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LAND EVALUATION AND FARM SURVEYS IN THE CHUKA AREA

R.A. Schipper

Training Project in Pedology

Agricultural University of Wageningen - the Netherlands

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Table of contents

1. Introduction

The Chuka project is the third phase of the Training Project in Pedology (TPIP) of the University of Wageningen, the Netherlands, in Kenya. Previous phases were the:

The Kisii-project (1972-1978: 6 years)
The Kilifi-project (1979-1982: 3 year)

All activities of the TPIP, are carried out in close consultation with the cooperating agency, the Kenya Soil Survey (KSS) which is part of the National Agricultural Laboratories (NAL) of the ministry of Agriculture at Nairobi.

The objectives of the project are two fold

a) to produce a reconnaissance soil map (scale 1:100.000) of the 1:50.000 map sheets of Chuka and Ishiara, together with a detailed report and a land evaluation to assess the suitability of a number of land uses
b) to train post-graduate students in soil science, agronomy, vegetation and agricultural economics of the University of Wageningen. Training consists of graduate-student work (six month period) as well as research work for MSc thesis.

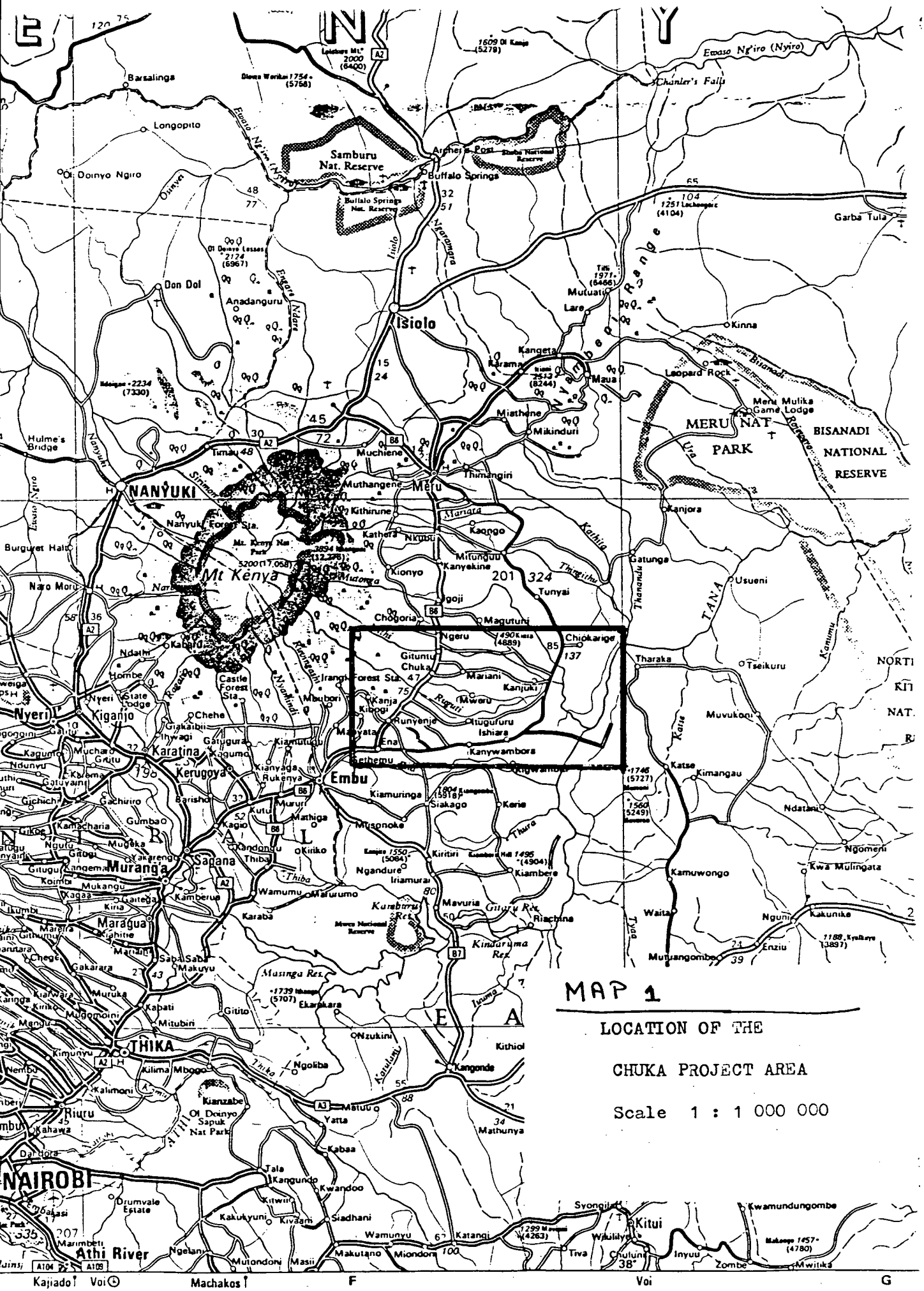
The project is lead by the principal (Dr. T. de Meester) and the team leader (Dr. D. Legger), both staff members of the Department of Soil Science of the University of Wageningen. Furthermore the project is assisted by staff members of the Departments of Agronomy, Taxonomy and Development Economics of this University through regular visits to supervise the work of the students. The present report deals with the economic and agronomic aspects of landevaluation. After a description of the area in chapter 2, it proposes a form to describe land utilization types in chapter 3, and annex 5. In chapter 4 the data to be collected to describe the land utilization types is outlined. Part of this data collection consists of a farm survey. Aim, scope and methods are described. The survey will be the responsibility of Jan Helder and Geert van der Donk, graduate students of the University of Wageningen in respectively development economics and agronomy, for whom a workprogramma is included.

2. The Area

The Chuka and Ishiara 1:50.000 map sheets forms part of the Embu, Meru and Kitui districts of Kenya. The sheets are located South-East of Mount Kenya, just South of the Equator (latitudes 0 15'S and 0 30'S, longitudes 37 30'E and 38 00'E), at a distance of about 150 km North of Nairobi.
See map 1. The area measures about 56 km from West to East and about 28 km from North to South. The size of the area is 154321 ha.

2.1 Agro-ecology

Because of the differences in altitude and rainfall the area is ecologically very divers. Altitude ranges from 2300 meters in the North-West to 600 meters in the South-East, while rainfall ranges from about 2000 mm in the North-West to 500 mm in the South-East. The area is divided in a number of agro-ecological zones, mainly according to the temperature and the rainfall/eva-transporation relation. The zones are characterized by (a) crop(s) which is/are most suitable for this zone from an ecologicl point of view, which however presently may not be the most important crop. The A-E zones are shown on map 2 in Annex 4 and listed in table 1. For purposes of the land evaluation the zones are grouped in order to a) simplify matters and b) to consider only the most important crops in each zone for evaluation. Furthermore the rough correspondence to the former Kenya System of ecological regions, as presented for Meru in Bernard (1971), is given. For details on the agro-ecological regions one is referred to Jeatzold and Schmidt (1983).



