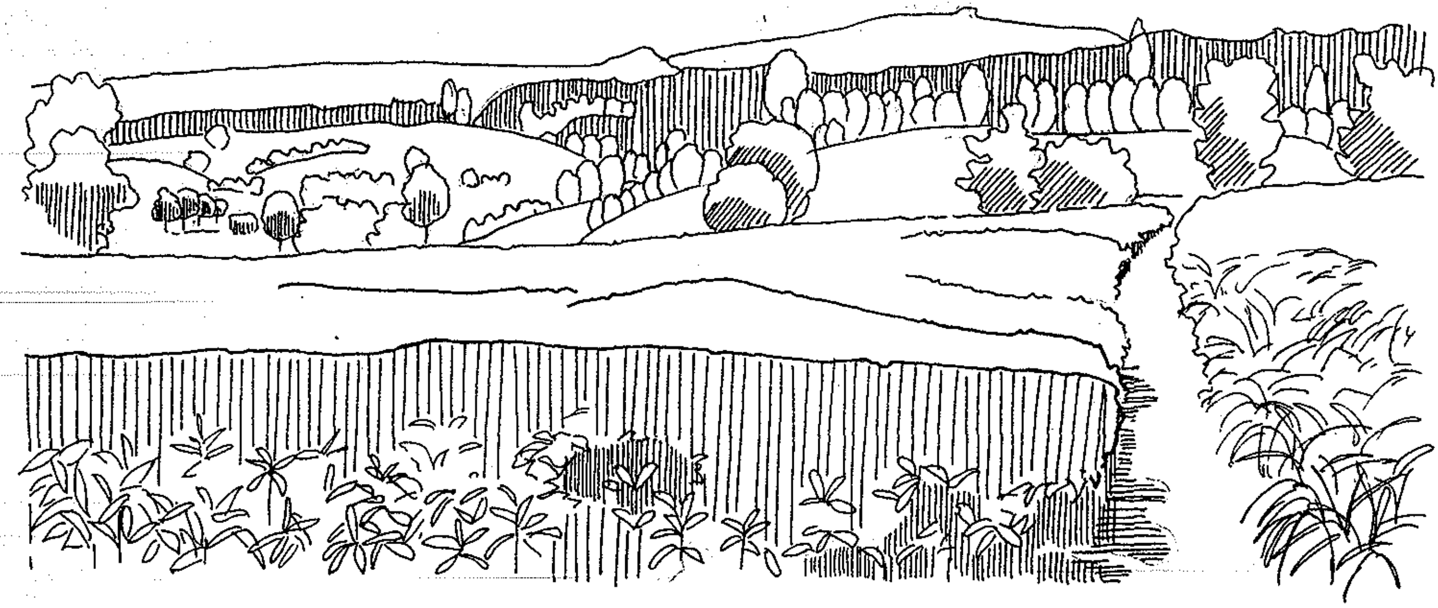

the landevaluation ~~of~~ for tea in Rukuriri and Chuka, Kenya

MARIAN DE HAAN 1986

Errata

In paragraph II.6 on page 31 should be added :

4. Extention meetings

On account of extention , it is observed that 88 % of the farmers said to attend the monthly meetings organized by KTDA tea-extention-officers or assistant-tea-officers (the farmers refusing to assist for whatever reason , were living in Rukuriri area).

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Contents

Preface

In January 1986 the author started with a land-evaluation survey in part of Embu and Meru district , in the eastern province of Kenya. This survey was carried out within the framework of the Training Project In Pedology , which performed soil-mapping , and land-evalution activities in the area covered by the 'Chuka and Ishiara topographic mapsheet' (no. 122/3 and 122/4).
The T.P.I.P. has been carrying out land-evaluation surveys and soil-mapping activities before in Kisii and Kilifi area , and any of these projects has been executed in consultation with the Kenyan counterpart ; the Kenya Soil Survey.
Within the possibilities of this project advantage was taken of the knowledge of especially soils within the area of my survey, which was already acquired.
The result is an evaluation of the land-utilization-type Tea , set in the context of the farming system of which this crop forms an important part.

Methodology

The survey was carried out from February till July 1986 , roughly consisting of a two months interviewing part and a three months analysing part.
The work started with the familiarizing with the survey area and the design of a relevant questionnaire. This took me approximately two weeks . The first draft of the questionnaire was tested in the field and adjusted . The final questionnaire is to be found in Appendix .
Meanwhile I had some talks and an excursion with a tea-extention-officer of the K.T.D.A. , Mr. Kamau , and received a list of names of all the farmers delivering their tea to Rukuriri factory. These farmers formed the group out of which was taken at random a sample of farmers in the following way : Rukuriri receives its tea via the 25 collection-points to which all tea farmers are associated. Primarily , at random 5 collection-points were taken out of the total number of collection-points situated in the southern part of the area covered by Rukuriri factory (in the report called Rukuriri-area) , and also 5 collection-points to the north of the Thuchi river (called in the text Chuka-area). Within the list of farmers connected with the buying-centres concerned ,at random 4 farmers per buying-centre were chosen. The purpose was to interview 25 to 30 farmers.
Together with my assistant-interpreter we went into the field carrying the questionnaire and the names of the farmers I wanted to visit . It turned out to be quite easy to find the farmers in the surroundings of the buying-centre concerned by asking people on the road.
One interview took us approximately 2 hours on the average , and we could do 2 or 3 interviews a day.
By the end of March we interviewed the 29th farmer and it was decided to stay with a sample size of 29 farmers ; 13 in Rukuriri-area , and 16 in Chuka-area.This means that out of my list of 4 farmers per collection-point on the average one or two farmers were least well-known by passers-by , and fell out of the previously composed sample.
The following period was predominantly used for analysing the data provided by the farmers ; tabulating , calculating , and writing the report , which took me the months of April , May and June.
Some activities undertaken alongside to be mentioned are the taking of leaf- and soil-fertility-samples on each and every farm. Unfortunately because of lack of time , the results of the analysis of these samples ,except for the pH-samples , are not taken along within the report.
Nevertheless the sample-taking provided the author a chance to get an impression of the total farm and the tea-plantation in particular.
Furthermore , I met with the tea-collection-officer of Rukuriri factory and several other tea-extention-officers and buying-clerks , and got additional information from them.
A very interesting tour of the tea-factory was made , which provided an impression of tea-processing.
In April I visited Kenya's most famous tea-producing area ; the area around Kericho in Rift Valley Province , and went to the Tea Research Foundation to talk with some research-engineers.
The officially recorded yield- , number of trees per farmer- , and use of fertilizer- data I got from K.T.D.A.-functionaries at the K.T.D.A. headquarter in Nairobi ,which I visited thrice.

At this place something should be said about the reliability and exactness of the provided data and results within this report. The report as

presented here is breathing a level of accurateness which goes beyond the level which was presented to me by the farmers in the field. Nearly every answer on my questions was a mere guess. And , allright , if I was asked (in between a hundred other questions) how much time I spend in studying , I wouldn't be accurate myself either. And yet I am somebody carrying along a watch and an agenda , wherever I go.
May this be a warning to the reader , and an explanation of the vague or contradicting results of the report.

I INTRODUCTION

I.1 Population and infrastructure

The footslopes of Mount Kenya in Embu and Meru district are densely populated.The area involved in this study is about 150 square kilometers , with a population of about 70.000 people, while the population density ranges between 300 and 600 persons per square kilometer.
Major tribes are the Kiembu , living at the southern side of the Thuchi-river , and Kichuka-people , a subtribe of the Kimeru , living north of this river.

With respect to infrastructure , this area is well provided with connections to the outside world , being situated along the main tarmac road Embu-Meru. Fairly big villages within reach are Runyenyes in the south , and Chuka in the north of the sample area.
The area is dissected by smaller roads , having one major problem : in rainy periods these roads become muddy , and as containing slopy parts (the area being hilly) , they are quite difficult for wheel-transport by then.
Being one of the more developed areas within Kenya , schools , dispensaries , weekly markets , and well-provided shops can be found within for every inhabitant reasonable distances to reach. Even matatus (bush-taxis) , are transporting people up to small villages in the west of the sample-area.

I.2 Physiography and geology

The eastern slopes of Mount Kenya , which is the remains of a late-Tertiary vulcano ,have a relatively flat profile .
A distinction can be made between mountain footridges (symbol R) and major valleys (symbol V) , which are the major incisions in the mountain-footslopes.
The volcanics from Mount Kenya are so-called lahars ; consolidated mudflows which descended from the slope of the volcano and embed all kinds of volcanic rocks in a matrix of pyroclastics.

I.3 Rainfall and evaporation

Rainfall in the sample area is not equally distributed over the year , but concentrated in two rainy seasons. The 'long rains' are to be expected in the months of March to May , extending to June. The short rains fall in October till December. Most of the rain precipitates in showers with high intensities.
Average annual rainfall varies from almost 2200 mm in the very western part to 1500 mm at the eastern border of the sample area.
Figures of the reliability of the long rains resp. short rains are shown , which render the amount of rain which can be expected at least in 6 out of 10 years ; the so-called 60 % reliability.

The average annual potential evaporation (E0) varies from 1200 to 2000 mm.
The ratio R/E0 (R being the average annual rainfall) can be calculated out of this information , which was used by Braun et al (1980) for distinguishing the agro-ecological zones , of which shall be spoken later.

I.4 Temperature

The temperatures in the sample area vary somewhat over the year. In the dry periods and during the first months of the rainy period it can be very hot ; the months of June and July being especially cloudy and cold .
Average temperatures in the sample area are calculated according to a quantified relation between altitude and temperature. This relation revealed by Braun (1980) and revised by Pulles (1986) , can be represented as follows :

mean maximum	T = 36.26 - 7.507 * A
mean	T = 28.97 - 6.514 * A
mean minimum	T = 21.97 - 5.526 * A

where T= temperature in °C , A= Altitude in m.

This reveals a temperature range within the sample-area as follows :

The altitude varies from 1500 to 1700 m.

At 1500 m :	mean maximum = 25.0 °C		At 1700 m :	mean maximum = 23.5 °C
	mean = 19.2 °C			mean = 17.9 °C
	mean minimum = 13.7 °C			mean minimum = 12.6 °C

I.5 Agro-ecology

The sample area is situated east of Mount Kenya , just below the equator.
The coordinates are given in Figure
The figure covers the western part of mapsheet 122/3 of Kenya.
The sample area comprises specific agro-ecological zones being situated along the south-eastern Mount Kenya footridge , which are defined according to the agro-ecological zones concept by Jeatzhold and Schmidt (1983).
The particular zones are referred to as the Tea-Dairy zone (LH 1) , and the Coffee-Tea zone (UM 1) ; the zones being distinguished on basis of differences in temperature and the rainfall/evaporation quotient.
Rainfall decreases with elevation , the altitude decreasing from 2290 to 1620 ms in south-eastern direction , causing a simultaneous decrease in rainfall from 2200 mm to 1500 mm averagely per annum over the sample area.
Another consequence of the change in altitude is a change in temperature over the area , the mean annual temperature being 16 °C. in the west and increasing to about 19 °C. at the eastern border of the sample area. Out of this background information Braun et al as well distinguished agro-ecological zones , based on climatical variables , like moisture-availability ,expressed by the R/E0 ratio of average annual rainfall and average annual potential evaporation * 100 % , probabilities of moisture deficit , and resulting probabilities of crop-failure.

II THE FARMING SYSTEM IN THE AREA

II.1 General

Farming in the area is described as rainfed agriculture , smallholder mixed-farming , carrying-out crop-production with an animal-keeping-unit. As a result of the production of two cashcrops , tea and coffee , next to foodcrops like maize and bananas , the farming system may be considered as partly commercially oriented , and partly self-supporting , as most farmers produce foodcrops next to cashcrops in a surface-ratio of 10 : 9.
In the next paragraphs , 3 different aspects of the farming system are described ; land , labour , and agronomy .

II.2 LAND

The land in the survey-area is property of the farmer according to landdivision and adjudication rights applicated by the government not long ago.
17 % Bought the land , few bought or borrowed (either or not free of charge) an extra plot at some distance from the houseyard. 83 % Inherited their land.
Almost all the land I visited was under cultivation for a considerable period. An extention of the tea-area is planned for in the direction of Mount Kenya. 25 Hectares (60 acres) of freshly cleared mountain-belt will be given out by the government to farmers who apply for it. Some of it is already been given and being planted with maize and beans or other reclamation-crops.

The average farm-size in this area is 5.6 acre , being a real smallholder-area. There is a difference within the two areas Rukuriri and Chuka which should be mentioned ; Rukuriri-area having average farms of 4.8 acres , and Chuka-area of 6.3 acres.

To get an overview of average farm-sizes in the sample-area , the farms have been classified according to size as follows :

Table 1 Percentage of families and average farmsize for different farmsize classes

	less than 2.5 acres I	2.5 to 5 acres II	5 to 8 acres III	more than 8 acres IV	total average
% of families	14	45	24	17	100
average farm-size (acres)	1.9	3.8	6.6	12.0	5.6

At this place something is said about the number of dependents , living on the produce on account of their farming activities.

