ICRA

BULLETIN 15

The Farming System in Tharaka: Strategies for Subsistence in a Marginal Area of Kenya

December 1984

Course for development oriented Research in Agriculture (ICRA)
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The Farming System in Tharaka: Strategies for Subsistence in a Marginal Area of Kenya

by

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ABSTRACT

The study was carried out in three months in Tharaka, the driest and most neglected division of Meru District, Kenya by an interdisciplinary group from ICRA. The study aimed to identify and evaluate development options and research recommendations likely to meet the objective of both farmers and Government. The physical and natural resources of Tharaka present an unsuitable environment for arable farming, but the density of population makes mixed farming unavoidable. Cropping is undertaken in a situation of severe erosion and decreasing fertility. Over-grazing is a serious problem. Proposals for arable agriculture are directed to soil and water conservation, more reliable cropping patterns, more efficient use of labour, and food insurance through specific measures to improve the marketing system. The most appropriate solution to the problem of over-grazing is seen as the establishment of small group ranches. The encouragement of co-operatives is proposed to act as a channel for improved health services and husbandry advice and to make marketing more reliable.

Keywords: farming systems, research and development, erosion control, over-grazing, traditional farming, farm survey.

CONTENTS

APPENDICES

LIST OF FIGURES

LIST OF TABLES

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Our debts of gratitude are many. Firstly, we thank the farmers of Tharaka for their kindness and patience in discussing their problems with us. Secondly, the EMI* Programme for their encouragement and generous assistance in providing us with accommodation. Mr. and Mrs. Ian Skea of the EMI Sheep and Goat Project were gracious and attentive hosts throughout our stay in Tharaka and we thank them very much. Thirdly, we acknowledge the help of the many government officials - chiefs, sub-chiefs, Division and District officials of MOALD, and others - who shared their time and gave assistance to us.

Finally, our thanks must go to the seven Tharakan interpreters for their skilful assistance. None of the above are responsible for any of the information or ideas contained in this report. The authors are solely responsible.

* EMI: Embu, Meru and Isiolo (districts)

PREFACE

The ICRA team consisted of:
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This report was organized and written in such a way that it can serve the various needs and interests of different readers.

In particular, Chapter 3 was intended for busy readers who are able to find there the basic descriptions, arguments and recommendations for the farming system in Tharaka in just a few pages.

For those who are interested in more detailed information, Chapters 4 and 5 can be read after Chapter 3 as well as the Appendices.

Finally, the entire report can be read by those interested in the methodology and analysis which were used.

SUMMARY

In line with the objective of the International Course for development oriented Research in Agriculture (ICRA) in Wageningen, Netherlands to train agricultural scientists in analysis of farming systems, six participants conducted a three months field study during April-June 1984 in the driest and most neglected division of Meru District, Kenya: Tharaka. The study aimed to identify and evaluate development options and research recommendations which are likely to meet the objectives of both the farmers and the Government.

After familiarization at different levels with the general policy of the Government of Kenya for the arid and semi-arid areas, two surveys were conducted. The first survey (27 respondents) aimed at understanding the farming system. The second survey (103 respondents) was done to verify the understanding and to collect data to support the ideas.

The study area comprised 80% of the total 370,000 acres (150,000 ha) of Tharaka Division, making up the arid and semi-arid parts of the Division.

The physical and natural resources of Tharaka present an unsuitable environment for arable farming, but the density of population makes mixed farming inevitable. Extensive pastoral systems, as planned by the Government, have more potential in this area. A scarcity and in some cases the poor state of infrastructure contribute towards low resource productivity.

The bimodal rainfall is low and unreliable in amount, date of onset and seasonal distribution, resulting in high probabilities of crop failure. Following the two successive crop failures in 1983 there is little chance of the system providing a subsistence food crop in 1984.

One-third of the study area consists of soils with moderate to low fertility of a deep, red, sandy to clay type. The rest consists of shallow soils of moderate to low fertility with steep slopes.

Population growth in Tharaka is around 3.3% per year (1969-1984). If this growth rate continues, it will result in a decrease of landholdings from 20 acres at the moment to 10 acres per household by the year 2005, far too small to support a household if the land is predominantly cultivated under a bush fallow system with fallow lengths of mainly 2-5 years.

Labour is almost entirely provided by family members. Cash is required in certain periods to buy food and make up for a poor harvest. It is also needed for school fees, especially for secondary education. Small amounts of cash are also required for domestic needs. The economy in Tharaka is still largely run without cash. Sales match purchases in a way that is only a short step from a barter economy. Goats

almost function as commodity money.

Cropping is undertaken in a situation of severe erosion and decreasing fertility of soils because the measures undertaken to prevent erosion are very poor. Eighty-three per cent of the cultivated area is devoted to food crops, mainly millet, sorghum, green gram and cowpeas. The remaining 17% is devoted to the cash crops, cotton and sunflower. Some farmers occasionally use ox ploughs but handtools are mainly used in cropping.

Livestock (sheep, goats and cattle) are owned by 85% of the farmers surveyed for a variety of socio-economic reasons. They are regarded as a source of wealth and prestige, inherited and exchanged as dowries and gifts. Owners sell their livestock only to purchase food, pay school fees or for some other pressing reason. As a result livestock are accumulated and stocking densities of five acres per livestock unit are reached, leading to over-grazing and erosion. This problem occurs on both fallow and communal lands, although it is particularly prevalent on the latter. Poor organization of dips and extension compound the problems of overstocking and drought.

Beekeeping is the most promising way of earning money other than from sale of crops and/or livestock. More sales of honey or wax could provide a significant increase in income for a wide range of farmers. There is very little prospect of charcoal-burning, basket-making or other income-earning activities being able to make a significant impact in Tharaka.

A complex of interlinked constraints leads to an advancingly degraded physical and natural environment, resulting in a perennially increasing food shortage. The recommendations concentrate on measures to sustain or achieve a subsistence level of food crop production and to make livestock a surer form of insurance, while at the same time safeguarding the resources on which production is based.

For arable agriculture the emphasis is on reducing risk. Proposals are directed to soil and water conservation measures in order to maximize the use of rainfall and minimize soil and water losses; to the introduction of more reliable cropping patterns; to more efficient use of labour; and to food insurance through specific measures to improve the marketing system. Research recommendations concentrate on improving the reliability of crop yields.

The recommendations for livestock are directed less to research than institutional and organizational developments. The most appropriate solution to the problem of over-grazing is seen as the establishment of small group ranches. The encouragement of cooperatives is proposed to act as a channel for improved health services and husbandry advice and to provide a more reliable external outlet for livestock sales. The only recommendation for additional research relating to livestock is

to evaluate the browse and grazing in the area.

While marginal improvements can be made at the moment the basic problems of population growth and the limiting agro-ecological circumstances remain.

1 INTRODUCTION

1.1 Background

Agriculture is the dominant sector in the economy of Kenya. Although mainly subsistence-oriented, it accounts for 30-40% of the Gross Domestic Product and 60-70% of the value of exports. Of the total 15 million people (1979 census), 90% derive their livelihoods from agriculture (Tibayuka et al., 1980). The country is characterized by wide variations in climate, altitude and soils and, therefore, in cropping patterns and farming systems. Seventy to eighty per cent of Kenya can be characterized as arid and semi-arid land. These areas are occupied by only 20% of the total population. At the end of the 1970's, the Government of Kenya (GOK) drew up the Arid and Semi-Arid Lands (ASAL) Policy to give more emphasis to the development of the dry areas. Because of high population growth (4%), which also entails a high percentage of population (50%) below 15 years of age, pressure on the land has been increasing. The ASAL Policy, therefore, proposed that surplus population expand into the marginal areas. The major problems for development in the ASAL are drought, reduced length of fallow and overstocking leading to soil erosion.

The British Government responded to the ASAL Policy and agreed with GOK in 1980 to concentrate its efforts in Embu, Meru and Isiolo Districts (the EMI Programme). The EMI Programme needs basic information on farming systems in the semi-arid areas to support its various projects. Hence, this study was formulated and conducted in Tharaka Division, Meru District (Figure 1) to satisfy both the requirements of ICRA and the interests of the EMI Programme.

1.2 Objectives of the study

In line with the ICRA objectives to train participants in analysing farming systems and to give them the opportunity of working in an interdisciplinary team, the field study conducted in Tharaka Division aimed mainly to identify and evaluate development options and research recommendations which are likely to meet the objectives of both the farmers in the Division and the Government.

To reach the main objective, intermediate objectives were formulated as follows:

1. to understand the existing farming system in the area with a view to analysing the constraints to improving the system,
2. to relate the farming system in Tharaka to the development priorities of the local and national government in order to sustain or improve the current farming system.

Figure 1 Map of Eastern Province showing Tharaka Division

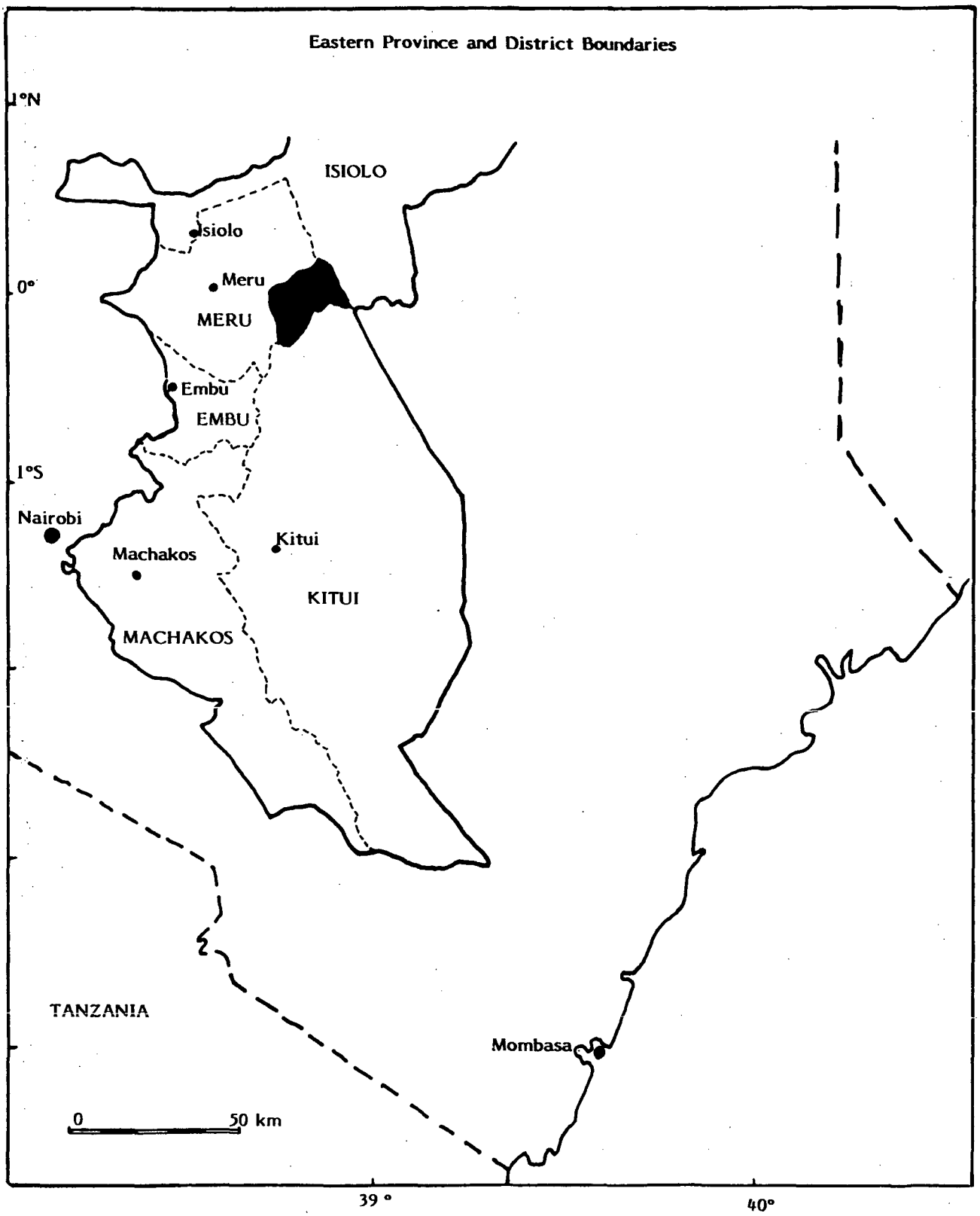
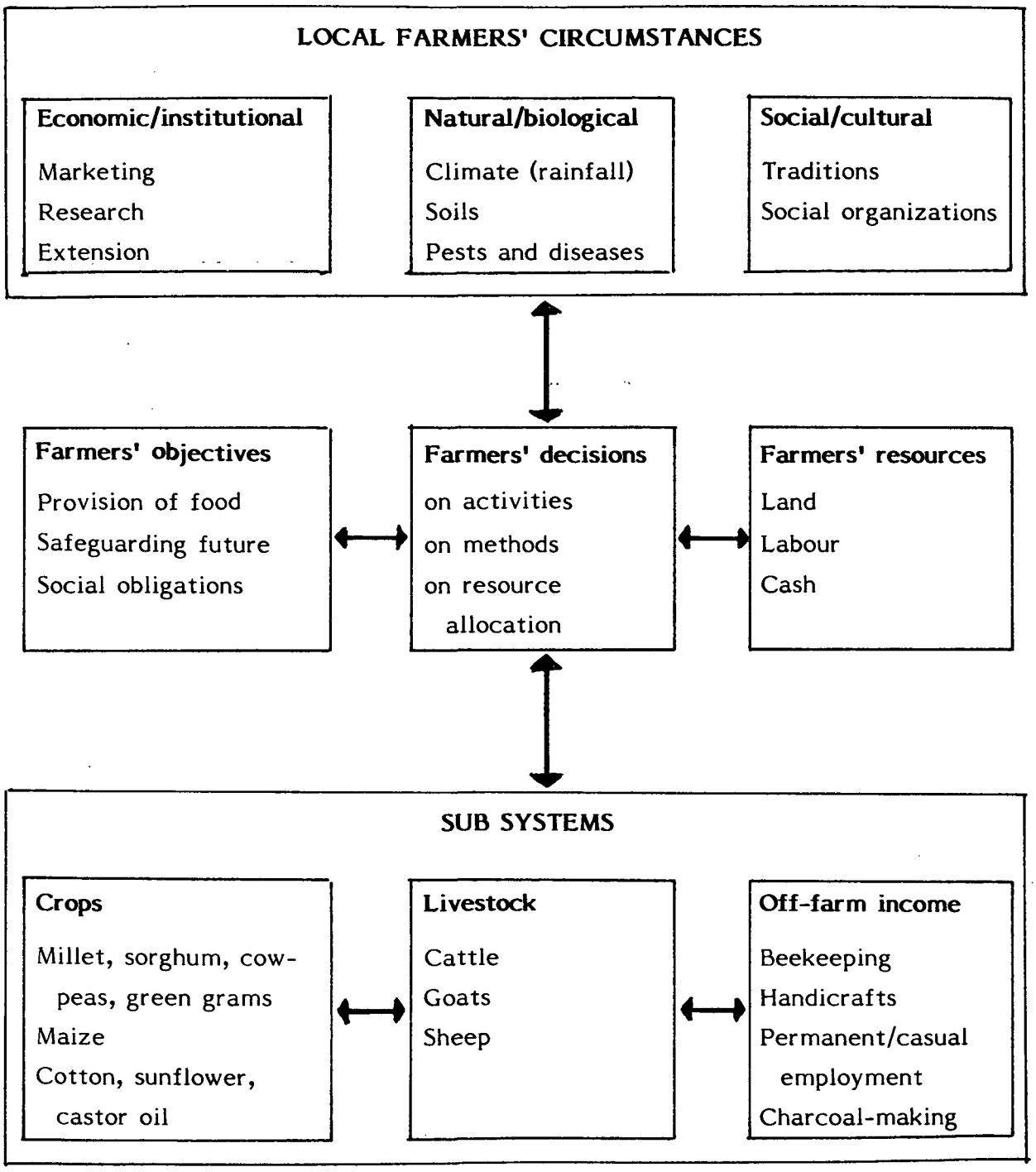


Figure 2 Conceptual model for farming system research in Tharaka



This study aims to provide policy makers, researchers, extension agents and others concerned in the development of Tharaka with information on the following:

1. appropriate recommendation domains for which to initiate or continue relevant research and development,
2. short- and long-term proposals for research and development,
3. relevant aspects of the farming system for the ongoing and proposed projects in the EMI Programme.

A final objective is the evaluation of the research methodology used in the field study.

1.3 Conceptual model

Several authors have developed diagrams to explain farming systems. For this study, figure 2 (developed originally by Collinson) is used as a broad conceptual model for the description and analysis presented in Chapters 3 and 4.

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 sub-systems: 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.

2 METHODOLOGY

The field study was conducted for 13 weeks and was divided into three parts: reconnaissance/exploratory survey (2 1/2 weeks); in-depth survey (5 weeks); and formal survey (5 1/2 weeks). Appendix 1 gives a detailed timetable for the various activities. The objectives, procedures and analysis of each of the surveys are discussed below.

2.1 Reconnaissance/exploratory survey

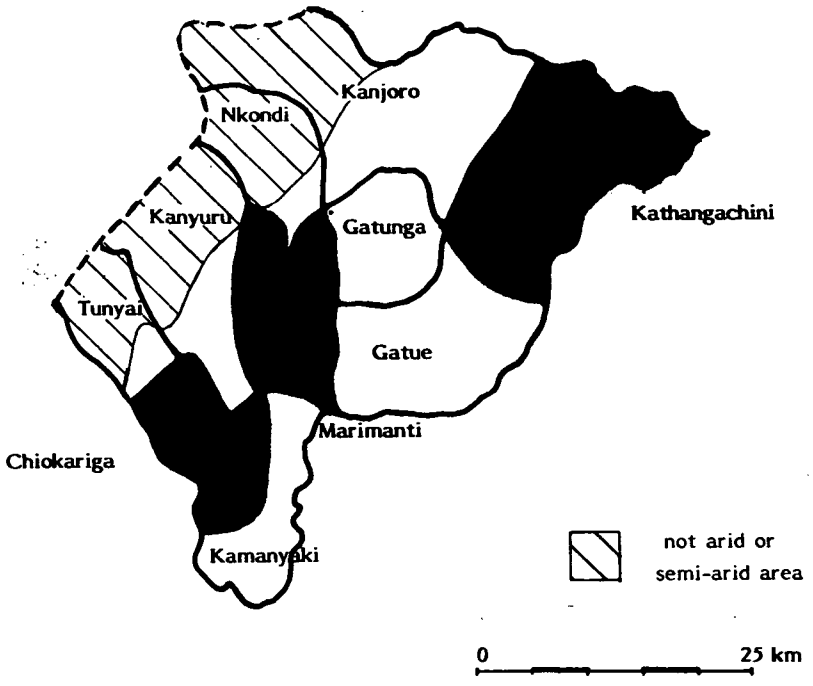
This survey was conducted to familiarize the team with the general policy of the Government of Kenya in utilizing the arid and semi-arid areas. It was also done to collect relevant information about current research and development efforts in the arid and semi-arid areas, specifically in Tharaka Division, from the national, provincial, district, division and local levels. Checklists of questions appropriate at various levels, which were prepared beforehand in Wageningen, were used as guides during meetings with government officials in Nairobi, researchers and administrators, and local authorities. Literature and maps were collected for future reference. The reconnaissance/exploratory survey gave the team an impression of cultural homogeneity within Tharaka Division and the importance of administrative boundaries to government agencies. At this stage, the information was found inadequate to judge differences in farming systems within Tharaka Division on the basis of agro-ecological circumstances. Hence, the scope of the next stage, the in-depth survey, was delineated on the basis of the administrative boundary of Tharaka Divsion in Meru District. The Division consists of three locations and 10 sub-locations (Figure 3).

