.

Constraints influencing the physical well-being of the rural population are:

- poor accessibility to and from the main villages and centres in the Juba Valley. This makes it difficult for the rural population to get treatment in case of illness
- non- or hardly- existent health facilities in the Study Area. Although a few hospitals and dispensaries are available in the major towns and some villages, they can not cope with the health situation in the Study Area. In addition, such facilities are in general under-equipped, under-staffed and medicines are almost not available at all
- absence of any disease prophylaxe by the rural population (e.g. the use of mosquito nets). No extension is given in this respect by the medical authorities
- absence of good quality drinking water in the rural areas
- lack of a well-balanced, vitamin-rich diet. In rural areas hardly any fresh vegetables are grown to enrich the daily diet.

9. Assessment for Improvements

9.1 Introduction

This Chapter deals with some general ideas and broad outlines of possible improvements to rainfed agriculture in the Juba Valley. It contains a formulation of the aim of such improvements, the description of two possible approaches, the pros and cons of these approaches and the assessment of possible

improvements in some specific technical agricultural fields. Definite proposals and programmes and their quantification in terms of organization, personnel requirements, agricultural inputs and required financial support will be subject to the elaboration of specific development programmes.

9.2 Aim of Improvements

The goals for the improvement of rainfed agriculture would be

- to ensure and increase the production of food crops and hence
- to improve the farm income of the farmers and their families.

These aims are in scope with the current 5-year development plan (1982 - 1986) in which - under point 1.17.a - it is stated that the drive to self-sufficiency in the production of the main grain crops, sorghum, maize should be accelerated in order to decrease imports of these commodities progressively. In addition, points 1.17.g and 1.17.e mention respectively that agricultural production and storage facilities should be oriented to meet situations arising from drought conditions and the aim to raise the standard of living and welfare of the rural population in order to reduce the widening disparity between urban and rural standards of living.

9.3 Possible Approaches

Basically there are two possible approaches to improve and raise agricultural production. They are broadly outlined below:

- one approach might be to redirect the present agricultural methods based on self-sufficiency in food crops to a mainly market-oriented production method (high technology approach). This would thus mean a change of the present production systems

- the second approach might be geared towards the strengthening of the prevailing system, securing self-sufficiency in food crops and gradually raising the production. This would aim in the long run at larger proportions of the achieved yields being marketed (low-technology approach).

9.3.1 The High Technology Approach

The high technology approach would aim at the production of food crops for the market in a relatively short period. To introduce and execute such an approach the following preconditions would be required:

- high technological inputs
  Such inputs would consist of farm mechanisation for the whole production line i.e. from soil preparation over mechanical planting, chemical and mechanical weed control, disease and pest control, fertilizer inputs, mechanical harvesting and appropriate yield processing and storage

- high managerial skills from the farmers on one hand and on the other hand from the machinery attendants and advising personnel. Farmers would need to adapt themselves to new farming techniques (e.g. crop rotation system, fallow for soil regeneration, new crop varieties with higher yields etc.). The machinery to be used would have to be managed with well-trained personnel, not knowing only how to drive the machinery but also able to use the equipment in an appropriate manner (e.g. plough setting, use of spraying equipment and fertilizer distributors and combine harvesters). Highly skilled advisory and management personnel would be needed to determine the types of crops and the area to be planted withcertain crops, deployment of equipment and inputs and determination of harvesting times, processing and storage

- in such an approach farmers have to put their cultivated land together in order to use it as one entity to facilitate the utilization of machinery and equipment.

Such an approach would have to be backed up by assisting services such as:

- an extension service to assist farmers in technical queries and to adapt farmers' managerial skills towards new production techniques

- a service handling the necessary input supply, and its distribution, which would have to deploy the required inputs of certain types at the right time (fertilizers, agro-chemicals)

- a servicing system which would have to look after the functioning of machinery and equipment e.g. fuel, spare parts, maintenance

- a credit system to enable farmers to pay for the necessary mechanical work and inputs

- a marketing organization, which would organize the processing of the crops (e.g. threshing of non-combinable crops),set up an appropriate storage system, organize the collection of the crops from the farmers and channel the produce into the market.

In addition this organization would have to set up a credit recovery programme i.e. to deduct the credits from the farmers at the time they would be paid for their products.

Such an approach however would be difficult to realize for the near future. The reasons for this are:

- at present little is known on the most appropriate method to develop rainfed agriculture in Somalia. As far as the available information on the impovement of rainfed agriculture is concerned three programmes are presently being carried out on this subject:
  - in 1980 the Somali Government created the Agricultural Farm Management and Extension Training Project (AFMET). This organization absorbed the Department of Crop Production and Extension of the Ministry of Agriculture (MOA). The tasks of AFMET included:
    - setting up of a Project Management Unit, responsible for project implementation
    - creating a National Extension Service with educational programmes to strengthen and form managerial skills of the farmers
    - setting-up Farm Management Extension Training Centres for the improvement of the MOA to train extension and farm management officers and upgrade the capabilities of the existing personnel
    - introduction of a Farm Management Service to assist newly trained managers in planning, formulation and execution of agricultural programmes
    - assisting financially agricultural secondary schools in their training programmes and setting up new schools

    AFMET is still a young institution. After the commencement of this ambitious programme and its rapid implementation, a phase of consolidation, strengthening and reconsidering of this programme is presently being done. The effects of AFMET in the Juba Valley have been, apart from construction of some office facilities, largely negligible

  - in the Bey Region a project has been set up to improve living conditions of the rural people and raise rainfed agricultural production. For the agricultural component of the project variety-trials have been carried out for sorghum (120 varieties), groundnuts (54 varieties), beans (30 varieties), sunflower (5 varieties), safflower (one variety) and forage crops (16 varieties). In addition farmers were assisted in dressing of the seeds and control of plant diseases and pests. Particular results of the outcome of the project are being processed and evaluated

- rainfed farming under a high technology approach would still depend on the uncertain and erratic rainfall pattern as found in the Middle Juba and Gedo region. For Lower Juba agricultural production would be hampered by floods coming from the adjacent areas

- a high technology approach would need high investment costs. Such high investment costs would contain to a greater extent foreign exchange (machinery, fertilizers, agro-chemicals, fuel, spare parts) with which mainly crops would be produced for the local market

- farmers would lose to a large extent control over their land as decisionson farming techniques would be made by project management and not by themselves

- this approach would need well organized and well functioning service systems, to enable its execution.

Such organization (e.g. input supply, credit system, mechanization) do not exist at the moment in Somalia. Also it can be assumed that such organization will not be readily available in the near future.

For these reasons a high technology approach is not recommended for the improvement of rainfed agriculture in the Juba Valley.

9.3.2 The Low Technology Approach

The aim of a low technical approach would be to consolidate and strengthen the present farming systems in the rainfed areas in a gradual way. From field visits it became obvious that the farming systems were economically and socially stable, sound and well-developed.

Farm-management capacities of the farmers are turned towards the existing difficult environmental conditions and they have adopted a response to climatic hasards which is quick.

By consolidating and strengthening this equilibrium, the production of staple food crops would be ensured. In the long run production might be raised in such a way that a part of the produce could be channelled into the market system. This surplus production would then play a role in the reduction of the country's dependence on improving food commodities. Ensuring the production of food crops and gradually increasing yields could be done by :

- enlargement of the production area
- increasing the yields per ha
- enlargement of production area and simultaneous increase of yields per ha.

An enlargement of the production area would be possible without difficulties to managerial capacity of the farmers and land ownership. Presently, as mentioned in Chapter 4.2.3 in Bardheere District 13 per cent of the total farm land is left fallow. For Saakow/Bu'aale Districts this is around 12 per cent. For Jilib/Jamaame/Kismayo Districts only 43 per cent of the farm land is used at present (see Table). As especially in Bardheere and Saakow/Bu'aale Districts the fallow land was once cultivated, and has now been left fallow for various seasons, a resumption of this land into the production process would be very difficult.

The increase of yields per ha could, although the production would still be subject to rainfed conditions, gradually be improved by low input packages. The third possibility of gradually raising production would be a mixture of the two methods, described above.

To enable the securing and gradual raising of the production, the following measures could be proposed:

- improvement of agricultural techniques
- improvement of marketing and storage
- gradual raising of the educational standards of the farmers and hence to improve their management capabilities.

In particular, the following packages could be introduced to implement these measures:

- the introduction of water retention measures such as small basins in order to raise the soil moisture content at the onset of the rains. This might enable the farmers to sow earlier and make better use of the precipitation, especially during Der season

- construction of small bunds in the Jilib/Jamaame/Kismayo Districts to keep flood waters from adjacent areas out of their fields. Such construction works would have to be carried out mechanically and therefore the services of ONAT required. Maintenance could be done by the farmers themselves

- improvement of soil preparatory work. This can be achieved by the introduction of more tractors and implements. This again would imply, that the farmers would be dependent on a tractor organization (e.g. ONAT), which would have to cope with fuel scarcity and difficulties in spare parts' availability. During the field visits numerous farmers mentioned being very much interested in animal draught. Such a programme was introduced around 10 years ago by MOA but faded away quietly in the meantime. However, many farmers were acquainted with animal draught and the implements to be used. Some of the old implements were still present in the villages. It is therefore considered appropriate to re-introduce a programme on animal draught.

Such a programme would have the advantages that
- farmers themselves would determine the use and utilization of animal draught implements
- land left fallow at present, due to lack of manpower, could be taken into cultivation. Hence the cultivated areas could be extended
- as an extended area would require more man-days for crop cultivation, such bottlenecks could be reduced by using animal draught also for other activities e.g. sowing, crop maintenance and construction of basins for water retention purposes

- improvement of seed quality.
  As there is little information on available improved seeds in Somalia, farmers would have to carry on growing crops from their own seeds. However, a proper treatment of the seeds, e.g. proper storage and treatment with agro-chemicals would increase the quality of the seeds

- pest and disease control by means of agro-chemicals would also lead to higher yields

- control of quelea and locusts would lead to less harvest losses and higher yields

- processing of yields after the harvest might lead to fewer losses than with the present system where the yields are left on the field or stored in the underground storage facilities.

The advantage of introducing such low technical packages over a longer period would be

- the present land ownership would not be touched. Farmers would remain farmers and not be degraded to mere farm labourers as in the high technology approach

- the introduction of such packages would not require high investments. The demand on foreign exchange would be relatively low

- farmers would slowly and comprehensibly get acquainted with the introduction of new techniques

- by leaving the decision when and how to use the packages to the farmers themselves, they might easily identify with such new techniques

- the farmers' attitudes could change slowly from a self-sufficiency oriented production system towards a more market-oriented system

- the management ability of the farmers could be built up gradually

- if one of the packages should fail, farmers could still rely on their present farming systems.

One disadvantage of this approach might be found in the fact that production increase would be slow. Furthermore, it might be expected that it would take a rather long time before any substantial amounts of food crops could flow into the market. But also it can be expected that the change in the farmers' attitudes from a self-sufficiency oriented production system towards a more market-oriented one would be a slow process.

