AGRICULTURAL SURVEY OF THE LOWER RUFIJI PLAIN

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JANUARY 1974

OVERSEAS TECHNICAL COOPERATION AGENCY

I. INTRODUCTION

The lower part of the Rufiji River downstream of the Stiegler's Gorge is a very flat plain, subject to flooding almost every year from the Rufiji. FAO Survey on the Rufiji Basin which reported in 1961 concluded that building a dam at the Stiegler's Gorge would not only enable the generation of large amount of electricity, but also would provide flood control in the downstream area. It would then be possible to plan for the large scale introduction of irrigated agriculture in the Lower Rufiji Plain.

Tanzania Second Five-Year Plan states as follows concerning the Stiegler's Gorge Feasibility Study to be undertaken during its plan period:

> "A detailed study of the Lower Rufiji River Basin is planned with a view to designing a multi-purpose dam at Stiegler's Gorge. The project will include economic and sociological studies; the detailed engineering investigations of Stiegler's Gorge Dam site and the outline design of the dam; a detailed study of the effect of flood control on the life of the people of the Lower Rufiji and the outline design of irrigation facilities to effect the necessary re-adjustments."

The former National Water Resources Council (NWRC) took up the matter, and its 4th Council meeting held on 28th February, 1970 concluded that a study of the present agricultural conditions and cropping patterns, and the data collection on the farm management and land use in the Lower Rufiji Plain could be undertaken by the Council's Secretariat with the joint effort of the University, Devplan, Kilimo, Maendeleo, and other Ministries concerned.

A meeting was convened on 16th March, 1970 by the Council's Secretariat to consult with the University and the Ministries concerning the types and the scope of the survey to be conducted. The preparation of the survey itself was then started along the line suggested at this meeting.

Since the termination of the NWRC at the end of June 1971, the survey has been conducted under the Ministry of Water Development and Power.

The objectives of the survey can be generally stated as follows:-

(1) To supply basic data for the forward planning of irrigation aspects of the Stiegler's Gorge Project.

(2) To clarify the present agricultural systems of the irrigable area so that the future farm management programmes of irrigated agriculture could be based on the advancement of the present systems rather than the introduction of systems totally diverced from the present one in order to achieve smoother transformation into the irrigated agriculture.

(3) To point out the bottlenecks and constraints of the present agricultural system by means of a whole-farm study, and to show the directions of possible improvements until such time comes when the introduction of the irrigated agriculture becomes reality.

It is aimed therefore that the survey should be useful not only for the forward planning of the Stiegler's Gorge Project, but also for the more immediate needs of agricultural and rural development in the Lower Rufiji Plain, where even very basic data to effect development are lacking.

II. BACKGROUND DESCRIPTION OF THE SURVEY AREA

1. Physical Features of the Area:

Lower Rufiji Plain is a flood plain of the Rufiji River between the Stiegler's Gorge, situated 110 km south of Morogoro, and the Indian Ocean. The Plain is about 160 km long along the flow of the river from west to east, something like 10 km wide just after the River leaves the Gorge and widens to about 40 km before it reaches the ocean thus forming a delta.

The flood plain and the delta consist almost entirely of recent alluvial deposits and offer fertile soils for agricultural activities. This alluvium is bounded on both the north and south by low lying hills which are cut here and there by the valleys of minor tributaries of the main river. The mouth of the river branches out to several channels and flows through thick forest of mangroves.

The Rufiji River has the largest river basin area in Tanzania which covers about 177,415 km^2, or about 20 percent of Tanzania which is entirely within the country's boundary. The latest hydrological records indicate an average annual flow at Stiegler's Gorge of approximately 31.8 billion m^3. The flow varies widely from season to season, from year to year, and during seasons of above normal rainfall in the basin, the River remains in Flood condition for a long period. The road communication between Dar es Salaam, the capital, and the southern coastal area is cut off during the rainy season for months due to the Rufiji River flood.

Average annual rainfall varies considerably between the western (upstream) and the eastern (downstream) parts of the river plain. The available meteorological record shows that the western part has much less rainfall than the coastal eastern part. The mean annual rainfall in Mtanza is 698 mm while that in Mohoro is 1096 mm. Utete which is situated about in the middle has the mean annual rainfall of 885 mm. (See Table I-1 and Chart I).

Table I-1 Average Monthly Rainfall (mm)

	Mtanza	Utete	Mohoro
Jan.	110.5	108.8	119.6
Feb.	56.9	101.9	105.7
Mar.	135.1	154.5	159.8
Apr.	140.0	193.0	269.2
May	63.2	71.8	102.1
June	2.5	11.1	10.9
July	1.5	6.4	6.4
Aug.	0.9	6.6	15.0
Sept.	13.0	14.1	12.3
Oct.	24.6	30.5	37.8
Nov.	31.8	86.1	98.7
Dec.	111.5	100.4	158.5
Total =	697.5	885.2	1096.0
	Average of 4 years (1955)	Average of 38 years (1967)	Average of 21 years (1966)

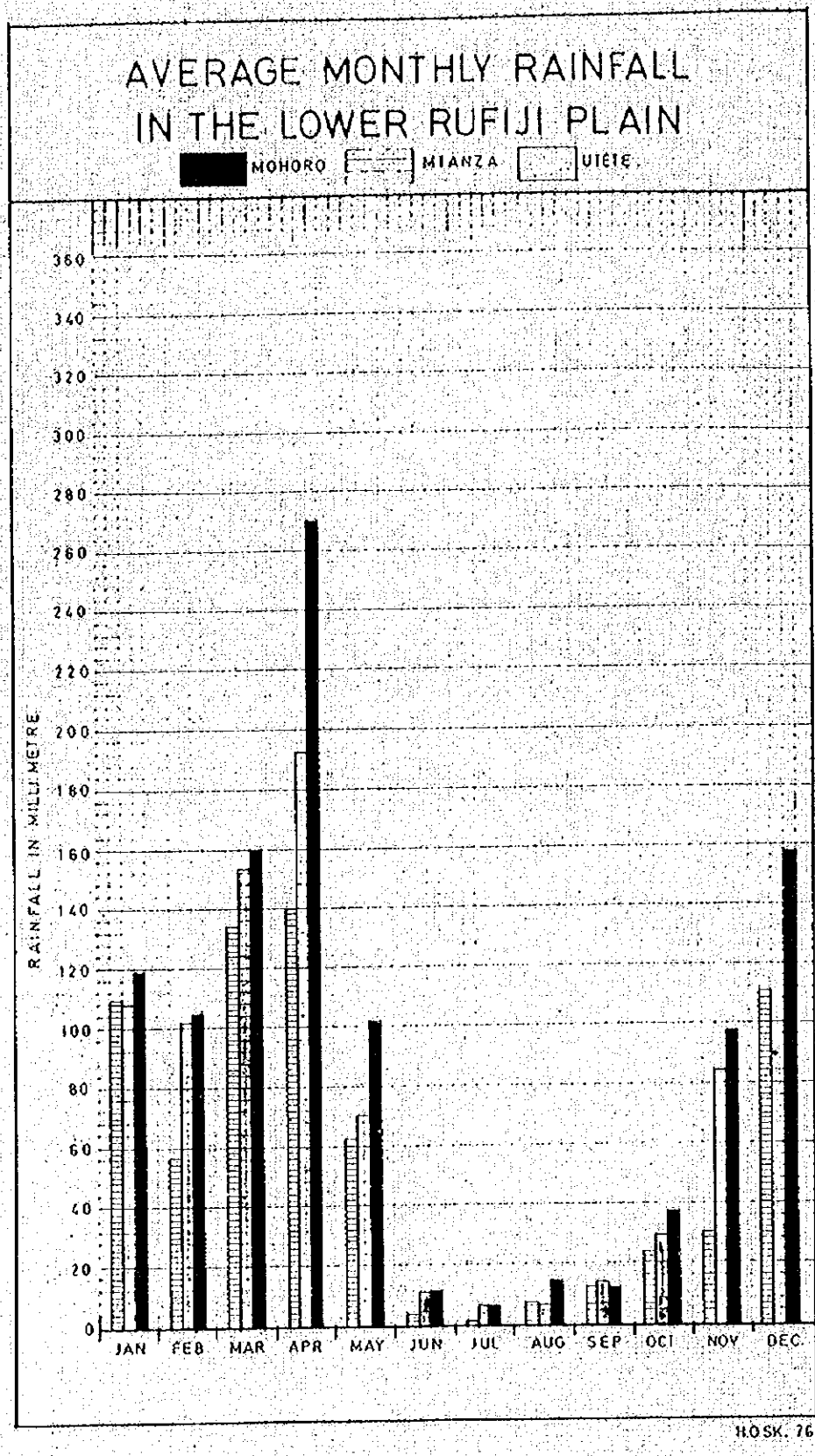
AVERAGE MONTHLY RAINFALL
IN THE LOWER RUFIJI PLAIN
MOHORO
MIANZA
UIETE
RAINFALL IN MILLIMETRE
360
340
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
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Chart I

The rainy season starts around the end of November and normally lasts until May, although in some years February could be rather dry. High peak of rainy season comes in April. Practically no rain falls between June and September. The level of the Rufiji River is however influenced more by the rainfall in further upstream regions, i.e. Kilomboro Valley, Mbeya and Njombe areas. Of the three main tributaries of the Rufiji, the Kilomboro River normally contributes about 62 percent of the runoff, the Ruwegu River about 18 percent and the Great Ruaha about 15 percent.

The major floods in the past sometimes resulted in change of the river course, and the old river course was left with dotted small lakes. The banks of old and new river courses form levee, and settlements were formally located along the lines of these levee. The geomorphology of the area is complex, and different types of soils could be found in small patches. Soil survey was conducted in the Lower Rufiji Plain as a part of the FAO Survey on the Rufiji Basin, 1961 and the information on the soil types could be obtained from the report. Further analysis of the soil is awaited.

The area is very hot as the plain is situated less than 100 metres of altitude, and having little breeze as it is bounded by low hills. However temperature records in this area are not available.

2. Inhabitants:

The majority of the inhabitants in the Lower Rufiji Plain are called Warufiji. A closer examination reveals that this is not a tribal name but just means that people living along the Rufiji River. Most of them belong to Ndengereko tribe who also inhabit to the north of the river plain and Mafia Island. However these other Ndongereko who live on the higher ground call the Ndengereko along the river as Warufiji because they are different in their skill for fishing and handling of canoe.

Wandengereko who are living along the Rufiji River are also called differently if they are residing in the upper part or the middle part or the lower part of the River. Those who are living in the upper part, above Kipo, are called Waruhingo,

those who are in the middle part down to Ndundu are called Wamininge, and those below Ndundu are called Wanyagatwa. Those differences seem to have come from different dialect of their language, Kindengereko.

There are also other tribal people who have moved to the River Plain from the surrounding area. In the upstream area, there are many Pogoro who have moved from Mahenge area. Some Zarame have moved from Kisargire side of Kisarawe to the upstream area of Rufiji Plain. In the downstream area, Matumbi people have moved from the hill to the south to settle in the Plain, and in the south eastern corner towards Kilwa many Ngindo people are living.

All these inhabitants have acquired so called Swahili culture prevalent along the Tanganyika coast. They are Moslems who read Swahili language in Arabic script, but retained strong tradition of Shetani cult.

Arabs are seen as traders in many dukas in the area, but occasionally also as farmers. Asians of the Indian origin who must have been many at one time are very rarely found now. The area is characterized by extremely small number of Europeans residing.

According to 1967 Population Census, Rufiji District had the total population of 121,024 with the household number of 30,935. The total population is broken down to the number of males, 56,768, and the number of females, 64,256. Population density is 9.1 person per km^2. These are the district total, and we had to estimate the number of population in the Lower Rufiji Plain from the Census figures for each enumeration areas and the Census map.

If we assume that the area of the Lower Rufiji Plain is corresponding to the Agricultural Survey Area we have chosen by the method which would be described later, the total population of the area in 1967 was 64,086, while the household number was 15,697. These figures constitute 53.0 percent and 50.7 percent respectively of the District totals.

The size of this area is in the order of 5,000 km^2, and thus the density of the population of the River Plain is around 12.8 person per km^2. This figure looks very small, but the area covers the very sparely populated area between 10 km to 20 km distance from the River, as well as a part of Selous Game Reserve just below the Stiegler's Gorge. Thus, if the area within 10 km from the River on both sides were taken, the population density would be very much higher.

The population increase for the Rufiji District between 1957 and 1967 Census was only 0.2% per annum, while the increase between 1948 and 1957 was 1.4% per annum. The decline of the annual growth of population may be the reflection of the hardships fell on the Rufiji people during these recent years, caused by major floods and draught, which have probably resulted in considerable emigration from the District. In comparison, the population increases for Bagamoyo, Kisarawe and Mafia Districts were respectively 2.8%, 1.8% and 3.2% per annum between 1957 and 1967.

3. Historical Background:

The area was acknowledged to have a good potential for agriculture by Germans from the beginning of their colonial rule. It was one of the earliest area in German East Africa where cotton was introduced as a plantation crop.

The first attempt to establish this crop in the area was made through force, and ended in disaster. Maji Maji Rebellion broke out in the Matumbi hills just south of the River Plain in 1905 which was at the beginning essentially a revolt by the inhabitants against the forced labour at the cotton plantations.(1) The Rufiji River Plain was a part of the battleground at the initial stage and probably suffered by the crop destruction campaign by the colonial government to put down the rebellion.

Despite this however, cotton growing took root among the inhabitants of the Rufiji River Plain who started to grow it in their own small farms. The change of the German colonial policy was also conductive to such small-holder development,

(1) J. Iliffe, Tanganyika under German Rule, 1905-1912, Cambridge 1969, p. 23.

and the Lower Rufiji Plain became one of the leading producing area of cotton in German East Africa. Many Germans continued to settle along the river and grew cotton and sisal. To serve such plantations, a stern-wheeler which has a draught of only 3 feet and could carry 10 tons of cargo once plied back and forth through the River.(2)

After the World War I, under the British mandate, the area was considered to be promising for development at first. In 1920's there was an experimental station at Mpanganya which was one of the very few agricultural experimental stations existed at that time in Tanganyika. The Mpanganya station contributed a lot for selecting better seeds of cotton, rice and other produce, and distributed them not only to the Rufiji area but also to the entire eastern parts of Tanganyika.

However the enthusiasm of the government on the cotton production in the Lower Rufiji Plain seems to have waned soon. Hazards of the Rufiji flood, decline of the plantations in the area, and the necessity of stringency in the government expenditure following the Great Depression, etc., led to the closure of Mpanganya station around 1951. The performance of the cotton growing farmers in the area never reached the level expected by the officials of the colonial government.

The cotton production figures for Rufiji District for these early years and for more recent years are shown in Table II-1. For some years, records of seed issues to Rufiji District (all cotton seeds for planting purpose must be obtained from the government) are available, and these figures when compared to the production figures of cotton in the same year indicate the very low yields of cotton in general in this area. The higher production level after 1958 seems to have been achieved through larger acreage planted, but this cannot be verified through look of data.

The next upserge of the government's interest started in 1948 when a mechanized rice cultivation scheme was launched in the Rufiji River Plain. Earlier the marketing of rice surplus to the subsistence requirement had commenced around 1928

(2) F.S. Joelson, The Tanganyika Territory, London, 1920.

stimulated by the erection of a rice mill in Dar es Salaam.[3] After the World War II, the government put a great faith in mechanisation, and the tractor ploughing service was initiated for increasing the production of rice. The justification for choosing the area for this service was stated to be:

(a) the flood plain needs no heavy bush clearing, the existing system of flood-grown rice can be extended without irrigation works, fertility is maintained by silt, and ploughing is possible throughout the dry season;

(b) tractor ploughing besides permitting increased rice acreages and reducing rice failures caused by late land preparation, was expected to enable cultivators to increase their hoe-prepared acreages of other food crops and of cotton.[4]

This scheme was financed to the extent of £18,835 from the Development Loan Fund, and in 4 years between 1948 and 1951; 10,699 acres were ploughed. However by then many difficulties of the scheme became apparent. There were:

(a) Frequent mechanical break-down and no spare parts. Only one European mechanic was available for the repair work.

(b) Reluctance of cultivators to abandon the accustomed boundaries.

(c) Reluctance to pay ploughing charges in advance.

(d) The delayed payments resulted in uneconomic under-utilization of tractors and ploughs.

(e) The expected increase in acreage of hand prepared land had not occurred.[5]

In order to save the scheme from financial loss, the ploughing charge had to be raised from Shs. 16/= per acre in 1949 to Shs. 23/= per acre in 1950, 51, to Shs. 40/= per acre in 1952. At the height of the scheme's progress in 1955, 7,720 acres were ploughed, but when the ploughing charge went up to Shs. 60/= per acre in 1956, only 700 acres were booked, and the scheme had to be wound up in that year.[6] The government attention was then turned to fostering the formation of ploughing associations by groups of interested Africans.

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(3) Tanganyika, Dept. of Agriculture Annual Report, 1928/29, p. 11.
(4) Hill and Moffet, Tanganyika, a review of its resources and their development, Dar es Salasm, 1955, p. 511.
(5) Ibid, p. 512
(6) Tanganyika, Dept. of Agriculture Annual Report, 1955, Part I, p. 28.

The most recent change was brought about by a large scale resettlement of the inhabitants of the Rufiji flood plain at the time of flooding in 1968. The government as well as the people, seeing the level of the water was unusually high decided that they must move to more raised areas, and with the help of national servicemen and TANU Youth League transported building materials from their traditional habitat to the newly allocated sites in Ujamaa villages. Thus the traditional ribbon-like settlements on the river levee were almost completely replaced by the more clustered settlements of the Ujamaa villages on the higher ground.

Table II-1: Cotton Production in Rufiji District

(Unit: Metric Ton)

Year:	Seed Cotton Produced:	Seed Distributed For Planting:	Year:	Seed Cotton Produced*
			↓	Data not available
1923	350	70	1958	1,263
24	507	120	59	548
25	340	164	60	3,917
26	438	132	61	163
27	13	41	62	5,981
28	116	45	63	5,255
29	166		64	3,197
30	140		65	1,455
31	48		66	1,688
32	255		67	1,106
33	443		68	2,522
↓	Data not available		69	407
			70	1,995
1944	950			
45	993			
46	151	80		
47	602			
48	119			
49	298			
50	875			
51	38			
52	404			

* Seed cotton figures are calculated from the cotton lint figures on the assumption of 31% lint out-turn.