2.2 In-depth survey

The in-depth survey was conducted to understand the farming system at the farm level and so to formulate a set of hypotheses that could be tested in the formal survey. A questionnaire (Appendix 9) was designed and 27 respondents were selected from lists provided by the (sub-)chiefs of the different (sub-)locations. The criteria in selecting respondents were farm size, herd size and off-farm income. Interviews were conducted in rotating pairs with the help of interpreters.

Results of the in-depth survey showed that there were differences in agro-ecological circumstances among sub-locations (Figure 4). Nkondi, Tunyai and Kanjoro sub-locations belong to agro-ecological zone 4; they have higher agricultural potential than the rest of Tharaka and also include some settlement areas. The other seven sub-locations, except a small part of Chiokariga, are in zone 5 (medium to low

Figure 3 Sub-locations of Tharaka Division, Meru District, Kenya



potential for plant growth) and zone 6 (not suitable for crops but suitable for ranching). Because of the differences in agricultural potential and because of the fact that very limited research and development efforts have been implemented in these arid and semi-arid areas of Tharaka, the next stage of this study, the formal survey, was confined to these marginal areas.

Results of the in-depth survey also indicated the relative importance of crop production compared to livestock production. Hence, there is an emphasis on crops in the formal survey. The different hypotheses, which were discussed by the group as a whole, but were not, however, formally formulated, are reflected in the formal survey questionnaire, as an input for its formulation.

2.3 Formal survey

The formal survey was conducted to test the hypotheses and collect data for sophistical support. Some information on livestock was collected at the request of EMI's Goat and Sheep Project.

Three sub-locations out of the seven sub-locations initially defined, were chosen according to the geographical and administrative coverage of the area (Figure 3). The three sub-locations were the following:

1. Kathagachini sub-location (North Tharaka Location)
2. Marimanti sub-location (Marimanti Location)
3. Chiokariga sub-location (South Tharaka Location).

These sub-locations represented large differences in population density in the study area (see 3.2.4) and differences in proximity to market. There were also agro-ecological differences, with Chiokariga being partly in zone 5 and partly in zone 4, Marimanti in zone 5 and Kathangachini in zone 6.

Respondents were chosen at random from two sources: (1) voters' registration lists which covered 75% or more of all people older than 18 years, and (2) village lists which had the names of some of the farmers in the villages. The number of farmers interviewed in each sub-location was chosen according to the number of households.

There was a total of 103 farmers interviewed, broken down as follows: 28 in Kathangachini, 50 in Marimanti and 25 in Chiokariga. In cases where the farmer or his wife were not at the homestead, the nearest available farmer who was willing to be interviewed was taken. The interviews were conducted by each team member and an interpreter. Interpreters were changed daily.

The formal survey questionnaire is given in Appendix 10. Results of the formal survey were analysed by pairs of team members.

3 FARMING SYSTEMS IN THARAKA

3.1 The problem stated

The physical and natural resources of Tharaka present an unsuitable environment for arable farming. Agro-ecological conditions favour livestock farming, but the density of population makes mixed farming unavoidable. A scarcity and in some cases the poor state of infrastructure contribute towards low resource productivity.

Management of resources is not optimal; there is a tendency towards overstocking with consequent overgrazing and increased erosion. Soil and water conservation measures are generally absent and a number of present farm practices could be improved. Where farmers have adapted to the environment, the dynamics of increasing population density without changes in technology have made some of their management practices increasingly inappropriate.

There is unlikely to be any lessening of population growth in Tharaka for the foreseeable future. A major inflow of capital to transform the resource base (by introducing irrigation for instance) is equally unlikely. Breakthroughs in crop and livestock productivity are somewhat more likely but still offer limited immediate prospects.

Therefore, recommendations must concentrate on measures to improve the use of existing resources. The introduction of soil and water conservation measures, more reliable cropping patterns, improved livestock practices and land management can help make farming in Tharaka marginally less risky and more prosperous.

While marginal improvements can be made at the moment, the basic problems of population growth and low productivity of resources remain.

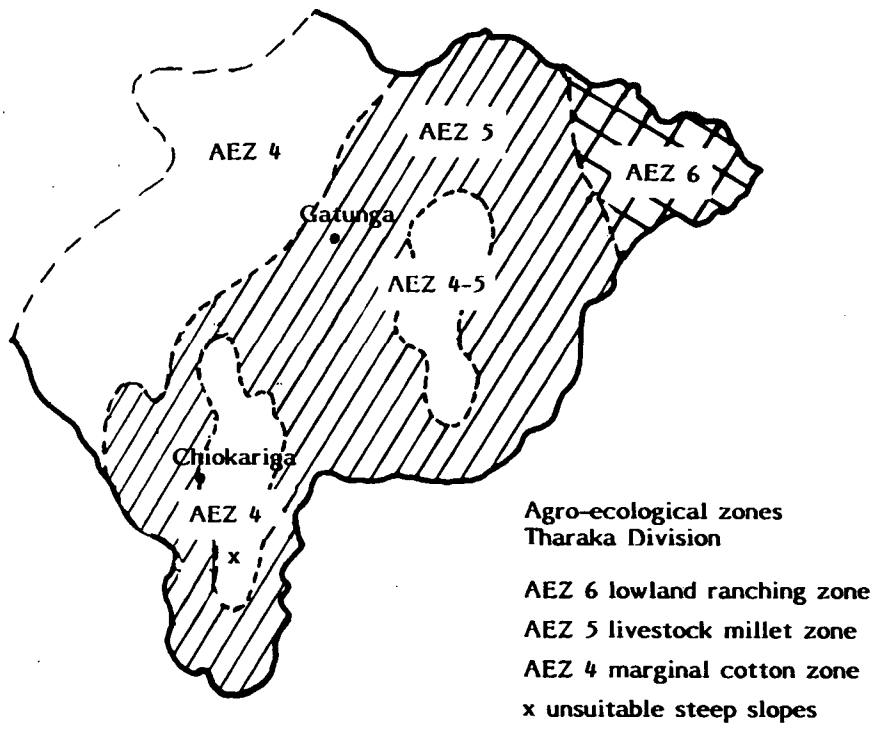
3.2 Background to farming in the area

3.2.1 The Agro-ecological zone concept*

An agro-ecological zone (AEZ) is a zone defined by its relevant agroclimatic factors, differentiated by soil pattern. The main zones are based on their probability of meeting the temperature and water requirements of the major crops. Tharaka Division is situated on the lower slopes of Mount Kenya and is classified as having 20% of its area in zone 4 and 80% in zones 5 and 6. The different agro-ecological circumstances in zone 4 result in a different farming system in this part of Tharaka, a reason to exclude it and define the study area as the part of Tharaka classified

* The information in this section is based on Kenya Soil Survey zonation methodology which is a follow-up to the system introduced by Pratt, Greenway and Gwynne (1966) which is described in Jaetzold and Schmidt (1983) and Exploratory Soil Survey Report no. E1 (1982).

Figure 4 Agro-ecological zones, Tharaka Division



Source: Jaetzold and Schmidt, 1983

as zones 5 and 6. Of the study area 87% is located in zone 5 and 13% in zone 6.

Zone 5 is semi-arid (moisture supply 25-40% of the annual potential evapotranspiration), with medium to low potential for plant growth if soil is not limiting. There are two rainy seasons. In each of them a seasonal total of 250 mm is reached in the western part of the zone in six years out of ten. The corresponding figure in the east is only 130 mm. This area is not suitable even for a drought-resistant variety of maize such as Katumani maize which can be expected to fail two years out of three (see 3.2.2). Even a mixture of sorghum, bulrush millet, cowpeas and green grams can be expected to fail partially in one year out of four to five and totally in another year out of four to five. The potential carrying capacity of land for livestock is up to four hectares per stock unit (1 stock unit = 300 kg).

Zone 6 is arid and not suitable for cropping. It is suitable for ranching and has a potential carrying capacity of 4-20 ha per stock unit.

3.2.2 Water

Water is the most limiting factor for crop production in Tharaka Division.

3.2.2.1 Sources of water

In general the rainfall is low and unreliable in amount, date of onset and seasonal distribution (see Appendix 2). It is very erratic, though possibly cyclical over periods of more than 5 years (see Appendix 3). It is bimodally distributed with first rains (muratho) from March to May and second rains (nthano) from October to December.

The amount of annual rainfall decreases considerably from the western (1000 mm) to the eastern (400 mm) parts of the Division. Moreover, rainfall intensities are relatively high (see Appendix 2), contributing to a "sealing effect" on soils which have become compacted due to overstocking and poor cultural-management practices. This results in increased surface run-off and consequently soil erosion. There are high evaporation rates in the area and a positive water balance is limited to a few weeks per year.

The average annual amounts of available moisture (rainfall/evaporation) for zones 5 and 6 are 25-40% and 15-25%, respectively (Sombroek, Braun and Van der Pouw, 1982). Even in zone 5 a positive water balance is limited to a few weeks per year. Because of these circumstances, the farmers have developed strategies in their cropping patterns to spread the risk of crop failures (see 3.3.3).

There are a number of perennial rivers which are superficially promising for irrigation in the area. However, there are three major problems: (1) the scope for irrigation in the Upper Tana is possibly reduced by the water rights allocated to the Lower Tana Irrigation Scheme, (2) apparently little cash benefits for irrigation to justify investment, and (3) no proven system of low-cost irrigation yet for the area. Therefore, continued experimentation is encouraged in this direction.

The ground water potential is as yet largely unknown. No hydrological surveys have been conducted, nor are there proposals for deep well (bore hole) programmes in the area.

In some catchment areas the EMI Programme (Soil and Water Conservation Project) has completed its water-harvesting projects which are primarily for human and domestic uses. It is, however, too early to assess their impact.

3.2.2.2 Effects of water constraint

With the water constraints discussed earlier (particularly rainfall), there is a high probability of crop failure. Calculations were made which suggest the following probabilities of crop failure in any one season (Table 1).

The above figures indicate that the most common crops grown by the farmers (millet, sorghum, cowpea and green gram) have generally higher chances of crop success than the others (particularly maize). It should be noted that the degree

Table 1 Probability of crop failure: Marimanti

Crop	Probability of crop failure (%)
Millet	40
Sorghum	40
Cowpea	45
Green gram	40
Maize	65
Cotton	50
Sunflower	50

Note The probabilities of crop failure were calculated by determining the proportion of 34 cropping seasons (1967-83) in which the theoretical moisture requirements of the different crops were met (Agricultural Compendium, 1981).

of crop success or failure varies from place to place.

Finally, the regeneration of cropland when left in fallow is slow and the ability of land in Tharaka to regain fertility through fallowing remains to be determined.

3.2.3 Soils and their agricultural potential

The soils in Tharaka are derived from ancient basement complex rocks (predominantly gneisses and granites) and usually of high quartz content. Ministry of Agriculture officials estimated that one third of the Division may be regarded as suitable for cultivation.

Table 2 shows three general fertility groups of soil in the study area. These soils

Table 2 Percentage of soils in different categories

Sub-location	Shallow soils, moderately fertile	Soils with moderate to low fertility	Soils with low fertility and steep slopes	Distribution of soils with moderate to low fertility in study area
			(per cent)	
Kamanyaki	100	-	-	-
Chiokariga	3	-	97	-
Kanyuru	-	22	78	12
Marimanti	47	53	-	22
Gatunga	-	66	34	25
Gatue	56	31	13	25
Kathangachini	76	24	-	16
				100%

Source: Jaetzold and Schmidt, 1983

are fairly location-specific and are considered in turn:

1. Shallow soils, moderately fertile (42% of the area). These soils are concentrated in east and central parts of the study area. Soils have a paralithic layer that impedes infiltration and increases the erosion risk. The combination of virtually no soil conservation measures, no action to maintain fertility and high intensity of rainfall means that these areas have poor and declining potential for cropping and grazing.
2. Soils with moderate to low fertility (31% of the area). These are deep, red, sandy to clay, and friable to firm. The soils account for nearly all of Gatunga sub-location, 53% of Marimanti, 31% of Gatue and 24% of Kathangachini; they do not occur in Chiokariga. This confirms that water rather than cultivable soil is the main limitation in the study area except for Chiokariga.
3. Soils with low fertility and steep slopes (27% of the area). Virtually all of Chiokariga sub-location falls within this category. Despite these soils having a low potential for cultivation, this sub-location is relatively densely populated (45 persons/km^2).

3.2.4 Land and population

Population densities vary greatly in Tharaka (Appendix 4). In the study area, 80% of Tharaka, the density is 24 persons/km^2 while in the four westerly sub-locations the density is 55 persons/km^2. Within the study area the available land per household varies from 175 acres (70 ha) in the north-east to 20 acres (8 ha) in the south-west. On average 85% of the land is cultivable (Jaetzold and Schmidt, 1983).

Population growth in Tharaka, although lower than the national average of 4.1% per annum, is still high at 3.3% p.a. and is not expected to fall. There is some migration to the neighbouring areas in Meru district. However, migration to the industrial sector and cities is unlikely to be a solution to Tharaka's population increase. Within the Division there have been considerable population increases in the more north-westerly sub-locations where settlement schemes were set up in the 1960's. It appears that migration to these more favourable areas is becoming more difficult.

Population pressure will diminish the available land resources per household. If present trends were to continue, by the year 2005 there would be only 10 acres of land available per household throughout the division. A shift to a different system of land use is therefore necessary. The official government policy for most of Tharaka is to encourage ranching. No decisions have been made as to the type of ranch for the area, although several are under consideration (see Appendix 5). Large-

scale irrigation of areas of Tharaka is unrealistic and unlikely, although small-scale irrigation schemes may be feasible. There is also a future for dryland farming (permanent cultivation system) in certain more suitable areas, taking advantage of patches of more fertile soils and more favourable moisture conditions. This could be combined with the ranching policy (see 3.3.3).

3.2.5 Infrastructure

The infrastructure of Tharaka Division is poorly developed. None of the roads is metalled. Public transport costs Ksh 2-3/- per 10 km, the equivalent of one kg of maize. There is a primary school for every 200 children aged 5-15 years, a secondary school for every 1,300 children aged 15-20. There are no hospitals in the area and in local clinics there is usually only one nurse plus a clinical assistant per 7,500 inhabitants.

In the formal survey, 68% of households had children at primary school and 18% at secondary school. Of households with children at school, 23% spent less than Ksh 100/- per year, 71% spent less than Ksh 1,000/- per year.

There are ten weekly markets of which three are important for livestock. Transport difficulties make people favour the nearest market.

3.2.6 Institutions

The agricultural extension service in Tharaka is poorly staffed with one field assistant per 1,250 farm households (Sese, 1983). Around 70% of the Ministry's budget is spent on salaries leaving little money for running costs. No institutes are doing research specifically catering for areas like Tharaka. The National Dryland Farming Research Station (Katumani) can only do research for less dry areas (agro-ecological zone 4) due to shortage of staff and funds. There is some evidence that the relatively new British-funded EMI Programme has some impact in Tharaka with a soil and water conservation programme and the goat and sheep project.

The Government's policy to establish ranches in Tharaka is until now no further than the planning stage.

3.2.7 Conclusions

Due to physical and natural resources, most of Tharaka is unsuitable for arable farming (zones 5 and 6). Extensive pastoral systems have more potential in these areas. However, population density, reliance on crops as a major source of food and the poor accessibility to "outside" sources of food make it unavoidable that arable cropping continues to be undertaken in Tharaka.

Tharaka will remain reliant on outside assistance for food supplementation in drought seasons, infrastructural development and other services. Recommendations must aim at raising productivity of livestock and cropping can be made marginally more reliable for food supply.

To achieve this marginal subsistence crop production and higher productivity of livestock, the EMI project, working in collaboration with Katumani Research station, presents the brightest hope for innovative research. Self-help projects by the people themselves can be tapped to supplement such innovative research.

3.3 The basic farming system

3.3.1 Objectives

There are four major objectives underlying what the Tharaka farmer does and how he does it. These are:

1. provision of food for the family
2. safeguarding the future
3. meeting social obligations
4. maintaining status and wealth symbols.

Subsistence for the family is of major importance in the farmer's objectives. Of an average farm size of 14 acres, 5.2 acres is put under crops and 83% of this is for food crops. Even under the very unfavourable physical and natural environment, the farmer still repeatedly tries growing food crops to meet this objective.

The farmer's second objective of safeguarding the future is exhibited by the diversification of crops and livestock, the cropping pattern and the attitude of accumulating livestock, even in the obviously overgrazed pastures. Risk avoidance is the strategy used here towards achieving the farmer's objective.

Meeting social obligations like dowries, settling disputes and school fees for children is the third major objective of the farmer in Tharaka. Except for obligations which demand cash payment (e.g. school fees) the traditional obligations require the use of specific numbers of specific livestock and these play an important part in determining the farmer's stocking practices.

Finally, the farmer has symbols of status and wealth as an objective in what he does and how he does it in his farming practices. Food produced above the subsistence level is transformed into livestock because higher numbers of livestock are a sign of higher status or wealth.

3.3.2 Resources

3.3.2.1 Land

Although there are plans to adjudicate all the land in Kenya, to date in Tharaka land titles are only available for some of the settlement areas. Land in the rest of Tharaka is still governed by traditional rights under the informal control of the clans. This land is classified into: land traditionally cultivated by a family, abandoned land still under control of a family and communal lands available for livestock of anyone in the clan. Land use within Tharaka may be classified according to the intensity of the fallow. Land is predominantly cultivated under a bush-fallow system with fallow lengths mainly of 2-5 years, although there are farmers in both shifting cultivation and permanent cultivation. Average farm size among farmers surveyed was 14 acres although this varied considerably (3.2.4). Land fragmentation does not appear to be a problem, with 45% of farmers cultivating one field and a further 36% cultivating only two separate fields. According to the local chiefs everyone has access to some land.

3.3.2.2 Labour

The farm labour is almost entirely provided by family members. Half of the farms are operated by just two adults and only one-quarter by four or more adults. The children participate in a lot of activities like livestock herding, weeding and bird-scaring, but are increasingly only available during weekends and school holidays.

Around forty-five per cent of the farmers hire labour though the extent differs. A few hire labour for all activities while most hire only for weeding which is the most labour-intensive activity. Besides hiring labour, in the more strict sense of paying cash, labour assistance is sometimes extended in exchange for food or beer. Self-help via women's groups and harambee schemes also exist. In the survey no attempt was made to prepare labour profiles for the farming year.