Table 2 Percentage of families and average number of dependents per farm , per farmsize class

farmsize-class	% of families	average number of dependents per farm
I	14	5.5
II	45	6.2
III	24	7.7
IV	17	7.8
Sample area	100	6.8

Let us pass a quick glance on the possible appearance of this area in the future by counting the average number of sons per farmer to which finally the land shall be given ; The observation that the average farmer as the owner of 5.6 acres agricultural land has 2.6 sons , shows a possible fragmentation which is threatening.

For an overview of the cultivation-sizes see the table below. This table provides a more accurate view on the land that is actually being used by its inhabitants and is contributing to their food and income.; Farmed land is the total acreage of the property of the farmer subtracted by land which is fallow and land which is occupied by the homestead.

Table 3 Average farmsize , average farmed land size , and ratio farmed land\total land per farmsize class

	less than 2.5 acres	2.5 to 5 acres	5 to 8 acres	more than 8 acres	average farm
average farm-size	1.9	3.9	6.6	12.0	5.6
average farmed land size	1.7	3.2	5.8	8.2	4.5
ratio farmed land/ total land	0.9	0.8	0.9	0.7	0.8

Over the sample area on the average 80 % of the total land which is property of the farmer is being farmed directly.

An overview is given of the amount of fallow land for the different size-classes.

Table 4 Amount of total land , fallow land ,percentage of farmers having fallow land , and percentage fallow of total land per farmsize class

farmsize-class	total land (acres)	fallow land (acres)	% of the farmers keeping fallow land	% fallow of total land
I	7.7	0	0	0
II	48.9	4.3	39	9
III	46.1	3.3	43	7
IV	60.0	17.0	80	28
sample area	162.6	24.5	41	15

I must acknowledge that 'fallow land' in most of the cases in this area means : land which has not been cultivated before ; uncropped land , which is taken up in the rotation system is rarely being found .
The fallow here consists of former Mount Kenya forest-residues ; secondary forest .Sometimes it is being used for building houses and selling wood.

The difference between the farmed land\total land ratio (Table 3 ,third row) and the percentage fallow of the total land (Table 4 , fourth column) , which is 5 % in the case of the average farm in the sample area , indicates the surface in use for housing , sheds and direct non-cropped surroundings.

II.3 Labour

A picture of the labour-availability is given in the table below , again subdivided per farmsize-class.

Table 5 Average number and percentage of male and female workforce and total number of people working full-time on the farm ,per farmsize class

size-class	workforce male		workforce female		number of people working full-time on the farm
	average number	%	average number	%	
I	1.1	52	1.0	48	2.1
II	1.0	46	1.2	55	2.2
III	1.7	52	1.6	49	3.3
IV	1.1	38	1.8	62	2.9
average farm	1.2	47	1.4	53	2.6

A summary is given of the number of persons full-time available for farming, split up in male and female workforce.
On the average between two and three persons are full-time available for work on the farm.

To estimate more exactly the number of (wo)mandays labour available per household , the following calculation can be made :
The labour availability of an adult household member working permanently on the farm is approximately 5 to 7 hours per day for about 260 days per year. Hence the total working-capacity per year of adult household-members at the average farm is to estimate at 2.6 * 260 * 6/8 = 507 (wo)mandays.

Besides this , school-going children usually help their family in the holidays , especially with the harvesting of tea or coffee. These holidays happen to occur every April (4 weeks) , August (4 weeks) , and December (5 weeks) ,which are the flush-periods for cash-crops (not August).

For the different farmsize-classes , the percentage of households hiring labour in busy months is given,being 73 % for the whole sample area. In addition , 55 % of the farmers is making use of irima (free help by neighbourers).

Table 6 Percentage of farmers hiring labour, using irima, and having an off-farm income, per farmsize class

farmsize-class	% of farmers hiring labour	% of farmers using irima	% of farmers having an off-farm-income
I	50	75	25
II	75	54	23
III	83	43	0
IV	75	60	60
sample area	73	55	24

Here appears the first indication of the presence and importance of casual labour in our area.

Besides , 24 % of the farmers in our area get an off-farm income out of employment in mostly casual activities like timber-selling , building of stone houses or being evangelist. Some keep their own shop , or work as a teacher. These income-generating activities are for the individual household very important, but can be considered as of minor significance in the area.

II.4 Agronomy

The best way of typifying the farming system in this area , is to give an impression of the occurrence of the different crops.

Table 7 Occurrence of different types of crops in the sample area

croptype	major crops	minor crops	sporadic crops
cash crops	coffee tea		pyrethrum macademia
cereals	maize		
pulses	common beans		
tuber crops	english potatoes	cassava yams	sweet potatoes arrow root
fruits and vegetables	bananas passion fruits	vegetables (sukumawiki) avocados sugercane english fruits	pumpkin pineapple

To give conform to an excact figure of the occurrence of different crops in the area , see the information in the Tables below.
The first column indicates the percentage of households growing the listed crops. For tea this value can not be given , because the sample was taken out of tea-growing farmers. Accordingly , nothing can be said about the occurrence of this crop in the area , however it may be taken for granted that nearly every farmer grows tea here.
The second column indicates the total area in acres occupied by the different crops.
The third column , headed : `percentage of occurrence of the crop`, is calculated as a percentage of the farmed-land area (e.g. 13 acres of tea being 25 % of a total of 53 acres farmed land in Rukuriri area).
The fourth column indicates the average acres occupied per farm of the different crops ,which is a clear indicative for the farmers` relative priorities for the different crops.

Table 8 Quantified occurrence of different crops in Rukuriri area

Rukuriri	% of households growing the crop	total area occupied by the crop (acres) 1)	% of occurrence of the crop in the sample area 2) 3)	average area occupied by the crop per farm
tea	n.a. 4)	13.3	25	1.0
coffee	85	9.0	17	0.7
maize	92	10.4	20	0.8
beans	77	3.6	7	0.3
grass 5)	77	6.3	12	0.5
bananas	62	2.5	5	0.2
potatoes	54	2.0	37	0.2
yams	39	1.8	34	0.1
cassavas	39	1.8	3	0.1
others	39	2.2	4	0.2
totals		52.7	100	4.1

Table 9 Quantified occurrence of different crops in Chuka area

Chuka	% of households growing crop	total area occupied by the crop	% of occurrence of the crop in sample area	average area occupied by the crop per farm
tea	n.a.	13.3	17	0.8
coffee	100	25.1	33	1.6
maize	100	15.4	20	1.0
beans	100	9.9	13	0.6
bananas	81	4.6	6	0.3
grass	69	4.3	6	0.3
potatoes	56	2.5	3	0.2
yams	19	0.6	1	0.0
others	25	0.8	1	0.1
totals		76.6	100	4.8

Table 10 Quantified occurrence of different crops in the sample area

sample area	% of households growing the crop	total area occupied by the crop (acres)	% of occurrence of the crop in sample area	average area occupied by the crop per farm
tea	n.a.	26.6	21	0.9
coffee	93	34.0	26	1.2
maize	97	25.7	20	0.9
beans	90	13.5	10	0.4
bananas	72	7.0	5	0.2
grass	72	10.6	8	0.4
potatoes	55	4.5	3	0.2
yams	28	2.4	2	0.1
cassavas	24	2.2	2	0.1
others	31	3.0	2	0.1
totals		129.3	100	4.5

1) Farmed land is resp. 53 , 76.5 and 129.5 acres
2) Percentage of farmed land = percentage of (total acreage - fallow - homestead)
3) Average farmed land size is resp. 4.1 , 4.8 , and 4.5 acres
4) n.a.= not applicable because the sample was taken out of tea-growing farmers
5) Napier grass (strips) included

This table shows the relative importance of the cash-crops tea and coffee , together representing the the kind of farming-system which is found in this special area.
As a result of the production of tea and coffee next to foodcrops like maize and bananas , the farms may be considered as partly commercially oriented , and partly subsistence oriented.
The average ratio between cashcrops and foodcrops in the sample-area counts 0.9 , being exactly the same in both areas, Rukuriri and Chuka.This means that for each one acre foodcrops , on the average 0.9 acres cash-crops are being cultivated.

Of special interest is the ratio tea/coffee which shows that in this distinct tea-area , coffee is a cash-crop of major importance , and , coming through as a second, supplementary cash-crop , shouldn't be over-looked when gaining an impression of the farming-system of the tea-farmers in this area ;Out of this study it is clear that in the survey-area , which is at the same time the very tea-producing area , coffee is , as compared to tea , of at least the same importance with respect to priority of cultivation (area) and cash-income.

The most important foodcrops appear to be maize and beans , together taking an average of 1.3 acres per farm , of which 24 percent is intercropped. Maize and beans which are grown in pure stand , are being rotated among eachother. Some of the farmers replied that maize or beans are being rotated by potatoes or cassavas.
In addition to maize and beans , the average farmer grows another 0.4 acres staple-crops , 0.3 acres fruits and vegetables , and 0.4 acres grassland.
Mixed cropping , which is the simultaneously growing of two or more crops within one plot , without a row arrangement , occurs within the area with respect to maize and beans , and also within bananas , which are mixed up with all sorts of minor crops (arrow-roots , sugergane , yams , vegetables , beans etc.). Bananas appear to be mixed with other crops in 100 % of the cases.

The grassland usually consists of small plots ordinary Kikuyu-grass around the homestead , but also included are strips of Napier-grass alongside the terraces within the coffee-plot or elsewhere.This grassland is used for the zero-grazing part of the farming-system.

Table 11 Percentage of the households owning different kinds of livestock-units

A record of livestock-keeping in the study-area is given below :

	cows	calves	goats	sheep	poultry	rabbits
Rukuriri	92	39	39	15	100	0
Chuka	94	13	81	50	94	25
Sample area	93	24	62	35	97	14

Livestock-keeping is an important part of the farming-system in tea-area. The way of keeping livestock in this area may be included within the definition of zero-grazing. Most of the farmers keep their cows in a small boma , a fenced enclosure within the homestead , let them graze on a small part of grass around the house , and feed them on bunches of Napier-grass.
Cattle is kept for :
- social aims (dowry , status)
- savings-bank (unexpected expenditures)
- producing milk and meat
- producing cow-dung
- traction-purposes

The average farmer is keeping 2.1 cows , 0.3 calves , 1.8 goats , 0.8 sheep and 8.8 chicken.

II.5 SUMMARY

Summarizing this chapter an overview is given on the different variables determining the character of the farming system in tea-area on the Mount Kenya slopes in Embu-district.

Table 12 Summarizing table on different variables determining the character of the farming system in Rukuriri/Chuka area , Kenya

farmsize-class (acres)	less than 2.5	2.5 to 5	5 to 8	more than 8	total average
% of families	14	45	24	17	100
average farm size (acres)	1.9	3.8	6.6	12.0	5.6
average farmed land size (acres)	1.7	3.2	5.8	8.2	4.5
average workforce (persons)	2.1	2.2	3.3	2.9	2.6
average plot-size (acres)					
tea* :	0.5	0.9	0.9	1.4	0.9
coffee:	0.6	1.0	1.5	1.6	1.2
staple crops* :	0.5	0.7	2.6	4.1	1.7
fruits/ vegetables :	0.1	0.2	0.4	0.4	0.3
grass :	0.1	0.3	0.4	0.6	0.4
average farmed land size (acres)	1.7	3.2	5.8	8.2	4.5

* This tea only consists of tea which is in production at the very moment

* Maize and beans and potatoes and yams and cassavas and half of the 'others'

III TEA

III.1 General Introduction

Tea was first planted in Kenya in 1903 , but it was not until the early 1920's that planting on a commercial basis was undertaken. As the tea-estates expanded , from the fifties smallholders were stimulated to grow tea as a cash-crop , and the first factory built especially for smallholders was completed in 1957 at Ragati in Nyeri-District.
As it is profitable for a country to export tea to obtain foreign currency , for the farmer it is quite attractive to have a regular (monthly) cash-income. For tea is a crop which in this area produces throughout the year ,though having dips and flush periods. A farmer can get some money out of it at least every month. In spite of the rather heavy labour demands of tea (250 to 320 mandays per acre per year) its lack of extreme seasonality and the extent to which plucking operations can be concentrated on a few days in a week , allows tea to match remarkably well with annual crops with bimodal profiles of labour-requirements.

Tea is made from the young leaves and the unopened buds of the perennial tea-plant Camellia Sinensis (L.), a species of plant which includes widely different varieties. Of the three main varieties - the China , the Assam and the Cambodia - the Assam Jat is the most suited to East-African conditions , and found in the project-area.
Within the Assam jat , many sub-varieties (clones) are found , and the growers in our area are provided with at least two clones within their plot (about 25 clones are available). Since 1966 tea is being vegetatively propagated.
Harvesting tea is aptly called "plucking" , or "picking". This involves the selection by the plucker of young leaves and unopened buds which are easily broken off between thumb and forefinger , and placed in a basket usually carried on the pluckers' back.
In this state the tea is described as "green leaf". After processing in a factory the tea is referred to as "made tea". About four and a half kilograms of green leaf make one kilogram of made tea. This made tea , from the Assam jat , is the common "black tea" of the world tea trade.

