FARMING ON THE LOWER SLOPES OF EASTERN MOUNT KENYA

BY
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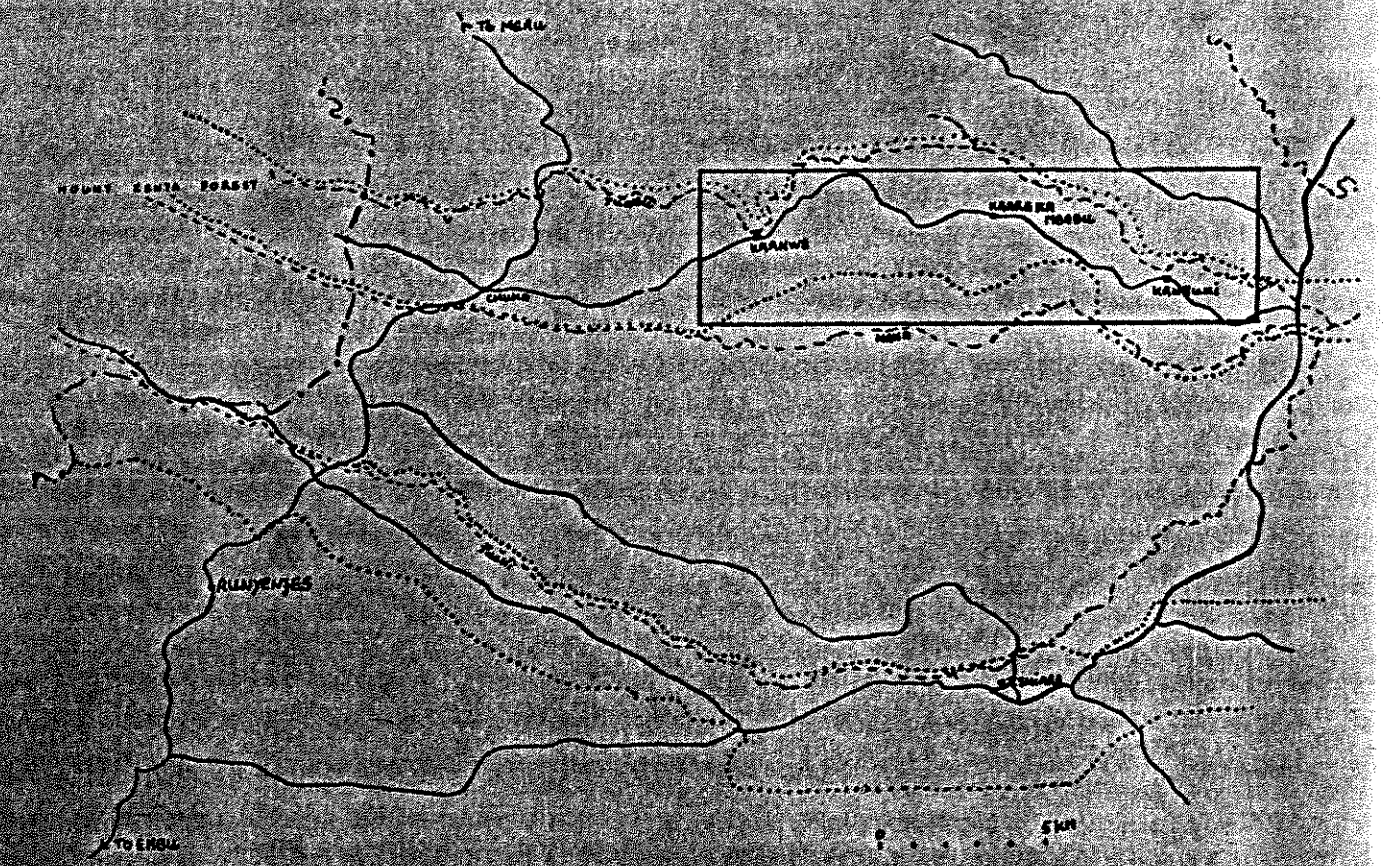
march 1986



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PREFACE

The underlying report reflects the results of a farming systems research we executed from june upto december 1985, in the south of the Meru District in Kenya.
For both of us the research and report writing are elements of the practical training which forms part our respective studies in tropical agronomies (GvdD) and agricultural development economics (JH) at the Agricultural University of Wageningen AUW.
The research was executed within the broader frame of the Training Project in Pedology of the AUW, in collaboration with the Kenyan Soil Service. Our field study was guided by Rob Schipper and Henk Waayenberg, both staff members of the AUW. The cooperation passed off in a highly motivating sphere which, together with their professional skills and experiences, guaranteed a high quality of the training. In a relative short time and a very pleasant manner we learned a lot, for which we are very grateful.
We are also indebted to Titus de Meester and Dick Legger, respectively leader and manager of the project, for their assistance in supplying the necessary material assets to execute the research, and their flexible and supportive attitude; our interpreters Jane Mbogo and Maria Nyoka who enabled us to communicate with the local population, without loosing their spirits on the many dust-eating expeditions. However, most of all we are indebted to the households in the survey area which all, with no exception, were more than ready to co-operate when asked.

Geert van der Donk
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march 1986
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Chapter 1. INTRODUCTION

1.1 Background

The Chuka Project is the third phase of the Training Project in Pedology (T.P.I.P.) in Kenya. Previous phases were the Kisii Project and the Kilifi Project. All the activities of the T.P.I.P. are carried out in close consultation with her Kenyan counterpart, the Kenya Soil Survey (K.S.S.), part of the National Agricultural Laboratories at Nairobi.
The objectives of the Chuka Project are twofold:

a) to produce a reconnaissance soil map of scale 1:100.000 of the map sheets of Chuka and that of Ishiara, both scale 1:50.000, of the Survey of Kenya, together with a detailed report and a landevaluation to assess the suitability of a number of land uses and
b) to train post-graduate students in soil science, agronomy, vegetation and agricultural economics of the Agricultural University of Wageningen (AUW), Holland. The training consists of graduate-students work as well as research work for MSc-thesis.

The funds for the Chuka Project are provided by the AUW and estimated on a project length of 14 months. The selection of the two project map sheets was spelled out in full cooperation with the K.S.S. (see Memorandum of Understanding, 1985)

1.2 Objectives of the study

In general the underlying study deals with the first project objective as far as it concerns the land evaluation, and of course the second project objective. More specified objectives of this study are:

a) the description of a number of Land Utilization Types (LUTs) within the framework of the Land Evaluation and
b) the description of the occurring farming system in the study area.

The Land Utilization Types form part of the farming system. "The suitablility of different land mapping units must be assessed and classified with respect to a specific kind of use. Such a kind of land use is called a Land Utilization Type (LUT) and described according to a set of technical specifications in a given agro-ecological and social-economic setting.
In order to be able to give clear specifications a LUT must be uniform. Most often it is therefore necessary to interprete a LUT as a crop or a group of crops which are alike. Examples of LUTs are tea, coffee, cotton, maize, beans, millet and sorghum. Since farms often have mixtures of crops it can be useful to treat a mixture as a LUT, an example of which could be maize and beans.

LUTs should be described according to technical specifications and requirements, and within an agro-ecological and social-economic setting. Technical specifications refer to types of output, types of input, and agronomic practices (technology) and operations. Requirements are equivalent to the concept landquality of a land mapping unit. For example a LUT is in need for a certain amount of nutrients, nutrients which can be supplied by the land mapping unit. In this way nutrients will be a requirement for the LUT while the availability of nutrients will be a land quality of the land mapping unit (Scipper, 1985:15).
"Land evaluation aims at an assessment of different land mapping units with regard to their suitability for different LUTs. The LUTs are assessed independently" (Schipper, 1985:25).

1.3 Choice of the study area

For the soil mapping and discription in the Chuka Project, the area is divided in two, from west to east going sample strips. One in the south of Embu district along the road Rukuriri, Kathageri, Ishiara and one in the north of Meru district along the road Gachima, Chuka, Kanjuki, on the interfluve between the rivers Tungu and Naka (see Figures 1 and 2). Both strips cover each five, so called agro-ecological zones. Each zone supplies her own LUTs. However since the agro-economical fieldwork could only be of a limited scope, it was decided to choose those zones of which relatively the least was known, the so called main and marginal cotton zone (Jaetzold and Schmidt, 1983). In the northern strip this zone covers roughly the area from the village Kaanwa as western, up to the village Kanjuki as eastern border.

1.4 Conceptual Model

For the discription and analysis of the farming system the broad, conceptual model as developed by Collinson, is used (Collinson, 1981). This model is schematically represented in Figure 3, and in accordance with the ICRA discription and analysis of the farming system in Tharaka district (ICRA, 1984). The farmer's decisions on activities, methods and resource allocations are regarded as influenced and determined by the local circumstances (natural, socio-economic, etc), his objectives and the available resources. The results of the farmer's decisions can be described by using three subsystems: crops, livestock and off-farm income. The unit of analysis is the household farm. The household is the major labour supplying and food demanding unit. The way the model is presented gives an impression of a static instead of a dynamic system. A clear example of the dynamic nature of farming systems is the change from shifting cultivation to permanent agriculture. Therefore, the model should be interpreted as no more than a time exposure in a development process.
For the discription and analysis of the LUTs the guidelines as composed by the FAO are followed as much as possible (FAO, 1983). This study describes the LUTs for the single foodcrops maize, sorghum and millet

Figure 1 Map of Eastern Province showing the Project Area

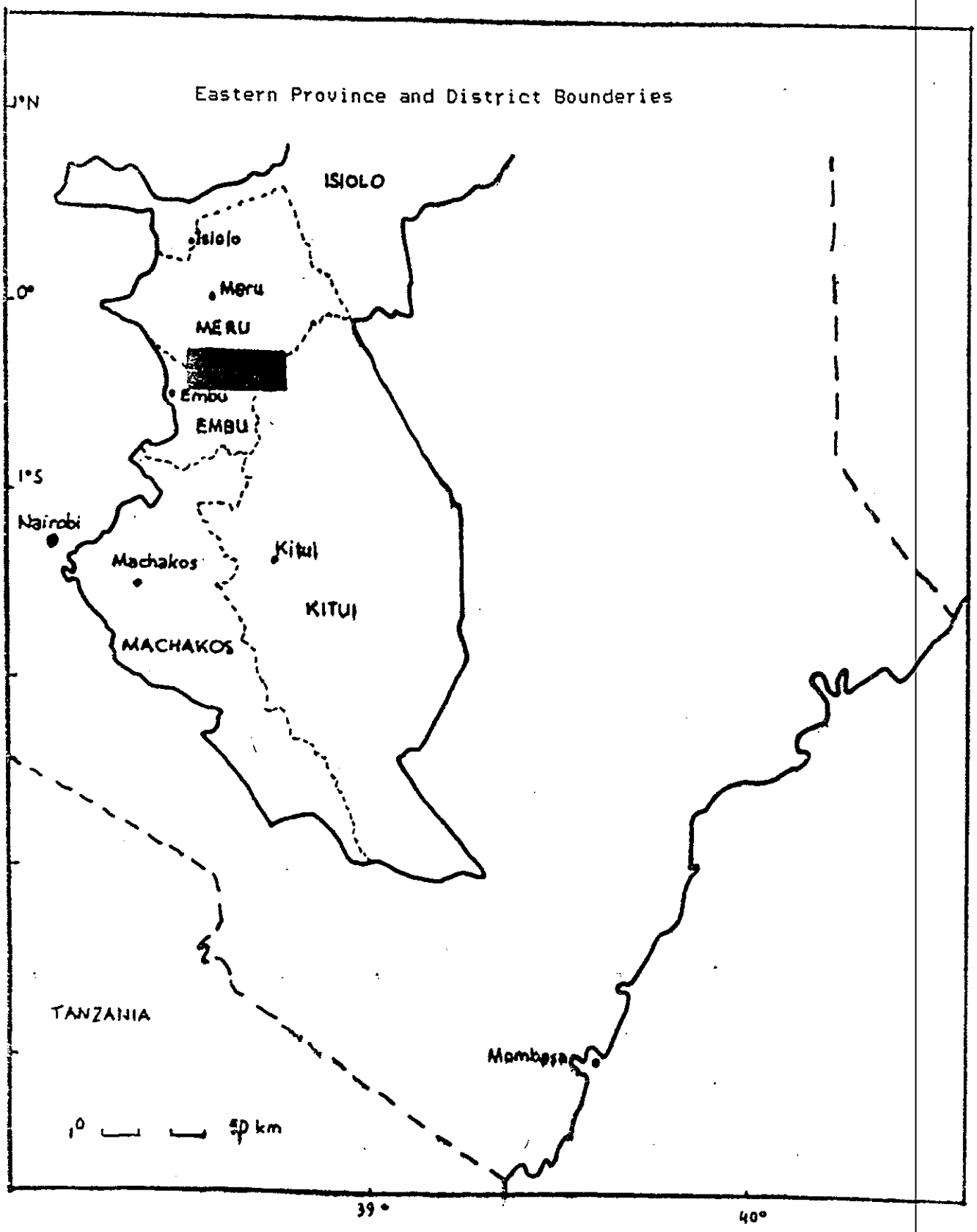
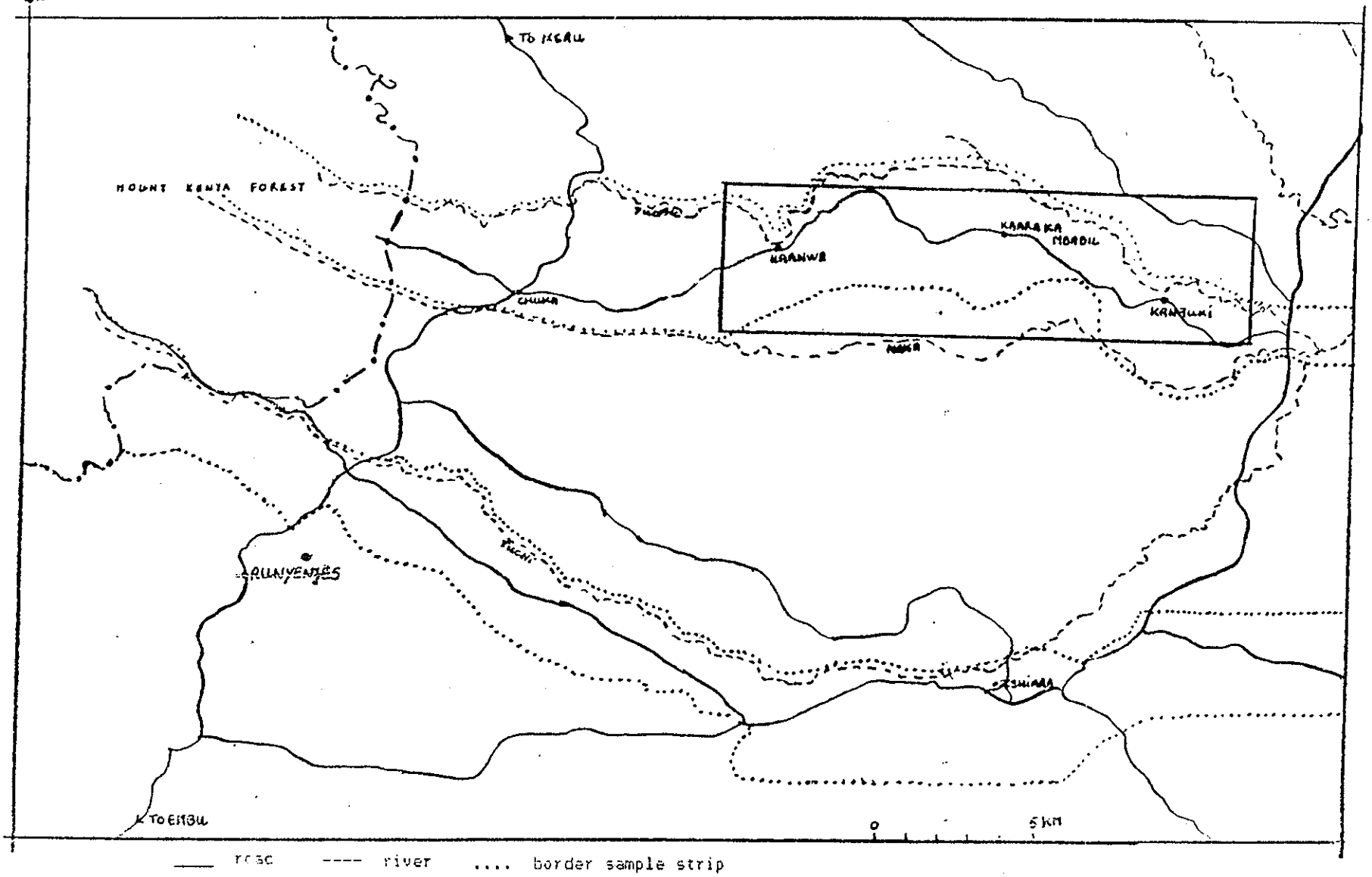
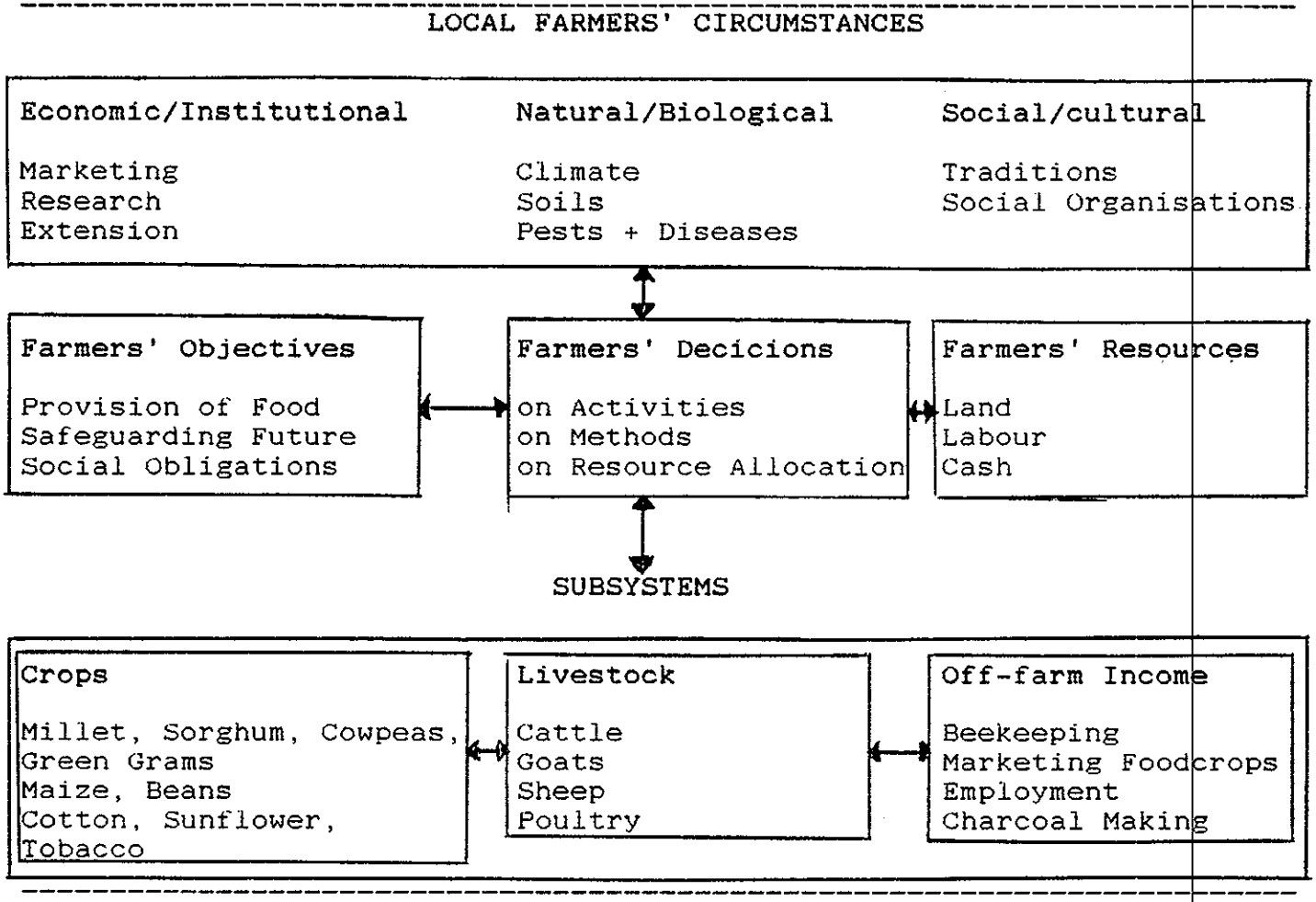


Figure 2 Map of Project Area showing the Survey Area



and cashcrops tobacco and cotton in the main and marginal cotton zone. You can find these discriptions in Appendix 1.

Figure 3 Conceptual model for farming system research



Chapter 2 METHODOLOGY

2.1 Introduction

The research period plus report writing was conducted in six months, from half june 1985 to half december 1985. For a time table see Appendix 2. The research period is divided into three subperiods. The first to familiarize with the survey area, to organize the survey and to do the sampling. The second for the actual fieldwork and the third for the analysis of the survey data and the report writing.

2.2 Preparation of the formal survey and the sampling

This period is to be subdivided in several activities.It was started with an orientation on the farming in the survey area. Meanwhile a planning was made of the coming activities, followed by some informal surveys in the survey area with no more than a refined checklist, based on the foregoing orientation. On the basis of those informal surveys the questionnaire was designed and after testing the first draft the final questionnaire was framed. This final questionnaire is represented in Appendix 3.
Next to the drawing of the questionnaire the sampling formed a main activity. After some discussions it was decided to choose three subsample areas, i.e. the regions round the villages Kaanwa, Kaara Ka Mbabu and Kanjuki, all within the main and marginal cotton zone and the livestock/millet zone (see for the description of the agro-ecological zones chapter 3.2). Due to the lack of reliable population c.q. households lists, it was decided to draw the proper samples on the basis of aerophotographs from 1982, scale 1:12.500, of the survey area, by stereographic interpretation. The procedure was as follows. Round each of the centres Kaanwa, Kaara Ka Mbabu and Kanjuki (see Figure 13), sixty homesteads were chosen by going, starting in the centre, spirally outward counting every homestead on the line, upto sixty homesteads. Out of the sixty homesteads a sample twenty was drawn at random. For the three areas a total of sixty homesteads were selected in this manner.

2.3 Fieldwork

The fieldwork was divided into two activities. First, the interviewing and second, the so called farm measuring. Out of every twenty households in each region, seven were selected for measurements of the cultivated fields and, if possible, the size of the area of the farm. Because a lack of time it was decided to do no crop yield measurements during the planning phase. Furthermore, the actual timing of the fieldwork was by some crops during the harvesting and by other crops after the harvesting, so crop yield measurements anyhow could not have been made.

