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The Farming System in the Coffee Area, Kyeni South Location, Embu District, Kenya

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urse for development oriented Research in Agriculture (ICRA)
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ABSTRACT

A field study was carried out in three months in part of Embu District, Kenya by an interdisciplinary group from ICRA. The purpose was to describe and analyse the farming system, to identify constraints and to make proposals for research and development. The area is of medium potential and comprises a "main" and a "marginal" coffee zone. The principal constraints identified were the low proportion of cash income which is invested in farming, labour constraints at particular times of the year, and the inadequacy of conservation measures. Since it is not seen as possible to greatly increase the quantity of resources employed, the interventions proposed are mainly directed at improved management practices and environmental protection. A more integrated approach to research is recommended, particularly one which considers coffee in its place in the farming system.

Key words: farming system, research and development, farm survey, coffee.

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GLOSSARY AND ABBREVIATIONS

Debe	-	a unit of measurement equivalent to a 20 litre kerosene tin
Forked jembe	-	a forked hoe
Harambee	-	("Pull together"), term generally used for communal work or fund raising effort
Irima	-	a traditional form of reciprocal labour cooperation
Jembe	-	a broad bladed hoe
Matatu	-	taxi
Panga	-	single edged matchet
Shamba	-	farm

A.I.	-	artificial insemination
CAN	-	calcium ammonium nitrate
CBD	-	coffee berry disease
CBK	-	Coffee Board of Kenya
CRSP	-	Collaborative Research Support Project
CZ	-	coffee zone
DAO	-	District Agricultural Officer
DAP	-	diammonium phosphate
DC	-	District Commissioner
DDC	-	District Development Committee
DLO	-	District Livestock Officer
DO	-	Divisional Officer
GLP	-	Grain Legume Project
KPCU	-	Kenya Planters Cooperative Union
KMC	-	Kenya Meat Commission
Ksh	-	Kenya shilling
KSS	-	Kenya Soil Survey
LMB	-	Livestock Marketing Branch
LU	-	livestock unit (equivalent to one adult cattle)
MALD	-	Ministry of Agriculture and Livestock Development
NCPB	-	National Cereals and Produce Board
TPIP	-	Training Project in Pedology

PREFACE AND ACKNOWLEDGEMENTS

The report was jointly prepared by a multidisciplinary team from the fourth International Course in development oriented Research in Agriculture. It presents the findings of a three month field study which took place in Embu District, Kenya during the period April-July 1985. The participants were:

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The group would like to express its gratitude to the Kenya Ministry of Agriculture and Livestock Development for allowing the study to be undertaken. The assistance of the Director of Agricultural Research Mr. W.W. Wapakala, Head of Kenya Soil Survey Mr. F.N. Muchena and Mr. Malcolm Hall and Mr. Dürr is particularly appreciated. The group would like to thank the Provincial Director of Agriculture Mr. J.G.M. Mwasya, the Acting District Agricultural Officer and from Embu Province also the District Officer in charge of Runyenjes division. The cooperation of the Chief of Kyeni South Location Mr. Fred Nthambiri was of immense benefit to the group. Thanks are also due to directors and staff of the Horticultural Research Station Thika, Livestock Research Station Naivasha and Agricultural Research Station Embu.

During field work discussions held with the staff and students of the Training Project in Pedology (TPIP) of the Agricultural University, Wageningen were of great benefit.

Special gratitude goes to the farmers of Kyeni South without whose cooperation and patience this study would not have been possible.

SUMMARY

The study area

The field study was undertaken in Kyeni South Location, Embu district, in Kenya. It is located on the Eastern footslopes of Mount Kenya at altitudes between 1,250 and 1,500 m. The landscape consists of narrow interfluves (ridges) and steep V-shaped valleys. The area is of medium agricultural potential and comprises a "main coffee" and a "marginal coffee" zone.

The bimodal rainfall pattern results in two growing seasons per year. The first, coinciding with the long rains, is from mid-March to mid-July and the second season (short rains) is from early October to early January. Annual rainfall is 1,200-1,500 mm and 1,000-1,250 mm in the main and marginal coffee zones, respectively.

Soils in the area are predominantly Nithosols. They are generally deep to very deep with a silty clay texture and good physical properties. The A horizon is generally deeper in the marginal than in the main coffee zone. On the slopes in both zones there is serious soil erosion.

Objectives of study

The objectives of the study were :

- to describe and analyse the farming system in Kyeni South Location;
- to identify the constraints to improving the system;
- to review research results and make proposals for research and development.

The surveys

Information was collected in the following four phases :

- reconnaissance survey to familiarize the group with national agricultural policy and priorities;
- exploratory survey to familiarize the group with the study area;
- informal survey to obtain an in-depth understanding of the farming system;
- formal survey to focus on specific subjects, whose importance had been revealed in the informal survey.

The farming system

Components of the farming system include cash crop production (arabica coffee), food crop production (maize and beans), and livestock production (cattle and goats). Smallholders have the following objectives :

1. provision of sufficient food for the household;
2. keeping of livestock as a source of cash and a safeguard against emergencies;
3. generation of cash for food and other purchases;
4. maintenance and improvement of the household's social status.

The average farm size is small (2.1 ha in main zone, and 2.7 ha in marginal zone). Farmers have to utilize their land intensively to produce sufficient food and cash for the household.

Farm operations are carried out manually, mostly using family labour. The use of draught animals is limited by the small farm size and the steep slopes. The cash economy in this farming system is well developed.

Generally, yields for both coffee and food crops tend to be higher in the marginal coffee zone than in the main coffee zone. The yields of coffee (5.5 to 7.0 tonnes cherry per ha) are higher than the national average of 4.5 tonnes cherry per ha. For maize and beans, however, the yields appear to be rather low (2.0 to 3.0 tonnes and 1.2 to 1.7 tonnes per ha per year, respectively). Cattle are kept mainly for the production of milk and manure, the latter being an important input for the coffee enterprise.

Constraints on the system

The main constraints acting on the system concern cash resources, labour, and land degradation.

It was found that a large proportion of cash income (68% and 50% in main and marginal coffee zones, respectively) was devoted to expenditure on non-farm items. There were at least two periods of the year when family labour was insufficient to meet labour requirements preventing some important farming activities from being completed.

Land conservation measures are often inadequate because of the cash and labour constraints, and certain cultivation practices also contribute to the erosion of the soils.

Areas of intervention to alleviate constraints

It is not possible to increase greatly the quantity of resources used or the proportion of existing income which can be invested in agricultural production. Thus interventions are recommended which aim to improve the environment and to increase the productivity of existing resources by improved management practices. It is hoped that these will contribute towards both increased returns from farm enterprises and more effective soil stabilization.

Firstly, several areas where government action would help to improve the environment have been identified :

1. Improved market outlets for milk.
2. Investigation into the efficiency of the factory processing of coffee.
3. Adoption of a more integrated approach to research programmes covering the various farm enterprises.
4. Continued and increased support for family planning.
5. Improved prospects for non-farm employment.

Secondly, recommendations to improve farmers' management are as follows :

1. Capped stem pruning for coffee. This should result in improved disease control and reduced labour requirements for harvesting and spraying.
2. Improved pest and disease control. Use of sticking agents with fungicides and increased use of mulching to avoid moisture stress (to reduce incidence of thrips).
3. Availability of alternative composite maize varieties. Hybrid maize seeds should only be used when farmers can apply the correct management practices. Use of a composite variety would be more suitable for most farmers in this area.
4. Increased attention to control of bean fly.
5. Increased fodder production. Fodder should be grown on presently under-utilized areas of the shamba (e.g. edges of terraces and hedges).
6. Increased efforts to control soil erosion. Use of techniques such as tying of terraces, fodder grass lines and trash lines. Improved cultivation practices such as alternate strip weeding in food crops.

Recommendations for research

Research is required in the following areas :

1. On-farm testing of recommended management practices of coffee production.
2. On-farm evaluation of weed control methods in coffee and food crops.
3. On-farm trials to develop suitable crop rotations for intercropped food crops cultivation.
4. Development of a suitable composite maize variety.
5. Selection of a suitable fodder grass for use in stabilizing terraces.
6. Evaluation of the potential of crop by-products as feed for livestock.

1 INTRODUCTION

1.1 Objectives of the study

The objectives of the field study were :

1. to describe and analyse the farming system in the coffee production area of Kyeni South Location, taking into account :
   a) the effects of the physical environment
   b) the availability and use of resources
   c) the technology of production of crops and livestock
   d) household objectives and how they are met
   e) relationships with infrastructure, rural institutions and government policy;
2. to identify, on the basis of the analysis of the farming system, the constraints and indicate their order of importance;
3. to identify and evaluate development options which are likely to meet the objectives of rural people and their government;
4. to review existing research results and make proposals for new research.

2 SURVEY METHODS

The following surveys were implemented :

2.1 Reconnaissance survey

The objectives were to familiarize the group with the country and the national and agricultural sector policies and priorities. Meetings were held with key officials in government ministries and research stations and relevant documents and records examined.

2.2 Exploratory survey

Meetings and discussions were held with relevant officials at district, divisional and village level; direct observations, which took the form of a "windscreen survey", were made; and interviews were conducted with a small number of farmers. These were in preparation for the informal and formal surveys.

2.3 Informal survey

The objectives were to obtain an in-depth understanding of the farming system, to determine the interrelationships of its various components, and identify the possible constraints within the system. It also enabled the construction of tentative hypotheses to be tested during the formal survey.

The informal survey took the form of interviews with a random sample of 21 farmers which were a sub-set of those chosen for the formal survey. The interviews were conducted by team members in rotating pairs using a checklist.

2.4 Formal survey

This was conducted on a random sample of 80 farmers which included those interviewed in the informal survey. The survey employed a structured questionnaire administered by individual team members (Appendix A). It was to provide quantitative information on the farming system and to enable the testing of hypotheses generated during the informal survey.

A total of 40 clusters were randomly selected from a household list using random number tables; 20 from the main coffee zone and 20 from the marginal coffee zone. Within each selected cluster four households were randomly selected; two to be interviewed and two others to be reserves in case the first two could not be contacted.

2.5 Sampling frame

Both samples were selected using a map and household list compiled by the Ministry of Water Development. The map showed all the land holdings (and plot numbers) in the location and the list gave the names of the corresponding land holders; it was arranged in ready made clusters of households around water supply points.

2.6 Evaluation of study methods

The reconnaissance and exploratory surveys were aimed at the national and district institutions and the local study area, respectively. They can be considered as preparatory surveys for the informal and formal surveys with the following objectives:

- familiarisation with agricultural and development issues
- definition of study area
- testing and amending the checklist for the informal survey.

Due to logistical difficulties the timing of these surveys was not as originally intended. There were considerable overlaps so that at times more than one were being carried out simultaneously. This was not a problem and may have been an advantage. For example, we visited some research stations after having become well acquainted with the study area.

After completion a "mini-report" was prepared in order to synthesize all the information collected. This was a useful exercise which made report writing easier later on, although it was time-consuming.

For the informal survey a checklist was used to structure discussions with the farmers. This survey confirmed that there was one main farming system in the area.

When the information had been analysed an "interim report" was written and an informal seminar took place with the Training Project in Pedology (TPIP). This was a very valuable exercise as it put us under a certain amount of pressure to put our ideas in an orderly form on paper.

The discussions also helped in the formulation of hypotheses to be tested.

The formal survey was aimed specifically at issues covered by the hypotheses. However, the formal survey questionnaire turned out to be very long and, even after reducing, took a great deal of time to complete.

A major drawback was that all the information collected was based on farmers' recall. The inaccuracies concerning labour use, yields and cash income and expenditure were thus likely to be substantial. This led us to question the usefulness of such a questionnaire. We feel that an alternative approach may be better. Thus a questionnaire aimed at the whole sample might be restricted to questions where reasonable

accuracy can be expected. Information on other items could be collected in a few detailed case studies which, while still based largely on farmers' recall, would allow more detailed examination and cross-checking of information. Rough field measurements might even be possible in such an approach.

2.7 General comments on multidisciplinary group work

The group adopted a formal approach to discussion of ideas and plans which it felt was successful. Meetings were held at agreed times with rotating chairmen and recorders. A minute book was used to record all important decisions, plans, work allocations and so on, so that they could be referred to if necessary.

Working as a large group was not necessary for all tasks and thus much work was carried out in subgroups. Allocation of tasks was fairly flexible and working in rotating pairs was generally most effective. It was agreed that group members should be able to work in those areas where they felt most competent. Thus working in pairs ensured some degree of expertise for each task as well as allowing interdisciplinary exchange. The two agronomists and the two social scientists did not generally work in the same group.

When written work was done it was circulated to all members of the group for their comments to be added. The comments were discussed by the whole group and a final version agreed upon. Voting on issues was avoided to prevent the group from splitting and most decisions were arrived at by concensus.

3 BACKGROUND TO THE STUDY AREA

3.1 Kenya's agricultural economy

About 18% of Kenya's total land area of 582,000 km² is suitable for rainfed agriculture. Additional irrigated land presently amounts to 2% of the total area. Kenya has a population of about 19 million (1984) and an average growth rate of 4% per year, the highest in the world.

Kenya is an agrarian nation with about 70% of the population employed in the agricultural sector, which contributes over 35% to the Gross Domestic Product (GDP) and 50% to total exports, although it is not self-sufficient in food production. Since 1970 Kenya has been faced with balance of payments difficulties. In 1983, although showing a marked improvement over previous years, the country's trade deficit (provisional) was US$ 400 m..

Kenyan agriculture is overwhelmingly a smallholder activity with holdings of less than three hectares constituting about 56% of arable areas.

3.2 Embu District

3.2.1 Administrative structure

Embu is the smallest of six districts in Kenya's Eastern Province, having a total area of 2,714 km². It is divided into three administrative divisions, Runyenjes, Siakago and Gachoka, which are further sub-divided into fifteen locations and seventy-one sub-locations. (Figure 1).

The District Commissioner (DC) is in charge of all administration and development in Embu District, and is the chairman of the District Development Committee (DDC), composed of representatives of the various ministries and departments. At divisional and location levels a Divisional Officer (DO) and a Chief are in charge of the administration.

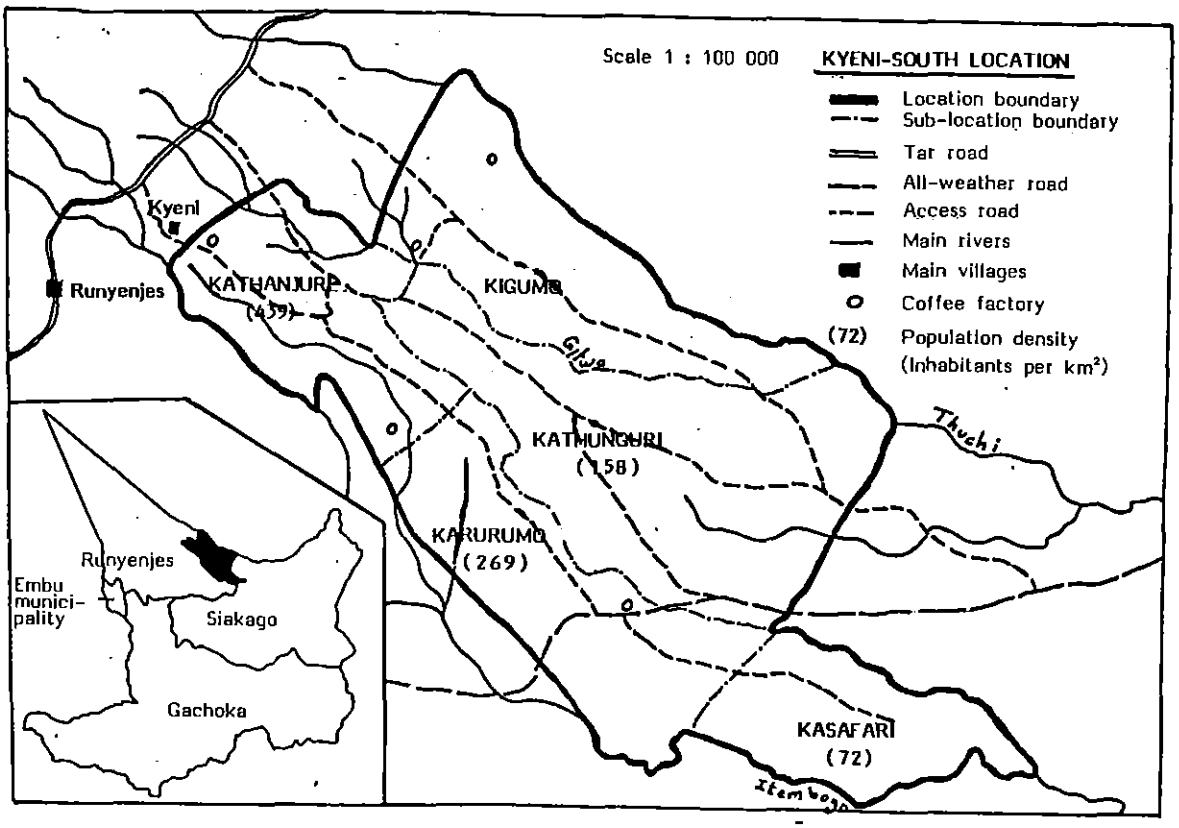
3.2.2 Population

In 1979 the population of Embu District was 263,173 persons with a density of about 100 persons per km².