MAP 1

LOCATION OF THE

CHUKA PROJECT AREA

Scale 1 : 1 000 000

MAP 1

RS/d1 -4A-

Table 1. Agro-ecological zones

Agro-ecological group	Agro-ecological zones according to Jeatzold + Schmidt (1983) symbol	name	character-istic crop(s)	Ecological Regions as found in Bernard (1971) (approximate)
A (forest)	LH 0	Lower Higland, per humid	forest	moist-montane forest
B (dairy-tea-coffee)	LH 1	Lower Higland, humid	tea-dairy	Kikuyu grass zone (upland)
	UM 1	Upper Midland, humid	coffee-tea	
C (coffee-sunflower-maize)	UM 2	Upper Midland, sub humid	main coffee	
	UM 3	Upper Midland, semi humid	marginal coffee	Star grass zone (homestead)
	UM 4	Upper midland, transitional	sunflower-maize	
D (cotton)	LM 3	Lower Midland, semi humid	cotton	Grass woodland zone
	LM 4	Lower Midland, transitional	marginal cotton	Acacia-Combretum zone (seed crop)
E (livestock-millet)	LM 5	Lower Midland, semi-arid	livestock-millet	Acacia-Commiphora zone (lowland)
	IL 5	Inner Lowland, semi-arid	livestock-millet	

2.2 Population

The area is densely populated. One can estimate the population in 1979 between 240,000 and 270,000 persons. This estimate is based on the census and the position of the locations and sub-locations in the

Embu, Meru and Kitui districts on the map. Given the size of the area of 1,543 km^2 this amounts to a density of 155 to 175 persons per km^2. With an assumed population growth of 4.0% per year the 1985 population density will be between 196 and 221. These however are average densities for the area. Settlement is very much concentrated in the ecologically more favourable zones, mainly zone C ('star' grass zone/'homestead' zone), roughly along the Embu-Meru road, but also in zone B ('Kikuyu' grass zone). Population density ranges here from 300-700 persons per km^2. In the lower and dryer zone E population density can be as low as 30 persons per km^2.

Administratively the area belongs to three districts, Embu, Meru and Kitui. The area is subdivided in locations and sub-locations. In annex 4 a list of the locations and sub-locations in the area is given together with some details on population and area.

The districts also indicate the major tribes Embu, Meru and the Akamba (in Kitui). In the highland parts of Embu and Meru (roughly agro-ecological groups B, C and partly D) sub-tribes are living along the interfluves between the main rivers. These interfluves are equivalent with one or two of the present locations. For example in Meru one can distinguish the following tribes with their locations:

tribe	location
Mwimbi	Chogoria plus Kiera
Muthambi	Muthambi
Chuka	Karingani plus Magumoni

In the lowland parts of Embu and Meru, roughly equivalent with the Agro-ecological groups E and partly D, other (sub) tribes are living. In Embu in the project area a number of Mbeti people are living (Evurore location, Nguti, Evurore, Kamarandi and Thambu sublocations) while in Meru Tharaka people are living (South Tharaka location, Chiokariga and Kamanyaki sub-locations).

2.3 Farming

- Classification by agro ecological (A-E) groups and some background.

Traditionally farming could be seperated in a Highland System and a Lowland System. In the Highland System (A-E group, B, C and D) people had their homes in A-E group C - the Homestead zone by Bernard (1971) - more or less along the road from Embu to Meru. Each household used land in the 'uplands', A-E group B, mainly for grazing; in the homestead zone itself, A-E group C, around the house, mainly for rootcrops (yam, taro, sweet potatoes, cassave), bananas and a few other crops (pumpkin, gourd, sugarcake, tobacco, miraa); and in the seed crop zone, A-E group D, mainly for staples (millets, sorghum, maize) and pulses (pigeon peas, cow peas, hyacinth bean, haricot bean). Although homes were sedementairy, fields were shifted from time to time so land could have its fallow. Land belonged to the tribes, but allocated on a permanent basis to individual clans/households for use. The highland system made use of three different ecological zones which made it stable, divers and fairly free of risks.
With the increasing population and the advent of the cash crops tea and coffee households became more dependent on a single ecological zone. This process started in the fifties. In the sixties a programm of land consolidation was executed. Each household became owner of a piece of land in either of the ecological zones on which it had to grow food crops as well as cash crops. Nowadays, maize and beans, which is the most important food crop, is grown in A-E group B, C and D. Cash crops are grown more or less according to the A-E groups (B: tea, dairy, coffee; C: coffee; D: cotton) although some overlap does occur.

The Lowland System, confined to the A-E groups D and E, in contrast to the Highland System was more mobile. Agriculture was mainly shifting, and ecological zones were not distinguished. Local differences, caused by rivers, depressions, soil fertility etc., were more important. Depending on the fertility fields were used between 2-3 and 5-7 seasons. Between cultivation periods of fallow of 10-20 years were normal.

Because of the very different climatological conditions of the

lowlands from the highlands, especially the high temperature and the low and unreliable rainfall the crops grown are very different. Most important crops were millets, sorghum, pigeon peas, cowpeas, black gram, green gram, haricot beans, pumpkin, gourd, castor, and tobacco. Furthermore livestock, cattle as well as sheep and goats, were (and are) an important part of the farming system. The most important staple were millets. Because of the fluctuations of the climate from year to year, life was much more insecure and years of famine were quite normal.

Although farming in the Highlands is quite different from farming in the Lowlands there are also a number of similarities, mainly because of a common cultural heritage. Division of labour, settlement forms, tools and techniques reflect that. The factors present in the Highlands related to the profound changes in the last 30-40 years were not felt in the Lowlands except for the population increase. Cash crops like tea and coffee were absent, cotton and tobacco had much less influence. Land consolidation hardly took place. More important was the introduction of maize as a staple. Because of the ecological conditions maize, even the Katumani variety, is a risky enterprise. Population growth, of course, had its consequences. Shorter cycles of cultivation and fallow degrades the natural fertility and overgrazing causes erosion.

Animals form an important part of the farming systems, but animals were not very integrated with farming, neither in the highlands nor in the lowlands. "They were grazed away from the homestead, no special pastures were prepared for them and their manure was hardly used", as Bernard (1971, p. 68) puts it. Also cattle is generally not used for soil preparation although this does occur. "Nevertheless, because of their social significance, it would be erroneous to ignore their importance to Meru life and land". He continues "Meru cattle, by far the most desired animals, were hardy beasts capable of withstanding serious water shortages, poor forage, and a considerably number of debilitating diseases". Sheep and goats together outnumber cattle in the area, especially in the lowlands. As said before animals have a great social importance. Cattle is well looked after and in the past wealth of a household was generally measured in 'cattle units'.

Animals are also held as reserve when in need for cash or, in case of crop failures, to buy food. The importance of cattle can be observed by the number of cattle dips. A relatively new development is (milk) cattle held under 'zero' grazing especially in the A-E groups B and C.