2.4 Analysis and report writing

These activities speak for themselves. In this period a final check on the filled-in questionaires were made, although, for most subjects it was too late to adjust eventual mistakes. Some of the mistakes or missing data which came up during the analysis, could be obviated by revisits, but for some items revisiting would have taken too much time. If and when in the remainder of the report some passages or conclusions are based on dubious data it is mentioned. The 'justification' of the mistakes based on missing data is found in the training objective of the project.
The used methods of data basing and processing are shortly described in Appendix 5. In the same appendix an introduction to the organising of and access to the data is given.

Chapter 3 ENVIRONMENTAL PROVISIONS IN THE SURVEY AREA

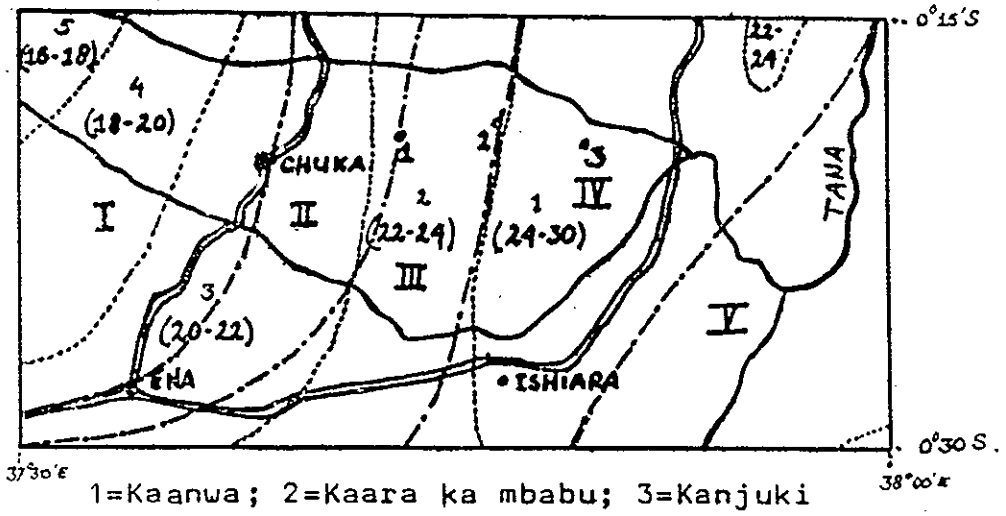
3.1 Introduction

This chapter deals with all those variables concerning the farming in the survey area and which can't be influenced by the individual farmers. Variables like the climate, in this chapter treated within the concept of the agro-ecological zones, the water supply, the soils and their possibilities, the infrastructure and the institutions of the survey area.

3.2 The agro-ecological zone concept

The area of the Chuka project is situated East of mount Kenya, just below the equator. For the exact geographical boundaries, see figure 4. The figure covers the mapsheets 122/3 and 122/4 from the Survey of Kenya.
Due to its situation close to Mount Kenya, the elevation differs from 2100m. in the Westen part (Mount Kenya forest) to 700m. or less in the Eastern part (Tana river). The rainfall also decreases in West-East direction: 2200 to 700mm averagely per annum. Another consequence of the differences in altitude is the variation of the temperature: the mean annual temperature is 16-18oC in the West and increases to about 30oC in the drier Eastern parts (Braun 1982).
The mentioned ecological factors highly influence the farming systems in the area. Several teams have tried to summarize the ecological determinants in a map wich differentiates the various zones. Jeatzold et al especialy stress the occurrence of crops by interpreting the climatological and geographical data (figure 5). The team of Braun (figure 4), operating for the Kenya Soil Survey, emphasizes both moisture availability and temperature, without refering directly to crops. This is to be prefered as the zone-names of Jaetzold are suggesting crop suitabilities. Next to the moisture availability, the main limiting factors of zone III and IV (the survey area) are husbandry and soil-fertility.
The moisture availability of Braun's zones are expressed by r/Eo, i.e. the ratio of average annual rainfall and average annual potential evaporation x 100%. Like the 60% rainfall values of Jaetzold (see 3.3), Braun has calculated probabilities of moisture deficit (the chance that rainfall < 2/3Eo). Furthermore he has given probabilities of cropfailure. For this purpose he used maize which was adapted to its environment (esp. length of growing season). The probabilities of cropfailure are based on the probabilities of moisture deficit.
For more information, one can consult the here quoted reports. The figures 4 and 5 have been derived from them.

Figure 4 Agro-climatic zones according to Braun



1=Kaanwa; 2=Kaara ka mbabu; 3=Kanjuki

-·-·-·- means boundary of moisture availability zone
..... means boundary of temperature zone

Explanation to figure 4 and some implications

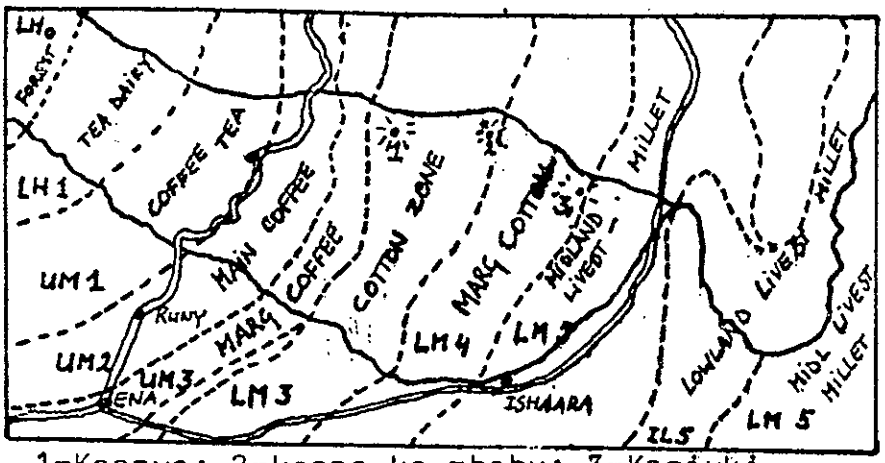
zone	r/E_o (%) moist.av.	average # of growingdays/yr	pot. for pl-growing	Probility of moist.deficit(%)	risk of failure of adapted maize(%)
I	>80	365	very high	0	0- 1.
II	65-80	290-365	high	0- 1	1- 5
III	50-65	235-290	med-high	1- 7	5-10
IV	40-50	180-235	medium	7-20	10-25
V	25-40	110-180	low-med	20-70	25-75

Relations between temperature and altitude according to Braun (1980)

mean max. temperature = 35.5 - 5.94 Y
mean min. temperature = 24.8 - 7.05 Y
mean temperature = 30.2 - 6.50 Y
absolute max. temperature = 42.5 - 5.51 Y
absolute min. temperature = 16.3 - 6.56 Y

Y = altitude in meters

Figure 5 Agro-ecological zones according to Jeatzold



1=Kaanwa; 2=kaara ka mbabu; 3=Kanjuki

Explanation to figure 5

LH Lower Highlands
Annual mean temperature of 10-15°C, and seasonal nightfrosts.

UM Upper Midlands
Annual mean temperature of 18-21°C, and a minimum mean temperature of 11-14°C.

LM Lower Midlands
Annual mean temperature of 21-24°C, and a minimum mean temperature > 14°C.

IL Inner Lowlands
Annual mean temperature > 24°C, and a mean maximum temp. > 31°C.

Subscripts
0 : perhumid
1 : humid
2 : subhumid
3 : semi-humid
4 : transitional
5 : semi-arid

Figure 6 Rainfall of Embu town

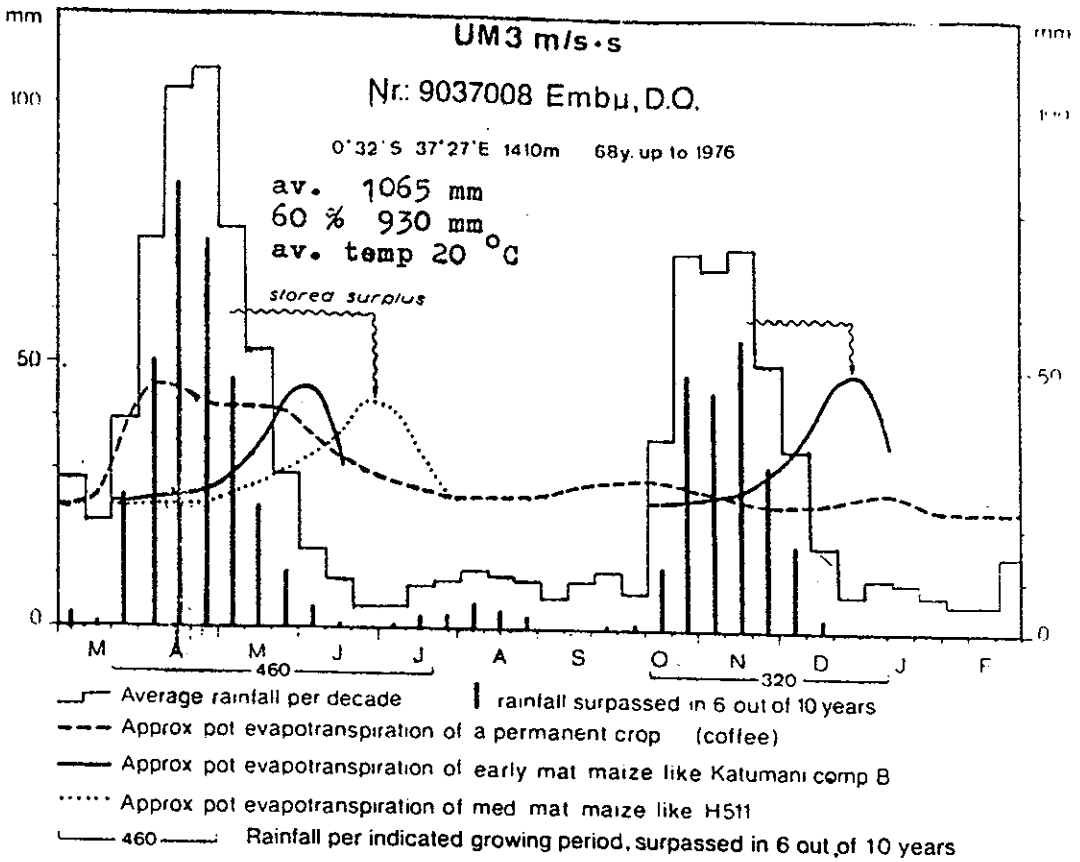


Figure 7 Rainfall of Embu foreststation

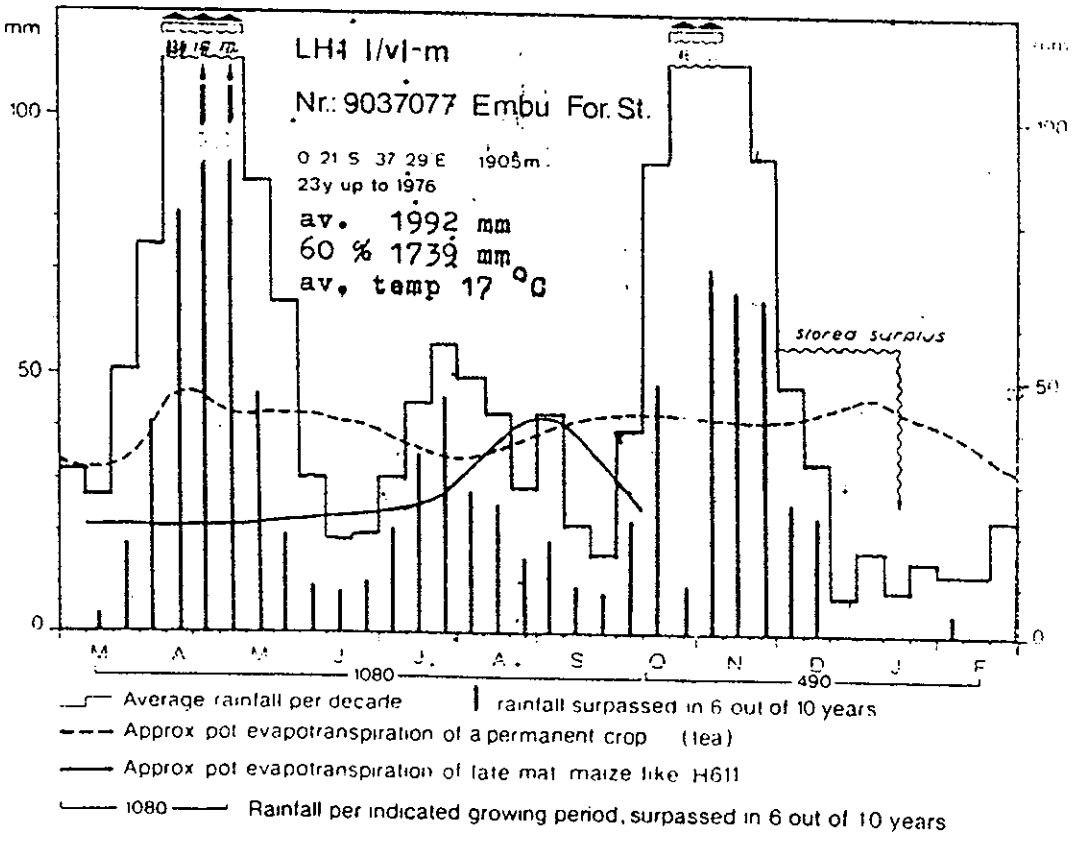


Figure 8 Rainfall of the Tharaka area

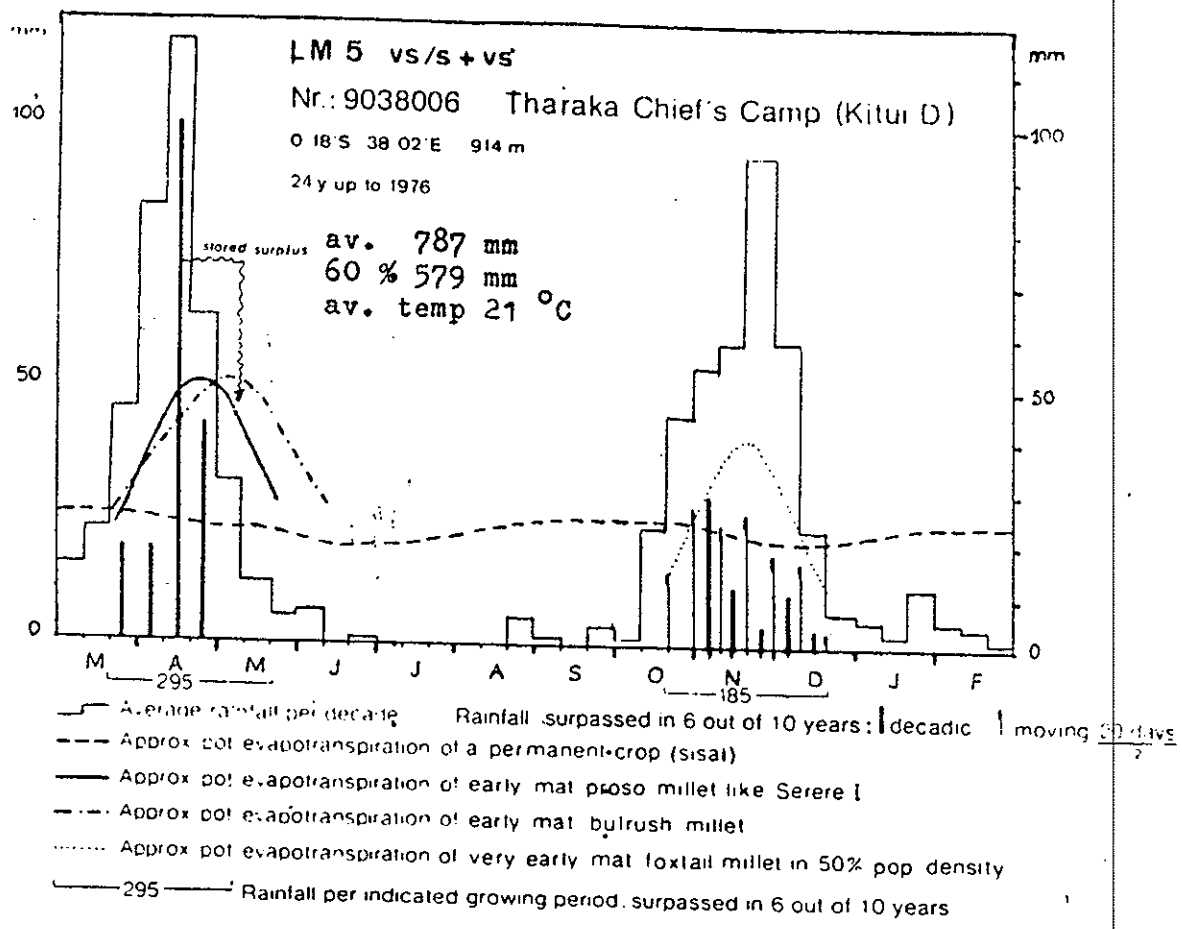
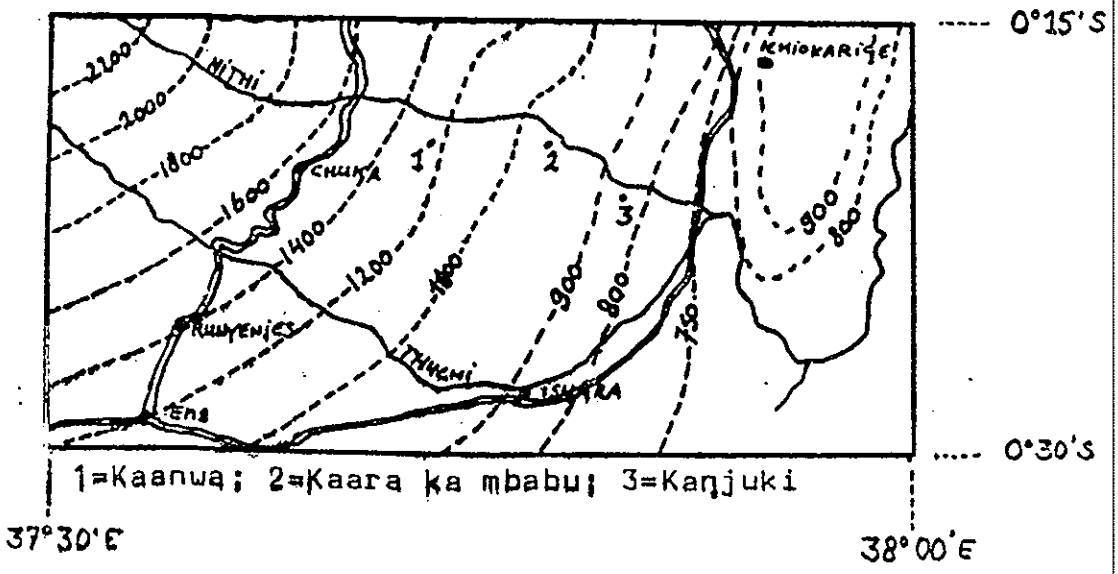


Figure 9 Average anual rainfall



3.3 Water

Of the survey area, no reliable figures on rainfall are available. This means we have to rely on figures of previous research, notably of Jaetzold & Schmidt, and statements of farmers.
Jaetzold and Schmidt (see figures 5-11) use in their handbook average amounts of rainfall and a 60% reliability of rainfall. The latter means that one can expect a certain amount of rainfall in at least 6 out of 10 years. Embu (fig. 6 and 7) is just outside of the mapsheet on the South-West side and Tharaka also, on the East side.
In the West side of the two mapsheets, there isn't a real dry season and the rainfall is not clearly bimodal. Jaetzold speaks for these wet areas of first- and middle rains on the one side and second rains on the other side, to express the presence of in fact three rainy periods. When moving to the East, the middle rains disappear and only the first- and second rainy season remain.

Figure 10 First and middle rains of the Chuka and Ishiara mapsheet (60% reliability)

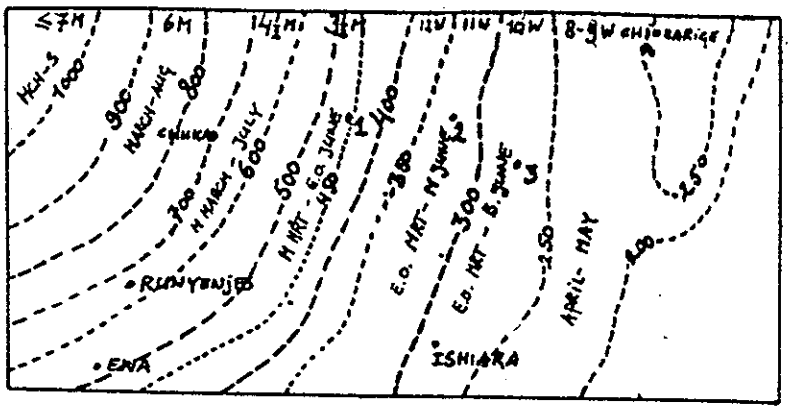
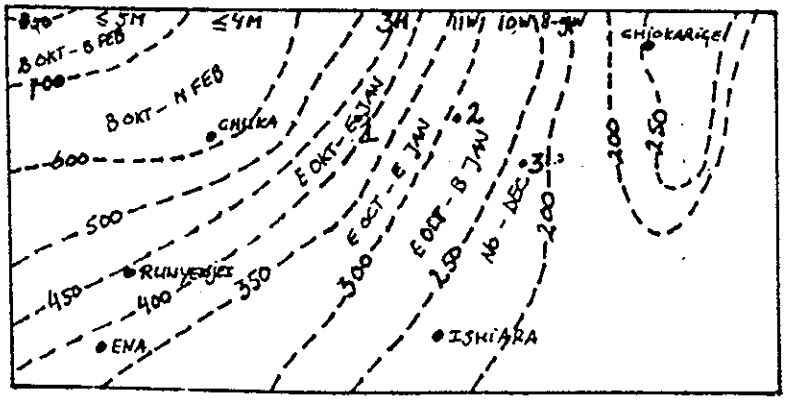


Figure 11 Second rains of the Chuka and Ishiara mapsheet (60% reliability)



On the slopes of Mount Kenya the rainfall is well distributed and there is no preference to grow crops in either the first or second season. For both seasons the dates of onset are fairly reliable (respectively 15/3 and 15/10).
In the Tharaka area the situation is more alike the situation in the survey area. First of all the amount of rainfall is much less than in the higher areas. Moreover the rains are less reliable with respect to date of onset and distribution. Using the 60% numbers of figure 8 it is clear that only a very short period of the year (1-2 weeks/year) shows a positive water-balance. For the remaining time, the potential evapo-transpiration surpasses the rainfall.
In the figures 10 and 11 a deviding between the two seasons has been made. At the top of the figures the average length of the growing season is indicated, so one can see that it is shorter in the drier areas (m=month; w=week). Normally the second rainy season, which tends to be slightly shorter but more reliable, is prefered by the farmers.
In table 3.3 are given some figures concerning the survey area. One should consider these as estimates (or intrapolations) as of the survey area not a single measured figure is available.