Sources: Information from the Statistics Division, Kilimo.
Annual Reports of the Department of Agriculture, 1924.
Annual Report of the Lint and Seed Marketing Board, 1967.

III. SURVEY METHODS AND SAMPLING PROCEDURE

1. Survey Area:

The survey area was chosen in the following manner. The proposed dam-site of the Stiegler's Gorge Project is located at the altitude of 76 metre above sea level. From this point, lines were drawn on the map at the inclination of 1/5,000 towards the downstream area. These lines could be considered as the possible route of the main canals if the gravity irrigation method is to be chosen in the future. At any rate this would give us the maximum possible irrigable area downstream of the dam-site.

Thus the area within these lines (excluding lakes, river beds, forest reserves, swamps, and islands) was tentatively defined as the irrigable area. This area covers approximately 5,000 km^2 of land. Then the 1967 Consus Enumeration Area Map of Rufiji District was consulted, and the Enumeration Areas (E.A.) which fell within the above mentioned irrigable area were taken together and defined as the survey area.

When an E.A. was bisected by the boundary of the irrigable area, the E.A. was included in the survey area only when the larger portion of that E.A. fell within the irrigable area. Thus 190 E.A. were included in the survey area out of the District Total of 380 E.A. The number of the household in the survey area, according to 1967 population census, was 15,697 out of the District total of 30,935 households.

2. Survey Method:

The method of the survey adopted was the interview method. Enumerators were employed for interviewing the sample farmers with frequent intervals. For the measurements of some of the variables, such as the area of crops and the harvested amount of crops, direct measurements by the enumerators and other specially hired personnel were made.

The samples were to be chosen randomly and consist of farm households as a unit. Twice-weekly visit to a household by an enumerator was planned in order to

record farming labour inputs accurately. (A field office was set up at Kilimani Ujamaa Village.)

The data were collected and checked by a field supervisor every two weeks who then made weekly summaries. Over all planning, training of enumerators and supervision of the actual survey, as well as the analysis and writing up the report were done by an Agricultural Economist. Tabulation of the data was done at the office in Dar es Salaam.

The actual survey period was from 1st September, 1970 to 31st August, 1971, thus covering a full year so that it could record the seasonal changes of the agricultural activities and identify cropping patterns.

3. Sampling Procedure:

The survey area was stratified into two areas: namely, the upstream area, for which the Rusendo-Mtanza Division (now called Mkongo Division) roughly corresponds, and the downstream area which was constituted of the whole of Ikwiriri Division plus a part of Kikare and Mohoro Divisions. The upstream area has less rainfall (available record shows that the average annual rainfall in Mtanza is 698 mm), the flood damage in 1968 severer, and the majority of the inhabitants have moved from the former villages to the Ujamaa Villages. The downstream area has more rainfall (the average annual rainfall in Mohoro is 1096 mm), the flood damage in 1968 less severe, and the movement to the Ujamaa Villages is not so overwhelming as the upstream area.

The size of the sample had to be limited by the amount of fund available for the survey. Initially it was planned to have 1% sample of the total households in the survey area (i.e. 160 samples), but due to the depth of the survey planned and the scarcity of financial resources, we had to reduce it to 0.5% sample (i.e. 80 samples).

The method of choosing these sample households was three-stage clustered random sampling. At the beginning the Population Enumeration Areas (E.A.) were to become the first stage sample in both the upstream and downstream areas. 20 E.A. were to be selected randomly with the probability proportional to the

number of households in each E.A. However we found it necessary to modify this plan considerably.

Due to a large scale population movement from the former villages to new Ujamaa Villages in the upstream area since the last population census, we had to discard E.A. to be used as a first stage sample and had to seek an alternative sampling frame. Thus the list of the Ujamaa Villages which contained the number of household in each village was taken as the alternative sampling frame, and the Ujamaa Village became the first stage sampling unit in this area. A slight bias was introduced here, because the total number of households in the Ujamaa Villages here was 6,014 whereas the total number of households in the Rusende/Mtanza Division which fell within the survey area in the census was 7,349.

In the downstream area the E.A. were actually used as the first stage sample unit, but here also some modification had to be made. In five of the E.A. which were selected, it was found that all the inhabitants moved to Ikwiriri Ujamaa Village. It was decided therefore to reconstruct the lists of the former inhabitants of the E.A.s selected from the present Ikwiriri inhabitants. In another E.A. where all the inhabitants moved away, the adjoining E.A. was selected instead.

The second stage sampling frame was the list of ten-cell leaders in the selected first stage samples. Letters were sent to the Divisional and Ward Executive Officers from the Area Secretary at Utete to cooperate with our staff in this selection procedure.

As the lists of the ten-cell leaders were not obtainable beforehand, the Agricultural Economist visited every selected village or E.A. accompanied by the Ward Executive Officer concerned. A meeting was arranged in each of the village or E.A. by the respective TANU Chairman, and all the ten-cell leaders were asked to be present at the meeting.

After a brief explanation of the purpose of the survey and the selection procedure, all the ten-cell leaders were asked to give their names. 4 names were selected by drawing papers from a hat. 4 ten-cell leaders thus chosen in turn gave the names

of the ten people in their respective cells (including themselves). Each chosen ten-cell leader then drew a paper from a hat, and the chosen name constituted the final sample farm household. (In 8 E.A. in the downstream area, the second stage was skipped as the lists of all farmers were presented in these places.)

The final samples thus selected are composed of 36 households in the upstream area and 44 households in the downstream area, making total of 80 households.

Table III-1: Number of Samples Selected

	Upstream Area	Downstream Area	Whole Area
Total Household No.	7,349	8,348	15,697
1st Stage Sample No.	9	11	20
Sample Household No.	36	44	80

List of the first stage sample villages or Enumeration Areas Upstream Area:
Msona, Mtanza, Nyaminywili, Ndundunyikanza (I), Ndundunyikanza (II), Ngorongo, Mkongo, Ruwe, Mbunju.

Downstream Area:
Ndundu (E.A.3 Ikwiriri), Mtanango (E.A.7 Ikwiriri), Kitonga (E.A.9 Ikwiriri), Malemba Sule (E.A.12 Ikwiriri), Malemba Mkangema (E.A.13 Ikwiriri), Mpera (E.A.15 Ikwiriri), Mohoro (E.A.2 Mohoro), Kiwauga (E.A.11 Mohoro), Msomeni (E.A.28 Mohoro), Kilindi (E.A.40 Mohoro), Nyamwage (E.A.43 Mohoro).

IV. HOUSEHOLD CHARACTERISTICS OF THE SAMPLE FARMERS

At the beginning of the field survey, a questionnaire was administered to the sample farmers concerning their household characteristics. The purpose of this questionnaire was to find out the tribal, religions and educational backgrouhd of the farmers, their family size and age distribution, and the extent of their possession of the main factors of production, namely land, labour, livestock and farming tools.

The findings of the questionnaire are summarized in the following tables.

Some comments would be necessary here to clarify the nature of these tables. Concerning the education of the farmer, the Table IV-3 indicated that 72.2% in the upstream Area and 79.5% in the downstream had no schooling. However many of these farmers especially in the downstream area, received teaching in Koran schools in mosques, and in fact many can read and write Kiswahili in Arabic script. Therefore we should not hastily conclude that those who cannot read and write in Roman script are illiterate.(7)

Household was defieed as the farmer and his dependents living together most of the year. Children who are away most of the year were excluded. The average household sizes for the upstream, downstream, and the whole area are 4.3, 5.1, and 4.7 respectively, as shown in Table IV-4. Children below 10 years old and old persons above 61 years old could be excluded from the available labour force of the household. Thus, we consider the household members of between 10 to 60 years of age to be the available labour force per household, and their average for upstream, downstream and the whole area are respectively: 2.8, 3.0 and 2.9.

The average number of farm plots per household is shown in Table IV-10. Fragmentation here is defined as having plots which have no common boundary.

(7) Under such circumstances, agricultural instructions could have been given more effectively to the farmers if they were written in Kiswahili in Arabic script.

between each other. It is quite common in the Lower Ruffji Plain to call one area as farmers Shamba, the adjoining area as the first wife's shamba, and the next adjoining area as the second wife's shamba, and so on. However, for our purpose, these are not considered as separate plots, unless they are physically apart from each other. A rather few number of fragmentation found in the area may indicate that the land pressure there has not been too severe.

The size of landholding as well as the number of fragmentation were obtained by actual measurement. We measured only the area of plots which the sample farmers indicated as the land belonging to his household. The service of a consulting engineering firm was utilized for this measurement of the plots.

The average sizes of landholding (excluding the site of the house and the garden around it) were found to be 1.04 hectare, 1.23 hectare, and 1.15 hectare for the upstream, downstream, and the whole areas. As Table IV-11 shows, in the upstream area 53% of the households possess the land of less than 1 ha, 39% between 1 to 2 ha, and 8% between 2 to 3 ha. In the downstream area 41% have less than 1 ha, 45% between 1 to 2 ha, and 16% between 2 to 3 ha. None of the sample farmers possess more than 3 ha of land. The aspects of land holding and land use will be discussed later.

As Table IV-12 shows, the area is characterized by complete absence of cattle and very small number of small stocks like sheep and goat. Only chicken can often be seen in this area, but the number of chicken kept is not very much either. This feature could be explained by the occurrence of frequent flooding which have made the keeping of cattle and other domestic animals extremely difficult during flood season. Besides, this area is still inhabited by a large number of wild animals including predators like lions and leopards especially in the upstream side being close to the Selous Game Reserve, and the fear of their attack is still a strong deterrent to the introduction of domestic livestock.

However, the recent shift of the population to the higher ground since 1968 flood could open up the possibility of introducing cattles and other livestock as the above

causes for deterrent are very much reduced. The introduction of draught animal will be especially useful in this area since there is still plenty of grasses available and the land is abundant relative to the present population. Besides they could work in shallow water where tractors would have difficulties getting into.(8)

Farming tools possessed by the farmers in this area are composed of only simple tools as shown in Table IV-13. There are no farming machinery seen in the area except for a few tractors for contract ploughing. Otherwise plough is non-existent, and all cultivating operations as well as weeding are done with hoe. Wood cutting and grass clearing are done with axe and big machete (penga) while harvesting rice is done with small machete. Bicycle and canoe are important means of transporting both men and produce, but these are possessed by only 25% and 19% of the total sample households respectively. Fish nets are increasingly used in the area and 19% of the sample households possess them.

Concerning the source of domestic water supply, we find that most of the people who moved to Ujamaa Villages have already been getting water from pumped and piped water supplies, public water taps located within short distance from their houses. Others who are residing in higher ground are getting water from water-hole, and those who are residing near the Rufiji are getting water from river and lakes. These observations are borne out by Table IV-14. As is shown in Table IV-9, no one is practising irrigation at present.

The over-all impression emerging from this background knowledge of the sample farm household is that the technological level of the farming systems prevailing at present is very low, and this is reflected in the general lack of accumulated wealth among the people in the area, despite the often repeated assertion that physically the area has a great agricultural potential.

(8) Some suggests that Water Buffaloes of the type found in south east Asian countries may be an ideal type of draught animal for this area.

IV-1. Tribel Background of the Farmer

	Ndengerako	Pogoro	Matumbi	Ngindo	Saramo	Arab	Total
No.	69	5	2	2	1	1	80
Percentage	86.3%	6.3%	2.5%	2.5%	1.3%	1.3%	100%

IV-2. Religion of the Farmer

	Islam	Others
No.	80	0
Percentage	100%	0%

IV-3. Education of the Farmer

	Upstream		Downstream	
	No. of Farmers	Percentage	No. of Farmers	Percentage
No schooling	26	72.2%	35	79.5%
Standard 1	1	2.8%	0	-
Standard 2	2	5.6%	0	-
Standard 3	2	5.6%	3	6.8%
Standard 4	5	13.9%	5	11.4%
Standard 5 or 6	0	-	0	-
Standard 7	0	-	1	2.3%
Above Standard 8	0	-	0	-
Total =	36	100%	44	100%

TABLE IV-4: Average Household Size

	Adult Male (age 16-60)	Adult Female (age 16-60)	Youth (11-15)	Children (-10)	Old Persons (61-)	TOTAL
Upstream	1.1	1.4	0.3	1.4	0.1	4.3
Downstream	1.2	1.6	0.2	1.8	0.3	5.1
Whole Area	1.2	1.5	0.2	1.6	0.2	4.7

TABLE IV-5: Household Size Distribution

Size	Upstream		Downstream		Whole Area	
	No.	%	No.	%	No.	%
1	0	0	0	0	0	0
2-3	15	41.7	12	27.3	27	33.7
4-5	14	38.8	17	38.6	31	38.7
6-7	4	11.1	8	18.2	12	15.0
8-9	2	5.6	1	2.3	3	3.8
10-11	0	0	6	13.6	6	7.5
12-	1	2.8	0	0	1	1.3

TABLE IV-6: Household Age Distribution

Age	Upstream		Downstream		Whole Area	
	Male	Female	Male	Female	Male	Female
-10	23	26	43	35	66	61
11-15	5	4	6	2	11	6
16-20	5	11	4	13	9	24
21-30	8	20	15	31	23	51
31-40	13	12	8	17	21	29
41-50	7	3	14	7	21	10
51-60	6	4	11	3	17	7
61-	2	2	3	9	5	11
TOTAL	69	82	104	117	173	199

TABLE IV-7: Household Age Distribution in Percentage

Age	Upstream		Downstream		Whole Area	
	Male	Female	Male	Female	Male	Female
-10	33.4	31.7	41.3	29.9	38.1	30.7
11-15	7.2	4.9	5.8	1.7	6.4	3.0
16-20	7.2	13.4	3.8	11.1	5.2	12.1
21-30	11.6	24.4	14.4	26.5	13.2	25.6
31-40	18.9	14.6	7.7	14.5	12.1	14.6
41-50	10.1	3.7	13.5	6.0	12.1	5.0
51-60	8.7	4.9	10.6	2.6	10.0	3.5
61-	2.9	2.4	2.9	7.7	2.9	5.5
TOTAL	100	100	100	100	100	100

TABLE IV-8: Flood Resettlement

Area	Moved (Household No.)					Not Moved
	Before 1967	1968	1969	1970	TOTAL	(Household No.)
Upstream	0	24	12	0	36	0
Downstream	9	8	8	1	26	18
TOTAL	9	32	20	1	62	18

TABLE IV-9: Irrigation

	Practiced	Not Practiced
No.	0	80
Percentage	0%	100%

TABLE IV-10: Fragmentation of Land

No. of Plots per Household	No. of Households		
	Upstream	Downstream	Whole Area
0	-	-	-
1	15	11	26
2	16	19	35
3	3	10	13
4	2	-	2
5	-	3	3
6	-	1	1
Total No. of Households	36	44	80
Average No. of plots per	1.8	2.3	2.1

TABLE IV-11: Size Distribution of Landholding

Size of landholding (Hectare)	No. of Households			Percentage		
	Upstream	Downstream	Whole Area	Upstream	Downstream	Whole Area
0-0.19	-	-	-			
0.20-0.39	5	5	10			
0.40-0.59	6	2	8	53%	41%	46%
0.60-0.79	6	7	13			
0.80-0.99	2	4	6			
1.00-1.19	4	9	13			
1.20-1.39	3	2	5			
1.40-1.59	6	1	7	39%	43%	41%
1.60-1.79	1	5	6			
1.80-1.99	-	2	2			
2.00-2.19	-	2	2			
2.20-2.39	1	2	3			
2.40-2.59	-	1	1	8%	16%	13%
2.60-2.79	-	2	2			
2.80-2.99	2	-	2			
3.00-	-	-	-			
Total =	36	44	80	100%	100%	100%
Average holding size	1.04 ha	1.23 ha	1.15 ha			

IV-12. Possession of Livestock (80 Households)

No. of Livestocks	No. of Households					
	Cattle	Sheep	Goat	Chicken	Duck	Others
1 - 5	-	2	-	19	-	-
6 - 10	-	-	-	6	-	-
11 and over	-	-	-	7	-	-
Average No. per Household	-	0.10	-	3.35	-	-

IV-13. Possession of Tools for Farming and Fishing (80 Households)

No. of Tools	No. of Households								
	Hoe	Plough	Machete	Sprayer	Hand-cart	Bicycle	Canoe	Axe	Fishnet
1	0	-	38	-	-	20	13	12	7
2	20	-	23	-	-	-	1	-	3
3	8	-	10	-	-	-	-	-	4
4	23	-	4	-	-	-	-	-	1
5	3	-	1	-	-	-	-	-	-
6 and over	26	-	0	-	-	-	-	-	-
Average No. per Household	4.28	-	1.68	-	-	0.25	0.19	0.15	0.36

IV-14. Domestic Water Supply (80 Households)

Distance (mile)	No. of Households					
	Pumped & piped water	Hand-pump borehole	Water-hole	River	Waterpool and lake	Others
0 -0.25	39	-	11	8	2	-
0.26-0.50	1	-	2	7	-	-
0.51-0.75	-	-	-	-	-	-
0.76-1.00	-	-	1	8	-	-
1.01-2.00	-	-	-	1	-	-
2.01 and over	-	-	-	-	-	-
Total No.	40	0	14	24	2	0

V. LAND TENURE AND LAND USE

1. Land Tenure

Although we did not carry out detailed investigations into the system of land tenure in the Lower Rufiji Plain, we present here some informations obtained through informal conversations with various peoples residing in the area. As the problem of land tenure is one of the most important subjects when any improvement on the land or any reallocation of the land is planned, we would like to recommend that the subject should be investigated more fully by suitable persons before irrigation farming is introduced.

We may say that a customary land tenure still prevails in the Lower Rufiji Plain whereby the individual families (households) have rights of use of the land they cultivate. Land is not registered nor has been surveyed. However the rights of an individual for a certain piece of land are clearly recognized by the inhabitants in the area, and in most cases acquired fixed boundaries. Any farmer and his neighbours can clearly tell the boundaries of the lands which belong to him although there are no clear bench marks in the stranger's eyes.

Shifting cultivation is not practised, and almost all the land holdings are cultivated continuously unless the person who has established a right is sick or absent from the area. The rights of an individual on a land will cease if it is not cultivated for a long time. Continuous cultivation is made possible because of the fertility of the soil which is replenished frequently by silt carried and deposited in time of flooding. Prevention of flooding in future would therefore necessitate alternative method of keeping fertility of the land.