- Aggregated land use

On the basis of the District Development Plans for Embu and Meru, 1984-1988 the agricultural land use in 1982 in the area can be estimated as follows:

- staples	44%, of which	maize	78%
		millet/sorghum	16%
		wheat	6%
- pulsus	23%, of which	beans	89%
		pigeon peas	5%
		gram	4%
		cow peas	2%
- tubers	4%, of which	potatoes	88%
		sweet potatoes	10%
		cassave	2%
- annual cash crops	7%, of which	cotton	87%
		sunflower	12%
		tobacco	1%
- permanent crops	22%, of which	coffee	62%
	- for cash	tea	24%
		pyrethrum	1%
	- for food	bananas	15%
		mangoes	1%

As can be observed maize and beans, often intercropped are the most important food crops, while coffee, tea and cotton are the most important cash crops. Of course food crops can and are also sold but

in general only after subsistence is met.

Above land use on the basis of district statistics is in general confirmed by data from the Small Farm Survey of Jeatzold and Schmidt (1983). See also TPIP, Working Plan and Land Evaluation, Chuka Project, annex 2. From these data one can also observe the changes in cropping patterns if one moves from one A-E-group to another. See Table 2.

- Agro-ecological group, farmsizes and cropping patterns.

Farmsizes and cropping patterns are influenced by A-E group. This can be seen from tabel 2. In general it confirms the remarks in the section on 'classification by agro-ecological (A-E) groups and some background'. In all A-E groups (at least in B, C and D) maize and beans are the most important food crops. For cash crops in A-E group B tea and coffee are prominent, in C coffee and in D cotton and some sunflower. Moving from B to D farm sizes increase for the three farmsize classes. This obviously is very much related to population densities. Data are estimated from the Small Farmer Survey of Jeatzold and Schmidt (1983).

For A-E group B data presented are an average of surveys no. 41 and 44, for group C an average of surveys no. 42 and 46, and for group B an average of suveys no. 43 and 45.

For A-E group E there does not exist comparable information. However, in 1984 a group of ICRA students surveyed Tharaka division in the Meru district, of which the Chiokariga sublocation (South-Tharaka location) is in the North-Eastern part of the Ishiara mapsheet (Abella et al. 1984). Farming is much more of a shifting type. Out of 96 farmers interviewed 30% were shifting cultivators, 53% did a form of bush-fallow farming and 17% were occupied with permanent agriculture.

Farms in Chiokariga had an average size of about six hectares, however those farms with permanent agriculture only about two hectares. On the average the cultivated area per farm was 1.6 ha of which 1.3 ha for food crops and 0.3 ha for cash crops. Although maize is still an important food crop (grown by 41% of the farmers occupying 9% of the cultivated area), bulrush millet and sorghum are

the main staples (grown by more than 90% of the farmers), while green grams and cowpeas are the most important pulses (grown by 70-75% of the farmers). Millet, sorghum, green grams and cowpeas occupy 76% of the cultivated area. Because of the climate millet and sorghum have advantages over maize. Growing in a mixture millet and sorghum reduces risk.

As Abella et al. (1984), put it "In a year of high rainfall, when waterlogging is a problem, sorghum can still yield well; it can also survive drought periods within the rainy season. In years of low rainfall millet can still provide adequate yields so long as the rain is well distributed throughout the season".

About 50% of the farmers surveyed by the ICRA group grew a cash crop. Cotton was grown by 40% of the farmers, sunflower by 23%. Cash crops like cotton and sunflower occupy about 15% of the cultivated area. In the Chiokariga sublocation, which is partly in the LM-4 zone more farmers (52%) grow cotton and less (4%) sunflower.

Table 2. Farmsize and cropping patterns.

A-E group	B			C			D		
	small	medium	large	small	medium	large	small	medium	large
Total Farm Size (ha)	1.1	1.9	4.1	1.3	2.3	5.0	2.2	4.7	13.8
annual crops									
first season									
- maize	0.1	0.2	0.2	0.1	0.1	0.7	0.3	1.0	1.1
- maize + beans	0.2	-	0.8	0.3	0.3	0.3	0.3	0.4	0.4
- beans	0.1	0.4	0.2	0.1	0.1	0.2	0.3	0.6	0.8
- potatoes	-	0.2	0.2	-	0.1	0.2	-	-	-
- cotton	-	-	-	-	-	-	0.6	0.6	0.3
- sunflower	-	-	-	-	-	-	0.1	0.1	1.9
- other	-	-	-	-	-	0.2	-	0.1	0.4
total	0.4	0.8	1.4	0.5	0.6	1.6	1.6	2.8	4.3
second season									
- maize	-	0.1	-	-	0.1	0.4	0.2	0.8	1.1
- maize + beans	0.1	-	0.3	0.3	0.3	0.3	0.2	0.1	0.2
- beans	0.1	0.1	0.1	0.1	0.1	0.4	0.2	0.5	0.8
- millet	-	-	-	-	-	-	0.1	0.1	0.1
- potatoes	-	0.1	0.2	-	-	-	-	-	-
- sunflower	-	-	0.1	-	-	-	0.1	0.1	0.4
- other	-	-	-	-	-	-	-	0.1	0.2
total	0.2	0.3	0.7	0.4	0.5	1.1	0.8	1.7	2.8
Permanent crops									
- tea	0.1	0.1	0.2	-	-	-	-	-	-
- coffee	0.2	0.4	0.6	0.3	0.5	0.9	-	-	-
- pyrethrum	-	-	0.1	-	-	-	-	-	-
- bananas	-	-	-	-	0.1	0.1	-	0.1	0.3
- citrus	-	-	-	-	-	-	-	0.1	0.2
- total	0.3	0.5	0.9	0.3	0.6	1.0	-	0.2	0.5
Grazing + forage	0.4	0.7	1.4	0.4	0.8	1.8	0.5	1.5	7.7

- Farms: assets, labour, landuse, intensity, stocking rate and inputs.

Above the influence of the A-E groups on farmsizes and cropping pattern was shown. The relation between the latitude and climatic conditions and the farming system is elaborated here. In tabel 3 for the A-E groups B, C and D data on the following aspects of the farms is given: assets, potential labour availability, landuse, farming intensity, stocking rate and input use. These data are estimated from the Small Farmers Surveys of Jeatzold and Schmidt (1983). For A-E group B the data presented are an average of surveys no. 41 and 44, for group C an average of surveys no. 42 en 46, and for group D an average of surveys no. 43 and 45.

As one can observe the assets, farm sizes and the number of livestock increase from A-E group B to D. There is little difference in the potential labour availability. With regard to landuse, expressed in the broad categories of annual crops, permanent crops, pasture, forage, and fallow, there is little difference between the groups B and C. However in group D annual crops and pasture become much more important, while permanent crops become unimportant. Farming intensity is about equal in all A-E groups. Stocking intensity and the percentage of improved cattle diminish from group B to D. The use of improved seed as a percentage of total seed used for annual crops is more or less the same in all groups. There is no difference in the use of fertilizer and chemicals (insecticides and fungicides) between A-E group B and C, while in group D the use of such inputs is much less.