Table 3.3 Climatological and geographical data of the survey area

region	mm/yr av.	altitude	ACZ (Braun)	r/Eo
Kaanwa	1300	1100m	II4-III4	55-70%
Kaara Ka Mbabu	1000	950	III4-IV5	45-55
Kanjuki	850	850	IV5	40-50

Source: Jeatzold et al., Braun.

Of the Tharaka area some figures concerning the intensities of rains were available (Icra '84). In this area it was not exceptional that 50% of the amount for one season, fell in one day! Of course these intensities, especialy in areas without much vegetation, can be very erosive.
In the area are two perennial rivers, of which Tungu river is close to the three regions and Naka river distanced. The rivers are used for fetching water and are the closest drinking place for the livestock. For the residents of Kaanwa and Kanjuki this doesn't mean much walking as Tungu river is close to their homesteads, but the Kaara people have to walk about 2 km before reaching the nearest river. Some farmers use the riversides to maintain nurseries for their crops (see chapter 4). This occurs most frequently in Kaanwa, where tobacco is still an important cashcrop. Despite of these nurseries, the agriculture can be regarded as totaly rainfed. No irrigation occurs. There may be some possibilities for irrigated agriculture on the plateau between Kaara Ka Mbabu and Kanjuki; its site is quite large, nearly flat and situated near Tungu river.
In appendix 4 of this report some crop requirements are listed. One can determine for each region what may be the most suitable crops with respect to temperature (altitude), moisture availability and soils.

3.4 Soils and their agricultural potentials

Simultaneously with the farming system research, a soil survey was executed for the Chuka- and Ishara mapsheets. In this paragraph the attention will be focussed on the soils of the three regions of the agro-economic survey. For more elaborate information is referred to appendix 5 (concerning the three regions) and the reports of the Chuka project (concerning the soils of the entire project-area).

Table 3.4 Soil types of the survey area

soiltype	nitisol	acrisol	vertisol	luvisol
distrib. over the regions	kw: 80% kr: - kj: -	kw: 20% kr: - kj: -	kw: - kr: 10% kj: -	kw: - kr: 90% kj: 100%
texture	clay	clay	clay	sandy clay loam to clay
drainage	well	well	moderately well	well
erosion	slight	slight	none	rill & gully
fertility	low	low	low	low
deficiency	K	-	K	-
pH	5.0-5.5	5.0	7.0-8.0	6.0
stoniness	none	none	none	fairly stony

Source: Soil report of the Chuka area (not yet published).

The distribution of the soils in the survey area shows roughly two groups: the nitisols of the Kaanwa region and the luvisols of the Kaara Ka Mbabu and Kanjuki region. Acrisols and vertisols are a minority. All the soils have a heavy texture, but only in case of the vertisols this causes difficulties for tillage. The drainage of the soils is well. The infiltration is well also, exept for the luvisols. This fact causes that only this soil shows both rill- and gully erosion. Crops on this soil may suffer from moisture stress. For the nitisols, acrisols and vertisols of the area, moisture stress is related to lack of rainfall, not to limiting physical properties of the soil.
Chemically all soils are poor. Analysis of soil fertility samples showed potassium deficiency for the nitisols and vertisols. Moreover the crops show clear symptoms of phosphorus and nitrogen deficiency on nearly all soils. The low pH may contribute to these symptoms, but the low base saturation is more likely.
One of the main limiting factors of the Kaara Ka Mbabu and Kanjuki region is their stoniness. Notably the Kaara region, in fact the start of the basement, is very stony and shows rock outcrops. Furthermore the soils of the two eastern regions of the survey area, predominantly

existing of luvisols, cause problems due to crusting. This influences tillage, moisture availability and erosion.
In the light of agricultural potentials can be concluded that the physical properties of the soils in the survey area are quite well. Agricultural constraints are mainly caused by low soilfertility and soil erosion. The latter is the subject of the followin paragraph.

3.5 Soil and water conservation

Of the farmers interviewed, 87% has major or slight problems with soil erosion, which constitute 77% of the shambas. They are asked wether they thought soil erosion is a problem or not, and if yes, to what extent. For the latter they could answer it was a major, a slight or no problem in their shambas. In this way 98 shambas are screened. The results are listed in table 3.5.

Table 3.5 Farmers perception of soil erosion problem (%)

region	major	slight	no
Kaanwa	47*	29	24
Kaara Ka Mbabu	44	41	15
Kanjuki	33	36	31
Area	42	35	23

47* means that on 47% of the shambas are major erosion problems.

Source: Survey.

Obviously most of the farmers in the survey area are affected by soil erosion. On 77% of the shambas there are more or less problems with erosion experienced. Before discussing the problems, the topography of the farms must be clear. The farmers prefer flat shambas, of course. For the total area 59% of the shambas has a flat gradient (0-6%), 35% a moderate gradient (6-16%) and the remaining 6% of the shambas shows a gentle gradient (16-30%). Slopes over 30% are not encountered. Another important factor is the position of the shambas. Four classes were made: 'top' (of a hill), 'bottom' (valley) and in between the position can be 'high' or 'low' (resuming: top, high, low or bottom). For the total area 22% of the shambas are on the top of a hill, 34% on the higher slopes, 25% on the lower slopes and 19% has been classified as bottom. Of course there are more determinants of erosion, like slope-length, the texture of the (top-)soil, the drainage and infiltration, soildepth etc., but these are far beyond the scope of this report.
Where are most problems concerning soil erosion found ? On the top of the hills not much problems (slight or no) are observed. Nevertheless the farmers do take preventive measures. This might be to avoid run-off problems downhill or for water conservation. Further downhill the situation is different. Of the farmers having a shamba on the higher slopes, 55% of their shambas shows major problems and 34% slight problems. For the lower slopes the figures are even worse: 63% (major)

and 28% (slight), so in only 9% of the shambas no problems were reported. The shambas classified as bottom showed only slight (45%) or no problems (38%) with erosion. It is clear that the problem is concentrated on the slopes of the hills. It's surprising that in the valleys the erosion is at most slight. Apperently there is no strong flowing down of water and soil.
The preventive measures are in order of importance (i.e. occurrence): trashlines (64%), trees (43%), stonelines (34%), grass-strips and terraces (both in 16% of all shambas). Only 4% of the shambas had no preventive measure at all.
Trashlining was observed everywhere. The trashlines were approximatively placed along the contour lines and existed of stalks of cereals or sometimes other crops. Trees appear to be very important. Mostly one can find them on the edges of a shamba or even in the middle. Most trees are mango, pawpaw and avocado, but also trees like Eucalyptus, Grevillea and Leucena. All these trees are largely available in nurseries (e.g. in Kaanwa). An important detail concerning the treeplanting is the fact that the people are not entirely free to cut trees. The Kenyan goverment stresses very much the importance of treeplanting.
Stonelines occur predominantly on slopes with a moderate or gentle gradient. Of course stones must be available, so it's not surprising that the measure is popular in the Kaara Ka Mbabu and the Kanjuki region. Grass-strips (Napier and Bana) and terraces are not common. In Kaanwa they are encountered regulary, but in both other regions they were quite rare. For grass-strips, there should always exist a need of grass (for the livestock) but also the ecological circumstances must allow grass growing, which is not so in for instance the Kanjuki and Kaara Ka Mbabu region. For the construction of terraces a lot of labour is needed which is scarce. A major problem was the lack of technical knowledge among the farmers. They do not know how the terraces should be made (width, depth) and need advise of the agriculturist. Not classified as terraces were the ridges along the contourlines.
Of all farmers interviewed, 1/3 thinks the measures they have taken, are inadequate and the measures should be intensified, changed or replaced by another, because still soil erosion exists. One farmer even stated that the goverment forced him to take soil conservation measures. The need for intensifying the measures and maintenance is often obstructed by labour- ,cash- and timeshortages. Also the stoniness in Kanjuki and Kaara Ka Mbabu raise problems. Due to the activities of ants and termites, the maintenance of trashlines is difficult. An interesting erosion preventive measure is observed in Kaanwa: sorgum suttocks are planted very densily in squares of about 25x25m and inside these squares, other crops are planted.
A phenomenon closely related to soil conservation, is water conservation. In the survey area this is in fact unsignificant. Nevertheless it is important to use the water efficiently, and a few recommendations are given:
- Mulching (reduces evaporation and increases the water storing capacity by a higher organic matter content).
- When ploughing is usual, it should be done early in areas of high rainfall (as it improves the infiltration) and late in areas with high temperatures and little rainfall to prevent too much evaporation.
- Ploughing along the contour-lines.
- Contour-cropping (also against erosion).
- Whenever possible, use a crop with a quick initial growth.

3.6 Land and population

3.6.1 Introduction

The survey area is covered by two sublocations, Marianni and Kanjuki, part of the locations Karingani respectively Kanjuki. Both locations form part of the Nithi division from the Meru district in the Eastern Province of Kenya. The sublocation Marianni covers the Kaanwa region while the Kanjuki sublocation covers both the Kaara Ka Mbabu and Kanjuki regions. For the figures concerning the land and population of the Marianni and Kanjuki sublocations see table 3.6.1.

3.6.2 Land

Off all the land in the survey area 15% is not suited for agriculture. This 15% includes rocklands and hills not arable because of their steepness. For the size distribution of the farms in the survey area see table 3.6.1. The average size of the farms in the survey area is 4,46 acres (1,81 ha). Over the area the figures are (survey):

	acres	hectare
Kaanwa	5,29	2,14
Kaara Ka Mbabu	4,02	1,63
Kanjuki	4,02	1,63

Table 3.6.1 Figures on the land and population of the Marianni and Kanjuki sublocations.

sublocation	population no.	number of households	size of the sublocation km2	population density no./km2	
Marianni	3655	735	34	108	'
	4624	735-930	34	136	"
Kanjuki	3960	694	59	66	'
	5009	694-878	59	85	"

' based on the Population Census, 1979
" estimations for 1985 based on a 4% population growth rate

Figure 3.6.2 shows the size distribution of the farmes in the survey area. We did not check if there exists a relation between the farm size and the size of the household.
As shown in figure 12 52% of the households in the survey area own only 20% of all the farmed land.
In 1979 there were at average 9,71 acre (3,93 ha) of arable land

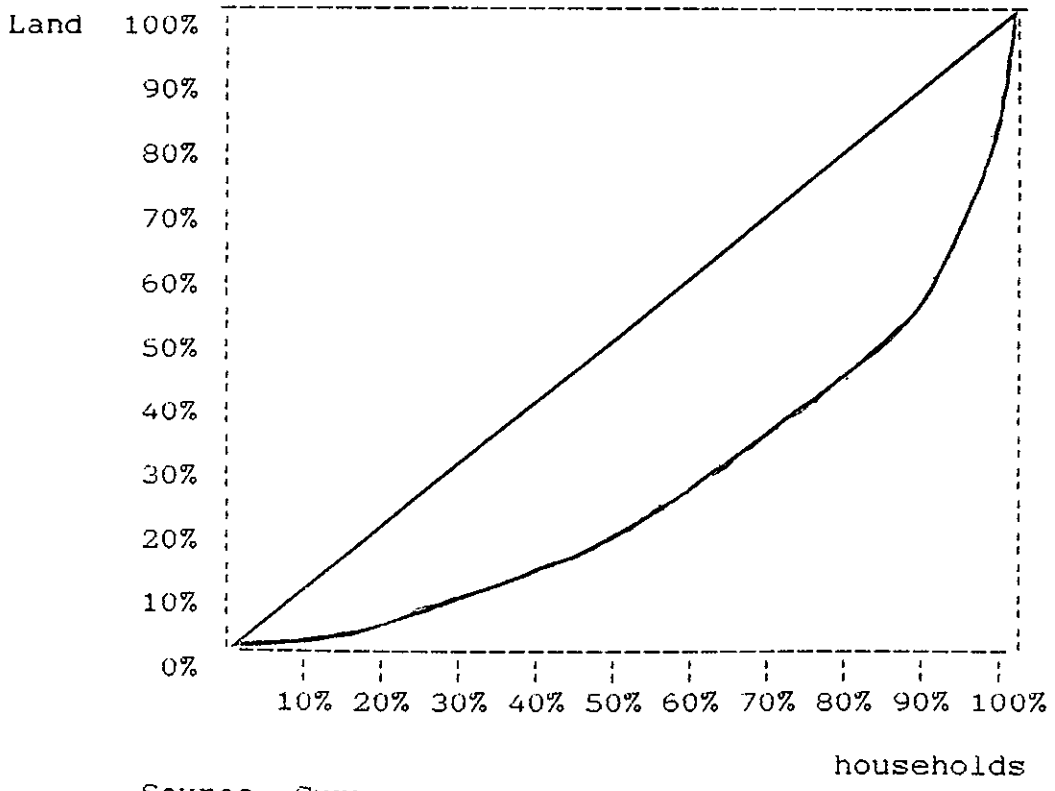
available per household in Marianni sublocation. In Kanjuki sublocation this was 17,84 acre (7,23 ha). With the population growth rate taken

Table 3.6.2 Size distribution of the farms in the survey area

Area of farm	Kaanwa number of farms	Kaanwa farmed land	Kaara Ka Mbabu number of farms	Kaara Ka Mbabu farmed land	Kanjuki number of farms	Kanjuki farmed land	Area number of farms	Area farmed land
(ha)								
< 1,0	5	2,5	5	1,8	6	2,4	16	2,1
1,0 to < 2,0	5	5,6	8	7,1	5	5,3	18	6,3
2,0 to < 3,0	3	5,2	3	4,4	5	8,7	11	6,4
3,0 to < 4,0	4	10,0	1	2,1	1	3,1	6	4,9
> 4,0	3	76,7	3	84,6	3	80,5	9	80,8

Source: Survey.

Figure 12 Lorenz curve of the farm size distribution in the survey area



Source: Survey.

into account these figures become 7,67 acre (3,11 ha) for Marianni and 14,10 acre (5,71 ha) for Kanjuki sublocation in 1985. With the present population growth rate it means that for Marianni sublocation all the arable land is cultivated within 15 years and for Kanjuki sublocation in

less than 30 years.

3.6.3 Population

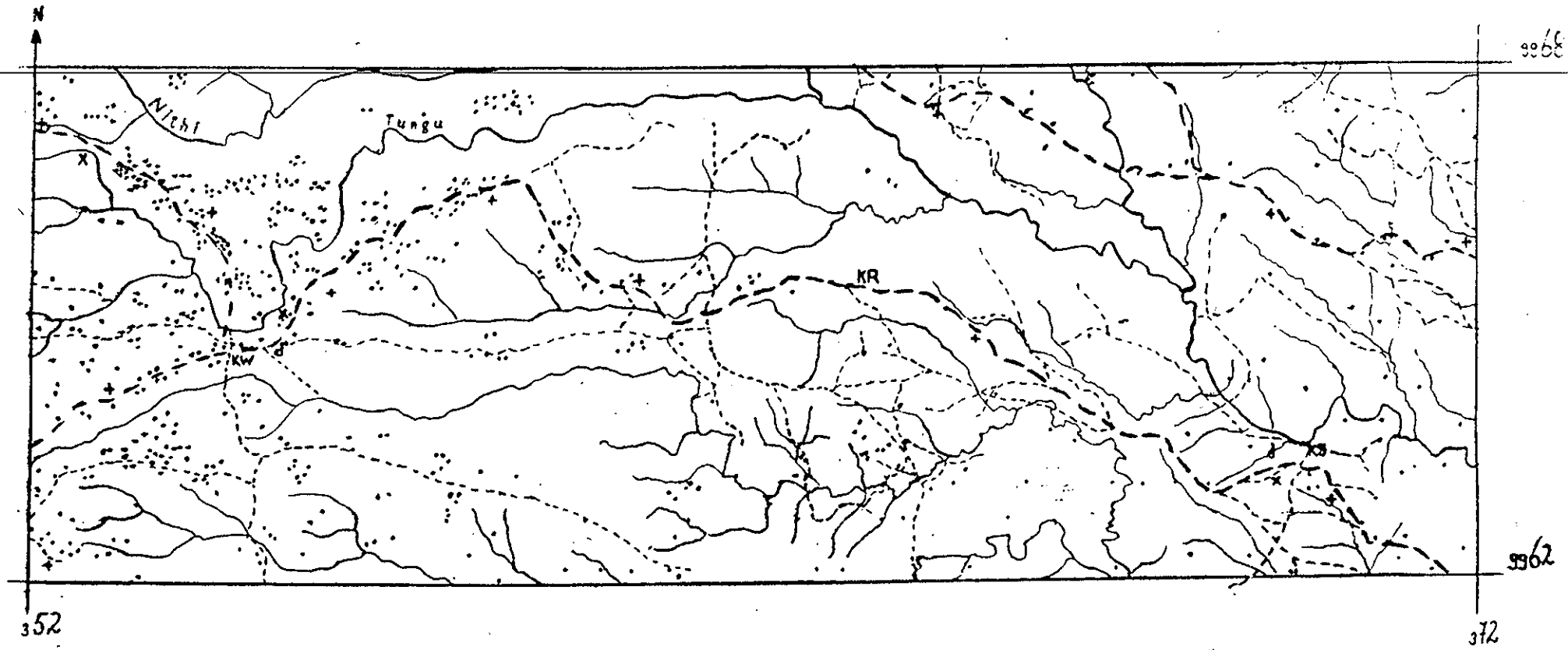
In the survey area the sizes of the households differ much. Table 3.6.3 shows these differences. Of the different regions Kaanwa is most densily populated and Kaara Ka Mbabu most less densily. For an overview of the population densities in the area see Figure 13. In Kaanwa 35% of the interviewed mzee's have more than one wife. These figures are for Kaara Ka Mbabu and Kanjuki respectively 25% and 5%. At average there are in Kaanwa region 1,4, in Kaara Ka Mbabu 2,4 and in Kanjuki 0,6 remaining dependent adults part of the households, of whome just a few are still visiting school. In the survey area the population growth rate since several years is just less than 4% p.a. East of Kaanwa the area is still free for settling and especially from eastern areas like Tharaka, people indeed come and settle. By an unchanging growth rate in the future, this means a doubling of the population within 18 years. However there are no realistic signals of a slowdown of the rate in the future. The direct result of such a fast growing population is the large and growing amount of young people in the population. At the moment already more than half of the population in the survey area is younger than 18 years (see table 3.6.3), a process of rejuvenation that still goes on. This together with the fact that there is no realistic outsight on employment in other areas of Kenya, shows the immediate and growing problems of the area, expressed in growing pressure of the population on the land and a growing army of the unemployed. Without a serious governmental policy aimed at solving these growing problems, they will inevitable 'solve' theirselves in disasters.

Table 3.6.3 Sizes and composition of the households in the survey area

	Kaanwa	Kaara Ka Mbabu	Kanjuki	Area
average number of dependent				
- adults	2,95	4,65	2,25	3,25
- children	4,50	4,10	3,80	4,13
average size of the household	7,45	8,75	6,05	7,41

Source: Survey.

Connected with the subsistence level of the farming in the survey area, the households attache importance to the long known traditions, religions and social organisations. So in the survey area you still meet celebration of circumcising, sacrificing of sheep, reciprocal resources of labour like Irima (see Chapter 4.3.3.), etc.



Source: Survey of Kenya, mapsheets Chuka and Ishiara.

KW = KAANWA
KR = KAARA KA MBABU
KJ = KANJUKI

\+ = SCHOOL
x = CATTLE DIP
d = DISPENSARY

. = CLUSTER OF POPULATION

—— = MAIN ROAD
--- = SECONDARY ROAD
___ = WHOLE YEAR STREAMING RIVER
___ = NOT-WHOLE YEAR STREAMING RIVER

SCALE 1:100.000

3.7 Infrastructure

In general the survey area is well open. This counts more so as related to the typical subsistence oriented farming in the survey area. There's one main road in the area, upgraded at least once a year, which is mostly easy to reach for the population by the many secondary roads in the area. In the west the main road debouches on the newly opened macadam road between the towns Embu and Meru, a road which shortens the travel time between Embu and Meru with 2 to 3 hours, going by motorcar, while in the east the main road debouches to the old road between Embu and Meru. Transport costs are for single trip from Kanjuki to Kaanwa vice versa 6,-- Ksh and for Kanjuki to Chuka vice versa 10,-- Ksh, which are the places of the local markets in the area. Of course this amount is mostly too much for the members of the households.
There are four weekly markets in the survey area. Wednesday and saturday in Katwana, just east off and near Kanjuki, monday and thursday in Kaanwa. In Kanjuki there is developing a market on sunday. Because of transport most people only visit the nearby market.
There are two dispensaries in the survey area. One near Kaanwa and one near Kanjuki. In general there is only one nurse and a clinical assistant per dispensary. Once in the three or four weeks the dispensary is visited by a doctor from the 'motherhospital'. The dispensaries are only for clinical treatments. For the more serious treatments the households in the survey area are committed to the governmental hospital in Chuka town.
Most of the children in the survey area do visit school, 63% in Kaanwa, 44% in Kaara Ka Mbabu and 70% in Kanjuki region. Only in the Kaara Ka Mbabu region there is an amount of households (20%), who can not afford their, or part of their children to go to school. The rest of the non schoolgoing children are, like in Kaanwa and Kanjuki too young. In the survey area there are six primary schools, well spread over the area (see figure 13). For the toddlers every primary school has a so-called nursery attached to it. There are no secondary or other continuation schools in the survey area. Of all the interviewed households 28% have no school attending children. Of the other households 51% spent 300,-- Ksh or less, 32% between 301,-- up to 1000,-- Ksh and 12% more than 1000,-- Ksh per year on school fees. For one year, is three terms primary school, you pay 300,-- Ksh, irrespective the number of children you put on primary school per household, per year. A fee which has to be paid at the beginning of the first term of the year, i.e. januari. The school fee for secondary school is at least 600,-- Ksh per term depending on the type of school. The total scool expenditures for a household are of course more than the above mentioned amounts because there are allways the additional costs, like for example the purchasing costs of the school uniforms.

3.8 Institutions

In Karingani location of which Marianni sublocation forms part, there are eighteen extension workers. One Technical Officer (TO), five Technical Assistants (TA) and twelve Junior Technical Assistants (JTA).

In Kanjuki location of which Kanjuki sublocation forms part, there are five extension workers. One TO and four JTA's. At present this comes down on one extension worker per 400 households*. This figure counts for both locations.
Every extension worker has a certain number of farms under his wings which he visits every week. Next to this he has to gather information on local market prices of the foodcrops. Every fortnight all extension workers come together at the Agricultural Headquarters of the division, based in Chuka town. Here they are trained in all sorts of agricultural extension items and exchange information with each other.
In the whole division there is just one tree nursery. In this nursery fruit and forest trees are cultivated. The planting of the nursery trees is aimed at soil conservation. The nursery is established in Kaanwa.
Next to the banks the Agricultural Finance Cooperation is an institute to grant credits in the area. The intrest rate of 13-14% is not too high. However hardly any household in the survey area makes use of this service. Reasons that can be summed up for this low degree in agricultural credit-use in the survey area may be:
- the low influence of money in the economy of the survey area
- institutional thresholds
- the landregistration which till now only reached up to Kaanwa village; thus the biggest part of the households do not have yet title deeds with which it becomes less hard to attract credits.