Such packages can only be introduced successfully, if they are backed up and embedded into agricultural support services and organizations. Such support would have to be:

- an extension service.
  Such an extension service should not be a highly sophisticated, rigid and costly organization, but more an organization which would assist farmers in questions arising from the implementation of packages. Such particulars might be:

  . training of animals for animal draught
  . introduction of related implements for soil preparation, weeding and crop maintenance
  . distribution of and advice on the use of agro-chemicals e.g. seed dusting, plant protection
  . setting up training programmes for farmers on special technical issues
  . advising and guiding farmers in the use of offered packages
  . setting up demonstration plots to underline their advice
  . advice and guidance on the use of crop processing implements

- a technical service, with the functions of:
  . assisting farmers in Jilib/Jamaame/Kismayo districts to carry out flood protection bunds
  . servicing and repair of animal draught implements and threshers

- a credit service, to enable farmers to purchase equipment and inputs, the construction of flood protection measures and the building of storage facilities

- a service to combat quelea and locust attacks

- a storage and marketing organization to
  - advise farmers on appropriate storage facilities for seeds, agricultural inputs and produce
  - assist farmers in the construction of storage facilities
  - recovery of credits
  - facilitate the marketing of produce

- a service on the improvement of health and sanitation to raise the existing health standards in the rural areas.

Many of these service requirements can be embedded into existing agricultural organizations, however others would have to be created. As far as extension is concerned, this could be done through AFMET, technical services by ONAT, quelea and locust control by the Desert Locust Control Department of the Plant Production Department in MOA.

Improvements on health and sanitation could be covered by the Ministry of Health. For a credit service however, a new organization would have to be set up, as at present such does not exist in rural areas. This might be a challenge for e.g. the Somali Development Bank.

For storage and marketing also a new organization would have to be set up. Although the Agricultural Development Corporation (ADC) which handled the nationwide storage and marketing until 1983 presently functions as an organization to purchase basic foodstuffs for a national reserve in drought times, it is no longer engaged in general marketing.

The activities of such services within the framework of improvement of rainfed agriculture and the results of the introduction of the packages would need close screening by a monitoring and evaluation system. Such a system would form the basis on the viability of the packages and the exchange of information between farmers and services and vice versa.

9.3.3 Costs

At this stage of the study it is too early to weigh and define costs for such an approach. This would have to be a subject of specific investigation after the definition of quantities needed to implement such an approach. However, it is not imprudent to estimate that with such a low-technical approach, present yields could be raised by 20-30 per cent under the prevailing rainfall conditions.

10. Farmers' Attitudes Towards Future Irrigated Agriculture

It was also the intention of this Study to get an initial impression of the farmers' attitudes with regard to the possibilities that in the future, after the construction of the Bardheere Dam, either their land would be converted into irrigated land or they could move to a near-by irrigation scheme in order to get farm land on their own or work as labourer on a large scheme.

Therefore as many farmers as possible and in particular the village authorities were questioned with regard to this aspect.

It was found to be very difficult to discuss this matter with the local people since they are not at all familiar with the problem and can hardly imagine the consequences connected with such conversions of the economic system. Therefore the results drawn below from the discussion can be taken only as very preliminary and general.

The first reaction to the question of what farmers thought about future irrigation of rainfed land was always very positive. Due to various sources of information all the farmers were very much aware of the intention of the Somali Government to store the water of the Juba River upstream of Bardheere in order to generate electric power and to provide a secure water supply for agriculture. The latter they see as the only solution to overcome what they consider to be their main problem: the dependency on irregular and low rainfalls.

Most people in the Study Area think the construction of the dam by itself will solve the problem. It seems understandable that noone is aware of the additional efforts which will be required in order to be able to actually use the water from the water store for irrigation. By mentioning some of the pre-conditions which have to be fulfilled for reaching this aim, the answers became less enthusiastic. This fact, however, cannot be taken too seriously at the moment. It only shows the need to make the people concerned more familiar with the problems and needs as soon as concrete project planning comes up in the future.

Nevertheless some of the answers from the discussions carried out with the local authorities in particular are remarkable. Farmers are of the opinion that the Government will take care of conducting the water to their fields and that they can carry on practising agriculture in the same way as before with the sole difference that they no longer have to rely on rainfalls. On mentioning the possible need to re-allocate farm

land from their village or to make changes with regard to present structures, the attitudes become negative.

There was even great reluctance in general as to an active participation of the villages in implementing irrigation structures. Only a few answers were positive in this respect. The answers become even more dismissive when asked about the readiness to give up present farm land and to become owners of new land within an irrigation perimeter nearby. Re-settlement is considered to be out of the question. The possibility of working as hired labour elsewhere on an irrigated scheme is generally rejected in a similar manner.

APPENDIX A : Data on Rainfed Areas and Farm Sizes

APPENDIX A

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APPENDIX A Table 1 Planimetred Areas for Rainfed Agriculture in the Study Area

District	Mosaic	Planimetred area in ha (1) Level	H1	H2	H3	Total Area in ha (1)
Bardheere	49 NW	-	-	-	-	500
	49 NE	-	-	-	-	400
	50 NW	-	-	-	-	800
	49 SW	-	-	-	-	800
	49 SE	-	-	-	-	7,800
	50 SW	-	-	-	-	3,100
	61 NW	-	-	-	-	4,500
	61 NE	-	-	-	-	17,700
	62 NW	-	-	-	-	3,000
	61 SW	-	-	-	-	2,150
	61 SE	-	-	-	-	7,100
	62 SW	-	-	-	-	3,300
	73 NW	-	-	-	-	1,350
	73 NE	-	-	-	-	4,300
	74 NW	-	-	-	-	1,550
Subtotal		-	-	-	-	58,950
Saakow	73 NW	-	-	-	-	850
	73 NE	-	-	-	-	6,400
	74 NW	-	-	-	-	7,850
	73 SW	-	-	-	-	800
	73 SE	-	-	-	-	6,450
	74 SW	-	-	-	-	9,550
	85 NW	-	-	-	-	0
	85 NE	-	-	-	-	2,050
	86 NW	-	-	-	-	1,300
Subtotal		-	-	-	-	35,250
Bu'aale	85 SE	-	-	-	-	550
	86 SW	-	-	-	-	400
	97 NE	-	-	-	-	50
	98 NW	-	-	-	-	500
	97 SE	-	-	-	-	50
	98 SW	-	-	-	-	0
	110 NW	-	-	-	-	500
	110 NE	-	-	-	-	0
Subtotal		-	-	-	-	2,050
Jilib	110 SW	450	-	-	-	450
	110 SE	-	-	-	-	0
	122 NW	1,050	-	-	-	1,050
	122 NE	250	-	-	-	250
	122 SW	250	-	350	-	600
	122 SE	100	-	-	-	100
Subtotal		2,100	-	350	-	2,450

Table 1 Planimetred Areas in the Study Area (continued)

District	Mosaic	Planimetred area in ha (1) Level	H1	H2	H3	Total Area in ha (1)
Jamaame	134 NW	260	-	1,070	1,920	3,250
	134 NE	300	330	2,845	275	3,750
	134 SW	750	-	-	4,000	4,750
	134 SE	25	-	25	-	50
	2 NW	205	-	180	6,915	7,300
Subtotal		1,540	330	4,120	13,110	19,100
Kismayo	2 NW	700	-	-	-	700
	2 SW	500	-	-	-	500
Subtotal		1,200	-	-	-	1,200
Grand Total		4,840	330	4,800	13,110	118,400(2)

Source : Own Calculations

1) Rounded figures
2) The grand total does not coincide with the total area of the levees and heterogenous soils as the planimetred areas in the Bardheere, Saakow and Bu'aale Districts have not been interpreted in such detail.

APPENDIX A Jilib District : Area Under Actual Cultivation
Table 2

Mosaic	Farm Land in ha Levees	H1	H2	H3	Utilization in % Levees	H1	H2	H3	Area under actual cultivation in ha
110 SW/NW	450	-	-	-	10	-	-	-	45
122 NW	1,050	-	-	-	10	-	-	-	105
122 NE	250	-	-	-	10	-	-	-	25
122 SW	250	-	350	-	10	-	90	-	340
122 SE	100	-	-	-	10	-	-	-	10
Total	2,100	-	350	-	10	-	90	-	525

Source: Own calculations and information from the maps of the "Deshek Study".

Table 3 Kismayo District : Area Under Actual Cultivation

Mosaic	Farm Land in ha Levees	H1	H2	H3	Utilization in % Levees	H1	H2	H3	Area under actual cultivation in ha
2 NW	700	-	-	-	10	-	-	-	70
2 SW	500	-	-	-	10	-	-	-	50
Total	1,200	-	-	-	10	-	-	-	120

Source : Own calculations and information from the maps of the "Deshek Study".

APPENDIX A Jamaame District : Area Under Actual Cultivation
Table 4

Mosaic	Farm Land in ha				Utilization in %				Area under actual Cultivation in ha
	Levees	H1	H2	H3	Levees	H1	H2	H3	
134 NW	260	-	-	-	10	-	-	-	26
	-	-	-	270	-	-	-	60	162
	-	-	1,070	-	-	-	50	-	535
	-	-	-	1,230	-	-	-	30	369
	-	-	-	420	-	-	-	50	210
134 NE	300	-	-	-	10	-	-	-	30
	-	330	-	-	-	40	-	-	132
	-	-	2,845	-	-	-	60	-	1,707
	-	-	-	275	-	-	-	50	138
134 SW	750	-	-	-	10	-	-	-	75
	-	-	-	1,390	-	-	-	50	695
	-	-	-	2,430	-	-	-	60	1,458
	-	-	-	180	-	-	-	30	54
2 NW	205	-	-	-	10	-	-	-	21
	-	-	180	-	-	-	50	-	90
	-	-	-	5,780	-	-	-	50	2,890
	-	-	-	590	-	-	-	60	354
	-	-	-	365	-	-	-	70	256
	-	-	-	180	-	-	-	40	72
134 SE	25	-	-	-	10	-	-	-	3
	-	-	25	-	-	-	50	-	13
Total	1,540	330	4,120	13,110	-	-	-	-	9,290

Source : Own calculations and information from the maps of the "Deshek Study".