Table 3. A-E groups and some aspects of farms.

Some aspects of the farms	A-E groups B	C	D
Assets			
land (ha)	2.0	2.2	5.7
livestock (head)	7.3	7.3	17.2
Potential labour availability			
family adults	2.1	2.3	2.2
permament hired labour	0.3	0.3	0.5
children more than 14 yrs	1.8	1.6	2.0
Landuse (%)			
annual crops	36	31	48
permanent crops	26	25	2
pasture	25	29	41
forage	7	4	1
fallow	2	6	5
other	5	6	4
Farming intensity			
cropping intensity (crop/year)	1.3	1.5	1.5
Stocking rate			
farm land (LU/ha)	1.5	1.2	0.8
pasture + forage (LU/ha)	5.3	3.6	2.0
improved cattle (%)	77	59	15
Inputs			
improved seed AC (%)	51	48	55
N AC (kg/ha)	3.0	3.9	1.2
PC (kg/ha)	12.3	11.1	-
P_2O_5 AC (kg/Ha)	11.9	14.6	3.2
K_2O AC (kg/ha)	0.1	0.1	-
Insecticide AC (kg/ha)	2.1	1.7	3.8
PC (kg/ha)	0.5	0.4	0.1
Fungicide AC (kg/ha)	0.8	0.3	-
PC (kg/ha)	3.8	6.0	-

AC= annual crops

PC= permanent crops

LU= livestock units

3. Land utilization types

3.1 Introduction

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

LUTs should be described according to technical specifications and requirements, and within an agro-ecological and social-economic setting. Technical specifications refer to types of output, types of inputs, and agronomic practices (technology) and operations. Requirements are equivalent to the concept landquality of a land mapping unit. For example a LUT is in need for a certain amount of nutrients, nutrients which can be supplied by land mapping unit. In this way nutrients will be a requirement for the LUT while the availability of nutrients will be a land quality of the land mapping unit.

A practical way of describing a LUT within the Chuka area could be as follows:

Name of LUT

setting

* Social - economic
  - type of farming
  - size of farms
  - importance of LUT on farms
* Technology
* Agro-ecological
* Season

Technical specifications

* Economic
  - market orientation
  - capital intensity
  - labour intensity
  - inputs
  - outputs
  - gross margin
* Agronomic
  - cropping characteristics
  - cultivation practices
  - source and use of power

Requirements

Further details on the description of a LUT is given in appendix 5 "Crop Land Utilization Types Description Form".
Description of the LUTs will be based in part on existing knowlege of crops, specific to the area or more genenral, and on the outcome of an agronomic and economic survey to be held in the Karingani and Kanjuki locations.
As the suitability evaluation will be based on the comparison of crop requirements with landqualities it is of primordial importance to select the right crop requirements/land qualities. In this respect it

is important to remark that given the limited time available as few as possible land qualitites should be selected.

Likely candidates will be:

- risk of land degradation by soil erosion
- moisture availability
- soil fertility

3.2 Main Land Utilization Types

In Annex 1 of the Working Plan Soil Survey and Land Evaluation of the Chuka Area (Dijkerman, 23/03/85) a provisional list of relevant LUTs is given per A-E group. With some minor revisions these LUTs are presented in tabel 4.

In a general way the social economic setting could be described as Small-Holder Rainfed Mixed Agriculture with, in A-E groups B and C adjudicated and consolidated farms on which a changing part of the land is in fallow, while in A-E group E farming is more of a shifting cultivation type. In A-E group D farming is both fallow and shifting.

In land evaluation it is important to indicate the season and technology of the LUTs. This is done for a number of LUTs in tables 5.1 to 5.4 together with the expected yield level, and the gross margin. These data are taken from enterprise budgets from the German Agricultural Team, Ministry of Agriculture, Nairobi for different agro-ecological zones in the Embu, Meru and Kitui districts. Many more details can be obtained by inspecting the budgets. As these budgets are estimates the results should be used with care.

To be more extact: the enterprise budgets contain a number of anomalies. The data should be seen as indicative only and to be checked as far as possible during the course of the project.

The different levels of technology are defined by Jaetzold and Schmidt (1983, Part C, p.16). In summary the levels can be described as follows.

Level I Traditional production techniques regionally developed with wide variations, no fertilizer and chemicals (except for coffee and tea). Use of own seed. Cultivation mostly by hoe, sometimes with the use of draught animals.

Level II Use of recommended husbandry methods, fertilizers and chemicals within the constraints of practical farming.

Level III Reflects the yield level which can be achieved under optimal conditions in practical farming, i.e. if the objective (natural) and subjective (management) conditions are optimal. Level III shows actual potential which can be reached if knowledge available at present is put into practice.

Table 4. Provisional list of LUTs per A-E group.

Name of LUT	Abbreviation of LUT	A-E Group B	C	D	E
Annual Crops					
Maize	Ma	x	x	x	x
Beans	Be	x	x	x	x
Maize/Beans	Ma/Be	x	x	x	x
Sorghum	So		x	x	x
Millet	Mi		x	x	x
Cowpeas	Cp			x	x
Pigeonpeas	Pp			x	x
Grams	Gr			x	x
Sunflower	Sn	x	x	x	x
Sweet potatoes	Sp		x	?	
English potatoes	Ep	x	x		
Cassava	Ca	x	x	x	?
Cabbages	Cb	x			
Vegetables	Ve	x			
Tobacco	To		x	x	
Cotton	Ct			x	x
Permanent Crops					
Tea	Te	x			
Coffee	Co	x	x	x	
Pyrethrum	Py	x			
Bananas	Bn	x	x	x	x
Citrus	Ci		x	x	
Pasture + Forage					
Natural Pasture	Pa	x	x	x	x
Napier Grass	Na	x	x		
Bana Grass	Ba	x	x	x	x

Table 5.1 Yields and Gross Margin of some LUTs, A-E group B.

		TECHNOLOGY LEVEL					
		I		II		III	
Name of LUT	Variety	Yield kg/ha	Gross margin Ksh/ha	Yield kg/ha	Gross margin Ksh/ha	Yield kg/ha	Gross margin Ksh/ha
First Rains							
Maize	H 612	2000-2500	2800-3400	3000-4000	3800-4900	4000-5000	4600-5700
Beans		800-1000	1500-2000	1000	2700	2000-2200	2600-2900
Maize/		2000		3000		4000	
Beans		400	3700	500	4400	600	4000
Engl. Potatoes		6000-10000	2600-5000	12000-15000	5600-7400	30000	14100
Cabbage		5000	3400	18000	11900	35000	23000
Sunflower	Kenya-White	400	400	800-900	1400-1600	1600	1900
Sweet Potatoes		7000	1600	18000	4100	35000	7500
Second Rains							
Maize	Katumani	1500	1900	2200-2400	3000-3200	3000	3500
Beans		1000	2000	1800	2800	2000	2600
Eng. Potatoes		6000-10000	2600-5000	12000-15000	5600-7400	20000	7800
Cabbage		5000	3400	18000	11900	40000-42000	26700-27900
Sunflower	Kenya-white	270	0	550	740	1100	1600
Permanent crops							
Tea (1)		5000	24000	6000	40000	9500	61000
Coffee (2)		700	12000	1000	15400	1600	26800

(1) Tea yields in kg green leaves, average 5th - 20th year.