Population pressure on the land is not yet a big problem at the present level of agricultural technology, and there are still enough land available for a new member of the family to acquire new land, except perhaps near Ikwiriri where most of the good land seem to be occupied. Dividing the land into smaller pieces upon inheritance is not a general case, and more often than not a man who does not inherit land just opens up new land for cultivation. While the rights on the land thus

acquired are strongly defended, land is never sold or bought, and renting seems to be very rare.

It is customary that a household land is divided into farmer's plot, his first wife's plot, his second wife's plot, and so on. Harvests from the farmer's plot are exclusively his, but those from a wife's plot are divided between hers and husband's. As we treated a household as a unit in this survey, we did not separate the harvested amount of crops accounted to these individuals within a household, nor did we separate the incomes or expenditures accounted to the individuals. These matters should be the subject of investigation by sociologists in future together with their implications on land inheritance.

2. Land Use

As the land in the flood plain is usually cultivated continuously, and much of these cultivated lands are double cropped, there is a high intensity of land use for these areas which have been brought into cultivation.

Table V-1 shows the average areas of cultivation for different crops per household in the Lower Rufiji Plain. Table V-2 shows what percentage of farmers grew particular crops and crop mixtures.

These cultivated areas are characterized by mixed cropping of many kinds. The most conspicuous is the mixed cropping of rice and maize, but also mixture can be found of various vegetables, sesame, and maize. However cotton is most often found in pure stand except sometimes with maize. Cashewnuts could be found standing sometimes in a rice field. Casava and pigeon pease together with beans are usually found mixed, and planted in the garden around a house. In case of Ujamea Villages, almost every house has this cassava/pigeon pea garden which is about the size of 0.05 ha.

The cropping intensities which are the ratio of the cultivated areas for both rainy season and dry season crops to the areas of landholding (including gardens) are:

1.15 in the upstream area, 1.20 in the downstream area, and 1.18 in the whole area.

The area of crop cultivation was first measured in October, 1970 together with the area of landholding. For these measurements we utilized the service of a consulting engineering firm, the Design Partnership Ltd. Their actual measurements took place in the late October which was at the height of cotton picking season. Our field supervisor and enumerators arranged the sample farmers to meet the survey team, and as a farmer indicates the boundaries of his landholdings, the survey team measured the length of the boundaries as well as the diagonals of the plots using accurate large size range-finders and ranging poles. Then the crop areas inside the plots were measured. Then each plot was then drawn in scale at the consulting engineer's office and the size of the area calculated.

The second measurement took place in March, 1971. This time it was thought wise to use local persons for measuring the fields in order to alleviate the farmer's suspicion that their land may be taken away. Two local persons were selected to undertake this task. They went to the fields with the farmers and the enumerators who by then knew their respective interviewing farmers very well, and measured the boundaries of the cultivated areas using measuring wheels and compasses. Drawings in scale were then made at our Dar-es Salaam office based on these measurements, and the size of the area calculated.

Table V-1: AVERAGE CROP AREAS PER HOUSEHOLD

(Measured in Oct. 1970 and March 1971)

Crops:	Upstream (ha)	Downstream (ha)	Whole Area (ha)
(Annual Crops)			
Rice and Maize Mixed	0.58 (Mar.)	0.78 (Mar.)	0.69 (Mar.)
Rice pure-stand	0.24 (Mar.)	0.11 (Mar.)	0.17 (Mar.)
Maize pure-stand	0.01 (Mar.)	Nil	Nil
Cotton	0.30 (Oct.)	0.44 (Oct.)	0.38 (Oct.)
Vegetable/Maize/Sesame Mixture	0.01 (Oct.) 0.04 (Mar.)	0.06 (Oct.) Nil (Mar.)	0.04 (Oct.) 0.02 (Mar.)
(Perrenial Crops)			
Cassava/Pigeon Pea Mixture	0.07	0.03	0.05
Cashew Nuts	0.03	0.08	0.06
Banana	Nil	0.01	Nil
Total (Including double cropping)	1.28	1.51	1.41
Total (Oct.)	0.44	0.62	0.53
Total (Mar.)	0.97	1.01	0.99
Landholding Size (Including garden)	1.11	1.26	1.20

Table V-2: NUMBER AND PERCENTAGE OF GROWERS OF DIFFERENT CROPS AND CROP MIXTURES

Crops	Upstream		Downstream		Whole Area	
	No.	%	No.	%	No.	%
(Annual Crops)						
Rice and Maize Mixed	27 (Mar)	75	36 (Mar)	82	63 (Mar)	79
Rice pure-stand	14 (Mar)	39	11 (Mar)	25	25 (Mar)	31
Maize pure-stand	1 (Mar)	3	-	-	1 (Mar)	1
Cotton	19 (Oct)	53	28 (Oct)	64	47 (Oct)	59
Vegetable/Maize/ Sesame/Mixture	6 (Oct) 3 (Mar)	17 8	11 (Oct) 2 (Mar)	25 5	17 (Oct) 5 (Mar)	21 6
(Perrenial Crops)						
Cassava/Pigeon Pea/ Mixture	22	61	14	32	36	45
Cashewnuts	3	8	4	9	7	9
Banana	-	-	1	2	1	1
Sample Farmers	36	100	44	100	80	100

VI. CROPPING PATTERN

1. Agricultural Calendar

The cropping pattern of the Lower Rufiji Plain is highly adapted to the natural environment which is dominated by the unstable flooding regime of the Rufiji River. The following agricultural calendar complied from the informations gathered in the survey would show the different seasonal agricultural activities.

Month	Rice	Maize	Cotton	Others
September	Start breaking the ground		Harvesting starts	
October			Harvesting and sorting	
November	Cultivation and land preparation continues		Marketing	Cashewnuts harvesting
December January	Planting (direct sowing)	Planting		Planting cassava, beans, sesame
February	Planting continues and weeding starts	Weeding		Weeding
March	Weeding continues replanting in the place of dead plants	Harvesting		
April	Flooding			Harvest pumpkin
May	Bird scaring Flood recedes	Plant dry season maize	Planting as the flood recedes	Harvest beans, sesame
June	Harvesting starts harvesting and threshing		Weeding	
July	Marketing			
August		Harvesting	Weeding	

2. Relation between Rice, Maize and Cotton

Rice is the mainstoy of the agricultural activities. It is the main subsistence as well as cash crop. However it is customary that rice and maize are interplanted in this area. The reason behind this practice is that, if they are planted at the same time, usually about the beginning of January, maize could be harvested three months before rice harvest, and thus before rice field is flooded.

A farm household can get the precious staple foods during the hungry season before the main rice harvest season. The practice is however primarily a method of minimizing risks. In this area rice crops could be easily destroyed by high flood, or also as often by excessive dryness with no flood. But in such cases the farmers at least have maize from that shamba if it is intercropped with rice.

If the flood comes after the rice plant has attained certain height, and remain below that height the condition would be ideal, and the farmers can expect a good rice harvest. Flood should subside before the harvest begins.

Cotton is an important cash crop but only subsidiary to rice even as a cash corner in normal years. Its importance lay in high flood years when rice crops are badly damaged. In the flood plain cotton is sown just after the rainy season when water pools disappear from the shamba. Thus it is essentially a dry season crop. The plant roots follow the falling water-table through the soil and a crop is produced with little or no rain. This method of cultivation is called Mlao cultivation locally.

However if the rice crop is good, the labour requirements for cotton sowing compete seriously with these of rice harvesting. Often cotton is sown between rice plants before harvesting, but this is a hard task. If they wait after the rice harvest, dry spell will set in, and the cotton may either fail to germinate or may dry out and wilt after germination. Also rodents (field rats) which feed on the fallen rice grain after threshing may destroy young cotton.

On the other hand if the rice crop has been destroyed by high flood, all the rice fields are ready to be planted with fortile silt freshly supplied. There is no labour competition between rice harvest and cotton planting. The formers must now get

enough cash income from cotton to purchase food for subsistence, and this necessitates them to plant more acreage. Thus in the past, cotton production has always shot up after the occurrence of high flooding, and the destruction of rice crops. The cropping pattern of the Rufiji flood plain is therefore based on a system which minimizes the risk of flood damage while utilizing the benefits of flooding. However this system has a serious labour contraints around May and June, which limits the level of income attainable. This will be discussed more fully in the next section on labour inputs.

In the upland area and on the surrounding hills which falls outside of the survey area, cotton is sown around February, and thus grown during rainy season. This rain-grown cotton production is not influenced by the level of flooding, but its growing period coincides with that of rice, and its labour requirements compete more directly with those of rice.

3. Agricultural Technology

Agricultural Technology presently used in the Lower Rufiji Plain could be termed as hoe culture. Almost all farming operations associated with growing crops are done by the use of hoe. Plough has not been introduced except for some tractor hire services. Draught animals are non-existent, and the inhabitants have not acquired any knowledge of training animals.

Transplanting of rice seedlings is not practised, and rice seeds are sown directly in the farm when the ground soften by the onset of rain. If maize is grown mixed, maize is sown first. After maize germinates and its sheets appear above the ground, rice is sown between these maize. Neither maize nor rice is sown in rows.

Sowing rice is done in the following manner. Someone holding a wooden pole pounds the ground with it and makes small holes about 30 cm. apart. Persons following him put about 10 seeds in each hole and cover them up. Weeding is done by hoes, and hoes for this purpose often have short handles.

When nearing harvest, someone stays near the farm in a raised but keeping watch on birds and animals which may destroy crops. Harvesting is done by knives with the blade length of about 20 cm. Rice is cut close to the ground, but at the early

season when small amount for home consumption is necessary, harvesting is done by cutting the ears of rice.

After harvesting, rice is heaped on a mat at the farm, and threshed by beating with sticks. Rice is not hang in bundles for drying. Threshed rice is then winnowed, and unhucked rice (paddy or mpunga in Kiswahili) is put into bags.

Maize stalks after the maize harvest are left in the field to rot and this process is hastened by the flooding. Cotton is sown as the flood subsides (Mlao cultivation).

It seems that there has been very little innovation in agricultural technology, especially in improving agricultural tools, and the method of transportation. Introduction of bigger boats instead of dug-out canoes will facilitate river crossing very much while some hand-carts to carry things instead of headload will be of great help.

In contract to crop production side, the method of fishing seems to be undergoing changes. This was brought about by wider use of nylon fishnets, and the use of fish-catching basket, locally called "Kiai" is becoming more and more limited.

VII. LABOUR INPUTS

1. Labour Inputs by Type of Persons

Labour inputs by type of persons, namely, farmer, other male adults, female adults, youths and hired labourers, are presented in Tables VII-1 and VII-2. These inputs are broken down into farming activities (including fishing), other paid work, and collecting water.

The tables show that the labour inputs by youths (age: 11-15) are very small, partly because the number of persons which falls into this category is small, and partly because they are usually attending schools. Most Ujamaa villages are now provided with schools which are attended by children and youths living inside and outside of the Ujamaa villages.

The labour inputs by hired labourers are also small, confirming the view that most of the farm works are done by family labour only. The only time hired labourers were used much was for harvesting and threshing of rice around June and July. Some of the works recorded as done by hired labour may be works done by relatives to whom usually payment in kind are made. Hire labourer's work tabulated in the column of paid work are mostly domestic servants' work.

The division of labour by sex is minimal in the area. Fishing is undertaken only by man. Women undoubtedly work harder than men in the shamba, but there is no crop nor farming operation that is done exclusively by women. For this reason, and for simplifying the survey, we did not differentiate labour inputs for different operations and crops by type of persons engaged in the works. We did not use the concept of Man Equivalent, and each person is assigned 1 unit of labour.

Collecting water is considered as a women's job, although children and man sometimes help. As the Tables VII-1 and VII-2 show, the amount of labour spent for this activity is extremely small. This owes greatly to the pumped and piped water supply (with many communal taps) which have been installed in the most Ujamaa villages in the area.

2. Labour Inputs by Crops and Operations

Tables VII-3 and VII-4 show the average labour inputs for different crops and enterprises by types of operations such as land preparation, planting, weeding, harvesting, etc. As these tables show the average of all the sample households,(9) they do not show the average of the growers of each crop.

Two things stand out in these tables. One is the importance of rice among the whole range of crops. This is generally followed by cotton, maize, and fishing. The other important factor is that walking to and from shamba takes up a considerable part of farming operations. In the upstream area walking time constitutes 14% of the whole farming operations while in downstream it constitutes 19%. This characteristics is readily observable if one goes to the area, as so many people are seen walking along the foot paths and reads with hoes in their hands or on their heads, especially in the early morning and early afternoon. This is partly a consequence of resettlement of the people to Ujamaa villages on the higher ground, and their houses and farms are now separated by a long distance (5 to 8 miles distance is common). We thought it proper to include walking hours among the farming operations because they represent hours forgone which could have been utilized for other farming activities.

Ujamaa Farm activities were separately recorded as one enterprise, as the main attention of this survey is on the individual shamba, and the farmers spend most of their labour in the individual shamba. Ujamaa farm is a communal farm for which all the able bodied adult member of the Ujamaa village are called to work, usually 2-3 days a week. All the sample farmers in the upstream area and 68% of the samples in the downstream belong to Ujamaa villages. Crops grown in these Ujamaa (communal) farms are sesame, rice and cashewnuts.

The extremely small labour inputs for harvesting operations for the Ujamaa farms reflect that the harvested amounts were almost nil for this year. Cashewnuts have not reached the bearing stage, but for annual crops like sesame and rice the failure

(9) Exactly speaking, average of 76 samples, as 2 samples each from both upstream and downstream areas were dropped because of incomplete recording.

seems to be attributable to the neglect of weeding, severe attack of insects, and general lack of attendance and care.

3. Seasonal Labour Inputs for Different Crops

Tables VII-5 and VII-6 show the average seasonal distributions of labour inputs for different crops and enterprises. These are again the average of 34 farmers for the upstream area and of 42 farmers for the downstream area. They are presented as charts in Chart II and Chart III.

There are visible differences in the labour profile between Chart II and III. Downstream area has more peaks while upstream area has smoother profile. This can be explained by the existence of larger cotton acreage per household and the greater percentage of farmers who grow cotton and maize in the downstream area. Also less rainfall in the upstream area at the time of rice planting means planting time for the area is more spread out. Flooding of some parts of the downstream rice farms reduced the time spent for weeding in this area in comparison with the upstream area where the effects of flooding to restrict weed growth was nil. The smaller amount of labour inputs for rice at the harvest month of June in the downstream area may be caused by the larger number of people who hired transport (lorries) to carry rice bags from their farms.

Fishing is done fairly constantly for all seasons. Only at the rice harvesting time, fishing is not much carried out.

One of the complex problems of seasonal labour inputs in this area is the timing of the month of Ramadhan. In this overwhelmingly Moslem society the labour inputs might be reduced during this period. In this survey year, the Ramadhan fell between 31st October to 29th November. In Chart II and III it fell mostly in the weeks indicated as November (3rd four-weeks), but also the last week of Ramadhan fell in the period indicated as December (4th four-weeks). This period covered from 23rd November to 20th December.

In order to convert these hours per household per 4 weeks to the hours per labour force per working day, we may calculate as follows:-

In the upstream area, the available labour force is 2.8 and they are prepared to work 22 days per 4 weeks. (People in this area do not work on Fridays. 2 more non-working days can be set aside for other reasons such as heavy rain, sickness, funerals, etc.) Thus the conversion factor of 61.6 (2.8 x 22) could be used to devide the hours per 4 weeks. For September, for instance, the time spent per labour force per day for farming is 5.7 hours, while for June it reaches 6.5 hours. Similarly in the downstream area the conversion factor of 66 (3.0 x 22) could be used. Thus in this area, the time spent per labour force per day for farming is 4.8 hours for September. In December/January it reaches 6.9 hours.

4. Labour Inputs on Rice and Cotton

In order to understand the labour constraints of the rice-cotton cropping system of the Lower Rufiji Plain, and also to calculate the return to labour or the cost of production for the two most important crops, the labour inputs per hectare for rice and cotton were calculated. These are presented in Tables VII-7 and VII-8.

Walking hours here are considered not changeable according to the size of a farm and calculated on that basis.

Concerning the labour inputs for cotton, a great difficulty arose because the survey period broke the cotton growing season into two, and in the second year much of the cotton growers of the previous year did not plant cotton. Tables VII-7 and VII-8 are therefore the average of the growers of cotton in both seasons. (The average of 8 farmers in the upstream area and of 9 farmers in the downstream area).

The average labour inputs on cotton per hectare were found to be 1104.1 hours in the upstream area and 1084.8 hours in the downstream area. For rice, the average labour inputs per hectare were 2774.3 hours in the upstream area and 2815.2 hours in the downstream area. (The averages of 34 farmers and 42 farmers respectively).

The Charts IV and V attempt to show the problem of labour peaks in the present agricultural system based on rice and cotton. The figures indicated in the charts are the labour hours for the average cultivated sizes of 0.84 ha for rice and 0.59 ha for cotton in the upstream area, and 0.90 ha for rice and 0.71 ha for cotton in the downstream area.

Assuming the available labour force per household of 2.8 in the upstream area and 3.0 in the downstream area, and the working hours of 8 hours per day and 22 working days per 4 weeks, the total available hours per household are 493 hours and 528 hours respectively for the upstream and downstream areas. The Chart IV shows that the peak in June needs 481 hours of labour for rice and cotton. This is very high 98% of the total available hours. The Chart V shows the peak in October needs 553 hours which exceeds the available labour hours by 25 hours. In this area the peak in May needs 447 hours which comes to 85% of the available labour hours.

The labour peak of May/June is probably more serious problem to the farmer as both the harvesting of rice and planting and weeding of cotton need more exact timing than the October peak of cotton harvesting and rice land preparation as the operation of rice cultivation could be halted for a while.

From these observations, it is quite clear that the further development of this rice-cotton cropping system is seriously hindered by the labour constraints which develop in October and around May/June. The further development of this system could however become possible if these labour constraints could be removed by using more efficient farming tools or simple farm machines.

For instance the introduction of simple threshing machines and better means of transporting crops at the harvest time of rice would help a great deal for expanding cotton acreage. Use of plough will enable the rice acreage to be expanded per unit of labour input, and could case the labour peak of the cotton harvest season around October. If row cropping is adopted the use of simple hand-pushing weeder could become possible which makes the tedious work of weeding much easier.

The introduction of irrigation farming will of course open up much more possibility of the development of this cropping system. It would enable to shift the planting time of the crops, especially of cotton which could now be sown later without the hazard of wilting. The labour peak around October could be smoothed by the introduction of transplanting system of rice.