APPENDIX A
Table 5

Farm Sizes in Bardheere District (1)

Village	Total Farm Area Income	No. of Farm Families	Farm Size Distribution in per cent						Average Farm size in ha
			1-5 ha	5-10 ha	10-15 ha	15-20 ha	20-50 ha	50 ha	
Doxiilow (2)	1,750	360	72	28	-	-	-	-	5
Sarinley (2)	1,520	141	-	-	-	-	-	-	11
Hureen (2)	1,600	120	-	-	-	-	-	-	13
Buulo Addey (2)	800	70	-	-	-	-	-	-	11
Baciidley (2)	1,200	140	-	82	14	4	-	-	9
Hiilo Shiid (2) Labka	1,740	150	-	-	-	-	-	-	12
Gaguure (2)	4,000	400	-	-	-	-	-	-	10
Jambaley (2)	1,300	200	3	28	39	20	10	-	7
Toorey	370	40	-	25	25	25	25	-	9
Mataniaha	1,530	190	-	50	18	12	20	-	8
Xanyaaley	380	40	92	5	3	-	-	-	10
Barow Dinle	2,730	300	-	-	-	-	-	-	9
Tobaaco	1,340	200	-	-	12	36	35	17	7
Garaska Shabada	620	60	-	-	-	-	-	-	10
Galgalmuudey	360	40	-	-	-	-	-	-	9
Kamaarey	900	100	-	-	-	-	-	-	9
Benlaodey	400	40	-	-	-	-	-	-	9

APPENDIX A Farm Sizes in Bardheere District (1) (continued)

Table 5

Village	Total Farm Area Income	No. of Farm Families	Farm Size Distribution in per cent 1-5 ha	5-10 ha	10-15 ha	15-20 ha	20-50 ha	50 ha	Average Farm size in ha
Dhobley area	3,500	460	53	8	39	-	-	-	8
Mundul M. Jalle	250	45	-	-	-	-	-	-	6
Gargelis	740	60	-	-	-	-	-	-	12
Aminaay	330	50	-	-	-	-	-	-	7

Source : Own calculations
1) calculations based on photo-interpretation and numbers of farm families indicated by local authorities
2) mixed rainfed and irrigated farming

APPENDIX A Farm Sizes in Saakow and Bu'aale Districts
Table 6

Village	Total Farm Area in ha	No of Farm Families	Farm Size Distribution in per cent 1-5 ha	5-10 ha	10-15 ha	15-20 ha	20-50 ha	50 ha	Average Farm Size in ha
Saakow District (1)									
Buulo Batuulo (2)	410	50	40	32	15	4	9	-	8
Gurmeyso (2)	270	65	71	24	3	1	-	1	4
Birbiriso (2)	240	60	93	4	-	-	3	-	4
Saakow (2)	250	80	98	2	-	-	-	-	3
Barka Mumin Dorow	1,260	135	24	52	18	4	2	-	9
Dagarras	1,030	76	8	42	17	8	25	-	14
Gaguudey	2,230	144	35	17	12	5	25	6	16
Goomir	2,100	227	17	56	15	5	6	1	9
Beeshka Goomir Maleyko	580	45	24	38	20	-	18	-	13
Marmarka	2,630	261	44	27	12	8	8	1	10
Nusduniya	610	52	35	25	20	10	6	4	12
Lebiley	370	40	20	55	20	-	5	-	9
Neefsooy	3,040	268	22	35	22	9	12	-	11
Lawyto	910	93	62	16	3	-	17	2	10
Boloy	1,140	71	10	20	23	15	32	-	16
Uurtaale	1,760	137	22	42	12	2	21	1	13
Buulo Soomow	150	27	67	18	4	7	4	-	6
Rowla Galoolka	900	68	50	22	7	9	10	2	13
Khardhuba	530	58	42	26	14	9	9	-	9

APPENDIX A Farm Sizes in Saakow and Bu'aale Districts (continued)

Table 6

Village	Total Farm Area in ha	No. of Farm Families	Farm Size Distribution in per cent 1-5 ha	5-10 ha	10-15 ha	15-20 ha	20-50 ha	50 ha	Average Farm Size in ha
Laba Fursa	850	72	22	31	11	21	15	-	12
Galuuley	360	27	22	30	26	7	11	4	13
Beesha Golooley	480	52	31	40	14	10	4	1	9
Caliow Arbow	470	44	14	18	61	5	2	-	11
Galooley	270	41	61	27	-	5	7	-	7
Bagaadey	1,410	98	17	32	33	4	11	3	14
Galgalonley	545	120	68	20	10	1	1	-	5
Caliyow Keerow	375	81	83	12	1	-	4	-	5
Basra	285	70	60	34	6	-	-	-	4
Doodox	295	45	20	76	2	-	2	-	7
Libi Buul	760	95	17	64	17	-	2	-	8
Beesha Bonda	440	60	60	16	12	2	10	-	7
Bonda Iffin	2,870	319	60	18	6	7	8	1	9
Buulo Wardiid	1,980	211	17	62	14	3	4	-	9
Bu'aale District (3)									
Different Villages	1,210	95	37	19	13	6	25	-	13

Sources: Registrations of the District and Regional Agricultural Coordinators of the Ministry of Agriculture in Saakow and Bu'aale and own investigations.

1) As registered at Saakow, office of the District Agricultural Officer and in addition calculated from photo-interpretation and number of farm families as indicated by local authorities.

2) Mixed rainfed and deshek farming.

3) As registered at Bu'aale, office of the Regional Agricultural Officer.

APPENDIX A Farm Sizes in Jilib, Jamaame and Kismayo Districts
Table 7

Village	Total Farm Area in ha	No. of Farm Families	Farm Size Distribution in per cent 1-5 ha	5-10 ha	10-15 ha	15-20 ha	20-50 ha	50 ha	Average Farm Size in ha
Jilib District									
Selected Villages	234	25	48	24	24	-	-	4	9
Jamaame/Kismayo Districts									
Banaawey	90	39	90	10	-	-	-	-	2.3
Galadley	190	161	100	-	-	-	-	-	1.2
Bander Jadiid	360	56	98	2	-	-	-	-	6.4
Deema	340	223	99	1	-	-	-	-	1.5
Beled Amin	150	97	99	1	-	-	-	-	1.5
Xongore	220	172	100	-	-	-	-	-	1.3
Thurdo Far Bullax	40	39	87	-	5	8	-	-	1.0
Buur Koy	100	108	-	-	-	-	-	-	0.9
Masagirow	300	53	100	-	-	-	-	-	5.7
Niirey	680	215	93	3	1	-	3	-	3.2
Naffa Quur	330	150	-	-	-	-	-	-	2.2
Janaale Lay	70	63	100	-	-	-	-	-	1.1
Goob Weyn	33	20	-	-	-	-	-	-	1.7
Gobiamo	520	57	100	-	-	-	-	-	9.1

Source: Registration of the District Agricultural Coordinators at the offices of the Ministry of Agriculture in Jilib and Jamaame.

APPENDIX B : Agro-Economic Data

APPENDIX B

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APPENDIX B Bardheere District :
Table 1 Labour Profile for One Hectare Sorghum, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	8	-	-	-	-	-	-	-	-	8
Sowing	-	-	-	-	3	-	-	-	-	-	-	-	3
Weeding													
- 1st	-	-	-	-	-	6	-	-	-	-	-	-	6
- 2nd	-	-	-	-	-	4	-	-	-	-	-	-	4
- 3rd	-	-	-	-	-	-	2	-	-	-	-	-	2
Harvesting	-	-	-	-	-	-	-	5	-	-	-	-	5
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	10	3	10	2	7	-	-	-	-	32

Source : Own calculations

APPENDIX B Bardheere District :
Table 2 Labour Profile for One Hectare Sorghum, Der Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	2	-	-	-	2
Soil preparation	-	-	-	-	-	-	-	-	8	-	-	-	8
Sowing	-	-	-	-	-	-	-	-	-	3	-	-	3
Weeding													
- 1st	-	-	-	-	-	-	-	-	-	-	6	-	6
- 2nd	-	-	-	-	-	-	-	-	-	-	4	-	4
- 3rd	-	-	-	-	-	-	-	-	-	-	-	2	2
Harvesting	5	-	-	-	-	-	-	-	-	-	-	-	5
Transport	2	-	-	-	-	-	-	-	-	-	-	-	2
Total Demand	7	-	-	-	-	-	-	-	10	3	10	2	32

Source : Own calculations

APPENDIX B Bardheere District :
Table 3 Labour Profile for One Hectare Maize, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	8	-	-	-	-	-	-	-	-	8
Sowing	-	-	-	-	3	-	-	-	-	-	-	-	3
Weeding													
- 1st	-	-	-	-	-	8	-	-	-	-	-	-	8
- 2nd	-	-	-	-	-	4	-	-	-	-	-	-	4
- 3rd	-	-	-	-	-	-	2	-	-	-	-	-	2
Harvesting	-	-	-	-	-	-	-	4	-	-	-	-	4
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	10	3	12	2	6	-	-	-	-	33

Source : Own calculations

APPENDIX B Bardheere District:
Table 4 Labour Profile for One Hectare Maize, Der Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	2	-	-	-	2
Soil preparation	-	-	-	-	-	-	-	-	8	-	-	-	8
Sowing	-	-	-	-	-	-	-	-	-	2	-	-	2
Weeding													
- 1st	-	-	-	-	-	-	-	-	-	-	8	-	8
- 2nd	-	-	-	-	-	-	-	-	-	-	4	-	4
- 3rd	-	-	-	-	-	-	-	-	-	-	-	2	2
Harvesting	4	-	-	-	-	-	-	-	-	-	-	-	4
Transport	2	-	-	-	-	-	-	-	-	-	-	-	2
Total Demand	6	-	-	-	-	-	-	-	10	2	12	2	32

Source : Own calculations

APPENDIX B Bardheere District:
Table 5 Labour Profile for One Hectare Sesame, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	8	-	-	-	-	-	-	-	-	8
Sowing	-	-	-	-	3	-	-	-	-	-	-	-	3
Weeding													
- 1st	-	-	-	-	-	8	-	-	-	-	-	-	8
- 2nd	-	-	-	-	-	4	-	-	-	-	-	-	4
- 3rd	-	-	-	-	-	-	2	-	-	-	-	-	2
Harvesting	-	-	-	-	-	-	-	6	-	-	-	-	6
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	10	3	12	2	8	-	-	-	-	35

Source : Own calculations

APPENDIX B Bardheere District :
Table 6 Labour Profile for One Hectare Sesame, Der Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	2	-	-	-	2
Soil preparation	-	-	-	-	-	-	-	-	8	-	-	-	8
Sowing	-	-	-	-	-	-	-	-	-	3	-	-	3
Weeding													
- 1st	-	-	-	-	-	-	-	-	-	-	8	-	8
- 2nd	-	-	-	-	-	-	-	-	-	-	4	-	4
- 3rd	-	-	-	-	-	-	-	-	-	-	-	2	2
Harvesting	6	-	-	-	-	-	-	-	-	-	-	-	6
Transport	2	-	-	-	-	-	-	-	-	-	-	-	2
Total Demand	8	-	-	-	-	-	-	-	10	3	12	2	35

Source : Own calculations

APPENDIX B Bardheere District :
Table 7 **Labour Profile for One Hectare** Beans, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	8	-	-	-	-	-	-	-	-	8
Sowing	-	-	-	-	3	-	-	-	-	-	-	-	3
Weeding													
- 1st	-	-	-	-	-	4	-	-	-	-	-	-	4
- 2nd	-	-	-	-	-	2	-	-	-	-	-	-	2
- 3rd	-	-	-	-	-	-	4	-	-	-	-	-	4
Harvesting	-	-	-	-	-	-	-	10	-	-	-	-	10
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	10	3	6	4	12	-	-	-	-	35