(2) coffee yields in kg dry leaves, average 5th - 20th year.

Table 5.2 Yields and Gross Margins of some LUTs, A-E group C.

		technology level					
		I		II		III	
Name of LUT	Variety	Yield kg/ha	Gross margin Ksh/ha	Yield kg/ha	Gross margin Ksh/ha	Yield kg/ha	Gross Margin Ksh/ha
First rains							
Maize	Katumani	1400	1700	2500	3000	2900	3100
Maize	Dry Land composite	1000	900	1800	1600	2400	1900
Beans		600	1100	1000	1800	1200	1300
Sorghum	(serena)	1900	1400	2600	1900	3300	1900
Sunflower	Isanka	400	400	600	1000	1000	1300
Foxtail-millet		400	400	800	1400	1200	1800
Cabbage		6000	4000	12000	7600	30000	19400
Second Rains							
Maize	Katumani	750	700	1300	1500	1500	1500
Beans		300	100	600	400	800	200
Sorghum	Serena	1900	1400	2600	1900	3300	1900
Foxtail-millet		-	-	800	1400	1200	1800
Sunflower	Isanka	400	400	600	1000	900	1000
Cabbage		6000	4000	12000	7600	30000	19400

Table 5.3 Yields and Gross Margins of some LUTs, A-E group D.

		Technology level					
		I		II		III	
Name of LUT	Variety	Yield kg/ha	Gross margin Ksh/ha	Yield kg/ha	Gross margin Ksh/ha	Yield kg/ha	Gross margin Ksh/ha
First rains							
Maize	Katumani	1200	1500	2000	2200	2900	2800
Maize	Dry land composite	900	900	1500	1600	2000	1800
Maize/ /Beans		1200 300	1900	2000 400	2700	2900 500	3400
Beans		800	1300	1200	1800	1300	1500
Sorghum	serena	1800	1300	2800	1700	3800	1800
Bulrush millet (1m3)		700	500	1500	1300	1700	1100
Bulrush millet (1m4)		400	100	1000	800	1500	900
Sweet potatoes		3000	100	5000	700	8000	1000
Cassava		4000	1900	7500	3000	17500	7300
Soya beans		-	-	800	1100	1400	1600
Green gram		400	400	900	1900	1200	2100
Pigean peas		400	400	900	1400	1200	1800
Sunflower	dwarf	-	-	600	900	900	1000
Second rains							
Maize	Kutamani	600	600	1000	1000	1500	1300
Sorghum	serena	1800	1300	2800	1700	3800	1800
Bulrush millet (1m3)		700	500	1500	1300	1700	110
Bulrush millet (1m4)		400	100	1000	800	1500	900
Sweet potatoes		3000	100	5000	700	8000	1000
Soya beans		-	-	800	100	1200	1300
Sunflower		-	-	600	900	800	900

Table 5.4 Yields and Gross Margins of some LUTs, A-E group E.

		Technology level					
		I		II		III	
Name of LUT	Variety	Yield	Gross margin	Yield	Gross margin	Yield	Gross margin
		kg/ha	Ksh/ha	kg/ha	Ksh/ha	kg/ha	Ksh/ha
First rains							
Beans		400	600	800	1300	1000	1100
Bulrush millet		200	200	700	500	1100	400
Sunflower	dwarf	-	-	500	500	-	-
Green gram		400	600	600	1100	900	1600
Second rains							
Bulrush millet		200	200	700	500	1100	400

3.3 Land Utilization Types within Farming Systems

The concept Land Utilization Type as used in the sections 3.1 and 3.2 is closely related to the concept enterprise or activity in the economic theory of the firm. By 'doing' one or more LUTs a farmer tries to make a living, in other words by engaging himself in one or more activities (e.g. maize, beans, maize/beans, coffee, cotton) the farmer tries to maximize his objectives, being sufficient food, cash, or otherwise.

Land evaluation aims at an assessment of different land mapping units with regard to their suitability for different LUTs. The LUTs are assessed independently. However within a farm LUTs are interdependent, either through an input-output relation or through the use of a common factor of production which is scarce.Given the level and scale on which the land evaluation is done (above farm level at a scale of 1 : 20.000 to 1 : 100.000) and the fact that the evaluation is only a first approximation of the suitability, the independent assessment is justified.

This does not diminish the importance of a correct description of the LUTs as part of the farming system. An ideal way would be to research the input-output relationships between LUTs as well as the use of the common factors of production by each LUT. Research into the input-output relations is very difficult and impossible within the limited time and means available for agro-economic research. It is somewhat easier to research the use of common factors of production. With regard to land it is fairly straight forward to determine how much land a LUT is using of the total land available of a farm. But even here one has to be cautious especially in the case of mixed cropping, and when it is not clear how much land is actually available. The latter problem is not important in the areas with ajudicated holdings, but is acute in the areas where shifting cultivation is predominant. In the latter case labour is probably the scarcest factor and LUTs should be analysed with regard to the use of labour. However experience shows that establishing how much labour is required and how much is used for a LUT is extremely difficult especially through the use of a one-visit survey. It is even very difficult to establish the

availability of labour on a farm. This does not only depend on the number of persons, ages, sex, etc., but also on the hours worked per day (which can change as result of something urgent to be done), number of days worked per week or per month, health conditions, food availability, off-farm work opportunities, etc.

Given the above mentioned difficulties it seems advisable to concentrate the description of LUTs, with regard to the place the LUTs take in the farming system on the amount of land used. In the areas with adjudicated holdings or where land is scarce the land used by a LUT should be related to the total land available. In areas where shifting cultivation is more predominant the land used by a LUT should be related to the amount of land a farm family is able to cultivate. In this way the scarcity of labour finds its expression in the total amount of land cultivated.

4. Agro-economic research

The main aim of the agro-economic research of the TPIP project in the Chuka area is to give a qualitative and quantitative description of actual land utilization types within the agro-ecological and social economic secting. More specific it aims at a description of the enterprises or activities within the present farming systems. Topics are:

- place of activity on the farm as a whole
- size of activity
- inputs
- production
- labour requirements
- source and use of power
- agronomic practices and operations

The description of the LUTs should be placed against the agro-ecological background and social economic setting.
The main results of the research will be a description of LUTs as proposed in annex 5, "Crop Land Utilization Type Description Form".