3.2.3 Economy

Agriculture is the main economic activity in Embu, directly or indirectly employing about 95% of the population. Tea and coffee are the main cash crops in the high and medium potential areas while cotton is grown in the drier marginal areas. Beans and maize are the main food crops.

Figure 1 Map of Kyeni South Location showing the five sub-locations



3.3 The study area

3.3.1 Selection of study area

Kyeni South Location of Runyenjes Division was selected as the study area because of the expected cooperation between ICRA and the Training Project in Pedology (TPIP) of the State Agricultural University, The Netherlands, which in collaboration with the Kenya Soil Survey (KSS) is conducting soil investigations in that area. At present TPIP is carrying out a semi-detailed survey of one of the inter-fluves. The study area is located on the eastern footslopes of Mt. Kenya, at a latitude of 0°30' and a longitude of about 37° E (Figure 2).

3.3.2 Topography

Altitudes within the area vary between 1,250 and 1,500 m above sea level. Perennial rivers, fed by rainfall and melting snow, have formed deeply incised V-shaped valleys with very steep sides (over 30°). These main rivers are fed by tributaries whose valleys have gentler slopes. There are three main ridges (inter-fluves) in the study area, which are wider in the marginal coffee zone, resulting in a relatively

Figure 2 Map of Eastern Province showing location of Embu District and Runyenjes Division

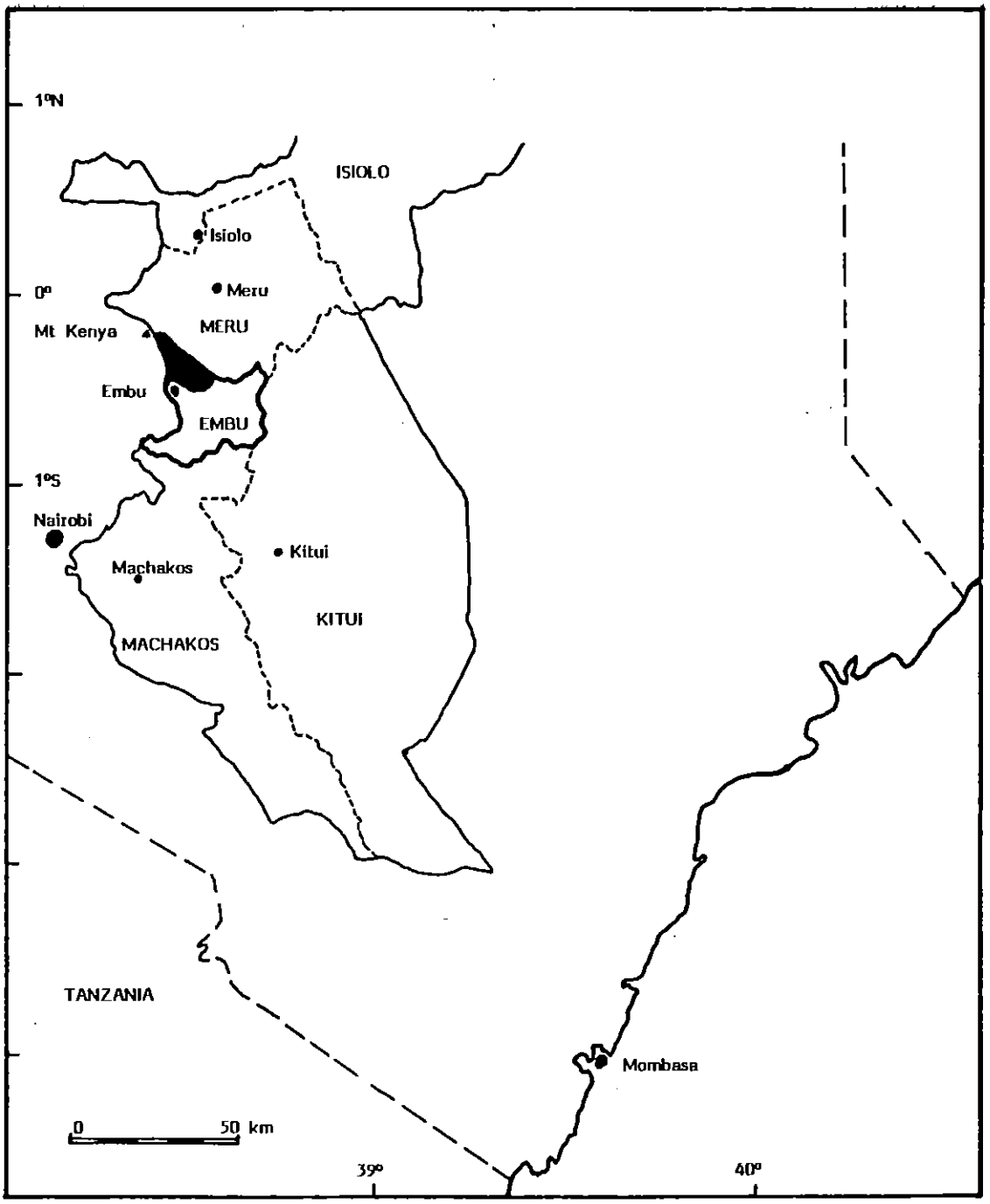
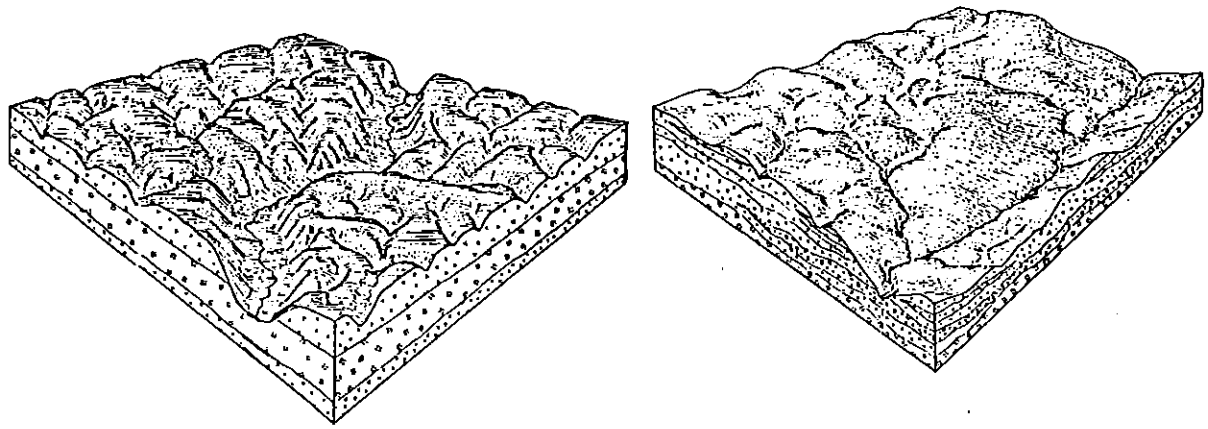


Figure 3 Models of topographies illustrating the main and the marginal coffee zones



larger proportion of flat to gently sloping land than in the main coffee zone. Figure 3 illustrates the differences in the topography of the two zones.

3.3.3 Agro-ecological zones

Kenya's land is classified into a system of agro-ecological zones, the latest system being developed by Jaetzold and Schmidt in 1983. This is based on the probability of meeting the temperature and water requirements of the major crops in at least six out of ten years. There are two zones found in the study area.

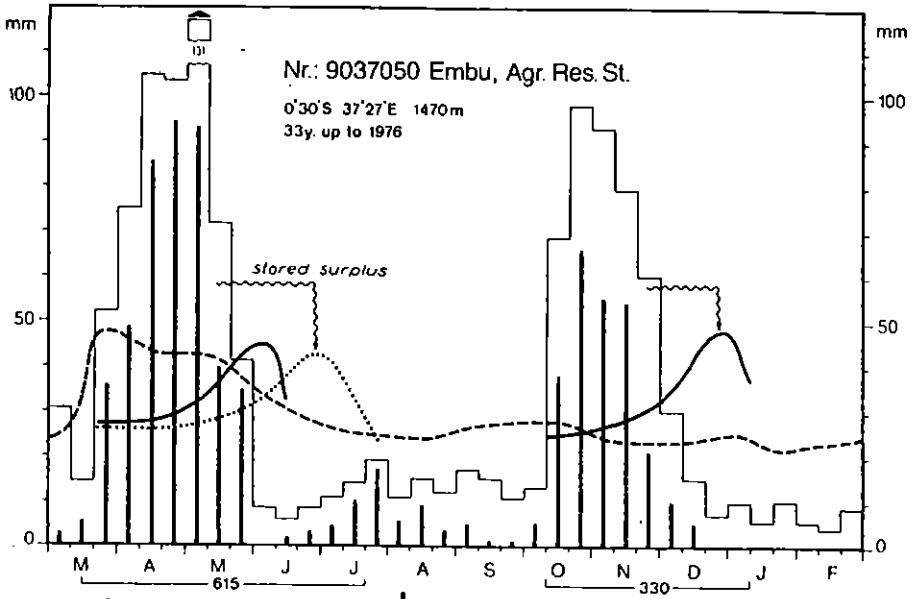
The main coffee zone lies between altitudes of 1,400 and 1,590 metres with annual mean temperatures of 18-20°C. Rainfall is bimodal with an annual average of 1,200 to 1,500 mm. This rainfall pattern has given rise to two distinct growing seasons, i.e. a medium growing season (160 or more days) during the first rains and a short to medium growing season (105-115 days) during the second rains. Normally the first rains start in mid-March while the second rains start in mid-October.

The marginal coffee zone lies at altitudes of 1,280 to 1,460 metres. The annual mean temperature is about 20°C. The rainfall pattern is again bimodal but has a lower annual average of 1,000 to 1,250 mm. The zone also has two distinct growing seasons. A medium length growing period of 120-140 days is followed by a short growing period of 85 to 105 days. Normally the first rains start at the end of March and the second in mid October.

The annual rainfall distribution in the main and marginal coffee zones within Embu District is illustrated in Figure 4, which also shows potential evapotranspiration of coffee and maize.

Figure 4 Rainfall distribution and evapotranspiration pattern

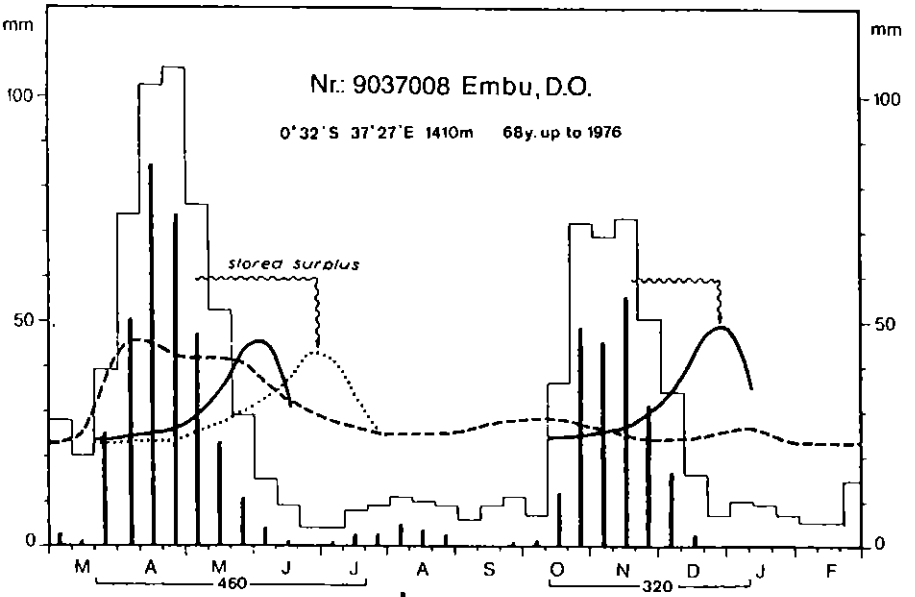
a. Main coffee zone



Average rainfall per decade | rainfall surpassed in 6 out of 10 years
Approx pot. evapotranspiration of a permanent crop (coffee)
Approx pot evapotranspiration of early mat maize like Katumani comp B
Approx pot evapotranspiration of med mat maize like H511
615 Rainfall per indicated growing period, surpassed in 6 out of 10 years

Source: Jaetzold and Schmidt

b. Marginal coffee zone



Average rainfall per decade | rainfall surpassed in 6 out of 10 years
Approx pot evapotranspiration of a permanent crop (coffee)
Approx pot evapotranspiration of early mat maize like Katumani comp B
Approx pot evapotranspiration of med mat maize like H511
460 Rainfall per indicated growing period, surpassed in 6 out of 10 years

Source: Jaetzold and Schmidt

3.3.4 Soils

The soils in the area are derived from volcanic material. On the top of the ridges soils are classified as Nithosols which have a dark reddish brown topsoil (A horizon) of silty clay texture and granular structure. The B horizon is a dark red silty clay with a moderate to weak, fine structure. The permeability of these soils is good. In the main coffee zone the depth of the A horizon is about 0.5 m, whereas in the marginal coffee zone the depth is 1.0 to 1.5 m. The Nithosols become shallower and turn into Acrisols midway down the valley sides. All soils in the area are rather acid, with the pH ranging from 4.0 to 5.0.

3.3.5 Vegetation

The original vegetation of forest land has been replaced by cultivated crops or open grassland. Traces of the original vegetation are found in a few places, mainly on sloping land.

4 THE FARMING SYSTEM

4.1 Conceptual model

The information gathered during the reconnaissance, exploratory and in-depth surveys led to the construction of a conceptual model of the farming system (Figure 5). The farming system involves food crop production (maize and beans), cash crop production (coffee) and the keeping of livestock (cattle and goats). The pattern of production is the same in both the main and marginal coffee zones. Differences which exist are variations in degree rather than type.

Smallholders in the area have a number of objectives which are :

- the provision of sufficient food for the household
- the keeping of livestock as a source of cash and as a safeguard against emergencies
- the generation of cash for food and other purchases
- the maintenance and improvement of the household social status.

These objectives influence the ways in which households allocate their land, labour and cash resources between the various components of the farming system.

4.2 Household size and composition

Most of the households in the area consist of nucleated families. In a few cases married sons live on the shamba and are allocated a piece of land and some coffee trees.