Source : Own calculations

APPENDIX B Bardheere District :
Table 8 Labour Profile for One Hectare Beans, Der Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	2	-	-	-	2
Soil preparation	-	-	-	-	-	-	-	-	8	-	-	-	8
Sowing	-	-	-	-	-	-	-	-	-	2	-	-	2
Weeding													
- 1st	-	-	-	-	-	-	-	-	-	-	4	-	4
- 2nd	-	-	-	-	-	-	-	-	-	-	2	-	2
- 3rd	-	-	-	-	-	-	-	-	-	-	-	4	4
Harvesting	10	-	-	-	-	-	-	-	-	-	-	-	10
Transport	2	-	-	-	-	-	-	-	-	-	-	-	2
Total Demand	12	-	-	-	-	-	-	-	10	2	6	4	34

Source : Own calculations

APPENDIX B Bardheere District : Crop Budget Sorghum (1 ha)
Table 9 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sorghum	kg/ha	480	11	5,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	7	11	77
- Packing Materials	Bags(1)	4	60	240
Subtotal				317

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	10
- Sowing	-	-	-	-	-	-	3
- Weeding	-	-	-	-	-	-	12
- Harvesting	-	-	-	-	-	-	5
- Transport	-	-	-	-	-	-	2
Subtotal							32
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							322
4. Gross Margin							
- SoSh per ha							4,958
- So Sh per Man-day Family Labour							155

Source : Own Calculations
1) 100 kg per bag; each bag used four times; transport of cobs, i.e. 3 times the grain weight

APPENDIX B Bardheere District: Crop Budget Sorghum (1 ha)
Table 10 Use of Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sorghum	kg/ha	480	11	5,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	7	11	77
- Packing Materials	Bags(1)	4	60	240
Subtotal				317

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	10
- Sowing	-	-	-	-	-	-	3
- Weeding	-	-	-	12	100	1,200	-
- Harvesting	-	-	-	-	-	-	5
- Transport	-	-	-	-	-	-	2
Subtotal						1,200	20

1,200		
2.3 Tax		5
2.4 Total Variable Costs (SoSh)		1,522
4. Gross Margin		
- SoSh per ha		3,758
- So Sh per Man-day Family Labour		188

Source : Own Calculations
1) see Table 9

APPENDIX B Bardheere District : Crop Budget Sorghum (1 ha)
Table 11 Use of Machinery, Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sorghum	kg/ha	480	11	5,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	7	11	77
- Packing Materials	Bags(1)	4	60	240
Subtotal				317

2.2 Operations	Machinery			Hired Labour			Family Labour	
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days	
- Land Preparation	3	350	1,050	-	-	-	-	
- Sowing	-	-	-	-	-	-	3	
- Weeding	-	-	-	12	100	1,200	-	
- Harvesting	-	-	-	-	-	-	5	
- Transport	-	-	-	-	-	-	2	
Subtotal			1,050			1,200	10	2,250
2.3 Tax								5
2.4 Total Variable Costs (SoSh)								2,572
4. Gross Margin								
- SoSh per ha								2,708
- So Sh per Man-day Family Labour								271

Source : Own Calculations
1) see Table 9

APPENDIX B Bardheere District : Crop Budget Maize (1 ha)
Table 12 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Maize	kg/ha	520	14	7,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	14	84
- Packing Materials	Bags(1)	4	60	240
Subtotal				324

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	10
- Sowing	-	-	-	-	-	-	3
- Weeding	-	-	-	-	-	-	14
- Harvesting	-	-	-	-	-	-	4
- Transport	-	-	-	-	-	-	2
Subtotal							33
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							329
4. Gross Margin							
- SoSh per ha							6,951
- So Sh per Man-day Family Labour							211

Source : Own Calculations
1) see Table 9

APPENDIX B Bardheere District : Crop Budget Maize (1 ha)
Table 13 Use of Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Maize	kg/ha	520	14	7,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	14	84
- Packing Materials	Bags(1)	4	60	240
Subtotal				324

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	10
- Sowing	-	-	-	-	-	-	3
- Weeding	-	-	-	14	100	1,400	-
- Harvesting	-	-	-	-	-	-	4
- Transport	-	-	-	-	-	-	2
Subtotal						1,400	19

					1,400
2.3 Tax					5
2.4 Total Variable Costs (SoSh)					1,429
4. Gross Margin					
- SoSh per ha					5,551
- So Sh per Man-day Family Labour					292

Source : Own Calculations
1) see Table 9

APPENDIX B
Table 14

Bardheere District : Crop Budget Maize (1 ha)
Use of Machinery, Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Maize	kg/ha	520	14	7,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	14	84
- Packing Materials	Bags(1)	4	60	140
Subtotal				324

2.2 Operations	Machinery			Hired Labour			Family Labour	
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days	
- Land Preparation	3	350	1,050	-	-	-	-	
- Sowing	-	-	-	-	-	-	3	
- Weeding	-	-	-	14	100	1,400	-	
- Harvesting	-	-	-	-	-	-	4	
- Transport	-	-	-	-	-	-	2	
Subtotal			1,050			1,400	9	2,450
2.3 Tax								5
2.4 Total Variable Costs (SoSh)								2,779
4. Gross Margin								
- SoSh per ha								4,501
- So Sh per Man-day Family Labour								500

Source : Own Calculations
1) see Table 9

APPENDIX B Bardheere District : Crop budget Sesame (1 ha)
Table 15 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sesame	kg/ha	240	60	14,400
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	60	360
- Packing Materials	Bags(1)	0.6	60	36
Subtotal				396

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	10
- Sowing	-	-	-	-	-	-	3
- Weeding	-	-	-	-	-	-	14
- Harvesting	-	-	-	-	-	-	6
- Transport	-	-	-	-	-	-	2
Subtotal							35

2.3 Tax				5
2.4 Total Variable Costs (SoSh)				401
4. Gross Margin				
- SoSh per ha				13,999
- So Sh per Man-day Family Labour				400

Source : Own Calculations
1) see Table 9

APPENDIX B Gardheere District : Crop Budget Sesame (1 ha)
Table 16 Use of Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sesame	kg/ha	240	60	14,400
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	60	360
- Packing Materials	Bags(1)	0.6	60	36
Subtotal				396

2.2 Operations	Machinery			Hired Labour			Family Labour	
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days	
- Land Preparation	-	-	-	-	-	-	10	
- Sowing	-	-	-	-	-	-	3	
- Weeding	-	-	-	140	100	1,400	-	
- Harvesting	-	-	-	-	-	-	6	
- Transport	-	-	-	-	-	-	2	
Subtotal						1,400	21	1,400
2.3 Tax								5
2.4 Total Variable Costs (SoSh)								1,801
4. Gross Margin								
- SoSh per ha								12,599
- So Sh per Man-day Family Labour								600

Source : Own Calculations
1) see Table 9

APPENDIX B Bardheere District : Crop Budget Beans (1 ha)
Table 17 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Beans	kg/ha	230	36	8,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	4	36	144
- Packing Materials	Bags(1)	0.6	60	36
Subtotal				180

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	10
- Sowing	-	-	-	-	-	-	3
- Weeding	-	-	-	-	-	-	10
- Harvesting	-	-	-	-	-	-	10
- Transport	-	-	-	-	-	-	2
Subtotal							35

2.3 Tax	5
2.4 Total Variable Costs (SoSh)	185
4. Gross Margin	
- SoSh per ha	8,095
- So Sh per Man-day Family Labour	231

Source : Own Calculations
1) see Table 9

APPENDIX B Saakow/Bu'aale Districts :
Table 18 Labour Profile for One Hectare Sorghum, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	3	-	-	-	-	-	-	-	-	3
Sowing	-	-	-	-	2	-	-	-	-	-	-	-	2
Weeding													
- 1st	-	-	-	-	-	6	-	-	-	-	-	-	6
- 2nd	-	-	-	-	-	2	-	-	-	-	-	-	2
- 3rd	-	-	-	-	-	-	1	-	-	-	-	-	1
Harvesting	-	-	-	-	-	-	-	5	-	-	-	-	5
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	5	2	8	1	7	-	-	-	-	23

Source : Own calculations

APPENDIX B Saakow/Bu'aale Districts :
Table 19 Labour Profile for One Hectare Sorghum, Der Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	2	-	-	-	2
Soil preparation	-	-	-	-	-	-	-	-	3	-	-	-	3
Sowing	-	-	-	-	-	-	-	-	-	2	-	-	2
Weeding													
- 1st	-	-	-	-	-	-	-	-	-	-	6	-	6
- 2nd	-	-	-	-	-	-	-	-	-	-	2	-	2
- 3rd	-	-	-	-	-	-	-	-	-	-	-	1	1
Harvesting	5	-	-	-	-	-	-	-	-	-	-	-	5
Transport	2	-	-	-	-	-	-	-	-	-	-	-	2
Total Demand	7	-	-	-	-	-	-	-	5	2	8	1	23

Source : Own calculations

APPENDIX B Saakow/Bu'aale Districts :
Table 20 Labour Profile for One Hectare Maize, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	3	-	-	-	-	-	-	-	-	3
Sowing	-	-	-	-	2	-	-	-	-	-	-	-	2
Weeding													
- 1st	-	-	-	-	-	8	-	-	-	-	-	-	8
- 2nd	-	-	-	-	-	3	-	-	-	-	-	-	3
- 3rd	-	-	-	-	-	-	1	-	-	-	-	-	1
Harvesting	-	-	-	-	-	-	-	4	-	-	-	-	4
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	5	2	11	1	6	-	-	-	-	25

Source : Own calculations

APPENDIX B Saakow/Bu'aale Districts :
Table 21 Labour Profile for One Hectare Maize, Der Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	2	-	-	-	2
Soil preparation	-	-	-	-	-	-	-	-	3	-	-	-	3
Sowing	-	-	-	-	-	-	-	-	-	2	-	-	2
Weeding													
- 1st	-	-	-	-	-	-	-	-	-	-	8	-	8
- 2nd	-	-	-	-	-	-	-	-	-	-	3	-	3
- 3rd	-	-	-	-	-	-	-	-	-	-	-	1	1
Harvesting	4	-	-	-	-	-	-	-	-	-	-	-	4
Transport	2	-	-	-	-	-	-	-	-	-	-	-	2
Total Demand	6	-	-	-	-	-	-	-	5	2	11	1	25

Source : Own calculations

APPENDIX B Saakow/Bu'aale Districts:
Table 22 Labour Profile for One Hectare Sesame, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	1	-	-	-	-	-	-	-	-	1
Soil preparation	-	-	-	3	-	-	-	-	-	-	-	-	3
Sowing	-	-	-	-	2	-	-	-	-	-	-	-	2
Weeding													
- 1st	-	-	-	-	-	8	-	-	-	-	-	-	8
- 2nd	-	-	-	-	-	3	-	-	-	-	-	-	3
- 3rd	-	-	-	-	-	-	1	-	-	-	-	-	1
Harvesting	-	-	-	-	-	-	-	6	-	-	-	-	6
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	4	2	11	1	8	-	-	-	-	26