III.2 The Kenya Tea Development Authority

The national institution which now organizes the tea production for small-scale farmers was officially established in the sixties , taking over responsibilities from two marketing boards.
The Kenya Tea Development Authority is acting as a source of planting material and major source of credit , operating the extention system for smallholder tea-farmers , and besides the only avenue through which farmers can sell their produce, being both monopolist and monopsonist. The K.T.D.A. as such , took care of the infrastructure , necessary for a fluent stream of tea-leaves from the farmer up to the world market. Factories were being established within tea-producing areas , road construction and improvements took place , and buying centres were being located along the roads , supposing a farmer will be located within a mile (1.61 km) of the nearest

collection-point.
The organization within K.T.D.A. can be charcterized by the three top-representatives of its hierarchical structure in one producing unit (which is the factory and its buying centres) : the tea factory officer , in charge of the manufactoring department , the tea extention officer , in charge of the agricultural department , and the leaf-officer , in charge of the leaf-collection department (the so-called leaf-base).
The farmers bring their tea to the buying centre where it is being taken care of by a tea-collection clerk , after control on quality (3 or more leaves and a bud (coarse plucking) is not accepted).
Then it is taken with trucks to the factory, (officially within 6 hours after plucking it has to be there) and the processing is started the next morning.
In the sample area the tea-leaves are being transported to Rukuriri-factory , which was established in 1984 . 25 Collection points are linked up with Rukuriri factory . The daily capacity of the factory is 70.000 kg. , which can be a severe limit in the months of May and October , when even more than 100.000 kg green leaves can reach the factory.

III.3 Tea in the course of time in the sample area

Mount Kenya footslope in the north-western part of Embu-district became covered with the first patches of the smooth fresh green tea-carpet in the sixties of this century.
Small farmers since then have been encouraged by the KTDA to bring into cultivation parts of freshly cleared Mount Kenya woodbelt.
Within the sample-area an estimation can be made of the averge age of the bushes, which can be seen in the underlying table.

Table 13 Percentage of trees planted per time-period

planting year	%
before '70	13
'70 to '75	49
'75 to '80	23
'80 to '85	15

Tea shrubs start production after 4 years. Commercially significant yields are obtained from the sixth year , maturity is achieved in the tenth year ,and life- and production-time can be 50 years or more (D. Etherington ,'73)
With this background knowledge , an estimation can be made of the total number of producing trees in the area , taking into account the number of trees that died because of drought (and other causes linked with it).
If we keep in mind that a decently growing tea-plantation contains about 3500 trees per acre , the total amount of acres grown within the farmyards of these 29 farmers can be indicated in the table below.
Out of this , the number of trees that died is expressed as a percentage of the total area occupied with tea in the relevant area.

Table 14 Percentage of the total number of tea-acres that is said to have dried up in the two distinguished areas and the total sample area

	total number of acres	% of the area that dried up
Rukuriri	13.3	3
Chuka	13.3	48
Sample area	26.6	41

This table expresses the difference in performance of tea-growing within the two areas , Rukuriri and Chuka , which shall turn out again in the progress of this report with respect to some other facts like yields .

Of the farmers being interviewed ,59 % were reporting that they are intending to plant new trees in the near future (1986 , 1987) , of which 45 % calls it 'filling in ' on the empty spots where tea has been drying up before.
This 45 % can be devided in 28 % in Chuka-area , and 17 % in Rukuriri-area. Of the farmers interviewed 31 % is intending to extend their tea-plot, of which 17 % in Rukuriri and 14 % in Chuka-area.The extention in the coming years will then be 21 % of the actual acreage in Rukuriri , and 9 % of the actual acreage in Chuka .

Table 15 Average tea-plots and number of producing trees now and in the future in Rukuriri , Chuka , and the sample area

	average actual tea-plot per farmer (acres)	average tea-plot in the near future	average number of producing trees per farmer	number of producing trees per farmer in future
Rukuriri	1.0	1.2	3570	4305
Chuka	0.8	0.9	2905	3185
Sample area	0.9	1.1	3238	3745

In conclusive terms it is clear that tea-growing is quite promising for the farmers in this area , and that even in spite of the seemingly poor growing and high death-rate of trees in Chuka-area farmers keep on filling in , and even extending their plot.

A point to be reminded of at this place is the relative importance of tea with respect to coffee , without weighing accurately the relative advantages of both crops or the more or less favourable natural circumstances for one crop or the other. The only data shown here are the average tea- and coffee-plots , which provide an idea of the farmers priority.

Table 16 Average tea- and coffee-plots in Rukuriri , Chuka , and the sample area

	average tea-plot (acres)	average coffee-plot (acres)
Rukuriri	1.0	1.0
Chuka	0.8	1.3
Sample area	0.9	1.2

It seems that according to land-use as an indication for relative priorities , coffee is at least of the same ,if not more importance to the farmer than tea.

III.4 Tea Cultivation in the sample area

Starting at the beginning the farmer buys the tea-cutting from the K.T.D.A.-nursery , or gets it from his own bushes , tea being vegetative propagted. The cuttings are taken from a good tea-bush, which has not been plucked for several months. 38 % of the farmers get their cuttings from their own shamba , and 3 % buys his cuttings from somebody else. K.T.D.A. nowadays is said not to be able to meet the demands for cuttings and the farmers are teached by the extention-officers to make their own nurseries.
On the average , eleven months are spent in the nursery.
67 % Of the farmers use fertilizer , and 13 % use manure in the nursery. An NPK-material , which is being mixed with water and sprayed every now and then , about 250 grammes ,is used throughout the period for more than thousand cuttings. Also a type which is being mixed with the soil (superphosphate) is used when planting in the nursery , and accordingly when planting in the field.
The cuttings are planted in polyethene bags , and shaded by a roof of plastic or branches.
When they are about 20 cms high they are sold and\or planted.
Land-preparation comprises the removal of possible Armillaria-causing elements (all roots) , and Couch-grass. The land is dug with forked jembes , and plantholes are made with panga's.
Nearly all farmers plant their tea at a density of 5 by 2.5 feet (1.5 by 0.75 m) , giving a population of 8888 plants per hectre , or 3703 plants per acre. The polyethene sleeves are removed.
The planting mostly takes place in April , at the beginning of the big rains ; few do it in October (beginning of the small rains).
When the shoots have reached a height of 60 to 75 cms , they are pegged down ; Each shoot is held down with a wire peg , so that the bush spreads out in a wide cirkle.
After the frame has been formed , the shoots are allowed to grow and each shoot is being plucked above a desirable height of the plucking-table , according to the age of the frees.
When the tea-bush is young , weed-control is necessary. In mature tea , the growth of weeds is suppressed by the shade of the bush and by the mulch.
Once or twice per year , the soil below the bushes is provided with

fertilizer , which is broadcasted by hand.In our area this occurred in March to July , or October to December ; during the rainy months.
Manure is given in the months of January to March , or June , July or September , during the more dry months , to prevent it from flowing away , and to give it time to decompose.
The pruning is done to prevent the bush from growing too high and to prevent decline of yields. After four years the first pruning is carried out (at 55 cms) , three years later the bush is pruned at a level increased by 5 cms over the previous pruning.Almost every farmer cuts once in three years , usually deviding his tea-plot in three blocks , so every year there is pruning activity (June or July). 10.3 % prunes once in two years , 13.8 % prunes less often , and even there were two farmers said they never prune.
The pruned material is left behind on the plot as mulching material.After pruning one has to wait four months for new harvest.
Routine picking is done at intervals depending on growth.
Sometimes a stick is laid on the plucking-table for guidance ; I saw it two times (a tea-plot is sometimes referred to as a "garden") and shoots above this level are picked , two leaves and a bud.
If growers leave too long a period between subsequent plucking , the shoots will grow tall. That's why after picking two leaves and a bud (fine plucking) , the grower is "breaking back" the extra growth above the level of the table.
Within 6 hours after plucking the leaves have to be delivered in the factory.

III.5 Yields

When calculating the yields in kg per tree , there seems to appear a significant yield-difference in the two areas separated by the Thuchi-river.

Table 17 Yields in kg\tree\year for the different areas

	kg/tree/yr 1983/1984	kg/tree/yr 1984/1985
Rukuriri	0.58	0.77
Chuka	0.23	0.32
Sample area	0.38	0.53

or :

Table 18 Yields in kg\acre\year for the different areas

	kg/acre/yr 1983/1984	kg/acre/yr 1984/1985
Rukuriri	1619.4	2277.9
Chuka	655.9	1019.8
Sample area	1068.8	1583.8

An average of 1 kg per tree per year is said to be the yield of the Kenyan tea farmer , and according to the Tea Growers Handbook (1969) yields of 1250 to 2700 kg per acre per year usually are obtained . So it seems that this area cannot be especially proud on its production-figures.

Other symptoms indicating the measure of tea-quality and crop-performance to be remarked and observed in the field are :

a. the amount of trees that is said to have died

b. the coverage of the soil by trees at this moment

c. the healthyness of the trees

ad a. : One is referred to paragraph III.3 and table 14.
It is clear that within the Chuka part of the area average life-time of the tea-bushes seems to be much shorter than at the southern side of Thuchi-river.

ad b.: Soil-coverage is measured by estimating the percentages of the soil-surface fully covered by leaf-foliage.

Table 19 Soil-coverage in percentages in Rukuriri and Chuka

	soil-coverage (%)
Rukuriri	92
Chuka	85

This is a very important feature, indicating the number of trees that had died for whatever reason.
Fact is, that a not fully serried plucking-table enables the rain to take grip of the topsoil, causing the washing away of rich soil-

material containing nutrients or even fresh fertilizer,and the formation of gullies.
Soil deprived of organic matter is less capable of fixing and storing rainwater, inducing poor growing and drought.
In this way an irreversible process of soil deterioration and crop-quality-decline is caused which promises the worst.

ad c.: The healthyness is estimated just by subjective observation with distinguishing, but non-professional eyes with respect to the possible causes like diseases, deficiencies or direct drought.
Considered were :

- yellowness of the tea-leaves (N-deficiency ?)
- dryness of the bushes (brown spots on the leaves)
- abundance of shoots and leaf-formation , and consequently the overall impression which the single trees and the tea-plantation provides.

Three classes can be distinguished , indicated by a + sign which means healthyness , a - sign which represent plantations showing severe signs of some misfortune , and +/- plots in which turned out to be some slight signs of lack of health.

Table 20 Percentages of tea-plantations within different classes of healthyness for Rukuriri, Chuka, and the total sample area

	+	-	+/-
Rukuriri	39	39	23
Chuka	64	29	7
Sample area	52	33	15

The information in this table seems to contradict what has been found before ,namely , poor tea-growing in Chuka-area in comparison to Rukuriri-area ,and can be considered just as a reproduction of the findings of my investigation as such,this report not being a thorough analysis of the causes of differences in two tea-growing areas.

Fact is , that there turns out to be a considerable amount of tea-plantations showing signs of unhealthiness, which can be expressed in the future as 'drought' after what is been mentioned as the main cause according to the farmers.

It must be brought in mind that observations were done at the beginning of the rainy period , with tea showing sufferings from the preceding dry period.

III.6 More about loss of yields

The main factors to which poor growing can be imputed are :

A : climatic and physical factors

B : Farm management and input level

A Climatic and physical factors

Tea gives a continuous flush growth when there is a considerable amount of moisture throughout the year , but tolerates dry spells. So tea thrives well in areas of high altitudes with on the average quite low tempertures. In addition , tea requires deep , permeable , well-drained , acid soils of which the tropical red earths form the most extensively cultivated group in tea-producing countries.
In general , tea-soils are of only moderate fertility owing to severe erosion and leaching. They are low in bases and phosphorus and their nitrogen content is very variable. The bulk of the world's tea is grown on land that is not of first-class quality , and moderately productive tea is grown on land that produces but sparse crops of the type usual in annual husbandry. As economic crops of tea are garnered from soils which leave much to be desired with respect to fertility , no special requirements with respect to fertility are to be considered for tea-cultivation.

The table below contains crop-requirement-ranges for tea in the case of Kenya with regard to a number of climatic and physical factors.

Table 21 Crop-requirements for tea according to Acland (1971) and Eden (1965)

1 altitude	1500-2200 m
2 moisture-requirements	100-150 mm/month , 1500-1750 mm/yr
3 temperature	13 - 30 °C
4 slope	less than 65 %
5 soil pH	between 4.0 and 6.0
6 other soil qualities	well drained profile more than 1.8 m. depth
7 weeds and diseases	absence of weeds and diseases

1. Altitude

The altitude-map of this area shows that part of the area , especially the Chuka belt , is found on altitudes which represent the lower border-height at which tea can be grown succesfully. This can explain for the greater part the complaints of the farmers about the drying up of the tea-leaves. Of course altitude-requirements have to be considered in close correlation with temperature- ,and moisture-requirements.