Nothing is known of eventual traditional credit and/or saving systems in the survey area or of local money lenders. There have been no seperate interviews with the credit facilitating institutions.

* The figure of 400 is estimated on basis of the Population Census, 1979. Taken into account by this estimation is the population growth rate of 4% as well as a delayed growth rate of the number of households in comparison with that of the population.

Chapter 4 THE FARMING SYSTEM IN THE SURVEY AREA

4.1 Introduction

Following those variables which in general can't be influenced by the individual farmer, this chapter deals with those variables concerning the farming in the survey area which can be and are influenced by the individual farmer. In a way also the environmental variables belong to the farming system in their determining of the outmost 'borders' in between which the farming system can variate. However when dealing with the farming system in the survey area there is meant the way of farming and use of land of the household you can find in general in the area. In the short run the dynamic of this system depends on the variables which can be influenced by the households. Hence the justification for describing the farming system on the base of those variables is found.
As mentioned in chapter 1, use is made of the conceptual model developed by Collinson for describing the farming system. So the variables that are dealt with in this chapter are the objectives of the household, its decisions and resources as well as the subsystems formed by the cropping, livestock and the off-farm income.

4.2 Objectives of the household

The objectives of the household are in seqeunce with their importance for the household (see Collinson, 1981):

a) safeguarding the future
b) provision of food
c) meeting of the social obligations
d) maintaining or improving status and wealth symbols.

Of course these objectives are linked with each other and so the ranking is not of the kind of first meeting objective a) and after this the meeting of objective b), etc., but the household tries to meet them all at once. The ranking is because in a way the last three objectives are subjected to the first, the last two to the second, etc.
The predominate characteristic of the farming system in the survey area is the subsistence orientation of the household. Their main task is to survive from year to year or season to season. Seen in this light all the activities of the household are to relate to the safeguarding of the future. In this safeguarding the avoidance of risks plays an important role. Of course as a farmer you can't avoid those risks which are in the nature of farming. You can't predict the outcome of the farming. Still in the farming as a form of enterprising you allocate the means and resources in such a way to guarantee yourself as much as possible of a maximum profit. However the risks taken in this enterprising way of farming are too high to be taken by households which farm as a necessity for surviving. So the households in the survey area first put their means and resources, allocated on the base of experience, in the producing of the needed foodcrops. The eventual 'remaining' means and

resources they put in the producing of the most promising cashcrop(s). Another way of avoiding risks is the planting of several foodcrops instead of just one. So there is a big change that at least one foodcrop will produce something in a bad year.
The meeting of the social obligations is an important factor to survive within and as a society. That counts for every society, small or large. But in a relatively small society where almost everybody knows everybody and which existence is continuously threatened, the importance of this factor is unaccountable. Examples of such obligations are the (sizes of the) dowrys, the participation in irima, etc.
Also like in every society the maintaining or improving of the status and wealth symbols, in general is of certain importance for the individual households and household members. Examples of those symbols are the number of wifes a mzee has married, the sizes of the livestock herds, etc.

4.3 Resources of the household

4.3.1 Introduction

The resources of the households are roughly to divide in their disposition over land, labour and capital. All three are important means of production.

4.3.2 Land

Concerning the mean of production land, the survey area is to divide in two parts. The part already controlled by the landdivision and the part of the survey area that is still 'free'. The governmental landregistration* has reached at the moment, coming from the west, the Kaanwa region. East of Kaanwa region the area is still free for settling and indeed a settling area of Kenya.
Because the registration in Kaanwa region took place in the near past the households do have enough land to provide them of enough food and cash in an average year. A household in Kaanwa region which wants to enlarge their cultivation sizes, are now obliged to either buy or rent that land. The price of an acre land in the Kaanwa region varies between 6000,-- to 8000,-- Ksh, depending on factors like the scarcity, the

* In this report no attempt is made to deal with all the other effects, apart from that on the landavailability, the registration has on the farming in general. Partly due to the lack of time and space, parlty because this subject got a lot of attention in other publications. For the interested readers in this subject there is referred to those publications. However where the influence of the landregistration is striking, it is dealt with in the report. See for example the influence of the registration on the keeping, meaning and sizes of the livestock in Kaanwa region (chapter 4.5).

situation and the fertility of the land. The rent of an acre land is about 200,-- to 250,-- Ksh per year. The landavailability in the future, with the present population growth and bad foresight in relation with employment in other branches than the agriculture, is not really influenced by the landregistration. With or without the registration the problem of probable landscarcity in the future will present itself.
As mentioned already the rest of the survey area is still free to be settled. So here there are no official titles on the lands and in accordance with it no prices or rents either. The settled households just cultivate as much as the other resources like the labour and cash allow them to.
For an overview of the average cultivation sizes in the survey area see Table 4.3.2. In this table two sizes for each region are given. The first is estimated on the measurements done at several farms scattered over the survey area. The second is based on the figures given by the interviewed households.

Table 4.3.2 Average cultivated sizes by the households in the survey area (in acres)

Region	Average cultivated size	
Kaanwa	2,9	3,7
Kaara Ka Mbabu	2,1	2,6
Kanjuki	4,5	3,3
Area	3,2	3,2

Source: Survey and Measurements.

Table 4.3.3.1 Labour availability of the households in the survey area

	average availability per household (manday/day)		
region	male adults*	female adults	total
Kaanwa	0,7	0,9	1,6
Kaara Ka Mbabu	1,6	1,2	2,8
Kanjuki	0,5	0,7	1,1
Area	0,9	0,9	1,8

Source: Survey.

* The used division between adults and children is on the base of the age. All household members of eighteen years and older are accounted as adults.

4.3.3 Labour

On the farms in the survey area different kinds of labour are available and their contribution to the work of the farm varies. The most prominent supplier of the labour on the farm is of course the household itself. For the distribution of the labour availability of the household in the survey area see Table 4.3.3.1. The in this table used conversion factors, to estimate the number of mandays labour available per household per day are, in accordance with the Farm Management Handbook of Kenya (Vol. 1, 1979):

1 male adult = 1,0 manday
1 female adult = 0,8 manday.

The labour availability of an adult household member working permanently on the farm is approximately 5 to 7 hours per day, for about 260 days per year (see F.M.H.K, Vol. 1, 1979). The used number of working hours per manday is 8 hours. Hence the working capacity per year of an adult household member is to estimate at 195 mandays if male, and 158 mandays if female.
Another kind of available labour on the farm is supplied by the children. However this availability is not included in the labour supplied by the household (according to the Farm Management Handbook of Kenya Vol. 1, 1979). The childrens' contribution is relatively small and they are mostly occupied with work like herding, collecting water and firewood, etc. which can not be assessed correctly and has therefore to be excluded. Their (additional) help during peak periods is most welcome, as labour shortage is common during these periods. The possibility that one of the adults falls ill or is unavailable during a peak period makes it also necessary to consider the work contribution of the children as a reserve factor. The help of children on family farms can not be considered 'child labour' in the usual sense, as it benefits both parents and children. In the survey area there is a strong emphasis on education which reduces the time available for work on the farm. It speaks for itself that in the labour demanding peak periods the elasticity of the labour availability supplied by the household is high. The kind of permanent employed labour by households was not met in the survey area. However the use of casual labourers is sometimes used by some households, although this is still pretty rare because of cash constraints and the relatively low returns from the various enterprises of the households. Besides the use of casuals is an unreliable labour source because they offer themselves for work by passing by the farm and so, often when a household intend to make use of a casual, there is none. The casuals are hired only in the labour demanding peak periods, i.e. the preparation of the land, the weeding of the land and sometimes during harvesting. They are paid mostly in the form of piece-wages, corresponding with about 10,-- Ksh. per manday work. In Kanjuki region at least half of the households prepare their land by making use of a oxen-draught plough. Some of those households have a plough themselves, others do hire a plougher, usually a neighbouring farmer who has the disposal over a plough. The price paid for the ploughing is about 100,-- to 120,-- Ksh. per acre. The herefore required labour is one manday.
Apart from the above mentioned kinds of labour used by households in the survey area, the use of a traditional form of reciprocal labour cooperation called Irima, is pretty commmon in the survey area. In this

kind of labour relatives, friends and neighbours from various households cooperate with one another to alternatively offset individual labour constraints during the labour demanding peak periods, or in completing particularly labour demanding farm operations, like for example the building of a house. The obligations of an Irima using household involves reciprocation and the provision of lunch and tea during the work on its farm. For the percentages of households using Irima in the survey area see Table 4.3.3.2. An explanation of the relatively low number of households in Kanjuki region using Irima is perhaps the common use of oxen-draught ploughs, which makes the landpreparation from a high labour intensive activity into a low labour intensive one.

Table 4.3.3.2 Percentage of households in the survey area using Irima

region	percentage of households using Irima
Kaanwa	75 %
Kaara Ka Mbabu	70 %
Kanjuki	50 %
Area	65 %

Source: Survey.

4.3.4 Cash

The disposal over cash by the household in the survey area is, as already mentioned between the lines, of a small meaning. Mostly this resource of the household is in the form of a constraint. There are just a few ways open for the household to get the disposal over cash. First by selling the cultivated cashcrops. Secondly through off-farm enterprise(s) by one or more of the household members. Off-farm enterprises like the trading in eventual resting foodcrops, the trading in charcoal, the beekeeping and/or (permanent) employment off the farm (see chapter 4.6). Lastly by selling (parts of) the livestock when there is cash needed on short notice, i.e. in cases of urgent need of cash.
The general expenditures concern the school fees to be paid every year in januari and payments for medical treatments. By foodshortnesses the household has to buy the food on the local market(s). Small amounts of cash are also needed for domestic needs such as sugar, tea, salt and kerosine.
In the survey area it is pretty common among the households to sell things only when cash is required. So what they sell depends on the by the household required amount of money. For example foodcrops for very small, poultry for small, goats for large and cattle for very large expenditures.
The reigning economy in the survey area runs largely without cash. A lot of trading between the households still takes place trough the exchange in kind.

4.4 Agronomy

4.4.1 Introduction

As shown in appendix 3, the agronomical part of the questionaire starts with gathering general information on the food- and cashcrops the farmers grow. The crops listed in this part of the questionaire appeared

Table 4.4.1.1 Crop occurrence

	% of households growing crop			
crop	ar	kw	kr	kj
maize	84	100	100	50
red sorghum	39	95	15	5
white sorghum	35	35	45	5
compact sorghum	72	30	85	100
sorghum together	100	100	100	100
bulrush millet	89	70	95	100
beans	53	95	55	10
pigeon pea	88	100	90	75
cow pea	97	90	100	100
green gram	72	30	85	100
cotton	60	35	55	90
sunflower	33	25	30	45
tobacco	42	90	35	0
coffee	13	40	0	0

ar=Area; kw=Kaanwa; kr=Kaara Ka Mbabu; kj=Kanjuki

Source: Survey.

Table 4.4.1.2 List of minor crops per area

Kaanwa	Kaara Ka Mbabu	Kanjuki
mango	mango	mango
pawpaw	pawpaw	pawpaw
castor	castor	castor
pumpkin	pumpkin	pumpkin
cassava	cassava	
arrowroot		
sweet potatoe		
english potatoe		
napier grass		
bana grass		
banana		

Source: Survey.

to be the most important crops during the exploratory survey and the testing of the questionaire. They are therefore called the major crops. By starting in this inventorial manner, one gets an impression of the farmers priorities on the one side and the environmental constraints on the other side. The results are joined in the tables 4.4.1.1 and 4.4.1.2. The data of the two tables are based on the answers of the farmers only.
Further research on the so-called minor crops has not been performed. On the other hand, additional information concerning the major crops, could be obtained from the measurements.

4.4.2 Major crops

After interviewing sixty farmers, the farms of twenty-one of them were measured. This was done to have a check on the estimates made by the farmers, esp. concerning farmsize and acreage per crop, and to obtain some accurate figures. The followed procedure implicated a revisit of seven farms per region, so the measurements are, of course, related with the interviews.
The tables 4.4.2.1, 4.4.2.2 and 4.4.2.3 contain the results of the measurements. Naturely the figures should be regarded with considerably caution,as they originate from a fairly small sample and reflect just one season (first season '85) in stead of a whole year.
Each of the three tables has five items. The given percentages are all based on square meters (100%= all farmed land) except the avarage

Table 4.4.2.1 Cropping data for the Kaanwa region

crop	total acreage of crop in m2	(real) % of occurrence	average % (priority)	% of crop planted pure	no.
maize	31690	39.0	35.0	39	7
sorghum	8450	10.3	10.3	0	6
milllet	200	0.2	0.5	0	2
beans	2040	2.4	4.4	0	3
pigeon pea	24490	29.9	25.9	25	7
cowpea	1490	1.8	3.3	5	5
greengr	0	-	-	-	-
cotton	2700	3.2	4.4	14	3
sunflower	0	-	-	-	0
tobacco	2250	2.8	5.2	0	4
(coffee	1250	1.5	1.6	100	1)
others:					
cassava	2300	2.8	2.7	0	5
sweet pat	2450	2.9	3.4	18	6
banana	1980	2.4	1.9	41	3
grasses	640	0.8	1.4	22	2
total	81930	100.0	100.0	26	-

Source: Survey.

percentages; this item exists of the summed percentages per farmer devided by the sample-size. Example for sorghum in the Kaanwa-region: (10%+24%+19%+0%+3%+1%+15%)/7=10.3%. This figure has been calculated, because it is an indication for the farmers priorities and it eliminates the influence of very large farms. The accuracy of the 'total acreage' might be somewhat exaggerated, but enables you the possibility to check. According to Jaetzold, the Kaanwa region is situated in the east part of the cotton zone, close to the marginal coffee zone. The Kaara Ka Mbabu

Table 4.4.2.2 Cropping data for the Kaara region

crop	total acreage of crop in m2	(real) % of occurrence	average % (priority)	% of crop planted pure	no.
maize	12365	20.8	17.0	4.4	7
sorghum	14500	24.4	26.7	0	6
millet	11385	19.1	21.4	0	7
beans	0	-	-	-	-
pigeon pea	6175	10.4	9.1	0	5
cowpea	1105	1.9	1.7	0	3
greengr	0	-	-	-	-
cotton	13850	23.3	23.9	75.0	5
sunflower	85	<0.1	0.1	0	1
tobacco	65	<0.1	0.1	100.0	1
coffee	0	-	-	-	-
total	59530	100.0	100.0	18.4	-

Source: Survey.

Table 4.4.2.3 Cropping data for the Kanjuki region

crop	total acreage of crop in m2	(real) % of occurrence	average % (priority)	% of crop planted pure	no.
maize	13705	10.7	7.4	24.6	5
sorghum	15105	11.8	20.6	5.8	5
millet	11420	8.9	6.7	26.5	4
beans	0	-	-	-	-
pigeon pea	10410	8.2	6.5	0	4
cowpea	10525	8.2	7.5	0	5
greengr	11275	8.8	9.7	0	5
cotton	52390	40.9	37.0	67.8	6
sunflower	3200	2.5	4.6	0	3
tobacco	0	-	-	-	-
coffee	0	-	-	-	-
total	128030	100.0	100.0	33.5	-

Source: Survey.

region lies also in this zone, but close to the marginal cotton zone, and the Kanjuki region has its place in the transition of the marginal cotton zone and the livestock-millet zone. The agro-ecological zonation of Jaetzold is quite dubious; the crop characterizing a zone, is not necessarily the major crop of that zone. It is for this reason, that in this report simple symbols will be used to characterise the different zones: D for the cotton zones (Kaanwa and Kaara Ka Mbabu) and E for the livestock-milletzone (Kanjuki) For all AE-zones, see appendix.....

Kaanwa

The Kaanwa figures (table 4.4.2.1) show the popularity of maize and pigeon pea, and to a less extent sorghum. Together the three crops cover nearly 80% of the farmed land. Another striking fact is the unsignificance of the cashcrops, which cover only 7.5% of the area. Coffee and sunflower are neclectable, also in the two other regions. It is questionable to call sunflower a cashcrop anyway, because it is mainly used as chicken food (the vernecular name for sunflower is mbembe cia nguku, maize for the chickens). Tobacco and coffee are grown on a rather small scale. Of course the figures are based on only one season, but the present crops are grown as two-seasonal crops in this region. It may be clear that here is dealt with subsistence farming.
The foodcrops extremely dominate this area (92%), and are grown in quite a ballanced way: cereals 50% and pulses 34%. Also some tubercrops are grown (6%); cassava and sweet potatoe don't occur on special sites, but arrowroot, like banana, prefers a moist soil and is only seen on river-sides.
The planting of the crops is mostly done in a mixture. Only 5% of the (farmed) area is planted pure (of which 87% by maize and pigeon pea). As the landadjudication already passed Kaanwa (moves to the east), and the landpressure is high (small farms), not many farmers practise a period of fallow. Averagely 12% of the land is left fallow, which of course is insufficient for the soil to recuperate. Farmers owing more land, tend to leave a higher percentage fallow. More information on this subject can be found in paragraph 4.4.3.

Kaara Ka Mbabu

The enormous variety in crops as shown in the Kaanwa region and to a less extent the Kanjuki region, is entirely absent in the Kaara region. The remaining crops are maize, sorghum (predominantly the drought resistant white and compact types), pigeonpea, millet and cotton.
Notwithstandig this impoverishment in cropchoice, the farmers do grow more cashcrops (i.e. cotton) compared to the Kaanwa region. The cashcrops cover 23% of the farmed land, the foodcrops 76%. In real percentages the cereals are prefered above the pulses (respectively 64% and 12%). Pigeon pea is in fact the only representative of the Leguminosae. When one compares the the tables 4.4.2.1 and 4.4.2.2, the figures on the pulses differ very much. The unreliability of the first rains may be an explanation.
Also in this area, most farmers practise intercropping. Only 18% of the crops is planted pure, but this percentage originates for 95% from cotton. Obviously the farmers prefer a pure stand of cotton. This corresponds with the opinion of most farmers: cotton does best in pure stand. Especialy in the most productive second season of cotton, most farmers think that a second crop will reduce the cotton production. According to Jaetzold, this area would be classified as marginal cotton

zone. The cotton percentages in both Kaara and Kanjuki contradict this classification.

Kanjuki

From west to east we have seen a steady increase in cashcrop growing and consequentely a decrease in growing foodcrops. This tendency continues in Kanjuki: cashcrops cover 43% of the farmed land and foodcrops 57%. The importance of sunflower seems to gain, but the acreage on cashcrops consists for 94% of cotton. The high percentage of cashcrops is partly due to a quite large farm concentrating on cotton. It would be better to use the average percentages in this case. The cereals (25%) have a minor position with respect to the pulses (31%). A decrease in growing cereals when going east is clear, mainly due to the striking decrease of maize-growing. Concernig the pulses, there is no preference for either cowpea,

Table 4.4.2.4 Cropping data for the survey area

crop	total acreage of crop in m 2	no.	(real) % of occurrence	% of crop planted pure
maize	57760	19	21	28
sorghum	38055	17	14	2
millet	23005	13	9	13
beans	2040	3(kw)	1	0
pigeon pea	41075	16	15	15
cowpea	13120	13	5	<1
greengram	11275	5(kj)	4	0
cotton	68940	14	26	67
sunflower	3285	4(kj)	1	0
tobacco	2315	5(kw)	1	3
other	8620	-	3	-
total	269490	-	100	30

Source: Survey.

Table 4.4.2.5 Relative importance of various items (%)

item	kw	kr	kj	ar
cashcrops	8	23	43	28
foodcrops	92	77	57	72
pulses	34	12	25	25
cereals	50	64	31	45
fallow	5	<5	<5	<5
pure cropping	26	18	34	30

kw=Kaanwa; kr=Kaara Ka Mbabu; kj=Kanjuki; ar=Area

Source: Survey.

pigeon pea or greengram.
The cotton is, like in the Kaara region, mostly planted in pure stand. This results in a fairly high percentage for pure cropping. Also the liberty of the famers to choose the sites and locations for their plots, resulting in a larger farmsize, implicates a lower landpressure and therefore a lower percentage of intercropping.

4.4.3 Fallow and clearing

4.4.3.1 Introduction
During the measurements not much information on fallow-practices was gained, simply because not many farmers with a fallow plot were encountered. Due to this small number of observations, most information of this paragraph comes from the questionaire.

4.4.3.2 Fallow
As can be seen in table 4.4.3.1, 45% of the farmers don't practise fallow. in percentages of land an even lower level of importance is indicated.

Table 4.4.3.1 Importance of fallow in the survey area

region	% of farmers without fallow	% of land left fallow
Kaanwa	55	12
Kaara	35	31
Kanjuki	45	21
Area	45	23

Source: Survey.

Table 4.4.3.2 Fraction of land fallow

landclass: % of dedicated to fallow	% of farmers in this class %	cum
no fallow	45.0	45.0
>0 - 20%	16.7	61.7
20 - 40%	20.0	81.7
40 - 60%	13.3	95.0
>60%	5.0	100.0

Source: Survey.

The average size of fallow acreage per farmer who had such is 2,6 acre, occupying 23% of the land (farmed + fallow = 123%). The size of the fallow plots is mostly very small: 66% smaller than 3 acres and more than half of this smaller than 1 acre. Looking to table 4.4.3.1, it is striking that in the Kaanwa region fallow is quite insignificant. In

Kanjuki and Kaara the practise is more common, but still considerably low. Some farmers stated that proper rotation was adequate to maintain soilfertility; for the Kaanwa region, with its fairly elaborate variety of crops, this might be true, but for both other regions another explanation has to be given, for they are less suitable for many crops. A reason for the Kanjuki region can be the increasing importance of livestock when moving east. In the Kaara region a higher frequency of the practise is prevented by the dense vegetation that appears quickly when a piece of land is left fallow.
Hardly any of the farmers had a regular system or time-schedule for his fallow piece(s). Most of the farmed land didn't have a fallow-period for a long time. In the Kanjuki region the farmers prefered to clear an entire new piece of land, as land is largely available here, it hardly means extra work (quite open physiognomy) and the soil contains more nutrients than a piece of land that has been temporary fallow.
Especialy for a subject like fallow it's hard to make conlusions based on average figures. Therefore an attempt was made to perform a one-variable regression analysis. The result was a linear function of available land and fallow land. However, the obtained curve showed a degressive increase at the larger farms (exponential). The main reason for this flattening is, again, the lack of labour and cash to maintain a large piece of land. The lack of proper tools, of time, of chemicals etc., can always be reduced to these two factors.