Source : Own calculations

APPENDIX B Saakow/Bu'aale Districts :
Table 23 Labour Profile for One Hectare Sesame, Der Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	1	-	-	-	1
Soil preparation	-	-	-	-	-	-	-	-	3	-	-	-	3
Sowing	-	-	-	-	-	-	-	-	-	2	-	-	2
Weeding													
- 1st	-	-	-	-	-	-	-	-	-	-	8	-	8
- 2nd	-	-	-	-	-	-	-	-	-	-	3	-	3
- 3rd	-	-	-	-	-	-	-	-	-	-	-	1	1
Harvesting	6	-	-	-	-	-	-	-	-	-	-	-	6
Transport	2	-	-	-	-	-	-	-	-	-	-	-	2
Total Demand	8	-	-	-	-	-	-	-	4	2	11	1	26

Source : Own calculations

APPENDIX B Saakow/Bu'aale Districts :
Table 24 Labour Profile for One Hectare Beans, Gu Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	3	-	-	-	-	-	-	-	-	3
Sowing	-	-	-	-	2	-	-	-	-	-	-	-	2
Weeding													
- 1st	-	-	-	-	-	5	-	-	-	-	-	-	5
- 2nd	-	-	-	-	-	2	-	-	-	-	-	-	2
- 3rd	-	-	-	-	-	-	1	-	-	-	-	-	1
Harvesting	-	-	-	-	-	-	-	10	-	-	-	-	10
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	5	2	7	1	12	-	-	-	-	27

Source : Own calculations

APPENDIX B Saakow/Bu'aale Districts Crop Budget Sorghum (1 ha)
Table 25 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sorghum	kg/ha	480	11	5,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	9	11	99
- Packing Materials	Bags(1)	4	60	240
Subtotal				339

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	5
- Sowing	-	-	-	-	-	-	2
- Weeding	-	-	-	-	-	-	9
- Harvesting	-	-	-	-	-	-	5
- Transport	-	-	-	-	-	-	2
Subtotal							23
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							344
4. Gross Margin							
- SoSh per ha							4,936
- So Sh per Man-day Family Labour							215

Source : Own Calculations
1) see Table 9

APPENDIX B
Table 26 Saakow/Bu'aale Districts : Crop Budget Sorghum (1 ha)
Use of Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sorghum	kg/ha	480	11	5,280
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	9	11	99
- Packing Materials	Bags(1)	4	60	240
Subtotal				339

2.2 Operations	Machinery			Hired Labour			Family Labour	
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days	
- Land Preparation	-	-	-	-	-	-	5	
- Sowing	-	-	-	-	-	-	2	
- Weeding	-	-	-	9	126	1,130	-	
- Harvesting	-	-	-	-	-	-	5	
- Transport	-	-	-	-	-	-	2	
Subtotal						1,130	14	1,130
2.3 Tax								5
2.4 Total Variable Costs (SoSh)								1,474
4. Gross Margin								
- SoSh per ha								3,806
- So Sh per Man-day Family Labour								272

Source : Own Calculations
1) see Table 9

APPENDIX B Saakow/Bu'aale District : Crop Budget Maize (1 ha)
Table 27 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Maize	kg/ha	470	14	6,580
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	14	84
- Packing Materials	Bags(1)	4	60	240
Subtotal				324

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	5
- Sowing	-	-	-	-	-	-	2
- Weeding	-	-	-	-	-	-	9
- Harvesting	-	-	-	-	-	-	4
- Transport	-	-	-	-	-	-	2
Subtotal							22

2.3 Tax	5
2.4 Total Variable Costs (SoSh)	329
4. Gross Margin	
- SoSh per ha	6,251
- So Sh per Man-day Family Labour	248

Source : Own Calculations
1) see Table 9

APPENDIX B Saakow/Bu'aale Districts: Crop Budget Sesame (1 ha)
Table 28 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sesame	kg/ha	290	60	17,400
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	60	360
- Packing Materials	Bags(1)	0.7	60	42
Subtotal				402

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs	Costs	Man-days	Unit costs	Costs	Man-days
		in SoSh			in SoSh		
- Land Preparation	-	-	-	-	-	-	4
- Sowing	-	-	-	-	-	-	2
- Weeding	-	-	-	-	-	-	9
- Harvesting	-	-	-	-	-	-	6
- Transport	-	-	-	-	-	-	2
Subtotal							23
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							407
4. Gross Margin							
- SoSh per ha							16,993
- So Sh per Man-day Family Labour							739

Source : Own Calculations
1) see Table 9

APPENDIX B
Table 29 Saakow/Bu'aale Districts : Crop Budget Beans (1 ha)
Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Beans	kg/ha	360	36	12,960
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	6	36	216
- Packing Materials	Bags(1)	0.9	60	54
Subtotal				270

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs	Costs in SoSh	Man-days	Unit costs	Costs in SoSh	Man-days
- Land Preparation	-	-	-	-	-	-	5
- Sowing	-	-	-	-	-	-	2
- Weeding	-	-	-	-	-	-	8
- Harvesting	-	-	-	-	-	-	10
- Transport	-	-	-	-	-	-	2
Subtotal							27

2.3 Tax	5
2.4 Total Variable Costs (SoSh)	275
4. Gross Margin	
- SoSh per ha	12,685
- So Sh per Man-day Family Labour	470

Source : Own Calculations
1) see Table 9

APPENDIX B Jilib/Jamaame/Kismayo Districts:
Table 30 Labour Profile for One Hectare Maize, Gu/Xagaa

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	2	-	-	-	-	-	-	-	-	2
Soil preparation	-	-	-	6	-	-	-	-	-	-	-	-	6
Sowing	-	-	-	-	8	-	-	-	-	-	-	-	8
Weeding													
- 1st	-	-	-	-	-	16	-	-	-	-	-	-	16
- 2nd	-	-	-	-	-	14	-	-	-	-	-	-	14
- 3rd	-	-	-	-	-	-	8	-	-	-	-	-	8
Harvesting	-	-	-	-	-	-	-	6	-	-	-	-	6
Transport	-	-	-	-	-	-	-	2	-	-	-	-	2
Total Demand	-	-	-	8	8	30	8	8	-	-	-	-	62

Source : Own calculations

APPENDIX B Jilib/Jamaame/Kismayo Districts:
Table 31 Labour Profile for One Hectare Sesame, Gu/Xagaa

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	2	-	-	-	-	-	-	2
Soil preparation	-	-	-	-	-	6	-	-	-	-	-	-	6
Sowing	-	-	-	-	-	-	8	-	-	-	-	-	8
Weeding													
- 1st	-	-	-	-	-	-	-	16	-	-	-	-	16
- 2nd	-	-	-	-	-	-	-	14	-	-	-	-	14
- 3rd	-	-	-	-	-	-	-	-	8	-	-	-	8
Harvesting	-	-	-	-	-	-	-	-	-	10	-	-	10
Transport	-	-	-	-	-	-	-	-	-	2	-	-	2
Total Demand	-	-	-	-	-	8	8	30	8	12	-	-	66

Source : Own calculations

APPENDIX B Jilib/Jamaame/Kismayo Districts:
Table 32 Labour Profile for One Hectare Beans, Gu/Xagaa Seasons

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	2	-	-	-	-	-	-	2
Soil preparation	-	-	-	-	-	6	-	-	-	-	-	-	6
Sowing	-	-	-	-	-	-	7	-	-	-	-	-	7
Weeding													
- 1st	-	-	-	-	-	-	-	16	-	-	-	-	16
- 2nd	-	-	-	-	-	-	-	14	-	-	-	-	14
- 3rd	-	-	-	-	-	-	-	-	8	-	-	-	8
Harvesting	-	-	-	-	-	-	-	-	-	10	-	-	10
Transport	-	-	-	-	-	-	-	-	-	2	-	-	2
Total Demand	-	-	-	-	-	8	7	30	8	12	-	-	65

Source : Own calculations

APPENDIX B Jilib/Jamaame/Kismayo Districts:
Table 33 Labour Profile for One Hectare Groundnuts, Gu/Xagaa Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	2	-	-	-	-	-	-	2
Soil preparation	-	-	-	-	-	6	-	-	-	-	-	-	6
Sowing	-	-	-	-	-	-	7	-	-	-	-	-	7
Weeding													
- 1st	-	-	-	-	-	-	-	16	-	-	-	-	16
- 2nd	-	-	-	-	-	-	-	14	-	-	-	-	14
- 3rd	-	-	-	-	-	-	-	-	10	-	-	-	10
- 4th	-	-	-	-	-	-	-	-	-	7	-	-	7
Harvesting	-	-	-	-	-	-	-	-	-	-	25	-	25
Transport	-	-	-	-	-	-	-	-	-	-	2	-	2
Total Demand	-	-	-	-	-	8	7	30	10	7	27	-	89

Source : Own calculations

APPENDIX B Jilib/Jamaame/Kismayo Districts:
Table 34 Labour Profile for One Hectare Cotton, Gu/Xagaa Season

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Total
	In Man-days												
Cleaning of fields	-	-	-	-	-	-	-	-	-	-	-	-	-
Soil preparation	-	-	-	-	-	-	-	-	-	-	-	-	-
Sowing	-	-	-	-	-	7	-	-	-	-	-	-	7
Weeding													
- 1st	-	-	-	-	-	-	16	-	-	-	-	-	16
- 2nd	-	-	-	-	-	-	14	-	-	-	-	-	14
- 3rd	-	-	-	-	-	-	-	10	-	-	-	-	10
- 4th	-	-	-	-	-	-	-	-	-	8	-	-	8
Harvesting	-	-	-	-	-	-	-	-	-	-	28	-	28
Transport	-	-	-	-	-	-	-	-	-	-	2	-	2
Total Demand	-	-	-	-	-	7	30	10	-	8	30	-	85

Source : Own calculations

APPENDIX B
Table 35 Jilib/Jamaame/Kismayo Districts: Crop Budget Maize (1 ha)
Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Maize	kg/ha	1,200	14	16,890
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	12	14	168
- Packing Materials	Bags(1)	9	60	540
Subtotal				708

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	8
- Sowing	-	-	-	-	-	-	8
- Weeding	-	-	-	-	-	-	38
- Harvesting	-	-	-	-	-	-	6
- Transport	-	-	-	-	-	-	2
Subtotal							62
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							713
4. Gross Margin							
- SoSh per ha							16,087
- So Sh per Man-day Family Labour							259

Source : Own Calculations
1) see Table 9

APPENDIX B Jilib/Jamaame/Kismayo Districts : Crop Budget Maize,(1 ha)
Table 36 Use of Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Maize	kg/ha	1,200	14	16,890
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	12	14	168
- Packing Materials	Bags(1)	9	60	540
Subtotal				780

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	8
- Sowing	-	-	-	-	-	-	8
- Weeding	-	-	-	38	118	4,500	-
- Harvesting	-	-	-	-	-	-	6
- Transport	-	-	-	-	-	-	2
Subtotal						4,500	24