2. Moisture

The type of rainfall distribution is an important factor in assessing rainfall requirements. Prevailing tempertures are an additional conditioning factor and here elevation is an important chracteristic in modifying transpiration losses.Overcast skies during dry weather and occult precipitation in the form of mist play a significant part in modifying drought conditions.
However , there is a consensus of opinion that at fifty inches per annum (127 cm.) rainfall is marginal unless other climatic conditions , such as those enumerated above , provide mitigating circumstances.
Without exception the rainfall in the dry weather period is critical , and if monthly averages fall below two inches (5.1 cm.) over a period of several months , crop production suffers severely.

Being intercorrelated with altitude , moisture-stress at lower parts of the area in the dry period of january and february causes much suffering within the tea-plots here.

3. Temperature

In general , mean minimum temperatures below 13 °C are likely to bring about damage to the foliage and a cessation of growth ; mean maximum temperatures above 30 °C are likely to be accompanied in Kenya by humidities so low that a similar cessation of active development is inevitable. (T.Eden , 1965)
Growth is faster and yields tend to be higher in warmer areas and at warmer times of the year. Temperature-stress does not appear in this region, as we find ourselves in the lower and warmer parts of the altitude-range suitable for tea-growing.

4. Slopes

General slopes tend to be quite steep.
They were classified as follows :

Table 22 Percentage of teaplots within the different slope-classes (some plots cover two slope-classes)

	0-6 %	6-16 %	16-30 %	30-60 %	more than 60 %
Rukuriri	39	31	15	31	-
Chuka	13	25	50	31	-
Sample area	24	28	35	31	-

The impression is that soil-erosion processes do not occur in tea plantations , because of complete coverage of the soil in mature healthy plantations , protecting the top-soil from being washed away by impact of heavy rains.
Danger of soil erosion can only arise when the soil is not completely covered and no soil conservation measures have been taken (terraces , mulching) i.e. in young plantations and just after pruning.
Also a tea-plantation at the lower part of the slope can get problems of deprivation of nourishing top-soil by run-off from a badly covered plot on the upper side of the slope.
No significant signs of soil-erosion were found within the tea-plots of the farmers which were visited.
Summarizing , slope can be considered of no particular significance as a limiting factor for tea-growth in this area.

5. Soil-pH

pH-(H_2O)-samples have been taken at every farm within the tea-plot at two different depths , the top-soil-pH normally being somewhat lower because of formation of humus-acids within the organic-matter containing layer .

Table 23 Soil-pH within the sample area at different depths

	pH - topsoil 0 - 20 cm.	pH - subsoil 40 - 60 cm
Rukuriri	4.91	5.01
Chuka	5.12	5.13
Sample area	5.02	5.07

The best soil-pH for tea-growing is said to be between 5.4 and 5.6. A pH below 5.4 causes deficiencies of base nutrients and phosphate , while a pH above 5.6 gives problems of establishment of plants , particularly stumps (cuttings).
The data from the sample area seem to be favourable regarding the pH-requirements although they are a bit lower than optimal.
There is no need of improving through adjusting the fertilizing.
No significant difference is to be found between the two distinguished areas.

6. Soils

Generally,well-drained and permeable soils are essential for satisfactory growth of tea. Whilst there are well-defined exceptions , red soils are usually superior to black or grey ones. If the subsoil is not red , or red-brown , indicating a high state of oxidation of iron compounds,a condition of impeded drainage can usually be expected , and consequently tea-growing fails.
The tea-plant has only feeble powers of root penetration through stiff and compacted soils . Pans , whether of gravel or clay , offer an almost impenetrable barrier to root growth.
No consistent relationship is found between mechanical composition of soil material and field-properties of the tea-crop. Tea can grow on diverse soils with respect to texture.

The soils of our area consist of well-drained , very deep , red and friable clays being mainly dystric or humic nitosols , supplemented with some chromic , orthic or humic acrisols , and chromic or humic cambisols.
No significant limitation with respect to drainage or depth of the soil profile is occurring within our sample-area.

7. Weeds and diseases

Weeds

Of the farmers visited , 48 % raises the point of having to contend with weeds , although most of it appearing only on the sides of the plot , and on the bare spots.
It goes without saying that farms having problems with drying up of tea , dying of bushes and formation of dry spots, are most susceptible to coming up of weeds.
Competition for moisture by then will be stirring up further deficiencies of moisture in tea-bushes.
Most common weeds farmers are confronted with , are :

Snelle
dif
[illegible]
[illegible]

- black jack (muchege) (Bidens pilosa L.)
- couch grass (kithangari) (Digitaria scalarum L.)

and other small annual weeds , like ruthiru , muthengeria , and mithogu (which are Kiembu or Kichuka names).

Weed control is being performed mechanically or chemically , most farmers undertaking only the weeding , using panga's and forked jembes (removing couch grass).

Severe black-jack-growth is controlled by spraying Gramoxin or Round-up mixed with water to root out this weed completely and prevent new growth for a considerable period.

diseases

The only disease which is said to be found in the are according to the farmers is Armillaria Root Rot (or 'malaria' as it is called by some of the farmers).24 % of the farmers did find armillaria symptoms within their plot.The disease is caused by the fungus : Armillaria mellea.It is confined to the soil and is normally a saprophyte , living on dead stumps and roots of forest trees. In the Kenya Highlands it is said to be also found in an epiphytic association (i.e. an association which does not harm the host) with tea roots.These are often in close contact with tea-roots , but in epiphytic stage they never penetrate far , because healthy roots are able to seal off the portions of the root surface which have been invded by the fungus.
If the root-surface of the tea-bush is damaged by cultivation or by boring insects , Armillaria can enter the roots and become parasitic. Once in this stage , the main root system rots away and the bush eventually dies .The leaves turn yellow and fall , and sheets of white mycelium can be found between the bark and the wood.
Armillaria should be prevented by ensuring that there are no stumps or pieces of wood in the field which could serve as a reservoir for the fungus. (J.D.Acland ,'71)

In this area of freshly-cleaned-forest-belt , attention must be paid to thoroughly clearing away of forest-tree-remainders. In addition , as much root as possible must be removed from the soil during land-preparation.
No special treatment to cure affected bushes or to prevent contamination is known. So if armillaria occurs in established tea , diseased trees must be thoroughly removed so that they do not become a source of infection for the neighbouring bushes. Once thoroughly vanished , the plantation will be free of Armillaria in the future.

In addition I was told by an enthomologist employed by Tea Research Foundation , that some other diseases do occur especially in this area without being recognized by the farmer . Drying up of trees may be caused by or at any rate aggravated by some diseases being brought about by mycosis or mite-born diseases (mites do not attack healthy bushes).
Common diseases are caused by the Red Crevice Tea Mite (the blades of flush leaves cupped or otherwise distorted) , Red Spider Mite (the leves turn brown , dry up and are shed) , and Tea Purple Mite (the older leaves inside the bush turn brown , greyish-white skins are found on upper leaf-surfaces).
Other dangers are represented by Black Tea Thrips (silvery patches covered with black spots on the underside of the older leaves) , Kangaita Weevil (damages the roots) , Systates Weevil (eats round holes in the edge of tea leaf ; it may also eat the bark of young tea) , Phomopsis Thea (branch cancer ; dark sunken patches on the bark which rots away and becomes separated from the wood ; growth of branch continues on the not-affected side , and the stem becomes deformed) , and Hypoxylon Wood-Rot (pruned portion between the cut and the first new bud causes lower downdying of texture which is subject to invasion by saprophytic fungi).

The symptoms of these diseases mentioned above were not to be detected during the present survey.

8 : Farm Management and Input Level

Although arbitrary ,a distinction can be made between good tea, and less well-doing tea , which most probably can be ascribed mostly to the level of management.
Firstly , different factors being symptoms of the level of management can be enumerated :

1. fertilizer/manure-use
2. flatness of the plucking-table and over-all condition of the tea-plantation
3. rate of pruning and plucking
4. attention of meetings organized by KTDA-functionaries

In the next , these factors are considered with respect to the sample area.

1. Fertilizer-use

"Only" 10 % of the farmers told me that they never used fertilizer , and those were exactly the farmers which carried the fewest tea-leaves to their buying centre , according to KTDA-yield-data.

Most farmers used fertilizer which was provided by the KTDA. An individual bought from somebody else. The amount of fertilizer to be provided through KTDA is said to be adjusted to the amount of trees which has been recorded within the accounts of the leaf-collection - section of the factory. So it is not possible for the farmers to put an excess on their fields or to be deficient in fertilizer , unless the KTDA-records are out of date , because of dying of trees , and planting out off farmers' own nurseries (which is the case for a number of farmers).

Commonly used is NPK 25:5:5:5S , replaced by NPK 20:10:10 in case of shortage of the former. Few farmers were using phosphate-fertilizer.

Of the farmers 42 % put their fertilizer two times a year , 58 % once.
Different periods of the year are being claimed for this practice , although most of the fertilizing is done in the rainy months (April , December).

The data of fertilizer-use , provided by the farmer , and those provided by KTDA , do not agree for a considerable part , namely in 48 % of the cases, most of the farmers using less than is said to be given them by KTDA (33 %).
19 % seem to buy their fertilizer somewhere else , or using spare bags.

These bags contain 50 kilos ; sold at the price of about 200 Ksh., and are given on credit by subtracting an amount of money (about 11 cts per kilo leaves)from the farmers' monthly payment.

An average amount of 3 bags per acre per year is used. An interesting difference is found in the two distinguished areas ; Rukuriri-area putting 3.8 bags per acre per year , against 2.3 bags in Chuka-area.Farmers are advised by KTDA to put 5 bags per acre (21 % N).
Even when omitting the three farmers who do not use fertilizer (all of them being situated in Chuka-area) , there seems to be a significant difference in measure of fertilizer-use between our two areas.

At the moment of writing the report no chemical data of soil-fertility are available. Nothing can be said about just application of fertilizer with respect to (natural) availability of nutrients.

Manure

Of the farmers 45 % is using manure on tea from the own cow-shed , of which all of them but one use it in addition to artificial fertilizer.
With respect to the use of organic manure can be remarked that the immediate response to organic nitrogenous fertilizers appears to depend on their rate of mineralization which, in turn , is related to their ratios of carbon- and nitrogen-content.
It appears that the more easily the simple nitrogenous substances which the roots can assimilate , are released , the better use the plant is able to make of them. In this respect , organic manure , which gradually releases its absorbable nutrients , is at a disadvantage. (T.Eden '65)

2. Flatness of the plucking-table

Derived factors which could be symptoms of the level of management are the flatness of the plucking-table , and the over-all condition of the tea-plantation . 46 % of the farmers (of which 25 % in Rukuriri-area) keep their plucking-table flat , whether or not using a stick to level the height when breaking back after plucking the very two leaves and a bud.
The other farmers don't pay much attention to this , or stay with a deformed tea-plantation because of drying up and successively dying of trees.
In the last case it will be obvious that farmers , when picking the leaves from a tree not directly surrounded by other bushes , are liable to pick even the sides and the undergrowth ,because the leaves are visible and easy to reach , or in order to obtain still as much leaf-yield as possible. So in this way the different trees will grow out into huge convex bushes (underplucking causes the plucking-table to rise very quickly).

As for the over-all sight of the plantation , and the healthiness of the tea ; this is mentioned in paragraph III.5 , table 20.

It can be stated that a good farmer should be able to manage his tea in such a way that a healthy plantation can be kept in both Rukuriri- and Chuka-area in spite of the actually appearing unfavourable climatic- and

soil-derived conditions.
The best farmer among the ones I visited was situated on quite steep slopes , below the 1600 m. altitude-line in Chuka-area. I was told he won several times KTDA-prizes for the best tea-quality.

3. Rate of pruning and plucking

Pruning and plucking provide a stimulus for new growth and keep the tea-bush in a continuous state of vegetative development.
As such , the rate of pruning and plucking can be a symptom of whether or not the farmer tries to make best use of his tea by providing his bushes the optimal conditions for continuous , healthy growth and fresh leaf-production.

One farmer in Rukuriri and one in Chuka-area said they never cut their tea. In imitation of KTDA-prescription , nearly all farmers cut their trees once in three years.
As for the farmers in the two different areas , no appreciable deviation from this frequence of pruning is to be indicated.

The rate of picking is a variable which is difficult to measure , because the variation over the year is great , and the farmers don't seem to be able to answer questions about this very accurately.
A number of different variables can be compared , like : the picking days per week , the picking rounds per month , and the total number of persons usually picking.
Their number of picking days and the number of people usually picking are to be related to the size of the tea-plot.