Table VII-1: AVERAGE LABOUR INPUTS PER HOUSEHOLD FOR FARM WORKS, OTHER PAID WORKS AND COLLECTING WATER

(UPSTREAM AREA)

Unit = Hour

4-Weekly	Farmer			Adult Female			Adult Male			Youth			Hired Labourer			Total
	Farm work	Paid work	Water	Farm work	Paid work	Water	Farm work	Paid work	Water	Farm work	Paid work	Water	Farm work	Paid work	Water	
1. Sept.	146.1 (13.3)	20.3	0.2	169.2	2.8	9.7	14.1	0.3	1.2	20.3 (2.1)	0.2	0.8	-	-	-	385.0
2. Oct.	137.4 (28.5)	16.7	0.2	156.4 (3.8)	3.4	7.1	20.2	0.3	0.4	26.7	5.6	0.5	-	-	-	374.9
3. Nov.	136.8 (30.2)	6.9	-	146.3	1.2	6.4	15.2	-	0.1	10.0 (3.1)	6.2	0.9	-	-	-	329.0
4. Dec.	130.4 (18.6)	10.7	0.2	127.8 (0.2)	-	8.3	11.2	-	-	6.5 (1.6)	-	0.6	-	-	-	295.6
5. Dec/Jan	127.9 (29.8)	18.1	0.1	142.8	-	6.6	10.8	-	-	12.1 (3.8)	-	0.4	-	-	-	318.8
6. Jan/Feb	119.1 (18.6)	29.0	-	146.4	1.0	5.4	16.1	-	0.1	9.7 (3.1)	-	0.3	1.1	-	-	328.3
7. Feb/March	118.8 (21.1)	40.0	-	147.9	0.3	4.6	20.5 (0.1)	0.2	0.2	10.4 (3.4)	-	0.3	-	-	-	343.0
8. Mar/Apr	135.7 (34.2)	39.4	-	133.9	0.1	4.3	23.2 (0.9)	-	0.4	4.3	-	0.3	-	-	-	341.5
9. April	114.5 (11.2)	37.2	0.2	140.4	1.3	3.5	11.3	0.2	0.2	2.4	-	0.7	-	-	-	312.3
10. May	136.0 (1.6)	48.3	-	208.4	8.3	4.4	15.7	4.7	0.2	6.7 (0.1)	-	0.2	9.2	-	-	442.2
11. June	118.1 (1.4)	45.5	-	230.0	22.1	4.4	16.5	1.1	-	17.8 (0.1)	-	0.2	16.5	-	-	472.2
12. July	66.3 (14.8)	35.5	0.2	58.1	4.8	3.9	2.6	-	-	3.3	-	0.2	14.3	-	-	189.1
13. Aug.	40.5 (19.6)	27.3	0.1	11.1	-	4.0	-	-	-	0.1	-	0.2	-	-	-	83.3
Whole Year	1527.8 (242.8)	374.9	1.1	1818.7 (4.0)	45.2	72.4	177.4 (1.0)	6.9	2.7	130.4 (17.3)	11.0	5.7	41.1 (-)	-	-	4215.0 (265.1)

Farm work includes fishing which is indicated in parenthesis. Totals do not add up because of rounding.

Table VII-2: AVERAGE LABOUR INPUTS PER HOUSEHOLD FOR FARM WORKS, OTHER PAID WORKS AND COLLECTING WATER

(DOWNSTREAM AREA) Unit = Hour

4-Weekly	Farmer			Adult Female			Adult Male			Youth			Hired Labourer			Total
	Farm work	Paid work	Water	Farm work	Paid work	Water	Farm work	Paid work	Water	Farm work	Paid work	Water	Farm work	Paid work	Water	
1. Sept.	118.7 (4.8)	28.1	-	178.5	-	7.5	28.0 (5.4)	2.1	0.7	5.2 (0.9)	0.4	0.2	-	1.8	-	371.1
2. Oct.	131.8 (15.4)	27.0	0.3	186.8	-	8.3	48.3 (7.6)	4.6	1.7	10.6 (0.3)	-	0.3	-	5.9	-	425.3
3. Nov.	122.2 (16.3)	26.0	0.6	182.5	0.2	10.0	40.5 (2.4)	3.3	1.7	17.6 (7.2)	1.2	0.1	0.1	1.5	0.1	407.4
4. Dec.	108.6 (25.6)	25.1	0.2	130.3	-	10.7	29.4 (1.1)	2.9	1.6	11.8	-	0.2	-	-	-	320.8
5. Dec/Jan	160.5 (9.2)	21.6	0.0	228.3	0.5	9.0	54.7	1.2	1.6	9.8 (6.4)	-	0.2	0.2	1.6	-	489.3
6. Jan/Feb	134.9 (9.4)	21.2	0.1	196.6	-	10.2	43.5 (3.4)	5.0	1.8	3.8 (2.9)	-	0.2	0.8	-	-	418.1
7. Feb/March	112.0 (12.7)	24.4	0.1	160.5	-	10.8	43.8 (6.8)	2.4	2.3	-	-	-	-	-	-	356.4
8. Mar/April	78.7 (15.3)	27.9	0.1	119.7	-	18.7	11.5	2.3	2.0	2.7	-	0.1	-	1.8	-	265.4
9. April	61.8 (28.7)	17.2	-	151.1	-	16.2	14.3 (7.2)	5.1	0.3	8.7	-	-	1.7	-	-	276.5
10. May	110.6 (16.6)	19.7	0.2	224.1	-	12.7	21.6	2.9	0.4	9.6	-	0.1	13.0	-	-	414.9
11. June	93.5 (7.3)	20.3	0.1	134.8	-	14.3	14.7	2.3	0.3	9.8 (7.9)	-	-	39.4	-	-	329.6
12. July	37.2 (4.5)	22.6	0.1	69.8	-	21.1	4.9 (2.0)	7.8	6.1	7.2 (3.6)	-	0.3	34.5	-	-	211.4
13. Aug.	30.5 (6.8)	22.9	0.3	37.8	0.2	28.0	10.6 (10.6)	1.8	0.5	-	-	0.1	1.9	-	-	134.4
Whole Year	1301.1 (172.4)	304.2	1.9	2000.7 (-)	0.9	177.4	365.7 (46.4)	43.6	21.0	96.6 (29.2)	1.6	1.7	91.6	12.5	0.1	4420.5 (247.9)

Farm work includes fishing which is indicated in parenthesis. Totals do not add up because of rounding.

TABLE VII-3: AVERAGE LABOUR INPUTS PER HOUSEHOLD PER YEAR BY FARMING OPERATIONS

(UPSTREAM AREA) Unit = Hour

Farming Operations \ Crops Enterprise	A Cotton	B Cashew nut	C Rice	D Maize	E Cassava	F Vegetables	G Fruits	H Fish	I Ujamaa Farm	J Others	Total
1. Wood Clearing	3.0	0.4	13.4	9.7	1.2	2.5	1.1	-	26.7	3.2	61.2
2. Land Preparation	18.7	17.8	600.0	16.0	1.9	5.7	0.1	-	148.6	26.9	835.7
3. Planting	30.5	-	140.6	23.2	4.6	1.4	-	-	18.7	8.2	227.2
4. Weeding	95.5	4.3	367.8	107.2	23.4	5.8	-	-	36.4	15.0	655.4
5. Insecticide/Fertilizer	0.2	-	-	-	-	-	-	-	-	-	0.2
6. Harvesting/Processing/ Marketing	88.8	5.6	318.3	24.3	0.4	0.6	-	12.5	3.4	7.8	461.7
7. Other operations (including fishing, birdscaring, animal watching)	16.9	1.4	590.6	2.0	0.2	0.3	3.5	265.1	8.6	56.5	945.1
8. Walking	69.8	7.9	296.8	54.0	1.5	2.2	0.1	7.8	60.1	18.4	518.6
TOTAL =	323.4	37.4	2327.5	236.4	33.2	18.5	4.7	285.5	302.6	136.0	3705.2

TABLE VII-4: AVERAGE LABOUR INPUTS PER HOUSEHOLD PER YEAR BY FARMING OPERATIONS

(DOWNSTREAM AREA)

Unit = Hour

Farming Operations \ Crops Enterprise	A Cotton	B Cashow nut	C Rice	D Maize	E Cassava	F Veget-ables	G Fruits	H Fish	I Ujamaa Farm	J Others	Total
1. Wood Clearing	-	0.5	3.7	0.1	0.1	1.3	-	-	7.9	-	13.4
2. Land Preparation	10.1	6.6	620.9	35.3	16.5	1.8	-	-	3.5	0.1	694.8
3. Planting	32.3	1.2	176.7	24.7	13.2	0.8	-	-	6.5	5.7	260.9
4. Weeding	47.3	4.4	503.3	328.3	11.1	2.8	-	-	13.7	0.2	911.3
5. Insecticide/Fertilizer	-	-	0.1	-	-	0.5	-	-	-	-	0.6
6. Harvesting/Processing/ Marketing	163.1	8.3	444.0	60.0	0.6	3.5	-	3.1	1.0	1.4	685.0
7. Other operations (including fishing, birdscaring, animal watching)	0.5	-	304.3	-	-	-	-	223.4	4.2	10.4	542.0
8. Walking	75.6	4.5	515.8	100.6	3.1	2.7	-	0.4	13.8	1.7	718.4
TOTAL =	328.9	25.5	2568.8	44.6	44.6	13.4	-	226.7	50.4	20.6	3827.1

TABLE VII-5: AVERAGE SEASONAL LABOUR INPUTS FOR FARMING BY CROPS AND ENTERPRISES PER HOUSEHOLD

(UPSTREAM AREA)

Unit : Hour

Crops and Enterprises	1 Sept.	2 Oct.	3 Nov.	4 Dec.	5 Dec-Jan	6 Jan-Feb	7 Feb-Mar	8 Mar-Apr	9 April	10 May	11 June	12 July	13 August
Cotton	43.0	79.1	21.9	3.9	0.4	-	-	3.5	24.4	53.2	48.9	28.7	16.4
Cashewnuts	5.2	7.6	17.2	-	-	-	-	-	-	-	1.4	2.1	4.0
Rice	174.2	165.4	202.6	212.6	167.7	170.6	177.3	186.1	183.7	275.2	331.2	84.9	6.2
Maize	15.6	2.3	0.6	12.4	58.4	43.7	53.6	33.8	7.4	3.1	3.4	2.0	0.4
Cassava	5.8	1.6	0.5	0.6	5.1	3.6	4.0	3.6	7.2	0.2	1.2	0.1	-
Fishing	21.7	33.8	36.9	21.6	35.2	23.2	28.0	35.3	11.2	1.7	1.6	15.1	20.1
Ujamaa Farm	67.2	46.4	32.3	20.4	18.3	36.6	15.4	28.3	26.4	7.8	3.2	0.5	-
Others	17.1	10.1	8.0	4.8	10.5	20.6	14.4	6.5	8.3	34.9	8.2	11.3	4.6
TOTAL =	349.8	336.3	320.0	276.2	295.6	293.3	292.7	297.1	268.6	376.1	399.1	144.7	51.7

TABLE VII-6: AVERAGE SEASONAL LABOUR INPUTS FOR FARMING BY CROPS AND ENTERPRISES PER HOUSEHOLD

(DOWNSTREAM AREA)

Unit : Hour

Crops and Enterprises	1 Sept.	2 Oct.	3 Nov.	4 Dec.	5 Dec-Jan	6 Jan-Feb	7 Feb-Mar	8 Mar-Apr	9 April	10 May	11 June	12 July	13 August
Cotton	29.4	125.5	62.3	0.1	-	-	-	1.6	6.6	27.0	14.9	26.2	37.0
Cashewnuts	4.0	5.2	1.4	1.9	-	0.2	-	-	2.5	6.4	0.5	1.2	0.7
Rice	241.8	219.1	252.0	181.2	284.3	200.8	146.0	151.7	209.0	326.1	253.0	97.3	6.5
Maize	6.4	11.9	5.3	56.8	144.7	155.1	136.7	38.6	-	-	4.2	16.2	12.4
Cassava	5.4	14.0	5.1	8.9	1.3	0.5	1.6	2.6	0.9	0.5	0.6	0.8	2.6
Fishing	11.0	23.2	26.1	26.8	16.1	15.7	19.6	15.3	12.7	17.5	15.2	10.1	17.6
Ujamaa Farm	6.2	4.0	3.2	3.7	6.1	6.0	12.1	2.6	4.5	0.6	1.2	0.3	-
Others	10.3	2.7	6.1	0.6	0.9	1.3	0.4	0.4	1.6	1.3	2.6	1.5	4.0
TOTAL =	314.5	405.6	361.5	280.0	453.4	379.6	316.4	212.8	237.8	379.4	292.2	153.6	80.0

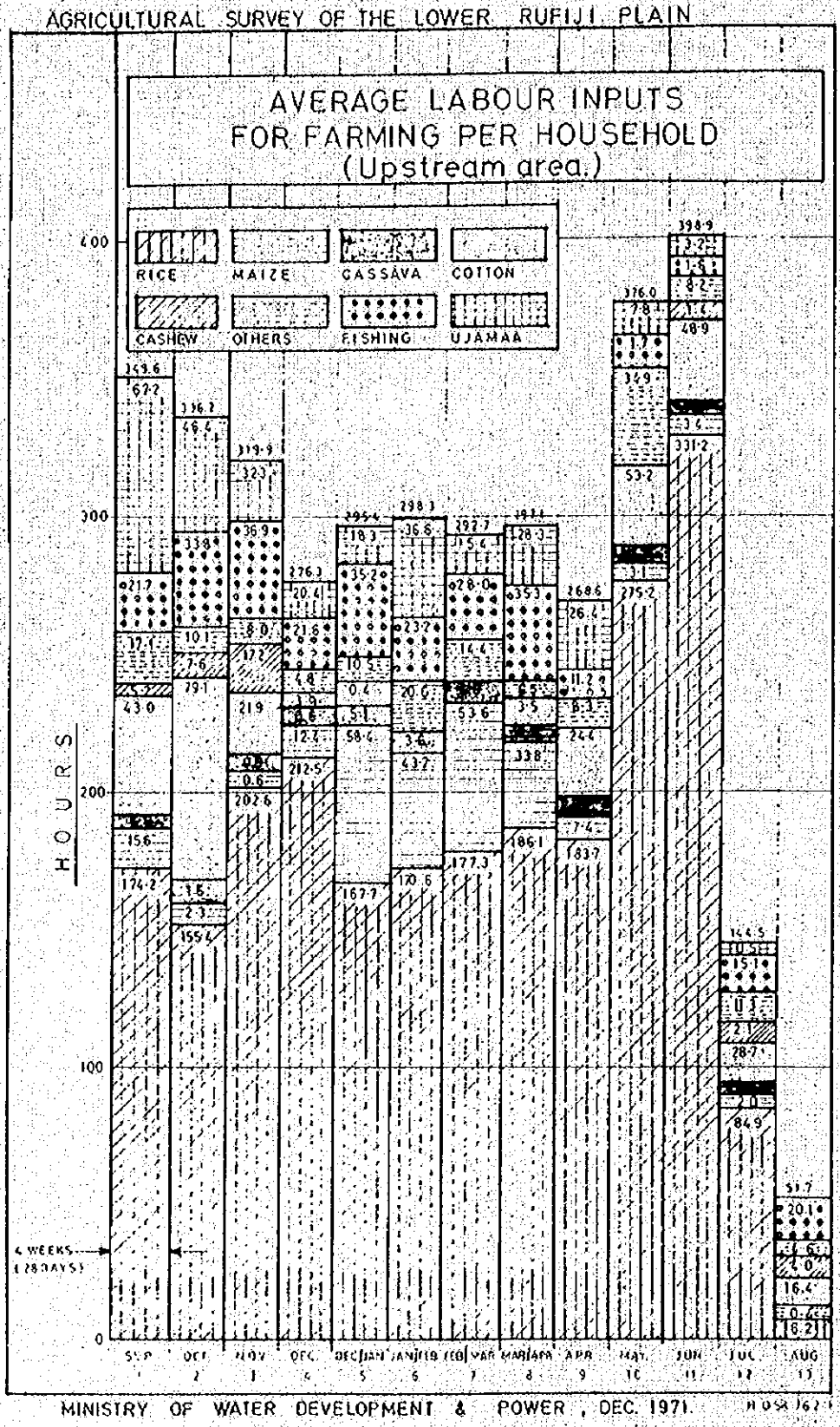

AGRICULTURAL SURVEY OF THE LOWER RUFIJI PLAIN
AVERAGE LABOUR INPUTS
FOR FARMING PER HOUSEHOLD
(Upstream area.)
RICE
MAIZE
CASSAVA
COTTON
CASHEW
OTHERS
FISHING
UJAMAA
HOURS
400
300
200
100
0
4 WEEKS
(28 DAYS)
SEP 1
OCT 2
NOV 3
DEC 4
DEC/JAN 5
JAN/FEB 6
FEB/MAR 7
MAR/APR 8
APR 9
MAY 10
JUN 11
JUL 12
AUG 13
MINISTRY OF WATER DEVELOPMENT & POWER, DEC. 1971.