	4,500	
2.3 Tax		5
2.4 Total Variable Costs (SoSh)		5,213
4. Gross Margin		
- SoSh per ha		12,787
- So Sh per Man-day Family Labour		533

Source : Own Calculations
1) see Table 9

APPENDIX B
Table 37 Jilib/Jamaame/Kismayo Districts : Crop Budget Maize(1 ha)
Use of Machinery, Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Maize	kg/ha	1,200	14	16,800
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	12	14	168
- Packing Materials	Bags(1)	9	60	540
Subtotal				708

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	4	450	1,800	-	-	-	-
- Sowing	-	-	-	-	-	-	8
- Weeding	-	-	-	38	118	4,500	-
- Harvesting	-	-	-	-	-	-	6
- Transport	-	-	-	-	-	-	2
Subtotal			1,800			4,500	16

	Total Values
Subtotal	6,300
2.3 Tax	5
2.4 Total Variable Costs (SoSh)	7,013
4. Gross Margin	
- SoSh per ha	9,787
- So Sh per Man-day Family Labour	612

Source : Own Calculations
1) see Table 9

APPENDIX B Jilib/Jamaame/Kismayo District: Crop Budget Sesame (1 ha)
Table 38 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sesame	kg/ha	600	60	36,000
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	9	60	540
- Packing Materials	Bags(1)	1.5	60	90
Subtotal				630

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	8
- Sowing	-	-	-	-	-	-	8
- Weeding	-	-	-	-	-	-	38
- Harvesting	-	-	-	-	-	-	10
- Transport	-	-	-	-	-	-	2
Subtotal							66
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							365
4. Gross Margin							
- SoSh per ha							35,365
- So Sh per Man-day Family Labour							536

Source : Own Calculations
1) see Table 9

APPENDIX B
Table 39 Jilib/Jamaame/Kismayo Districts: Crop Budget Sesame (1 ha)
Use of Hired Labour and Family labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sesame	kg/ha	600	60	36,000
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	9	60	540
- Packing Materials	Bags(1)	1.5	60	90
Subtotal				630

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	8
- Sowing	-	-	-	-	-	-	8
- Weeding	-	-	-	38	118	4,500	-
- Harvesting	-	-	-	-	-	-	10
- Transport	-	-	-	-	-	-	2
Subtotal						4,500	28

2.3 Tax		5
2.4 Total Variable Costs (SoSh)		5,135
4. Gross Margin		
- SoSh per ha		30,865
- So Sh per Man-day Family Labour		1,102

Source : Own Calculations
1) see Table 9

APPENDIX B
Table 40 Jilib/Jamaame/Kismayo District: Crop Budget Sesame (1 ha)
Use of Machinery, Hired Labour and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Sesame	kg/ha	600	60	36,000
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	9	60	540
- Packing Materials	Bags(1)	1.5	60	90
Subtotal				630

2.2 Operations	Machinery			Hired Labour			Family Labour	
	Hrs	Unit costs	Costs in SoSh	Man-days	Unit costs	Costs in SoSh	Man-days	
- Land Preparation	4	450	1,800	-	-	-	-	
- Sowing	-	-	-	-	-	-	8	
- Weeding	-	-	-	38	118	4,500	-	
- Harvesting	-	-	-	-	-	-	10	
- Transport	-	-	-	-	-	-	2	
Subtotal			1,800			4,500	20	6,300
2.3 Tax								5
2.4 Total Variable Costs (SoSh)								6,935
4. Gross Margin								
- SoSh per ha								29,065
- So Sh per Man-day Family Labour								1,453

Source : Own Calculations
1) see Table 9

APPENDIX B Jilib/Jamaame/Kismayo Districts: Crop Budget Cotton(1 ha)
Table 41 Use of Machinery and Family Labour

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Cotton	kg/ha	400	20	8,000
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	15	0	0
- Packing Materials	Bags(1)	3.3	60	198
- Chemicals	kg/ha (2)	2.1	0	0
Subtotal				198

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	4	236	944	-	-	-	-
- Sowing	-	-	-	-	-	-	7
- Weeding	-	-	-	-	-	-	48
- Harvesting	-	-	-	-	-	-	28
- Transport	-	-	-	-	-	-	2
Subtotal			944				148

		944
2.3 Tax		5
2.4 Total Variable Costs (SoSh)		1,147
4. Gross Margin		
- SoSh per ha		6,853
- So Sh per Man-day Family Labour		46

Source : Own Calculations
1) see Table 9
2) Provided free of charge by SOMALTEX

APPENDIX B Jilib/Jamaame/Kismayo Districts : Crop Budget G'nuts(1 ha)
Table 42 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Groundnuts	kg/ha	500	45	22,500
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	30	45	1,350
- Packing Materials	Bags(1)	1.3	60	78
Subtotal				1,428

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	8
- Sowing	-	-	-	-	-	-	7
- Weeding	-	-	-	-	-	-	47
- Harvesting	-	-	-	-	-	-	25
- Transport	-	-	-	-	-	-	2
Subtotal							89
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							1,433
4. Gross Margin							
- SoSh per ha							21,067
- So Sh per Man-day Family Labour							237

Source : Own Calculations
1) see Table 9

APPENDIX B Jilib/Jamaame/Kismayo Districts: Crop Budget Beans (1 ha)
Table 43 Use of Family Labour Only

	Unit	No of Units	Farmgate Price (SoSh per Unit)	Total Values
1. Production				
Gross Output Beans	kg/ha	500	36	18,000
2. Variable Costs				
2.1 Materials				
- Seeds	kg/ha	3	36	108
- Packing Materials	Bags(1)	1.3	60	75
Subtotal				183

2.2 Operations	Machinery			Hired Labour			Family Labour
	Hrs	Unit costs in SoSh	Costs	Man-days	Unit costs in SoSh	Costs	Man-days
- Land Preparation	-	-	-	-	-	-	8
- Sowing	-	-	-	-	-	-	7
- Weeding	-	-	-	-	-	-	38
- Harvesting	-	-	-	-	-	-	10
- Transport	-	-	-	-	-	-	2
Subtotal							65
2.3 Tax							5
2.4 Total Variable Costs (SoSh)							188
4. Gross Margin							
- SoSh per ha							17,812
- So Sh per Man-day Family Labour							274

Source : Own Calculations
1) see Table 9

APPENDIX C : Meteorological and Hydrological Data

APPENDIX C.

List of Figures

Figure 1 Juba River at Luuq: Frequency Analyses of Monthly Total Rainfall

Figure 2 Juba River at Bardheere : Frequency Analyses of Monthly Total Rainfall

Figure 3 Juba River at Alessandria : Frequency Analyses of Monthly Total Rainfall

Figure 4 Juba River at Mareerey : Frequency Analyses of Monthly Total Rainfall

Figure 5 Juba River at Jamaame : Frequency Analyses of Monthly Total Rainfall

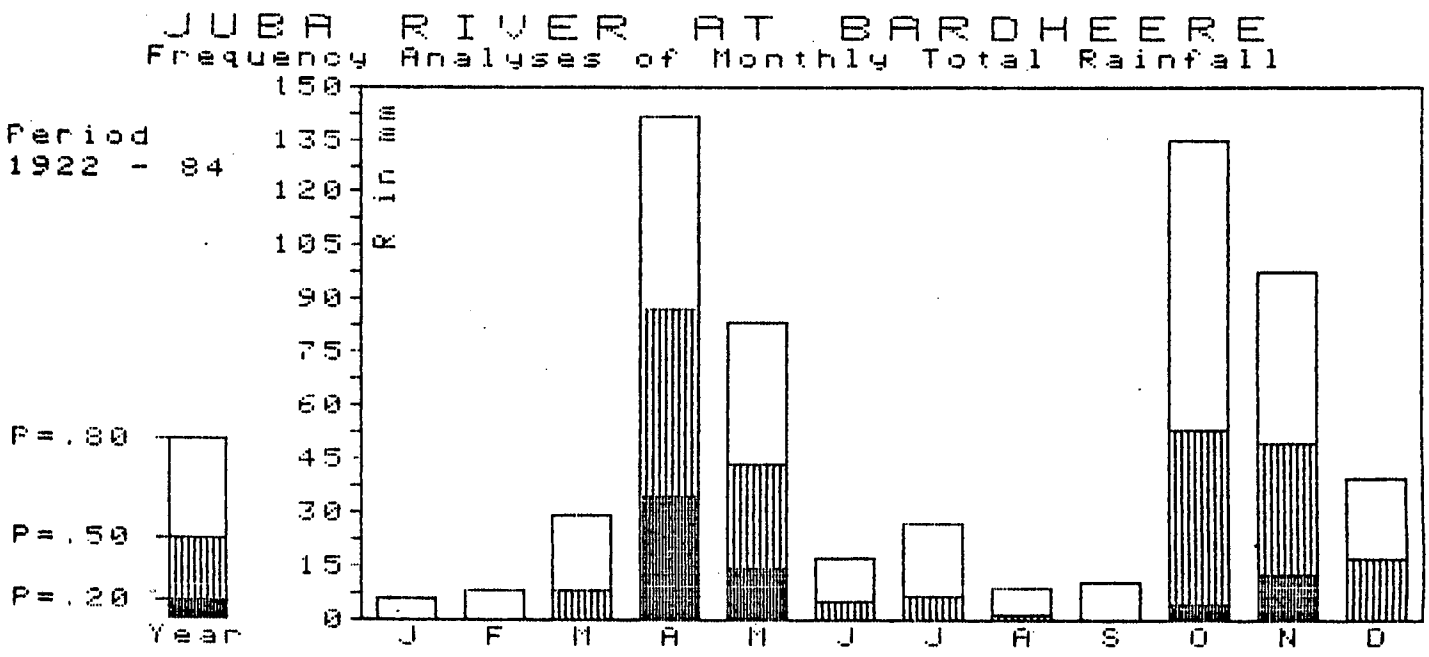
Figure 6 Juba River at Mareerey : Hydrograph of Daily Total Pan Evaporation. Year 1983

APPENDIX C
Figure 1

Monthly Total Rainfall in mm Calculated for Empirical Frequencies
Juba River at BARDHEERE Period 1922 - 1984

Freq.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.20	0.0	0.0	0.0	34.4	14.0	0.0	0.0	0.0	0.0	4.0	12.8	0.0
.50	0.0	0.0	8.2	87.0	43.6	5.4	6.7	1.3	.2	53.0	49.9	16.9
.80	6.0	8.3	29.2	141.4	83.2	17.4	27.0	8.6	10.5	134.9	98.0	39.8
N	49	49	48	47	46	46	45	43	44	45	45	46

N = sample size (years with data complete for resp. interval)