4.4.3.3 Clearing
Also for clearing the scarcity of labour is the main limiting factor. Only 13% of the farmers cleared a plot in the past 5 years! Each region has its characteristic physiognomic unit (=appearence of the vegetation).
In the Kaanwa region the not cleared pieces are classified as bushland, Kaara Ka Mbabu has dense bushland and the Kanjuki region shows woodland (literaturelist #). In the latter region the landscape is quite open and easy accessible, in contradiction to the Kaara region. The motives for clearing can be various: the advantages the farmer sees, present land-use, the fertility, his availability of labour, cash, land etc. For the Kaanwa region the low clearing rate can be explained by the fact that the land has been devided. In Kaara the labour availability and the dense bush are the main obstacles.
The clearing is mostly executed very long ago (sometimes beyond people's memory). As most land is inherited, this is not surprising. The 'original' vegetation (secondair) exists of trees, bush and grass. First of all this vegetation is cut down with a panga and left for a while to dry. Consequentely the material is burned. Time- and labourshortage obstruct the mixing of the material with the soil, so a lot of valuable nutrients volatilize (esp. nitrogen and phosphorus). In some cases just burning or weeding is sufficient for the clearing (notably the farmers of Kanjuki profit of this advantage). After removing the vegetation, the soil is prepared with a panga, a (forked) jembe or an animal-drawn plough. The latter method is frequentely used in Kanjuki.
Considering the low importance of fallow and clearing, the cropping system of two crops (seasons) per year, the absence of fertilizing and low level of manuring, a decrease in soilfertility is inevitable.

4.4.4 Cropping patterns and rotations

As shown in the paragraph on the major crops, mixed cropping occurs on 70% of all farmed land. An attempt has been made to discover the most important intercropping combinations and rotations, if present anyway. For this purpose every plot was screened on its cropping pattern and subsequentely the owner was asked which crops would be in it next season (see appendix..... for questionaire). Thus 400 intercropping and rotation 'systems' were obtained. The tables 4.4.4.1 and 4.4.4.2 are based on the interview, accept the values on pure cropping, which are based on the measurements (indicated with *). Furthermore a considerable simplification was necessary to reduce the enormous amount of combinations: no distinction was made between the three sorghum types, the four Leguminosae were joined and sunflower was excluded. In this way 'only' 38 combinations remained.

Table 4.4.4.1 Relative and absolute percentages of crop combinations

	absolute %	
30% pure cropping of which		
64% cotton	19.2%	(0.64*30)
22% maize	6.6%	
8% a leguminose	2.4%	
6% other crop	1.8%	
55% two crop combinations of which		
28% maize/leguminose	15.4%	
19% sorghum/leguminose	10.5%	
15% millet/leguminose	8.3%	
9% millet/sorghum	4.6%	
7% maize/tobacco	3.9%	
6% maize/millet	3.3%	
5% maize/cotton	2.8%	
11% other combinations	6.2%	
13% three crop combinations of which		
25% sorghum/millet/leguminose	3.3%	
75% other combinations	9.7%	
2% four or more crop combinations	2.0%	
	100.0%	

Values < 2% have been excluded.

Source: Survey.

As the table concerns the whole area, it is advisable to consult the tables 4.4.2.1, 4.4.2.2 and 4.4.2.3 to determine the important crops per region.
It is clear that the combinations of a cereal with a leguminose occur most (together 37.5% which means over 50% of all intercrops). Next to these combinations, there isn't another that realy dominates. In an area of subsistence farming and rainfed agriculture this absence is not surprising; each farmer makes an individual decision considering his (food-)references, expected rainfall, his experiences with cropfailure, available inputs, etc. Minimizing the risk is the most important facor. No one can give a guarantee that a certain crop or combination won't fail.

The mentioned decisionmaking factors, also highly influence the succesion of crop (combinations) in a quite negative manner. The need of food has priority. So when for instance maize failed in the previous season, the farmer will try the crop again as it is an essential ingredient of the local diets, and he often can't afford to buy food. The second priority is to obtain cash. One can imagine that maintainance of soilfertility by rotation, soilconservation etc, are minor issues when fundamental needs prevail (see for the objectives of the households chapter 4.2).
The figures on rotation support more or less this exposition. The table is more a hotchpotch of figures, than a serious indicator for rotation-practises.

Table 4.4.4.2 Rotations (%)

succeeding crop	'maize'	'sorghum'	'millet'	'legume'	'cotton'	'tobacco'
'maize'	18	16	21	20	15	29
'sorghum'	11*	17	16	13	15	4
'millet'	27	30	16	29	21	17
'leguminose'	29	30	44	27	15	29
'cotton'	5	2	3	5	32**	4
'tobaccco'	10	5	0	6	2	17

* This means that a maize combination (pure stand included), is succeeded by sorghum in 11% of the cases.
** The high figure is because cotton is grown for two season or more.

Source: Survey.

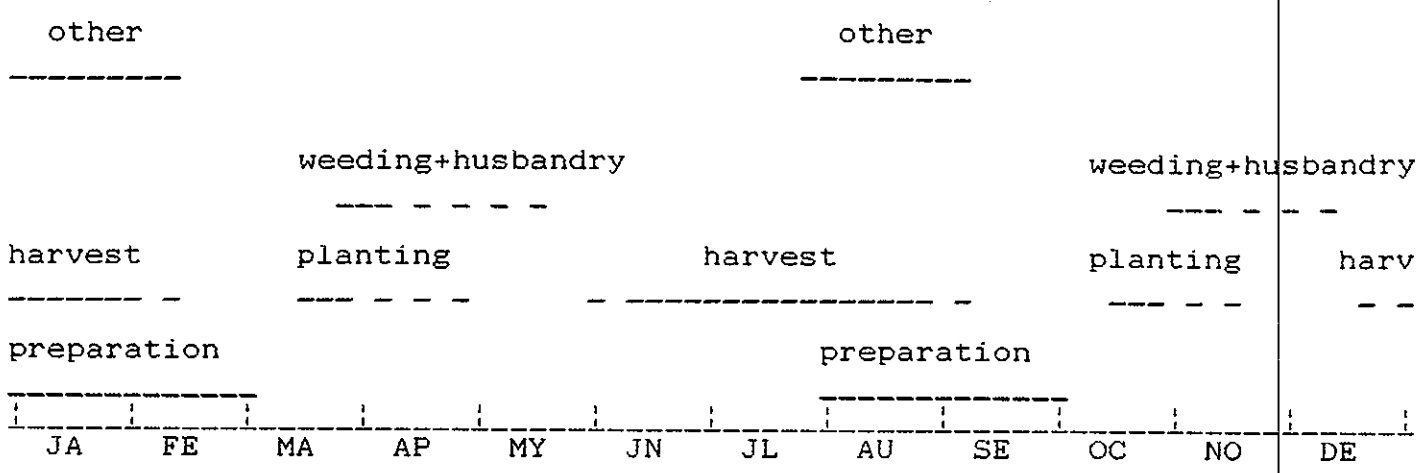
4.4.5 Culture practices

Before going into the details of the culture practices of the survey area, a calendar of activities is given in figure 14. However only one season is investigated and the timing of individual farmers may differ very much, the figure gives a general idea of the activities of the farmers.

4.4.4.1 Preparation

The preparation can be done after the previous crop is harvested. Roughly can be said that it is done in the dry periods between the rainy seasons. Again one should consider that the survey was executed in the second season, so for the first season we have to rely on the statements of the farmers. The preparation is, like weeding, very labour intensive, as it is performed with simple tools in most cases (see figure xx). In the Kaanwa region the jembe was popular, but in the drier areas the forked jembe is prefered to turn the topsoil (upper 10-15cm). The panga is used to remove weeds, but in the stony areas one uses the morro to do so.
In the Kanjuki region often a plough is used (by 50% of the farmers) to prepare the soil. The reason for this is that the stoniness hampers the use of other tools. Moreover the soil is very hard after the dry sea-

Figure 14 Activity calendar for the survey area



Other activities:
- house building
- making terraces
- clearing
- making stone lines
- charcoal production
- beekeeping
- irima
- selling products
- etc.

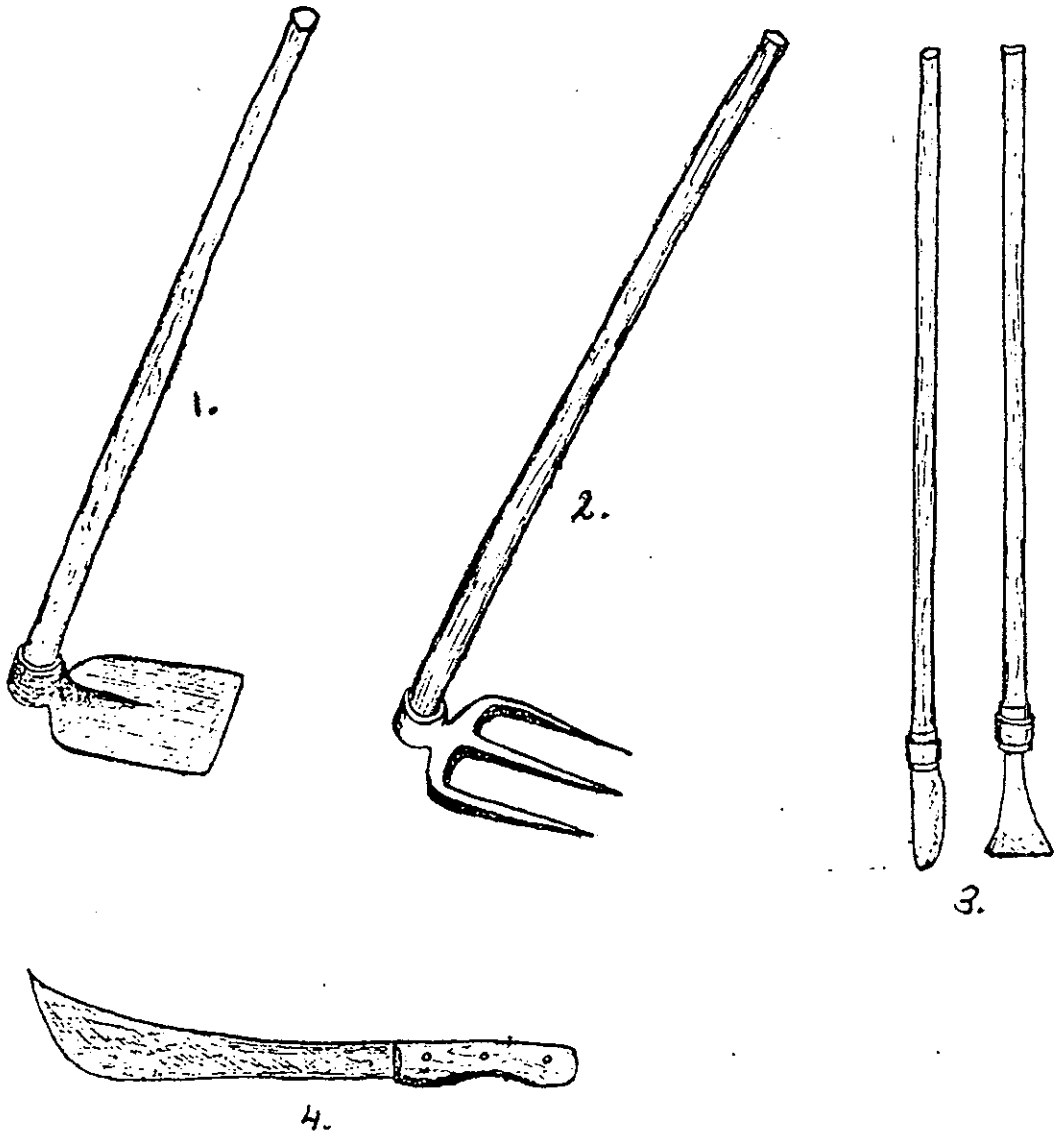
sons. When the preparation would be delayed till after the start of the rains, when the soil is softer, the growing season would be too short for several crops. The preparing by plough saves the farmer an enormous amount of time: one acre takes only one day. Another advantage of this tillage is the larger deepness one can reach, which is stimulating for the rooting of the crops.
Normally the soil is just loosened. For some crops the farmers do create ridges sometimes. Also zero-tillage occurs; the sole activity is weeding then.

4.4.4.2 Manuring
Whenever a farmer uses manure, it is mixed with the soil during the preparation. The use of manure is not common. There are two crops on which more or less regular manure is applied: tobacco (90%) and maize (80%). The percentages mean that tobacco is manured by 90% of the farmers. For the other crops this percentage is very low: 10-20%. This means that in 1-2 out of 10 years manure is applied.
The manure is produced in a kraal, a fenced place in the open air where the livestock spends the night. When there is enough to manure a plot, the farmer transports it to the shamba.
Fertilizer is almost never applied, the use of mulch is rare, fallow periods are too short or absent and manuring is unsufficient. One doesn't need a vivid imagination to draw a conclusion.

4.4.4.3 Planting
The planting is always done before the onset of the rains. The crops are always planted in rows; occasionally a stick or rope is used for straight lining and regular spacing. Some farmers do the planting

straight behind the plough. The seeds are put in the soil with a panga or a morro. For the transplanting of tobacco, a stick with a sharp point is used. The seedrates of the different crops haven't become clear from the interviews. No hybrids are used, except for cotton (provided by the cottonboard). Nearly all farmers select the seeds from the harvest of a previous year by simply taking 'the best'. None of the farmers uses seed dressings, except for cotton. The rotoonig of sorghum is performed at the beginning of the dry season.

Figure 15 Some cultivation tools



1. Jembe
2. Fork-jembe
3. Morro
4. Panga

4.4.4.4 Weeding

The first weeding is performed 2-3 weeks after the onset of the rains (after germination), so no fixed dates exist. Normally a crop is weeded twice, but cotton sometimes three times. In the Kaanwa region the panga is used for this purpose, but in the stoney areas a morro is used at the same time. The weedings are facilitated by the fact the crops are planted on rows. Often the farmers, esp. the women, work together in groups (irima). Then it is possible to weed a certain plot very quickly.

4.4.4.5 Crop protection

The crop protection is a very neglected subject. Simple methods like applying honey (against ergot) and ash, are still practised. Only cotton is protected on a resonable level. A wide range of diseases and pests bothers the crops, but only few measures are taken to prevent or control them. When chemicals are involved in the crop protection, this is understandable, as most chemicals are expensive. However, when dealing with bacterial and fungal diseases, a lot can be achieved by hygienical measures like removal of infected material (or destroy it by burning), using no seeds of infected plants, intercropping or rotation systems with different hosts etc. Most of these measures are simple and cheap, but the farmers are not aware of them nor do they see the dangers of the diseases. A clear example is the frequent occurrence of both loose- and covered smut (Sphacelotheca spp.) on sorghum. The disease can be airborne (or seed-borne) as the spores of the fungus which are produced inside the grains, are easily spread by the wind. It would be very effective to burn the infected plants before this can happen, but as the farmers don't see any danger, no action is taken. This ignorance occurs widely. Infected material is not removed and destroyed. On the contrary there is even created a reservoir; the pathogens are given the opportunity to multiply almost unlimited as the remainder of most crops is left on the land for trashlining.

Extension officers should teach the farmers how to discover infective diseases and how to deal with them. They should provide the farmers with information on phyto sanity, intstead of just concentrating on cash crops and pests. It is wrong to stress cashcrops too much when foodproduction is at stake, especially in an area of subsistence farming. Also the problems caused by monkeys and birds deserve more attention in research and extension.

4.4.4.6 Harvesting

Of course the harvest methods of the various crops differ. For details is referred to the LUT's, appendix 1.

The harvest of crops like maize, millet and sorghum, is done in the dry season, when the plants are completely withered. It is done in a few stages, like the picking of the cotton. Much earlier the beans are harvested and the same with the leaves of cowpeas. The tubercrops stay in the soil as long as possible and are harvested just before consumption as it is hard to store them.

The cereals are harvested with a knife and a panga, for tubers both panga and jembe are needed. Nearly all croprests are left on the land and are used for trashlining. The cereals are dried, threshed, winnowedand stored in small huts which are about 50 cm above the ground. Often a white powder (2% malathion) against storage insects is added. Also the pulses are stored in these huts. The cotton is also stored in a dry elevated place.

4.4.4.7 Production
No accurate figures on yields resulted from the survey The figures given in table 4.4.4.3 must also be regarded as rough estimates. For comparison figures of Jaetzold and Acland are added.

Table 4.4.4.3 Yields of some major crops (kg/ha)

crop	survey		Jaetzold (average)		Acland average
	range	average	LM3	LM4	(range)
maize	200-1100	600	1100	1100	1000-1200
millet	50- 450	100	1300	900	450
sorghum	100-2500	1000?	800	800	500-1700
cotton	400- 500	450	450	500	200- 450
grams	-	-	1000	900	200- 450

Source: Survey.

Whatever the yields may be, over 65% of the farmers stated to have shortage of food regulary. These shortages predominantly occur towards the end of the year. The months October, November and December are desastrous for many people. The first season is unreliable of rainfall and its harvests are often bad. The best harvests must come from the second season.

4.5 Livestock

4.5.1 Introduction

The figures concerning livestock as presented below should be regarded with caution. Due to the last draught in 1984 one better not use these figures for general purposes. This because of the fact that periods of continuos draught in the investigated area are more common than exceptional and so it should be better to work with reliable chronological tables of changes in climate and rainfall and the of the size of the herds. Unfortunately such tables still don't exist.

4.5.2 Inventory

The kind of cattle herded in the investigated area is the local Zebu. In Kaanwa we only intervieuwed one household dealing with upgraded cattle, i.e. the frysian. And indeed Kaanwa is situated on the outmost eastern border of the district where it has any use keeping upgraded cattle. Going from Kaanwa on to the east it is non paying to keep upgraded cattle due to the lack of enough and the right browse. The used goat in the area is the well known multicrossed east-african goat and the sheep are of the fat-tailed Masai type.
For the distribution over the area of households owing no livestock at all see table 4.5.2.1. In the investigated area 18.3% of the intervieuwed households have no livestock at all. Most of them use to

Table 4.5.2.1 Households without livestock

	% of households owing no		
	livestock	cattle	goa/she
Kaanwa	10.0	25.0	25.0
Kaara	25.0	63.1	30.0
Kanjuki	20.0	20.0	20.0
Area	18.3	35.0	25.0

livestock = cattle + goa/she.

Source: Survey.

Table 4.5.2.2 Maximum sizes of the herds

	livestock	cattle	goa/she
Kaanwa	24	16	19
Kaara	36	18	35
Kanjuki	56	20	36

Source: Survey.

Table 4.5.2.3 Means of the sizes of the herds

	livestock	cattle	goa/she
Kaanwa	8.2	4.1	5.3
Kaara	12.1	6.5	9.2
Kanjuki	27.4	7.3	20.1
Area	15.6	5.9	11.8

Source: Survey.

Table 4.5.2.4 Distribution of livestock in whole area

number of animals	% of households owing					
	livestock	cum	cattle	cum	goats/sheep	cum
< 5	35	35	73,3	73,3	48,3	48,3
5 - 10	23,3	58,3	13,3	86,6	21,6	70
10 - 15	6,6	65	3,3	90	3,3	73,3
15 - 20	8,3	73,3	6,6	96,6	11,6	85
20 - 25	10	83,3	3,3	100	3,3	88,3
> 25	16,7	100	-	-	11,7	100

Source: Survey

Table 4.5.2.5 Distribution of livestock in Kaanwa

number of animals	% of households owing					
	livestock	cum	cattle	cum	goats/sheep	cum
< 5	40	40	80	80	65	65
5 - 10	35	75	15	95	25	90
10 - 15	10	85	0	95	5	95
15 - 20	5	90	5	100	5	100
20 - 25	10	100	-	-	-	-

Source: Survey.

Table 4.5.2.6 Distribution of livestock in Kaara Ka Mbabu

number of animals	% of households owing					
	livestock	cum	cattle	cum	goats/sheep	cum
< 5	45	45	85	85	60	60
5 - 10	25	70	5	90	20	80
10 - 15	0	70	0	90	0	80
15 - 20	15	85	10	100	10	90
20 - 25	5	90	-	-	5	95
> 25	10	100	-	-	5	100

Source: Survey.

have more or less, but as already mentioned lost all of it either by selling or disease, due to the draught. Striking is the large amount of households in Kaara Ka Mbabu who lack any livestock. Probably due to the bad physical access of that region and the absence of nearby situated rivers which are filled with water the whole year through. This in contrast with Kaanwa and Kanjuki which both have a whole year flowing river, i.e. Tungu and Mara. Besides the existence of the shrub Ocimum basilicum which covers large sizes of the area is possible a sign for overgrazing and so another reason for explaining the relative lack of livestock in this region. The difference between Kaanwa and Kanjuki is

Table 4.5.2.7 Distribution of livestock in Kanjuki

number of animals	% of households owing					
	livestock	cum	cattle	cum	goats/sheep	cum
< 5	20	20	55	55	20	20
5 - 10	10	30	20	75	20	40
10 - 15	10	40	10	85	5	45
15 - 20	5	45	5	90	20	65
20 - 25	15	60	10	100	5	70
> 25	40	100	-	-	30	100

Source: Survey.

to be explained out of the fact that the draught of 1984 influenced Kanjuki more because of her more eastern location.
Going from west to the east in the area the sizes of the herds become bigger and the distribution between cattle and goats+sheep moves in favor of the goats+sheep (see table 4.5.2.2 to 4.5.2.7). The reason for this shift is because of the better performing of goats+sheep in the dryer areas and that of cattle in the wetter areas. Also the chances of good rains are higher when going to the west. Besides also the landdivision has influence on the sizes of the herds in the area. Till now the division has passed Kaanwa and the households there are not allowed anymore to let their livestock graze free in the area. So in Kaanwa all the livestock keeping households are obliged to 'rope-graze' their livestock on their own shamba('s). And the relative small sizes of those shamba's allow the households to keep just small numbers of livestock. So due to the landdivision there is to say that the meaning of keeping livestock in Kaanwa has become more marginal.

Table 4.5.2.8 Distribution of poultry in survey area

number of poultry	% of households owing poultry							
	area	cum	kw	cum	kr	cum	kj	cum
< 5	48,3	48,3	40	40	60	60	45	45
5 - 10	15	63,3	20	60	15	75	10	55
10 - 15	16,6	80	10	70	20	95	20	75
15 - 20	5	85	10	80	0	95	5	80
20 - 25	3,3	88,3	5	85	5	100	0	80
> 25	11.7	100	15	100	-	-	20	100

kw=kaanwa;kr=kaara ka mbabu;kj=kanjuki

Source: Survey.

Almost all households keep poultry. For the distribution of poultry in the area see table 4.5.2.8.