What I did by way of comparison is the calculation of the averages of these variables , and looking for possible differences or deviations from the average within the two areas.

Table 24 The number of persons usually picking per acre in the sample area

	number of persons usually picking per acre
Rukuriri	4.2
Chuka	3.1
Sample area	3.6

Table 25 The picking days per month per acre for the dry and the wet season in the sample area

	picking days per month per acre dry	wet
Rukuriri	7.5	20.9
Chuka	13.6	25.2
Sample area	11.3	23.7

Table 26 Number of picking rounds in dry and wet season in the sample area

	Picking rounds dry	wet
Rukuriri	2.3	2.9
Chuka	2.3	3.5
Sample area	2.3	3.3

In the dry season farmers pick normally half of the time necessary in the rainy period , when they are picking three quarter of the days within one month.
A picking-round is the action of picking of the whole shamba.
In the wet season on the average every tea-plot is been finished more than three times a month with more than three people picking per acre , belonging to the family.

The fact that people in Rukuriri seem to be picking for a smaller part of the time is probably compensated by the fact that in this area more people are helping to pick.

An important factor restricting proper removal of ready tea-leaves is labour-shortage , which is reported of by 40 % of the farmers (24 % in Rukuriri and 16 % in Chuka) in the rainy periods.
In the next chapter we shall have a look at the distribution of labour employment over the year in tea , the periods and causes of labour-shortage , and the employment of casual labour.

III.7 Labour

On the basis of rough calculations as to the plucking requirements of tea , KTDA aimed to achieve an average of one-acre-holdings , a size generally considered the maximum within the capacity of a family-unit without the need of employing labour.
However below we will see that even holdings of less than 1 acre employ extra labour sometimes.
The different activities a farmer has to carry out when cultivating tea, are clearing , land-preparation , planting , fertilizing , cutting , weeding , picking , and transportation.

The description of labour-reqiurements as given below , by indicating the number of days per person per acre, may give us the impression that all of the work is done by the farmer himself. This is definitely not the case in our project area, and much of the work can be finished within the time-periods given below , because of the help of members of the family and casual labourers.

Clearing

Clearing of the land only takes place if the farmer is provided with land from the forest area , which has to be brought into cultivation for the first time.
The clearing of a plot containing bush and secondary forest-trees , can take a farmer two months when working with at least two persons.
Especially the danger of Armillaria which exists if not a thorough removal of every piece of root or shoot takes place , makes the clearing a tough task.

Land-preparation

Land-preparation contains the digging (cleaning ; 1 week) and making of terraces and plant-holes (2 weeks) using pangas and forked jembes.
It is said to take a farmer 3 weeks for one acre when doing it all by himself.

Planting

The planting , the provision of plantholes with one-year-old cuttings, can take also a full week for one person on one acre (3500 plants).

Fertilizing

Fertilizing on one acre will occupy one person a full day.

Cutting

The cutting will be done once in the three years , dividing an acre in three blocks so that this activity takes place every year within 1000 stems. Per person pruning a thousand stems , it will take him a week to finish.

Weeding

How much time the weeding takes , is difficult to estimate, because this very much depends on the state of the plantation , and the amount of weeds that have to be removed.
It is evident that relatively a lot of time is been spent on weeding if it has come so far as to be necessary to weed.

Picking

The amount of time which is needed for proper picking depends of course on the size of the plot to be picked.
Even there is a big difference within the year in the rate of growing of new leaves , and thus in the rate of harvesting a certain amount ; while in the dry period it is not possible to fill one bag (15 kilos) by one person a day , in the rainy period within 4 hours a bag is said to be filled.

If we think about the amount of fresh leaf that has to be harvested , the best way to measure time-requirements within a tea-plantation with respect to the picking , is to determine the number of picking rounds per month necessary to compensate the rate of formation of new leaves.

How much time do we consume in picking ?
Suppose,someone wants to pick his shamba of one acre in the dry period two times , and in the wet period three times , as the farmers in our sample on the average did.
According to these farmers this person can pick one acre in more than four days in the dry , and more than nine days in the rainy period.
This means that in the dry period a farmer having one acre ,and being alone , can spend two weeks , and in the rainy period at least the whole month on picking.

If we calculate properly according to the data summoned in table 26, the following result can be shown :
Data : 2.3 picking rounds per month
one person needs say 5 days for one picking-round
and ; 3.6 persons are normally picking .
This shows that 5*2.3 = 11.5 mandays per month are spent in tea-picking in the dry period (1 manday being about 6 hours).
In the rainy period : 3.3*10 = 33 mandays per month are spent in this activity.
Mark the comparison with information from Table 25 which tells that in dry resp. wet season 11.3 resp. 23.7 days are used for picking (which was based on the direct question "How many days do you spend per month in picking if alone?").
In getting a proper indication of the number of mandays spent in tea-picking , I took the value in between the above-mentioned two levels of quantities of mandays spent in picking per month.
This reveals the assumption that on the average 11.4 mandays per month are spent in picking in the dry period , while 28.4 mandays per month are spent in the wet period (assuming a picking-(wo)manday being about 6 hours).

Transport

Another time-consuming activity within the tea-cultivation must be mentioned : the transport of the tea-leaves to the buying centre after every picking-day.
Roughly it will take the average farmer one hour to bring his leaves , to sort them out and wait for the weighing , and walk back home. This takes the farmer in total about 1.5 mandays in the dry, and about 3.5 mandays in the wet period.

Table 27 Time consumption in mandays of the different tea-cultivation-activities per acre

	land-prep.	plant.	fert.	cutt.	weed.	picking and transport
jan						12.9
feb.					6	12.9
mar.	6					12.9
apr.		6	1			31.9
may					6	31.9
jun.						31.9
jul.			1	6		31.9
aug.						12.9
sep.						12.9
oct.						12.9
nov.						31.9
dec.						31.9
tot.	6	6	2	6	12	268.8

Out of these data it can be calculated the total number of mandays spent in tea per year.
For the total number of mandays spent in mature tea the time consumption of cutting and weeding have to be added to the picking- and transport-data.
This makes a total of 268.8 + 2 + 6 + 12 = 288.8 mandays per acre per year = 693.1 mandays\ha\yr.
From this overview it is clear that tea-farmer is supposed to spend most of his time in the picking of the leaves , and that especially in the flushing months he will be very busy.
It is so calculated , that in this area , 71 % of the labour within tea is

engaged in the task of picking.

From this table it also becomes evident that April , May , and December are the months in which the flush-growth requires the farmer to do a lot of picking.
Even these are the months in which also a lot of coffee has to be picked, usually two days within every week , and as we've seen nearly every farmer in our area grows both coffee and tea.

Consequently most farmers speak about labour-shortage and make use of so-called 'irima' and/or casuals during these months,although 24 % of the farmers said they never make use of any help from outside the family.

Irima is the Kiembu name for a kind of cooperation among people whereby a small group of about 2 to 5 persons go and help a particular farmer harvesting his tea or coffee. Irima is provided on the expense of a meal during luching-time by the farmer. The group stays to help for a couple of days (1 to 4 days) and a farmer can be assisted in this way twice or thrice a year , mostly during the months of april , may , and december.
Of the farmers in our sample-area 48 % said they make use of irima every now and then.

In addition , also 48 % of the farmers pointed out that they use to employ casuals at the expense of 10 to 15 Kshillings a day , or at a piece-rate of 0.50 to 0.60 cts. per kg. green leaves.
More people and more days are involved when employing casuals , compared to when making use of irima , which can be looked upon as incidental help.
On the average , casual labourers are being employed throughout the year , 1 to 6 people per farm , each working from 1 to 6 days a month during a month or 4 , with of course only few being employed in the months of january and february.

Still there seems to exist a labour problem ,35 % of the farmers argue that it is difficult to find labourers at the time when everybody has to work on his own shamba or help his or her own family.
Of the people who said they got into problems sometimes because of labour-shortage 10 % said that it was not a labour-problem as such , but merely a cash-problem for them, which , to my account , is of course very relative.

III.8 Cash

Once the farmers bring their green tea to the collection-point, their yield is being weighed and the amount is being recorded.
At the end of the month every farmer is being paid by the leaf-collection-officer at the factory , according to the delivered amount ; two months lay between deliveries and payment.

The monthly payment is composed as follows :

- the gross amount of money the farmer gets for selling his tea , based on a fixed price (1.90 Ksh per kilo since july 1985 ; before it was 1.50 Ksh for two years)

subtracted by :

- cess (0.38 cts per kilo)
- transport costs (to Nairobi for export , 0.05 cts per kilo)
- administration costs (0.05 cts)
- rebate (0.03 cts)
- fertilizer-deduction , depending on the amount given on credit , and being proportional to the periods of the year , in order to level the monthly income of the farmer (about 0.11 cts per kilo)

The monthly income in the wet season is usually two or three times as high as the dry season payment.
Once per year in the month of July, a second payment is done, which settles the changes in the world market price of tea and fertilizer credit items over the past year.
The second payment or bonus can be twenty times the monthly income in the rainy season.
To get an impression: The average farmer in our area during 1985\1986 received around 150 shillings per month in the dry period, around 350 shillings in the rainy period, and a yearly bonus of about 7000 Ksh.

IV Landevaluation

IV.1 Introduction

Landevaluation is the process of assessing land performance when used for specified purposes. This involves the execution and interpretaion of soil-surveys and studies on landforms , vegetation , climate , and other aspects of land , in order to identify and compare promising kinds of land-use in terms applicable to the objectives of the evaluation.(FAO 1976)
To be of value in planning , the range of land-uses to be considered and the implications of results out of physical studies have to be limited to those which are relevant within the economic and social context of the area considered. Accordingly , a landevaluation generally has of two stages ; an ecological analysis which is to be followed by a socio-economic analysis.
This chapter is only concerned with the former stage , and only one type of land-use is considered. Thus follows the ecological landevaluation with respect to tea of the area around Rukuriri and Chuka.

IV.2 The ecological landevaluation procedure

A.Selection of Land Utilization Types (LUT's)
Relevant kinds of land-use with respect to the physical , social , and economic conditions of the area and according to the development objectives are to be identified and described.

B.Determination of the requirements of the relevant land-uses.
A certain crop has its specific needs with respect to its physical surroundings and socio-economic context in order to show a proper performance.
Thus in order to estimate the suitability of the different Land-Units (LU's) for a specific crop , the minimum requirements and requirements for optimal production of this crop have to be enumerated.

C.Determination of the Land-Units (LU's) and their Land-Qualities (LQ's) and Land-Characteristics (LC's).
A Land-Unit is a mapped area of land with specified characteristics. A LU consists of one or a combined number of soil-mapping-units , which is homogeneous with respect to its LQ's.
Land-Qualities refer to a certain complex attribute of land which acts in a distinct manner in its influence on the suitability of land for a specific kind of use.
LQ's may be expressed in a positive or negative way. Examples are moisture-availability , erosion resistance , flooding hazard etc.
Land-Characteristics are attributes of land that can be directly measured or estimated , e.g. slope gradient , soil depth , amount of rainfall. They often don't affect the land suitability in an indiscriminate way , and are aggregated to LQ's.
The LQ's cover the requirements of land-use and determine the suitability of a LU , more or less independent of eachother (e.g. moisture availability and nutrient availability).

D.Compilation of conversion-tables.
Conversion-tables for different LUT's are compiled on the basis of 1.crop-requirements , 2.land-quality ratings , and 3.the different defined suitability-classes. In this way , a conversion-table for one specific crop shows per distinguished suitability class its ranges of suitability with respect to the different land-qualities according to their previously determined ratings.

E.Matching and suitability classification.
Matching refers to the process of comparing the requirements of a LUT with the LQ's of a LU.
When comparing conversion-tables with land-quality ratings of land-units the suitability-class turns out , and also the most limiting land-quality can be determined .

Notes :
-If the socio-economic evaluation is taken into accounta different picture of the suitability will turn out.

-Any change in given environmental circumstances or improvements carried out by man (fertilizer-application , irrigation , erosion-control) will require adjustment of the suitability rating.

When describing the different land-suitability-classes , an explanation of the term normative yields should be given.
Normative yields refer to outputs (in kg\ha or kg\acre) obtained by farmers under optimal ecological conditions and a certain specified technology level.

Suitability classes

S1 Ecologically highly suitable ; land with no or slight limitaions for the sustained cultivation of a given crop. Yields are 76-100 % of the normative yield.

S2 Ecologically moderately suitable ; land with moderate limitations for the sustained cultivation of a given crop. Yields are 51-75 % of the normative yield.

S3 Ecologically poorly suitable ; land with severe limitations for the sustained cultivation of a given crop. Yields are 26-50 % of the normative yield.

N Ecologically not suitable ; land having limitaions which appear so severe as to preclude any possibility of successful sustained use for a certain crop. Yields are 0-25 % of the normative yield.