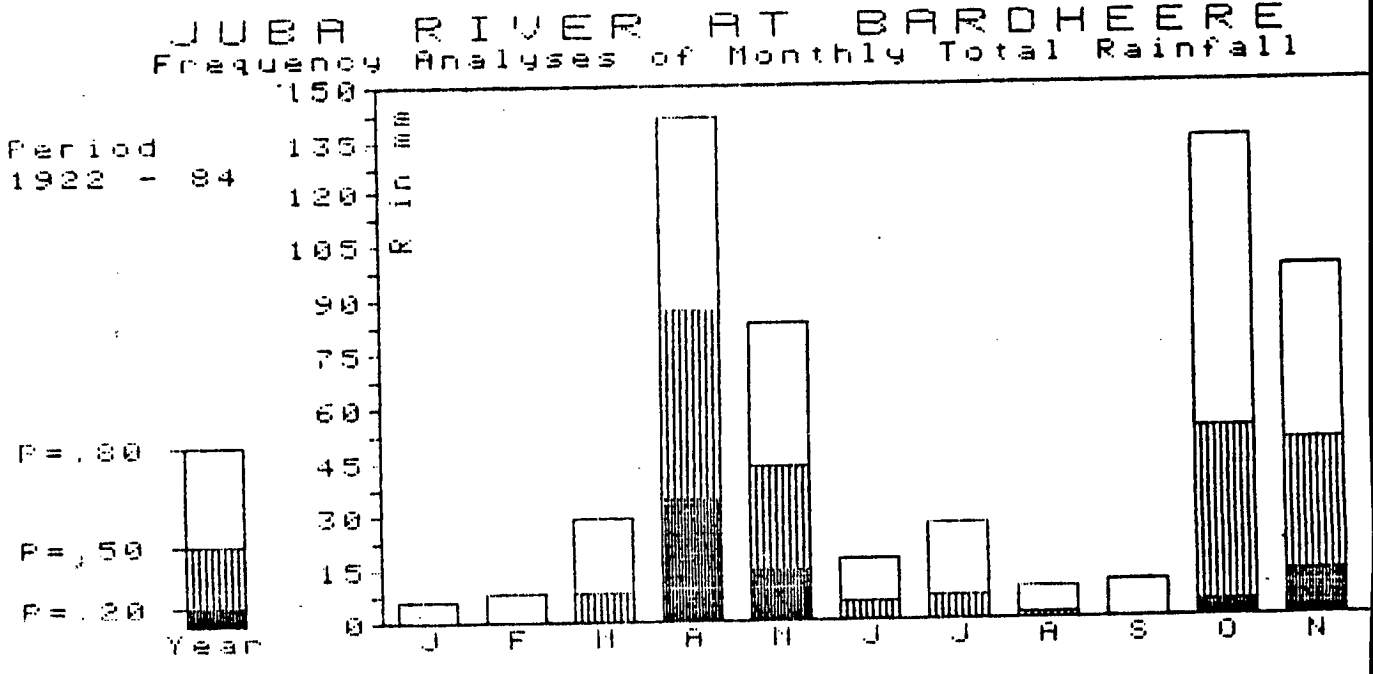
Date of computation : 11.9.1984

APPENDIX C
Figure 2

Monthly Total Rainfall in mm Calculated for Empirical Frequencies
Juba River at BARDHEERE Period 1922 - 1984

Freq.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.20	0.0	0.0	0.0	34.4	14.0	0.0	0.0	0.0	0.0	4.0	12.8	0.0
.50	0.0	0.0	8.2	87.0	43.6	5.4	6.7	1.3	.2	53.0	49.9	16.9
.80	6.0	8.3	29.2	141.4	83.2	17.4	27.0	8.6	10.5	134.9	98.0	39.8
N	49	49	48	47	46	46	45	43	44	45	45	46

N = sample size (years with data complete for resp. interval)



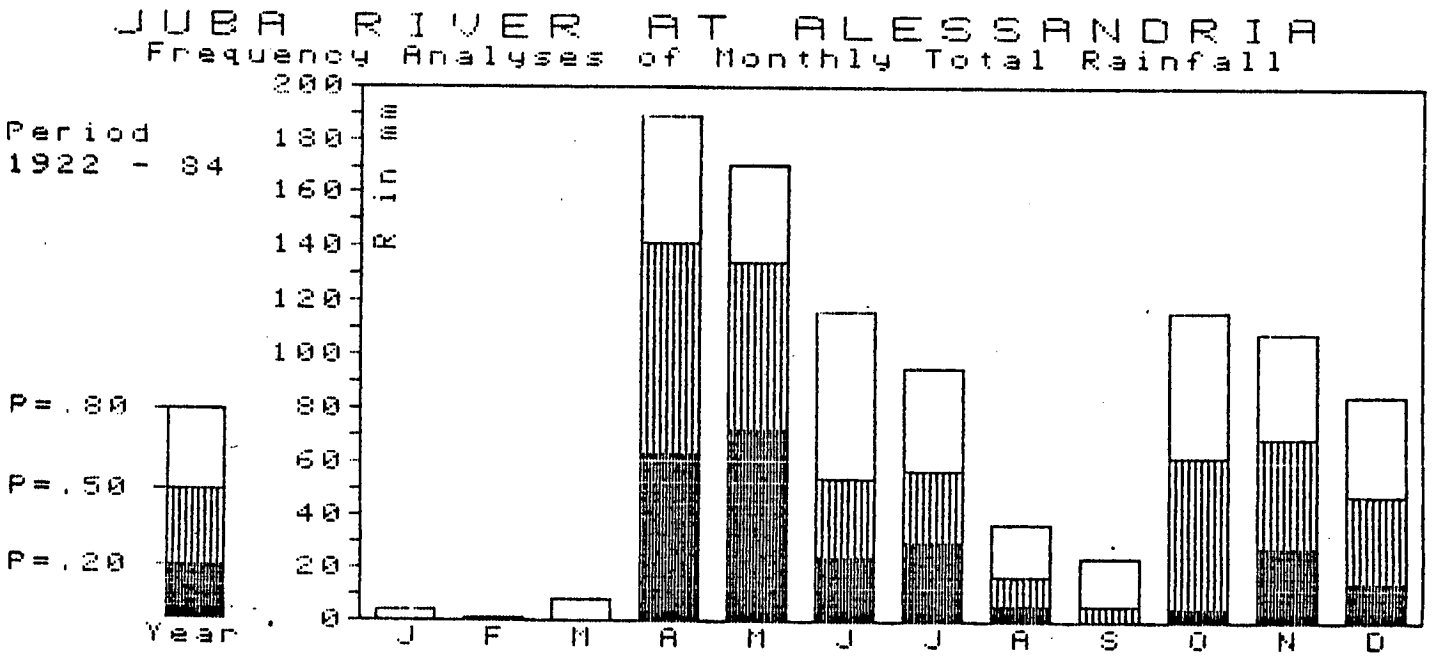
Date of computation : 11.9.1984

APPENDIX C
Figure 3

Monthly Total Rainfall in mm Calculated for Empirical Frequencies
Juba River at ALESSANDRIA Period 1922 - 1984

Freq.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.20	0.0	0.0	0.0	63.1	72.1	24.0	30.3	5.6	.0	4.6	27.7	14.6
.50	0.0	0.0	0.0	141.2	134.0	53.8	56.6	16.5	6.1	62.3	69.0	48.0
.80	3.8	.9	7.8	188.6	170.5	116.4	95.3	36.9	24.2	116.1	108.7	84.7
N	23	23	23	24	23	23	23	22	20	21	21	21

N = sample size (years with data complete for resp. interval)



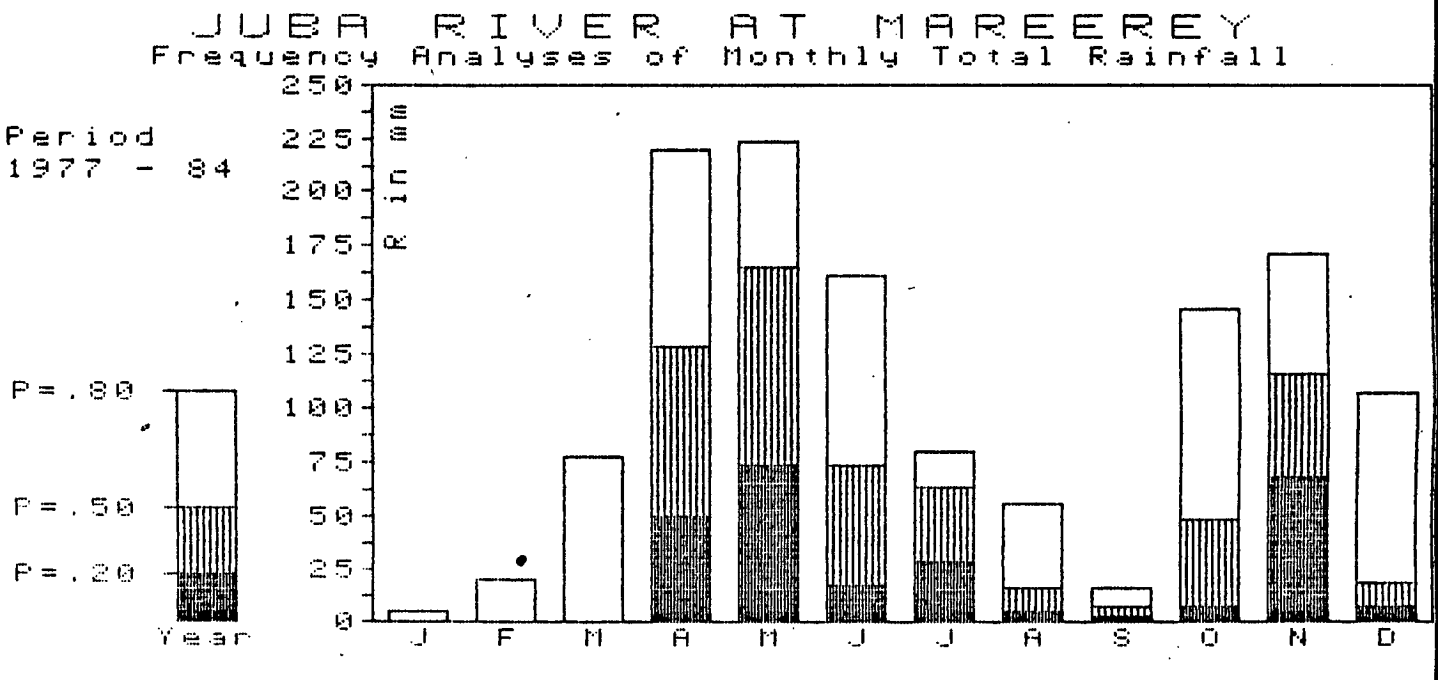
Date of computation : 11.9.1984

APPENDIX C
Figure 4

Monthly Total Rainfall in mm Calculated for Empirical Frequencies
Juba River at MAREEREY Period 1977 - 1984

Freq.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.20	0.0	0.0	0.0	49.6	74.3	17.1	28.4	4.8	2.7	7.8	68.7	7.5
.50	0.0	0.0	0.0	129.2	165.6	73.9	64.1	16.5	7.7	48.5	116.6	19.1
.80	5.0	20.3	77.5	219.1	222.8	162.3	79.9	56.5	15.9	146.9	171.4	107.8
N	7	7	7	8	8	8	8	7	7	7	7	7

N = sample size (years with data complete for resp. interval)