Chart II

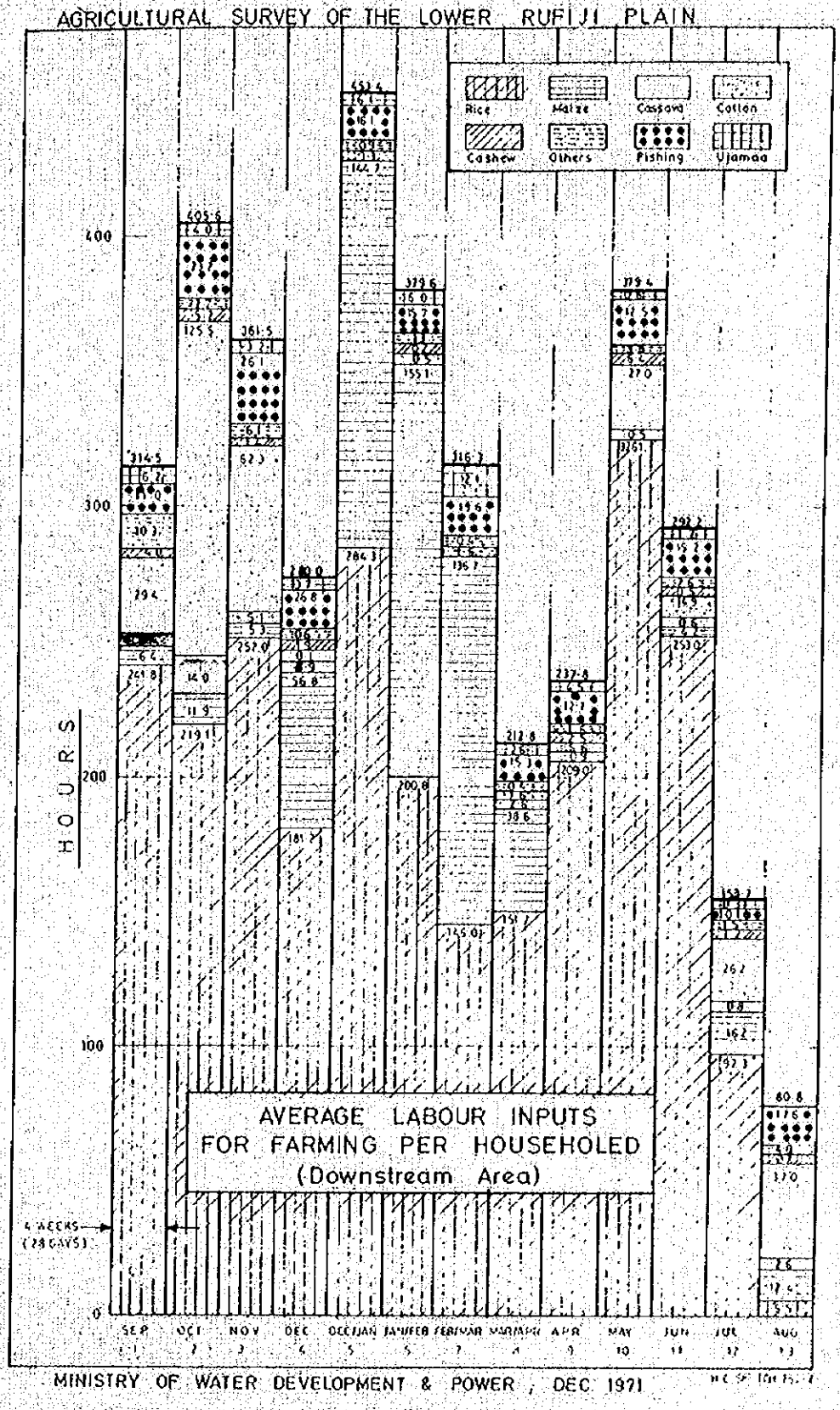

AGRICULTURAL SURVEY OF THE LOWER RUFIJI PLAIN
Rice
Maize
Cassava
Cotton
Cashew
Others
Fishing
Ujamaa
HOURS
400
300
200
100
0
AVERAGE LABOUR INPUTS
FOR FARMING PER HOUSEHOLED
(Downstream Area)
4 WEEKS
(28 DAYS)
SEP
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
MINISTRY OF WATER DEVELOPMENT & POWER, DEC 1971

Chart III

TABLE VII-7: AVERAGE LABOUR INPUT ON RICE PER HECTARE BY OPERATION

(UPSTREAM AREA)

Unit = Hour

Operations	1 Sept.	2 Oct.	3 Nov.	4 Dec.	5 Dec-Jan	6 Jan-Feb	7 Feb-Mar	8 Mar-Apr	9 April	10 May	11 June	12 July	13 Aug.	Whole Year
Wood Clearing	12.2	2.8	0.2	-	-	-	-	0.4	0.1	0.2	-	-	0.5	16.5
Land Preparation	149.5	145.8	203.6	159.8	38.0	20.9	2.4	-	-	-	6.6	1.3	4.2	732.1
Planting & Replanting	-	-	-	45.3	59.9	52.9	6.0	2.6	5.1	-	-	-	-	171.7
Weeding	-	-	-	0.2	62.1	91.8	145.0	95.8	46.3	7.5	-	-	-	448.7
Harvesting, threashing and Marketing	-	-	1.0	-	-	-	-	0.4	-	84.6	219.2	82.3	0.9	388.4
Others (including Birdscaring and Animal Watching	0.2	0.7	1.2	2.8	1.7	6.2	31.0	106.1	155.5	233.0	164.9	17.3	-	720.6
Walking	41.5	33.1	33.8	42.0	35.2	29.8	26.2	17.9	14.1	8.5	11.0	2.2	1.6	296.9
TOTAL =	203.4	182.4	239.8	250.1	196.8	201.6	210.6	223.2	221.1	333.9	401.7	103.1	7.2	2774.4

TABLE VII-8: AVERAGE LABOUR INPUT ON RICE PER HECTARE BY OPERATION

(DOWNSTREAM AREA)

Unit = Hour

Operations	1 Sept.	2 Oct.	3 Nov.	4 Dec.	5 Dec-Jan	6 Jan-Feb	7 Feb-Mar	8 Mar-Apr	9 Apr.	10 May	11 June	12 July	13 Aug.	Whole Year
Wood Clearing	1.1	-	-	2.7	-	-	-	-	0.4	-	-	-	-	4.1
Land Preparation	190.8	175.2	201.3	113.5	10.7	2.9	-	-	-	-	-	-	1.1	695.4
Planting and Replanting	-	-	-	37.3	141.1	17.9	-	1.6	-	-	-	-	-	197.9
Weeding	-	-	-	-	98.1	162.8	131.9	128.9	41.3	0.4	0.3	-	-	563.7
Harvesting, Threshing and Marketing	-	-	1.6	-	0.8	-	-	-	-	131.2	252.1	105.4	6.2	497.4
Others (including Birdscaring & Animal Watching	-	-	0.8	0.1	0.1	-	-	-	152.0	186.6	1.3	-	-	340.9
Walking	70.5	62.7	70.1	44.2	60.4	36.9	28.3	35.1	36.0	42.0	26.5	3.2	-	515.8
TOTAL =	262.3	237.9	273.8	197.7	311.2	220.5	160.2	165.7	229.7	360.2	280.2	108.6	7.3	2815.2

TABLE VII-9: AVERAGE LABOUR INPUT ON COTTON PER HECTARE BY OPERATION

(UPSTREAM AREA)

Unit = Hour

Operations	1 Sept.	2 Oct.	3 Nov.	4 Dec.	5 Dec-Jan	6 Jan-Feb	7 Feb-Mar	8 Mar-Apr	9 April	10 May	11 June	12 July	13 Aug.	Whole year
Wood Clearing	-	1,4	5,8	-	-	-	-	-	-	-	0,7	-	-	7,9
Land Preparation	-	-	-	-	-	-	5,8	33,1	55,0	14,9	55,6	-	-	163,7
Planting	-	-	-	-	-	-	-	-	4,4	30,8	2,4	-	-	37,6
Weeding	13,2	-	-	-	-	-	-	-	12,9	14,4	138,1	69,4	26,4	274,4
Harvesting, Sorting, Marketing	60,7	259,1	26,2	1,7	5,3	-	-	-	-	-	-	-	-	353,0
Others	0,3	-	-	-	-	-	-	-	-	-	-	0,3	-	0,6
Walking	63,1	78,6	9,3	-	-	-	-	3,9	10,2	25,3	34,1	24,3	18,1	266,9
TOTAL =	137,3	339,1	41,3	1,7	5,3	-	5,1	37,0	82,5	85,4	231,1	94,1	44,6	1104,1

TABLE VII-10: AVERAGE LABOUR INPUT ON COTTON PER HECTARE BY OPERATION

(DOWNSTREAM AREA)

Unit = Hour

Operations	1 Sept.	2 Oct.	3 Nov.	4 Dec.	5 Dec-Jan	6 Jan-Feb	7 Feb-Mar	8 Mar-Apr	9 Apr.	10 May	11 June	12 July	13 Aug.	Whole year
Wood Clearing	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Land Preparation	-	-	-	-	-	-	-	-	6.1	56.3	-	-	-	62.5
Planting	-	-	-	-	-	-	-	-	-	81.7	58.7	8.5	-	148.9
Weeding	3.3	-	-	-	-	-	-	-	-	-	-	85.1	96.0	184.4
Harvesting, Sorting Marketing	80.5	332.6	-	-	-	-	-	-	-	-	-	-	-	447.2
Others	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Walking	28.2	97.3	14.7	-	-	-	-	-	2.3	23.3	10.2	29.7	36.2	241.9
TOTAL =	112.0	429.9	48.9	-	-	-	-	-	8.5	161.3	68.8	123.3	132.2	1084.9

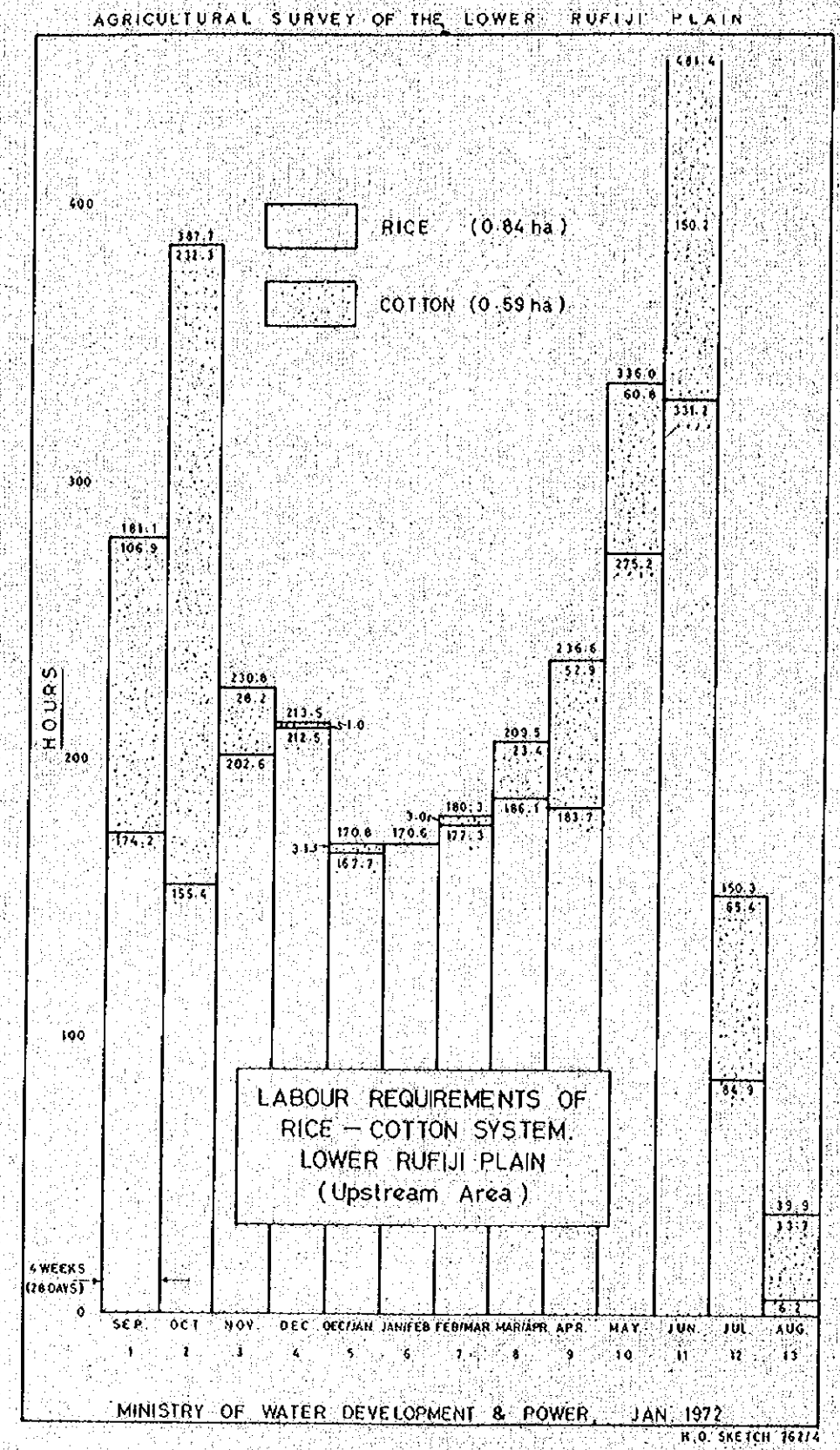

AGRICULTURAL SURVEY OF THE LOWER RUFIJI PLAIN
RICE (0.84 ha)
COTTON (0.59 ha)
HOURS
400
300
200
100
0
4 WEEKS (28 DAYS)
SEP. OCT NOV. DEC DEC/JAN JAN/FEB FEB/MAR MAR/APR APR. MAY JUN. JUL AUG.
1 2 3 4 5 6 7 8 9 10 11 12 13
LABOUR REQUIREMENTS OF RICE – COTTON SYSTEM. LOWER RUFIJI PLAIN (Upstream Area)
MINISTRY OF WATER DEVELOPMENT & POWER JAN. 1972
R.O. SKETCH 762/4

Chart IV

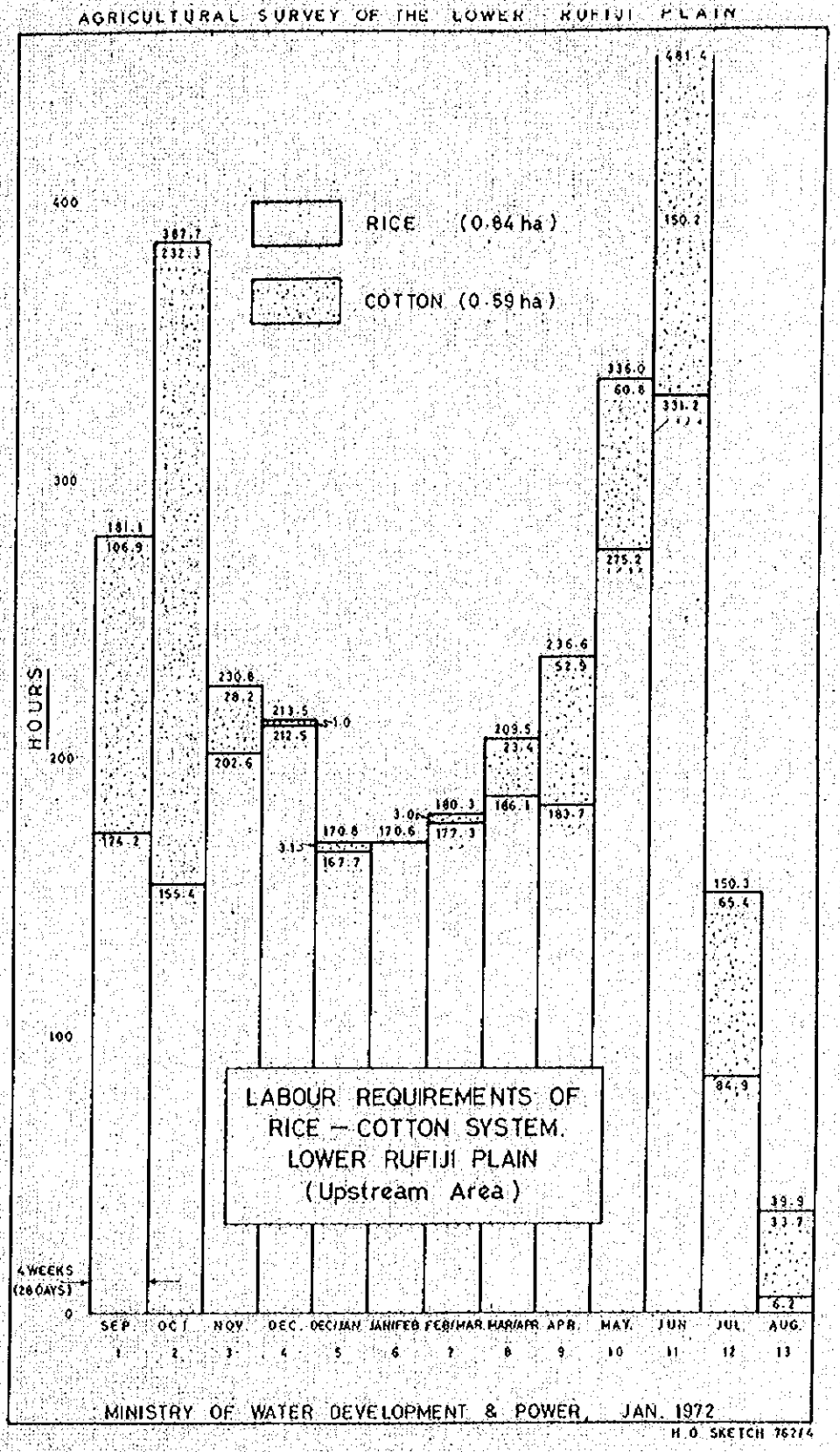

AGRICULTURAL SURVEY OF THE LOWER RUFIJI PLAIN
RICE (0.64 ha)
COTTON (0.59 ha)
HOURS
400
300
200
100
0
4 WEEKS (28 DAYS)
181.1
106.9
174.2
387.7
232.3
155.4
230.6
28.2
202.6
213.5
212.5
1.0
3.0
170.8
3.1
167.7
180.3
170.6
177.3
209.5
23.4
166.1
236.6
52.9
183.7
336.0
60.8
275.2
481.4
150.2
331.2
150.3
65.4
84.9
39.9
33.7
6.2
SEP 1
OCT 2
NOV 3
DEC. 4
DEC/JAN 5
JAN/FEB 6
FEB/MAR 7
MAR/APR 8
APR 9
MAY 10
JUN 11
JUL 12
AUG 13
LABOUR REQUIREMENTS OF
RICE – COTTON SYSTEM.
LOWER RUFIJI PLAIN
(Upstream Area)
MINISTRY OF WATER DEVELOPMENT & POWER, JAN. 1972
H.O SKETCH 76214

Chart V

VIII: CROP YIELDS

1. Cotton Yield

(i) Measurement of Production and Acreage:

The measurement of production of cotton was carried out by enumerators by interviewing the farmers and weighing the actual harvest with spring balances after the cotton was brought home. This data was checked against their sales figure of cotton to the cooperatives by asking the farmers to show all the receipts for their cotton sales. Checking the cooperative books for individual sales was not possible in this District.

As was explained in Chapter V, the measurement of the crop acreage was carried out by the Design Partnership, a consulting engineering contracted for this purpose. The actual measurement took place in October which was at the height of the picking season. The acreage includes the portion indicated by the farmer as having been planted with cotton and which was destroyed subsequently.

The following results were obtained from these measurements on the sample farm households.

(ii) Results:

(a) Percentages of farmers who grow cotton are:
53% in the upstream area, and 64% in the downstream area. In the whole area, cotton growers constitute 59% of all the farmers.