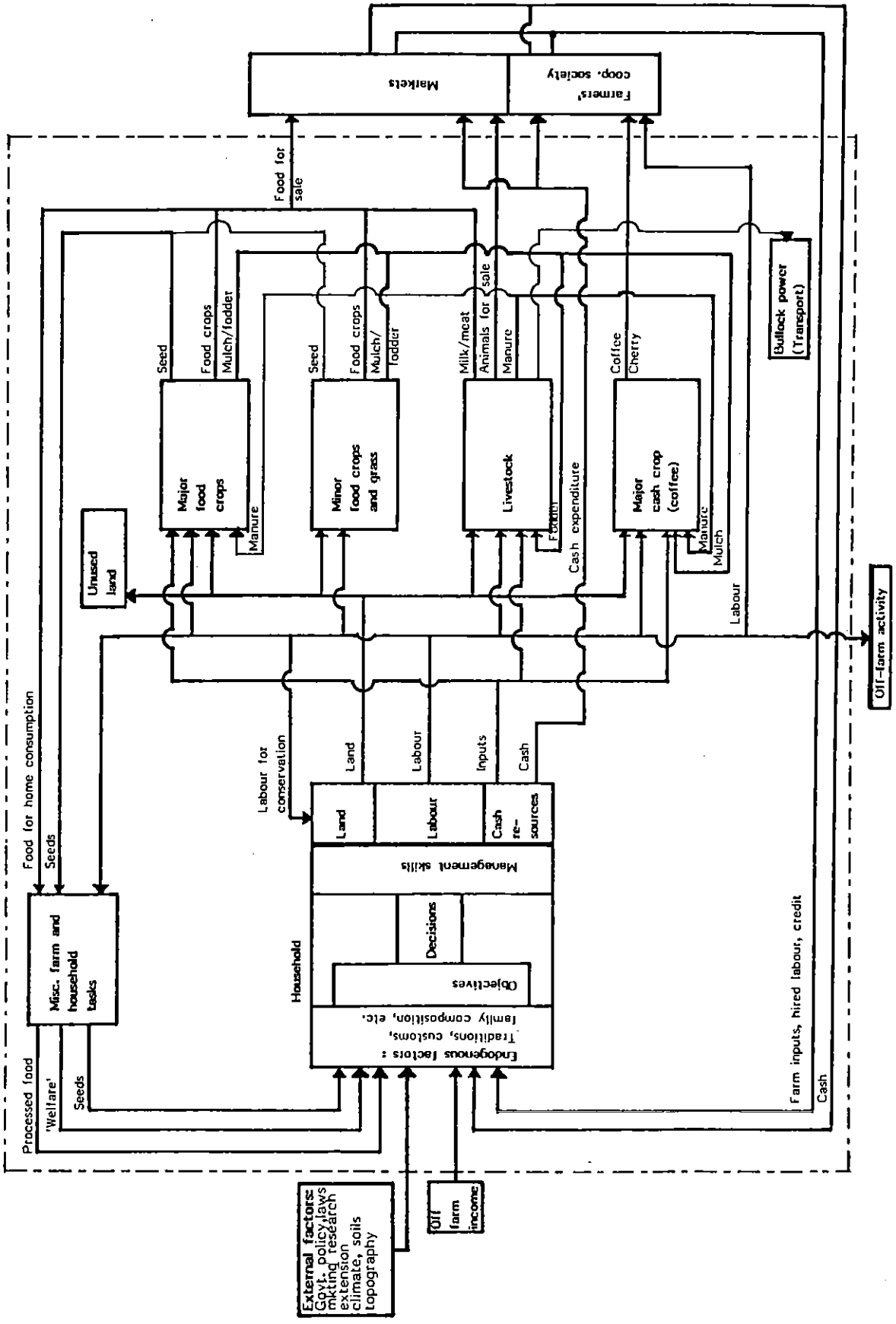
The composition and size of the household in the sample are shown in Table 1. The average size was similar in the two zones, 9.3 persons in the main and 9.1 in

Table 1 Household composition and size

Description	Main coffee zone	Marginal coffee zone
Average age of household head	49	45
Average number of adults living on farm	4.0	3.7
working full-time	3.0	3.0
working part-time	0.6	0.5
not available for farm work	0.4	0.2
Average number of children	5.3	5.4
pre-school/nursery	1.5	2.2
primary school	3.4	2.8
secondary school	0.3	0.2
further education	0.1	0.2
Average family size	9.3	9.1

Source: ICRA Survey 1985

Figure 5 Diagram representing the farming system in Kyeni South Location



the marginal zone. The average number of children per household was about five for both zones. Older children contribute labour, particularly at weekends and in school holidays, but their school fees represent a major drain on the resources of the family.

4.3 Land tenure and family size

During the late 1950's and early 1960's communal landholdings were transformed by land adjudication into private freehold titles. Table 2 shows the present land ownership structure in the area. It shows that about 80% of farmers obtained their shamba before 1965, indicating first generation ownership since the adjudication. Over 90% of households inherited their land, with the others having purchased it since 1960. About 46% of respondents reported a second shamba and about 16% a third.

Table 2 Land fragmentation and acquisition

	Main coffee zone		Marginal coffee zone	
	no of farmers	% of those replying	no of farmers	% of those replying
Main shamba	40		40	
Inherited : 1958-64	31	79	33	87
1965-80	4	10	4	10
since 1980	1	3	-	-
Bought (since 1960)	3	8	1	3
No reply	1		2	
		100		100
Second shamba	20		17	
Inherited	4	20	8	47
Bought	4	20	1	6
Rented	5	25	3	18
Borrowed	7	35	5	29
		100		100
Third shamba	6		7	
Inherited	-	-	1	14
Bought	1	17	2	29
Rented	2	33	-	-
Borrowed	3	50	4	57
		100		100

Source: ICRA Survey 1985

Sub-division of holdings is occurring to provide land for male children. Of the farmers sampled 28% indicated that their lands had been sub-divided since the adjudication. Two-thirds said that further sub-division will take place within the next 10 years. Average farm size for the main and marginal zones was 2.1 and 2.7 ha, respectively. Figure 6 presents a distribution of farm sizes for the two zones.

4.4 Farm layout

The layout of a typical farm is shown in Figure 7. Maize, beans and any tree crops are cultivated around the homestead which is usually located on flat upland areas. The coffee areas occupy the slopes while additional food crops are cultivated in the valley bottoms.

4.5 Labour

Farm labour is mainly provided by the household members. Usually the farm is cultivated by the household head and his wife or wives, as the younger children are at school for most of the year and the older children prefer off-farm employment if they can get it (Table 3). The result is that farmers often experience labour shortages, even though there may be a relatively high number of people in the household.

Figure 6 Distribution of farm sizes (ha)

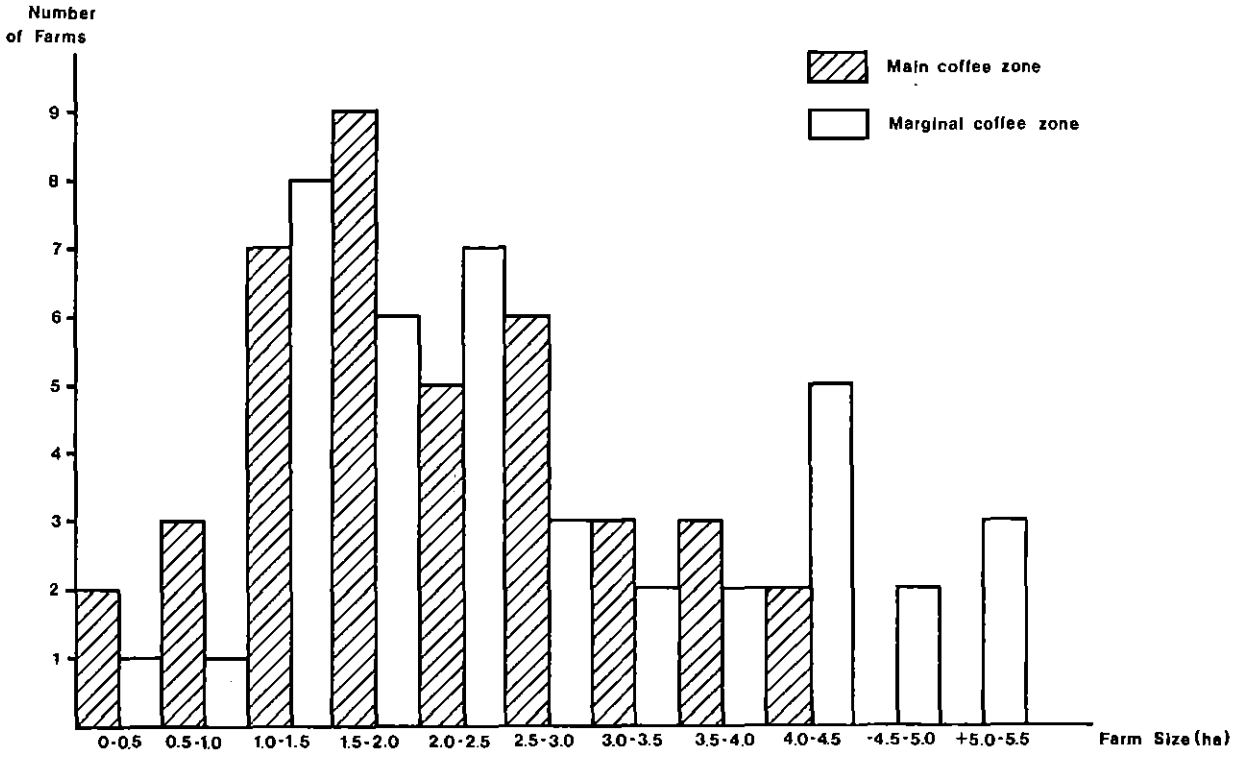


Figure 7 Layout and cross-section of a typical shamba (farm)

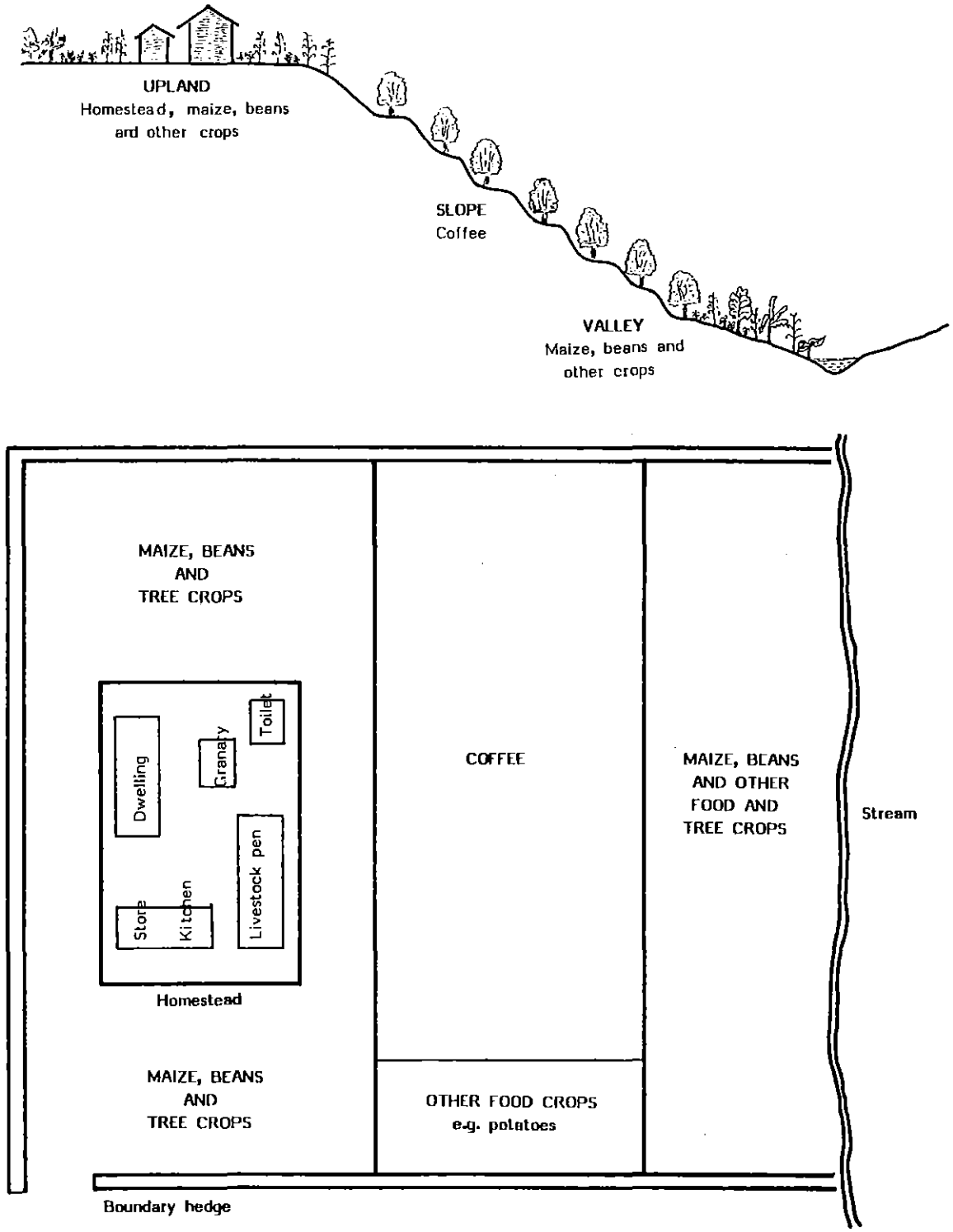


Table 3 Land and household labour parameters

	Main coffee zone	Marginal coffee zone
Average farm size (ha)	2.13	2.72
Land per caput (ha)	0.18	0.27
Land per adult (ha)	0.52	0.72
Land per full-time farm worker (ha)	0.72	0.91

Source: ICRA Survey 1985

Some 45% and 47% of respondents in the main and marginal zones, respectively, claimed they had hired labour the previous season. This was usually provided by other small farmers in the area and paid at a rate of 200-300 shillings per month or 10 to 15 shillings per day.

A traditional form of reciprocal labour cooperation, called **Irima**, is also practised, whereby the recipient provides food for the workers during the day's work.

4.6 Crop production

Due to the high population pressure, land cultivation is intensive. Any land not under perennial crops is double-cropped. Land use patterns are shown in Table 4.

Table 4 Land use patterns

Area	Main coffee zone		Marginal coffee zone	
	ha	%	ha	%
Coffee	0.47	22	0.43	16
Food crops (maize and beans)	0.91	43	1.04	38
Banana	0.23	11	0.39	14
Fodder (Napier grass)	0.06	3	0.09	3
Other crops*	0.46	21	0.77	29
Fallow, homestead and livestock pens**				
Average size total farm area	2.13	100	2.72	100
Average size of main plot	1.87		2.17	

* The range of other crops and the number of farmers growing these crops are shown in Table 13.

** The area occupied by the homestead and livestock pens is estimated roughly at 0.10 ha.

Source: ICRA Survey 1985

On average 22% of the total area of the farm was under coffee in the main zone and 16% in the marginal zone. The area under both maize and beans was 43% and 38% of the total for the main and marginal żones, respectively. About 3% of the land was put under Napier grass in both zones for fodder production.

4.6.1 Coffee

Topography

Arabica coffee (Coffea arabica) is the main cash crop for farmers in both zones of the study area. It has been grown in the main coffee zone since the early 1960s. In the marginal coffee zone, however, it appears not to have been planted until the late 1970s when world prices were high. Coffee is mainly grown on the slopes of the **shambas** while the flatter areas are reserved for food crops. As shown in Table 5 the incidence of steeply sloping coffee soils is higher in the main coffee zone than in the marginal coffee zone.

Plant population and varieties

The number of trees is shown in Table 6. The proportion of bearing trees in each zone is approximately the same, almost 90%.

Normally each farmer grows at least two coffee varieties. The predominant varieties are K7, SL28 and SL34, with K7 being the most popular in both zones. Growing a range of varieties reduces the risks arising from uncertainties in biological and climatic conditions (for example disease incidence and drought) as each variety has slightly different yield and disease resistance characteristics.

Yields

Average coffee yields reported by respondents for a "normal" year and for the 1984 season are shown in Table 7. Yields were reportedly higher in the marginal

Table 5 Topography of coffee areas

Topography	Percentage of area	
	Main coffee zone	Marginal coffee zone
Flat	25	23
Gentle slope	22	43
Steep slope	53	34

Source: ICRA Survey 1985

Table 6 Number of coffee trees and varieties

	Main coffee zone	Marginal coffee zone
Number of trees		
Total	622	571
Bearing	549	493
% Bearing	88	86
Varieties (%)		
K7	80	87
SL28	55	52
SL34	47	45

Source: ICRA Survey 1985

zone than in the main zone although not significantly so, except for the second 1984 season. In general the yields of coffee in both zones are slightly higher than the average for coffee production in Kenya which is estimated to be 4,540 kg per ha (Acland, 1980).