4.5.3 Herding

In Kaanwa region there is zero grazing or some other form of minimal grazing method like rope grazing. In Kaara Ka Mbabu and Kanjuki almost all livestock keeping households herd their cattle. Only the stalks of the grown maize and grains are mostly brought to the livestock in the livestock fence near the homestead of the households in those regions. Pooling of the herds or some of them is hardly practicised and when it occurs it is due to friendship between the herding boys. In Kaanwa region half of the livestock keeping households bring the water once a day to the livestock. The other half guide their livestock every day in the evening to the most nearby river, i.e. the Tungu. In Kaara region a quarter of the livestock holders bring the water to the cattle and here it concerns the smaller herds. The rest brings the herds to the river and in Kanjuki region all the livestock holders bring their herds to the nearby flowing river. The main grazed grasses are the young stages of the Heteropogon contortus, Speargrass, that in a later growing stage

becomes unsuitable for livestock due to the generation spearshaped chaff needles, the Enteropogon macrostachys and the Hyparrhenia sp., both broadly spread in the area and of a medium fodder quality. Striking in comparison with areas situated more east of Kanjuki is the large share of grasses in the vegetation. Due to this they use east of Kanjuki more browse, palatable sprays of trees and shrubs, although later in the season the browse as fodder becomes also more important in the Kaara Ka Mbabu and Kanjuki regions. Browses like the Acacia brevispica, Tephiosia sp., etc. A shrub which covers large surfaces of the area between Kaara Ka Mbabu and Kanjuki is Ocimum basilicum, which has a strong lemon smell and is possible indicative for overgrazing! Through the main share of the grasses in the vegetation the livestock keeping households use a technique which is specific for the area. Namely they burn down the vegetation every year or two years. They need to do this because of the growing characteristics of the Heteropogon contortus which after a certain time dominates the other grasses, and they can do it because the grass cover is so thick that the fire will spread. In the more eastern siuated areas this is not possible anymore due to the more thin ground covering of the grasses. So before burning down they have to cut the vegetation to obtain the right cover grade for the spreading of the fire. This asks for a lot more labour input often not available through which the practice of burning down the vegetation is hardly found in those more remote areas.
So in short there is to be distinguish between two types of herding of the livestock. First around Kaanwa with mostly rope or zero grazing, specially grown fodder like Napier grass and a lot of water bringing to the livestock. Second east of Kaanwa, full herding with the one or two year burning down of the vegetation in the herding area. The bringing of the water to the cattle is here less practicised. Both 'systems' give if possible the stalks of the grown maize and/or grains after harvesting to the livestock.

4.5.4 Function

The most important function of the overall livestock as a part of the farming system is the cash saving. The cattle for the large, the goats and sheep for the medium and the poultry for the small expenditures. The selling of the livestock for the need of cash concentrates in the last monthes of the year. Then the stocks of food run out and besides have the school fees to be paid at the beginning of january. Next to this function the different species have other own secondary functions. The cows have their milk. When they give birth to a calf they give milk for about eleven months, two to three bottles per day, that is slightly more than one and a half liter. The average amount of milk the cattle keeping households get is 2,2 liter per day. One third of all the cattle keeping sell a part of the milk production. At average they sell two thirds of the output. In the area you can buy one 0.7 l. bottle of milk for Ksh 2,50. For comparison you can buy half a liter sterilized milk in the shop for Ksh 3,50. Consuming of the cattle is very uncommon. The bulls are sometimes used for ploughing especially in the region round Kanjuki. The topsoil there is to tough for cultivation with handused tools like the fork-jembe and the morro. In Kanjuki one of the four households have their own plough and they use their bulls to pull it. The second function of the goats and sheep is the consuming of them.

Every household which owns goats and/or sheep consume one to two of them every year. The milk of the goats is slight and never used. The sheep have a third cultural given function. Their fat is used as a medicine against all sorts of human ailments, for the cooking and most of the people are inclined to impute to the sheep and their fat superstitious functions. Sometimes the wool is used for preparing mats. Apart from the above mentioned functions there is of course the function of the dowry but in a way this is also a sort of cash saving. Poultry is further used for consuming, especially the hens, and for the eggs. Of all the eggs a chicken produces, around 30 a year, half is breeded and half is consumed or sold by the household. At the market you can get an egg for Ksh 1,00 to Ksh 1,50 depending on the supply.

Table 4.5.4 Means of selling and purchasing prices of livestock

	selling price		purchasing price	
	1984	average year	1984	average year
cattle	600,00	1025,00	--	800,00
goats	90,00	125,00	80,00	110,00
sheep	120,00	133,00	100,00	95,00
poultry	20,00	35,00	20,00	25,00

Source: Survey.

Table 4.5.4 lists the means of selling and purchasing prices of the different species in the draught year 1984 and at average. Not taken into account is the ageing of the livestock and the fluctuation of the price with it. Also no differentiation to regions is made. But it may be clear that although cattle has a peference over goats and sheep the latter are more adjusted to the dryer eastern part of the area and consequent of this the relative price of the goats and sheep grows in comparison with the price of cattle. The high prices of sheep in 1984 is due to farmers who sold or bought early in the year. Besides the selling and purchasing of sheep is less practicised then that of goats and so the number of figures to estimate the prices of the sheep in 1984 is very small. In the region around Kanjuki it is very common to exchange goats for cattle and of course the other way round. The price in this region is one cow for vife goats. In Kaanwa one cow equals about seven goats but exchange in kind is here very rare.

4.6 Farm and off-farm income

4.6.1 Introduction

The following main forms of farm and off-farm income are to distinguish. First the selling of food- and cashcrops on nearby markets. Second the trading in charcoal. Third the beekeeping and fourth off-farm income out of casual or permanent employment off the farm. All these types are to charaterise by forming no structural part of the farming system in the

area. More than half of the households have no off-farm income at all! And so for them the only way of getting disposal of cash is by selling livestock and/or their cultivated cash crops. Striking is that the meaning of the off-farm income, espescially the forms of the charcoal trading and the beekeeping, in the Kaara Ka Mbabu region is of much more importance then in the other regions. Undoubtedly this is due to marginality of the farming recources of this region in comparison with the other two regions (see herefore chapter 4.3).
The marketing of the foodcrops is a typical women's work. The women sell their crops at the most nearby market. The trading in charcoal and the beekeeping however is fullly men's work.

4.6.2 Marketing of food crops

In a way this is not a pure type of off-farm income but because the farming type in the area is to define as subsistence farming it is justified to treat the selling of grown food crops as a form of off-farm income. Going from west to east in the area the marketing of food crops becomes more incidental. After the harvesting of the foodcrops there can be estimated by the household what part of it can be sold. Simply by withdrawing the part needed for home consumption. Mostly the harvest is not even enough for the latter and so there will be no selling at all. The average prices of the foodcrops bought and sold at the markets in the area are listed in Table 4.6.2 There has to be kept in mind that by food scarcety, i.e. bad harvests, the prices of the foodcrops rise very sharp and then most of the households with shortnesses can't afford themselves anymore to buy the needed foodcrops and start consuming on whatever they can lay hands on with of course the expected rise in all kinds of human ailments.

Table 4.6.2 Average local market prices of foodcrops

foodcrop	average price	foodcrop	average price
maize	4,00	cabbages	4,00
beans	8,60	carrots	3,50
milllet	6,80	tomatoes	4,00
sorghum	5,00	bananas	2,50
green grams	11,10	eng. potatoes	3,80
pigeon pea	8,00	swe. potatoes	2,00
cow pea	7,00	onions/kales	6,00

All prices are in Ksh per kilogram.

Source: Agricultural Extension Officer, Chuka and Survey.

4.6.3 Trading in charcoal

Trading in charcoal is only found in the region around Kaara Ka Mbabu. But in this region it is a relative often practicised form of off-farm income. Due to the thick ground covering of shrubs and small trees this is the exquisite area for this type of trading. Off all the households

in this least populated region of the area a quarter trades in charcoal. You can buy one bag charcoal from about 60 kilograms for Ksh 20,00 to 25,00. The households which practicise this trading do it serious and a prodution of 80 bags a year is pretty common. The replanting of trees for charcoal is also practicised. This also counts for the Kaanwa and Kanjuki region because all the households in these area organise the charcoal needed for home consumption themselves. Only in the Kanjuki region the replanted trees don't do well because of the higher draughtness.

4.6.4 Beekeeping

One third of all the intervieuwed households in the area keep beehives. Like the traders in charcoal, most of them are concentrated in the Kaara Ka Mbabu region. In this region also the number of beehives per household exceeds those in the regions of Kaanwa and Kanjuki, as is clearly shown in Table 4.6.4. Out of the table it is to conclude that

Table 4.6.4 Distribution of beekeeping households and the numbers of beehives in the area

region	percentage of beekeeping households	number of beehives		
		total	producing	not producing
Kaanwa	35	7	1	6
Kaara Ka Mbabu	45	78	48	30
Kanjuki	20	15	10	5

Source: Survey.

the beekeeping in the Kaanwa region makes no sense. The reason for this is hard to find. But possible also in this case, like in the case of the meaning of livestock, the landdivision has a negative influence on the beekeeping because for a bit of beekeeping you have to cover a pretty large area with hives. But we lack any information about the meaning of beekeeping in the Kaanwa region before the landdivision.
For the beekeeping use is only made of traditional hives, hollowed out treetrunks of about one meter in length and 0,2 to 0,3 meter in cross-section. This use of traditional hives counts for the whole survey area. The beekeeping is fully men's work. The preparing, the putting out and the emptying of the hives, the selling of the honey to a buyer-up or the illegal manufacturing of the popular honey-beer.
By selling the raw honey and beeswax to a buyer-up of a table honey manufacturing industry the famer gets 20,-- to 25,-- Ksh. per kilo honey. However when the farmer decides to brew or let brew beer out of the honey he can make 25,-- to 30,-- Ksh. out of a kilo honey. ICRA estimated for the nearby Tharaka division east of the survey area, that of the total honey production in the division 90% was used for the illegal brewing of honey-beer and only the remaining 10% went to refineries (ICRA, 1984). Probably this counts too for the survey area.

The reason for this one sided distribution is twofold. Firstly because of the popularity of the beer and its traditional use by all kinds of celebrations. Secondly because of the prices favouring the beer brewing. this last reason mentioned as second because most of the honey beer is used for home consumption.

4.6.5 Employment off the farm

Off-farm income out of employment off the farm is, although of course for the individual household of a main importance, of minor significance in the survey area. As shown in Table 4.6.5 only 18% of all the households in the survey area have in one way or another a permanent income through a household member permanent employed off the farm. Even this figure should be treated with care because it includes former on the farm depending household members, now working and living off the farm, who every month contribute a certain amount of money to the household.

Table 4.6.5 Off-farm employment in the survey area

region	% of households with an off-farm income		
	permanent	casual	total
Kaanwa	15	30	45
Kaara Ka Mbabu	15	20	35
Kanjuki	25	20	45
Area	18	24	42

Source: Survey.

The casual off-farm employment is according to the figures of slightly more significance then the permanent form although because of her casuality of less meaning. The casual form is off-farm but mostly within the survey area and so more to be seen as the counterpart of the employed labour used by the houeholds in the survey area (Chapter 4.3.3).
Within the permanent employment off the farm it has no use to distinguish between kinds of employment. Firstly because the low significance of this form of employment for the survey area and secondly because the kinds vary very much.
For the distributions of the kinds of casual employments off the farm one is referred to Chapter 4.3.3, labour as a resource of the household.

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APPENDICES

Appendix 1: CROP LAND UTILIZATION TYPE DESCRIPTION FORM

COTTON MINUS PLOUGHING

I General

Name of crop: cotton

Setting:

- Agro-ecological Group: -Jaetzold: LM3 (main cotton), LM4 (marginal cotton and LM5 (livestock-millet)
  -Braun: III2 and IV1.

- Type of Farming: smallholders; subsistance farming.

- Size of Farms:

	class			
	small	medium	large	average
class size (ha)	< 1.0	1.0-3.0	> 3.0	2.69
% of farms in class	16	42	42	

Average size of LUT per farm (ha)	0.46 (reduced to pure cropping).

Season: second.

Technology: traditional, low inputs.

Remarks:

Name of LUT: cotton minus ploughing
Abbreviation of LUT: ct-p

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: cotton minus ploughing

II Economic Aspects

Market orientation: 100% COMMERCIAL
Capital intensity

	Shs.
- class : low	
- value of physical working assets per hectare:	2180,--
- value of physical working assets per kg product:	4,85

Labour intensity

	days
- class : high	
- no. of days per hectare :	229
- no. of days per kg product :	0,51

Production and Inputs per hectare Item	Price/unit	quantity	value
Production:	5,--	450	2250,--
Inputs:			
Planting material:	--	--	free
Fertilizer:	--	--	--
Pesticides,etc:	216,40	2	432,80
Costs of hired power:	--	--	--
Var. costs of owned power:	--	--	42,90
other:	--	--	--
Total variable costs:	--	--	475,70

Gross Margin Analysis	
per hectare	1774,30
per Sh. variable costs	3,73
per Sh. physical working capital	0,82
per labour hour / day	7,75

per average size of LUT:

	Farm class small	medium	large
average cultivation size	0,46		
gross margin	816,18		

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: cotton minus ploughing

III Agronomic Aspects

Cropping characteristics:

- Annual/~~permanent~~ i.e. two seasonal
- ~~Single~~/multiple
- Intercropped with: 67% of the cotton aceage is planted pure. The remainder is not intercropped regular.
- Rotation: no regular system.
- Cropping index: 200%
- Other

Cultivation practices:

- Land preparation: This is done predominantly in the months August and September. It exists of turning the topsoil (forked jembe) and weeding by panga or morro. Off all 'cotton-farmers' 36% did use a plough and for the Kanjuki region this figure is even 62.5%. In case of ploughing, the preparation can be executed later to achieve waterconservation. Moreover ploughing saves a lot of time and the growing season isn't shortened due to lack of labour. The weeding is sometimes done by burning.
- Cultivations: See preparations.

- Planting/seeding	Is done in the first half of October. When the land is ploughed it is often done straight behind the plough; otherwise a panga or morro is used and 3-5 seeds are put at regular distances (40 x 80cm, measured with a stick, a rope or the feet). the cotton ginneries supply the seeds which are dressed with a copperfungicide. Planting instructions are on the bags of 9 kg which contain the varieties UKA/59/240, UKA/59/540, UKA/59/520 or Bakiba 75. The first variety occurs most.
- Weeding	The first weeding is done 1-2 weeks after the onset of the rains. The crop is weeded slightly more intensive than other crops: 2-3 times each season, sometimes even four times. This implicates 4-6 weedings per year. Panga and morro are the only tools.
- Crop protection	Cotton is relatively the most intensive sprayed crop; of all farmers 66% applied chemicals for contolling insects. Especialy Calidea dregii was a major pest during the survey besides several bugs and worms. In spite of the spraying, normally twice per season, the insects form one of the main yield-reducing factors. Rainfall is optimal in the Kanju-ki region.
- Harvesting	This is totaly done by hand. The first harvest always yields less than the second (about 1/3 of the second harvest). Per year year yields of 150-675 kg/ha are reached, 400-500 kg/ha averagely. At regular intervals the cotton is picked by hand, and collected by the cotton board. The board collects abaot four times per year in several villages of each location.This board differentiates two qualities and the farmers must keep them separated. The harvest is done in two periods of the year: July-September and Februari- March.
- Processing	The cotton is processed in ginneries and the products are mainly for export.
Source and use of power: Largely human power.	

COTTON PLUS PLOUGHING

I General
Name of crop: cotton

Setting:

- Agro-ecological Group: -Jaetzold: LM3 (main cotton), LM4 (marginal cotton) and LM5 (livestock-millet).
  -Braun: III2 and IV1.

- Type of Farming: smallholders; subsistance farming.

- Size of Farms:

	class			
	small	medium	large	average
class size (ha)	< 1.0	1.0-3.0	> 3.0	3.67
% of farms in class	20	60	20	
Average size of LUT per farm (ha)	0.82 (reduced to pure cropping).			

Season: second.

Technology: traditional, low inputs.

Remarks:

Name of LUT: cotton plus ploughing
Abbreviation of LUT: ct+p

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: cotton plus ploughing

II Economic Aspects

Market orientation: 100% COMMERCIAL
Capital intensity
- class : low
- value of physical working assets per hectare: Shs. 2630,-- (2020,--)*
- value of physical working assets per kg product: 6,-- (4,50)

Labour intensity
- class : high
- no. of days per hectare : 192 days (187)
no. of days per kg product : 0,43 (0,42)

Production and Inputs per hectare Item	Price/unit	quantity	value
Production:	5,00	450	2250,--
Inputs:			
Planting material:			free
Fertilizer:	--	--	--
Pesticides,etc:	216,40	2	432,80
Costs of hired power:	(300,--)	(1)	(300,--)
Var. costs of owned power:	--	--	247,20
other:	--	--	--
Total variable costs:			680,-- (732,80)

Gross Margin Analysis per hectare	1570,-- (1517,20)
per Sh. variable costs	2,31 (2,07)
per Sh. physical working capital	0,60 (0,75)
per labour hour / day	8,18 (8,11)

per average size of LUT:

	Farm class small	medium	large
average cultivation size	0,82		
gross margin	1287,40 (1244,10)		

*
Figures in brackets are meant for plough hire.

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: cotton plus ploughing

III Agronomic Aspects

Cropping characteristics:

- Annual/~~permanent~~ i.e. two seasonal.
- ~~Single~~/multiple
- Intercropped with: 67% of the cotton aceage is planted pure. The remainder is not intercropped regular.
- Rotation: no regular system.
- Cropping index: 200%.
- Other

Cultivation practices:

- Land preparation: This is done predominantly in the months August and September. It exists of turning the topsoil (forked jembe) and weeding by panga or morro. Of all 'cotton-farmers' 36% did use a plough and for the Kanjuki region this figure is even 62.5%. The farms making use of o plough, are nearly always larger than those who don't. One cannot say that the decission for ploughing depends on cotton. The weeding is sometimes done by burning.

- Cultivations	See preparations.
Cutltivation practises:	
Planting/seeding	Is done in the first half of October. A panga or morro is used and 3-5 seeds are put at regular distances (40 x 80cm, measured with a stick, a rope or the feet). the cotton ginneries supply the seeds which are dressed with a copperfungicide. Planting instructions are on the bags of 9 kg which contain the varieties UKA/59/240, UKA/59/540, UKA/59/520 or Bakiba 75. The first variety occurs most.
- Weeding	The first weeding is done 1-2 weeks after the onset of the rains. The crop is weeded slightly more intensive than other crops: 2-3 times each season, sometimes even four times. This implicates 4-6 weedings per year. Panga and morro are the only tools.
- Crop protection	Cotton is relatively the most intensive sprayed crop; of all farmers 66% applied chemicals for contolling insects. Especialy Calidea dregii was a major pest during the survey besides several bugs and worms. In spite of the spraying, the insects form one of the main yield-reducing factors. Rainfall is optimal in the Kanjuki region.
- Harvesting	This is totally done by hand. The first harvest always yields less than the second (about 1/3 of the second harvest). Per year year yields of 150-675 kg/ha are reached, 400-500 kg/ha averagely. At regular intervals the cotton is picked by hand, and collected by the cotton board. The board collects about four times a year in several villages of each location.This board differentiates two qualities and the farmers must keep them separated. The harvest is done in two periods of the year: July-September and Februari- March.
- Processing	The cotton is processed in ginneries and the products are mainly for export.
Source and use of power: Largely human power, animal power for ploughing.	

MAIZE

I General

Name of crop: maize

Setting:

- Agro-ecological Group: all AE/AC-groups of both Jaetzold and Braun.

- Type of Farming: smallholders; subsistance farming.

- Size of Farms:

	class			
	small	medium	large	average
class size (ha)	< 1.0	1.0-3.0	> 3.0	2.43
% of farms in class	6	82	12	

Average size of LUT per farm (ha)	0.30 (reduced to pure cropping).

Season: first.

Technology: Traditional, low inputs.

Remarks:

Name of LUT: maize
Abbreviation of LUT:ma

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: maize

II Economic Aspects

Market orientation: Subsistence, rests sold on the local market.

Capital intensity

- class : low	Shs.
- value of physical working assets per hectare:	230,--
- value of physical working assets per kg product:	0,38

Labour intensity

- class : high	days
- no. of days per hectare :	203
- no. of days per kg product :	0,34

Production and Inputs per hectare

Item	Price/unit	quantity	value
Production:	2,61	600	1566,--
Inputs:			
Planting material:	2,61	2	5,22
Fertilizer:	--	--	--
Pesticides,etc:	--	--	--
Costs of hired power:	--	--	--
Var. costs of owned power:	--	--	42,90
other:	--	--	--
Total variable costs:			48,12

Gross Margin Analysis

per hectare	1517,88
per Sh. variable costs	31,54
per Sh. physical working capital	6,60
per labour hour / day	7,48

per average size of LUT:

	Farm class small	medium	large
average cultivation size	0,30		
gross margin	455,36		

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: maize

III Agronomic Aspects

Cropping characteristics:

- Annual/~~permanent~~: i.e. one seasonal.
- ~~Single~~/multiple:
- Intercropped with: only 28% planted pure, so mostly intercropped with various crops like a leguminose (often), tobacco, cotton and sometimes with another cereal.
- Rotation: no regular systems.
- Cropping index: 200%
- Other

Cultivation practices:

- Land preparation: The preparation of maize is done in either Januari/Februari or August/September. The main activities are clearing the coprests of last season, removal of weeds, loosening and turning the topsoil and sometimes making lines. The loosening is done by jembe or forked jembe, the weeding is done by panga (or morro in the stony areas). Ploughing is restricted to the drier zones. When manure is applied, it is mixed with the soil at this stage.
- Cultivations: See preparation.

Planting/seeding	In March and October **before** the rains. Usually on lines, two seeds per hole which results in 1-2 stalks per stand. Hand panga and morro are the used tools. The only selection of the seeds exists of taking those seeds that originate from the middle of the cob. Average spacing in pure stand: 40 x 100 cm.
- Weeding	Performed each season twice. The first time 1-2 weeks after the onset of the rains with either a panga or a morro.
- Crop protection	Five farmers out of 18 did apply chemicals against pests and diseases (notably stalkborers, ants, termites and grasshoppers), but the majority didn't apply anything or simply a soil-ash mixture. In the bushy areas it's very labour intensive to chase away the monkeys with stones or arrow and bow.
- Harvesting	The harvest is done 3-4 months after planting, with peaks in July/August and Januari. The ripe cobs are taken from the totaly withered plants by hand or with a knife. The stalks are used to feed the cattle or one makes trashlines of it to prevent soilerosion.
- Processing	After harvesting the complete cobs are dried or just the seeds. This is done by sun. The product is stored in small (elevated) huts or the cobs are hanged in the trees. The grains are either cooked (together with beans one makes 'githeri' of it) or grinded.
Source and use of power: Handtools and occasionaly ploughs.	

SORGHUM

I General
Name of crop: sorghum

Setting:

- Agro-ecological Group: -Jaetzold: UM3 (marg.coffee), LM3 (cotton), LM4 (marg.cotton), LM5 (midl.livestock-millet), IL5 (lowl.livestock-millet).
  -Braun: II2, III2, III1, IV2, IV1 and V.

- Type of Farming: smallholders; subsistence farming.

- Size of Farms:

	class			
	small	medium	large	average
class size (ha)	< 1.0	1.0-3.0	> 3.0	2.66
% of farms in class	40	33	27	

Average size of LUT per farm (ha)	0.22 (reduced to pure cropping)

Season: first.