3.3.2.3 Cash

Cash is needed in certain periods to buy food and make up for a poor harvest. Small amounts of cash are also needed for domestic needs such as sugar, tea, salt and kerosene. School fees, especially for expensive secondary education, also require cash. What a farmer sells depends on the amount of cash required; food crops for little things, goats for slightly larger and cattle for the occasional large item of expenditure. Fifty per cent of the farmers surveyed received some cash from honey sales. A few also earned cash from charcoal-burning, basket-making, contract labour and trading. Regular employment was practically of little importance since very

few are involved. Scarcely any cash remittances were admitted as being received by the farmers surveyed.

The survey confirmed the impression of an economy still largely run without cash. Sales match purchases in a way only a short step from a barter economy. Goats almost function as commodity money.

3.3.3 Cropping

In marginal areas of Tharaka, the problem of maintaining reliable production of food crops is tied to the following factors: (1) unreliable rainfall within a year and from year to year, (2) insufficient rain to support plant growth throughout the growing season, and (3) declining soil fertility because of (a) a virtual lack of measures to maintain or improve it, and (b) soil erosion attributed to high rainfall intensity and poor vegetative cover, due to overgrazing while in fallow as well as during the cropping period.

The survey showed that on average farmers cultivated 5.2 acres of crops per farm/household. Sixty-three per cent of this area was devoted to mixed cropping. The range of sizes about the mean was very great (3.3.7). Food crops accounted for 83% of the cultivated area with most farmers growing millet and sorghum and over 72% growing a legume (generally green gram in sole cropping and cowpeas intercropped with a cereal). Maize was grown by 41% of the farmers but accounted for only 9% of the total cultivated area. Only two cash crops were of any importance, cotton and sunflower. They accounted together for only 16% of the cultivated area.

Millet, sorghum, green gram and cowpea are grown during the two rainy seasons (March-May and October-December). Planting of all crops is done before the onset of the rain to maximize the use of rainfall as an insurance against crop failure. Intercropping is most common although sole cropping is common for cash crops, maize and green grams. The traditional intercropping patterns of planting seeds in the same hole are the most common, 29% millet/sorghum/cowpeas, 26% millet

Table 3 Area per farm of food and cash crops by sub-location

Sub-location	Food crops	Cash crops	Total
		(acres)	
Kathangachini	6.1	0.5	6.6
Marimanti	3.6	1.7	5.3
Chiokariga	3.1	0.7	3.9
Average	4.3	0.9	5.2

Source: Formal survey

and sorghum. Both row and random methods of planting are commonly practised.

Farmers practise traditional technology. Handtools such as the steel hoe (jembe) and the cutlass knife (panga) are used in land preparation and weeding. Problems related to the use of ox-ploughs which need clarification include the availability of ox-ploughs and the extent to which they are used on different soil types and slopes.

Hand-weeding is the most labour-intensive activity on the farm. Ninety-eight per cent of the farmers surveyed do their first weeding within eight days of crop germination, well within the recommended time. An improved technique of hand-weeding using a hoe could be a topic of research.

Pests were not a major problem except perhaps for birds in millet. Eighty-eight per cent of farmers who grew cotton used spray, an extension message popularized in the 1960's.

Farmers are aware of the problem of soil erosion and declining soil fertility, but only a few steps (trashlines, stones or wood barriers) are taken to maximize the use of water or improve the soil. Research is being conducted on the effectiveness of using millet stalks to conserve the water or minimize erosion and their contribution as sources of organic matter (EMI-SWC). The effects of ploughing on soil and water conservation are worth investigating.

Farmyard manure is only used by a limited number of the farmers surveyed. Rate and time of application were not well-known. The fallowing of land for a period of 2-5 years, as is done by most farmers at the moment, is a doubtful means of restoring soil fertility since fallow land is grazed and the period for bush regeneration is too short.

Storage of crops is not a major problem. Farmers' produce, in a season with sufficient rain, can last for two seasons, but, in cases of drought, people have to sell livestock to make up for small or non-existent harvests.

3.3.4 Livestock

The economic exploitation of the resource base in Tharaka has moved from hunter-gathering, through pastoralism and shifting cultivation, to settled farming in less than a century (Barnard, 1971). Livestock has become part of a farming system with cropping and other sources of income. Of the farmers surveyed 85% owned some livestock and 60% owned cattle, sheep and goats. The average herd is 12 cattle, 28 goats and 11 sheep with very wide variation in the number of stock owned. At one extreme, 25% of farmers own 60% of livestock; at the other 25% own only 6%.

Livestock are kept for a variety of socio-economic reasons. They are regarded

as a source of wealth and prestige, inherited, and exchanged as dowries and as gifts. Owners sell their livestock only to purchase food, pay school fees or for some other pressing reason.

As a result, livestock are accumulated and stocking density is of the order of two goat equivalents per acre or five acres (two hectares) per livestock unit*. Sixty per cent of livestock owners graze communal land and 80% graze their own fallow land. The general pattern is to graze communal land in the rainy seasons and fallow in the dry seasons. A minority of farmers (30%) rent, own or borrow land from other farmers for additional grazing.

The high stocking density leads to over-grazing and erosion, plainly visible in Tharaka. The ability of land to regenerate under fallow is affected by the over-grazing, thereby affecting crop production. Regeneration of fallow is also negatively influenced by slow bush regrowth due to limited rainfall.

Another result of overstocking is the poor health and condition of livestock. In 1983-4, owners reported mortality rates of 27% for cattle, 20% for goats and 28% for sheep. Poor organization of dips and extension services compound the problems of overstocking and drought. In 1984 the poor quality of animals and the large numbers brought to the market left many livestock unsold. In 1983, offtake was high in response to crop failure, with sales amounting to 20% of cattle, 30% of goats and 13% of sheep.

The livestock system is not presently well integrated with cropping. Manure is applied by 20% of farmers and there seems scope to increase this proportion. The survey did not find out how many cattle were used for draught, but only 15% of farmers used their own ox-ploughs (another 35% hired ox-ploughs). Again there seems to be scope for increasing the use of cattle for draught power and so raising the productivity of cultivated land. Three-quarters of owners fed their stock with stover.

Overstocking can only be reduced by owners recognizing the problem and being prepared to take action themselves. The GASP dissemination of improved breeds and an acceptance of group ways to control communal grazing are two possible ways in which action by livestock owners can be encouraged.

3.3.5 Honey and beeswax

Beekeeping is recognized in Kenya as offering potential for increased exploitation. The greatest part of the crude honey production, nationally estimated at some 80%,

* One livestock unit (300 kg) = 20 goats = 20 sheep = two cattle.
Estimate of stocking density from survey data on the basis of census data.

is utilized in the brewing of illegal beer while only 10% of marketed honey goes through refineries for table consumption (Kasalia, n.d.). This is most likely true for Tharaka too, where present local prices for honey to be converted to beer are higher than those offered by the refinery. From the estimated 59,000 traditional hives in Tharaka, with a very conservative production estimate of five kg per annum of crude honey per hive, a total of 300,000 kg of honey would be expected each year. Last year (1983) only 26,000 kg of refined honey and a similar quantity of beeswax found their way to the recorded market. More sales of honey or wax could provide a significant increase in income for a wide range of farmers.

It is difficult to say what the potential carrying capacity of the Tharakan environment is for bees, although based on figures from other areas there would not appear to be much room for increasing the number of hives. The present traditional hives seem adequate in production levels (higher than national quoted figures) although the quality of honey is not as good as in the officially encouraged Kenya Top Bar hives (K.T.B.), nor is collection as easy.

There is no organized collection and use of beeswax within Tharaka, even though the national domestic demand for beeswax is very high, as is export demand. In other areas of Kenya beekeeper associations organize marketing and processing of honey as well as some small industries using beeswax in producing candles and polishes. There is no such organization within Tharaka.

Apart from the beekeeping courses run by the Marimanti Rural Training Centre (M.R.T.C.), there is very little extension of information, although demonstration apiaries using the K.T.B. hives have been set up.

3.3.6 Other

There is very little prospect of charcoal, basket-making or other income-earning activities being able to make a significantly increased impact in Tharaka. These activities will remain important for individual farmers but of negligible importance to the farming system.

3.3.7 Variations in the system

The study area is regarded as having one homogeneous farming system because the similarities are more important than the variation in characteristics. However, some variations are important, although not always statistically significant, and these are discussed below. Land pressure differences due to different population densities play an important role in the explanation of the variation observed. Going from the south-west (Chiokariga) via the centre (Marimanti) to the north-east (Ka-

Table 4 Changes in certain variables across the study area

	Chiokariga	Marimanti	Kathangachini
Population densities (inhab./km^2)	47	43	9
Infrastructure	++	+	0
Cultivated area per household (acres)	4.5	5.3	7.6
Use of communal land for grazing (% of farmers)	40	50	85
Percentage of farmers growing cotton	52	24	4
Percentage of farmers visited at least once in last five years by extension officer	52	22	10
Percentage of farmers using manure	40	22	18

Source: Main survey

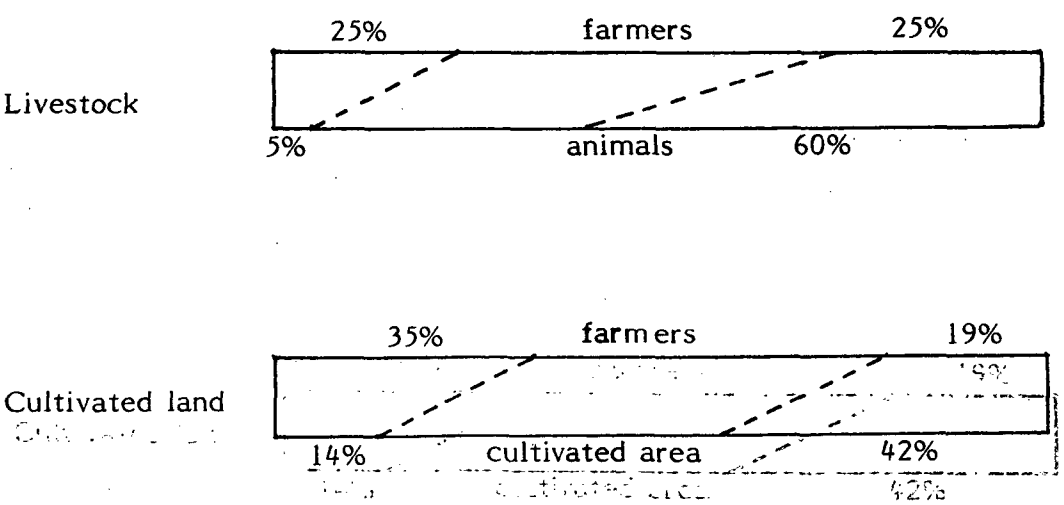
thangachini), we have the picture shown in table 4.

Within the whole of the study area the resources are divided as in figure 5.

3.3.8 Conclusions

The present farming system in Tharaka is not notably integrated. There is, however, scope for increasing the complementarities. There is an almost complete absence of effective measures of soil and water conservation, and ways of controlling over-grazing. Following the two successive crop failures since 1983, there is little chance of the system providing a subsistence food crop in 1984. However, there

Figure 5 Distribution of livestock and cultivated land



Source: Main survey

Figure 6 Summary of constraints and recommendations

Constraint	Recommendations	Main/initial action to be taken by						
		Local		Ministry of Agriculture and Livestock Development				EMI-project
		farmers	leaders	Tharaka Division			National research institute	
				Extension service	Range management division	Mechanization unit		
Livestock								
1. Poor marketing organization	. Formation of livestock owners' cooperatives		x					
2. Degrading pastures	. Evaluate carrying capacity							x GASP
	. Form Group Ranches	x			x			
	. Feasibility study for construction of wells or boreholes							x SW
3. Inadequate health service and husbandry practices	. Involve livestock owners cooperatives in dip management			x				
	. Mobile training programme on health care and husbandry practices							x GASP
Crops								
1. Soil and water conservation	. Identify and use demonstration farms			x				
	. Set up demonstration plots							x SW
	. Feasibility study for small-scale irrigation							x SW
2. Stability and reliability	. Millet/sorghum/cowpea intercropping research						Katumani	x DC
	. Incorporate intercropping messages in extension system			x				
	. Use of farmyard manure on home plots			x				
3. Labour use	. Develop labour-saving handtools for weeding					x		
	. Study implications of increased use of ox-plough/cultivators							x DC
4. Food insurance in Tharaka	. Evaluate and, if feasible, stimulate grain storage programme		non-governmental agencies					x
Off-farm income								
1. Honey/beeswax does not bring in a lot of cash income	. Encourage sale of beeswax and improve marketing							x
	. Not to bring in KTB hives until made more suitable for area							
	. Bring hives onto field/farms							
	. Encourage setting up of beekeepers association							

SW = Soil and water programme, GASP = Goat and sheep project, DC = Dryland cropping.

is possible scope for reducing crop failures in the long term.

Within the largely homogeneous farming system there are still notable differences among farmers, particularly in farm size and livestock numbers. Considering the marginality of the productivity of the physical environment, there is very little potential to improve the lot of the 20% of farmers who cultivate less than 2.5 acres and the 6% of farmers who own no cattle or sheep and only a few goats.

The existing practices and measures (dips, ranching, marketing groups) need to be modified to increase the productivity of livestock. Experimentation aimed at stabilizing crop yields at a subsistence level could evolve useful advice on soil and water conservation, soil fertility maintenance and the use of cattle and oxen on the farm. The dynamics of the farming system which lead to overstocking can in this way be taken into account. However, the above measures would have only a marginal effect on crop and livestock productivity. It is, therefore, essential that there be a continued emphasis on population control as a long-term stability measure.

3.4 Recommendations for improving the farming system

The natural/biological environment limits the potential for improvement of the farming system. Therefore, the recommendations which are summarized in figure 6 have to be considered as only able to improve the situation marginally. They are discussed in detail in chapter 5.

4 COMPONENTS OF THE FARMING SYSTEM

4.1 Land use

Calculation of land use intensity for the farms surveyed show that fallow systems are the most common. A classification was made relating the land under cultivation to the total available for cultivation (Figure 7). This is roughly equivalent to the intensity of rotation (R) used by Ruthenberg (1983) which is defined as:

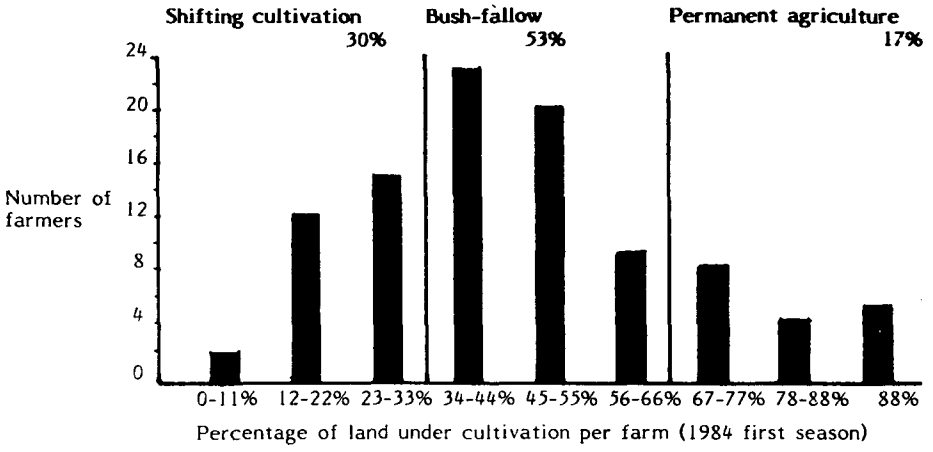
$$R = \frac{\text{number of years of cultivation}}{\text{number of years of cultivation + number of years of fallow}} \times 100\%$$

Values of less than 33% indicate shifting cultivation, while 33-66% indicates a fallow system, and greater than 66% is defined as permanent cultivation.

The more densely populated settlement areas of Tharaka Division (which were excluded from the survey) are mainly under permanent cultivation, although they do have fallow periods. In these areas land titles have been granted and farmers are unable to shift onto other land.

The traditional rights governing land use in the study area allow for the shifting of fields with restrictions. In more densely populated areas one would expect there to be fewer opportunities for shifting cultivation and an increase in the sedentary nature of farms and fields. The results from our survey do now show any significant difference between the three sub-locations surveyed despite considerable differences in population densities. Of those classified as being in permanent cultivation 80% had farms which were considerably smaller than the average for their sub-location

Figure 7 Distribution of the percentage of each farm under cultivation



Source: Main survey

Table 5 Comparison of farm size of permanent cultivators and all farmers

	Average farm size (in acres)	
	Permanent cultivators	Overall
Chiokariga	4.8	15.1
Marimanti	6.0	12.5

Source: Main survey

(Table 5). There were no noticeable differences in the farming methods and crops used by these permanent cultivators.

Medium rest fallows are the most common in the study area. There was no significant difference between the sub-locations surveyed. The length of fallow is governed by many factors, land availability, agricultural potential of the land, changes in family size (hence food crop demands and labour availability), climatic conditions affecting crop failure and bush regrowth. Therefore, it was impossible to relate the period of fallow to population densities alone. Of the farmers surveyed, 50% stated that the recent droughts had resulted in an increase in their fallow period. This short-term effect masked the longer-term trend towards a shortening of the fallow period, a result of increased population pressure. It has been reported that in the past farming in Tharaka was shifting cultivation, with cultivation for three years and fallow of 10-20 years, with shifting homesteads (Barnard, 1971). Fallow periods have been considerably reduced from this and 77% now have fallow periods of five years or less. In addition, only 10% of the farmers had moved their homesteads in the recent past for reasons which could be related to shifting cultivation.

Communal grazing lands would be expected to be more available in less densely populated areas. Table 7 shows that there is, in fact, more use of communal land

Table 6 Distribution of lengths of fallow period

		Percentage of farmers reporting
Long rest	(5 - 20 years)	23
Medium rest	(2 - 5 years)	56
Short rest	(1 - 2 years)	12
No fallow		9
		100%

Source: Main survey

Table 7 Percentage of farmers grazing different categories of land

	Kathangachini	Marimanti	Chiokariga
1979 population/km^2	9	43	47
Percentage of farmers grazing fallow	85	83	75
Percentage of farmers grazing communal lands	85	50	40
Percentage of farmers borrowing, renting, owning grazing land	10	45	35
Percentage of farmers using only fallow	10	20	30

Source: Main survey

in the less densely populated Kathangachini sub-location. Linked to this one would expect in areas of higher population more farmers having to resort to borrowing, renting or owning specific grazing land. Most farmers at present graze their fallow land as well as other grazing lands. It is to be expected that with continued reduction of fallow land and the increasing pressure on communal lands for cultivation, due to increasing population pressure, the problems of overstocking will become more severe. There is no reason to suggest that the long-term trend of intensification of land use and reduction of fallow will not continue considering population growth rates (3.3.2).

4.2 Crop system

4.2.1 Crops grown

The main objective of farmers in Tharaka is the provision of their subsistence needs. Therefore, one would expect an emphasis on food crops rather than cash crops. In terms of acreages, food crops clearly dominate with 83% of the cultivated area under food crops. Cash crops are grown by 50% of the farmers surveyed. All of the farmers surveyed grow food crops and 85% grow some combination of bulrush millet, sorghum, cowpeas and green grams.