- Above-mentioned symbols , indicating different suitability-classes , can be extended by a symbol reflecting the main limitation :
f.e. m = moisture availability
t = temperature
n = nutrient availability

Generally two different levels of technology are distinguished . These two levels will render different normative yields under the same ecological circumstances. The levels are defined and described depending on the actual situation in the area under consideration.

The technology levels applying to Rukuriri\Chuka tea area can be proposed as follows :

Technology level I

The most characterizing factor of trhis technology level is fertilizer-use. Farmers do not put fertilizer at all , or put less than is been advised them by the K.T.D.A.
In addition no effort is taken to keep the plucking table level , and the cutting and picking are activities not regularly undertaken.
Open spaces on account of dying of trees which got covered by weeds , are not immediately cleared and filled in with young plants.

Technology level II

This is the antagonist of level I, representing a fertilizer provision according to the prescriptionsfor optimal productions (which is 5 bags of 50 kilos NPK 25:5:5:5S (21 % N) per acre).
The picking is done regularly, keeping a flat plucking-table, removing the weeds, and cutting the trees once in three years.

Taken into account that both levels of technology are represented in the sample area, normative yields and suitability classes can be specified for the two distinguished technology levels.
The Tea Growers Handbook (1969) tells us possible yields lay between 1250 and 2700 kg/acre/year.
Accordingly , the normative yield for technology level I is set at 2000 kg\acre\yr and for technology level II at 2500 kg\acre\yr.
Below, the normative yields for tea per suitability class are presented in kg/acre/yr :

S1	T-I 1500-2000	T-II 1875-2500
S2	T-I 1000-1499	T-II 1250-1874
S3	T-I 500 -999	T-II 625 -1249
N	T-I less than 500	T-II less than 625

IV.3 Landevaluation for tea in Rukuriri\Chuka area.

The landevaluation is carried out on basis of the reconnaissance soil survey of the area and climatological data , and according to the FAO-framework for landevaluation with in addition the third approximation of the "proposals for rating of land-qualities" (Weeda , 1978) . except for the land-quality 'availabil;ity of water' , which is calculated according to Braun and v\d Weg in their publication in KSS internal communication no 7 ,(1977).

A.Selection of LUT's.

The only LUT to be considered in this report is tea .

B. Determination of crop-requirements.

The tea-requirements are shown in the underlined table (which is also to be found in paragraph III.6 ,table 21).

Table 28 Crop-requirements of tea,according to Acland (1971)and Eden(1965)

1. altitude	1500 - 2200 m
2. moisture-requirements	100-150 mm\month , 1500-1750 mm\yr
3. temperature	13 - 30 °C
4. slope	less than 65 %
5. soil-pH	between 4.0 and 6.0
6. other soil-qualities	well-drained profile more than 1.8 m. depth

For additional information on these specific requirements and actual conditions of the area , one is referred to paragraph III.6.

Additional facts on the requirements of tea with respect to the soil will be given here.

- Requirements of the tea-crop with respect to soil-properties.

The most evident requirement to be mentioned is the soil-pH , which should be between 4.0 and 6.0 .
The best soil-pH for tea-growing is said to be between 5.4 and 5.6 . A pH below 5.4 causes deficiencies of base-nutrients and phosphate , while a pH above 5.6 gives problems of establishment of plants , particularly stumps (cuttings). pH

The second important requirement of tea is a well-drained and permeable soil , which is essential for satisfactory growth of tea. permeability

Another requirement to be considered is the fact that tea-roots are not very thick and firm , and pans or otherwise compacted soils offer an almost impenetrable barrier to root-growth. no pans

With respect to fertility ,it can be said that in general , tea-soils are of only moderate fertility owing to severe erosion and leaching. They are low in bases and phosphorus , and their nitrogen content is very variable. The bulk of the world's tea is grown on land that is not of first-class quality , and moderately productive tea is grown on land that produces but sparse other kinds of crops.
So economic crops of tea are garnered from soils which leave much to be desired with respect to fertility.

fertiliteit

Still , the following remarks can be made :
- Whilst it is true that tea does not grow healthily on soils of high base saturation , it cannot be rightly maintained that tea is a calcifuge.
- It is stated that the available Aluminium status of the soil is a diagnostic characteristic of good tea soil.
  The titrable acidity of these solutions are termed 'reserve' acidity , and it is maintained that when two soils showed the same pH-value , that one which was having the greater reserve acidity , was the more suitable for tea.

  ? uitleggen

- Great emphasis is put on the need for high organic matter content of tea-soils . But the potentialities of soils of high organic matter content are sometimes delusory . They can become denaturated and dry out after prolonged cultivation , and the high organic matter content can immobilize available copper.

  andere reden? (erosie!) Structuur stabiliteit.

C.Determination of 1. the Land-Units , and
2. their Land-Qualities and Land-Characteristics

ad 1. Determination of Land-Units

According to the procedure and planning of the TPIP project , and according to the principles of soil-mapping , land-units are to be distinguished upon general land-qualities which are said to be of importance for agricultural land-use. Hence , this paragraph is started with the presentation of the land-units from our sample-area distinguished according to the reconnaissance-map of Chuka-area.
Two major LU's are to be found :
RP1h\AC or DF , and
RP2p\AC or DF ,
which are dissected by two broad strips , indicated as a separate land-unit on this map with the symbol V1PC\EF , representing Thuchi-river- and Ruguti-river-valley.

The area is indicated by the symbol R , representing the morphological unit : Mountain Footridges.
The P stands for soils developed on (un)consolidated pyroclastics (lahar).
So Rukuriri\Chuka-area consists of :
- RP1h ; well drained , very deep , dark reddish brown to dark red friable clay. Predominantly acid humic topsoil. They are classified as dystric and humic Nitisols.
- RP2p ; well drained , moderately deep to deep , dark reddish brown to yellowish red and dark red friable clay. They are classified as dystric Nitisols and dystric Acrisols.

The supplements AC and DF refer to slope-classes , AC representing soils with slopes between 0 and 20 % , and DF between 20 and 60 % .
The valley-bottoms represent soils developed on lahars which form a complex

of well-drained , dark reddish brown clay soils of varying depth and rockiness (dystric Nitisols , humic and chromic Acrisols , chromic luvisols and Lithosols).

ad 2. Determination of Land-Qualities and Land-Characteristics

General LQ's to be considered according to the Kenya Soil Survey publications are :

1. Availability of water
2. Temperature
3. Chemical soil fertility
4. Salinity and alkalinity
5. Availability of oxygen
6. presence\hazard of waterlogging
7. Resistance to erosion
8. Possibilities of land-preparation
9. Hindrance by vegetation\ease of land-clearing
10. Presence of overgrazing (and other mismanagements)

It is advised for actual evaluation of the suitability to apply only the relevant LQ's for the LUT under consideration. This gives some change in the number and kind of LQ's with respect to the general ones listed by KSS. Selection of LQ's to be considered in this landevaluation is also based on the relevance of the LQ for the Rukuriri\Chukla area , and on the available data concerning a certain LQ.

ad 1. The availability of wàter is a relevant LQ

With respect to this LQ, the following distinction is made :
-available moisture , according to climatic characteristics , and
-moisture storage capacity , according to soil characteristics.

ad 2. Temperature will be considered as a relevant LQ .

ad 3. Chemical soil fertility
Also this LQ is subdivided into two aspects :
- The value of pH , which shall be considered ; and
- The availability of nutrients . This LQ will not be inserted in the final land-evaluation for three reasons :
- Chemical analysis data are not yet available
- according to the literature (see previous paragraph) no special requirements other than pH are presenting severe limiting factors on tea-growth.
- chemical surroundings of plant-roots are for a considerable part determined by fertilizers, applied by most farmers ,and not by its original nutrient-availability.

welke?

ad 4. Salinity and alkalinity are phenomena which occur in aride and semi-aride climate-zones , and is not relevant in this area.

ad 5. The available oxygen is to be considered as a LQ of relevance in this survey . ?

ad 6. Tea is always growing on the slopes of mountain-footridges and water-logging is not probable here.

ad 7. Soil-erosion is not playing important in mature plantations according to the farmers , because of complete coverage of the soil with the tea-plants , which protects the top-soil from being washed away.
Only in young plantations , when the soil is not completely covered , soil conservation measures (terraces , mulching) should be taken. But over the life-time of a tea-plantation, this is a relatively short period (about 2 years).
? Hence , slope , (and erosion hazard), can never be a limiting factor for proper tea-growth. Even it can be stated that tea is a crop especially suited to growing on steep slopes with respect to erosion-prevention , a crop to be preferred above other crops because of its erosion-preventing quality. max. slope? ? ben ik t niet mee eens!

ad 8. While tea is a permanent crop , land-preparation plays a minor part in the total crop-husbandry. Once the prepared land is planted with young tea , the land can stay like that for at least 50 years.

ad 9. The land in Rukuriri\Chuka area is already cleared , so the LQ hindrance by vegetation \ ease of land-clearing is not taken into consideration. overwoud

ad 10. With respect to a landevaluation of Rukuriri\Chuka area for the growing of tea , the LQ absence of overgrazing can stay out of consideration.

In the next, the relevant landqualities and the calculation of their ratings will be explained, followed by the determinations of the specific ratings of the three distinguished land-units in the sample area.

A. Available moisture

Moisture zone

The moisture zone is determined by the ratio $r \backslash E_o$, the average annual precipitation (r) and the average annual potential evaporation (E_o). With this ratio it is possible to make an estimation of the amounts of days per year with full moisture according to : amount of days full moisture = $100 \backslash 0.8 * r \backslash E_o$.
The agro-climatic zone map of the KSS (Braun et al , 1982) distinguishes 7 zones for moisture availability ;

Dit lijst?

Table 29 Moisture availability zones (Braun et al, 1982)

zone	$r \backslash E_o * 100$ %	amount of days full moisture	description
I	more than 80	365	humid
II	65 - 80	297 - 365	sub-humid
III	50 - 65	228 - 297	semi-humid
IV	40 - 50	182 - 228	semi-humid \ arid
V	25 - 40	114 - 182	semi-arid
VI	15 - 25	68 - 114	arid
VII	less than 15	0 - 68	very arid

-RP1h : $r = 1700$, $E_o = 1400$, $r/E_o * 100$ % = 121 ; moisture class I
-RP2 : $r = 2000$, $E_o = 1800$, $r/E_o * 100$ % = 111 ; moisture class I
-V1PC : $1600 < r < 2200$, $1400 < E < 1800$, $r/E * 100$ %>80 ; moisture class I

Moisture storage capacity

This soil-characteristic factor is composed of a factor : Total Productive Available Moisture (TPAM in mm.) and a factor : hindrance to root development.
Since there are no reliable pF-data available , the TPAM has to be estimated from table 30 . This table is based on correlations between available moisture , clay content , and soil depth. — welke text. is gekozen? en waarom?
The rating for the soil-moisture-storage-capacity is given in table 31.

Table 30 TPAM for different soil depth and textures

Silty

depth (cm)		LS	SL	SCL	SC	C
25	very shallow	8	10	14	20	28
50	shallow	15	20	28	40	55
80	moderately deep	24	32	44	64	88
120	deep	36	48	66	96	132
150	very deep	45	60	83	120	165
180	extremely deep	54	72	99	144	198

Table 31 Rating of the soil-moisture-storage-capacity

Rating		TPAM (mm)
1	very high	160 - 200
2	high	120 - 160
3	moderate	80 - 120
4	low	40 - 80
5	very low	less than 40

geen onderschriften bij de tabellen!

The TPAM - rating has to be adjusted taking into account "hindrance to root development".
- no adjustment if hindrance is slight (in case of oxic , argillic , and cambic horizon)
- downgrade rating with one class if hindrance is moderate (in case of pronounced argillic horizon \ pronounced sedimentary stratification).
- downgrade rating with two classes if hindrance is strong (in case of planic horizon (abrupt textural change) \ natric horizon \ impermeable layer).

For the sample area :
-RP1h ; texture :clay, depth : very deep ,TPAM : 165/198
rating 1 ,very high
-RP2 ; texture :clay, depth : mod. deep/deep , TPAM : 88/132
rating 3/2 , moderate/high
-V1PC ; variable data
rating 2 to 5

Note : As a result of aggregation of clay , which is said to take place in Nitosols, TPAM may be found in silty classes , and accordingly available moisture may be somewhat less than indicated.

Temperature zone

Table 32 The temperature zones

zone	mean annual temperature °C	mean maximum temperature °C	mean minimum temperature °C
I	24 - 30	30 - 37	18 - 23
II	22 - 24	28 - 30	16 - 18
III	20 - 22	26 - 28	14 - 16
IV	18 - 20	24 - 26	12 - 13
V	16 - 18	21 - 24	11 - 12
VI	14 - 16	19 - 21	9 - 11

These zones are compiled according to the relation between altitude and temperature.