Weeding, manure and fertilizer application

Usually weeding takes place once to three times a season. It is one of the most labour-intensive activities of the coffee enterprise. Herbicides were reportedly used by 40% and 16% of households in the main and marginal zones, respectively, with rates of application being slightly higher in the main zone (Table 8). However, many farmers who use herbicides carry out additional manual weeding.

Animal manure is applied by the majority of farmers in both zones, although

Table 7 Average yields of coffee cherry (kg per ha and per tree)

	Main coffee zone		Marginal coffee zone	
	1984	normal year	1984	normal year
First season (March-August)	2,120	2,820	3,120	3,660
Second season (Sept.-Feb.)	2,310	2,830	2,300	3,270
Total (kg per ha)	4,430	5,650	5,430	6,930
(kg per tree)	(3.8)	(4.8)	(4.7)	(6.0)

NB : Drought conditions prevailed for the first season in 1984; rains in the second season were normal.

Source: ICRA Survey 1985

Table 8 Chemical application in coffee

Chemical	Main coffee zone		Marginal coffee zone	
	% of respondents	Rate litres/ha	% of respondents	Rate litres/ha
Herbicide (Glyphosate, Paraquat)	40	8	15	6
Pesticide (Fenitrothion)	77	7	85	12
Fungicide*	93	15	95	28

* Talc al application kg/ha

the rate of application is higher in the marginal zone (Table 9). It is normally applied once a year in August or September and often incorporates crop residues. Another source of manure is waste coffee pulp which can be obtained free from the factories. However, few farmers make use of this because of the difficulties involved in transporting it from the factory.

Chemical fertilizers were also applied by the majority of households in both zones. The fertilizer most commonly used was Calcium Ammonium Nitrate (C.A.N.), applied by 50% of the farmers in the main zone and 66% in the marginal zone at a reported rate of 270 kg/ha and 296 kg/ha for the two zones, respectively. These are less than one tenth of the rates recommended by the extension service.

Table 9 Manure and fertilizer application in coffee

	Main coffee zone		Marginal coffee zone	
	% of respondents reporting use	Rate of* application	% of respondents reporting use	Rate of* application
Animal manure**	98	12.5	90	18.3
Chemical fertilizers	85		62	
CAN	50	271	66	296
DAP	6	334	13	213
CAN + DAP	6	318	-	
Others	33	436	13	276

* Manure is expressed in debes (20 litres) per ten trees and fertilizer in kg/ha

** Application rates derived from only ten informants

Source: ICRA Survey 1985

Pests and disease

The most prevalent diseases in the area are Coffee Berry Disease (CBD), caused by the fungus Collectorichum coffeanum, and leaf rust (Hemileia vastatrix). They are most widespread during the wet season, especially in the main coffee zone, and are extremely damaging to the crop. Reported pests were coffee leaf miner (Leucoptera spp) and thrips (Diarthrothrips coffeae). Thrips is more common in the marginal coffee zone. Pesticides and fungicides were applied by the majority of farmers in both zones but at rates below these recommended by extension (Table 8).

Pruning

Pruning generally takes place after harvesting. The pruning method adopted in the study area is known as multiple stem pruning. It allows the growth of two or more main stems, which are replaced by suckers every three to five years. The laterals bear two crops before being pruned. As a consequence of this method of pruning many trees are very tall or bent over making correct spraying and a complete harvesting difficult to achieve.

Harvesting

Harvesting is done by hand and takes place during April-June and October-December. The picking is normally carried out three to four days per week during the busiest months and one to two days per week during the rest of the season. The days on which picking takes place are regulated by the cooperative societies.

After picking, the cherry is taken to the nearest factory of the cooperative society to which the farmer belongs. Most farmers (54%) do not own wheelbarrows or ox-carts and so have to carry the sacks to the factory, although hiring of transport is quite common. The cherry must be delivered on the same day as it is picked to maintain the quality of the product. There are six factories and two collection depots in the study area which means most farmers do not have to travel more than two kilometres.

4.6.2 Maize and beans

Areas cultivated

Maize and beans are the main staple foods grown by all the sample farmers. These crops are grown both in pure and mixed stands. The average areas covered by pure stand maize and beans and maize beans intercropped are shown in Table 10. About one third of the total area under maize or beans is cultivated with pure stand maize, one third with pure stand beans and one third with maize/beans intercropped.

Table 10 Average areas under maize and beans

	Main coffee zone	Marginal coffee zone
Pure stand maize (ha)	0.33	0.46
Pure stand beans (ha)	0.29	0.23
Mixed stand maize/beans (ha)	0.29	0.35
Total	0.91	1.04

Source: ICRA Survey 1985

Farmers who grow their food crops in pure stands normally do so because they believe it produces higher yields. It also facilitates crop rotation, which helps to control diseases. Those who only practise mixed cropping (13%) are unable to rotate, unless they have other land. Other crops are sometimes used in the rotation, e.g. English potatoes, but they only constitute a small fraction of the food crop area.

Varieties

Maize hybrids 511 and 512 are the most common varieties in the main coffee zone, and 511 with the Katumani composite are predominant in the marginal zone (Table 11). Although the majority of farmers use hybrid varieties only 30 to 35 per cent of them purchase hybrid seed each season. In general, maize fields show a very irregular stand and uneven growth, indicative of the improper use of hybrid seed. About 30% of farmers noticed a decline in yield after the first season.

Bean varieties are predominantly local, although Rose Coco and Canadian Wonder were grown by about a quarter of the farmers.

Table 11 Maize varieties

Varieties	Percentage of respondents	
	Main coffee zone	Marginal coffee zone
Hybrid 512	38	11
Hybrid 511	40	55
Katumani	12	20
Local	10	14

Source: ICRA Survey 1985

Cultivation practices

The bimodal rainfall pattern permits the growing of two crops a year. Land preparation for the first season is undertaken in February/March and for the second season in August/September. A hand hoe (**Jembe** or forked **Jembe**) is normally used for land preparation. Maize, followed by beans, is sown in March and October. In both seasons, maize was sown at a rate of 25 to 35 kg per ha and beans at a rate of 40 to 50 kg per ha.

Manure and fertilizers are applied only to maize and are applied either during land preparation or at the time of sowing. Manure was applied by 46% of respondents in the main zone and 28% in the marginal zone. Fertilizer was applied by 69% of households in the main zone and 50% in the marginal zone. Average application rates in both areas varied between 60 and 120 kg per ha per season. The types of fertilizer used are C.A.N. and 20:20:0. If manure is used, it is applied once a year at the time of application to coffee (August-September).

The only crop protection measure in the field is the use of pesticides to control maize stalk borer (Busseola fusca). The chemical is applied once per season by placing the granules in the funnel of each plant. This chemical was used by 82% and 73% of the farmers in the main and marginal coffee zones, respectively, at a seasonal rate of about 6 kg/ha. Beans are not protected at all; beanfly (Melanagromyza phaseoli) attack on the young bean seedlings was observed on all farmers' fields.

Weeding is carried out twice per season. Using a **panga** or a **jembe**. Some 80 to 90% of the farmers reported shortages of labour, and thus neglected their weeding of maize and/or beans.

Yields

Average yields for maize and beans reported by respondents for 1984 (a drought year) and a "normal" year are shown in Table 12. Yields were significantly higher in the marginal zone for both maize and beans, reflecting the differences in their agro-ecological conditions and management practices.

4.6.3 Other crops

Other crops grown are presented in Table 13. Bananas, English potatoes and cassava were grown by the largest proportion of farmers, followed by sweet potatoes, fruit trees and vegetables.

Bananas are an important food source, particularly during times of food shortage. Banana stems and leaves are also an important source of livestock feed. They are usually grown in scattered patches, mainly around the compound and the valley bot-

Table 12 Maize and bean yields for different seasons (kg/ha)

Season	Main coffee zone		Marginal coffee zone	
	Maize	Beans	Maize	Beans
1984				
Season 1	280	140	180	50
Season 2	770	350	1330	350
Total	1050	490	1510	400
Normal year				
Season 1	980	630	1580	850
Season 2	1070	580	1630	880
Total	2050	1210	3210	1730

Source: ICRA Survey 1985

Table 13 Number and percentage of households growing other crops

Crops	Main coffee zone		Marginal coffee zone	
	Number	%	Number	%
Cotton	3	7	6	15
Tobacco	0	0	5	12
English potatoes	29	72	23	57
Cassava	32	80	33	82
Sweet potatoes	18	45	25	62
Yams	14	35	11	27
Taro (Arrowroot)	8	20	11	27
Tree crops				
Bananas	33	82	35	87
Pawpaw	13	32	29	72
Mangoes	20	50	18	45
Macadamia	15	37	21	52
Citrus	16	40	20	50
Avocado	2	5	4	10
Others				
Vegetables	22	55	18	45
Pigeon peas	6	15	13	32
Sorghum	5	15	17	42
Sugar cane	11	27	6	15
Cowpeas	0	0	4	10
Gourds/Pumpkins	0	0	2	5
Sunflower	0	0	3	7
Millet	0	0	2	5

Source: ICRA Survey 1985

tom. The average number of banana trees per **shamba** was about 100. Little management appeared to go into banana production.

English potatoes have become increasingly important as a food crop over the last 10 years. The crop is usually grown on ridges, near the homestead, in patches of less than one-tenth hectare, and is often rotated with maize, beans or other crops. The level of input use is generally low, and problems of late blight and bacterial wilt diseases were evident on many farmers' fields.

Cassava is grown by the majority of respondents in both zones. It is grown in scattered patches throughout the **shamba.**

Pawpaw, mango, citrus and macadamia are the main tree crops. These tend to be more important in the marginal zone.

4.7 Livestock production

4.7.1 Types and numbers of livestock

Livestock were kept by 94% of the farmers surveyed (Table 14). Cattle and poultry were kept by 89% and goats by 71%. The average household owned three cattle and three goats. Sheep, rabbits and bees were kept by a few households in the sample. In the marginal zone 2.8 livestock units per farm were kept and in the main zone 2.0 livestock units. (One livestock unit is equivalent to one adult head of cattle.)

The proportion of improved cattle breeds was about 70% in the main zone, but only 60% in the marginal zone, which is closer to and trades with the drier zone where the Zebu type is more common. In both zones the proportion of improved calves is greater than the proportion of improved adults, indicating that the process of improvement is a continuing one. These percentages are likely to increase further with the Government's policy of improvement through artificial insemination and castration of local Zebu bulls.

The main reasons given by farmers in both zones for keeping livestock are the production of milk and manure, rather than for meat or saving.

Table 14 Livestock types and numbers owned

	Cattle	Goats	Poultry	Sheep	Rabbits	Beehives
% of farms	89	71	89	9	15	22
Average number per farm	3.3	3.3	9.2	2.6	2.6	2.9

Source: ICRA Survey 1985

4.7.2 Feed

The increasing human population has forced farmers to grow more food crops and to adopt zero or minimal grazing for cattle and goats. This practice has been promoted by the extension service since 1978. At present only about half the livestock owners have areas of natural pasture (less than 0.1 ha).

The main source of feed for cattle is Napier grass (Pennisetum purpureum). This is most often grown along the edges of coffee terraces, although many farmers (55%) grow it in pure stands. The average area was 0.16 ha which, on it own, is far from sufficient to meet livestock feed requirements, given that 0.2 ha of this crop is estimated as necessary to feed one livestock unit (Agricultural Information Centre, 1984). Only 57% of farmers reported replanting Napier grass every 4-5 years, as recommended.

Other sources of feed are Setaria splendida (known locally as Kericho grass), which is also grown in lines on coffee terraces, and crop by-products such as maize stalks, banana leaves and stems, and bean and sweet potato vines (Table 15). In addition, animals graze along roadsides. Some farmers occasionally give small amounts of commercial dairy meal to their grade cows.

Goats receive less care and graze around the compound or eat occasional surpluses.

Poultry are generally kept in a wooden henhouse and fend for themselves, although half the respondents reported also giving them maize grain or waste left over after pounding.

Feed shortage was reported to be a problem by 55% of respondents. This shortage is most acute in the period from June to October.

4.7.3 Livestock production and sales

Among farmers keeping cattle, 61% and 46% in the main and marginal coffee

Table 15 Food sources for cattle and goats

	Percentage of respondents using						
	Napier grass	Kericho grass	Dairy meal	Maize stalk	Banana leaves/ stem	Vines	Grazing
Cattle	94	57	53	100	90	83	77
Goats	58	25	0	68	75	60	65

Source: ICRA Survey 1985

zones, respectively, reported owning improved milk cows (mainly crossbred), whereas 25% and 31% kept exclusively local Zebu cows. Milk production, even from improved breeds, was low, mainly due to under-nourishment (Table 16). Milk is used mainly for home consumption. One third of milk producers sold part of their production locally, with average sales of two litres per day. For those who sold milk the average revenue was Ksh 4,000 per year.

Milk production is not a major objective for cattle-owners. Animals are sold when cash is needed or feed in short supply. The most common age at which cattle are sold is two years, although there is considerable variation. Most sales are between neighbours or at local markets.

Most farmers (96%) use artificial insemination (A.I.). This service is provided, at 1 Ksh per cow, by the District Agricultural Office. Organization and efficiency seem good, since slightly fewer than two inseminations are required per conception. Nevertheless, an irregularity in calving intervals has been noticed; on 66% of the farms they were more than 12 months.

The main reason for keeping goats is to provide meat for special occasions and as a source of cash; milk production is almost non-existent. In 1984, one quarter of goat-owning farmers sold 2.3 goats each. An average of 1.2 goats were consumed by a further quarter.

Poultry, together with milk, is the main source of animal protein. Of the farmers surveyed, 58% consumed an average of 6.7 chickens in 1984 and 30% obtained eggs more or less regularly throughout the year. Only 18% sold any poultry products. Replacements are generally produced on the farm.

4.7.4 Draught power

Draught animals are not very common in the area. Only 14% and 26% of livestock owners in the main and marginal coffee zones, respectively, kept oxen, usually just one per farm. The small size of farm and, in the main coffee zone particularly,

Table 16 Average milk production at the beginning and end of lactation (in litres per cow per day)

Improved cows		Local cows	
Beginning	End	Beginning	End
5	2	2	1

Source: ICRA Survey 1985

the hilly topography limit the suitability of oxen for cultivation. Only one farmer reported ox-ploughing; the rest use their draught animals for pulling carts. Most oxen are of local breed (66%). However, the proportion is lower among the younger animals, suggesting a tendency to replace with cross-breds. The main constraint to keeping draught animals seems to be the provision of adequate feed.

4.7.5 Diseases

Vaccination against Rinderpest is compulsory and is provided at low cost for Anthrax, Foot and Mouth Disease and Newcastle Disease. The compulsory weekly dipping of cattle has reduced greatly the incidence of tick-borne diseases such as Heart-water, East Coast fever and Anaplasmosis. In the last two years severe losses of poultry due to Newcastle Disease were reported.

4.7.6 Integration of livestock in the farming system

Provision of manure for crops is an important factor influencing the decision to keep livestock. In return, crop by-products provide considerable amounts of livestock feed. In a zero grazing system one cow is able to produce 10 tonnes of manure per year provided the nutrition is adequate. However, manure is left in the pen, in most cases exposed to rain and sun. This must cause substantial losses of nutrients during the rainy season.

Farmers readily turn their cash surpluses into livestock, since they are a rather liquid form of investment, easily convertible when cash is needed.

5 GOVERNMENT POLICIES AND AGRICULTURAL SUPPORT SERVICES

5.1 Agricultural development policy

Agricultural development policy is geared towards:

- encouraging the growth of the agricultural sector
- improving the balance of payments by increasing domestic food production and expanding exports
- increasing employment opportunities
- raising rural incomes and
- conserving natural resources.

The Ministry of Agriculture and Livestock Development (MALD) is responsible for measures to implement these policies, together with parastatals such as the Kenya Coffee Board, the Kenya Tea Development Authority, the National Cereals and Produce Board and the Agricultural Finance Corporation.