Description of LUTs could be based on several sources:

1. Literature
2. Jaetzold and Schmidt (1983)
3. German Agricultural Team: Enterprise Budgets
4. Results of past surveys in the area.
   (Cymmit's Farming System Surveys in Rukuriri, Gichiche, Ena, Mufu, and Kevote sublocation, Haugurud's studies of Cichiche and Gichera locations, ICRA's studies of Tharaka location and of Kyeni location. Small Farmer Surveys of Jaetzold and Schmidt, no. 41 to 46).
5. Results/Data of Research Stations, Cooperatives, Extension service, etc.
6. Field work to be carried out by the project.

In this section point 6 will be elaborated. However since the field work can only be of a limited scope the project has to find ways and means to provide adequate description of relevant LUTs for the whole area in time for the land evaluation exercise starting February 1986.

Originally the agro-economic field research was intended to cover the northern sample strip 'B' up to Kanjuki. This strip is situated going West to East, along the road from the Mount Kenya Forest Guard Post near Gachima - via Chuka, Marianni, Kaanwa, Miraa, Kiegumo, Kaara-Ka-Mbabu to Kanjuki, on the interfluve between the rivers Tungu and Naka. It was supposed to be representative for Meru part of the map sheets except for the Tharaka division. It would comprise the agro-ecological groups B, C, D and E. However, since the two MSc-students Jan Helder and Geert van der Donk, responsible for the survey, can only handle a limited number of interviews in the order of 60, research has to be concentrated in only two of the A-E groups. Since the recent ICRA survey concentrated on the A-E group B (main and marginal coffee zones in the southern sample strip 'A') it was decided to limit the survey to the A-E groups D and E (main and marginal cotton zones and livestock millet zone)*.

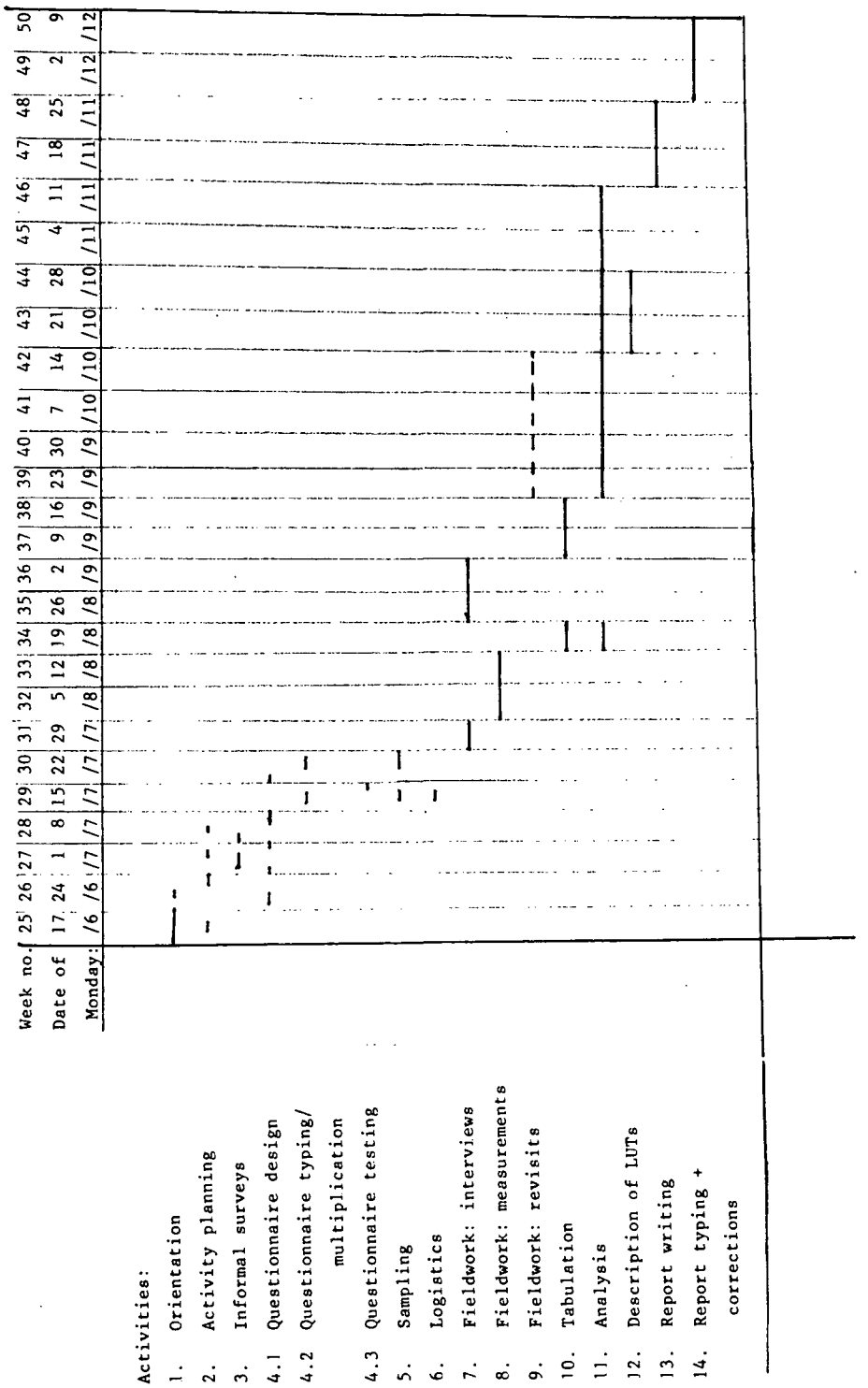
For practical purposes research will be concentrated on the sublocation Marianni (location Karingani) and the sublocation Kanjuki (location Kanjuki). Possible research sites/villages will be Kaanwa, Kaara-Ka-Mbabu and Kanjuki, with 20 interviews in each.

Next to the 60 interview with households in which data will be collected on the basis of recall, in 20 cases additional data on the exact layout and sizes of the fields and on yields for maize, sorghum and millet by area measurements and crop cuttings (or some sort of simulation harvest weighing by cob dimensions measurements).

In Table 6 a weekly work plan for Jan Helder and Geert van der Donk will be outlined. This workplan was prepared together with Henk Waayenberg, consultant for agronomy. In addition to the weekly workplan a day to day programme for the months of July and August was discussed.

* The 'forgotten' zone B ('dairy-tea-coffee') should be covered by later research, possibly by Msc student Bart Ooms, agronomist.

Table 6. Workplan Jan Helder and Geert van der Donk. -1985.



Important points of the above approach and workplan are:

a. the research of Jan Helder en Geert van der Donk will only yield results for the A-E groups D and E, not for group B and C;
b. the survey concentrates on description of the most important present LUTs, together with their place in the farming systems;
c. most of the data will be based on recall of the farmers, either the head of the household or one of his wifes. This will be supplemented by field observations and some area measurements and crop cuttings;
d. as the period of interviews is concentrated in the weeks 31 (29/7) up till and included week 37 (2/9) a four-wheel drive vehicle is required during this period to transport Helder and Van der Dronk and their interpreters. For preparation of the interviews, logistics, sampling and testing of the questionnairs transport is also required on a number of days in July as indicated in the day-to-day programme. Transport will also be required on some days during late September and early October for revisits to solve possible doubts. Transport requirements will have to be settled early with the project manager.
e. Helder and Van der Donk will have to work with interpreters conversant with Kimeru (Marianni Sublocation) and Kitharaka (Kanjuki Sublocation). Possible candidates are Miss Jane Njoli and Miss Maria Mwendwa.