Ratings for the sample area :

-RP1h ; altitude :about 1600 m ; mean maximum T = 24.2 °C
mean T = 18.5 °C
mean minimum T = 13.1 °C

zone IV

-RP2 ; altitude :about 1700 m ; mean maximum T = 23.5 °C
mean T = 17.9 °C
mean minimum T = 12.6 °C

zone V

V1PC : zone IV and V

The value of the pH

The pH-ratings as recorded in KSS-publications have to be adapted for the LUT tea :

Table 33 The pH-ratings

rating	pH
1 very favourable	5.4 - 5.6
2 favourable	4 - 5.4 , 5.6 - 6
3 unfavourable	below 4 , beyond 6

All pH values within the entire sample area are found in the range of 4 to 6 , which makes rating 2 (favourable).

Availability of oxygen

The rating for the availability of oxygen is given in table . The ogygen - availability is only in danger in bottomlands , which are flooded in the rainy periods.

Table 34 Availability of oxygen-ratings

rating	soil drainage class
1 high	well to excessively drained
2 high	moderately well drained
3 moderate	imperfectly drained
4 low	poorly drained
5 very low	very poorly drained

The soil-units RP1h and RP2 are well to excessively drained , which constitutes a rating of 1.
The valley-bottoms in general are not well drained and likely to cause an oxygen-deficit ; rating 2 to 5.

The results of the classification of the different land-units with respect to relevant land-qualities for tea , will be given in the summarizing table below :

Table 35 Landquality-classes of 5 relevant landqualities for growing of tea in 3 different land-units which occur in Rukuriri/Chuka area, Kenya

land unit	available moisture zone (a)	moisture storage capacity (b)	temp. zone (c)	pH (d)	available oxygen (e)
RP1h	I	1	IV	2	1
RP2	I	3/2	V	2	1
V1PC	I	2 to 5	IV + V	2	2 to 5

D. Compilation of the conversion - table

Table 36 Conversion-table for the Land-Utilization-Type Tea

LQ suit.class	available moisture zone (a)	moisture storage capacity (b)	temp. zone (c)	pH (d)	available oxygen (e)
highly suitable (S1)	I	1	IV	1	1
moderately suitable (S2)	II	1 - 2	III + V	2	2
marginally suitable (S3)	III	2	V	2	3
unsuitable (N)	III	3	III + VI	3	4

This table is compiled according to the crop-requirements and the land-quality-ratings described before.

E . Matching and suitability classification

Table 37 Suitability classification of the occurring land-units in Rukuriri- and Chuka-area, Kenya ,for tea at two distinguished technology levels

Tea	Technology level I	Technology level II
RP1h	S1 a	S1 a
RP2	S1\S2 a,b	S1 a,b
V1PC	S4 a,b,d,e	S3

a = available moisture
b = moisture storage capacity
c = temperature
d = pH
e = available oxygen

This table shows that within tea-culture in this area the most limiting factor is available moisture , which together with a reduced moisture-storage-capacity as a result of the occasionally shallow soils within the RP2 - unit , can cause the drying up of tea , as experienced in the sample-area.
Valley-bottoms are not suitable for tea , limiting factors varying because of the complex nature of this land-unit.

IV.4 Conclusions

It seems that the entire area can be considered suitable for tea-growing.
Only decreasing attention to management and inputs can lead to a lower suitability class.
Available moisture is always the limiting factor. The in this report indicated problems in the field may be carried back upon this moisture deficiency.
Besides, the low yields in this area , especially in Chuka area , can be blamed for a considerable part to input and management facors , like f.i. labour-deficit in flush periods.
But this study was not meant to find the limiting factors for tea-production.To that end more research need to be done , especially with respect to soil-fertility , management, and the specific properties of the tea-crop and its requirements to the surroundings.

Annex I Questionnaire

GENERAL DATA

_Name of the farmer

_Date

_Location _name

_coordinates

_elevation

_Farmers number

_Number of the soilpit,if present

_Name interviewer

SHAMBA

#crops	1	2	3	4	5	6	7	8	9	10
	tea	coffee	maize	beans	potat	fallow	grass	home	cass	others
size (#acres)										
Distance from homestead										
Farmers land										
Bought										
Inherited										
Borrowed land										
Rent cash										
kind										
Borrowed free										
Farmed by this hh										
Not farmed										
Rented										
Fallow										
Other										

LIVESTOCK

:cattle
goats
sheep
poultry
others

product

sales

purchases.

Did/Do you practice any rotation or are you intending to change your cropping arrangment ?

Last year

Crops :	tea	coffee	maize	beans	potat	fallow	grass	home	cass	other
Size :										

Coming year

Crops :	tea	coffee	maize	beans	potat	fallow	grass	home	cass	other
Size :										

Fallow : For how long ?

Why ?

Former vegetation ?

Household composition and workavailability

	number	full-time	part-time	not	sex
father					
wife(s)					
dep.adults not at school > 18 years					
dep.adults still at school					
dep.children working on the farm not at school					
young children < 6 years					

Age youngest child :

Age eldest child :

off-farm work

person	sex	activity	income total	income contr	working months 2	3	4	5	6	7	8	9	10	11	12	1

Any other income\revenues ? (pension , trading , firewood/charcoal)

Activity :

How much :

The Cash-Crop

Area : Size : (acres)

Shape : (drawing)

Planting

Number of trees :

When planted : amount year

When are you intending to plant ?

How many acres ?

Cuttings bought ?

if bought : amount
price
source

or nursed at home from own trees ?

when bought immediately planted ?

or kept in nursery for a certin period ?

for how long then ?

Land prepration before planting ? What method (tools) ?

What is the rate of planting (cuttings/acre) ?

Distance/Density :

X X

X X

Planting-method (tools) :

Use of shade-trees or wind-breaks : (names)------

When planting : use of fertilizer (growth stimulation) ?
if yes: name
amount
source
price

MAINTAINANCE

Rate of cutting/pruning :

In what period :(month)

When pegging ?

Dressing

	when	name	amount	price	source
manure					
fertilizer					
mulching					

Weeds

Name :

Symptoms :

% covering :

weed - control method
mechanical or chemical ?

if mechanical : what tools ?

if chemical : spraying or pouring ?
name chemical :
when used ? (frequence/period)
amount :
price :
source :

Diseases

name :

symptoms :

% covering :

chemical control method :

name chemical

when used :(frequence , period)

amount

price

source

SOIL CONSERVATION

gradient :	flat ,	0-6 %	T
	moderate	6-16 %	H
	gentle	16-30 %	L
	steep	> 30 %	B

Slope length:

farmers idea of the problem : no
slight
major

Conservation measures ?   yes   no

terraces
----
trashlines
----
grassstrips
----
stonelines
----
trees
----
other

Are the measures adequate ? yes   no

If no , why ?   no time/labour
----
no cash
----
no interest
----
other

How was last rainy season ?
more or less rain as usual ?
more or less erosion as usual ?

PLUCKING/PICKING

How many bags do you bring to the collectionpoint per day on the average
in the dry period ?
in the rainy period ?

How many bags 1 person can pick per day on the average
in the dry period ?
in the rainy period ?

How much time is necessary to fill 1 bag by 1 person ?

1 person can pick 1 acre in how many days ?

How many picking hours a day by 1 person ?

Do you know your average production in kg
in the dry period ?
in the rainy period ?

CULTIVATION-CALENDAR

	2	3	4	5	6	7	8	9	10	11	12	1
planting												
weeding												
fertilizing												
manuring												
pruning/cutting												
picking												
other												

Name of the collection point ?

Distance from the shamba ?

Average monthly payment
- in the dry period :
- in the rainy period :

Second payment (bonus)
- in 1985 :
- in 1984 :

LABOUR-REQUIREMENTS

	days (weeks) for 1 acre	how many persons
clearing		
land-preparation		
planting		
fertilizing		
weeding		
pruning/cutting		
plucking insect control		
soil conservation		
other		

NON-FAMILY LABOUR	2	3	4	5	6	7	8	9	10	11	12	1
how many persons :												
days per person :												
what activity :												

Cost : piece-rate :
salary :

Cooperation (irima) yes or no :

if yes , what kind of work ?

Is labour easy to obtain ?

yes
sometimes
no

if no , why not ?

if yes , which months ? 2 3 4 5 6 7 8 9 10 11 12 1

Do you have any problems (according to tea or coffee cultivation) ?

Annex II Economic aspects of tea in Rukuriri\Chuka area

- market orientation : cash crop
- capital intensity
  - class : high
  - value of physical working assets :
    - per acre Shs : -
    - per kg product Shs : -

- labour intensity
  - class : high
  - number of days per acre : 288.8
  - number of days per kg product : 0.2

Production and inputs per acre per year :

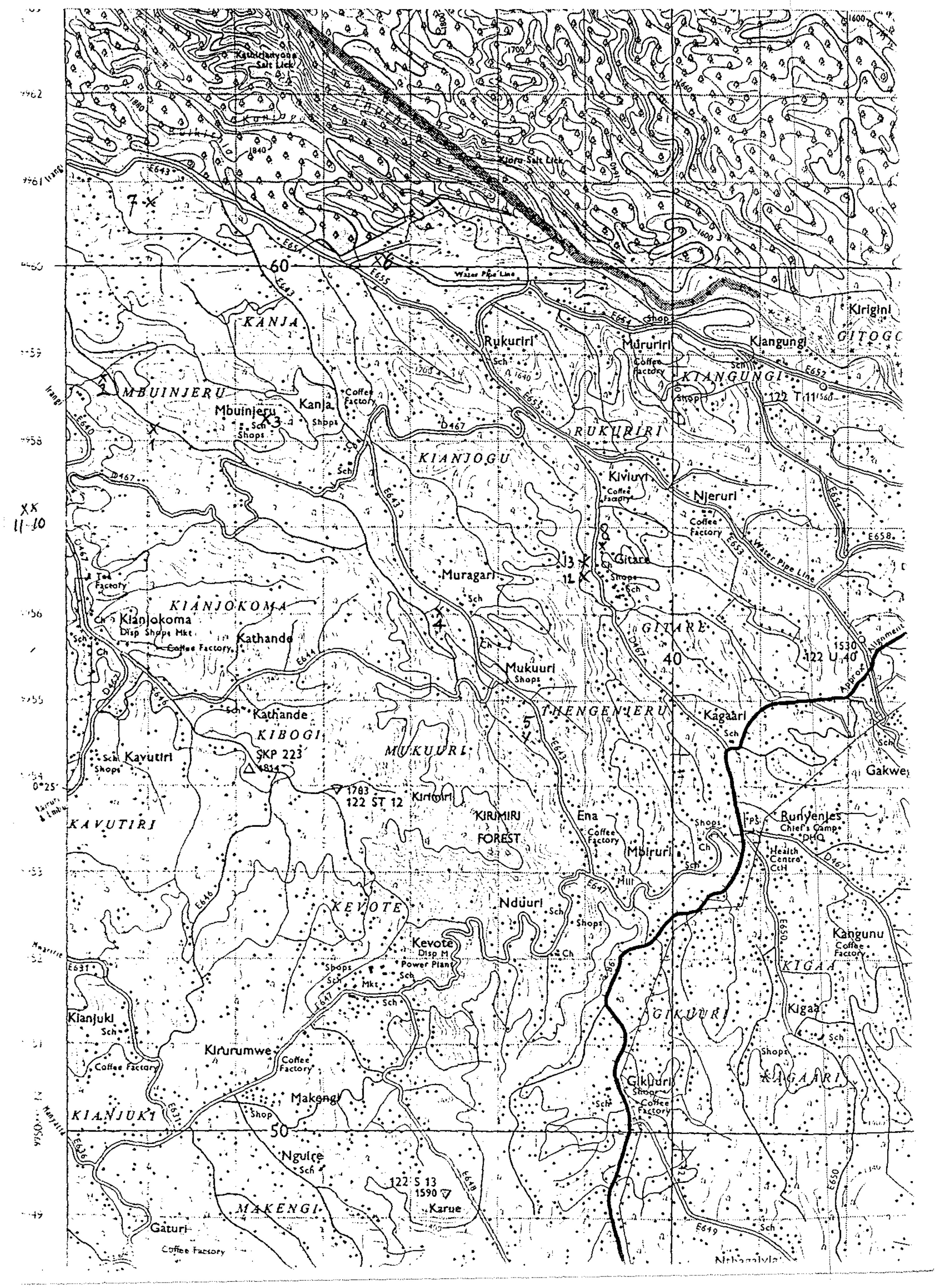
Item	Price/unit	Quantity	Value
Production	1.90 - (0.51)= 1.39 KSh per kilo + second payment (KSh 7000)	1584 kg	9202 KSh
Inputs			
planting material	0.50 KSh\tree	3600 trees	negligible
fertilizer	200 KSh	3 bags	600 KSh
Total variable costs			600 KSh
Gross Margin Analysis per acre			8602 KSh

GM per Sh variable costs	14
GM per Sh physical working capital	-
GM per labour day	30
GM per average size of LUT	