5.2 Agricultural research and extension

Agricultural research in Kenya is mainly the responsibility of the Ministry of Agriculture and Livestock Development (MALD), through its network of national and regional research stations and laboratories. Research done on major cash crops is promoted and supported by the respective marketing boards. In addition, the University of Nairobi's Agriculture and Veterinary Departments are involved in research programmes financed by direct Government grants.

Of direct relevance to the study area, is the research undertaken by the Coffee Research Station at Ruiru, the National Horticultural Research Station at Thika on beans, the National Livestock Research Station at Naivasha, especially on zero grazing, and the Regional Research Station at Embu on maize, beans and livestock production.

Extension operates a Training and Visit (T+V) system which was adopted two years ago by the MALD. In addition to the extension service the MALD also runs a veterinary programme providing services such as artificial insemination (AI), dipping and vaccination. These services are heavily subsidized. Coffee cooperative societies run training courses and organize meetings for their members. About 50% of farmers in both zones reported having attended demonstrations on contact farms and/or courses organized by the extension services. One quarter of the farmers in both zones reported having had no contact with the extension service.

5.3 Marketing and prices

5.3.1 Coffee

Marketing of farmers' produce is undertaken by Farmers' Cooperative societies. Local cooperative factories forward partly processed coffee (parchment) to the Kenya Planters Cooperative Union (KPCU), which in turn sells the produce to the Coffee Board of Kenya (CBK). The CBK is the sole marketing agent at a national level. Farmers receive up to 70% of the world market price and there are no guaranteed prices.

There are two coffee cooperative societies in Kyeni and any smallholder wishing to sell coffee must be a member. The societies purchase, process, grade and market farmers' produce and also provide inputs and equipment, often on credit. Loans are also available, being dependent on the amount of coffee cherry the farmer delivers to the factory. Members are obliged to provide free labour for at least one day per week for the processing and maintenance work at the factory.

5.3.2 Food crops

The National Cereal and Produce Board (NCPB) has a monopoly on the purchase and distribution of large quantities of maize. Purchase and sale prices and retail prices of maize-meal are fixed by the Government. Private inter-district trade is only allowed on a limited basis. The majority of smallholder maize is sold on the local market through traders. For beans the NCPB sets an incentive price, but the market is not otherwise controlled. They are mostly sold on the local market, as are other food crops, including fruits and vegetables.

5.3.3 Livestock

Livestock are sold on the open market and at local auctions. The Livestock Marketing Branch (LMB) of the MALD buys livestock during times of distress sales. The Kenya Meat Commission (KMC) has a monopoly on meat exports.

Trade in sheep, goats, pigs and poultry occurs locally. Most smallholder produced milk is sold on the local market or direct to consumers with prices varying throughout the season.

5.4 Other facilities

A recently completed new road from Thuchi to Meru has greatly increased the accessibility of the area. Rural access roads in the area are reasonably well developed, although during the wet season some become impassable for short periods.

Taxis (matatus) provide a feeder service to the Embu-Thuchi-Meru road, where buses and taxis maintain regular services to Meru, Embu and Nairobi.

There are nine primary schools, three secondary schools and two technical schools in Kyeni South. In addition there are eight nursery schools, five adult literacy classes, and two Village Polytechnics. There are government and mission medical facilities in the area and a large provincial hospital in Embu.

A water project in the area provides untreated piped water. Other sources of water include wells, streams, rivers and springs.

6 ANALYSIS OF CONSTRAINTS WITHIN THE SYSTEM

6.1 Introduction

During earlier survey work it was observed that crop and livestock production were apparently constrained because farmers could not afford to buy sufficient agricultural inputs. In addition many farmers were unable to hire the extra labour required to cope with labour peaks or to complete satisfactorily certain tasks related to maintenance of soil quality. At the same time it was observed that large amounts of cash income were devoted to non-farm expenditures.

These observations led to the conclusion that the principle constraints facing farmers concern cash resources, labour use and land degradation. Hypotheses concerning these constraints were constructed and the formal survey was designed with these in mind.

The hypotheses were:

1. The high priority given to off-farm expenditures diverts cash from essential investments in the farm.
2. Family labour is inadequate to meet the cultivation and husbandry requirements of the (three main) farm enterprises.
3. The (physical) characteristics of land and the population density of the area, combined with the above, are leading to the deterioration of soil fertility.

The relationship between the constraints is illustrated in Figure 8. The hypotheses were tested by analysing a household's cash flows, its labour availabilities and requirements, and the quality of its land resources.

6.2 Cash flows

6.2.1 Cash income

Average household cash income from farm and non-farm activities is shown in Table 17. The major source of cash income in both zones is from sales of coffee. Gross margins have been calculated for coffee production which provide information on the factors affecting the profitability of the major cash-earning enterprise in the two zones (Appendix F).

Cash income on average was some 15% higher in the marginal coffee zone compared with the main coffee zone (Appendix B). This is largely accounted for by sales of maize, beans and minor crops. Yields of these crops were markedly higher in the marginal zone (Table 12) and areas planted were also greater (Table 4).

Sales of livestock and livestock products reflect slightly different patterns of livestock production in the two zones. The main zone, which has more grade cows,

Figure 8 Interrelationships of constraints

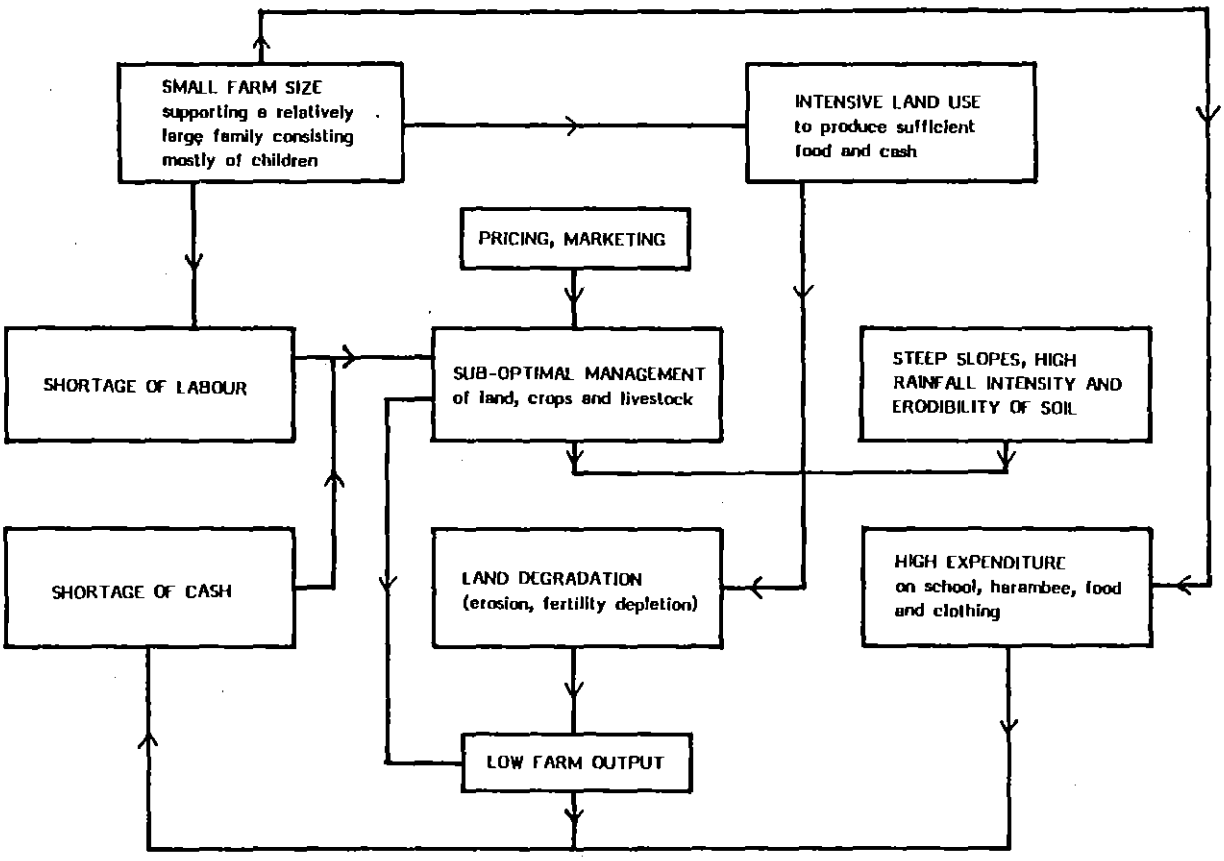


Table 17 Amounts and sources of cash income

Source	Percentage of total income		Income (Ksh)	
	Main coffee zone	Marginal coffee zone	Main coffee zone	Marginal coffee zone
Coffee sales	64	58	9900*	10400
Food crop sales	5	16	800	2900
Livestock sales	9	7	1300	1200
Non-farm	22	19	3500	3500
Total	100	100	15500	18000

* Calculation of Gross Margin for 1 ha of coffee. Appendix F.

Source: ICRA Survey 1985

gained more from the sale of livestock products, mainly milk, than the marginal zone.

The number of households reporting off-farm activities was higher in the main zone than the marginal zone (65% and 35%, respectively), but the average income was the same. Some households get large incomes from members with full-time professional or skilled jobs such as teachers, civil servants and carpenters, whereas others get smaller contributions from part-time or seasonal occupations, e.g. tailoring, labouring and selling handicrafts.

6.2.2 Expenditure

Expenditure was made by the household on food, hiring of labour, purchase of agricultural inputs, school fees, buying of clothes and meeting social obligations (Table 18).

Expenditure on both agricultural inputs and the hiring of labour was higher in amount and as a proportion of total expenditure in the marginal zone than the main zone. School fees accounted for 23% of total expenditure in the main zone compared with 13% in the marginal zone, due to the greater proportion of children of school age in that zone; the average number of children at primary and secondary school in the main zone are 20% and 50% higher, respectively, than in the marginal zone.

In general, expenditure on farm production accounts for less than a half of a household's total spending. Comparing Table 17 and Table 18 average household income is found to exceed expenditure by about 21% in the main zone and 33% in

Table 18 Household expenditures

Expenditure item	Percentage of total expenditure		Amount (Ksh)	
	Main coffee zone	Marginal coffee zone	Main coffee zone	Marginal coffee zone
Agricultural inputs	17	21	1960	2510
Livestock purchase	3	3	410	400
Hired labour	12	25	1380	2960
School fees	23	13	2710	1520
Food	19	16	2220	1930
Clothing	16	13	1870	1600
Harambee/Social/Housing	10	9	1220	1100
Total	100	100	11770	12020

Source: ICRA Survey 1985

the marginal zone, which appears unlikely in view of last year's drought. It is possible that farmers exaggerated their income or, more likely, that they were not able to recall accurately amounts of income and expenditure that occurred some time in the past. Thus the figures should be seen as an indication of relative orders of magnitude of different items of income and expenditure rather than in absolute terms. It does seem that households have particular commitments regarding their expenditures which result in them only being able to allocate relatively low proportions of their cash resources to expenditures on agriculture.

6.3 Labour

6.3.1 Input

Based on farmer responses, labour inputs for coffee, maize and beans were calculated for the main and the marginal zones. The annual labour input in mandays per ha and the relative importance of each operation are shown in Figure 9.

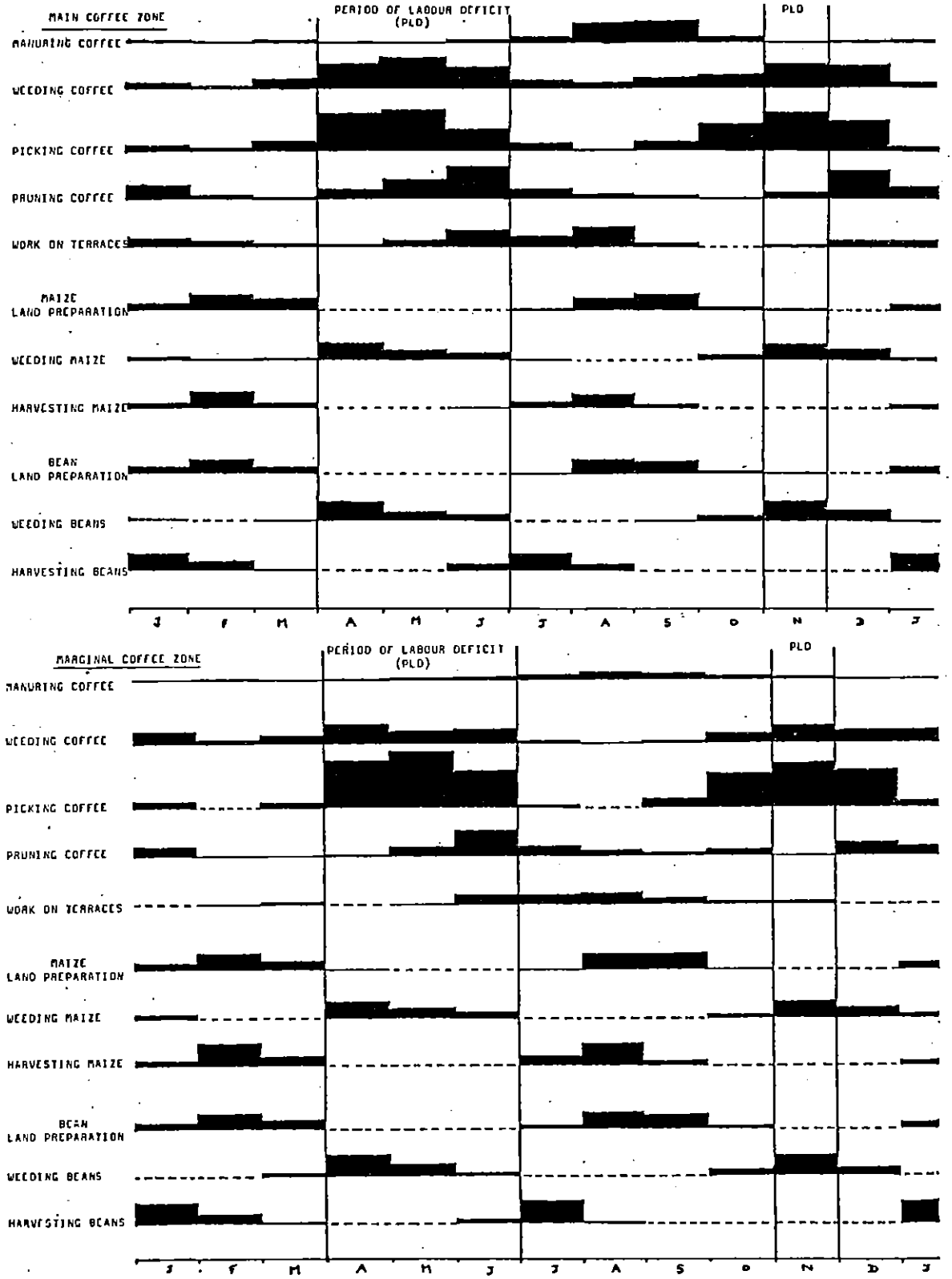
In addition to the labour input for the production of coffee, maize and beans, the labour supplied to the coffee factory and labour used in tending livestock have been included. Labour inputs on tending other crops and on household activities, were not included in the figure.

For both the main and the marginal zones there are three peaks in the farm labour activities, although the peaks are generally higher in the former than in the latter zone. The highest peaks occur in April to June and in November/December (main zone), and October/November (marginal zone). A lower peak occurs in August in both zones. In the main coffee zone there appears to be a higher labour input for coffee and a lower input for beans than in the marginal zone (Appendices C and D).