Table 8 Percentage of farmers growing and area occupied by different food crops

Food crop	% farmers growing crop	% cultivated area
Maize	41	9
Bulrush millet	99	76
Sorghum	91	
Green grams	74	
Cowpeas	70	

Source: Main survey

Maize is grown by 41% of the farmers but only on 9% of the cultivated area, so it does not qualify as a staple in the food production system. Millet (throughout it is bulrush millet which is referred to) and sorghum have superior characteristics in conditions of low, unreliable rainfall and short growing seasons. Furthermore millet and sorghum when cropped together provide complementarities that reduce risk. In a year of high rainfall, when waterlogging is a problem, sorghum can still yield well; it can also survive drought periods within the rainy season. In years of low rainfall millet can still provide adequate yields so long as the rain is well distributed throughout the season. Millet and sorghum have the added advantage of being able to flourish on less fertile soils than maize. Despite its disadvantages, maize is still grown by a substantial minority of farmers. The reason for this probably lies in a food preference for maize to give variety in a millet/sorghum diet. The survey found that 70% of farmers normally bought food and that maize was the most popular purchase. This, of course, also reflects availability in the market, particularly in times of drought.

The drought-tolerant Katumani maize variety is more suited to agro-ecological zone 4 than to zones 5 and 6 which are more common in Tharaka. Further research on even more drought-tolerant varieties seems unlikely to be successful. Therefore, research into maize varieties is not a research priority for the area, especially considering the already superior adaptation of millet and sorghum.

In addition to food crops 50% of farmers surveyed also grow a cash crop. Cotton was grown by 40% of farmers and 23% grew sunflower. However, they accounted together for only 15% of the cultivated area.

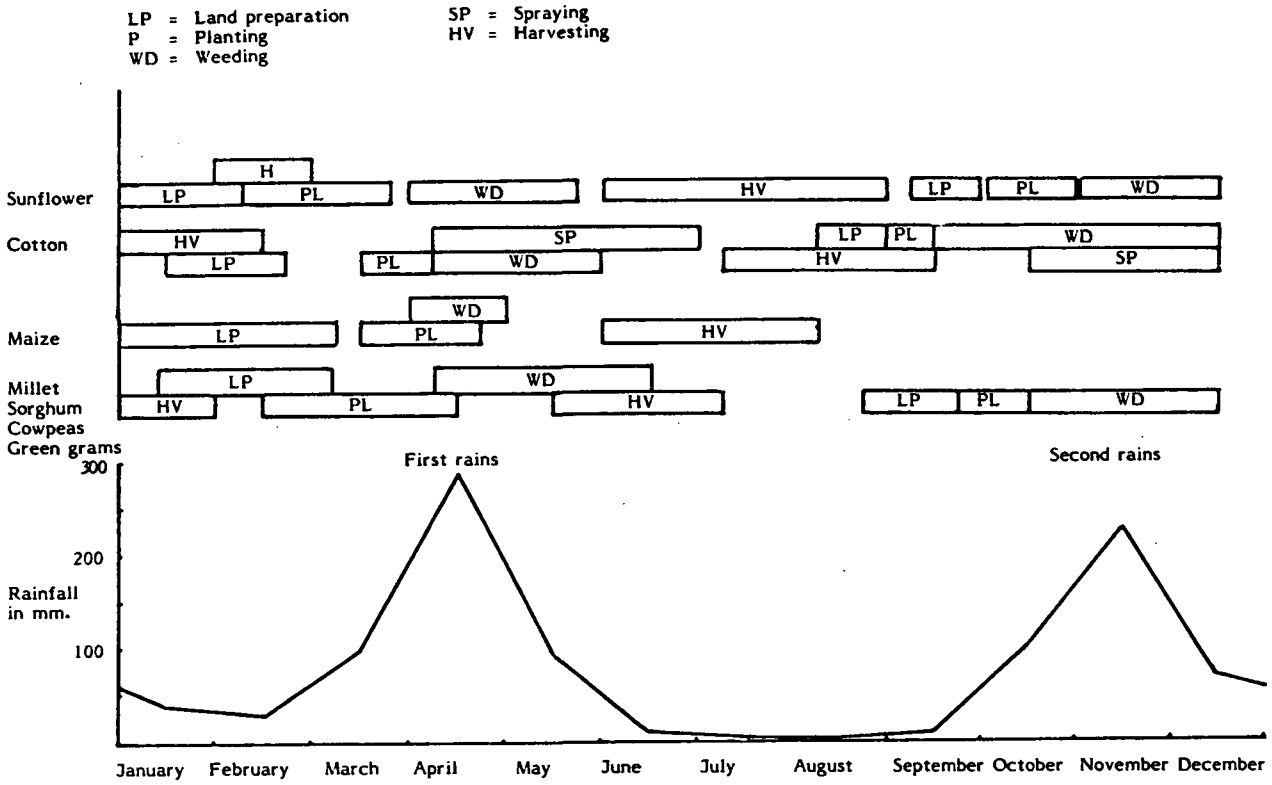
Relatively more farmers in Chiokariga grow cotton (52%) and only very few grow sunflower (4%). This could be attributed to the fact that part of Chiokariga is in the more favourable agro-ecological zone 4, i.e. the marginal cotton zone. It is also possible that the intensive extension efforts started in the province in the late 1960's have advanced towards this area of Tharaka.

Table 9 Percentage of farmers growing food and cash crops by sub-location

	Kathangachini	Marimanti	Chiokariga	Tharaka
Food crop + cotton	4	24	52	27
Food crop + sunflower	14	12	4	10
Food crop + cotton + sunflower	21	18	0	13

Source: Main survey

Figure 8 Cropping calendar



4.2.2 Cropping calendar and patterns

Figure 8 shows the cropping calendar for the study area. Millet, sorghum, green grams and cowpeas are grown in both seasons (March-June and October-December). Katumani maize is grown only during the first rains. Cotton is planted usually in October and harvested twice (once each season). Sunflower is grown in both seasons.

Sole cropping is quite common with over 200 instances of crops grown alone compared with only 100 instances of intercropping. However, in terms of area intercropping is more dominant with some 260 acres compared to 200 acres under sole crops.

Millet and sorghum are more commonly intercropped, while green grams, maize, cotton and sunflower are more commonly grown as sole crops (Table 10). Overall, 65% of farmers practise both intercropping and sole cropping with very few relying on sole cropping alone (15%).

The most common intercropping pattern is millet, sorghum and cowpeas randomly planted in the same hole followed by millet and sorghum, again mostly planted randomly in the same hole. Table 11 shows the occurrence of the most common intercropping patterns. There are many other combinations and patterns but these

account for 80% of all instances of intercropping.

For sole crops it is far more common to plant in rows while for intercropping random or row planting are equally likely (Table 12). The cash crops, cotton and sunflower, whenever they are planted in sole stands, are planted in rows.

4.2.3 Cultural practices

4.2.3.1 Land preparation and crop husbandry

Two-thirds of farmers surveyed prepare the land using only handtools; steel hoe (jembe) and cutlass (panga). One-third additionally used ox-ploughs (discussion under tillage practices). Only three farmers (of 103) used tractors supplied by the agricultural mechanization depot at Chiokariga. Where land is brought into cultivation after a long period of fallow the land must first by cleared. All farmers used handtools for this. Trees and shrubs were cut and burnt while tree stumps and stones were often left in place.

Most of the farmers surveyed planted before the rain. Of these, 78% reported that it was to make maximum use of the rain and 13% to obtain an improved yield over late planting. The planting method was to make a hole with a stick or panga, place in the seeds and stamp the soil on top. Even farmers using ox-ploughs and planting in rows hand-seeded in this manner.

Weeding was regarded as the most labour-intensive activity by all the farmers surveyed and 39% hired labour for this. All the farmers carry out their first weeding within eight days of crop germination. This early weeding is regarded as critical for crop establishment. Traditional tools, 'jembes' and 'pangas', are used by most of the farmers (91%), while older people prefer a light, thin-bladed hoe, 'mero'. Ox-drawn implements were used by 9% but hand-weeding within rows was also still required. Research on hand-weeding should focus on equipment that can be used standing up. Improvements in weeding techniques and tools could reduce the labour requirement of this important activity.

Of the farmers surveyed 70% usually replant when a crop fails and practically all of these did so with the same crop. Sometimes a failed crop is replaced by a shorter maturing crop such as cowpeas. Most farmers (97%) use their own seeds for planting. However, during drought periods the majority have to buy additional seeds. It was not possible to determine how skilfully farmer selected their seeds. Research into farmers' seed selection methods and possible improvements would be useful. The few localities which consistently out-perform the rest of Tharaka in crop success/yields may have a seed advantage as well as more favourable conditions. One such area lies astride the Chiokariga-Marimanti road.

Table 10 Instances of intercropping and sole cropping for the major crops

	Intercropping instances	Sole cropping instances
Millet	66	36
Sorghum	75	24
Cowpeas	35	22
Green grams	20	59
Maize	13	25
Cotton	11	33
Sunflower	6	12

Source: Main survey

Table 11 Occurrences of different intercropping patterns as percentage of total

Intercropping pattern		Percentage of all intercropping patterns	
Millet/sorghum	(a) random, same hole	15	26
	(b) other patterns	11	
Millet/sorghum/cowpeas	(a) random, same hole	16	29
	(b) rows, same hole	8	
	(c) others, same hole	5	
Green gram/sorghum		10	25
Green gram/other crop		15	
Others			20
			100%

Source: Main survey

Table 12 Instances of crops grown in rows and randomly

	Rows	Randomly
Sole crops	146	56
Intercropping	50	52
Total	196	108

Source: Main survey

In the in-depth survey many crop pests were mentioned by farmers, chafer grubs at planting and Heliothis sp. attacking most crops. Cotton has a particularly wide range of pests and spraying is common (88% of those growing cotton). The Cotton Board supplied "ambush" on credit. Many of the farmers used up left-over spray on other crops, whether or not it was suitable. The most important pests, however, were birds, Quelea sp., in millet, sorghum and sunflower.

4.2.3.2 Tillage practices and the use of ox-ploughs

Little can be said about hand-powered tillage but that the size of the cultivated area and timing of operations are likely to be determined by the availability of labour.

Ox-ploughing means that a farm moves into a different system of cultivation, planting in rows, preparation of land after the rains have started, using less labour and physical effort for land preparation and weeding. However, ox-ploughing requires cash; 77% of the farmers who used ploughs hired them for around KSh 150/- per acre. Skills and trained oxen are also needed and farmers must have suitable land, without steep slopes, rocks or stumps. By delaying land preparation until after the onset of the rains the maximum use of rainfall cannot be achieved and evaporation rates would be higher. Ox-ploughing may further introduce a conflict with the timing of weeding. If it results in untimely weeding, as it does in Machakos (FAO, 1981a), crop yields may suffer. Investigations into the timing of ploughing must therefore be made.

From the survey 50% of farmers had used ox-ploughs at least once, but only 36% used ox-ploughs every season. Of those who regularly used ploughs the majority used them for land preparation (92%), 17% used them for both land preparation and weeding, while only 8% used them for weeding alone. Of those who did not use ox-ploughs most (70%) were interested in using them. Most of those uninterested in ploughing (66%) had land which they felt was unsuited to ploughing.

At the sub-location level, Marimanti had the highest proportion of ox-plough users (68%), reflecting, perhaps, a greater coincidence of flattish land with suitable soils. The Rural Training Centre at Marimanti has also been supplying ploughs to local people. Chiokariga has the lowest proportion (20% of farmers) using ploughs, perhaps a result of the rocky, hilly country and smaller average size of cultivated land. The use of ox-ploughs seems not to be related to extension visits, as only 15% of those using ox-ploughs had been visited by an extension worker.

4.2.3.3 Manuring

Although almost all the farmers own livestock, 75% of those surveyed do not manure, which is the only source of fertilizer available in Tharaka. The main reason given for not manuring was mainly labour inadequacy (26%), which depends largely on the time of application of manure and the distance of the field from the boma, where the animals are kept. Few farmers (15%) give the insufficiency of manure as a reason for not doing it and a further 15% said that they do not know how to apply it. Interestingly, 54% of farmers applying manure have been contacted by an extension worker. Thus the percentage of farmers applying manure in Chiokariga is higher (40%) than in Kathangachini and Marimanti (20%). This might be related to the presence of extension workers. It would appear that an appropriate extension message might motivate more farmers to apply manure.

The timing and the rate of manure application, which are still to be determined, will influence the labour requirement. For instance, most of the farmers (77%) who apply manure do it before planting. Therefore, the main labour constraint at weeding time would not jeopardize any attempts to increase manuring.

4.2.4 Soil and water conservation

4.2.4.1 Erosion control measures

The survey found a high awareness of the problem of erosion. Most of the respondents (92%) recognized it and only few (8%) either gave no answer or took no control measures. The most common, but not very effective measure, was to make 'trashlines' of millet and sorghum stalks (55%) while others constructed barriers of stones and wood (24%) or undertook ridging (13%). Experiments are underway by the EMI Programme (Soil and Water Conservation Project) to compare these measures. A possible advantage of trashlines is that they add organic matter. Perhaps there is also scope for a combination of trashlines with manuring to build up localized fertility. Millet and sorghum stalks can also be used as fodder or roofing material and there may be a conflict in their use. Additionally, the EMI Programme is involved in some studies on water catchment schemes in other areas which may be of relevance for Tharaka.

4.2.4.2 Fallowing and crop rotation

The topic of fallowing is dealt with in detail in 4.1. Most of the farmers (77%) practised less than five years fallowing. Generally, they recorded an increase in the length of fallow because of drought, but the general tendency is to shorter fallow periods. Consequently, crop rotation, which at present does not seem to

be an essential aspect of the present cropping (cereals and pulses are planted in rotation to some extent), is likely to get more attention in the future.

4.2.5 Crop production and storage

In January 1984 only 15% of farmers in the survey area had a harvest sufficient to feed their families for a period of longer than a few weeks. The July 1984 harvest will also fail because of drought. Between the sub-locations the differences were substantial. In Kathangachini, for example, twice as many farmers as in Chiokariga had no harvest last season. This can be attributed to the differing agro-ecological conditions of the areas. Yield estimates obtained for each of the major crops were those expected had the rains not failed this season (July 1984 harvest). Appendix 6 sets out the averages for each of the sub-locations surveyed. However, analysis of the differences is confounded by the multitude of variables involved (cropping combinations, planting arrangement, local climatic conditions, etc.).

Cotton yields can be compared as practically all cotton is grown in the same way; we see that Chiokariga has on average 40% higher yields than Marimanti, due to its more favourable climatic conditions. For Tharaka as a whole the millet yields suggested are 1200-1600 kg/ha which compares most favourably with yields actually achieved at Katumani Research station (1500 kg/ha) and in on-farm trials at Katumani (600-800 kg/ha) (Appendix 7). Green gram yields are lower than at Katumani and maize, cowpea and cotton yields are considerably lower. Katumani, it must be remembered, is in the more favourable agro-ecological zone 4. Cowpea yields are affected by the practice of harvesting leaves rather than pods in Tharaka.

Although farmers are essentially subsistence farmers, they normally also sell some of their surplus production to meet small cash needs. Seventy-one per cent sold food crops, 38% for small domestic needs and 15% because of a preference for purchasing livestock rather than storing food crops. Only 18% reported that they sell food crops because of difficulties in storage. Storage problems do not seem to be very serious although green grams seem to have more problems than the other crops.

The storage of crops is essentially traditional; millet and sorghum, often mixed with ash, are stored in large (up to 900 kg) sealed woven containers. As Tharaka has a very dry climate, problems of moulds and insects are reduced since the small seeds dry very fast and thoroughly in the field. Only occasionally are insecticides used, usually for green grams. Farmers mentioned both Actellic dust and D.D.T.(!) applied to both food and seed grains.

The problems of crop failures are likely to continue and the dependence upon external agencies for food relief will remain. It is important that surplus food re-

mains within the Division and that maize is supplied at a reasonable price. So stores for both sale of maize and the purchase, storage and resale of local cereals are necessary supplements to any developments in the crop production system.

4.3 Livestock system

4.3.1 Size of the herd

Farmers in Tharaka keep a combination of cattle, sheep and goats. This sensible strategy ensures both pasture and browse are utilized. Also there is an insurance reward since cattle generally perform better in years of good rain, goats in years of poor rain. Diseases affect the three types of animals differently. The combination of the three types of livestock in the same herd is very common (63% of livestock owners surveyed). Cattle are local unimproved zebu, goats a polymorphic population broadly known as the East African goat, and sheep are of the fat-tailed Masai type.

Virtually all farmers milked their cows and 77% milked goats. Of those not milking goats, 60% gave insufficiency of milk for the kid as their reason and only 30% had reservations about the taste of goat milk. A very high proportion (93%), notwithstanding taste, expressed an interest in improved milking goats.

Of the interviewed households, 92% reported having owned livestock in April 1983. In twelve months (April 1984) this figure had dropped to 86%; of the interviewed households 6% had lost all their livestock. The average herd of a surveyed household consisted in April 1984 of 12 cattle, 28 goats and 11 sheep, though a wide variation was observed (Table 13).

Livestock are unevenly distributed among farmers. The top 25% owned around 60% of all the livestock, the bottom 25% around 4% (Figure 9).

A dramatic reduction in herd/flock size over the period April 1983 - April 1984 has taken place. Per household owning those particular livestock average rates of decline were 18% (cattle), 24% (sheep) and 35% (goats) regardless of the size of the respective herds. Large differences in the change-rate were observed between households (Table 14).

Death of animals and sales were the main reasons for the decline in herd size (Table 15).

The reasons given for selling animals were not very startling. A need to buy food (common reason for selling goats), the incidence of school fees (often requiring sale of cattle) and the need for small purchases (salt, kerosene) invariably matched the sale of livestock.

In effect farmers are often bartering goats for food and some farmers are bartering cattle for school fees. For 38 farmers it was possible to work out the timing

Table 13 Distribution of herd/flock size (April 1984)

Number of animals in herd/flock	Percentage of households owning		
	Cattle	Goats	Sheep
10 or less	57	20	59
11-20	23	23	23
21-30	9	23	7
31-40	7	15	7
more than 40	4	19	4
	100%	100%	100%

Source: Formal survey

Table 14 Percentage of herds/flocks with losses or gains (April 1983 - April 1984)

Herd/flock changes	Percentage of owners of		
	Cattle	Goats	Sheep
Losses	76	79	65
No change	12	8	16
Gains	12	13	19
	100%	100%	100%

Note This analysis is based on a reduced sample of 38 farmers for which full data were collected. The herd size of these farmers was not significantly different from that of the whole sample (103 farmers).