(b) The range of cotton planted area per farm household varies from a low of 0.01 ha to a high of 2.49 ha (6.15 acres). The average planted areas of cotton per cotton grower are:
0.59 ha in the upstream area, 0.71 ha in the downstream area and 0.66 ha in the whole area.

(c) The averages of the farmer's yield of cotton (kg/ha) are:
229.7 kg/ha in the upstream area, and
335.1 kg/ha in the downstream area. In the whole area the average is 290.6 kg/ha.

Standard errors were calculated for these average cotton yields, and found to be 58.0 kg/ha, 47.0 kg/ha and 36.4 kg/ha respectively. Therefore the confidence intervals at the 95% level are 113.7 to 345.7 kg/ha for the upstream area, 241.1 to 429.1 kg/ha for the downstream area, and 254.2 to 363.4 kg/ha for the whole area.

(d) Correlation Between Yield and the Size Acreage:

Yield may be affected by the size of the cotton shamba. It may be that the yield per ha would be higher in smaller shamba because the farmer has more labour available per ha and therefore can work more intensively. On the other hand, the yield per ha may be higher in larger shamba because the farmer would be a more progressive farmer, and he may have keener interest in cotton growing than those who grow it incidentally. In order to test the correlation between yield per ha and the size of acreage per household for the whole area, correlation coefficient was calculated between these two variables.

The result of the calculation shows that the correlation coefficient is +0.05. This means that no correlation can be found between the above two variables, as the correlation coefficient is too small to be significant.

Table VIII-1: Percentage of Farmers Growing Cotton (Oct. 1970)

	No. of Cotton Growing Households:	No. of Farm Households:	Percentage of Cotton Growing Households:
Upstream	19	36	53%
Downstream	28	44	64%
Whole Area	47	80	59%

Table VIII-2: Average Cotton Yield Per Hectare

Area:	Average Yield of Cotton kg/ha:	Standard Error of Average:		95% Confidence Limits:
		kg/ha	%	
Upstream	229.7	58.0	25.3	113.7 - 345.7
Downstream	335.1	47.0	14.0	241.1 - 429.1
Whole Area	290.6	36.4	12.5	254.2 - 363.4

Cotton yields were calculated for 26 farms only in the downstream area, omitting 2 farms with extreme high and low yields. Therefore the total area was represented by 45 farms.

Table VIII-3: Size Distribution of Cotton Planted Area per Household

	ha 0,01- 0,19	ha 0,20- 0,39	ha 0,40- 0,59	ha 0,60- 0,79	ha 0,80- 0,99	ha 1,00- 1,99	ha 2,00- 2,50	ha Total
No. of Households in Upstream Area (in %)	3 (15,8)	3 (15,8)	8 (42,2)	1 (5,2)	- (-)	3 (15,8)	1 (5,2)	19 (100)
No. of Households in Downstream Area (in %)	3 (11,5)	4 (15,4)	6 (23,2)	5 (19,2)	2 (7,7)	5 (19,2)	1 (3,8)	26 (100)
No. of Households in Whole Area (in %)	6 (13,3)	7 (15,6)	14 (31,2)	6 (13,3)	2 (4,4)	8 (17,8)	2 (4,4)	45 (100)

Table VIII-4: Size Distribution of Cotton Production per Household

	kg 0	kg 1-99	kg 100- 199	kg 200- 299	kg 300- 399	kg 400- 499	kg 500- 1000	Total
No. of Households in Upstream Area (in %)	5 (26,3)	6 (31,6)	4 (21,1)	1 (5,2)	2 (10,6)	- (-)	1 (5,2)	19 (100)
No. of Households in Downstream Area (in %)	3 (11,5)	7 (27,0)	3 (11,5)	6 (23,2)	1 (3,8)	3 (11,5)	3 (11,5)	26 (100)
No. of Households in Whole Area (in %)	8 (17,7)	13 (28,8)	7 (15,6)	7 (15,6)	3 (6,7)	3 (6,7)	4 (8,9)	45 (100)

Table VIII-5: Size Distribution of Cotton Yield per Hectare

	kg/ha 0	kg/ha 1-199	kg/ha 200-399	kg/ha 400-599	kg/ha 600-799	kg/ha 800-1000	Total
No. of Households in Upstream Area (in %)	5 (26.3)	6 (31.7)	3 (15.8)	3 (15.8)	1 (5.2)	1 (5.2)	19 (100)
No. of Households in Downstream Area (in %)	3 (11.5)	7 (26.9)	4 (15.4)	9 (34.7)	2 (7.7)	1 (3.8)	26 (100)
No. of Households in Whole Area (in %)	8 (17.8)	13 (28.9)	7 (15.6)	12 (26.6)	3 (6.7)	2 (4.4)	45 (100)

2. Rice and Maize Yields

(1) Measurement of Production and Acreage:

The measurement of production of rice and maize were carried out by enumerators by interviewing the farmers and weighing the actual harvest with spring balances, and when the harvested amount was very large, it was measured by counting the number of bags harvested and multiplying this number by the average weight of a bag. Maize was mostly weighed after it was brought home from shamba, but in case of rice the bags were measured on shamba just after it was threshed but before it was brought home or to the cooperatives for sale. Once rice is brought home it is customary to store it in a traditional type of storage called "seke" which is kept on the attic of one's house, and it would have been impossible to measure the amount of harvested rice correctly. All production figures for rice were measured in terms of paddy, while the figures for maize were in terms of threshed maize grains. Maize were usually weighed by the numerators as maize in cob or often the number of cobs were counted. In these cases standard conversion factors derived from the locally collected data were used to calculate the respective weights of the threshed maize obtainable. The basis of the conversion factors were that the average weight of threshed maize from a maize cob was taken as 154 g. and the average weight of a maize cob was taken as 250 g.

The measurement of the crop area was carried out by two enumerators who were chosen locally and employed only to fulfill this task as was explained in Chapter V. The actual measurement took place almost whole month of March. By this time the rice planting had finished completely and the maize harvest had just started.

The following results were obtained from these measurements on the sample households.

(ii) Results

(a) Practically all the farmers grow rice. 78 farmers out of the total 80 samples (97.5%) grew rice and 2 farmers, one each from the upstream and downstream areas did not grow rice. The reason for not growing rice by the one in the upstream was rather accidental. His wife ran away from him at the planting season, and he left for Dar-es Salaam after this incident. One farmer in the downstream started to sell pombe rather than growing rice. The following figures are therefore based on the sample of 78 farmers.

(b) It was found that the ratio of the area of rice-maize mixture to the total rice planted area are: 70.7% in the upstream area, 87.6% in the downstream area, and 80.2% in the whole area.

(c) The average sizes of the area of rice-maize mixture and that of the pure-stand rice per household were found to be as follows:-
In the upstream area, the average rice-maize mixture area is 0.59 hectare and the area of pure-stand rice 0.25 hectare. In the downstream area, these are 0.79 hectare and 0.11 hectare respectively. In the whole area, these are 0.70 hectare and 0.17 hectare respectively.

(d) The average sizes of all rice fields per household regardless of whether it is inter-planted with maize or pure-stand are:-

0.84 ha in the upstream area,

0.91 ha in the downstream area, and

0.88 ha in the whole area.

(e) The range of rice planted area per farm household varies from a low of 0.09 hectare to a high of 3.01 hectare (7.43 acres). The frequency distribution of the planted area is shown in Table VIII-9.

(f) The average yields of rice (paddy) regardless of whether it is inter-planted with maize or pure-stand are:-

810.4 kg/ha in the upstream area, and

1452.9 kg/ha in the downstream area.

In the whole area the average is 1164.6 kg/ha.

Standard errors of the average and the 95% Confidence Limits were calculated and shown below.

Table VIII-6: Average Rice Yield per Hectare

	Average Yield of Rice: kg/ha	Standard Error of Average:		95% Confidence Limits:
		kg/ha	%	
Upstream	810.4	114.5	14.1%	581.4 - 1039.4
Downstream	1452.9	166.0	11.4%	1120.9 - 1784.9
Whole Area	1164.6	111.9	9.6%	940.8 - 1388.4

(g) In order to find out if there is any significant difference of yield between the pure-stand rice field and rice and maize mixture field, two different sets of yield were calculated. One was the average of rice yields of the households who have grown only pure-stand rice, and the other was that of the households who have grown only mixed stand rice. The households which grew both pure-stand rice and the mixed stand rice were omitted. The following average yields were obtained:-

Table VIII-7: Rice Yields in Pure-stand and Mixed-stand Fields

	Upstream	Downstream	Total Area
Pure-stand rice yield (kg/ha)	822.9 (8)	1121.9 (7)	962.4 (15)
Mixed-stand rice yield (kg/ha)	641.1 (19)	1250.0 (30)	1013.9 (49)

Note: Number of samples in parenthesis.

In the upstream area pure-stand yielded better, while in the downstream area mixed-stand yielded better; which resulted in higher yield for mixed stand in the over-all area.

(h) Maize yields were calculated from the rice and maize mixture fields for the households who had such a mixture only. The households which grew both pure-stand rice and the rice/maize mixed stand were omitted. The number of the samples were 19 in the upstream area and 30 in the downstream area.

The average yields of maize (shelled) were:-

284.4 kg/ha in the upstream area, and

424.9 kg/ha in the downstream area.

In the whole area the average was 370.4 kg/ha.

Standard Errors of the average and the 95% Confidence Limits were calculated and shown below.

Table VIII-8: Average Maize Yield per Hectare from Maize/Rice Mixture Fields

Area:	Average Yield of Maize: kg/ha	Standard Error of Average:		95% Confidence Limits: kg/ha
		kg/ha	%	
Upstream	284.4	72.7	25.6%	139.0 - 421.8
Downstream	424.9	57.5	13.5%	309.9 - 539.9
Whole Area	370.4	46.1	12.4%	278.2 - 462.6

(i) Correlation between rice yield and the size of area planted with rice per household was examined by calculating the correlation co-efficient between these two variables for the whole area, as we did in the case of cotton. The result of the calculation shows that the correlation co-efficient is +0.07. This means that no correlation can be found between the above two variables, as the correlation co-efficient is too small to be significant.

Table VIII-9: Size Distribution of Rice Planted Area per Household

	ha 0.01-0.49	ha 0.50-0.99	ha 1.00-1.49	ha 1.50-1.99	ha 2.00-2.49	ha 2.50-3.01	Total
Upstream	11	14	6	1	1	2	35
(%)	(31.4)	(40.0)	(17.1)	(2.9)	(2.9)	(5.7)	(100)
Downstream	12	15	10	4	2	0	43
(%)	(27.9)	(34.8)	(23.3)	(9.3)	(4.7)	(-)	(100)
Whole Area	23	29	16	5	3	2	78
(%)	(29.5)	(37.2)	(20.5)	(6.4)	(3.8)	(2.6)	(100)

Table VIII-10: Size Distribution of Rice (Paddy) Production per Household

	0 kg	1-499 kg	500-999 kg	1000-1499 kg	1500-1999 kg	2000-2999 kg	3000-3999 kg	4000-6999 kg	
Upstream	4	13	9	7	2	0	0	0	35
(%)	(11.4)	(37.2)	(25.7)	(20.0)	(5.7)	(-)	(-)	(-)	(100)
Downstream	0	11	15	4	4	1	4	4	43
(%)	(-)	(25.6)	(34.9)	(9.3)	(9.3)	(2.3)	(9.3)	(9.3)	(100)
Whole Area	4	24	24	11	6	1	4	4	78
(%)	(5.1)	(30.8)	(30.8)	(14.1)	(7.7)	(1.3)	(5.1)	(5.1)	(100)

Table VIII-11: Size Distribution of Rice (Paddy) Yield per Hectare

	0 kg/ha	1-499 kg/ha	500-999 kg/ha	1000-1499 kg/ha	1500-1999 kg/ha	2000-2999 kg/ha	3000-5319 kg/ha	
Upstream	4	11	7	5	7	1	0	35
(%)	(11.4)	(31.4)	(20.0)	(14.3)	(20.0)	(2.9)	(-)	(100)
Downstream	0	8	12	8	4	8	3	43
(%)	(-)	(18.6)	(27.9)	(18.6)	(9.3)	(18.6)	(7.0)	(100)
Whole Area	4	19	19	13	11	9	3	78
(%)	(5.1)	(24.4)	(24.4)	(16.7)	(14.1)	(11.5)	(3.8)	(100)

IX. FARM AND HOUSEHOLD INCOME

1. Gross Farm Return

Table IX-1 shows the average volume of farm products harvested per household per year. Fishes caught and eggs collected were also included in the Table as well as chicken and other livestock killed or sold. (34 samples and 42 samples respectively from the upstream and the downstream areas.)

These harvested amounts were converted to values, and the Table IX-2 shows the average gross farm return per household per year. It shows the average gross return of Shs. 763/- for the upstream area, Shs. 1,441/- for the downstream area and Shs. 1,137/- for the whole area. Prices for different crops and other items were obtained locally to compute the values. For rice, cotton and cashewnuts, the official producer prices were used. (In order to take second-grade crops into consideration, we used the price of Shs. 1/- per kg for all cotton instead of Shs. 1/10 for the first grade and -/55 cents for the second grade, and -/90 cents per kg for all cashewnuts instead of -/95 cents per kg for the standard grade and -/75 cents per kg for the undergrade.)

The gross farm return presented here includes the values of the subsistence farm produce and fishes caught, as well as the value of the marketed farm produce. The Table shows that rice is by far the most valuable crop, followed by fishes, cotton and maize. Cashewnuts and coconuts, which are the major crops of the District as a whole, are mostly produced outside the boundary of the survey area, thus showing only small figures here.

Table IX-3 was presented to show the average value of the marketed farm produce. These figures were derived directly from the twice-weekly interview of the farmers. The Table indicates that the marketed values of rice were about 12% and 27% of the harvested values respectively in the upstream and downstream areas. The percentage of fishes marketed are very high, in both areas, more than 90%, but there may have been under-enumeration of the value of fishes eaten. In the upstream area fishes have the highest value among the produce marketed. Cotton and cashewnuts are of course

grown for cash only. However even in the downstream area the value of cotton was below the values of rice and fish. Maize, millet, cassava, beans and vegetables are mostly for subsistence and the marketed values were very small. In the downstream area much of banana was for sale.

Table IX-4 presents the distribution of annual gross return from fishing per household. It shows that 35.3% and 64.3% of the sample farmers did not fish in the upstream and downstream areas respectively. Therefore fishing is much more specialized occupation in the downstream area. In both areas those who got large catches were relatively few.

Table IX-5 presents the distribution of annual gross return from farming excluding fishing. The striking feature is that in the upstream area 91.2% of the sample farmers got less than Shs. 1,000/- gross return while in the downstream area it was only 59.5%. In the downstream area 19.1% got the gross return of between Shs. 1,000/- to Shs. 2,000/-, and 21.4% got the gross return of Shs. 2,000/- to 5,000/-. These figures apparently show the advantageous position of farming in the downstream area in comparison with the upstream area.

Table IX-6 shows the proportion of the gross farm return to the gross household income including off-farm incomes. The gross farm return including subsistence produce and fish constituted 77% of the gross household income in the upstream area. In the downstream area the proportion was 78.6%, very close to the proportion in the upstream. For the whole area the figure was 78.4%.

2. Cash Income

Table IX-7 shows the break down of the average annual cash income into different activities. Income from gifts is fairly large which may reflect the situation that many members of the family or relatives are sending back money from outside, most probably from Dar-es Salaam. Table IX-8 shows the distribution of annual cash income per household.

3. Income from Ujamaa Farm

The Ujamaa Villages in the survey area have set up communal farms called Ujamaa Shamba, usually by opening up new land near the villages sites, but sometimes near the River which may be very far away from the village. Five year development plan of Ujamaa Shamba for each Ujamaa Village covering the period 1970/71 - 1973/74 was drawn up by a team sent by the Government. Accordingly the inhabitants of the Ujamaa Villages were mobilized to implement this plan.

The production from these Ujamaa Shamba in the first year of implementation was very disappointing. Most of the Ujamaa Villages planted around 30-50 acres (12-20 hectare) with rice or sesame. A few villages also planted cashewnuts, cassava and maize. However the harvested amount was almost nil in most of the Ujamaa Villages. Data for all the Ujamaa Shamba production are not available, but it was reliably learnt that most of the village produced only 3-10 bags of rice or sesame. The largest harvest was 60 bags of maize in one village not included in our primary sample villages, which had more than 400 households. Cashewnuts have of course not yet reached the fruit bearing stage and their harvest must await some more years.

The poor result was no doubt caused by many factors, some natural and some organizational. The Development Plan may not have been realistic. Neglect of weeding, severe attack of insects, damage by wild animals, and general lack of attendance and care by the inhabitants were some of the more obvious causes. Competition of labour inputs between the individual farms and the Ujamaa farms at the critical labour shortage period seems to be the root cause of this result.

As the production from the Ujamaa farms was very small or nil, the proceeds from the harvest, if any, were not distributed to individuals, except in the case of maize in the above-mentioned village. They were retained by the villages to utilize for the communal purposes, or as seeds for the next planting season.

Table IX-1: AVERAGE VOLUME OF FARM PRODUCTS HARVESTED OR OBTAINED PER HOUSEHOLD PER YEAR

(Unit = kg) The last 4 items
(Unit = Number)

	Rice	Cassava	Millet	Maize	Beans and Pigeon Peas	Banana	Vege-tables	Cotton	Cashew-nuts	Sugar cane	Other Crops	Number of:			
												Eggs	Fishes	Chicken	Other Livestock
Upstream	618.09	28.17	23.83	104.00	6.20	2.11	17.99	59.66	3.96	6.62	18.01	5.19	900.46	0.83	0.16
Downstream	1,426.64	20.54	1.61	366.18	5.50	42.35	46.67	148.22	5.72	2.21	54.43	11.68	779.77	2.67	0.18
Whole Area	1,064.92	23.95	11.55	248.89	5.81	24.35	33.84	108.60	4.93	4.18	38.14	8.78	833.76	1.86	0.17

Table IX-2: AVERAGE GROSS FARM RETURN PER HOUSEHOLD PER YEAR

(Unit = Shs.)

	Rice	Cassava	Millet	Maize	Beans and Pigeon Peas	Banana	Vege-tables	Cotton	Cashew-nuts	Sugar cane	Other Crops	Eggs	Fishes	Chicken	Other Live-stock	Total
Upstream	358.49	4.79	23.83	41.60	8.06	1.06	10.79	59.66	3.56	1.32	13.50	1.30	225.12	1.25	8.00	762.33
Downstream	827.45	3.49	1.61	146.47	7.15	21.18	28.00	148.22	5.14	0.44	40.82	2.92	194.94	4.01	9.00	1440.84
Whole Area	617.65	4.07	11.55	99.56	7.55	12.18	20.30	108.60	4.44	0.84	28.61	2.20	208.44	2.80	8.50	1137.29

Table IX-3: AVERAGE VALUE OF FARM PRODUCTS MARKETED PER HOUSEHOLD PER YEAR

(Unit = Shs.)