6.3.2 Constraints

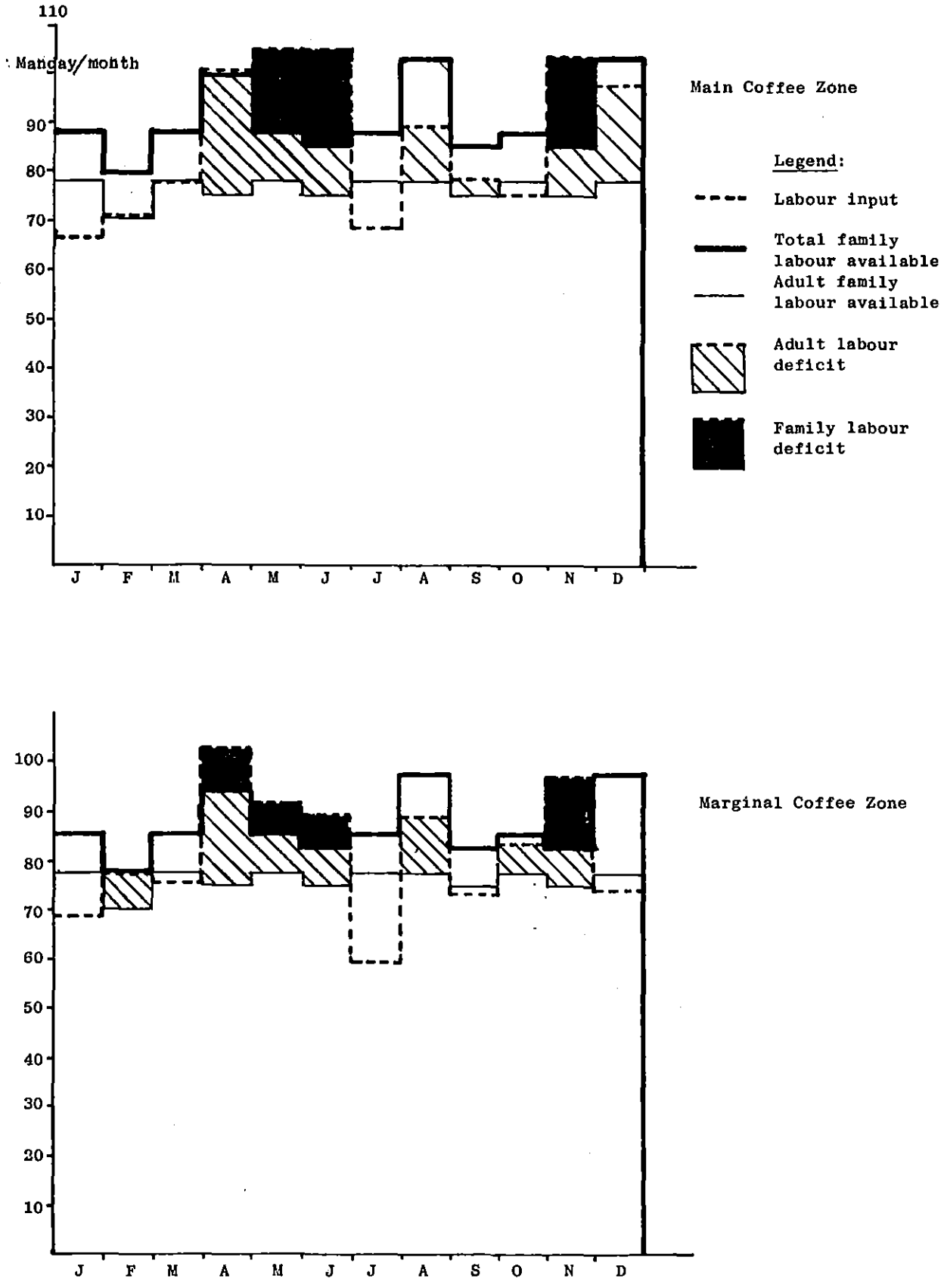
The average monthly family labour availabilities are shown in Appendix E. Days lost due to illness are not accounted for because their spread over the year is unknown. Their effect on farm labour availability can, however, be substantial. Last year on average 107 mandays in the main zone and 61 mandays in the marginal zone were lost. In Figure 10 the labour requirement for the three major enterprises is compared with the labour availability of the average family. This figure illustrates that adult family labour is not sufficient during the peak periods of April through June, August, and November through December (in the main zone) or October through November (in the marginal zone). Even though children help their parents, especially during school holidays (viz. April, August and December), the labour peaks in April

Figure 9 Labour inputs for cultivation of main crops in mandays per ha



Scale: 1 mm : 10 mandays

Figure 10 Farm labour demand and availability



through June and in November still cannot be satisfied by the average family. Shortfalls in family availability of labour are often overcome by households hiring labour. In the main zone 45% of respondents claimed they hired labour and 47% in the marginal zone. If a household has insufficient cash to hire such labour, it is weeding (of food crops and coffee) and pruning of coffee which are usually neglected.

Figure 10 also shows the relatively small surplus in labour availability during the off-peak seasons. This indicates that the average family in both zones has little capacity or flexibility to absorb calamities, such as prolonged illness or increased work loads.

6.4 Land

High population densities have resulted in a land shortage in the area, with a consequent high cost of land and increasing fragmentation of holdings. The land is cultivated intensively and this has resulted in soil degradation which is worsened by erosion on the steeper slopes.

Table 19 shows the proportion of farmers who reported erosion to be a serious problem and the measures currently being taken to control it. Nearly half of the respondents claimed erosion was a major problem.

To conserve soil by reducing run-off, coffee is cultivated on terraces by the majority of households in both zones. Terracing is less common in the other areas of the shamba, especially those where maize and beans are grown. Many terraces were observed not to follow the contours and were of little use in erosion control;

Table 19 Erosion and conservation practices

	Percentage of respondents			
	Main coffee zone		Marginal coffee zone	
	Coffee area	Other area	Coffee area	Other area
Farmers' perception of erosion				
Negligible	30	32	33	22
Slight problem	22	22	23	30
Major problem	47	45	44	47
Measures taken				
Terraces	30	10	32	10
Terrace + grass lines	47	15	45	12
Grass lines	5	42	0	52
Trash lines	0	0	0	7
None	17	32	22	17

Source: ICRA Survey 1985

others were in disrepair. Another method of erosion control practised by many farmers is that of planting Napier and Kericho grass lines along the edge of terraces. These are often of limited effectiveness as the grass is usually cut very short to provide cattle feed (probably the main purpose), and gaps in the lines are not filled with new plants.

Another practice which plays a part in controlling erosion is mulching. About 20% of the farmers in the main zone and 12% in the marginal zone reported that they carried out mulching using maize stalks and other suitable materials. There is, however, a shortage of mulching material to cover the total area susceptible to erosion.

Certain cultivation practices also contribute to erosion. The clear weeding of the coffee area exposes the soil to rainwater, especially since heavy pruning of the trees reduces the canopy protecting the soil.

Soil conservation measures are considered by farmers as activities requiring substantial labour and cash inputs from which no returns are realized in the short term. These activities thus receive low priority, particularly when labour is in short supply.

Thus it appears that soil quality is a constraint to many households. Many take measures to try and combat erosion, although these are often ineffective, due to shortages of family labour or the cash to hire labour.

7 AREAS OF INTERVENTION TO ALLEVIATE CONSTRAINTS

7.1 Introduction

Given the limited availability of a household's land and labour and the non-farm demands on its cash resources, it does not seem possible to greatly increase the level of land or labour use or the proportion of existing income that can be invested in agricultural production. Thus, three areas of intervention are considered in order to increase the productivity of existing resources. The first involves Government intervention at a "macro level" to modify the environment of the farming system. The second concerns interventions at the farm level, which involve changes in management practices which would reduce peak labour demands and yet not require extra cash investments. They would also help conserve the fertility of the soils. Thirdly, recommendations for research are made.

7.2 Policy recommendations

7.2.1 Marketing

The marketing of milk is an area in which the Government could intervene, perhaps in cooperation with the private sector. The absence of a well functioning marketing system results in farmers limiting their milk production to cater only for their own requirements. An increase in the number of outlets would likely encourage farmers to increase milk production at little cost, and sales would increase their cash incomes.

An increase in the efficiency of processing and marketing of coffee should be investigated with a view to reducing costs.

7.2.2 Research and extension

A more integrated farming system approach to research is recommended; which would also help the extensionists to realize the very close inter-relationships that exist between the various farm enterprises. For example, coffee research should take into account the importance of food crops and livestock production.

7.2.3 Family planning

The government of Kenya has realized the importance of controlling population growth, and has embarked on a campaign to educate the people about the importance of family planning. Population growth is threatening the future availability of sufficient agricultural land per household. Therefore, it is recommended that family plan-

ning programmes in the area are further encouraged. This is an area where assistance from voluntary agencies and donor organizations could be employed.

7.2.4 Off-farm employment

Off-farm income earning opportunities are very limited in the area. A population growth rate of 4% per year with little capacity for agriculture to absorb the increase necessitates the Government encouraging the creation of rural industries capable of absorbing the growing labour force. This would help reduce the population pressure on the land and slow the process of land fragmentation.

7.3 Recommendations concerning farm management practices

These recommendations concern improvements in the use of existing inputs and resources. Although they are discussed under specific headings they may affect several aspects of the farming system.

7.3.1 Pruning of coffee

The common practice of pruning coffee in the study area is the multiple stem method, which allows the stem to grow to 3-4 metres high. This makes harvesting time-consuming and effective spraying of the whole stem is difficult, contributing to increased levels of CBD (Acland, 1980). An alternative is capped multiple stem pruning, which has been recommended only for the coffee estates in Kenya. This method allows two or three stems to grow to a maximum height of 1.5 to 1.8 m. It requires much skill, however, and would need to be introduced through farm demonstrations and farming training programmes.

7.3.2 Pest and disease control in coffee

During the wet season chemical sprays could be made more effective by the use of sticking agents. In addition, since thrips outbreaks in the marginal coffee zone are usually associated with moisture stress, mulching would be an effective way to control thrips to such a level that the use of insecticides could be considerably reduced.

7.3.3 Maize

Suitable hybrid maize varieties are already available and are used by a high proportion of farmers. Nonetheless, poor management practices result in low yields. Most farmers only buy new seed when their harvest is poor. The importance of correct

management practices for hybrid maize needs to be emphasized and improved practices, such as correct time of planting, weeding, optimum land preparation and fertilizer use, demonstrated.

For those farmers who are unable to purchase new seed or provide adequate crop management, the use of hybrid maize is not advantageous. Development of suitable composite varieties is recommended (7.4.3).

7.3.4 Beans

Yields are limited by the widespread damage caused by bean fly (Melanagromyza spp.). Extension should help farmers to control this pest. Seed treatment is an existing recommendation and should be stressed, since it is simple to adopt and does not require much cash input.

7.3.5 Fodder production

Fodder shortage is the major limiting factor of animal production. It is therefore recommended that hedges along the boundaries of shambas be replanted with shrubs which could be used as fodder. A species such as Leucaena leucocephala which is fast growing and protein rich would also provide firewood or mulching material when in surplus.

It is recommended that fodder grasses be grown in a more systematic way between other crops and on the edges of coffee terraces. The growing of common fodder grasses in the coffee area is discouraged; in the present circumstances we consider this is an inappropriate recommendation (7.4.5).

7.3.6 Soil conservation

It is recommended that the following measures be encouraged through on-farm demonstrations:

- the construction of small retention bunds at regular intervals on the terraces to prevent water running along any unlevel terrace
- the establishment of double row grass lines on the edges of terraces, planted in such a way that clumps in one row are opposite spacings in the other row, to help prevent gaps developing in the lines
- more appropriate manual weeding practices
- the planting of grass in critical places to prevent gully formation
- the construction of trash lines and permanent grass lines that follow the contours on sloping food crop land

- strip weeding on sloping food crop land to help prevent erosion, the land being weeded across the slope, with alternate strips being weeded on each occasion.

7.4 Research recommendations

7.4.1 Input use in coffee production

The present recommendations concerning input use such as fertilizer application and chemical spraying against CBD are far from being adopted by small farmers. They are costly and require large amounts of labour. On-farm evaluation of the existing recommended technologies, plus the use of local material such as animal manure, is needed.

7.4.2 Weed control in coffee

At present, the recommendation for coffee is to grow it free from weeds to reduce competition for soil moisture and nutrients, as well as to lessen the risk of disease. However, rigorous and continuous clean weeding exposes the soil to erosion.

If the materials are available, weed suppression by mulching is more suitable. Alternatively, a less rigorous weeding would reduce soil erosion but still limit weed growth to an acceptable level. One method would be clean weeding on alternate terraces, while only slashing the ones in between.

Because weeding requires a lot of labour, some farmers use herbicides. It is usual to remove the dead weeds, but we recommend that they be left in place to help control erosion.

On-farm evaluation of weeding methods is proposed. The evaluation should take into account labour use, profitability, erosion control and coffee performance.

7.4.3 Maize varieties

For those farmers who cannot afford to buy new hybrid maize seed each year, a composite variety would be a better option. There is currently no suitable composite variety available; the Katumani composite used by some farmers was developed for drier areas. However, it is understood that there is a breeding programme to produce a suitable composite variety for this area; our findings confirm the need for this.

7.4.4 Intercropping of maize and beans

At present, it is normal practice to rotate maize and bean plots after every season, although an increasing number of farmers are adopting intercropping. Findings

at the National Horticultural Research Station have shown that there are yield advantages in mixed cropping. However, if only intercropping is practised rotation is no longer possible and there is a consequent risk of soil-borne pests and diseases. There is thus need for research to develop a cropping system for maize and beans which will exploit the benefits of intercropping without too great a cost in terms of pest and disease risk.

7.4.5 Fodder grasses in coffee

Grass lines on the edges of coffee terraces are discouraged because they act as a reservoir for coffee diseases and compete for nutrients. In our view this does not take into account the realities of the farming system. Many farmers grow grass on their coffee terraces; Napier grass (Pennisetum purpureum) and Giant Setaria (Setaria splendida) are the two most common species. However, Napier is too tall and hence tends to favour disease and Giant Setaria produces too little fodder. Other suitable species should be investigated, taking into account the possible adverse effects on coffee, fodder production potential and soil erosion control.

7.4.6 The use of crop by-products

Many different crops are grown in the region which have useful by-products, e.g. coffee, cotton, maize, beans and sunflower. More research effort should be made to identify the possibilities of using additional crop by-products for fodder such as coffee pulp and cotton-seed cake.

Dried waste coffee pulp, if mixed with molasses, could provide a good quality feed. The pulp is readily obtainable from the factories. Research would be necessary into the economics of using such a mixture, because the molasses would have to be transported from western Kenya. In view of the use of fungicides and pesticides on the coffee, monitoring of the residual effects of these chemicals on the pulp would be necessary. A study of the economics of using coffee pulp as fodder would also have to consider its alternative use as manure.

Finally, research is needed to develop appropriate methods for local farmers to use additives to improve the nutritional value of existing by-products, for example maize stalks and bean vines. The benefits of additives such as urea, NaCl and NaOH are well known and their use could help solve feed problems which limit livestock production.

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ICRA KENYA 1985

FORMAL SURVEY

Name of Respondent: _____ Interviewer: _____

Water Point: _____ Plot No.: _____ Main Coffee ☐

Marginal Coffee ☐

1) LAND

			SHAMBAS OWNED OR RENTED			
			MAIN SHAMBA	2	3	4
SIZE (ACRES)						
DISTANCE FROM MAIN SHAMBA KM						
OWNED LAND						
BOUGHT	COST					
	DATE					
INHERITED	DATE					
FARMED BY THIS H.H.?						
NOT FARMED BY THIS H.H.	NOT USED					
	RENTED OUT	CASH				
		KIND				
	LET FREE					
BORROWED LAND						
RENT PAID?	CASH					
	KIND					
BORROWED FREE						
PRESENT SIZE DUE TO SUB-DIVISION SINCE L.A.?						
WILL IT BE SUBDIVIDED WITHIN NEXT 10 YRS						
IF YES: IN WHAT WAY						
GRADIENT OF COFFEE AREA	FLAT					
	GENTLE					
	STEEP					

HOUSEHOLD ACREAGE BEING CONSIDERED IN THIS SURVEY

_____ ACRES.

2) FAMILY COMPOSITION

ADULTS		AGE	LIVING ON FARM AVAILABLE FOR WORK? FULL	PARTTIME	NO	LIVING AWAY
HEAD						
OTHER ADULTS 1						
2						
3						
4						
5						
6						
7						

E.g. Widows, Wives, Older sons and daughters, Daughters in Law, non.relatives

DEPENDENT CHILDREN/GRANDCHILDREN.