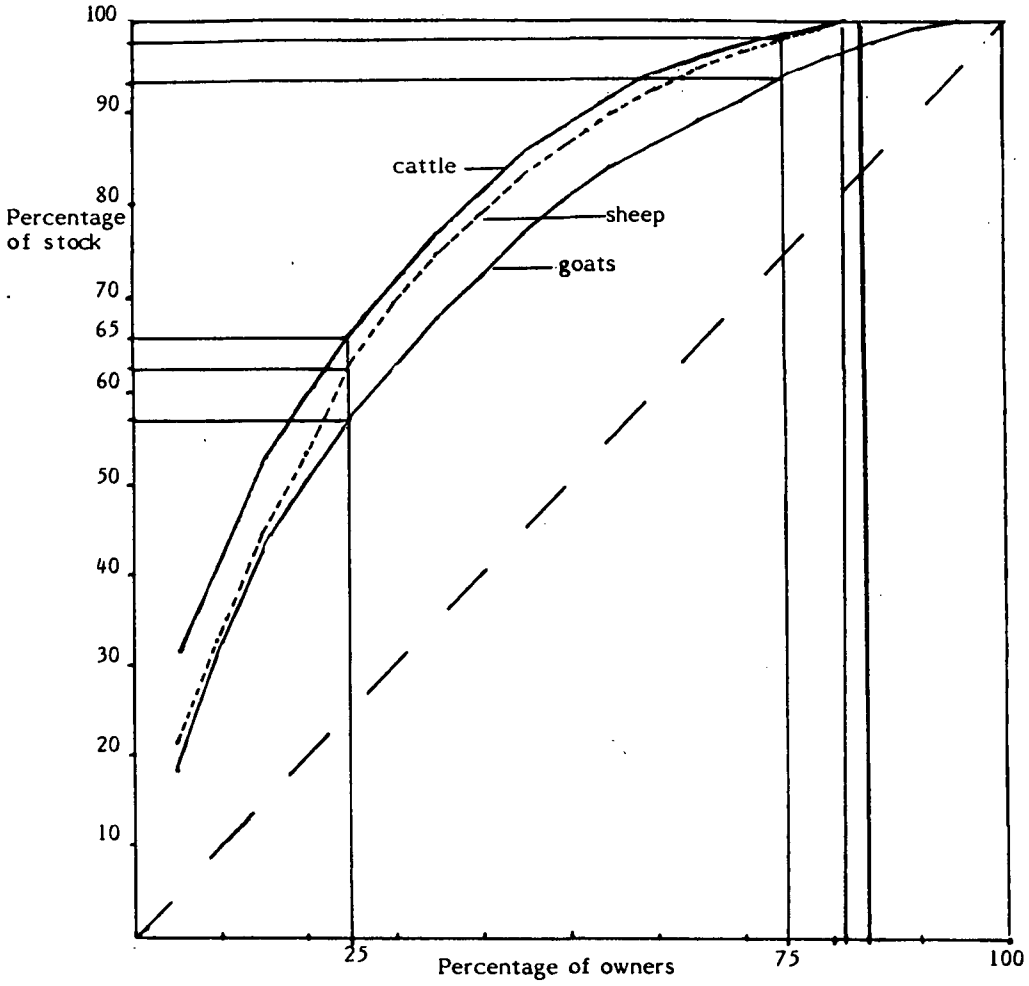
Table 15 Percentage of deaths and sales of cattle, sheep and goats (April 1983 - April 1984)

	Percentage of deaths	Percentage of sales
Goats	20	30 (1)
Cattle	27	23
Sheep	28	13 (1)

(1) statistically significant difference between sales of sheep and goats

Source: see footnote to table 14

Figure 9 Cumulative frequency distribution of livestock ownership



of sales. In the period April 1983 - April 1984 a typical peak of marketing was found in the latter part of the April-June 1983 rainy season for cattle and goats. A similar peak occurred in April 1984. Sheep sales were concentrated in March-April 1984, possibly related to Easter festivities.

Disease was the most common reason given for death but the absence of feed presumably had much of its impact through debilitating the animals. Certainly the combination of no rain and virtually no animal health services proved disastrous (4.3.3).

Gifts such as dowries play an important role in the social life of Tharaka. In the period April 1983 - April 1984 purchases of animals by households in the study area were very limited. Surprisingly few livestock are slaughtered on the farm for food according to the survey results (Table 17). The majority of the two-thirds of livestock owners who slaughtered sheep and goats during 1983/1984 did it only occasionally, mostly at Christmas. There is no tradition of preserving meat and

all has to be consumed fresh, making it an expensive food.

It was apparent that a high proportion of calves and kids died soon after birth, but it was impossible to work out the timing of births or their number. Return visits to farmers would be necessary through the year.

4.3.2 Husbandry practices

4.3.2.1 Herd composition management

A rough picture of the structure of the herds in the survey showed a balance in favour of adult females that may suggest the males are disposed of more than females. Castration is not common. Therefore, the possibility to obtain from castration fat male-animals, more acceptable on the market, is not realized. The type of animals disposed of was not ascertained, so the existence or not of policies to improve the breeding herd cannot be explored using the survey results.

4.3.2.2 Grazing

There are mainly three types of pastures: communal land, fallow (owned) land and owned(not fallow)/rented/borrowed land. Of these three the first two are predominant. Table 16 shows that about 80% of the households use combinations including fallow lands for grazing, 60% combinations including communal land and only 30% combinations including owned/rented/borrowed land.

The in-depth survey and formal interviews showed that the general pattern of livestock movement is as follows: livestock are grazed mainly during the wet season on communal lands when available and after exhaustion of feed on these lands are grazed on fallow land. However, farmers who can afford it rent or borrow land from other farmers or forest reserves, after exhaustion of the communal grazing,

Table 16 Type of grazing land used by livestock owners

	Percentage of livestock owners
Communal + fallow	37
Fallow only	20
Communal + fallow + owned/borrowed/rented	18
Fallow + owned/borrowed/rented	10
Other combinations	15
	100%

Source: Formal survey

before grazing their fallow lands. This saves their fallow until later in the dry season. The necessity of grazing animals further and further from the homestead in times of drought may lead certain farmers to build a temporary home close to the grazing area where animals will be kept during the night.

Herds and flocks of livestock are privately owned while communal pastures are used and 'managed' on a 'no-owner' basis. The outcome is that these pastures are excessively used since there are no restrictions on use and there are no obligations of management. Perhaps the greatest damage to communal pastures occurs in the first few weeks of the wet season. Farmers immediately put their livestock on these communal pastures before the young plant shoots are established. If well operated, the group ranches proposed by the government could be a remedy to this problem.

The pressure of population increase, both human and livestock, makes the final demise of communal grazing land in Tharaka inevitable. The obvious and widespread evidence of over-grazing (severe erosion, land degradation and a decline in the number of species of shrubs and grasses) leads one to the conclusion that the elimination of communal tenure in its present form might be desirable. However, the result might be an increase of pressure on fallow lands for grazing, which tends to negate the purpose of leaving land in fallow.

4.3.2.3 Fodder

No attempt has been made to establish a carrying capacity for Tharaka which would permit a regeneration of the soil fertility of the fallow lands and of the vegetation on the communal lands. In the formal survey a list of commonly grazed browses was collected (see Appendix 8). A consultant was contacted to do a first step in collecting samples from the fenced area used by the EMI Goat and Sheep Project (GASP) in Marimanti. This area had been destocked for six months before it was restocked with sheep and goats at the end of 1983 using a high level of management. The consultancy report is given in Appendix 11 and is meant as a contribution to EMI-GASP research on the livestock potential of Tharaka under better management conditions of the grazing land.

Three-quarters of livestock owners feed stover to their livestock, mainly by grazing directly from the field. This practice may conflict with the use of millet stalks as trashlines in an attempt to control soil erosion.

4.3.2.4 Watering

During the dry season animals are watered in most cases at least once a day,

generally in the middle of the day at a river or a well dug in the dry bed of a river. The average distance to the water is around two kilometres for the surveyed households. The time for walking to a watering point is at the expense of grazing/browsing time and is obviously energy-consuming for both people and animals. Moreover accessibility to water concentrates the grazing in certain areas. Further investigation would be necessary to determine the advantages and disadvantages of more permanent watering points/wells. The number of people benefitting, the costs of establishment and disadvantages such as fear of increasing the number of animals are subjects to be incorporated in a feasibility study in addition to the technical possibilities.

4.3.3 Health

Livestock owners in Tharaka are poorly served with veterinary services. Loss of livestock attributed to disease was reported by 60% of farmers for sheep deaths, 54% for goat deaths and 36% for cattle deaths. At the time of the formal survey none of the six dips in the study area was in operation due mainly to lack of water. Only 10% of the interviewed livestock owners had the opinion that there was no need to dip or spray or that such services did no good to their livestock. Over 90% of livestock owners were, therefore, aware of and willing to dip/spray their livestock. Two-thirds of these potential 'dippers/sprayers' had at some time dipped/sprayed their livestock.

From the survey and a visit to the District Veterinary Office the following livestock diseases were identified as being prevalent in Tharaka:

1. Tick-born diseases: East Coast fever, anaplasmosis, heart water and red water. These diseases are however not endemic and occur irregularly among herds or flocks.
2. Contagious diseases: foot and mouth disease (3 viral strains), anthrax, foot-rot. The first two of these diseases are very contagious and anywhere outbreaks occur the Veterinary Services impose quarantines against movement of livestock to and from the outbreak areas. Immunization of livestock around the quarantine areas follows immediately to check the spread of the disease. It was found that foot-rot commonly occurs only in the wet season in flocks kept in constantly wet bomas.
3. Worms: worm infestation seems not to be severe or one of the obvious causes of livestock losses. Naemonchesis is the only worm infestation identified as a cause of livestock death. The characteristic bell jaw symptom of this disease was described by some farmers in connection with severe losses. The drought situation in the Division, however, serves as a natural check on high worm infestations.

4.3.4 Marketing

Livestock are kept more as a saving than as a business. They are regarded as a security against crop failure. In times of drought a lot of farmers in need offer livestock for sale. This large supply causes price drops and makes livestock in some cases almost unsaleable within one market day. In May 1984 on some market days 75% of the animals were taken back unsold. The expected safety net against crop failure turns out to be not a panacea against famine in Tharaka. Annual reports of the Range Management Division-Tharaka (MOALD) show that livestock price fluctuations within a year can be of the magnitude of 200-400%.

Transportation between rural and urban markets is so poor that almost all the farmers surveyed who sold any livestock did so at the nearest market to their homestead. Data in table 17 and informal questioning suggested most buyers were from outside the study area, traders and butchers from upper Meru district.

The survey suggests that the sales of livestock in Gatunga, Chiokariga and Marimanti between April 1983 and April 1984 account for 20-30% of the total number of animals. This big off-take suggests a certain level of commercialization which partially contradicts the idea of a barter economy. Although the market might be defined in that respect as commercialized, the barter characteristics are more important. The reluctance to sell animals even when threatened by high mortality is some measure of lack of monetization of the Tharaka economy. No banking facilities are available in Tharaka Division. People have an aversion to holding cash and acquire it only to spend it immediately. Savings held as livestock are less easily borrowed, in a society where family and neighbourhood ties keep people alive. They

Table 17 Purchase, sales and slaughter of livestock (April 1983 - April 1984)

	Purchase	Sales	Slaughter
Goats			
number of animals involved	120	1000	195
number of farmers involved	30	78	50
Cattle			
number of animals involved	35	200	4
number of farmers involved	17	55	4
Sheep			
number of animals involved	24	162	50
number of farmers involved	9	39	26

Note A total of 95 farmers owned livestock in April 1983.

Source: Formal survey

also hold the promise of milk, off-spring, occasional meat and prestige. Unfortunately, last year demonstrated that such savings also die when conditions are bad.

The importance of goats relatively to sheep in sales by farmers (Table 15) confirm the impression that sheep are owned for largely ceremonial and festive occasions and not mainly considered as assets which can be cashed when food is short.

The marketing conditions of livestock need to be improved to make livestock raising an effective security against famine. Marketing cooperatives can be of help to reach these improvements. Any attempt to provide ready markets for livestock in Tharaka should, however, be accompanied by attempts or programmes of ensuring an availability of foodstuffs in the Division for purchase.

Initiatives of local authorities and/or non-governmental agencies aimed to do this should be encouraged.

4.4 Off-farm income

4.4.1 General

Approximately 75% of the farmers surveyed had some source of off-farm income. Off-farm income was defined for our study as a source of income which was not derived from the sale of either crops or livestock.

Regular employment (craftsmen, traders) is the most valuable source of income, although relatively uncommon. Incomes from regular employment varied between Ksh 400/- and Ksh 800/- per month. Of those surveyed with regular employment nine out of thirteen were from Marimanti sub-location, since Marimanti has more opportunities for permanent employment. There seems to be little likelihood of increasing the regular employment opportunities in Tharaka.

Table 18 Sources of off-farm income

Source	Percentage of farmers reporting
Beekeeping	48
Basketry, mats	28
Contract labour	21
Charcoal sales	15
Regular employment	13
Others (pension)	1

Note Some farmers had more than one source of off-farm income.

Source: Main survey

Contract labour is most commonly for weeding, employment being sought individually and through women's groups. Normally work is found locally. During periods of drought it becomes difficult to find contract employment. It is usually paid in kind, food or beer, although cash payments do occur; we obtained no values for this.

Basketry, although fairly common, brings in little money with palm baskets valued at Ksh 1-5/- each and mats Ksh 5-6/- each. There is little scope for improving this because of marketing problems and lack of transport to better markets for all but big traders.

Charcoal is an irregular source of income. It is usually made after clearing the land. Bags of 'makaa' were a common sight along the major roads through Tharaka this season (May-June 1984). It is likely that it was more common this year because of the continuing crop failures. Charcoal sells for Ksh 20-22/- per bag with some farmers reporting an income of Ksh 120-200/- per season. There is no scope for developing this as an income source.

Other off-farm activities include hunting and fishing, mainly for home consumption, as well as gathering of palm fronds for basketry and sausage tree fruits for making beer. These are often seen for sale in markets.

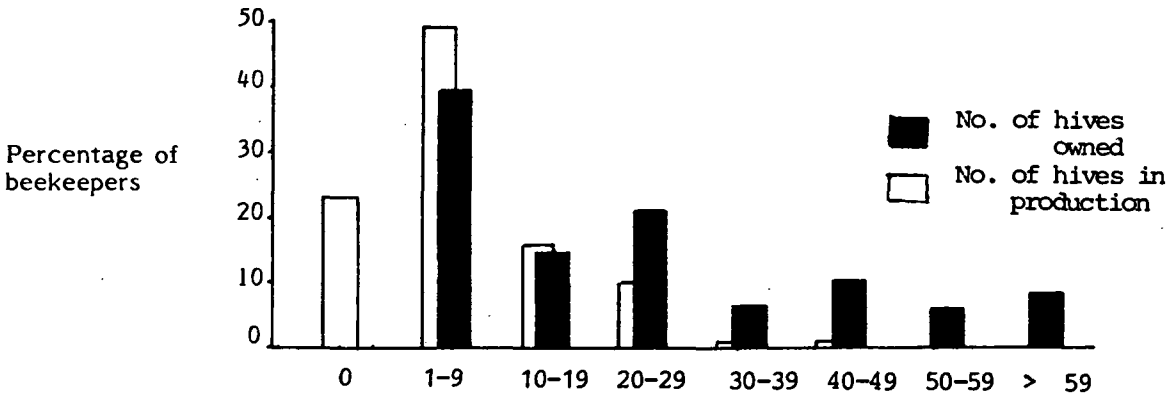
4.4.2 Beekeeping

Most honey in Kenya is produced in traditional log hives rather than in improved (Kenya Top Bar) hives or Langstroth hives. There are only 100,000 Kenya Top Bar hives in Kenya although they are officially encouraged. These hives have the advantage over traditional hives of producing more and better quality honey. No farmer using these hives was encountered in the survey although a few have been distributed to some farmers and women's groups, mainly in the settlement areas. It has been reported that the hives do not perform well under Tharakan conditions (pers. comm. M.R.T.C.) and the national beekeeping centre is presently engaged in research in connection with this.

Some 61% of the farmers interviewed kept bees and on average each farmer had 20 hives although this varies considerably. Figure 10 shows the distribution of hive ownership among farmers in the formal survey.

There was no significant difference between hive ownership in the three sub-locations surveyed, although Kathangachini did have a higher average. The drought had reduced the number of hives in production. In June 1984, 24% beekeepers had no inhabited hives. Furthermore, almost 50% had considerably reduced production. Beekeeping clearly cannot provide an alternative income source during drought periods.

Figure 10 Distribution of hive ownership and hives presently in production



In 1982 the government of Kenya imposed a restriction on the importation of honey in order to increase the market for domestic honey. Some honey is also exported but the poor quality and the high price of domestic honey are problems. The setting up of a refinery in Meru town and collection centres (one in Tharaka at Gatunga) will, it is hoped, increase the proportion of marketed honey going to refineries. However, the centre may find it difficult to compete with sales for local beer and continue only to take a relatively small proportion of the honey produced. The extent of sales of the illegal honey beer in Tharaka and the income it generates were, naturally enough, impossible to ascertain, but if national estimates are correct it could be very large.

Beeswax is not often sold separately, although it may form as much as 33% of the crude honey weight. Often it is simply discarded. Wax sold at local markets was reported to fetch Ksh 3-10/- per kg. There is no reason why beeswax cannot be separated by the farmer himself, as the method is very simple. This would not conflict with the use of honey for home consumption. The national domestic demand for beeswax is very high; local industries use it for manufacture of polishes, saddle soap, candles and cosmetics. Export demand for beeswax is also very high.

The traditional hives appear to be producing fairly large amounts of honey (even if reports are exaggerated) so the introduction of Kenya Top Bar (K.T.B.) hives would be unlikely to improve this much. The use of K.T.B. hives would, however, improve the ease of collection and quality of honey. The carrying capacity of the environment may not be able to sustain greater numbers of hives of either type. The national beekeeping centre recommends that an apiary of 25 K.T.B. hives be maintained in an area of one square kilometre. This would allow a population of only 40,000 of these hives in Tharaka. Luning (1973) quotes a density of one hive

per hectare (type unspecified) which would give a hive population potential of 125,000 for Tharaka. The present population is estimated by the bee advisor in Meru town to be 59,000 hives.

Under conditions of sufficient rainfall and good flowering the traditional hives were reported to produce between 15 and 50 kg of crude honey per hive per season (Source: interviews with beekeepers and workers at the Marimanti Rural Training Centre refinery.). Even if these yields are exaggerated, they compare very favourably with the estimated five kg per annum per hive quoted by the Ministry of Livestock Development (Government of Kenya, 1980) and with quoted yields of 30 kg per annum for Kenya Top Bar hives.

Of the farmers who kept bees 81% sold at least some honey. Most sold relatively little, although one farmer reported sales of as much as 400 kg valued at Ksh 8,000/-. Considering the potential yields, relatively little is actually sold. Most probably goes into the brewing of the traditional beer (national estimates report 80% of crude honey goes into beer-making). At local markets within Tharaka honey is valued at Ksh 15-20/- per kg, most of this probably destined for local brewing. Furthermore one kg of honey when converted into local beer can produce a net value of more than Ksh 40/-. These prices when compared with only Ksh 10-15/-per kg offered at the Marimanti refinery obviously present little incentive to sell to the refinery.