Estimated costs for interpreters: Ksh.

Interviews

- salaries	5 x Ksh 40 + 6 x 5 x Ksh 40	= 1400
	5 x Ksh 50 + 6 x 5 x Ksh 50	= 1750
- revisits: salaries	10 x Ksh 40	= 400
- tabulation: "	10 x Ksh 40	= 400
	Total	3950

f. As a consequence of point b. a number of white spots in the description of LUTs will remain after the work of Helder and Van der Donk. To mention here are:
   1) description of present LUTs in A-E group B ('dairy-tea-coffee' zone)
   2) measurements of crop yields in second rains
   3) description of all relevant LUTs for land evaluation for

reconnaissance survey of whole area by February 1986.

g. As a last point it is important to discuss the coordination of the fieldwork of the agro-economists and the soil scientists. In order to relate the agronomic and economic data (e.g. crop yields and input use) with land mapping data it will be necessary to mark the relevant shambas of the interviewed households on 1:12,500 airphotos of the northern sample strip, if available. This would enable the soil scientist to make an observation (augerhole) on these shambas. If the airphotos would not be available to Helder and Van der Donk some other method to enable the soil scientists to make their observations should be worked out (e.g. the interpreters could be sent with soil scientists?). Otherwise it is not possible to relate in a meaningful way land mapping data with the agro-economic data, which would hamper the evaluation excercise in a serious way.

In the Marianni and Kanjuki sublocations there do not exist cadastral maps of the holdings. A possible way of relating landmapping data with agro-economic data as is intended to do with the ICRA survey data in Kyeni location where cadastral maps are available, is therefore not possible in the Marianni and Kanjuki locations.

Annex 1

Itenary of April and June/July, 1985 visits.

APRIL VISIT

Tu. 9/4 Departure from Amsterdam together with Joost Dykerman

We. 10/4 Arrival at Nairobi. Met at airport by Titus de Meester, meeting at Kenya Soil Survey (KSS) with Mr. Muchena, head KSS, and Naut Weeda, advisor to KSS.

Th. 11/4 Meetings with/visits to:

- Dr. Schidt, German Agricultural Team, Ministry of Agriculture
- Dr. Malcoln Hall, Division of Planning, Ministry of Agriculture
- Governments Printers
- Dr. M. Collinson, Cimmyt East Africa Program
- Institute of Development studies, University of Nairobi; Dr. Ruigi, economist
- Dr. Keya, Dean of Faculty of Agriculture, University of Nairobi.

Fr. 12/4 Travel to TPIP project site: Kevoria, Embu

Sa. 13/4 Visit to Embu

Su. 14/4 Orientation trip through project area

Mo. 15/4 Orientation trip through project area

Tu. 16/4 Visit to Embu District Commissioner Office
meeting with Mr. T. Moodi, Project Manager Embu, Meru, Isiolo Project (EMI project)

We. 17/4 Travel to Nairobi, administrative arrangements

Th. 18/4 Meetings with/visits to:
Mr. Kenau, Farm Management Officer, Ministry of Agriculture
Van Engelen, KSS
Library, KSS
Institute of Development Studies

Fr. 19/4 Administrative arrangements

Sa. 20/4 Travel to Kevoria, Embu

Mo. 22/4 Meeting with Dr. Mansfield, landuse Planner, EMI
Excursion through project area

Tu. 23/4 Project meeting, etc.

We. 24/4 Travel to Nairobi

Th. 25/4 Departure from Nairobi to Amsterdam
Arrival at Amsterdam

JUNE/JULI VISIT

Fr. 14/6 Departure from Amsterdam

Sa. 15/6 Arrival at Nairobi, met by Titus de Meester
Travel to Kevoria, Embu.

Mo. 17/6 Lower sample strip excursion with students Jan Helder, development economy, and Geert van der Donk, agronomy.

Tu. 18/6 Trip to Meru town, with De Meester, Helder and Van der Donk, meetings with:
Mr. J.C. Yagan, Meru District Commissioner
Mr. C.O. Ses, Meru District Agricultural Officer
Back to Chuka, meetings with:
Mr. E.M. Maeri, Nithi Divisional Officer
Mw. Igeri, Nithi Divisional Extension Officer.

We. 19/6 Trip to Chuka with Helder and Van der Donk, meetings with:
Mr. Isaac Mugo Rugare, Chief Karingani location and
Mr. Ibrahim Gitari - Assistant Chief Ndagani Sublocation.
Trip through Upper sample strip: Chuka, Marianni, Kaanwa, Miraa, Kieguma, Kaara-Ma-Mbabu, Kanjuki.
Back via students camp in Ishiara to Kevoria.

Th. 20/6 Meeting with Helder and Van der Donk to discuss approach, methodology and work programme.
Travel to Nairobi.

Nairobi

Fr. 21/6 - Administrative arrangements
- Buying chemicals
- Van Engelen, KSS
- Visit to Dr. W.M. Mwangi, Head Department of Agricultural Economics, University of Nairobi.

Sa. 22/6 Collecting Joost Dijkerman from Nairobi Airport
Travel to Kevoria, Embu

Mo. 24/6 Excursion with Dijkerman and Wielemaker through lower sample strip.

Tu. 25/6 Office work, report writing

We. 26/6 Office work, report writing
Meeting with Helder and Van der Donk. Staff meeting.

Th. 27/6 Whole project excursion in lower sample strip with Dr. Mansfield, Land Use Planner, EMI.

Fr. 28/6 Trip through upper sample strip with Henk Waayenberg and Van der Donk.

Sa. 29/6 Office work, report writing

Mo. 1/7 Presentation of ICRA research results of survey in Kyeni location. Meeting with Waayenberg, Helder and Van der Donk

Tu. 2/7 Informal survey in Marianni sublocation to interview 5 households. With Waayenberg, Helder and Van der Donk. Interpreters: Maria Mwendwa and Jane Njoki Kuruona.

We. 3/7 Same, in Kanjuki sublocation. Meeting with:
Mr. Oreste Mwangi, sub chief Marianni sublocation and
Mr. Patric E.N. Nyagah, Chief of Kanjuki location.

Th. 4/7 Meeting with Waayenberg, Helder and Van der Donk to discuss work plan, questionnaire design, etc.

Fr. 5/7 Office work, report writing. Travel to Urimanti Hut, Mt. Kenya.

Sa. 6/7 Trip to Mount Kenya with Henk Waayenberg.

Mo. 8/7 Office work, report writing.

Tu. 9/7 Office work, report writing

We. 10/7 Land evaluation meeting.

Th. 11/7 Whole projet meeting: staff and student excusion.
Final meeting with Waayenberg, Helder, Van der Donk.

Fr. 12/7 Office work, report writing.