Technology: low inputs

Remarks: Of sorghum can be distinguished roughly two types: the red and white types with an **open** panicle on the one side and the **compact** types on the other side. The latter types can have a 'goose-neck' and their grains are mostly white, although red and even black varieties were encountered. The 'open' types are normally two-seasonal, planted once a year and ratooned. They occur esp. in the less drier zones (Jaetzold: UM3 and LM3; Braun: II and III). The more drought resistant 'compact' types are not ratooned, planted twice a year and prefer the drier areas (Jaetzold: LM4, LM5, IL5 and to a less extent LM3; Braun: IV and V and to a less extent zone III).

Name of LUT: sorghum
Abbreviation of LUT: so

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: sorghum

II Economic Aspects

Market orientation: Subsistence, rests sold on the local market.
Capital intensity

	Shs.
- class : low	
- value of physical working assets per hectare:	230,--
- value of physical working assets per kg product:	0,43

Labour intensity
- class : high days
- no. of days per hectare : 137
- no. of days per kg product : 0,25

Production and Inputs per hectare

Item	Price/unit	quantity	value
Production:	5,26	540	2850,--
Inputs:			
Planting material:	5,26	2	10,52
Fertilizer:	--	--	--
Pesticides,etc:	--	--	--
Costs of hired power:	--	--	--
Var. costs of owned power:	--	--	42,90
other:	--	--	--
Total variable costs:			53,42

Gross Margin Analysis

per hectare	2796,58
per Sh. variable costs	52,35
per Sh. physical working capital	12,16
per labour hour / day	20,41

per average size of LUT:

	Farm class small	medium	large
average cultivation size	0,22		
gross margin	615,25		

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: sorghum

III Agronomic Aspects

Cropping characteristics:

- Annual/~~permanent~~ - 'open' sorghum two seasonal.
  - 'compact' sorghum one seasonal.
- ~~Single~~/multiple
- Intercropped with: predominantly with leguminosae like pigeon pea, cowpea and green gram or sometimes with millet or maize.
- Rotation: a combination with sorghum was in about half of the cases followed by again a cereal and in 1/3 of the cases a leguminose followed.
- Cropping index: - 'open' 100%.
  - 'compact' 200%.
- Other

Cultivation practices:

- Land preparation The preparation is done in either Februari or September and exists of weeding and loosening of the

	soil with a panga or a (forked-) jembe. Sometimes only a weeding is done with a panga or a morro. Ridges are never made, manure is hardly ever applied.
- Cultivations	See preparations.
- Planting/seeding	This is always done before the rains. Sorghum is planted in rows between rows of other crops. The spacing is irregular. It is very rare that sorghum is the dominating crop of a plot. A row of sorghum is mostly altenated by 2-4 rows of other crops. The selection of the seeds is done by the farmer himself: he just takes the healthiest and biggest seeds or buys them on the local market. No hybrids were encountered. The 'open' type is planted once a year with no preference for either March or October, and the 'compact' type is planted twice a year, also without preference with respect to the season. No other tools than panga or morro were used.
- Weeding	Within a growing season two weedings are performed, of which the first is done 2-3 weeks after the onset of the rains. Again only using panga or morro.
- Crop protection	The crop protection is a very neglected subject. It is hard to find a sorghumplant without any disease or insects. Especialy Coletotrichum, Helminthosporium (both with severe neccroses) and Claviceps microcephala (which was called 'the honey disease' by the farmers) occurred very much. The latter disease was 'controlled' by applying honey on the panicles.Next to bacterial and fungal diseases, sorghum was also attacked by insects but only 3 out of 16 farmers did actually spray (ambush, polytrin, ribcord).
- Harvesting	Not all the panicles are harvested on the same time. The wives of the farmers do it in three or more stages in the periods June-August and december-februari. The open types are ratooned after one growing season and no harvest is obtained after this first season, but it has the advantage of many tillers (10-30) next season. The farmers use a knife and a panga for harvesting. First they cut (panga) the stalks and remove afterwards the panicles (knife). The stalks remain on the land and are used for trashlining.
- Processing	The sorghum is dried by sun, trashed, winnowed and grinded coarsely in a hollow trunk by using a stick or between stones. Hereafter the sorghum is fermented. The people think non-fermented sorghum is very unpalatable.
Source and use of power: Human power only.	

BULRUSH MILLET

I General

Name of crop: bulrush millet.

Setting:

- Agro-ecological Group: - Jaetzold: LM3 (cotton), LM4 (marg.cotton), LM5 (midl.livestock-millet), IL5 (interm.lowl.livest.millet).
  - Braun: III2, III1, IV2, IV1 and V.
- Type of Farming: smallholders; subsistence farming.
- Size of Farms:

	class			
	small	medium	large	average
class size (ha)	‹ 1.0	1.0-3.0	› 3.0	1.91
% of farms in this class	47	40	13	

Average size of LUT per farm (ha)	0.18 (reduced to pure cropping)

Season: first.

Technology: traditional,low inputs.

Remarks: fifth important crop after cotton, maize, sorghum, and pigeon pea. (with respect to the acreage)

Name of LUT: bulrush millet
Abbreviation of LUT: mi

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: bulrush millet

II Economic Aspects

Market orientation: Subsistence, rests sold on the local market.

Capital intensity

	Shs.
- class : low	
- value of physical working assets per hectare:	230,--
- value of physical working assets per kg product:	0,64

Labour intensity

	days
- class : high	
- no. of days per hectare :	134
- no. of days per kg product :	0,37

Production and Inputs per hectare

Item	Price/unit	quantity	value
Production:	5,27	360	1900,--
Inputs:			
Planting material:	5,27	2	10,54
Fertilizer:	--	--	--
Pesticides,etc:	--	--	--
Costs of hired power:	--	--	--
Var. costs of owned power:	--	--	42,90
other:	--	--	--
Total variable costs:			53,44

Gross Margin Analysis

per hectare	1846,56
per Sh. variable costs	34,55
per Sh. physical working capital	8,03
per labour hour / day	13,78

per average size of LUT:

	Farm class		
	small	medium	large
average cultivation size	0,18		
gross margin	332,38		

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: bulrush millet

III Agronomic Aspects

Cropping characteristics:

- Annual/~~permanent~~
- ~~Single~~/multiple
- Intercropped with: predominantly a leguminose but also with sorghum or maize.
- Rotation: a combination with millet is most frequently followed by a combination of a leguminose or a cereal.
- Cropping index: 200%
- Other

Cultivation practices:

- Land preparation: The preparation exists of weeding, removing croprests and loosening the soil. Tools: panga, (forked-) jembe, and in Kanjuki occasionaly a plough. It is done in August-September or in Januari-Februari. Applying manure is not common.
- Cultivations: See preparation.

- Planting/seeding	There is no preference for the first or the second season as often stated in the literature. The planting is done in March or October. It is done with a panga, sometimes straight behind the plough, and always before the onset of the rains. After a period of famine the seed is bought on the local market, but mostly the farmers select from their own stock. When planted pure the average spacing is 85x100cm with about 10- 20 tillers per tussock. The tillering is dependent of the spacing.
- Weeding	Two weedings are performed, the first 2-4 weeks after the onset of the rains, and usually the panga or morro are used for this purpose.
- Crop protection	Various kinds of insects attack the crop, but only 2 out of 14 farmers used chemicals. The 'honey disease' (Claviceps microcephala, ergot) is a major fungal disease. Squirrels and esp. birds are a severe threat for the crop. The birds like millet better than sorghum, as it hasn't the bitter taste of some sorghum varieties. The crop is often guarded by a person to prevent the birds from eating, but like the bird-traps, this is not always effective.
- Harvesting	The harvest is done in June or July and for the second season in Januari-Februari. Like Sorghum, it is done in stages in stead of harvesting all the spikes at once. The spikes are cut off and put in a bag. The stalks remain on the land.
- Processing	The millet is trashed with a stick when dry and winnowed hereafter. Normally it is cooked, but some people like to make beer of it.
Source and use of power: Mainly human power.	

TOBACCO

I General
Name of crop: tobacco.

Setting:

- Agro-ecological Group: - Jaetzold: LM3 (main cotton zone).
  - Braun: II2/III2.

- Type of Farming: traditional smallholders; subsistance farming.

- Size of Farms:

	class			
	small	medium	large	average
class size (ha)	< 1.0	1.0-3.0	> 3.0	1.85
% of farms in this class	11	66	22	

Average size of LUT per farm (ha)	0.023 ha (reeduced to pure cropping).

Season: second.

Technology: traditional, low inputs.

Remarks:

Name of LUT: tobacco
Abbreviation of LUT: to

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: tobacco

II Economic Aspects

Market orientation: 100% COMMERCIAL
Capital intensity
- class : low
- value of physical working assets per hectare: Shs. 230,--
- value of physical working assets per kg product: 0,32

Labour intensity
- class : high
- no. of days per hectare : 225 days
- no. of days per kg product : 0,31

Production and Inputs per hectare Item	Price/unit	quantity	value
Production:	12,50	726	9075,--
Inputs:			
Planting material:	--	--	--
Fertilizer:	--	--	--
Pesticides,etc:	--	--	--
Costs of hired power:	--	--	--
Var. costs of owned power:	--	--	42,90
other:	--	--	--
Total variable costs:			42,90

Gross Margin Analysis	
per hectare	9032,70
per Sh. variable costs	210,54
per Sh. physical working capital	39,27
per labour hour / day	40,14
per average size of LUT:	

	Farm class		
	small	medium	large
average cultivation size	0,023		
gross margin	207,73		

CROP LAND UTILIZATION TYPE DESCRIPTION FORM
Name of LUT: tobacco

III Agronomic Aspects

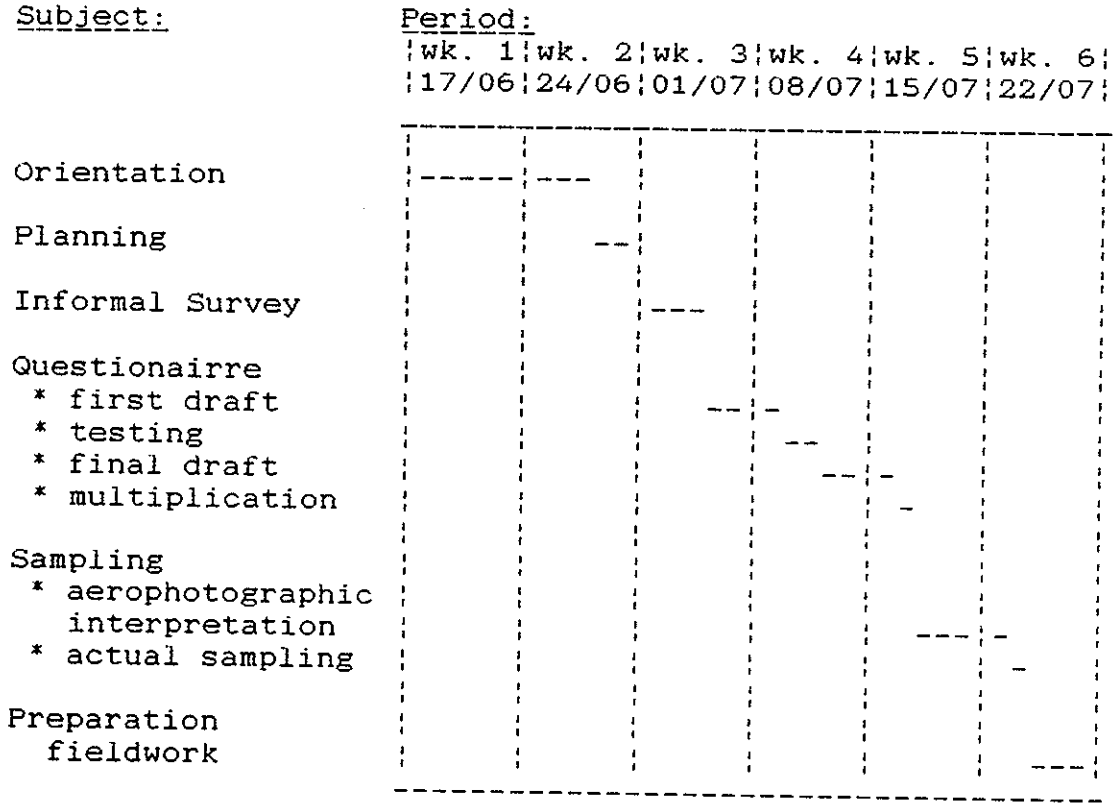
Cropping characteristics:	
- Annual/~~permanent~~ :	tobacco is grown as a two seasonal crop.
- ~~Single~~/multiple	
- Intercropped with:	predominantly maize in alternating rows.
- Rotation:	irregular, mostly an intercrop of maize and tobacco.
- Cropping index:	200%.
- Other:	tobacco is transplanted one month after the onset of the rains from the nurseries to the field. Then the plants are about 20 cm.

Cultivation practices:	
- Land preparation	Loosening and turning of the topsoil with a jembe or a forked jembe. Making ridges which are regular distanced by using a stick or rope.
- Cultivations	See preparation.

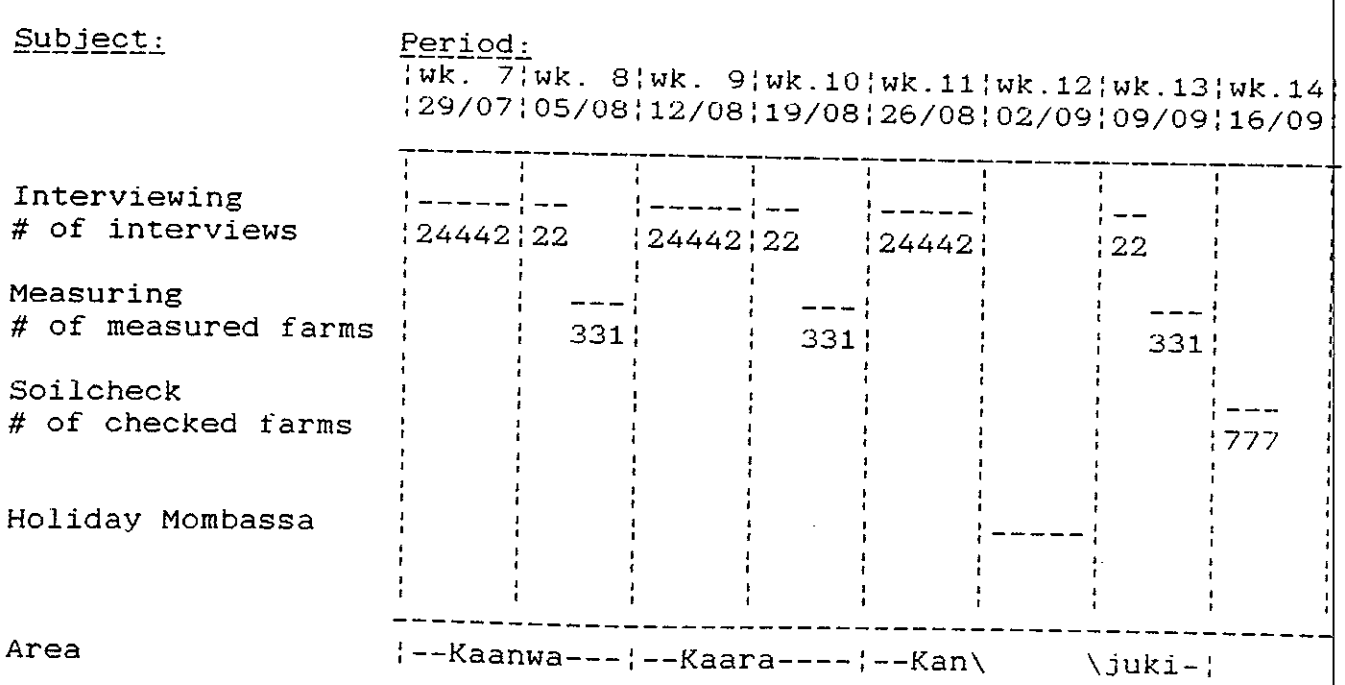
- Planting/seeding	The seeds are sown in a very fine seedbed in a nursery (mostly situated near a river). In this nursery the plants are intensively taken care of and one weeding is performed. When the rains start, the transplanting is done. Tobacco is predominantly planted in the second season (Oct). The seeds originate of the tobacco of the former year and are of a local variety. An estimation of the spacing: 50x100cm when planted pure.
- Weeding	Two weedings in the first, and two weedings in the second season. Together with the weeding in the nursery, this makes a total of 5 weedings. The first weeding is done 1-3 weeks after the rains. No other tools than a panga were encountered.
- Crop protection	Neglectible. No chemicals are used. Sometimes ash is applied to prevent attacks of insects.
- Harvesting	Twice per year, but at irregular intervals: The first harvest during Januari-march, the second from June till October. The harvest is done by hands. The upper leaves are of better quality than the lower leaves. To suspress the generative development, the flowers and plant-tops are often removed.
- Processing	The leaves are dried in bunches, hanging indoors. After drying, the leaves are cut and fermented (sometimes sheep-oil is added to get a mild taste). The product is grinded into snuff and it is sold on the local market.
Source and use of power: Entirely human labour, no animal power.	

Appendix 2: TIME TABLE

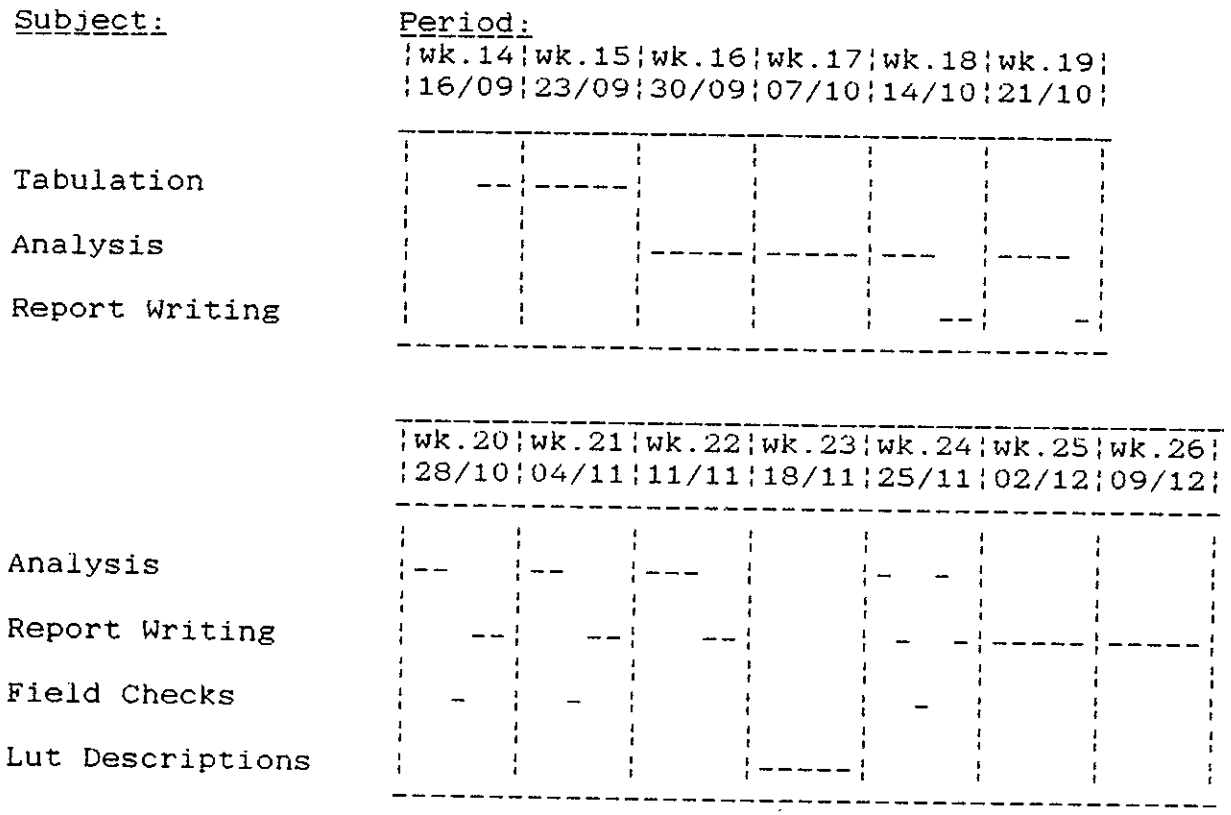
First phase: PREPARATION, from 17/06 to 29/07.



Second phase: FIELDWORK, from 29/07 to 23/09.



Third phase: ANALYSING and REPORTING, from 23/09 to 16/12.



Appendix 3.

QUESTIONNAIRE

LUTKOEK

name mzee

date

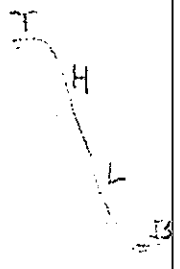
farmcode

interviewer

sublocation

1. LAND

		SHAMBA 1	SHAMBA 2	SHAMBA 3	SHAMBA 4
SIZE (#ACRES)					
DISTANCE FROM HOMESTEAD					
FARMERS LAND (TITLE)					
—	BOUGHT				
	INHERITED				
BORROWED LAND					
RENT PAID	CASH				
	KIND				
BORROWED FREE					
FARMED BY THIS HH					
NOT FARMED	RENTED-OUT				
	FALLOW				
	OTHER				
GRADIENT	FLAT 0-6 %	T H L B	T H L B	T H L B	T H L B
	MODERATE 6-16 %				
	GENTLE 16-30 %				
	STEEP >30 %				
REMARKS					



P.S. FIND OUT WHAT'S FARMER'S OPINION OF 'SHAMBA', BY TESTING

2. SOIL CONSERVATION

	SHAMBA											
	1			2			3			4		
A. FARMERS PERCEPTION OF THE PROBLEM:												
N=NO; S=SLIGHT; M=MAJOR	N	S	M	N	S	M	N	S	M	N	S	M
B. MEASURES UNDERTAKEN BY FARMER:												
TERRACES												
TRASH LINES												
GRASS STRIPS												
STONE LINES												
TREES												
OTHER:												
REMARKS												
C. ARE THE MEASURES UNDERTAKEN ADEQUAT:												
Y=YES; N=NO	Y		N	Y		N	Y		N	Y		N
D. IF NO, WHY												
☐ NO TIME/LABOUR ☐ NO CASH ☐ OTHER:												

3. FAMILY COMPOSITION

	#	LIVING ON FARM: YES — WORK AVAILABILITY: FULL	PT	NOT	LIVING ON FARM: NO #	SEX: ♂ #	♀ #	EDUCATION: NO X/#	PRIM X/#	SEC. X/#
MZEE										
WIFE (S) MZEE										
REMAINING DEP. ADULTS (≥18 YRS)										
DEPENDENT ADULTS STILL AT SCHOOL										
DEPENDENT CHILDREN (<18 YRS)										

AGE YOUNGEST CHILD ... YRS; OLDEST CHILD ... YRS.