	Rice	Cassava	Millet	Maize	Beans and Pigeon Peas	Banana	Vege-tables	Cotton	Cashew-nuts	Sugar cane	Other Crops	Eggs	Fishes	Chicken	Other Live-stock	Total
Upstream	42.76	0.19	-	0.06	-	2.14	-	49.25	3.87	0.68	3.76	0.12	167.39	1.11	-	271.33
Downstream	218.98	0.72	-	8.29	2.16	16.04	1.97	147.89	6.94	2.09	36.89	4.81	162.67	6.14	1.98	617.67
Whole Area	140.14	0.48	-	4.61	1.19	9.82	1.09	103.76	5.57	1.46	22.07	2.71	164.78	3.89	1.10	462.67

TABLE IX-4: DISTRIBUTION OF ANNUAL GROSS RETURN FROM FISHING PER HOUSEHOLD

Annual Return (Shs)	Upstream No.	%	Downstream No.	%	Whole Area No.	%
0	12	35.3%	27	64.3%	39	51.3%
01 - 199	12		8		20	
200 - 399	1		0		1	
400 - 599	5	61.8%	3	28.5%	1	43.4%
600 - 799	1		0		1	
800 - 999	2		1		3	
1000 - 1999	1		2		3	
2000 - 2999	0	2.9%	1	7.2%	1	5.3%
3000 - 3999	0		0		0	
4000 - 4999	0		0		0	
TOTAL	34	100%	42	100%	76	100%

TABLE IX-5: DISTRIBUTION OF ANNUAL GROSS FARM RETURN EXCLUDING FISHING PER HOUSEHOLD

Annual Return (Shs)	Upstream No.	%	Downstream No.	%	Whole Area No.	%
01 - 199	7	91.2%	7	59.5%	14	73.7%
200 - 399	7		8		15	
400 - 599	7		4		11	
600 - 799	6		5		11	
800 - 999	4		1		5	
1000 - 1199	1	8.8%	2	19.1%	3	
1200 - 1399	1		1		2	
1400 - 1599	0		2		2	14.5%
1600 - 1799	1		1		2	
1800 - 1999	0		2		2	
2000 - 2999	0	0%	5	21.4%	5	11.8%
3000 - 3999	0		3		3	
4000 - 4999	0		1		1	
TOTAL	36	100%	42	100%	76	100%

TABLE IX-6: AVERAGE GROSS HOUSEHOLD INCOME PER YEAR

(Unit : Shs.)

	Gross Farm Return (including subsistence production and fish)	Off-Farm Income	Gross Household Income
Upstream	762.33	218.85	981.18
Downstream	1,440.84	391.24	1,832.08
Whole Area	1,137.29	314.12	1,451.41

TABLE IX-7: AVERAGE CASH INCOME PER HOUSEHOLD PER YEAR

(Unit : Shs.)

	Sales of Farm Produce	Sales of fish	Other Sales	Income from Employment	Income from Trading	Income from Gift	Total cash Income
Upstream	103.94	167.39	32.49	113.79	21.91	50.66	490.18
Downstream	454.90	162.67	19.42	105.69	127.37	138.76	1,008.81
Whole Area	279.89	164.78	25.27	109.31	80.19	99.35	776.79

TABLE IX-8: DISTRIBUTION OF ANNUAL CASH INCOME PER HOUSEHOLD

Annual Return (Shs.)	Upstream No.	%	Downstream No.	%	Whole Area No.	%
0 - 199	7		4		11	
200 - 399	10		2		12	
400 - 599	4	88.2%	7	54.8%	11	69.7%
600 - 799	8		5		13	
800 - 999	1		5		6	
1000 - 1199	2		5		7	
1200 - 1399	2		6		8	
1400 - 1599	0	11.8%	4	38.1%	4	26.3%
1600 - 1799	0		1		1	
1800 - 1999	0		0		0	
2000 - 2999	0	0%	2	7.1%	2	7.0%
3000 - 3999	0		1		1	
Total	34	100%	42	100%	76	100.0%

X. FARM AND HOUSEHOLD EXPENDITURES

1. Farm Expenditures

Table X-1 shows the average annual farm expenditures per household. It was found that the levels of these expenditures were quite low: Shs. 47/- for the upstream area and Shs. 72/- for the downstream area.

A large part of these expenditures went to the payment for the hired labour, followed by transporting the produce. The seasonal break down of these expenditures show that the payments for the hired labour were made mostly in May, June and July for the purpose of harvesting and threshing of rice, while the transport payments were made in June, July, and August for carrying away rice bags from the shamba.

The number of farmers who used hired labourers for rice was 13 (36.1% of the sample) in the upstream area. For the downstream area the number was also 13 (29.5% of the sample). The use of hired labour for cotton was found to be very little. Only one farmer each from both areas used hired labour at the cotton harvesting time.

The payment for hired labour is usually based on piece work. The going rate for harvesting rice was around Shs. 15-45 per acre depending on how well the rice was growing. The payment for transporting produce is usually made in kind, and in case of rice the going rate was to pay one pishi (a weaved basket which holds 3 kg of paddy) for transporting one bag of paddy from the shamba to the farmer's house. When the payment was made in kind, we computed the cash value of such payment.

Hired labourers came mostly from the same village or neighbouring villages. They may be smaller farmers trying to earn extra income, but also quite often they are ordinary farmers helping each other, often between relatives. There seems to be no formal work group as such.

The capital expenditures such as the purchase of farm implements and machines were extremely small. Purchase of livestock here means mostly the purchase of chickens. The expenditures for insecticides and fertilizers were practically nil. The figures for others were mainly for the purchase of fish nets which were again very small.

Contract machinery work column in the Table shows the payment for hired tractor for cultivation of rice farms. The farmers who hired tractor for cultivation of rice farms. The farmers who hired tractors were very few, only 3 (8.3% of the sample) in the upstream area and 2 (4.6% of the sample) in the downstream area. The going rate for tractor hire was Shs. 45/= - 50/= per acre. No one of the above 5 farmers cultivated more than one acre by tractor.

We do not have the information on the number of tractors existing in the area. None of our sample farmers possessed a tractor. The total number of farmers who possess tractors must be quite small.

2. Household Expenditures

Table X-2 shows the average expenditures per household per year for different items. Food constitutes by far the largest item of expenditure which amounts to 66.6% in the upstream area, 50.8% in the downstream area and 57.1% in the whole area. The large expenditures on foodstuffs may be due to the bad harvest of food crops in 1969/70.

Table X-3 shows the break down of the expenditures for food into different kind of foodstuffs. Expenditures on rice in the upstream area and on maize flour in both areas are very high. These items are followed by sugar, fishes and coconuts. (10)

(10) Informations on the amount of food consumed per household can be obtained in another report: Ministry of Water Development and Power, Water and Food Consumption in a Rufiji Ujamaa Village, Sept. 1971

TABLE X-1: AVERAGE EXPENDITURE FOR FARMING ACTIVITIES PER HOUSEHOLD (SHS)

	Purchase of Farm tools	Contract Machinery Work	Seeds	Insecticides	Fertilizers	Empty Bags	Transport	Wages to Labourers	Purchase of Livestock	Others	TOTAL
Upstream	3,21	3,68	5,26	-	-	0,91	7,47	25,01	1,04	0,48	47,01
Downstream	0,65	1,73	5,63	0,60	-	5,94	26,70	23,20	6,20	1,42	72,07
Whole Area	1,80	2,61	6,46	0,33	-	3,69	18,07	24,01	3,89	1,00	60,86

TABLE X-2: AVERAGE EXPENDITURE FOR FARMING ACTIVITIES PER HOUSEHOLD (SHS)

	Food	Drink	Tobacco	Clothing & Shoes	Furniture Household Goods	Building & Repair	Fuel	Farm Expenses	Personal Transport	Taxes & Fines	TANU Coop.	Education	Medical	Other Expenses	TOTAL
Upstream	514,48	4,59	17,26	78,10	12,06	2,39	15,05	47,01	23,53	2,35	1,53	5,21	10,59	28,23	772,41
Downstream	482,88	9,80	45,70	116,98	20,15	33,91	20,31	72,21	36,72	2,64	2,31	12,16	6,67	88,81	950,65
Whole Area	497,02	7,47	32,98	99,59	16,53	19,81	17,97	60,94	30,49	2,51	1,96	9,05	8,42	66,18	870,92

TABLE X-3: AVERAGE EXPENDITURE FOR FOOD PER HOUSEHOLD PER YEAR (SHS)

	Meat	Fish	Rice	Maize Flour & Maize	Cassava	Wheat Flour	Cakes Buns Bread	Sugar	Salt	Milk	Tea Leaves	Coconuts	Vegetables	Others	Cooking Oil	Spices	TOTAL
Upstream	4.09	67.31	158.55	130.36	28.03	4.39	6.08	51.19	8.87	6.37	6.01	16.57	8.06	8.29	4.72	5.59	514.48
Downstream	8.94	76.56	61.26	100.56	6.47	3.70	3.78	93.38	9.52	3.92	17.26	60.10	7.71	11.06	4.77	13.89	482.88
Whole Area	6.77	72.42	104.78	113.89	16.12	4.01	4.31	74.51	9.23	5.02	12.23	40.63	7.87	9.82	4.75	10.18	497.02

XI. RETURNS TO LAND AND LABOUR

Finally we can obtain the returns to land and labour for the three main enterprises, namely, rice, cotton and fishing (return to labour only).

The farm expenditures for calculating the net returns for rice and cotton were based on the collected data per household converted to per hectare basis. The recorded cash cost for fishing was very small. We decided therefore to use the average price of a fishnet which is Shs. 25/- (50 yards) as the necessary cash cost of fishing per household.

Table XI-1: Return to Land and Labour on Rice

	Upstream	Downstream	Whole Area
a) Yield per ha	810.4 kg	1452.9 kg	1164.6 kg
b) Net Return Shs. per ha	418/86	782/82	619/54
c) Labour Input per ha (hour)	2774.3	2815.2	2796.9
d) Return to Labour cents per hour	15	28	22
e) Shs. per day (8 hours)	1/21	2/23	1/77

Table XI-2: Return to Land and Labour on Cotton

	Upstream	Downstream	Whole Area
a) Yield per ha	229.7 kg	335.1 kg	290.6 kg
b) Net Return Shs. per ha	225/51	321/04	280/37
c) Labour Input per ha (hour)	1104.1	1084.8	1093.4
d) Return to Labour cents per hour	20	30	26
e) Shs. per day (8 hours)	1/63	2/37	2/06

Table XI-3: Return to Labour on Fishing

	Upstream	Downstream	Whole Area
a) Catches per Household (Shs.)	225/12	194/94	208/44
b) Net Return (Shs.)	200/12	169/94	183/44
c) Labour Inputs per Household (hour)	285.5	226.8	253.1
d) Return to Labour Cents per hour	70	75	73
e) Shs. per day (8 hours)	5/61	5/99	5/80

XII. CONCLUSIONS

1. The present pattern of Rice-Maize-Cotton cropping system in the Lower Rufiji Plain has been evolved in adaptation to the environment, and is primarily the system for minimizing risks of both destructive flooding and draught without flooding. At the present level of technology it is a reasonable system, but it has many labour input constraints which prevents further development of the system.

2. Severe labour constraints develop in May/June in normal years when rice harvesting and cotton planting coincides. Cotton acreage is therefore limited and the optimal planting time tends to be missed. If the rice crop is destroyed or the crop is very little, these constraints do not develop.

Also there is a labour peak around October at the cotton harvest time and labour constraints develop if the crop is good. Rice field cultivation may have to be stopped temporarily.

3. Use of simple machines and improved tools could effectively reduce the peak labour requirements. For instance the introduction of simple threshing machines and the better means of transporting crops at the harvest time of rice would help a great deal for expanding cotton acreage. Use of plough will enable the rice acreage t to be expanded per unit of labour input, and could ease the labour peak of the cotton harvest season around October.

4. At present, the returns to labour for rice and cotton are extremely low, and cannot compare favourably with the returns to labour for fishing. The return to land for rice is fairly high.

5. The upstream area has lower rainfall and tends to have lower yields of crops and lower gross income, while the flood damages seem often to be severer, in comparison with the downstream area. The benefits of flood control and the introduction of irrigated agriculture will be felt more keenly in the upstream area.

6. The present agricultural system based on rice and cotton cropping seems well adaptable to irrigation farming. Much of the present labour constraints could be removed by shifting planting time, especially of cotton. With irrigation, cotton could be planted even after the dry spell sets in. Rice yield will be greatly increased under irrigation. Maize could be dropped which enables the introduction of transplanting and row-cropping of rice.

7. For the intermediate stage between the time the flooding is controlled and the irrigation facilities are provided, utmost care should be taken to devise a suitable cropping system. Reduction of a big element of uncertainty means many expansible measures would become possible without involving heavy risks. However the beneficial aspects of flooding, such as maintenance of soil fertility will be gone. Therefore it is important to introduce irrigation farming as sooh as flooding is controlled, together with necessary complementary measures such as training farmers for irrigation agriculture.

8. In case of irrigation farming, land consolidation and registration would be necessary. Utmost care should be taken in handling the land rights which the individuals are entitled at present.

9. The establishment of Ujamaa Villages on the higher ground removed the risk of their houses washed away by flood, and the provision of pumped and piped domestic water reduced the labour inputs for carrying water tremendously. On the other hand it increased the walking hours to and from the shamba greatly. Labour productivity of the Ujamaa Shamba for this year was extremely low, and unless the return to labour from Ujamaa Shamba increases appreciably, there will be continued reluctance on the part of the inhabitants in attending the Ujamaa Shamba works.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude here for all those who helped this survey and made possible the presentation of this report.

I owe the Ministry of Water Development and Power, and especially its Principal Secretary, Mr. F.K. Iwegarulila, for seeing to it that the survey could continue to the successful conclusion. To the former members of the National Water Resources Council, and especially its former director, Mr. H. Hori, I would like to acknowledge gratitude for initiating the survey itself.

Many other people have helped to shape the form of this survey. My gratitudes are due especially to Mr. G. Cunningham of the Ministry of Economic Affairs and Development Planning, and Mr. A. Owino, Rural Development Officer, Coast Region. For sampling of the farm household, I owe Mr. Egero of the Bureau of Statistics. For interview methods, I owe Dr. J. Morris A. Mascarenhas, and Dr. D. Feldman of the University of Dar es Salaam.

The administration of the Rufiji District was very helpful to us to carrying out the survey. I would like to thank the Area Commissioner, Mr. S. Mohammed, the former Area Secretary, Mr. F.W. Mtibili, the Chief Clerk, Mr. Manganjo, various Divisional and Ward Executive Officers, and Chairman of the Ujamaa Villages. Also to the general manager of the Coast Region Cooperative Union, Mr. Ngublagae, and the Supervisor of the Kilimani Ginnery, Mr. Katikati my gratitudes are due.

To the staffs of the Ministry of Water Development and Power who have encouraged me and have kept interest in the course of the survey, especially Mr. J. Inoue, the Irrigation Engineer, H. Yasui and A. Togo, the Hydrologists, and Dr. G. Mann, the Soil Scientist, I owe indeed very much. To the typist, Mr. W. Macha, who put so much of his time and energy for typing the questionnaires and this repert I am sincerely thankful.

The field works were carried out by twelve very hard-working assistants. They had to travel long distances with bicycles almost every day to make interviews with the sample farmers, and record the data. Much of the data was also processed by them later in the Dar-es Salaam Office. This report was not possible without their tireless work and for this I am very grateful. Their names are:

G. Yugi	-	Field Supervisor
P. Lubulira	-	Enumerator
S. Sanga	-	"
A. Chololo	-	"
K. Mahonge	-	"
R. Mlomba	-	"
S. Mkumboge	-	"
A. Mpangile	-	"
H. Kabandika	-	"
J. Mpanyu	-	"
U. Mpili	-	"
Y. Konge	-	"

The last but not least, I would like to thank all the sample farmers and their families for the cooperation they gave us during the whole course of the survey.

25th Jan. 1972
(DATE)

Masao Yoshida
MASAO YOSHIDA

Appendix 1

QUESTIONNAIRE FORMS

FORM NO. 1 BACKGROUND OF THE FARM HOUSEHOLD

(First visit only)

Enumerator .....

Date .....

District: ..... Division: ..... Ward: ..... Village: .....

..... Ten-house leader's name: .....

---

(1) Farmer and the family character:

1.1 Household No. .....

1.2 Name of the head of the family (farmer) .....

1.3 Tribe .....

1.4 Religion .....

1.5 Language .....

(2) Family size:

Name	Man or Woman	Adult or Child (year)	Relatives	Labourers	Those who are away

(3) Flood Resettlement:

3.1 Are you born in this village? .....

3.2 (If not) Where do you come from? (Name of the former villages) .....

Which year? .....

3.3 Why did you come to this village? .....

3.4 Did you come under flood resettlement program? .....

3.5 Do you get the flood damage now?

(a) Shamba every year

(b) Shamba sometimes (c) Shamba no damage.

(A) House every year

(B) House sometimes (C) House no damage.

Form No. I. cont'd.

3.6 How many houses do you have? .....

(Location?) .....

3.7 Do you practise irrigation? .....

(4) Farm plot:

(For initial information only. Later to be measured by enumerators)

	1st	2nd	3rd	4th	5th	6th
4.1 No. ?						
4.2 Size?						
4.3 Planted with?						

(5) Livestock:

	5.1	5.2	5.3	5.4	5.5	5.6
Type	Cattle	Sheep	Goat	Chicken	Duck	Others
No.						

(6) Farming tools and machines:

	6.1	6.2	6.3	6.4	6.5	6.6	6.7
Type	Hoe	Machete	Sprayer	Hand-cart	Bicycle	Canoe	Others
No.							

(7) Water supply:

Where do you get your drinking water?

	7.1	7.2	7.3	7.4	7.5	7.6
	Piped water	Borehole	Well	River	Waterpool	Others
Distance						

FORM No. 11 A.