Sixty per cent of the farmers surveyed kept bees, with an average of 20 hives each. Thus, an estimate for the study area alone (excluding Nkondi, Tunyai, Kanjoro and Kanyuru) would be 54,000 hives. With this figure and a conservative estimate of five kg of honey per year the study area of Tharaka should be able to produce almost 300,000 kg of crude honey per year of which 100,000 would be beeswax. Last year Tharaka as a whole sold a sixth of this (50,000 kg honey and wax).

4.5 Future scenario

The population in Tharaka Division has been increasing at an annual rate of 3.3% during the last 15 years. The amount of land available for cultivation by each family will decrease from 20 acres (1984) to 10 acres (2005) if present growth rates continue. This is too small to support a family even in the relatively higher potential areas. With drought a commonly recurring problem, the present state of technology in crops and livestock cannot give a reliable production to meet the fast growing population in Tharaka. Migration to other higher potential areas would not be easy because these areas are already densely populated and there are only limited job opportunities.

The present fallow system cannot continue given the likely population increases.

The expected trend would be a move to more permanent cultivation with the decreasing fallow periods becoming insufficient to restore fertility. Adaptation in the present farming system will, therefore, be necessary.

No major technological breakthroughs can be expected because of the nature of the environmental constraints. The main aim must be to make production more reliable and to improve the use and conservation of limited resources and of what is produced.

There is a current initiative by the Methodist Church to set up a pilot grain store in Marimanti. Should it materialize, it would ensure continuous purchase and resale of millet and sorghum to the villages as well as purchase and transport of maize to the Division, especially during drought.

Large-scale irrigation schemes are prohibitively expensive and benefit relatively few. They are, therefore, not a feasible solution to Tharaka's problems. Small-scale irrigation may offer more potential, although farmers have not reached a stage where they can organize and manage the relatively sophisticated set of inputs required for successful irrigation.

Livestock ranching is the development strategy presently favoured by the government for the marginal areas of Tharaka. Four types of ranch are being considered. These differ in ownership of livestock, opportunities for settlement and cropping within the ranch and size and organization of the ranch management (Appendix 5). Of the four types one is already planned for the eastern section of Tharaka (zone 6). For the rest of the area no decision has yet been taken. From our survey we felt that of the options open, the group ranches would be the most likely to succeed. There is in Tharaka a tradition of successful self-help, harambee, women's groups and a positive feeling about small cooperatives. Large-scale 'externally-organized' cooperatives become divided politically and socially. Additionally, the small group ranches have more flexibility in the determination of land use for crops and livestock and of additional importance, the farmer retains ownership rights over his livestock. In general, ranches should improve land use, especially by regulating stocking rates (4.3.2). Additionally, livestock should benefit by improvements in the infrastructural services which can be organized by the ranches. The possibilities of long-term rotation between crop land and land reserved for livestock would help solve some of the problems of soil fertility.

Our recommendations cover improvements of the present farming system as well as a farming system of more permanent character expected to develop in future which could include the establishment of a ranching system.

5 CONSTRAINTS AND RECOMMENDATIONS

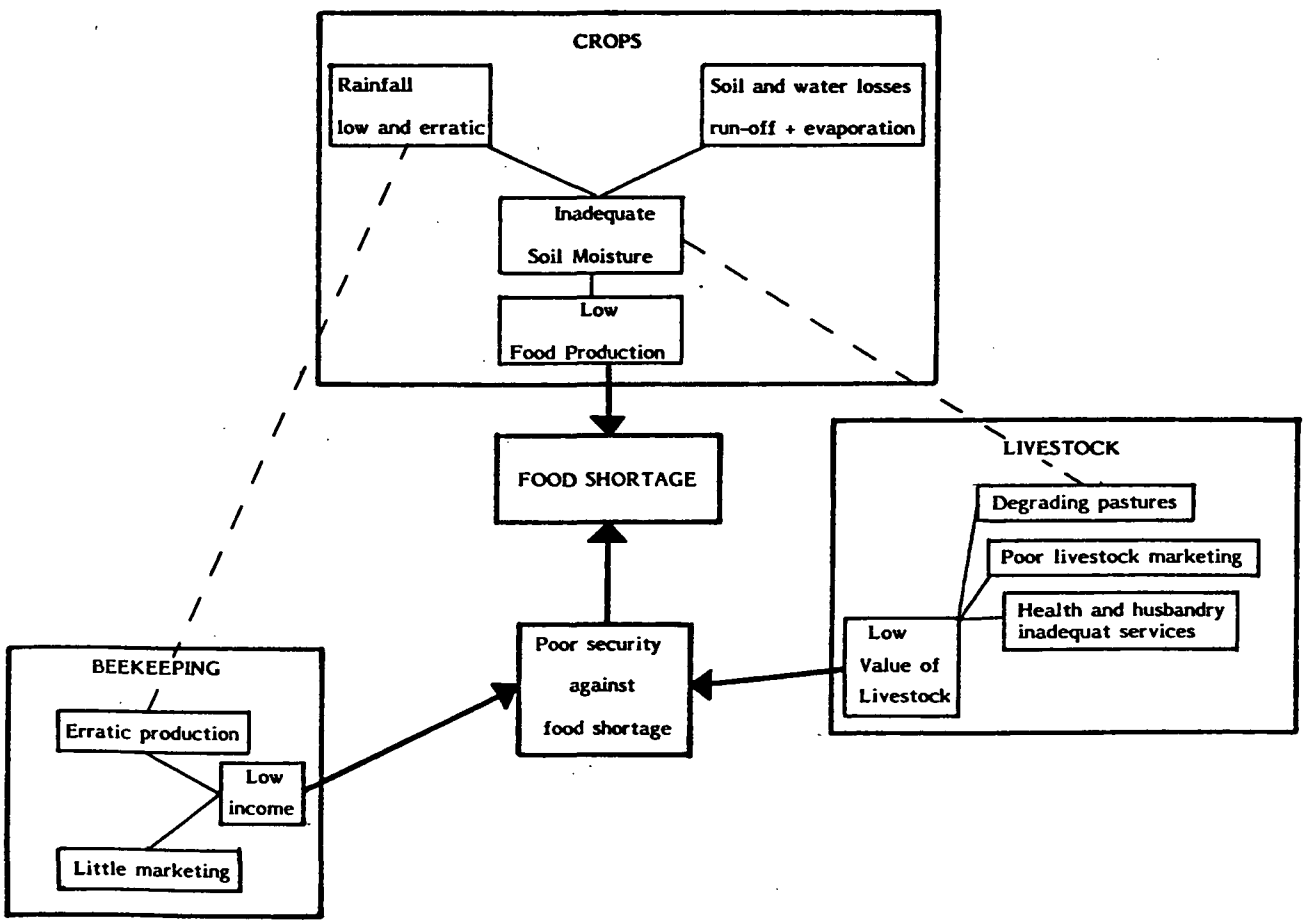
5.1 Constraints

The constraints as identified in the farming system of the study area in Tharaka are presented in figure 11.

The study area lies in an agro-ecological zone which characteristically is unsuitable for arable farming. Low and erratic rainfall and high rates of evapotranspiration result in inadequate soil moisture for arable cropping. Other physical constraints (soil type, topography) and management practices (soil management, fallow system, etc.) further contribute towards lowering the suitability of the study area for arable cropping.

Livestock raising, as a more suitable enterprise for the study area of Tharaka, however, also faces a host of interlinked problems. Over-grazed pastures, poor market accessibility and inadequate health and husbandry services are very pro-

Figure 11 Constraints to the farming system in Tharaka



nounced. These constraints to livestock raising in combination with management and institutional constraints such as overstocking, grazing practices and poor infrastructural/institutional development result in a low value of the livestock.

The inadequacy of soil moisture, as described above, with an attendant low regrowth of pastures contributes immensely to the degradation of the pastures and the occasionally high death rate of livestock from drought conditions and/or the low market value of livestock.

The major source of off-farm income in this farming system, being honey production, is very dependent on plant flowering and water availability for the bees. The level of honey production thus typically fluctuates with the intensity and regularity of the rainfall, as do the production levels of arable crops. Levels of honey production which are frequently low, in combination with a poor market for honey, result in a low and erratic off-farm income. A further constraint is the reluctance to sell honey and the lack of market facilities for beeswax.

The total effect of these interlinked constraints is an advancingly degraded physical and natural environment for both arable and livestock farming which results in a perennially increasing food shortage for an ever growing population. Evidence was found in the formal survey that local cooperation does exist on a sufficiently high level to build recommendations on local initiatives. Village meetings are well attended, half of the women interviewed participate in women's groups and 60% of the households have participated in self-help projects (Harambee schemes). More than 90% of the households interviewed were involved in food borrowing and/or lending.

Recommendations can only answer the needs of certain groups of farmers within the study area. Within the largely homogeneous farming system there are still notable differences among farmers with particular reference to farm size and livestock numbers. Considering the marginality of the productivity of the physical environment, there is very little potential to improve the 20% of farmers who cultivate less than 2.5 acres and the 6% of farmers who own no cattle or sheep but only a few goats. The recommendations here are, therefore, not geared towards this group.

On the other hand, some farmers have access to a lot of resources such as land, livestock and off-farm income. Their comparatively more advantaged situation compared to the group with limited resources caused us to direct recommendations towards the needs of the group of farmers with less than:

- 15 acres of land (= 65% of households surveyed),
- 7.5 acres cultivated land (= 70%),
- 15 cattle (= 80%),
- 30 goats (= 72%),

- 15 sheep (= 73%),
- Ksh 5,000/year off-farm income.

No special recommendations are developed for cash crop growing. Farmers with more resources than mentioned can also benefit, although the recommendations are not geared towards their interests.

5.2 Recommendations for research and development

5.2.1 Crops

Notwithstanding the unsuitability of Tharaka for arable farming, the total reliance on millet, sorghum, cowpeas and green grams as staple food crops, the poor access to 'outside' supply of these food crops and the high rate of population growth make arable farming inevitable.

The marginality of the ecological environment, however, limits the extent of possible improvements. The recommendations for improving the arable farming in Tharaka, therefore, aim to sustain or achieve a subsistence level of food crop production which would then make development of the livestock area (which has more potential) possible.

Development proposals are, therefore, given here directed at four elements of the crop sub-system.

1. Soil and water conservation.

   In order to maximize the use of rainwater for crop production and to minimize the amount of soil and water losses, soil and water conservation measures are proposed through:

   - the use of demonstration plots to be set up by the Soil and Water Conservation Project of EMI in conjunction with extension to demonstrate the various conservation practices (ridging, terracing, mulching etc.),
   - identify farmers practising sufficiently recommendable soil and water conservation measures to serve as demonstration/pilot farmers.

2. Stability and reliability of yields.

   To strengthen the farmers strategy of risk avoidance and to sustain a marginally subsistent crop yield:

   - extension should incorporate messages on intercropping of millet, sorghum and cowpeas in its programme,
   - the use of farmyard manure on home plots should be encouraged and extended.

3. Labour use.

   Labour was found to be limiting mainly for weeding. To reduce this limitation

and also to find an alternative use for cattle which could raise the value of cattle, the use of ox-drawn farm implements should be studied and expanded for plouging, weeding and carting of farm inputs (e.g. farmyard manure). However, the suitability of such operations needs to be considered on a location basis before introduction through extension.

4. Food insurance in Tharaka.

Food crops are marketed first (rather than livestock) after harvest at low prices. During the lean season, the farmers are obliged to purchase food crops at higher prices from middlemen traders who virtually control the marketing process. To reduce the outward flow of crop harvests and to achieve the above proposed development proposals there is a need to develop more farmer participation in problem-solving at the local level. We, therefore, propose that the EMI Programme evaluate the following alternatives with a view to providing a revolving fund to finance operations. The two ideas are:

- a central grain store constructed at Marimanti Rural Training Centre and managed by the Methodist Church. Food crop (millet, maize, sorghum, cowpeas) would be purchased and transported from inside and outside Tharaka and sold at cost during the lean periods of the year to alleviate famine. The church's funding and other support could be sought for:
- a network of small village/sub-location stores which would purchase, store and resell food crops to villagers. The stores would be built and run by local farmer committees with the help of the extension services based on the already existing harambee self-help group principle.

It is more realistic in the marginal situation of Tharaka to make research proposals for improving the reliability of crop yields rather than maximizing yields. Such proposals include:

- Investigations into intercropping millet/sorghum/cowpea/green gram by both Katumani Research Station and the Dryland Cropping Programme of EMI (more in terms of global probability of success according to the rainfall unreliability than in terms of absolute production by each single crop) with emphasis on yield reliability, weed suppression and maximum soil moisture use.
- Evaluation by EMI/DC of a collection of local varieties and their traditional performance in pure stand and intercropped.
- Testing in the EMI/DC project in sole and mixed stand of new varieties already identified by Katumani which are less productive but more drought resistant.
- Identification and evaluation of new intercropping patterns.
- Research by Katumani into new varieties which are successful in mixed stand and resistant against drought and bird attack, even if not so productive.

- Development of labour-saving handtools (especially for weeding) at the Mechanization Unit of the Ministry of Agriculture in collaboration with the Soil and Water Project of EMI, both to ease the labour constraint and to improve weeding without much disturbance to the soil.
- Feasibility study of small-scale irrigation schemes (i.e. up to five hectares irrigated land near perennial water) by the EMI/DC project. It should involve a full evaluation of the likely effects of such schemes and consider the following factors:
  - ownership of land,
  - likely settlers/beneficiaries,
  - access to water for drinking and livestock,
  - relative profitability of horticultural crops, cotton, cereals and perennial crops,
  - probable markets for crops grown.

5.2.2 Livestock

The livestock component of the farming system, although having more potential for improvement, requires less research and more institutional and organizational development. These development proposals are, therefore, set out with a view to improving the farmers' management of their livestock sub-system with the essential institutional support of agencies.

All the livestock recommendations and proposals point towards our overall view that the most appropriate solution for the future will be the establishment of small-size group ranches. This would combine the advantage of individual ownership of livestock with community rules for land use.

1. Degrading pastures.
   - We propose the setting up of group ranches (see 4.5). These ranches should take into consideration the carrying capacity of the environment, the willingness of the group members to be grouped and make use of the community rules of land use.
   - To strengthen the group ranch existence, there is the need to conduct feasibility studies for construction of wells and boreholes for both livestock and human use. These could be set up close to dry river beds. The EMI Soil and Water Conservation Project would be charged with this.

2. Inadequate health and husbandry services.

   In line with the group ranch formation it is proposed that livestock owners be motivated into forming farmer cooperatives. These cooperatives would then be

used for:

- mobile training programmes on health and husbandry practices by a training team comprising the GASP, extension services, range and livestock officers,
- controlling and managing the dip services in their locations. This would ensure the provision of water (and chemicals) in the dips as and when required.

3. Poor marketing situation.

The formation of livestock farmer cooperatives as proposed above would be of further use in obtaining a better marketing system for the farmers in Tharaka. Such cooperatives would organize the marketing of livestock outside the Tharaka Division and open up more channels for livestock trade with better returns; there is a higher demand for livestock (especially as meat) outside than inside Tharaka. The general pattern of selling livestock only at the moment that cash is needed is contradictory to the demands of the market.

A system of savings has to be established so that livestock are sold when they command the best price and that farmers are able to buy food when needed. This could be connected with the proposed grain store.

The establishment of a post office with a savings bank would also be an alternative.

The scope for research to improve the livestock sub-system, in our opinion, is limited to finding out the value of browse and pastures in Tharaka. The livestock-related divisions of the Ministry of Agriculture have little information at present on the carrying capacity of these pastures. However, to set up the group ranches as proposed above or to introduce any range management improvements such information is essential.

We, therefore, recommend that:

- GASP should undertake research into the feed values of the browse and pastures with a view to determining the carrying capacity of these pastures. Such a study has already started with analysis within the GASP area and should be continued with a more intensive analysis. This could be done in collaboration with the Kabete National Veterinary Laboratories and other institutions with capability for such analysis.
- To facilitate the above recommmendation and increase the value of its experimental results GASP should introduce flocks of local breeds of sheep and goats as control.

5.2.3 Off-farm income

There are several sources of off-farm income which include handicrafts (mats,

hats), contract labour work and beekeeping. However, our study showed that beekeeping is the only source of off-farm income with a potential for improvement. We, therefore, propose the following:

- Beeswax separation can be carried out by farmers themselves and sale of this wax should be encouraged. Mobile collection centres should be established and separate prices offered for beeswax.
- There should be encouragement of farmers to bring traditional hives to homesteads and near fields of sunflowers, since this could improve the yields of both the crops and honey. It would also reduce losses of hives from theft.
- Regular courses/talks at markets should be organized by the bee advisor to improve management and collection of beeswax.
- There should be an appraisal of the suitability of the transitional Kenya Top Bar hives for Tharakan conditions before encouraging the use of these hives in the area.
- Beekeepers associations, successful in other areas, should be encouraged in Tharaka. Such organizations could improve, encourage the marketing of wax and honey and possibly become involved in the manufacture of wax products (waxes, polishes, candles).

Conclusion:

In proposing the above interventions for improvement in the farming system of Tharaka, a number of overriding 'facts' have been taken as guidelines. The farmer, as the ultimate decision-maker on his activities, methods and use of resources, has certain objectives to meet (3.3.1). The local circumstances and his resource situation result in a combination of interlinked constraints (Figure 11).

The recommendations, although split up for the component sub-systems, can be seen to be complementary between sub-systems. For success, this complementarity has to be taken account of in the implementation of the recommendations.

6 EVALUATION OF THE METHODOLOGY

6.1 General comment

The field study conducted in Tharaka Division aimed to identify and evaluate development options and research recommendations which are likely to meet the objectives of both the farmers in Tharaka Division and the Government of Kenya.

To reach its main objective the team conducted:

1. an exploratory survey in order to set Tharaka in the research and development policies of governmental or non-governmental agencies,
2. an in-depth survey intended to provide an understanding of the farming systems, to be tested by the
3. formal survey.

Even though the main objectives were roughly reached, the hypotheses were not explicitly formulated in the two first stages and the formal survey questionnaire was not sufficiently elaborated. As a result, the data collected during the formal survey were difficult to analyse and did not permit a strong test of some of the hypotheses.

6.2 Detailed criticism

- Exploratory survey - in most cases there were too many people, i.e. the whole group, during the visits.

  Meetings not attended by all team-members were characterized by a lack of discipline in formally recording the collected information. As a result, during the last week a rush started to collect information from institutions, partially duplicating work of the first few weeks.
- In-depth survey - not enough collaboration is the main criticism of this period. The choice of farmers to be interviewed was done according to certain criteria. These criteria did not appear in the discussions later on, at least not explicitly. The use of a questionnaire was too restrictive and left a lot of questions unanswered. Nevertheless, taking into account the difficulty of good cooperation in a group of seven persons, there are advantages in formalizing the domains of investigation.

  Generally, not enough time was allocated for discussion of the in-depth surveys. Meeting every evening after a working day is too tiring to permit a good exchange of ideas about the understanding of the situation. A longer period for the analysis, i.e. the setting up of hypotheses, was very much needed.

- Formal survey - the survey was based on a weak and too ambiguous questionnaire. The fact that interviewing was done by one team member rather than two might have accentuated the diversity of answers. There was a possible bias in the selection of farmers arising from logistic considerations. If a selected respondent was absent a neighbour was chosen instead. However, it could be that the reason they were not at home indicates some particular characteristic of absent farmers.