TOTAL SCHOOL EXPENDITURES OF PRESENT TERM: ... Ksh.

REMARKS

4. LIVESTOCK

A. INVENTORY

SPECIES	BULL	DRAUGHT OX	FEMALES		GOATS	SHEEP	POULTRY	BEEHIVES	
			+C	-C				T	M
LOCAL									
GRADED									
REMARKS									

B. INPUTS

FEED SOURCE	CATTLE			GOATS			SHEEP		
	R	Z	H	R	Z	H	R	Z	H
FODDER (Q/T)									
GRASS (U/S)									
STALK/LEAVES (U/S)									
OTHER									
REMARKS WATERING POOLING									

ITEM	AVERAGE YEAR	
	QUANTITY	TOTAL COSTS
A.I. (#shots)		
DIPPING (#times)		
MEDICATION		
OTHER		
REMARKS		

. PRODUCTS

ITEM	# CONSUMED	# GIVEN AWAY	SALES				U.S. MTH OF SALE	PURCHASES				U.S. TIME OF PURCH.	# BIRTHS	# RECEIVED	# DEATHS
			#		REVENUE			#		COST					
	AVE. YR.	AVE. YR.	1984	AVE.	1984	AVE. YR.		1984	AVE.	1984	AVE. YR.		AVE. YR.	AVE. YR.	AVE. YR.
CATTLE															
GOATS															
SHEEP															
POULTRY															
COWS MILK P/D								PERIOD COWS MILK:							
GOATS MILK P/D								REMARKS:							
EGGS P/D															
HONEY															
HIDES/SKINS															

PURPOSE LIVESTOCK: MEAT CASH SAVING MILK ..... PRIORITY 1 TO 4

5.

FOODCROPS

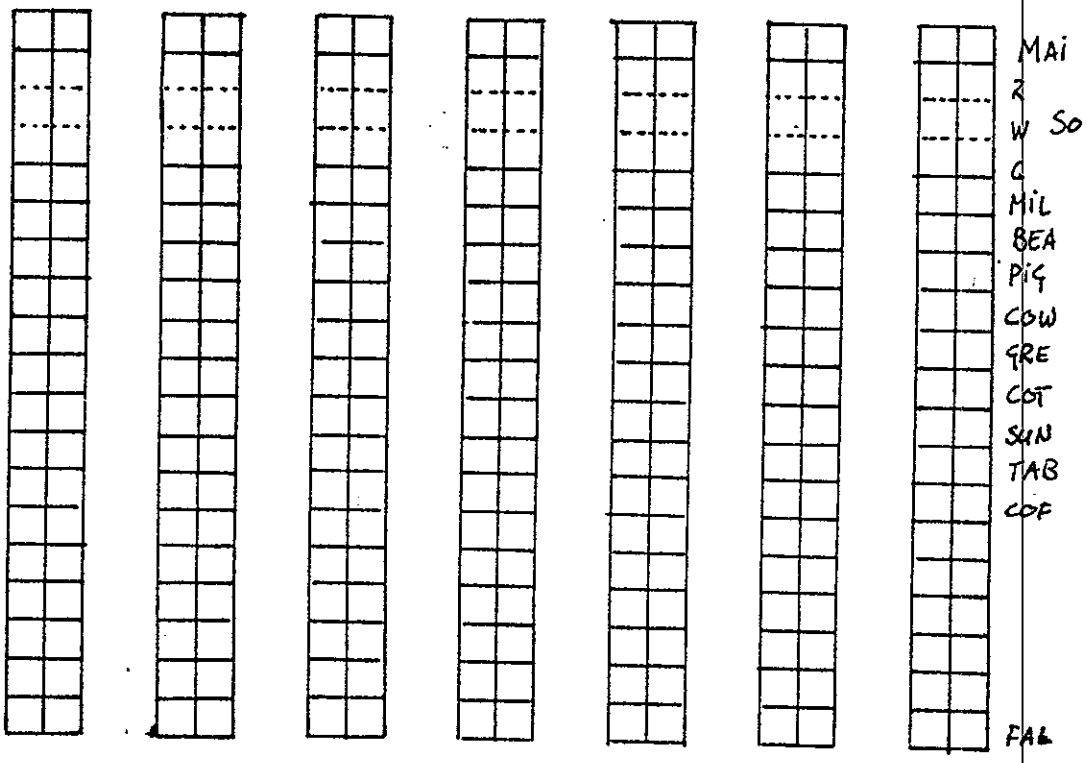
CROP	MAIZE	SORGHUM RED	SORGHUM WHITE	SORGHUM COMPACT	MILLET	BEANS	PIGEON	COW	GREEN GR	
X										
PLANTING										
HARVESTING										
REMARKS										

CASHCROPS

CROP	COTTON	SUNFL	TABACO	COFFEE						
X										
PLANTING										
HARVESTING										
REMARKS										

CROPPING PATTERNS / ROTATIONS

MAIZE
SORGH R
SORGH W
SORGH C
MILLET
BEANS
PIGEON PEA
COW PEA
GREEN GRAM
COTTON
SUNFL
TABACO
COFFEE
FALLOW



MAI
R
W SO
C
MIL
BEA
PIG
COW
GRE
COT
SUN
TAB
COF
FAL

FERTILITY

MANURE +_

MULCH +_

FERTILIZER +_

NAME

PRICE

AMOUNT

SOURCE

TOOLS

REMARKS

FOOD-

CASH-

HARVESTING

EST. DATE

PRODUCTION

QUALITY / GRADE

FRACTION (%) SOLD

TO WHOM

TOOLS

REMARKS

LABOUR REQ

CLEARING

LANDPREP

PLANTING

FERTILIZING

WEEDING

HARVESTING

INSECT CONTROL

DISEASE CONTROL

BIRDS / MONKEES ETC

OTHERS

REMARKS

INSECTS

NAMES OR SYMPTOMS

REMEDY

CHEMICALS

PRICE

AMOUNT

SOURCE

REMARKS

1.
2.
1.
2.
1.
2.

1.
2.
1.
2.
1.
2.

DISEASES

NAMES OR SYMPTOMS

REMEDY

CHEMICALS

- PRICE
- AMOUNT
- SOURCE

REMARKS

FOOD-

1.
2.
1.
2.
1.
2.

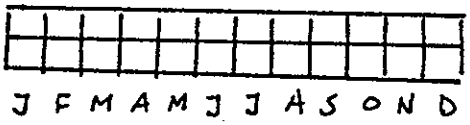
CASH-

1.
2.
1.
2.
1.
2.

PROBLEMS

FOODSHORTAGES

OWN FOOD
BOUGHT FOOD



6. EMPLOYED LABOUR

		SEX	ACTIVITY	WAGE RATE	WORKING MONTH 0884-0785												↑ # DAYS ↓
					8	9	10	11	12	1	2	3	4	5	6	7	
					A	S	O	N	D	J	F	M	A	M	J	J	
CASUAL	1			d / H													
	2			d / H													
	3			d / H													
	4			d / H													
PERMANENT	1			d / H													
	2			d / H													
	3			d / H													
	4			d / H													
OTHER	1																
	2																

IS LABOUR EASY TO OBTAIN ☐ YES ☐ SOMETIMES ☐ NO

IF NO, WHY NOT: .....

IF SOMETIMES, WICH MONTHS:	8	9	10	11	12	1	2	3	4	5	6	7

IRIMA: ☐ YES ☐ NO
IF YES, WHAT KIND OF WORK:

REMARKS

7. OFF FARM INCOME

PERSON	SEX	ACTIVITY	INCOME		WORKING MONTH 0884-0785											
			TOTAL	CONTR.	8	9	10	11	12	1	2	3	4	5	6	7
					A	S	O	N	D	J	F	M	A	M	J	J

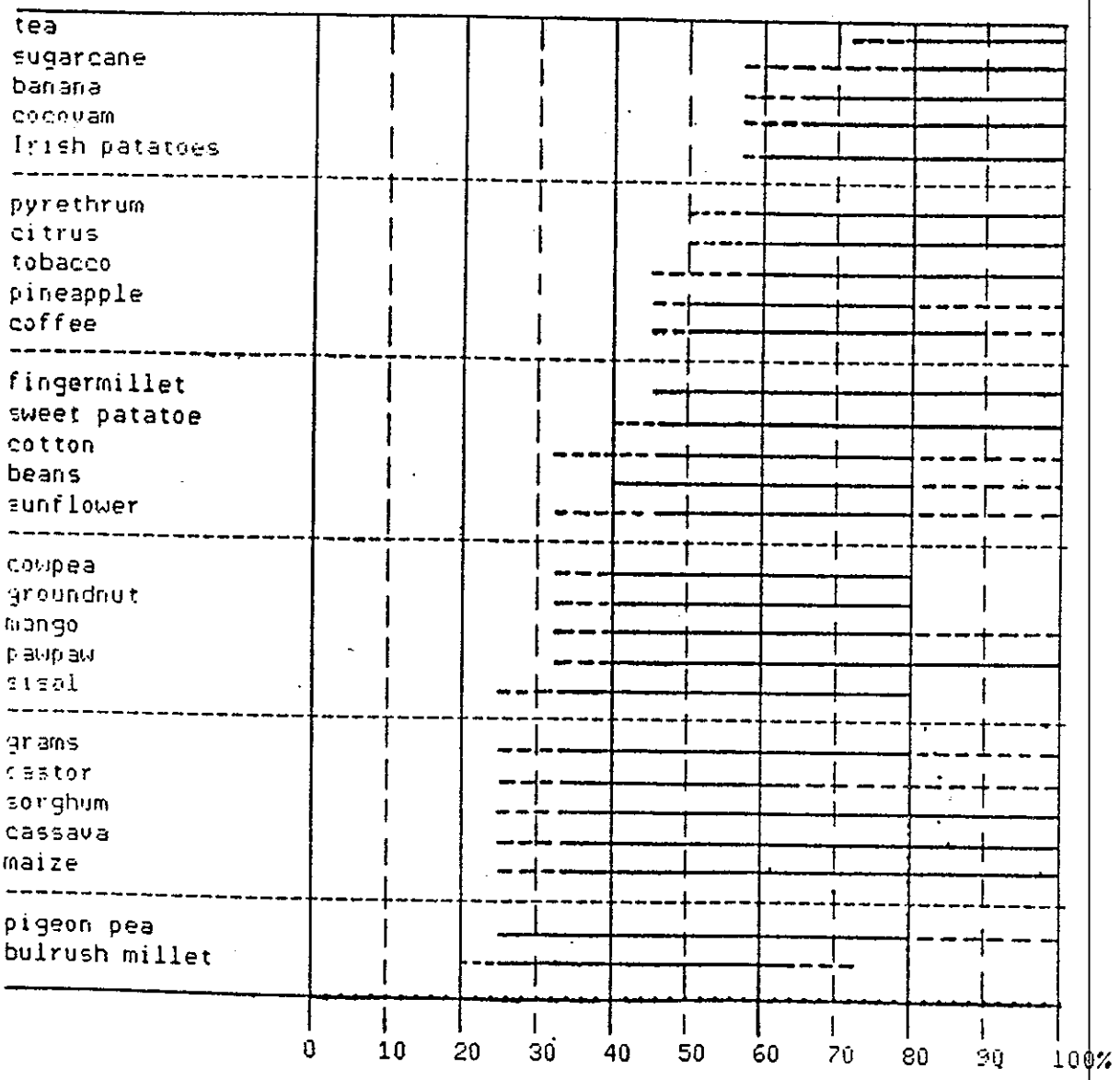
ANY OTHER INCOME / REVENUES:

PENSION:
TRADING:
FIREWOOD/CHARCOAL:

REMARKS

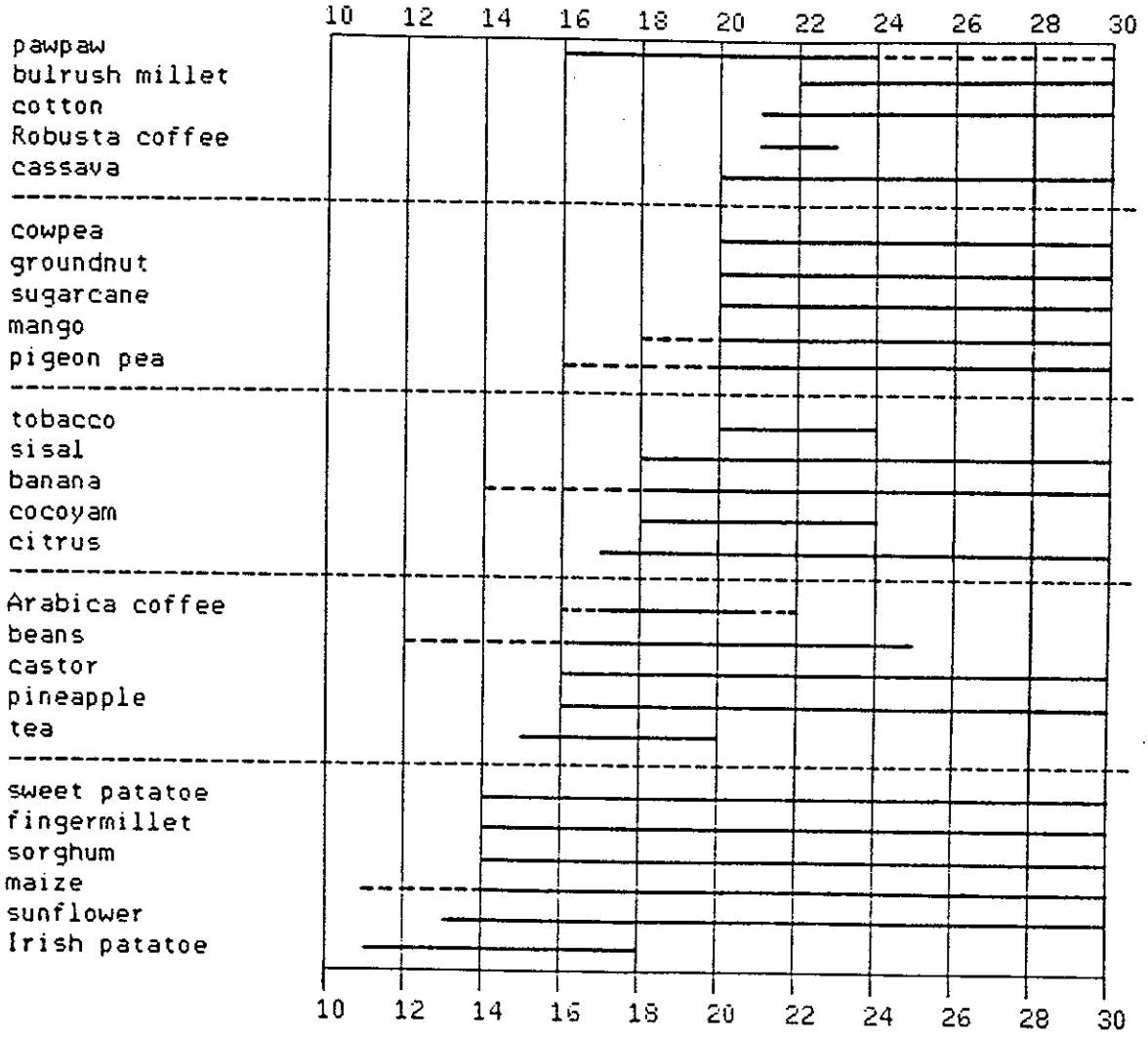
Appendix 4 CROP REQUIREMENTS

Appendix 4.1 Moisture range of crops



moisture availabilities r/E_o in %
source: Exploratory Soil Survey Report E1, KSS

Appendix 4.2 Temperature range of some crops



Temperature in ^{o}C
source: J.D. Acland 1971

Appendix 4.3 Soil requirements of some crops

crop	preferred texture	pH	drainage	remarks
maize	(light to) medium	5.5-8.0	free draining	not on very acid soils, not on water logging soils, at least moderately fertile soils
bulrush millet	light to medium	5.0-8.0	well drained	drought resistant, tolerates salanity
sorghum	medium to heavy	4.5-8.5	moderately well to well	low to moderately fertile soils
cowpeas	light	5.0-7.5	free draining	drought resistant
green gr	medium	6.0-7.5	well drained	drought resistant
beans	medium	6.0-7.5	free draining	not drought resistant, needs moist soil throughout the growing period
pigeon pea	light	5.0-7.5	free draining	fairly drought resistant
sunflower	medium (heavy)	6.0-8.0	moderately	very drought resistant
sw potatoe	wide range	various	various but on ridges in swamps	drought resistant, needs moderately fertile soils
potato	light to medium	4.5-8.0	free draining	not so drought resistant, needs good supply of nutrients
cassava	light to medium	various	free draining	very drought resistant, not on stony or shallow soils, sensitive to impeded drainage, thrives also on less fertile soils
cocoyam (C. antiquorum)	light to medium	4.5-8.0	tolerates waterlogging	grows well on riverbanks, demands a fertile soil
cotton	medium to heavy	6.0-8.0	well drained, sensitive to impeded drain.	tolerates salanity (0.5-0.6%), moderately to highly fertile soils, should contain bor
bananas	light to medium	5.0-7.0	well to moderately well drained	fertile volcanic or alluvial soils are best, with adequate aereation
coffee (Arabica)	medium	5.3-6.0	free draining	soil must allow reasonable water-retention, CaCO3 < 1% of fine earth and CaSO4 < 0.5% o.f.e.
tobacco	medium	(5.0) 5.5-6.5	well drained	not on heavy and saline soils CaCO3 <1% and CaSO <0.5%

tea	medium	4.0-6.0 (4.5-5.5)	free draining	soil must have a good water retaining-ingcapacity. $CaCO_3$ and $CaSO_4$ content must be nil
sisal	medium	5.5-7.5	well to moderately drained	cambered beds or ditches on heavy soils
citrus (spp.)	light to medium	5.0-7.0	well drained	needs proper areation, sensitive to impeded drainage, fertility
castor	medium	6.0-7.5	free draining	moderate to high moderately drought resistant, not on saline soils
sugarcane	light to medium	5.0-7.0	mod. well to well drained	moderately fertile soils, sensitive to waterlogging

source: Jaetzold

Appendix 4.4 Agro-climatological croplist

growing period	crop/variety variety	av # of days to phys maturity/ to harvest	alt. according to gr.period in meters	required well di during growing p not average!
s/vs	maize/v.e. mat.: dryland comp.	75 - 85/ 85 -100	700 -1500m	240-450mm
s	maize/e.mat. Katumani B	85 -105/ 100-120	700 -1500	260-450
s/m	ditto	105-135/ 120-150	1500-1900	280-480
s	bulrush mil.	70 - 90	0-1250	220-400
m	ditto	120-150	0-1250	380-800
vs	sorghum v.e.mat. IS 8595	75 -105	0-15/1800	200-430
s	sorghum (Serena)	85 -110	0-15/1800	220-480
s/m	sorghum m.mat.	100-130	0-15/1800	320-590
bimodal	sorghum: ratoon	90 -115+90-110	0-15/1800	280-500+230-450
vs/s	cowpeas/e.mat: Katuli	70 -90	0-1500	190-380
s/m	cowpeas	90 -120	0-1500	220-450
vs/s	green gram	75 - 90	0-1200	190-400
s	green gram	90 -100	1200-1500	200-400
s	beans (e.g. Rose-coco)	80 -100	700 -1500	230-430
s/m	pigeon peas 422	110-130	0-1500	370-600
l/vl	pigeon p. bimodal	180-260	0-1500	500-800
vs/s	sunflower: Russ. dwarf var.	75 - 85	0-1500	180-330
s	sunflower: issanka	80 - 90	0-1500	200-400
vs	sw. potat v.e.mat.	60 - 90	0-1800	350-650
m/per.	sw. potat m.mat.	120-180	0-1800	500-900
per.	cassava	540-720	0-1500	850-1700 ann.av.
per.	taro	>365	0-1800	1300-2300
vl/l	cotton bimodal	240-300	0-1400	550-950
per.	coffee Arabica	>365	1500-2100	1050-1800 ann.av.
per.	banana	365-540	0-1800	1000-2300 ann.av.
per.	tea	>365	1200-2300	1400-2000 ann.av.

source: Jaetzold

explanation: s=short m=medium l=long v=very per.=perennial ann.av.=annual average e.=early mat.=maturing

Appendix 5 DATA ORGANISATION AND ACCESS

The report writing, data basing and analysis have all been done with the help of a micro-computer. All the information is available on 5 1/4 inch floppy disks, DS and DD, or mapsheets, which are added to the copy which is in possession of Ir. R.A. Schipper, staff member of the Department of Development Economics of The Agricultural University of Wageningen.

The Report.
The last version of the report is written in Word Star, MsDos 2.11. The report is divided over two seperate diks and several files in such a manner, that an access is guaranteed for all micro computers with a double disk drive, without overscribing the possible disk-space of ± 360 kBytes too quick. The contents of the disks are as follows:

Diskname	Filename	Contents
Report a	chap1	chapter 1
	chap2	chapter 2
	chap3	chapter 3
	chap4	chapter 4
Report b	appendix	appendices 1, 2, 4.3, 4.4, 5
	contents	list of contents
	figtab	list of figures and tables
	litera	list of used literature

The Data base.
The data base is divided over two ordners and two floppy disks. On the two disks there are also some simple programmes written in Mbasic and used only for first degree counting, multiplying, distracting and dividing techniques on 'clean' dbase files. All the data on the floppy disks are in Dbase (extension .dbf) files of which some are transformed to 'clean' files (extension .txt). This transformation was necessary to execute some statistical analysis. The statistical analysis with the computer was done with the Statpac statistical packet. Because for an analysis of the data especially the basic data from the questionnaires are required, these data are still obtainable (see above). The mapsheets are divided over two ordners with the first ordner containing the data concerning land, soils, family, livestock, labour and income, and the second ordner the data concerning the crops maize, sorghum, millet, cotton and tobacco. As far as possible all the basic data were filed in Dbase files. Hereafter the basic data files are listed in correspondence with the questionnaire. Combining the structure of the dbase file with the structure of the tables in the questionnaire shows the meaning of the data.

Tables Questionnaire	Filename	diskname
1. Land	Lutland.dbf	database 1
2. Soil conservation	Lutsoil.dbf	database 1

3. Family composition	Lutfamil.dbf	database 1
4. Livestock		
a. Inventory	Liveinve.dbf	database 1
b. Inputs	Liveinpu.dbf	database 1
c. Item	Liveitem.dbf	database 1
d. Products	Liveproa.dbf	database 1
	Liveprob.dbf	database 1
	Liveproc.dbf	database 1
	Liveprob.dbf	database 1

5. Crops

The data of the crops are all to be found in ordner 2, with many small working files on the disk database 2. Here again the advice is given to study first the composition of the questionnaire and the structure of the dbase file.

6. Employed labour

The data of this subject are all to be found in ordner 1. Also these data are distributed over many small working files on the disk database 2.

7. Off-farm income

See above under 6.