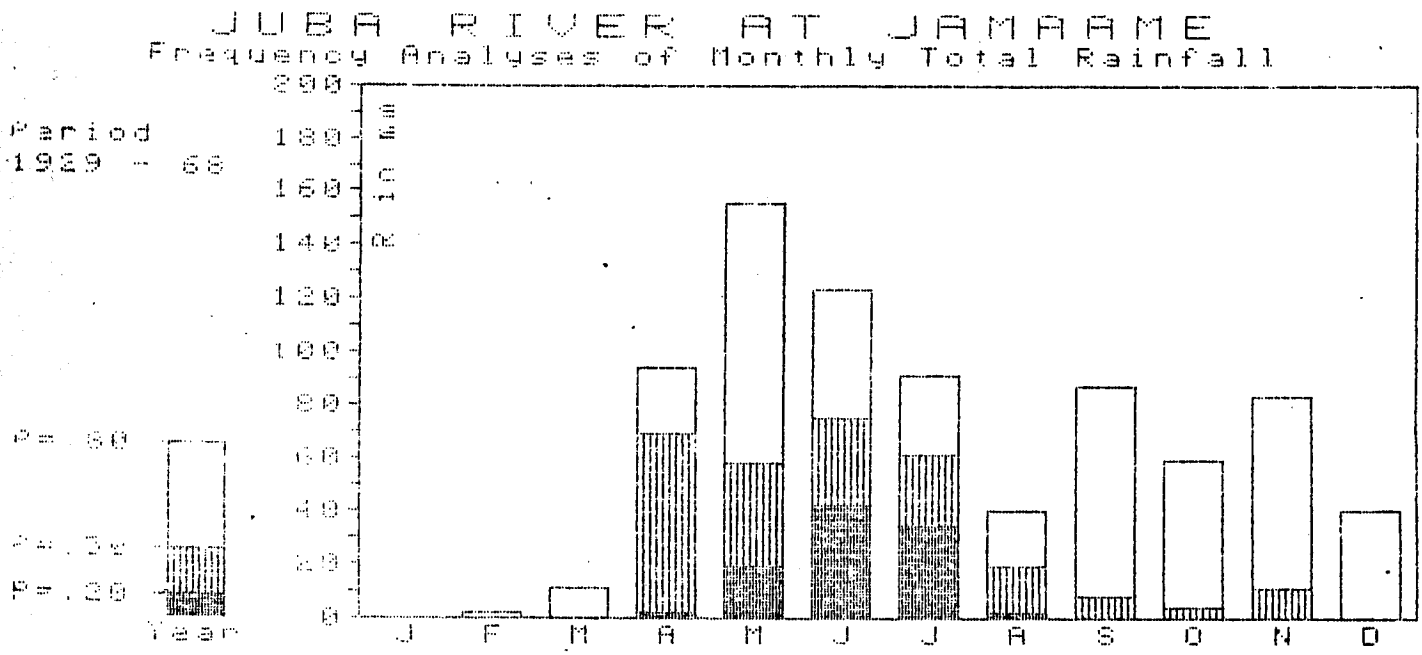
Date of computation : 12.9.1984

APPENDIX C
Figure 5

Monthly Total Rainfall in mm Calculated for Empirical Frequencies
Juba River at JAMAAME Period 1929 - 1968

Freq.	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
.20	0.0	0.0	0.0	2.2	18.8	41.8	33.8	2.2	0.0	0.0	0.0	0.0
.50	0.0	0.0	0.0	69.5	58.5	74.8	60.9	19.0	7.5	3.8	10.5	0.0
.80	0.0	1.8	10.9	93.8	155.0	123.0	91.2	39.7	87.0	59.4	83.1	40.2
N	18	18	16	18	18	18	16	15	16	16	16	17

N = sample size (years with data complete for resp. interval)

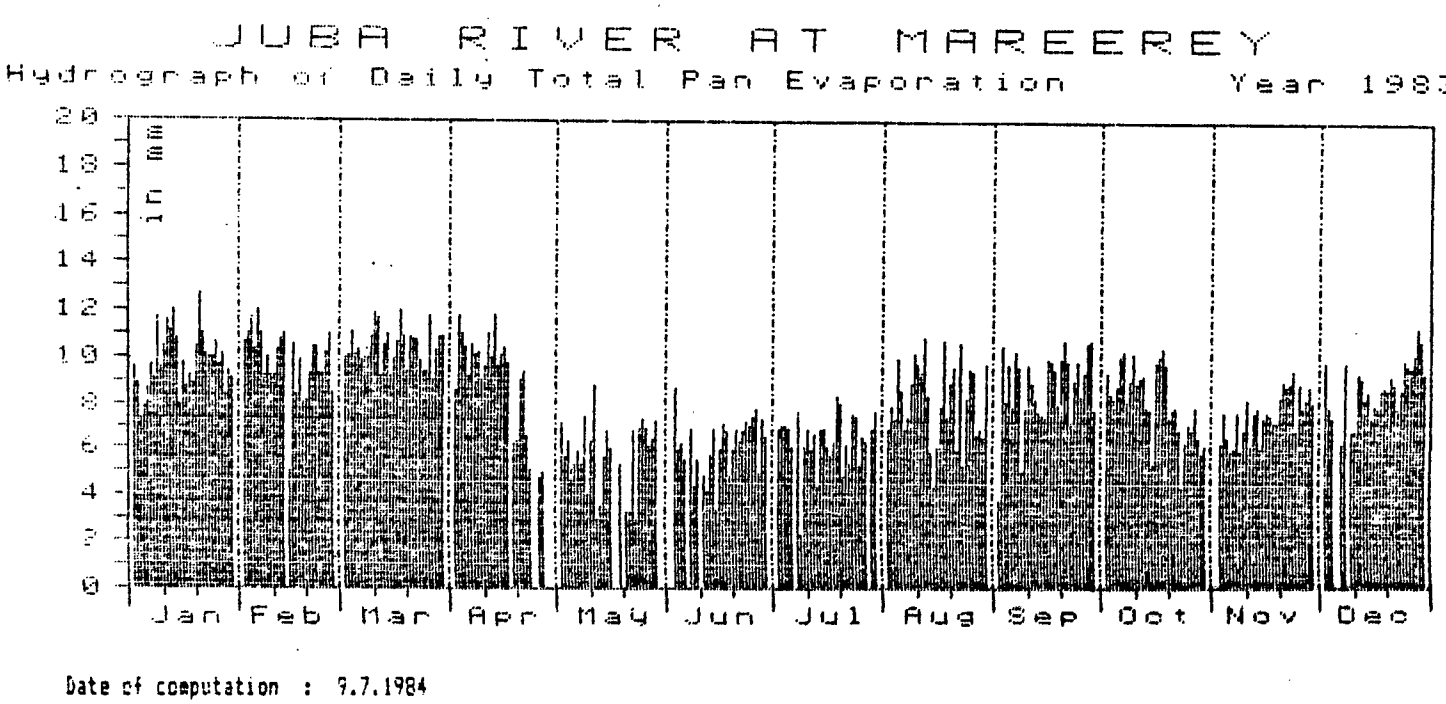


Date of computation : 16.7.1984

APPENDIX C
Figure 6

Daily Total Pan Evaporation in mm
Juba River at MAREEREY Year 1983

Day	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	9.5	10.6	9.9	8.6	7.2	.	7.0	6.9	3.9	9.4	.	9.8
2	8.8	10.9	10.1	11.7	5.7	8.7	7.1	7.9	10.5	8.5	6.4	8.0
3	7.3	11.6	11.1	11.0	6.4	6.1	7.1	7.4	8.2	8.3	7.7	7.5
4	7.8	10.3	10.1	10.4	5.2	6.3	6.9	9.9	9.7	8.8	6.6	.
5	8.6	11.9	10.3	9.2	5.4	5.6	6.2	8.6	7.9	10.1	6.1	.
6	9.6	10.9	9.8	10.5	5.9	.	.	7.0	10.3	10.3	6.2	6.4
7	9.1	9.2	9.9	10.1	5.4	7.0	7.7	7.5	9.6	8.2	7.7	9.8
8	11.6	9.9	9.9	10.2	7.5	4.5	2.4	9.0	5.2	9.1	6.1	.
9	9.5	9.2	10.8	9.1	4.2	5.6	6.2	10.2	8.0	10.2	6.9	7.0
10	10.4	9.2	11.8	9.6	6.4	.	6.9	9.7	9.7	9.0	8.3	6.9
11	11.5	10.3	11.6	11.0	8.8	4.9	6.0	9.4	8.9	9.2	6.3	9.4
12	11.1	10.7	9.2	10.0	3.0	4.3	6.7	10.8	8.3	9.3	7.7	9.2
13	11.9	10.9	10.5	11.7	3.6	5.8	4.5	8.4	7.7	8.0	7.9	8.3
14	10.7	.	11.0	9.6	5.7	6.9	7.0	5.9	7.6	7.8	6.2	8.6
15	8.0	5.1	9.2	10.1	6.8	3.5	6.9	4.5	7.5	5.5	7.5	7.5
16	9.7	10.5	10.0	10.4	6.0	6.0	6.2	6.2	9.9	9.8	7.7	8.1
17	8.7	8.4	10.6	9.7	.	7.2	5.8	8.0	9.8	10.1	7.6	8.0
18	9.2	9.8	11.9	.	.	6.8	6.4	10.7	9.5	10.4	7.3	8.7
19	8.8	8.1	10.8	6.3	5.4	4.9	8.4	7.5	8.1	9.7	7.3	8.8
20	10.4	8.2	9.4	6.4	.	6.1	8.1	8.9	9.9	7.5	8.4	8.7
21	12.6	9.3	10.8	9.1	3.4	6.9	4.9	9.6	10.7	7.8	9.1	9.3
22	11.0	10.4	10.7	9.4	3.4	6.4	6.3	6.0	9.8	7.9	8.8	8.9
23	10.1	10.4	10.7	6.6	6.8	6.8	5.5	10.6	7.3	6.9	8.9	7.9
24	9.9	9.3	9.8	5.2	3.1	7.3	7.6	5.4	9.1	4.5	9.5	8.7
25	10.0	9.3	9.4	.	7.0	7.1	7.5	8.3	9.8	6.4	7.0	10.0
26	10.6	10.2	9.4	.	7.4	7.5	5.4	9.5	8.4	7.2	8.9	9.7
27	9.6	10.9	11.7	4.8	6.9	7.8	6.6	9.4	9.4	7.0	7.9	9.6
28	10.1	8.5	9.1	5.1	6.2	5.0	6.4	6.7	10.6	8.0	8.3	10.2
29	8.4		10.3	.	6.5	7.4	.	7.0	10.7	6.6	8.8	11.3
30	9.4		10.8	.	7.3	6.6	7.0	6.6	7.8	5.9	8.2	10.7
31	9.1		10.8		.		7.7	9.7		6.3		9.4
Total	303.0	.	321.4	.	.	.	.	253.2	263.8	253.7	.	.



Date of computation : 9.7.1984