	NUMBER	AGE OF OLDEST	TOTAL EXPENSES P.A.
PRE-SCHOOL			
NURSERY SCHOOL			
PRIMARY SCHOOL			
SECONDARY SCHOOL			
FURTHER EDUCN.			

3) NON FARM INCOME

PERSON	TYPE OF ACTIVITY	INCOME	AMOUNT CONTRIBUTED

Any other Income/Remittances.

4) LABOUR

1. Do you employ permanent labour? ☐ Yes ☐ No

   If yes
   a. Number . . . . . .
   b. Months per year . . . . . .
   c. Wage rate . . . . . .
   d. Total cost of permanent labour per year . . . . . .

2. If you have the money, is it easy to find casual labour at the time you want it?

   ☐ Easy ☐ Not easy

3. Casual labour wage rate: . . . . . .

4. Who are the people who hire out their labour?

   ☐ Local unemployed or landless (within 5 km)
   ☐ Local small farmers
   ☐ Non local people
   ☐ Others: . . . . . .

5. Would you like to hire (more) labour?

   ☐ Yes ☐ No

6. If yes, why don't you hire (more) labour?

   ☐ No cash
   ☐ Not economic
   ☐ Difficult to find
   ☐ Other: . . . . . .

7. Number of days could not work due to sickness? . . . . . .

5) LAND AREAS

Indicate if areas for crops have changed since 1980:

	Increased	Decreased	Same	What is there now or what was there before?
Area of coffee				
Area of food (M+B)				
Area of fodder				
Area Fallow				

6) COFFEE

Total No. of Trees: . . . . . ; No. of Bearing Trees: . . . . . .

Varieties: ☐ SL 28; ☐ SL 34; ☐ K7.

FACTORY: ☐ GAKWEGORY ☐ KATHUGU

☐ GACHUNGU ☐ GITWA

☐ KASAGORE ☐ MIKUNDU

	OUTPUT (KG.)		TOTAL INCOME	
SEASON	1984	AV. YR	1984	AV YR.
1.Sept. 84-Febr. 85				
2.Mar. 84-Aug. 85				

1. Do you spray for CBD? ☐ Yes ☐ No

2. Do you think your spraying against CBD is effective? ☐ Yes

☐ No

If no, why? ☐ Require more frequent spraying

☐ Too much rain

☐ Chemical is not good

☐ Others . . . . . .

3. Do you apply fertilizer to your coffee? ☐ Yes ☐ No

If yes, do you thing you are applying enough fertilizer to your coffee? ☐ Yes ☐ No

If no, specify optimum amount: . . . . . .

4. Have you ever made use of waste coffee pulp from the factory?

☐ Yes ☐ No

If yes, what for? ☐ Manure ☐ Cattle feed

7) COFFEE OPERATIONS: First season: Sept-Febr. Second season: May-Aug.

OPERATIONS	TIMING	NO OF DAYS FOR THE WORK	NO. OF PEOPLE			INPUTS		REMARKS
			TOTAL	HIRED	IRIMA	TYPE	USUAL QTY.	
MANUAL WEEDING								
CHEMICAL WEEDING								
FERTILIZING								
MANURING PREP SPREADING								
PEST AND DISEASE CONTROL TYPE OF PID								
PICKING AND TRANSPORT TO FACTORY								
PRUNING								
REPAIR OF TERRACES AND DITCHES								
MULCHING								
FACTORY WORK								

8) PRUNING For individual coffee trees, when do you do the following types of pruning (tick box)

TYPE OF PRUNING	FREQUENCY/AGE OF TREE(After last major prune).						
	EVERY YEAR	2 YRS	3 YRS	4 YRS	5 YRS	>5 YRS	NEVER
1. Cut off the bottom laterals/suckers							
2. Cut off the inside laterals							
3. Cut the top of the stem							
4. Cut the stem down (major prune)							
Other							

9) SOIL CONSERVATION

1. Farmer perception of erosion problem

	Coffee area	Other area
Negligible		
Slight problem		
Major problem		

2. What measures have you taken to reduce the problem?

	Coffee area	Other area
Made terraces		
Repaired terraces		
Re paired all the terraces		
Planted grass lines		
Gap in grass lines		

3. Are these measures adequate? ☐ Yes ☐ No

4. If no; Why has further work not been carried out?

☐ No time/labour ☐ No cash ☐ Other: . . . . . .

10) MAJOR FOOD CROPS

	Maize	Beans	Maize + Beans
1. Variety			
2. Acreage			
1st season= march-august			
2nd season= sept.-febr.			

2. OUTPUT

2.1 Maize

SEASON	OUTPUT(BAG)		HOME COUP.(BAG)	SALES(BAG)	TIME OF GALES
	1984	Ave.yr.			
Mar.-Aug.					
Sept.-Febr.					

2.2 Beans

SEASON	OUTPUT(BAG) 1984	Ave.yr.	HOME COUP.(BAG)	SALES(BAG)	TIMES OF GALES
Mar.-Aug.					
Sept.-Febr.					

3. INPUTS (kg,bag)

Inputs		Total Quantity Used						
		Maize		Beans		Maize+Beans		
Items	Type	Mar-Aug	Sept-Feb	Mar-Aug	Sept-Feb	Mar-Aug	Sept-Feb	Total
Fertilizer	(1)							
	(2)							
Chemical	(1)							
	(2)							
Manure	(1)							
	(2)							
Storage								
Seeds								

4. LABOUR ☐ Maize ☐ Beans

Operations		Timing		Days to do job	No.of people	Of these	
		Mar-Aug	Sept-Feb			Hired	Irima
Land preparatn							
Sowing							
Weeding	1st						
	2nd						
Fertili zing	1st						
	2nd						
Manuring	1st						
	2nd						
Spray/ Dusting	1st						
	2nd						
Harvesting							
Threshing/ Winnow							

11) MAIZE AND BEANS

1. How do you normally grow maize and beans?

Pure stand ☐ Yes ☐ No Intercrops ☐ Yes ☐ No

2a. If NOT growing in PURE STAND; Why?

☐ Shortage of time/labour ☐ Shortage of land ☐ Less Risk

Others: . . . . . .

2b. If NOT INTERCROPPING; Why?

Reason: . . . . . .

3. Do you normally plant MAIZE in row or at random?

☐ Rows ☐ Random ☐ Both

Reasons for choice: . . . . . .

4. Do you normally plant BEANS in rows or at random?

☐ Rows ☐ Random ☐ Both

Reasons for choice: . . . . . .

5. Do you buy MAIZE seed every season. ☐ Yes ☐ No.

If No; (a) After how many season are new seeds bought . . . . . .

(b) Is a yield decline noticed in subsequent seasons?

☐ Yes ☐ No.

6. When was the last time you bought BEAN seeds?

(a) ☐ Never

(b) . . . . . .seasons ago; Sources . . . . . .

12) MINOR FOOD CROPS

CROPS	Area of No.stems/Trees	INPUTS + cost INCURRED	SALES Quantity Avenue
COTTON			
TOBACCO			
BANANAS			
ENGLISH POTATO			
SWEET POTATO			
PIGEON PEAS			
CASSAVA			
SORGHUM			
SUGAR CANE			
YAM			
TARO(Arrowroot)			
VEGETABLES			
OTHER			
PAWPAW			
CITRUS			
MANGOES			
MACADAMIA NUTS			
OTHER			

13) STORAGE, LABOUR SHORTAGE & TOOLS

1. Do you have enough Maize and Beans in store to last until the next harvest? ☐ Yes ☐ No

2. How often do you have to buy extra Maize or Beans at this time of the year?

time of the year?	Maize	Beans
Every year		
Often		
Seldom		
Never		

4. If you have a shortage of labour, which activities do you have to leave unfinished?

Activities	Time of the year

5. Which tools do you use?

	No. Owned	Hired	Cost
Panga			
Jembe			
Forked Jembe			
Sprayer			
Cart			
Wheel barrow			

14) LIVESTOCK

1. Inventory

Species		Bull	Draught	Cow Heifer	Calves	Goats ♂	Goats ♀	Poultry ♂	Poultry ♀	Pigs	Rabbit	Beehives (full)
No	Local											
	Grade											
Age												

2. What are the main reasons for keeping cattle?

Indicate Priority

- ☐ Draught Power
- ☐ Manure Production
- ☐ As a form of saving
- ☐ Milk Production
- ☐ Others

15) LIVESTOCK NUTRITION

1. Is there an area of grass (excluding Napier) for grazing on the shamba?

☐ Yes If yes, ☐ Natural grass

☐ No ☐ Planted:sown grass

2. Indicate the sources of feed given to livestock

Feed Source	CATTLE	GOAT	POULTRY
Napier=Muthara (Q/time)			
Kericho U S			
Concentrates(Q/time)			
Grazing Usual (U) Seldom(S)	U S	U S	
Maize stalk U or S	U S	U S	
Banana leaves U or S	U S	U S	
Bean/S.Potato Vines U or S	U S	U S	
Other= U or S	U S	U S	U S

3, Is there usually enough feed for the livestock throughout the year? ☐ Yes ☐ No

4. If not, when is there a shortage? . . . . . .

5. What height is Napier grass cut for feeding? . . . . . .

6. How is Napier grass grown?

☐ on terraces ☐ pure stand

area: . . . . . .

7. How often do you replant Napier grass?

. . . . . years

8. How do you provide water for your livestock?

☐ From tap on/near to shamba

☐ Carry from stream, Spring, etc.

☐ Other: . . . .

9. How much time does it take each day to look after livestock?

. . . . . hours

10. Calf rearing:

1. At what age are calves weaned? . . . . . .

2. At what age are calves sold? . . . . . .

17) REASONS FOR SALES + PURCHASES.

1. How do you decide when to sell Cattle and Goats.

	Cattle	Goats
Cash Need	☐	☐
Price is High	☐	☐
Age of Animal	☐	☐
Shortage of Feed	☐	☐

Other= . . . . . .

2. How do you decide when to Buy Cattle

	Cattle
Surplus Cash	☐
Price is low	☐
Replacement	☐
Ceremonies/Social	☐

Other: . . . . . .

18) LIVESTOCK PRODUCTION

1. How much milk does each cow produce?

	Gradi Cow 1	Local Cow 2	Cow 3
Beginning of Lactation (No. Bottles/day)			
End of lactation (No. Bottles/day)			

2. If Milk Goats were available would you keep them instead of cows? ☐ Yes ☐ No

3. Reproduction Parameters for Cattle.

	Usual calving Interval	Calving to First Heat	Usual No. times A.I. necessary for conception	Time between heat detection and A.I.
Time	months	weeks	times	hours

4. How is manure kept?

☐ Exposed to the Rain + sun.

☐ Under cover.

5. Purchased Inputs

	Average Year	
Item	Quantity	Total cost
A.I.		
Dipping		
Medication		
Concentrates		
Purchased Fodder		
Other		

6. Pathology

	No. Deaths		Reason for
	1983	1984	Death
CATTLE			
GOATS			
POULTRY			

19) LIVESTOCK PRODUCTS

ITEM	No. Consumed or given away	SALES				Month of Sale	PURCHASES				Month of Purchase	No. received or Births
		No.	Q	Revenue			No.	Q	Cost			
		1984	Av.Yr	1984	Av.Yr.		1984	Av.Yr	1984	Av.Yr.		
CATTLE												
GOATS												
CHICKENS												
RABBITS												
COWS MILK/DAY												
GOAT MILK/DAY												
EGGS/WEEK												
MONEY												
HIDES/SKINS												

20) CASH

1. What time of year are you most short of cash?

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

2. If you are ever short of cash, how do you overcome this difficulty?

☐ Delay Purchases ☐ Off farm income sources

☐ Sell Foodcrops ☐ Obtain credit/loans

☐ Sell Livestock ☐ Other: . . . . . .

3. How many times have you borrowed money or used credit in the last five years? . . . . . times

4. If you are able to borrow money, what are your priority expenditures? (indicate priority 1= highest)

☐ Food ☐ House Building/Repairs

☐ Clothes ☐ Household necessities

☐ School Fees ☐ Others= . . . . . .

5. Cash Expenditures.

Please indicate approximate amounts spent on the following items during a normal year:

NB. If amounts cannot be obtained, indicate relative importance of each item.

	Item	Amount	
School Fees			+ From other questions.
Farm Inputs			+
Purchased Food			
Clothing			
Harambee			
Social Activities			
Housing			

21) EXTENSION

		Coffee Society Co-op	MoA Extension services/Contact Farmer	Womens Organisation
1.	Membership/Contact with:			
2.	Visits to:			
3.	Ever attended Training Courses or Demonstration Organised by these:			

4. Have any of these organisations given you any advice on the following subjects? Source:

- ☐ Spraying
- ☐ Pruning Coffee
- ☐ Maintaining Terraces
- ☐ Planting Grass Strips
- ☐ Mulching
- ☐ Fertilizer for Coffee
- ☐ Fertilizer for Maize
- ☐ Fertilizer for Beans
- ☐ Livestock Feeding
- ☐ Livestock reproduction
- ☐ Calf rearing
- ☐ Others: . . . . . .

22) GENERAL OBSERVATIONS:

Erosion: . . . . . .

Grass lines: . . . . . .

State of Farm: . . . . . .

APPENDIX B

CASH INCOME AND EXPENDITURE BY ITEM

CASH EXPENDITURES

	Amount (Ksh)		% of Total	
Expenditure Item	Main	Marginal	Main	Marginal
CoffeeInputs	978	1,057	8	9
Maize/Beans/ Other crop Inputs	494	748	4	6
Livestock Inputs	346	570	3	5
Livestock Purchases	407	398	4	3
Rent	25	47	(-)[1]	(-)
Permanent labour	158	774	1	6
Casual labour	1,228	2,187	10	18
Tool Hire	116	83	1	1
Education	2,705	1,518	23	13
Food	2,225	1,926	19	16
Clothing	1,871	1,595	16	13
Harambee	290	268	3	2
Social activities	178	285	2	2
Housing/Other	749	547	6	5
Total	11,770	12,003	100	100

1) (-) less than 1

Source: ICRA survey 1985

CASH INCOMES

	Ksh		% of Total income	
Income Source	Main	Marginal	Main	Marginal
Non Farm Activities	3,493	3,469	22	19
Coffee	9,935	10,379	64	58
Maize	373	1,166	2	7
Beans	327	1,102	2	6
Minor Crops	119	642	1	3
Livestock	392	529	3	3
Livestock Products	999	691	6	4
Total	15,638	17,978	100	100

Source: ICRA survey 1985

APPENDIX C

LABOUR INPUT BY ENTERPRISE (MAN DAYS)

Enterprise	J	F	M	A	M	J	J	A	S	O	N	D	Year
A. Main Coffee Zone													
- Coffee (0.47 ha)	29.1	19.6	22.6	60.3	76.0	77.5	36.7	44.2	38.1	40.2	61.1	68.6	574.0
- Coffee factory	2.3	2.3	2.5	3.1	3.2	2.9	2.3	1.5	2.2	2.2	2.7	2.5	29.7
- Maize (0.33 ha)	6.2	17.3	18.0	10.2	7.1	4.0	5.8	14.6	11.6	9.4	11.3	7.0	122.5
- Maize/beans [1] (0.29 ha)	8.2	12.8	13.6	8.9	5.1	4.9	6.6	10.9	9.3	7.7	9.8	5.4	103.2
- Beans (0.29 ha)	11.0	10.4	11.3	8.8	4.0	6.3	8.1	8.9	8.4	7.0	9.6	4.6	98.4
- Livestock [2]	9.3	8.4	9.3	9.0	9.3	9.0	9.3	9.3	9.0	9.3	9.0	9.3	109.5
Total [3]	66.1	70.8	77.3	100.3	104.7	104.6	68.8	89.4	78.6	75.8	103.5	97.4	1037.3
Total available [4]	88.0	79.5	88.0	99.6	88.0	85.2	88.0	102.9	85.2	88.0	85.2	102.9	1080.5
B. Marginal Coffee Zone													
- Coffee (0.43 ha)	23.7	7.1	16.1	51.7	58.8	65.9	22.5	24.6	24.6	42.1	48.9	47.0	433.0
- Coffee factory	2.7	2.8	2.9	3.2	3.5	3.2	2.4	2.2	2.0	3.3	3.3	3.3	34.8
- Maize (0.46 ha)	10.7	29.6	21.5	16.1	8.6	4.4	7.2	29.5	17.8	11.2	14.5	6.7	177.8
- Maize/beans [1] (0.35 ha)	11.8	18.8	15.9	13.2	6.8	3.9	9.4	16.5	12.4	10.0	12.3	4.8	135.8
- Beans (0.23 ha)	10.2	9.9	10.1	9.3	4.6	2.9	8.7	6.8	7.4	7.6	8.9	2.9	89.3
- Livestock [2]	9.3	8.4	9.3	9.0	9.3	9.0	9.3	9.3	9.0	9.3	9.0	9.3	109.5
Total [3]	68.4	76.6	75.8	102.5	91.6	89.3	59.5	88.9	73.2	83.5	96.9	74.0	980.2
Total available [4]	85.4	77.2	85.4	94.2	85.4	82.7	85.4	97.4	82.7	85.4	82.7	97.4	1041.3

1) The average of labour input for maize and beans.
2) Assumed to be 0.3 mandays.
3) Total labour input excl. domestic activities and 'other crops'.
4) Includes adult and child labour contributions, calculations presented in Appendix E.
Source: ICRA survey 1985

APPENDIX D

COMPUTATIONS OF LABOUR INPUT REQUIREMENTS BY ACTIVITY BY CROP

Coffee : Labour input in mandays per ha for the various operations.