6.3 Cooperation between team-members

The members did not focus on the aspects of their own discipline but on the identified problems of the farmers in the study area, a decision which was never regretted. The result of this way of working is not according to discipline but according to 'problem areas'. Getting too specialized in this sense was starting to become a problem by the end of the work. Plenary sessions took up a lot of time because:

- agreeing on issues was not done very fast,
- decisions not taken in a plenary session were in most cases not accepted.

Investigating certain problems in assignments of a few days by a team-member on his/her own was not accepted by the group. The multidisciplinary approach, unfortunately, did not result in a large exchange of knowledge between disciplines.

6.4 Improvements

As an improvement of the adopted methodology the group proposes the following:

- Less distinction between reconnaissance/exploratory/in-depth survey. In these first stages the use of 'reasoned' (purposive) samples and visits with the use of checklists instead of questionnaires should be stressed with each member of the group obliged to record the activities in a written, consistent abstract. More time between interviews has to be allocated for discussion and deciding on further lines of investigation.
- Experimentation with writing a first draft of the final report after the in-depth survey/exploratory survey and before the formal survey. This report can be seen as the hypothesis on which the formal questionnaire is built. After the formal survey the draft has to be rewritten according to the results of the formal survey.
- Participants should spend enough time on the choosing of random samples.
- Both in communication training and the course exercises even more emphasis should be placed on some aspects of team-work:
  - team-work does not necessarily mean doing all the work with the full group; special assignments must be possible;

- team-work needs a lot of coordination and communication between the team-members;
- in avoiding disciplinary specialization, care has to be taken not to create new specialisms;
- team-work needs decisions within time limits and decisions need compromises;
- successful team-meetings need participants to prepare themselves and a constructive attitude to come up with alternatives for difficult problems.

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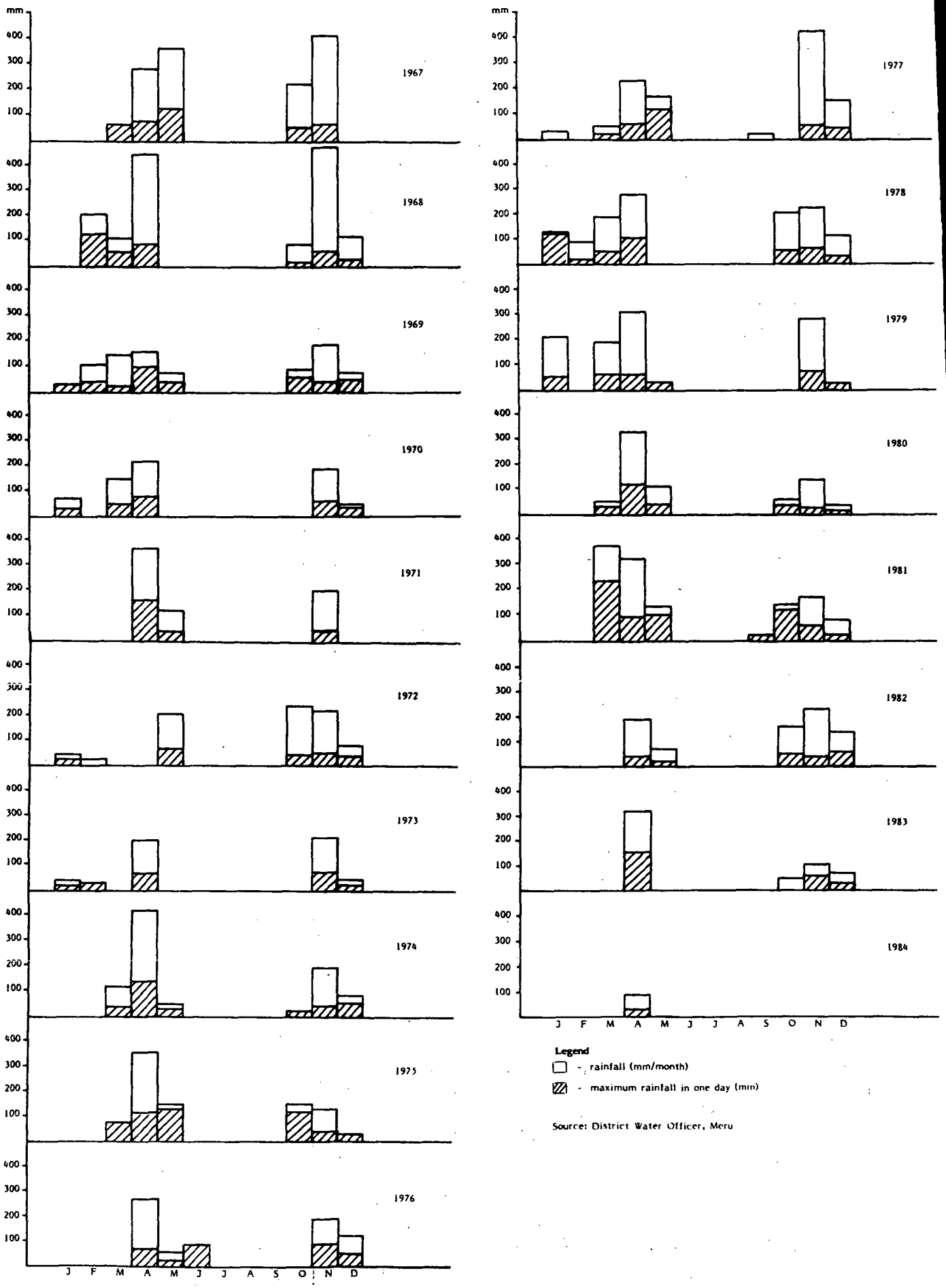
APPENDIX 1

Timetable ICRA Field study Tharaka Kenya April 9 - July 6 1984

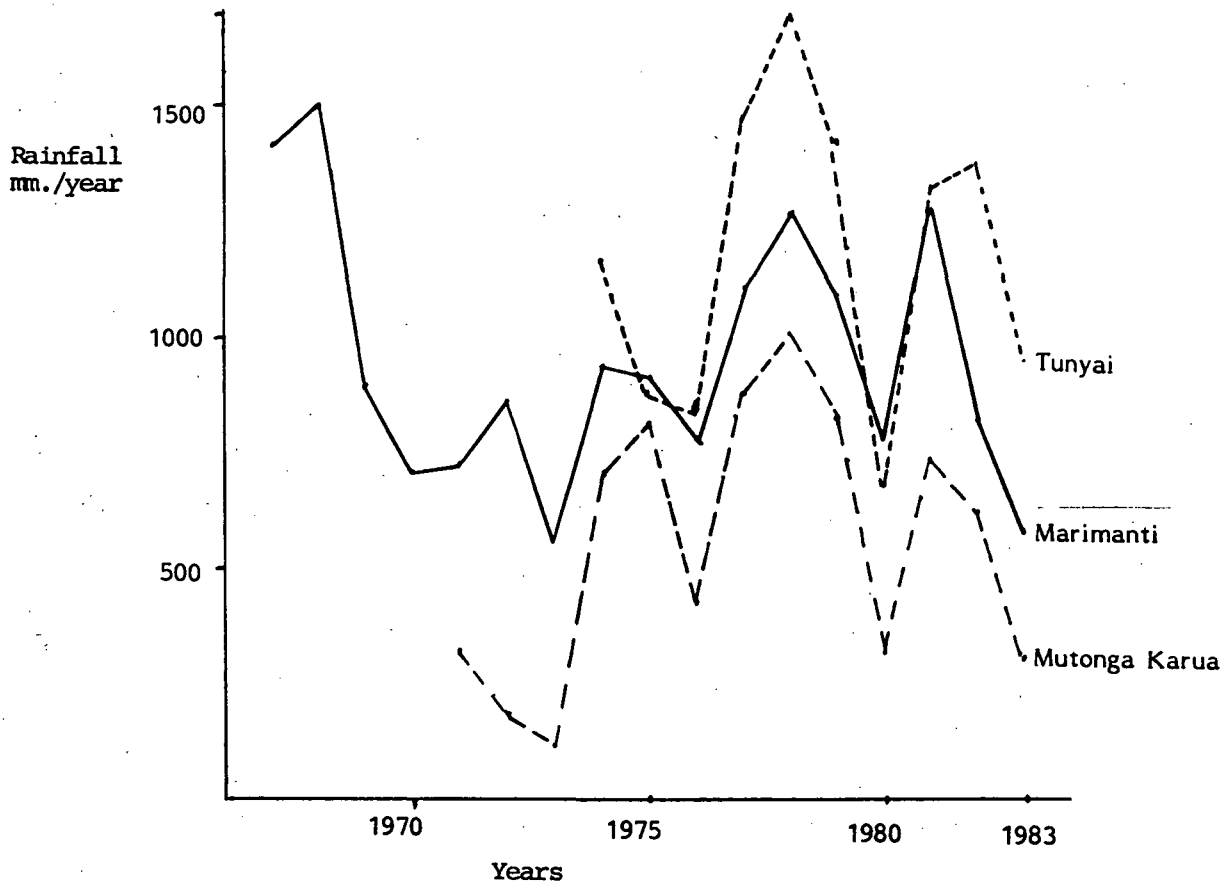
Week 1	Reconnaissance/ Exploratory survey period	National level
Week 2		Regional and provincial level
Week 3		Divisional and local level
Week 4	In-depth survey period	In-depth interviews Analysis of in-depth interviews Visits to Katumani Research Station and MIDP Project Discussions of the system Hypotheses drawn up
Week 5		
Week 6		
Week 7	Formal survey period	Formal survey questionnaire design Pre-testing Finalization of questionnaire Formal survey interviews
Week 8		
Week 9		
Week 10		Analysis of formal survey interviews
Week 11	First-draft period	First draft preparation
Week 12		
Week 13		Finalizing first draft, seminar preparation, seminar

APPENDIX 2 Monthly rainfall (1967-83) Marimanti (including maximum in a single day)



APPENDIX 3

Yearly rainfall: Marimanti, Tunyai and Mutonga Karua



APPENDIX 4

Population figures and densities from 1969 and 1979 censuses and 1984 sub-chiefs' estimates for Tharaka Division by locations and sub-locations.

Location/ Sub-location	Population figures			Population densities persons/km^2		
	1969	1979	1984	1969	1979	1984
Kalangachini	1402	2082	3500	6	9	15
Kanjoro	3894	7616	10000	19	38	50
Gatunga	4469	4608	6000	37	38	50
Gatue	2202	2799	4000	11	14	20
NORTH THARAKA	11970	17100	23500	18	22	31
Nkondi	4301	7085	8000	69	112	127
Marimanti	5785	5920	7000	42	43	50
Kanyuru	3845	7545	7499	37	73	72
MARIMANTI	13930	20550	24500	49	67	74
Tunyai	2257	4422	4500	28	53	54
Chiokarige	5805	4883	4200	56	47	41
Kamanyaki	3071	3558	3800	29	33	36
SOUTH THARAKA	11130	12860	12500	38	44	43
THARAKA DIVISION	37030	50510	60500			

APPENDIX 5

Ranch types under consideration for Tharaka

Agricultural directed company ranch	:	central herd only no settlement within ranch run by a board of directors headed by range officer
Cooperative communal ranch	:	central herd on 2/3 of the land individual herds on 1/3 of the land run by cooperative board, guidance of range officer
Cooperative commercial ranch	:	central herd on minimum of 60% of the land settlement and cropping on up to 40% of the land run by cooperative board, guidance of range officer
Group ranch	:	individual herds only amount of land for settlement and cropping to be decided by members run by elected representatives under guidance of range officer

APPENDIX 6

Average crop production (kg/ha) in normal season by sub-location Tharaka Division, 1984

Crops	Sub-location			
	Kathangachini	Marimanti	Chiokariga	Tharaka Division
Bulrush millet	1305	1602	1197	1368
Sorghum	945	1215	540	900
Cowpea	513	603	486	534
Green gram	1251	855	612	906
Maize	-	801	1278	1040
Cotton	-	941	1305	1123
Sunflower	1080	1233	-	1157

Notes:

Normal season means a season in which rains have not failed

- Means very limited number grow this crop and/or lack of data.

Source: Formal Survey.

APPENDIX 7

Comparison of production levels in kg/ha of some crops from various sources in Kenya.

Crops	Sources*) KES	KFF	TOE	ICRA
Millet	1500	600-800	1080	1368
Katumani maize	7000	1500	840	1040
Green gram (var/line 26)	1500-1700	700-900	450	906
Cowpeas	1800-2500	1500	360	534
Cotton	3400	1200-1500	900	1123

*) KES = Katumani Experiment Station
KFF = Katumani Farmer's Field
TOE = Technical officers estimate for the area
ICRA = ICRA-formal survey

APPENDIX 8

List of browse - Kitharakan names

mathigora
maura
magaa
mathunju
mangora
maruti
maramata
mathande
magokora
mabuu
maruruku
manua
mathenka
ndundu
murenda
kamurura
mububua
kamuthuchi
matharakondo
mahururu
nyaki
ndicha
majuria
matagaia
maguchwa

mathigiri
mauti
mathunthi
nyange
ngonko
narigicha
maruwra
mutuma
nathuana
mambatangao
mathiri
meemba
maricha
makuu
mabobwa
ciagaconde
mayiruyiru
marangare
iguku
nyue
ngatu

kiutha
mathundi
matithi
marundu
matoro
mathiu

N.B. (1) The first seven plants have been collected for analysis;
(2) The prefix ma- (plural mi-) would refer to the leaves, n- to the plant.

APPENDIX 9

In-depth Survey Questionnaire ICRA - Kenya Tharaka 1984

Farmer's name: Date:

Interviewer: Location:

Interpreter: Sub-location:

1. Crops

List all the crops usually grown by the farmer:

Crops	For consumption	For sale	Both
.....	.....	.....	.....
.....	.....	.....	.....

2. Agronomic practices

No. of plot	Soil type	size (acres)	crops on plot crops variety	cropping patterns - pure - mixed - interrow - alternate row - random	planted before or after rain
....	....	.....	.....	.....	.....

3. Cropping calendar:

Crop	April	M	J	J	A	S	O	N	D	J	F	M
....	.....	.....										
....	.....	.....										

- Land preparation = LP
- Planting = PL
- Weeding = WE
- Bird chasing = BC
- Harvesting = HA
- Threshing = TH

4. Labour use

Activity	Done by	Equipment used
Clearing	.....	.....
Planting	.....	.....
Weeding	.....	.....
Harvesting	.....	.....
.....	.....	.....

FA = Family labour
H = Hired labour
M = Male
FE = Female
C = Children (> 12 years)

5. Diseases, pests and other problems of crops

crop	pest	diseases	other problems	time occurrence (stage of growth)	control measures
....	....	.....	.....	.....	.....
....	....	.....	.....	.....	.....

6. Crop rotation and bush fallow:

a) How many seasons do you cultivate a plot?

b) After cultivating a plot, how long do you leave the plot fallow? (longest + shortest time)

c) How long would you like to leave the plot fallow before cultivating it again?

d) Do you do any crop rotation?

7. Crop production in a normal year

a) April season

crop production (bags)	Disposal: Food (Qty?	seed	sales where?)	other	total
.....	.....	.....	...	.....	.....

b) October season

Crop production (bags)	Disposal: Food (Qty?	seed	sales where?)	other	total
.....	.....	.....	....	.....	.....

c) Was production last year similar?

( ) yes

( ) no — why not?
how different?
which crops?

d) Up to what time did your harvest take you last harvest?

8. Storage of crops

crop	how stored	storage possible for how many seasons?	estimated storage loss
....	.....	.....	.....
....	.....	.....	.....

9. Livestock numbers:

a)	Cattle	Goat	Sheep	Poultry
Mature female	.....	....	.....	.....
Mature male	.....	....	.....	.....
Immature female	.....	....	.....	.....
Immature male	.....	....	.....	.....
Castrated males	.....	....	.....	.....
Young animals	.....	....	.....	.....
Total	.....	....	.....	.....

b) Use of livestock products? consumption + sale (milk, eggs, meat, skin, fat, horns).

c) Herd changes

Number April 1983	Death	Food	Slaughtered	Sales	Birth	Purchase	Other (gifts dowries)	Number April 1984
....	.....	....	.....	.....	.....	.....	.....	.....

d) How did you obtain your livestock?

( ) Inheritance
( ) Purchase
( ) Gift
( ) Marriage
( ) Other

10. Pasture management

Where do you keep your animals during different times of the year?

	April May June	July Aug. Sept.	Oct. Nov. Dec.	Jan. Feb. March
Cattle				
Goats				
Sheep				

A = at own land

R = rents land from others (price? duration?)

H = accepts other animals on his land

C = communal grazing

11. Breeding

a) Do you select for breeding?

( ) yes How?

( ) No

b) What is most important for you, quality or quantity of animals?

( ) Sheep Why?

( ) Goats Why?

( ) Cattle Why?

12. Animal husbandry

a) How often do you water your animals?

b) How many kilometers away?

c) Do you use - dipping facilities?
- service/advice from vets?

d) Who tends to look after animals?

e) What criteria do you use fo moving animals from one place to another?
(browse, soil, water, state of animals)

f) When and by whom are cows milked?

g) Do calves run with cows?

13. Houshold

a) Who normally lives with you on the farm? (wives, adult men, adult women, children (< 12, at school?))

b) Estimated age of respondent (20 - 49 or > 50)

c) Which is you most important source of income?

d) Do you have any sources of cash income other than farming?

e) Are you paying school fees for children at present? (primary, secondary school, value)

f) How long have you been in charge of a farm?

g) Where did you start farming?

h) Have you always lived in this farm/homestead?

i) If you moved your homestead, why?

14. General farming questions

a) Which would you rather have, more livestock or more land? Why?

b) Do your livestock get enough feed?

c) Which crops are most affected by drought?

d) Why do you keep growing these crops most affected by drought?

e) Have you ever taken steps to protect your farm from erosion? (dig bunds, trash lines, terraces) why or why not and what are the effects?

f) What contacts have you had with extension officers/field assistants?

15. Opinion on Tharaka and the future

a) Does the countryside look any different now to when you where a boy/girl? How different and what caused the changes?

b) What do you feel is most important for Tharaka in future, improved crops or improved livestock and why?

c) What is the one most important thing that government can do, in your opinion, to help Tharaka?

APPENDIX 10

Formal Survey Questionnaire - ICRA Tharaka Kenya, 1984

NUMBER OF INTERVIEW:

Interviewer:

Interpreter:

Date :

Sublocation: 1. Marimanti
2. Kathangachini
3. Chiokariga

SUB-UNIT/VILLAGE:

Name of respondent:

Age: 1. < 30 2. 30-50 3. > 50

Sex: 1. male 2. female

I. GENERAL INFORMATION

1. How many farms do you run/operate?
2. What is the total area of these farms
   Farm 1 .. acres
   Farm 2 .. acres
   Farm 3 .. acres
3. How is the area divided

	April-June Rains 1984	October-January 1983	(acres)
a) Total shambas cultivated			
b) Fallow land not grazed			
c) Fallow land grazed			
d) Other land not cropped, not grazed			
e) Grazed land, never cropped			

4. (If respondent is a female)
   Are there other farms in the family which you don't operate?
   1. Yes details
   2. No.