UTARATIBU WA KAZI

Jina la Mkulima _____ Jina la mahali _____ Tarehe _____ Siku katika juma _____

Nambari ya nyumba _____ Enumerator _____

Saa (muda)	Mkulima	Idadi ya wanawake Wazima (Kutoka miaka 16)		Idadi ya Watoto Wadogo (miaka 10-15)		Idadi ya Wanaume Wazima (kutoka miaka 16)		Idadi ya Watumishi
1 - 2								
2 - 3								
3 - 4								
4 - 5								
5 - 6								
6 - 7								
7 - 8								
8 - 9								
9 - 10								
10 - 11								
11 - 12								
12 - 1								

FORM No. 11 B.

UTARATIBU WA KAZI

Summary

Nambari ya nyumba _____ Jina la Mkulima _____ Enumerator _____

Tarehe _____

Utaratibu a Kulima / Muda wa Kazi	(a) Mkulima	(b) Wanawake wazima	(c) Watoto Wadogo	(d) Wanaume wazima	(e) Watumishi	(f) Jumla	A Pamba	B Korosho	C Mpunga	D Mahindi	E Mihogo	F Mboga	G Macunda	H Samaki	I Shamba la Ujaama	J Vinginevyo	K Jumla ya shamba
1. Utayarishaji wa Shamba																	
2. Upandaji																	
3. Upalilizaji																	
4. Unyunyizaji dawa/ Utiaji Mbolea																	
5. Uvunaji/Uwekaji/ Uuzaji																	
6. Kwenda na kurudi Shamba																	
7. Kuondoa vichaka																	
8. Mengineyo (na Uvuvi)																	
9. Jumla																	
10. Kazi nyingineyo ya mafipo																	
11. Kuchota Maji																	
12. Kazi za Nyumbani																	
13. Kazi/Safari Nyingine zisizolipwa																	
14. Jumla ya kazi nyinginezo																	
15. Kula/Kupumzika																	
16. Unywaji Pombe																	
17. Kutembelea marafiki/Kucheza																	
18. Hospitali/Ugonjwa																	
19 Msikitini/Kanisani																	
20. Jumla																	
21. JUMLA																	

Jumla ya Wanawake Wazima _____

Jumla ya Watoto Wadogo (miaka 10-15) _____

Jumla ya Wanaume Wazima _____

Jumla ya Watumishi _____

FORM NO. III.

FARM PRODUCTION AND SALES

Household No. ..... Enumerator .....

Date covering ..... Date .....

Farmer's Name .....

Type of Products	Harvested: kg.	Sold: Kg.	Sold: Shs.
1. Rice			
2. Cassava			
3. Maize			
4. Millet			
5. Pigeon pea			
6. Beans			
7. Sesame			
8. Banana			
9. Vegetable			
10. Cotton			
11. Cashewnuts			
12. Coconuts			
13. Sugar cane			
14. Oranges			
15. Other crops			
16. Eggs produced			
17. Fish caught			
18. Livestock killed			
18.1 (Cattle)			
18.2 (Sheep)			
18.3 (Goat)			
18.4 (Chicken)			
18.5 (Others)			

FORM NO. IV. FARM HOUSEHOLD EXPENDITURE AND INCOME

Household No. ..... Farmer's Name .....

Date covering ..... Enumerator .....

Date .....

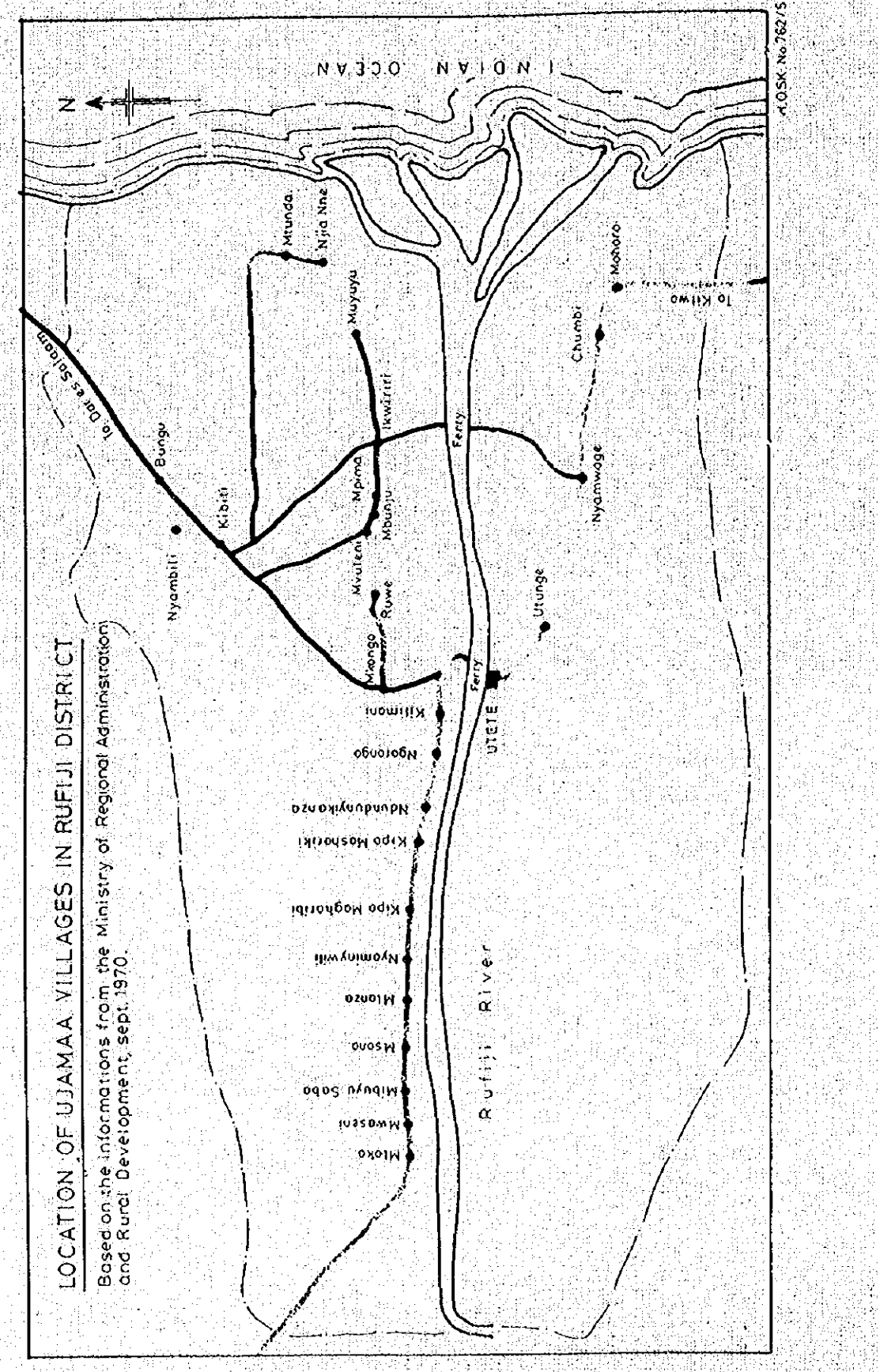
IV. EXPENDITURE

Items	Quantity	Price (Value)
1. Food:		
1.1 Meat		
1.2 Fish		
1.3 Rice		
1.4 Maize/Maize flour		
1.5 Wheat flour		
1.6 Cakes, Bread & other pastry		
1.7 Cassava/Cassava flour		
1.8 Sugar		
1.9 Salt		
1.10 Milk		
1.11 Tea leaves		
1.12 Spices, Curry powder, etc.		
1.13 Coconut		
1.14 Cooking oil		
1.15 Vegetables		
1.16 Fruits/Sugar cane		
1.17 Grinding		
1.18 Meal outside home		
Total Food		
2. Drink (alcoholic and soda)		
3. Tobacco		
4. Clothing and Shoes		
5. Furniture and household utencils/soap/match		
6. Building and repair		
7. Fuel (kerosene, charcoal)		
8. Farm expenses:		
8.1 Purchase of farm tools		
8.2 Contract machinery work		
8.3 Seeds		
8.4 Insecticides		

Form No. IV. cont'd.

Items Items	Quantity	Price (Value)
8.5 Fertilizers		
8.6 Empty bags		
8.7 Transport		
8.8 Wages to labourers		
8.9 Buying of livestock		
9. Taxes		
10. Personal Transport		
11. Education		
12. Medical		
13. TANU fees (and Coop. fees)		
14. Others		
Total Cash Expenditure		
V. INCOME		
1. Sales of Produce		
2. Other Sales (Handicraft etc,)		
3. Income from Employment		
4. Income from Gifts		
5. Income from Trading		
Total Cash Income		

Appendix 2

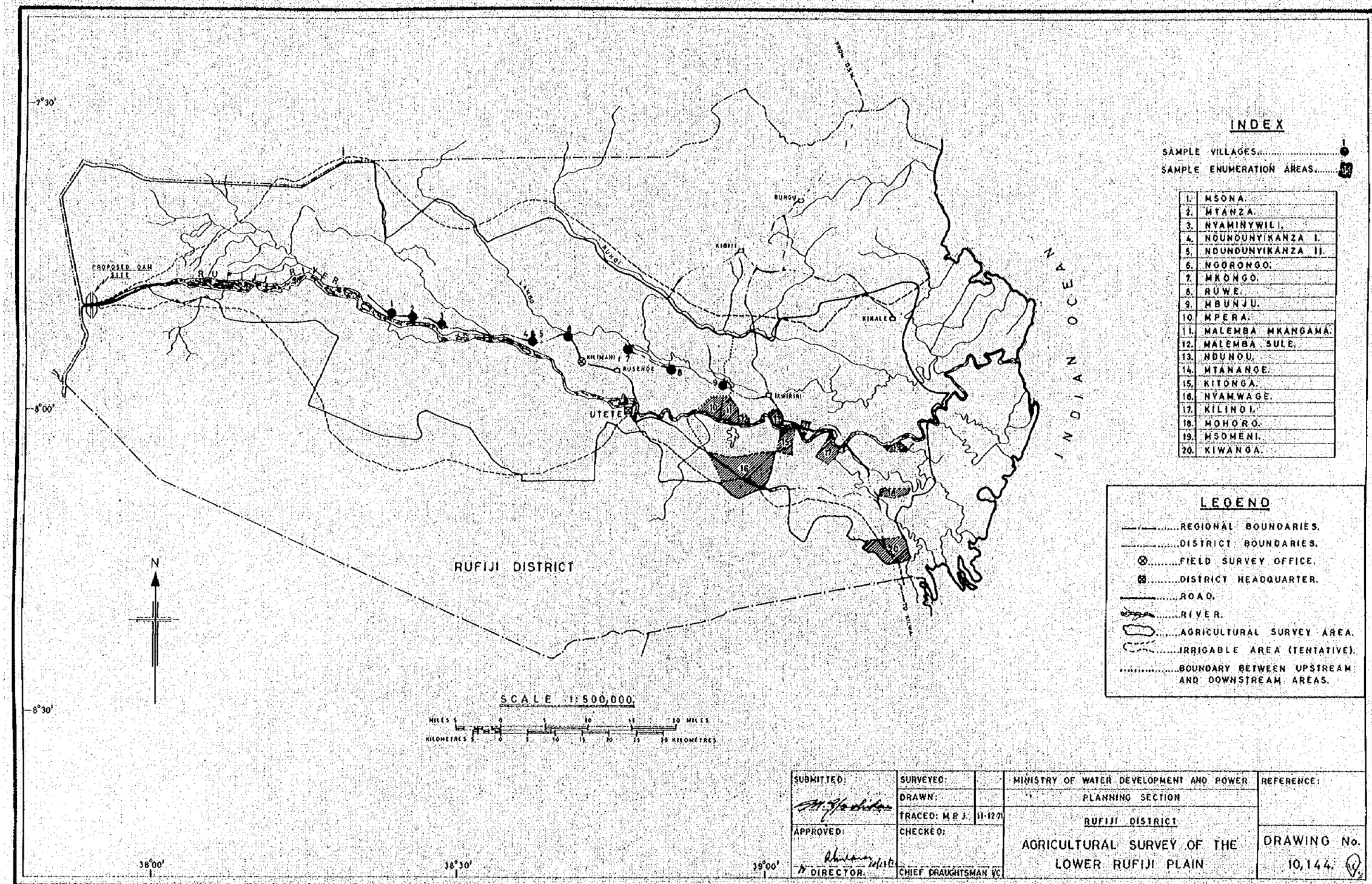

INDIAN OCEAN
N
Mtunda
Njia Nne
Muyuyu
Ikwiriri
Ferry
Chumbi
Mohoro
To Kilwa
Dar es Salaam
To
Bungu
Kibiti
Nyambili
Mpimo
Mbunju
Mvuleni
Ruwe
Mango
Nyamwage
Utunge
Ferry
UTETE
Kilimoni
Ngorongo
Ndundunyikanza
Kipo Moshoriki
Kipo Moghoriki
Nyominywili
Mtonzo
Msono
Mibuyu Sobo
Mwaseni
Mtoko
Rufiji River
LOCATION OF UJAMAA VILLAGES IN RUFIJI DISTRICT
Based on the informations from the Ministry of Regional Administration and Rural Development, sept. 1970.
UOSK No. 76215

Appendix 3:

LIST OF UJAMA VILLAGES IN RUFIJI DISTRICT

Village Names	Division	Date of Establish-ment	Number of Family	Number of Adult		Number of Children		Total Population	School	Dispensary	Social Services			Court	Water Supply
				Male	Female	Male	Female				Clinic	Community Centre	Police		
Mkongo	Mkongo	13/3/1968	825	749	1061	741	575	3126	1-VII	1	Inajengwa	-	-	1	Bomba
Kilimani	Mkongo	6/4/1968	416	480	685	Watoto	933	1933	1-IV	-	-	Inajengwa	-	-	Bomba
Ngorongo	Mkongo	10/5/1968	478	710	944	Watoto	478	2162	1-VI	1	-	-	-	-	-
Ndundunyikanza	Mkongo	6/5/1968	376	388	402	422	326	1938	1-V	1	-	-	-	-	Bomba
Kipo Mashariki	Mkongo	14/6/1968	336	341	307	252	252	1152	1-II	-	-	-	-	-	-
Kipo Magharibi	Mkongo	15/3/1968	267	267	386	Watoto	494	1147	1-VI	1	-	-	-	-	-
Nyaminywili	Mkongo	6/5/1968	380	350	385	Watoto	366	1539	1-IV	-	-	-	-	-	Bomba
Mtanza	Mkongo	17/4/1968	270	268	345	192	172	977	1-V	1	-	-	-	1	-
Msona	Mkongo	4/6/1968	276	273	319	280	233	1135	1	-	-	-	-	-	-
Mibuyu-Saba	Mkongo	25/6/1968	145	145	274	Watoto	250	669	1	First-Aid	-	-	-	-	-
Mwaseni	Mkongo	20/4/1968	241	243	296	197	218	956	1-V	1	-	-	-	-	-
Mloka	Mkongo	3/5/1968	572	572	748	504	587	2410	1-IV	-	-	-	-	-	-
Ruwe	Mkongo	17/4/1968	565	646	575	746	948	2825	1-II	-	-	-	-	-	-
Mbunju	Mkongo	1/8/1968	201	163	239	119	117	637	1-IV	-	-	-	-	-	-
Mvuleni	Mkongo	1/6/1968	90	-	-	-	-	313	-	-	-	-	-	-	-
Mpima	Ikwiriri	Old	140	147	179	85	184	595	1-III	1	-	-	-	-	-
Ikwiriri	Ikwiriri	1962 & 1968	2256	2591	3337	1682	1470	9080	1-VII	1	Inajengwa	1	1	1	Bomba
Njianne	Kikale	1/9/1968	22	39	48	13	15	115	-	-	-	-	-	-	-
Muyuyu	Kikale	5/7/1968	146	212	232	127	163	734	1	-	-	-	-	-	-
Mtunda	Kikale	9/9/1968	271	405	417	225	269	1306	1-II	Inajengwa	-	-	-	-	-
Chumbi	Mohoro	6/5/1965	356	356	360	Watoto	Watoto	1118	1-II	1	-	-	-	1	-
Utunge	Mkongo	6/5/1968	134	134	-	196	192	522	1	1	-	-	-	-	Kisima
Nyamwage	Mohoro	Nikijiji cha zamani na cha Uhamiaji						750	1-IV	1	-	-	-	-	-
Kibiti	Kibiti	20/7/1969	143	133	513	102	84	513	1-VII	Health Centre	-	-	-	-	Kisima
Nyambili	Kibiti	10/4/1969	45	36	50	54	46	186	-	-	-	-	-	-	-
Bungu	Kibiti	Old		268	312	183	174	937	-	-	-	-	-	-	Bomba
Mohoro	Mohoro	Old						760		1			1	1	Bomba
Utete	Mkongo		442	575	636	386	363	2401	1-VII		Hospital		1	1	Kisima

Compiled by - Administrative Officer Rufiji District - March, 1970.



INDEX

SAMPLE VILLAGES.....

SAMPLE ENUMERATION AREAS.....

1.	MSONA.
2.	MTANZA.
3.	NYAMINYWILI.
4.	NDUNDUNYIKANZA I.
5.	NDUNDUNYIKANZA II.
6.	NGORONGO.
7.	MKONGO.
8.	RUWE.
9.	MBUNJU.
10.	MPERA.
11.	MALEMBA MKANGAMA.
12.	MALEMBA SULE.
13.	NDUNDU.
14.	MTANANGE.
15.	KITONGA.
16.	NYAMWAGE.
17.	KILINDI.
18.	MOHORO.
19.	MSOMENI.
20.	KIWANGA.

LEGEND

- .....REGIONAL BOUNDARIES.
- .....DISTRICT BOUNDARIES.
- ⊗.....FIELD SURVEY OFFICE.
- ⊠.....DISTRICT HEADQUARTER.
- .....ROAD.
- .....RIVER.
- .....AGRICULTURAL SURVEY AREA.
- .....IRRIGABLE AREA (TENTATIVE).
- .....BOUNDARY BETWEEN UPSTREAM AND DOWNSTREAM AREAS.

SUBMITTED:	SURVEYED:		MINISTRY OF WATER DEVELOPMENT AND POWER	REFERENCE:
	DRAWN:		PLANNING SECTION	
	TRACED: M.B.J.	11-12-71	RUFIJI DISTRICT	
APPROVED:	CHECKED:		AGRICULTURAL SURVEY OF THE LOWER RUFIJI PLAIN	DRAWING No. 10,144.
DIRECTOR.	CHIEF DRAUGHTSMAN (C)