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Year	%
A. Main Coffee Zone														
- Manual weeding	7.8	3.9	11.7	41.0	46.8	37.0	13.6	7.8	15.6	21.5	42.9	33.2	282.8	23.1
- Chemical weeding	-	-	0.2	1.6	1.1	-	-	0.2	-	0.5	1.1	0.5	5.2	0.4
- Fertilizing	-	0.4	3.2	5.0	1.8	0.7	0.7	0.4	0.7	5.3	3.2	0.7	22.1	1.8
- Manuring	3.6	1.8	3.6	1.8	1.8	3.6	7.2	32.4	34.3	9.0	1.8	3.6	104.5	8.6
- Spraying	1.7	1.5	2.7	2.2	3.2	2.9	1.2	1.2	2.7	1.9	1.7	2.4	25.3	2.1
- Picking + transp.	9.4	5.6	15.0	60.2	62.1	37.6	11.3	1.9	16.9	45.1	63.9	48.9	377.9	30.8
- Pruning	21.0	7.0	2.3	14.2	32.6	49.0	16.3	7.0	4.7	2.3	9.3	44.3	209.8	17.2
- Repair terraces	12.4	9.3	6.2	3.1	12.4	27.9	18.6	31.0	6.2	-	3.1	12.4	142.6	11.7
- Mulching	6.1	12.2	3.1	-	-	6.1	9.2	12.2	-	-	3.1	-	52.0	4.3
Total mandays/ha	62.0	41.7	48.0	128.4	161.8	164.8	78.1	94.1	81.1	85.6	130.1	146.0	1222.2	100.0
B. Marginal Coffee Zone														
- Manual weeding	20.3	5.8	11.6	33.4	21.8	26.1	4.4	2.9	5.8	17.4	30.5	21.8	201.8	20.1
- Chemical weeding	-	-	0.2	0.3	0.3	-	-	-	-	0.3	0.2	0.1	1.4	0.1
- Fertilizing	0.6	-	1.8	3.4	0.6	0.9	0.3	0.3	0.9	3.4	1.8	0.6	14.6	1.4
- Manuring	2.1	3.1	1.0	2.1	3.1	5.1	6.2	15.4	12.4	4.1	3.1	1.0	58.7	5.8
- Spraying	3.7	1.8	3.7	2.6	2.2	4.4	4.8	3.0	3.3	3.7	2.6	4.4	40.2	4.0
- Picking + transp.	12.1	-	9.7	75.0	89.5	58.0	4.8	-	14.5	53.2	70.1	60.5	447.4	44.5
- Pruning	13.9	1.7	1.7	3.5	15.6	39.9	17.3	10.4	5.2	12.1	1.7	20.8	143.8	14.3
- Repair terraces	-	1.8	5.5	-	3.7	16.7	14.6	18.3	12.8	3.7	3.7	-	80.6	8.0
- Mulching	2.3	2.3	2.3	-	-	2.3	-	6.9	2.3	-	-	-	18.4	1.8
Total mandays/ha	55.0	16.5	37.5	120.3	136.8	153.2	52.4	57.2	57.2	97.9	113.7	109.2	1006.9	100.0

Source: ICRA survey 1985

Maize: Labour input in mandays per ha for the various operations.

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Year	
A. Main Coffee Zone														
- Land preparation	10.3	25.0	20.6	-	-	-	4.4	22.1	23.5	4.4	1.5	-	111.8	30.1
- Sowing	-	1.6	20.5	1.6	-	-	-	0.5	7.0	14.0	3.2	-	48.4	13.0
- Weeding	2.3	0.8	1.5	25.1	18.2	9.9	0.8	-	-	6.8	24.3	19.0	108.7	29.3
- Fertilizing	-	-	1.1	0.2	-	-	-	0.2	0.4	0.7	0.1	-	2.7	0.7
- Manuring	-	0.8	2.3	-	-	-	-	0.5	1.0	1.8	-	-	6.5	1.8
- Spraying/dusting	-	-	0.8	4.1	3.3	0.5	-	-	-	0.8	5.2	2.2	16.9	4.6
- Harvesting/thresh	6.2	24.1	7.8	-	-	1.6	12.4	21.0	3.1	-	-	-	76.2	20.5
Total mandays/ha	18.8	52.3	54.6	31.0	21.5	12.0	17.6	44.3	35.0	28.5	34.3	21.2	371.2	100.0
B. Marginal Coffee Zone														
- Land preparation	11.0	27.1	15.2	0.8	-	-	2.5	25.4	25.4	2.5	-	-	109.9	28.4
- Sowing	-	1.8	14.9	4.0	-	-	-	1.3	5.7	11.4	1.8	-	40.9	10.6
- Weeding	5.1	-	-	24.2	15.4	9.5	-	-	-	7.3	24.2	13.2	98.9	25.6
- Fertilizing	-	-	0.2	1.1	-	-	-	-	0.4	0.8	0.4	-	2.9	0.7
- Manuring	-	0.6	0.9	0.3	-	-	-	0.3	1.1	0.3	-	-	3.5	0.9
- Spraying/dusting	-	-	-	4.6	3.4	-	-	-	-	2.0	5.2	1.4	16.6	4.3
- Harvesting/threshing	7.2	34.8	15.6	-	-	-	13.2	37.2	6.0	-	-	-	114.0	29.5
Total mandays/ha	23.3	64.3	46.8	35.0	18.8	9.5	15.7	64.2	38.6	24.3	31.6	14.6	386.7	100.0

Source: ICRA survey 1985

Beans: Labour input in mandays per ha for the various operations.

Operation	J	F	M	A	M	J	J	A	S	O	N	D	Year	
A. Main Coffee Zone														
- Land preparation	10.8	21.6	12.8	-	-	-	2.7	21.6	19.6	3.4	0.7	-	93.2	27.4
- Sowing	-	1.2	22.6	1.8	-	-	-	-	8.6	14.7	3.7	-	52.6	15.5
- Weeding	1.8	-	1.7	28.7	13.9	9.6	-	-	0.9	6.2	28.7	15.7	107.2	31.5
- Harvesting	25.3	13.1	2.0	-	-	12.1	25.3	9.1	-	-	-	-	86.9	25.6
Total mandays/ha	37.9	35.9	39.1	30.5	13.9	21.7	28.0	30.7	29.1	24.3	33.1	15.7	340.0	100.0
B. Marginal Coffee Zone														
- Land preparation	12.2	26.3	16.0	-	-	-	3.8	25.4	24.4	4.7	-	-	112.8	29.0
- Sowing	-	2.9	20.9	5.8	-	-	-	-	7.9	18.0	2.9	-	58.4	15.0
- Weeding	-	-	3.8	34.6	20.1	5.1	-	-	-	10.2	35.8	12.8	122.4	31.5
- Harvesting	32.1	13.9	3.2	-	-	7.5	34.2	4.3	-	-	-	-	95.2	24.5
Total mandays/ha	44.3	43.1	43.9	40.4	20.1	12.6	38.0	29.7	32.3	32.9	38.7	12.8	388.8	100.0

Source: ICRA survey 1985

APPENDIX E

FAMILY LABOUR AVAILABILITY (MANDAYS)

Persons/Household	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
A. Main coffee zone													
Adults:													
Full time = 3	74.4	67.2	74.4	72	74.4	72	74.4	74.4	72	74.4	72	74.4	876
Part time = 0.6	3.7	3.4	3.7	3.6	3.7	3.6	3.7	3.7	3.6	3.7	3.6	3.7	43.7
	78.1	70.6	78.1	75.6	78.1	75.6	78.1	78.1	75.6	78.1	75.6	78.1	
Children:													
Primary Sch.= 3.4	8.4	7.6	8.4	20.4	8.4	8.2	8.4	21.1	8.2	8.4	8.2	21.1	136.8
Secondary Sch.= 0.3	1.5	1.3	1.5	3.6	1.5	1.5	1.5	3.7	1.4	1.5	1.4	3.7	24.0
Total	88	79.5	88	99.6	88	85.2	88	102.9	85.2	88	85.2	102.9	1080.5
B. Marginal coffee zone													
Adults:													
Full time = 3	74.4	67.2	74.4	72	74.4	72	74.4	74.4	72	74.4	72	74.4	876
Part time = 0.5	3.1	2.8	3.1	3.0	3.1	3.0	3.1	3.1	3.0	3.1	3.0	3.1	36.5
	77.5	70.0	77.5	75.0	77.5	75.0	77.5	77.5	75.0	77.5	75.0	77.5	
Children:													
Primary Sch.= 2.8	6.9	6.3	6.9	16.8	6.9	6.7	6.9	17.4	6.7	6.9	6.7	17.4	112.5
Secondary Sch.= 0.2	1.0	0.9	1.0	2.4	1.0	1.0	1.0	2.5	1.0	1.0	1.0	2.5	16.3
Total	85.4	77.2	85.4	94.2	85.4	82.7	85.4	97.4	82.7	85.4	82.7	97.4	1041.3

Continued .... APPENDIX E

N.B. : Estimates of the available family labour are based on the following assumptions:

1) Only 80% of the days in each month are considered as effective working days.
2) Part time labour is considered to be only 25% available.
3) Primary school children are 10% available during the school days and 25% available during the holidays.
4) Secondary school children are 20% available during school days and 50% available during the holidays.

Source: ICRA survey 1985

APPENDIX F

AVERAGE GROSS MARGIN FOR 1 HECTARE OF COFFEE

Table F shows the average gross margins for 1 ha of coffee in the main and marginal coffee zones. They are calculated by deducting the variable costs from the total value of the enterprise output, and thus provide an indication of the level of cash income from coffee production.

The gross margins are based on a smaller sample of farmers, for which more accurate output figures were obtained from one of the coffee societies. The variable costs are averages based on the quantities recorded (in the formal survey)for this smaller sample. The exception is the casual labour data whichwere based on the whole sample because of the unrepresentative nature of the data concerning this input in the smaller sample.

As has been noted, the cherry yield per hectare is higher in the marginal zone. The output data used here confirm this difference and indicate that it is in the order of 7%. However the value of the output per hectare is not so different in each zone. This is because the average price received for cherry is over 5% higher in the main coffee zone.

The difference in the price received is due to the difference in the quality of parchment produced by the factories. It is likely that the higher price received by factories serving households predominantly from the main zone is mainly due to the better quality cherry produced in that zone.

It is interesting to note the difference in the components of the variable costs in each zone. In the main coffee zone more cash is spent on fertilizer and less on pesticides and fungicides. In the marginal zone the converse is true. In view of the fact that CBD is generally more severe in the main coffee zone and that yields there are lower, it would seem likely that this is one area of the coffee enterprise in which increased investment, if possible, would be worthwhile.

Another difference between the two zones is the use of herbicides, which is much lower in the marginal coffee zone. The reason for this is not clear.

It should be remembered however that the present pattern of input use is a result of the various agricultural prices which affect the enterprise. These change over the years. For example, Appendix G shows that since 1979 coffee prices have risen by 44% whereas prices of inputs such as CAN and copper have risen by 59% and 93% respectively. Thus the use of these inputs is less profitable than it was in 1979.

Table F shows that the average gross margins per hectare are similar for both zones (about Ksh. 13,800). However, when expressed in per-man-day terms the gross margin is slightly higher in the marginal coffee zone. This is because households use on average 18% less labour per hectare in the main coffee zone.

However, the gross margins per man day of between 11 and 14 shillings per hectare seem to be reasonable estimates bearing in mind the local wage rates for casual labour which vary from 12 to 15 shillings per day. (The average in both zones is Ksh.12.8). This means that with the present returns from coffee it would not pay the farmer to employ additional casual labour on the coffee enterprise and explains why many reported that they are unable to afford casual labour. This finding again points to the need to increase the efficiency with which current inputs are used.

TABLE F

AVERAGE GROSS MARGIN FOR 1 HA COFFEE IN THE MAIN AND MARGINAL COFFEE ZONES

Description	Main coffee zone	Marginal coffee zone
No. Planted trees	617	683
Planted Area	0.463 ha	0.512 ha
% Bearing trees	86.27 %	88.55 %
Price/kg	Ksh. 3.97	Ksh. 3.77

	Quantity	Price/Unit	Ksh.	Quantity	Price/Unit	Ksh.
Output [1]						
1 Aug '83 - 31 July '84	4430.4 kg	3.97	17,588.60	4.772.6	3.77	17,992.7
Variable costs						
Gramoxone	6.00 /l	97.1 /l	582.60	1.73	97.10	169.98
Fertilizer - CAN	228.30 kg	3.02/kg	689.24	181.73	3.02	548.64
DAP	23.75 kg	4.84/kg	114.91	14.81	4.84	71.68
Copper	11.74 kg	29.0/kg	340.46	30.29	29.00	878.41
Sumithion	4.67/l	71.0/l	331.57	9.21	71.00	653.91
Tool Hire	-	-	134.37	-	-	174.40
Casual Labour [2]	-	-	1,509.20	-	-	1,747.00
Total variable costs			3,702.35			4,242.02
Gross margin			13,886.25			13,750.68
Total labour input [3]	1222 mandays			1007 mandays		
Gross margin per manday	Ksh. 11.36			Ksh. 13.65		

1) Based on a small sample from the New Kyeni Farmers Cooperative Society

2) Based on entire survey sample

3) See Appendix D

Source: ICRA survey 1985

APPENDIX G

PRICE TRENDS OF MAJOR COMMODITIES (KSH.)

Year	79	80	81	82	83	84	85
Coffee Actual[1)]	2.63	3.03	2.16	2.08	4.16	3.79	-
(1 kg) Index	126	146	104	100	200	182	-
Maize Actual	-	-	-	1.69	2.11	4.20	-
(1 kg) Index	-	-	-	100	125	249	-
Beans Actual	-	-	-	3.06	4.02	10.00	-
(1 kg) Index	-	-	-	100	131	327	-
CAN Actual	95.00	115.00	130.85	149.65	155.00	150.95	183.50
(50 kg) Index	63	77	87	100	104	101	123
Copper[2)] Actual	15.00	-	19.40	19.40	28.00	29.00	32.00
(1 kg) Index	77	-	100	100	144	149	165
Leybacid[3)] Actual	40.20	60.25	33.50	67.00	97.10	101.00	-
(1 l) Index	60	90	50	100	145	151	-
Sumithion[3)] Actual	-	42.60	42.60	51.15	72.40	68.05	71.00
(1 l) Index	-	83	83	100	141	133	139

1) Price paid to farmer by factory for 1 kg cherry
2) Fungicide
3) Insecticides

Source: ICRA survey 1985