Sa. 13/7 Travel to Nairobi.

Su. 14/7 Departure from Nairobi,
Arrival at Amsterdam.

Annex 2

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Annex 3. List of administrative units involved plus some data on areas and population of Population Census 1979.

Embu District

Division	Location	Sublocation	Population	Households	Area	Population Density
			numbers	numbers	km^2	people/km^2
Runyenjes	Gaturi-	.Kavuturi	4743	812	11	420
	North	.Kevote	4670	764	11	418
		.Kianjuki	3529	551	6	541
		.Makengi	3955	695	7	531
			12942			
	Gaturi-	Nembure	3301	518	7	425
	South	.Gatunduri	5028	810	13	382
		.Ena	3046	549	10	281
		.Githimu	4931	891	16	300
		Kithegi	3782	715	22	166
			20088			
	Kagaari-	.Nbuijeru	4116	704	13	298
	North	.Kianjokoma	2558	470	7	351
		.Kanja	4045	719	11	351
		.Gitare	2265	373	5	442
		.Mukuuri	3848	702	11	331
			16832			
	Kagaari-	.Gikuuri	5218	848	6	820
	South	.Kigaari	3733	672	11	339
		.Gichiche	3834	649	8	453
		.Gichera	4065	753	39	103
		.Kahanjara	2398	485	10	222
		.Nthagaiya	3933	776	23	166
		.Runyenjes TC	1566	454	1	932
			24747			

Divison	Location	Sublocation	Population	Household	Area	Popu.Dens.
	Kyeni-	.Rukuriri	3447	570	8	424
	North	.Kiangungi	3886	661	7	533
		.Mufu	2900	445	8	337
		.Kathari	5316	743	12	439
			15579			
	Kyeni-	.Kathanjuri	4833	799	8	569
	South	.Karuromo	3241	579	17	182
		.Kigumo	3028	488	11	261
		.Kathunguri	3736	681	16	220
		.Kasafari	558	107	8	66
			15396			
Siakago	Evurori	.Nguti	6173	1303	55	111
		.Evurore	4031	755	53	74
		.Thambu	2600	544	65	39
		.Kamarandi	2496	562	96	25
		Kathera	3756	917	69	54
			19056			
Total Embu District		Upper limit[1]	124610			
		Lower limit[2]	111132			
Meru District						
Nithi	Magumoni	.Thuita	7366	1116	17	421
		.Mwonge	3651	563	5	620
		.Kabuboni	4096	655	8	476
		.Mukuuni	5703	991	22	249
		.Rubate	3425	579	9	378
		.Kamwimbi	3965	904	63	62
			28206			

Divison	Location	Sublocation	Population	Households	Area	Popu.Dens.
	Karingari	.Mugiritwa	6318	1004	14	426
		.Chuka	2040	347	5	408
		.Chuka TC	1361	454	1	829
		.Ndagani	7121	1151	21	329
		.Mwiro	5034	835	10	495
		.Gitarene	6136	1017	21	288
		.Marianni	3655	735	34	108
		.Kithangani	2318	504	37	62
			33983			
	Kanjuki	.Kanjuki	3960	694	59	66
		.Kaimande	1674	350	28	58
		.Mutino	3439	667	37	93
			9113			
	Muthambi	.Iringa	2785	488	10	276
		.Igamura	2580	446	6	410
		.Gatua	5339	875	15	346
		.Chamunga	3953	659	8	457
		.Kadunga	2735	542	22	119
		.Karimba	4984	854	18	275
			22376			
	Upper-Mwimbi	.Muligi	10492	1576	27	379
			10492			
	Kiera/Mwimbi	.Mugumango	12637	2065	33	372
		Magutuni	12529	2353	94	131
			25202			
Tharaka	South-Tharaka	.Chiokariga	4859	1038	88	54
		.Kamanjuki	3554	615	137	26
			8443			
Total Meru District		Upper limit[1]	137815			
		Lower limit[2]	125250			

Division	Location	Sublocation	Population	Households	Area	Popu.Dens.
Kitui District						
Far North	Tharaka	Gakombe	1382	2658	16	11
		Kamaindi	2586	450	141	18
			3968			
	Katze	.Mugunga-Ikonga	2246	379	93	24
			2246			
Total Kitui District		Upper limit[1]	6214			
		Lower limit[2]	2246			
Total Map Sheets		Upper limit[1]	268639			
Total Map Sheets		Lower limit[2]	238628			

1. Upper Limit includes population of all mentioned locations and sublocations.
2. Lower Limit includes only population of those location and sublocations marked with a point.

Annex 4. Map showing administrative boundaries and agro-ecological groups and zones.

Annex 5: CROP LAND UTILIZATION TYPE DESCRIPTION FORM

I General

Name of crop: _____

Setting:

- Agro-ecological Group: _____

- Type of Farming: _____

- Size of Farms:

class			
small	medium	large	average

class size (ha)

Average size of LUT per farm (ha)

Season: _____

Technology: _____

Remarks:

Name of LUT: _____

Abbreviation of LUT: _____

CROP LAND UTILIZATION TYPE DESCRIPTION FORM

Name of LUT:_____

II Economic Aspects

Market orientation:

Capital intensity

- class : low / medium / high Shs.
- value of physical working assets per hectare:
- value of physical working assets per kg product:

Labour intensity

- class : low / medium / high hours/days
- no. of hours/days per hectare :
- no. of hours/days per kg product :

Production and Inputs per hectare

Item	Price/unit	quantity	value
Production:			
Inputs:			
Planting material:			
Fertilizer:			
Pesticides,etc:			
Costs of hired power:			
Var. costs of owned power:			
other:			
Total variable costs:			

Gross Margin Analysis

per hectare

per Sh. variable costs

per Sh. physical working capital

per labour hour / day

per average size of LUT:

	Farm class		
	small	medium	large
average cultivation size			
gross margin			

CROP LAND UTILIZATION TYPE DESCRIPTION FORM

Name of LUT: _____

III Agronomic Aspects

Cropping characteristics:

- Annual/permanent
- Single/multiple
- Intercropped with: _____
- Rotation: _____
- Cropping index: _____
- Other

Cultivation practices:

- Land preparation

- Cultivations

- Planting/seeding

- Weeding

- Crop protection

- Harvesting

- Processing

Source and use of power:

CROP LAND UTILIZATION TYPE DESCRIPTION FORM

Name of LUT:_____

IV Land use requirements

Land Quality	Diagnostic factor	Unit	Factor Rating: Highly suitable S1	moderately suitable S2	marginally suitable S3	not suitable N
Risk of land degradation by soil erosion						
Moisture availability						
Soil Fertility						

MAP of 'CHUKA' PROJECT AREA

Legenda:

- DISTRICT BOUNDARIES
- DIVISION BOUNDARIES
- LOCATION BOUNDARIES
- SUB-LOCATION BOUNDARIES
- AGRO-ECOLOGICAL ZONE BOUNDARIES
- ESCARPMENT

SCALE:

1 : 100.000