2. CROPS GROWN AND YIELDS

5. What are the crops grown this season?
6. Which of them is planted alone?
   (crop) (area in acres) (planted at random or in rows?)
7. What crops are planted together?
   1. Millet and sorghum: area ( ) cropping code ( )
      Do you plant other crops in this sorghum/millet area?
      (1) Cowpeas: area ( ) cropping code ( )
      (2) Green grams: area ( ) cropping code ( )
      (3) Others: area ( ) cropping code ( )
   2. Maize + sunflower
   3. Cotton + cowpeas
   4. Other mixtures (specify).
8. If any of your crops fail, what do you replant?
   Failed crop .....
   Crop replanted .....
   Why this crop? .....
9. Is your present cropping pattern the same every season/every year?
   1. Yes
   2. No How is it different? (crop, area, pattern).

Cropping codes

1. single crop, in rows
2. single crop, random
3. mixed crop, single stand, alternate rows
4. mixed crop, single stand, random
5. mixed crop, single stand, inter row
6. mixed crop, mixed stand, rows
7. mixed crop, mixed stand, random
8. mixed crop, mixed x single stand, alternate rows
9. mixed crop, mixed x single stand, random
10. mixed crop, mixed x single stand, inter row
11. other

10. Do you normally plant cotton on this farm?
    (1) No, why not .....
    (2) Yes, at what season? .....
        Do you use spray ( ) yes
                         ( ) no, why not? .....
        How many bags do you normally sell
        After April-June season .....
        After October-January season .....
11. Why do you grow crops together?
    (1) Better yield
    (2) Less weeding
    (3) Less pests
    (4) Insurance against crop failure
    (5) Less labour in planting
    (6) Others, specify
12. a) If the rains had not failed, what total yields (in bags) would you have expected from your crops this season?

Bulrush millet	(Mwere)	..... bags
Sorghum	(Munya)	..... bags
Cowpea	(Nthoroko)	..... bags
Green gram	(Ndengu)	..... bags
Maize	(Mpempe)	..... bags
Others		..... bags

    b) Are these yields enough normally to feed your family until the next season?
        (1) Yes
        (2) No
13. a) Do you grow any of the following permanent - drought tolerant crops?
        (1) Castor (Mbariki)
        (2) Cashew (Korongo)
        (3) Sisal (Nkonge)
        (4) Others
    b) If none of these crops are grown:
        Do you want to grow one of them?
        (1) Yes
        (2) No, why not? .....

3. PLANTING AND LAND PREPARATION

14. When do you do land preparation and planting?

	Before rain	At the start of the rain	After rain
Land preparation	(1)	(2)	(3)
Planting	(1)	(2)	(3)

15. Why do you do it at that time?
    (1) Better yield
    (2) Labour availability
    (3) Maximum use of rain
    (4) Ox-plough availability
    (5) Soil hardness
    (6) Other (Specify) .....

16. What implements do you use for
    Land clearing .....
    Land preparation .....
    Weeding .....

17. Do you use an ox-plough?
    (1) Yes, why?
        How often?
        Do you own one or hire?
    (2) No. If an ox-plough was available would you try using it?
        (1) Yes
        (2) No, why not?

4. SEEDS

18. Do you select seeds?
    (1) No
    (2) Yes, for ( ) Bulrush millet (Mwere)
        ( ) Sorghum (Munya)
        ( ) Cowpeas (Nthoroko)
        ( ) Green gram (Ndengu)
        ( ) Maize (Mpempe)
        ( ) Others (specify) .....

19. Do you buy seeds?
    (1) Yes, where? ....
    (2) No, why not? ....

5. FALLOW AND EROSION CONTROL

20. Do you have fallow land?
    (1) No
    (2) Yes, why do you leave it fallow?
        How long do you leave it normally?
        Has the length of the fallow period been increased or reduced? And why?
21. Do you do "mutaro" (terraces digging)
    (1) No, why not?
    (2) Yes, why? How?
22. Do you do "metaru" (trash lines making)
    (1) No, why not?
    (2) Yes, why? How?
23. Are you aware of other water conservation measures?
    (1) No, why?
    (2) Yes, which ones? .....

6. LIVESTOCK NUMBERS AND CHANGE IN NUMBERS

24. How many animals in each of the following livestock classes do you have?

	cattle-ng'ombe	goats-mburi	sheep-ngondu
Mature male	nchamba	nthenge	nturuma
Mature female	migoma	migoma	migoma
Immature male	tuchamba	kathenge	gaturume
Immature female	tumori	mparika	mwate
Castrated male	ndewa	nture	nture
Young animals	tuyou	tuburi	tugondu

Number of poultry - nguku

25. How many of your livestock died since April 1983?

	Number	Causes
Cattle		
Goats		
Sheep		

26. Have you ever had severe livestock losses (deaths) before?
    (1) No
    (2) Yes, when?
        Causes?
        Number of deaths?

27. Have any livestock been slaughtered for food since April 1983?

	Number	Month
Cattle		
Goat		
Sheep		

28. Have there been any purchase of livestock since April 1983?

	Number	Month	Market
Cattle			
Goat			
Sheep			

29. How many livestock have been sold since April 1983?

	Number	Month	Market	Reason
Cattle				
Goat				
Sheep				

30. Any other additions to or substractions from your livestock numbers since April 1983?
    (1) Gifts to others
    (2) Gifts from others
    (3) Dowry received
    (4) Dowry given away
    (5) Births
31. Why did you market your livestock in the markets mentioned?
32. Did you sell more goats last year than in previous years?
    (1) Yes, why?
    (2) No
33. Which livestock do you sell first if you need money?
    (1) Cattle
    (2) Goats
    (3) Sheep
    (4) No preference, depending on amount of money needed.
34. If your food crops were more reliable and did not fail, would you keep more or less livestock?
    (1) More, why? ....
    (2) Less, why? ....

7. FEEDING AND GRAZING

35. Do you (1) own grazing area outside this farm?
(2) rent
(3) borrow
(4) use communal

36. When do you use this area?
(1) all the time .... acres drought/normal year
(2) dry season .... acres drought/normal year
(3) others (specify) .... acres drought/normal year

37. Do you feed crop residues to your livestock?
(1) If yes, which residues?
(2) If no, why not?

38. Do you feed stover to your livestock?
(1) No
(2) Yes, how?
(1) graze stover in the field after harvest
(2) take stover out and take it home for immediate consumption
(3) store stover to feed at a later date
(4) other method .....

39. What are the best browse plants for goats (Kitharaka names)?
1. .... 3. ....
2. .... 4. ....

40. a. How often do you water your animals?
b. Why with this frequency?
c. How many kilometres do you have to go to reach water to water your animals?
d. How far do you have to go for drinking water?

8. MILKING

41. Do you milk your cows?
(1) Yes, Daily milk yield is .... liter/herd
.... liter/animals
(2) No
(3) Not applicable

42. Do you milk your goats?
(1) Yes
(2) No, why not?

(1) Not enough milk
(2) Don't like taste
(3) Other .....

43. Would you consider keeping improved milking goats?
(1) Yes
(2) No, why not? ...

9. DIPPING

44. Do you normally dip your animals?
(1) No, why not? Goats
Cattle
(2) Yes, how often? Goats ( ) times per month
Cattle ( ) times per month

10. OFF-FARM INCOME

45. Do any household member(s), living permantly on this farm, earn cash other than from the sale of crops and livestock from this farm?
(1) No
(2) Yes, what was the source and value?
(1) Honey/wax (Ksh .../per ...)
(2) Charcoal (Ksh .../per ...)
(3) Contract labour (Ksh .../per ...)
(4) Regular employment (Ksh .../per ...)
(5) Basket-making (Ksh .../per ...)
(6) Others .... (Ksh .../per ...)

46. Were cash remittances received?
(1) No
(2) Yes (1) Regularly (Ksh .../per ...)
(2) Irregularly (Ksh .../per ...)

47. If answer to question 45. is (2.1)
a) Do you normally earn cash from honey sales?
(1) Yes
(2) No
b) How many hives are at this moment producing honey? ...
c) How many hives normally produce honey if rain is sufficient? ..
d) If you produced more honey would you sell it?
(1) Yes
(2) No, why not?

48. If answer to question 45 is (2.2) or (2.5).
    Why do charcoal and/or basket-making not provide more cash?
    (1) low prices offered by traders
    (2) lack of market/poor sales
    (3) lack of time to produce
    (4) others

II. HOUSEHOLD/LABOUR

49. How many people are supported by this farm?
    (1) adults .....
    (2) children (less than 12 years)
50. How many adults available for farmwork live on this homestead?
51. Do you hire labour?
    (1) No
    (2) Yes, for which purposes? ....
52. Which is the most labour-intensive activity in the farms?
53. How many days after germination do you do your first weeding?
    ... days.
54. Do you apply manure to your crops?
    (1) Yes, when do you do it?
    (2) No, why not?
55. Do you cultivate now more or less than your father did when you were a child?
    (1) more, causes ....
    (2) less, causes ....
56. Have you moved your homestead in the recent past?
    (1) No
    (2) Yes, why? ....
57. Has your own shamba changed in size since you started farming?
    (1) Increased size, why?
    (2) Equal size
    (3) Decreased size, why?
58. How much do you pay intotal for building funds and school fees per term/per year?
    Primary school building funds ..... Ksh/year .... children
    Secondary school schoolfees ..... Ksh/term .... children

59. What are your main dishes?

Dish	Prepared from
....	....
....	....

60. How long does your food crop last after harvest?
    (1) Normal season ... weeks/... months
    (2) Last January harvest ... weeks/... months
61. a) What is the main food(s) you purchase? ....
    b) In which months do you purchase them?
       (1) normal season ...
       (2) last season ....
    c) From which market do you purchase them? .....
       Why these markets? ......
62. Do you sell any food crops?
    (1) No
    (2) Yes Which do you normally sell? ...
             Why do you sell? ....
             Why do you not sell livestock instead? ....
63. Do you eat crops from the field before harvest?
    (1) Yes
    (2) No
64. Have you received maize from the Government during the last 3 years at all?
    (1) Yes
    (2) No
65. a) Have you ever borrowed some food from others?
       (1) No
       (2) Yes
           (1) relatives
           (2) neighbours
           (3) traders
           (4) others ....
    b) Have you lend food to others since April 1983?
       (1) No
       (2) Yes to (1) relatives
                  (2) neighbours
                  (3) others
           In which month? ....

12. EXTENSION AND SOCIAL RELATIONS

66. a) Have you ever been visited by an extension officer in the last five years?

b) Do you know someone who is visited by an extension officer?

(1) No

(2) Yes, do you talk with this farmer about agricultural subjects?

(1) Yes

(2) No

67. a) Have you ever attended a course at the Marimanti Rural Training Centre?

(1) Yes year .... course ....

(2) No

b) Have you visited any other agricultural training course?

(1) Yes, year .... course ....

(2) No

68. Are you or your wife/husband member of a co-operative group?

(1) No

(2) Yes, which group? .....

69. Have you ever worked in a "Harambee" scheme?

(1) No

(2) Yes, year .... project .....

type of activity .....

How is "Harambee" organized in your place?

70. How many times in the last year did you attend a "Baraza" (Village meeting)?

71. Have you heard about the idea of "Group Ranches"?

(1) No

(2) Yes, what is your opinion?

(1) Good, why?

(2) Bad, why?

72. Are you intending to leave this sub-location and move to another?

(1) No

(2) Yes, when?

to which sub-location?

why?

73. Do you have land or close relatives in one of the following sub-locations?

(1) No

(2) Yes, Kanjoro (1) land (2) relatives
Nkondi (3) land (4) relatives
Tunyai (5) land (6) relatives

Asante Sana
Bwega Muno

APPENDIX 11

FEED QUALITY OF SOME COMMON PLANTS IN THE THARAKA AREA OF EASTERN KENYA

by

B.D. Akanmori and J.K. Muoria

INTRODUCTION

Sheep and goats play an important role as a source of livelihood for people in range areas. The estimated sheep and goats in Kenya is 4,299,000 and 8,282,000, respectively (Economic Survey (Kenya) 1982).

Tharaka Division is in Meru District. Livestock holdings for Meru District were estimated as 43,342 grade cattle, 119,610 beef cattle, 119,589 sheep and 223,080 goats. Out of these, Tharaka division had 7 grade cattle, 16,081 beef cattle, 11,945 sheep and 45,180 goats (Ministry of Agriculture, Annual Report 1977). The sheep in Tharaka Division is hairy type and not wool sheep. In Tharaka Division in 1977, 291 sheep were slaughtered, 2,762 goats and 550 cattle. It thus seems that goat meat is higher in demand than beef or mutton. Pig production is absent in Tharaka Division. The only other thing that is common is beehives with 16 improved hives and 50,000 local ones thereby having more hives than any other Division (Ministry of Agriculture, Annual Report 1977). Livestock rearing is therefore the major occupational activity of the people of Tharaka.

In range areas, grasses grow very fast during the rainy seasons developing flowers fast, and rapid decline in quality follows by the start of the dry season. Seasonal fluctuations in the quality and availability is a major problem in feeding animals in a rangeland area like Tharaka. Dry matter and digestible nutrient content of both mature and immature forages is relatively low (Bredor, Horrel, 1961), consequently animal production follows seasonal variability in quality and quantity.

As approximately 80% of the surface area of Kenya is rangeland, the animal production potential of such land would be considerable if it is well managed. Precise manipulation of the animal and its environment has to be done in order to obtain increased animal output in a rangeland like Tharaka Division.

The objective of this study was to investigate the Key food plants and their quality in the production of sheep and goats in Tharaka Division.

It would have been better if the study was done for a whole year but due to lack of time, this was not possible.

MATERIALS AND METHODS

1. Location

Field work was done at Marimanti, in the EMI project area in Tharaka, Meru. Laboratory analyses was done at the College of Veterinary and Agricultural Sciences of the University of Nairobi.

2. Key food-plant species studies

Food preference observation was done on only one day during the month of July.

A flock of sheep and goats numbering approximately 100 was followed and watched as they fed.

The plants fed on preferentially by these animals were marked and later sampled.

The samples were identified and then sent for chemical analyses at the College of Veterinary and Agricultural Sciences of the University of Nairobi.

3. Pasture sampling

Samples of herbage preferentially grazed by sheep and goats were taken, air dried and processed for analysis.

4. Analyses

Herbage samples were analysed for crude protein (CP) and Ash. Analyses of herbage samples also included cell-wall constituents (CWC), acid detergent fibre (ADF) and the minerals calcium (Ca), Phosphorus (P), Magnesium (Mg), Potassium (K) and Sodium (Na).

RESULTS

The few browse plants and grasses identified were:

1. Acacia Senegal — plant
   pods
2. Acacia tortilis — plant
   pods
3. Cadaba farinosa
4. Cassia longiracemosa
5. Themeda trianda

6. Combretum sp.
7. Corbichoma decubens
8. Hyparrhenia sp.
9. Lennea fulva
10. Commiphora candidula.

It is important to mention here that only Themeda triandra and Hyparrhenia were identified among grasses, the area being so dry there were no other grasses.

Chemical composition of key food plants

a) Grasses

The grasses generally had low crude protein (CP) content, high fibre levels.

Crude protein (CP) values were 3.6% and 5.1%.

Fibre fractions of CWC, ADF and lignin were very high (75.1% and 78.1%).

Mineral content of these two grasses is given in Table 2. These grasses contain low Ca, P, Mg, K and Na levels.

b) Herbs, shrubs and trees

The herbs, shrubs and trees had very high CP and ash values but low CWC, ADF and lignin content (Table 2). Cadaba spp. had a very impressive CP content, a value of 14.9%.

Mineral composition of these same plant species is given in table 1. Acacia tortilis, Acacia senegal and Cadaba spp. contained high levels of calcium, magnesium and potassium but the levels of phosphorus and sodium were rather low.

DISCUSSION

The work done was definitely inadequate and so does not supply all the information required to make a proper assessment of the vegetation and the available nutrients for livestock in this area.

An all year sampling of all plant species in the area would be a more useful way of coming up with proper recommendations. This should actually be done if the proper management of the rangelands is to be instituted in order to ensure that livestock will have feed throughout the year.

There are various methods of acquiring data on the feeding preferences of sheep and goats some of which actually yield more accurate results, however the direct observation method was used here since it is easy.

Most of the grasses tended to have low crude protein content and high fibre values.

Previous reports by Karue; Glover and French (Karue, 1974, 1975; Glover and French, 1957) support this.

Rapid decline in quality of plants associated with the fast growth of most of these plant species should be considered in divising grazing systems so as to obtain a maximum utilization of the rangelands.

The generally low levels of phosphorus in this area indicating a possible phosphorus deficiency might explain any reproductive problems such as low fecundity or reproductive efficiency.

Sodium deficiency and low protein intake can cause complete cessation of growth (Underwood, 1971; Crampton and Harris, 1969).

This means a mineral supplementation for animals might be necessary.

RECOMMENDATIONS FROM THE NUTRITION STUDIES

1. There should be an all round detailed study on the feeding preferences, identification, sampling and analyses of the key food plants available to the livestock in this area.

2. There should be a manipulation of the feeding management of the sheep and goats such that different routes of grazing are used and not the present system of leading animals along the same route and as such depleting important browses fast since sheep and goats are quite choosy when feeding.

3. An attempt can be made to introduce better goats in terms of feed conversion efficiency and utilization after experimentation on different breeds.

4. Another important source of feed for animals especially during the dry season is the pods of the various Acacia spp. With proper management these sources of high protein including any flowers of these plant species can be utilized as a form of supplement.

5. Overstocking should be discouraged as its consequence will be ecological degradation.

Table 1 Mineral composition of some common browse plants (%)

Browse plant	P	K	Ca	Mg
		(per cent)		
Acacia senegal - plant	1.71	1.36	2.35	0.10
- dry pods	0.77	0.62	0.97	0.04
- green pods	1.09	1.89	0.84	0.29
Cadaba farinosa	0.90	3.30	1.81	0.23
Lennea fulva	0.69	1.15	1.26	0.30
Acacia tortilis	1.68	1.30	2.30	0.15
Commiphora candidula	1.60	1.20	2.10	0.15

Table 2 Chemical composition of major key food plant species & for sheep and goats (%)

	CP	CWC	ADF	HC	L	ASH	Gross energy
Tree species							
Acacia tortilis	10.2	24.9	17.8	6.9	7.1	8.3	
Acacia senegal	13.1	23.8	17.3	7.2	6.8	8.0	
Cassia langiracemosa	12.2	20.5	16.3	8.0	7.3	9.7	
Cadaba sp.	14.9	-	-	-	-	-	
Grasses							
Themeda triandra	5.1	75.1	50.2	24.1	10.1	9.4	4.141
Hyparrhenia sp.	3.6	78.1	53.1	23.7	9.7	9.1	4.010

Table 3 Mineral composition of some grasses (%)

Plant Species	Ca	P	Mg	K	Na
Hyparrhenia spp.	0.25	0.07	0.17	0.80	0.08
Themeda triandra	0.44	0.07	0.19	0.56	0.07

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