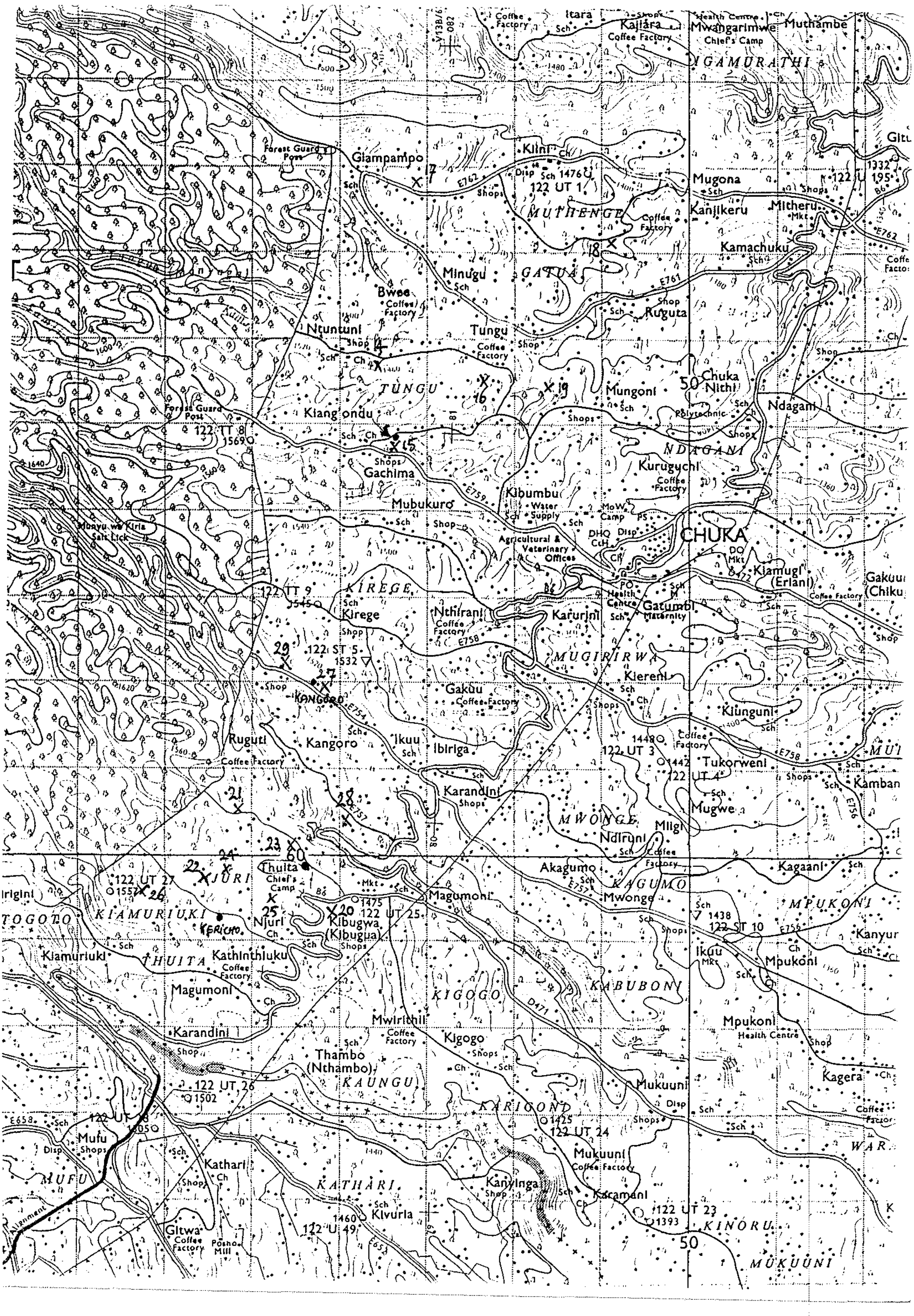
	Farm class			
	I	II	III	IV
average cultivation size	0.5	0.8	0.9	1.4
Gross Margin	4301	6882	7742	12043

Legenda Suitability map

S1a / S1a	=	Technology level I : highly suitable Technology level II : highly suitable The limiting factor being available moisture
S1/S2 a,b / S1 a,b	=	T-I : highly / moderately suitable T-II : highly suitable The limiting factors being available moisture and moisture storage capacity
N a,b,d,e / S3 a,b,d,e	=	T-I : not suitable T-II : poorly suitable The limiting factors being : available moisture , moisture storage capacity , pH , and available oxygen



Kathirianyone Salt Lick
Kioru Salt Lick
Water Pipe Line
KANJA
MBUINJERU
Mbuinjeru
Kanja
Coffee Factory
Rukuriri
Mururiri
Kiangungi
GITOGO
KIANGUNGI
Kirigini
RUKURIRI
KIANJOGU
Kiviuvi
Njeruri
Gitare
Muragari
KIANJOKOMA
Kianjokoma
Disp Shops Mkt
Kathande
Tea Factory
GITARE
Mukuuri
THENGENJERU
Kagaari
Kathande
KIBOGI
Kavutiri
SKP 223
1814
MUKUURI
122 ST 12
Kirimiri
KIRIMIRI FOREST
Ena
Mbiruri
Runyenjes
Chief's Camp
DHQ
Health Centre
Gakwe
KAVUTIRI
KEVOTE
Nduuri
Kevote
Power Plant
Kangunu
KIGAA
Kigaa
GIKUURI
Kianjuki
Kirurumwe
Makengi
Gikuuri
KAGAARI
KIANJUKI
Nguire
122 S 13
1590
Karue
MAKENGI
Gaturi
Coffee Factory
122 T 11
122 U 40
Approx Alignment



Itara
Kajiara
Coffee Factory
Mwangarimwe
Chief's Camp
Muthambe
IGAMURATHI
Giampampo
Forest Guard Post
Kiini
122 UT 1
MUTHENGE
Mugona
Kanjikeru
Mitheru
122 U 195
E762
Kamachuku
Minugu
GATUA
Bwee
Coffee Factory
Ntuntuni
Tungu
Ruguta
E761
TUNGU
Mungoni
Chuka Nithi
Polytechnic
Ndagani
NDAGANI
Kiang'ondu
122 TT 8
Gachima
Mubukuro
Kibumbu
Water Supply
Kurugucht
E759
MoW Camp
DHQ
Agricultural & Veterinary Offices
CHUKA
Kiamugi (Eriani)
Gakuu (Chiku
Monyu wa Kiria Salt Lick
122 TT 9
KIREGE
Kirege
Nthirani
Karurini
Health Centre
Gatumbi
Maternity
E758
MUGIRIRWA
122 ST 5
Kiereni
Gakuu
Coffee Factory
Kiunguni
E754
Ruguti
Kangoro
Ikuu
Ibiriga
122 UT 3
122 UT 4
Tukorweni
E758
Kamban
E756
Karandini
Mugwe
E757
MWONGE
Ndiruni
Migi
Thuita
Chief's Camp
JURI
122 UT 27
Akagumo
KAGUMO
Kagaani
Magumoni
Mwonge
122 UT 25
MPUKONI
122 ST 10
Kanyur
KIAMURIUKI
TOGOTO
Njuri
Kibugwa (Kibugua)
Ikuu
Mpukoni
Kiamuriuki
THUITA
Kathinthiuku
Coffee Factory
Magumoni
KIGOGO
KABUBONI
D471
Karandini
Mwirithii
Coffee Factory
Kigogo
Mpukoni
Health Centre
Thambo (Nthambo)
KAUNGU
122 UT 26
Mukuuni
Kagera
KARIGONI
122 UT 24
122 UT 8
E658
Mufu
MUFU
Kathari
KATHARI
Kanyinga
Mukuuni
Coffee Factory
Karamani
122 UT 23
KINORU
WAR
Kivuria
122 U 49
Gitwa
Coffee Factory
Posho Mill
Alignment
50
MUKUUNI
Kericho
Kangoro

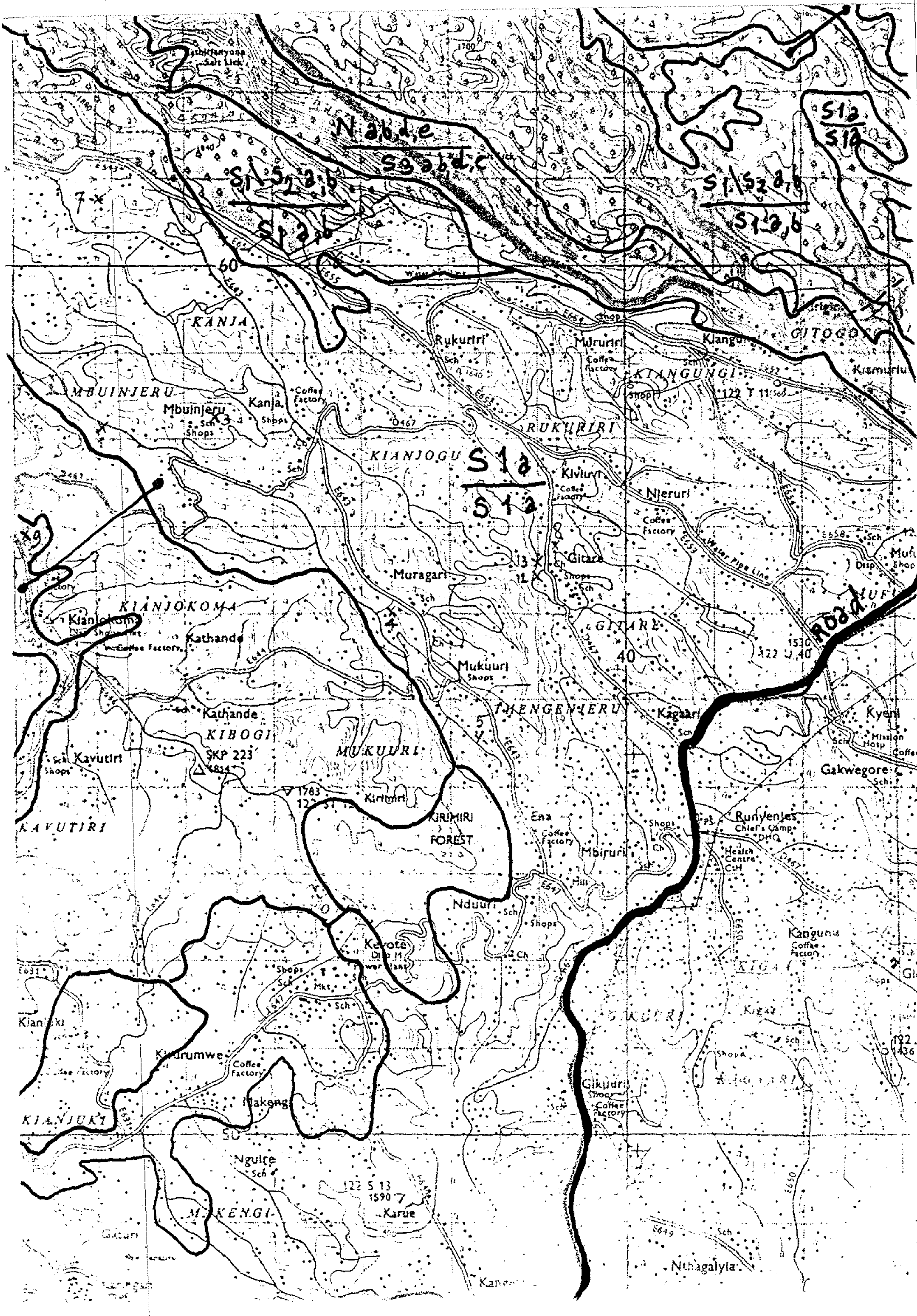
Legenda Soils

RP1h : well drained , very deep , dark reddish brown to dark red friable clay. Predominantly acid humic topsoil. They are classified as dystric and humic Nitisols.

RP2 : well drained , moderately deep to deep , dark reddish brown to yellowish red and dark red friable clay. They are classified as dystric Nitisols and dystric Acrisols.

V1PC : Complex of well drained dark reddish brown clay soils of varying depth and rockyness (dystric Nitisols , humic and chromic Acrisols chromic Luvisols and Lithosols ; about 10 % of this mapping unit are valley bottoms with very deep , clayey Nitisols , Acrisols or Luvisols).

AC : slopes between 0 and 20 %
DF : slopes between 20 and 60 %



N a,b,d,e
S9 a,b,d,c
S1\S2 a,b
S1 a,b
S1\S2 a,b
S1 a,b
S1a
S1a
S1a
S1a
Road
60
40
50
Kathirianyona Salt Lick
KANJA
Kanja
Shops
MBUINJERU
Mbuinjeru
Sch
Shops
Coffee Factory
Rukuriri
Sch
Mururiri
Coffee Factory
KIANGUNGI
Kianguri
Kismurlu
GITOGO
RUKURIRI
KIANJOGU
Kiviuri
Coffee Factory
Njeruri
Coffee Factory
Water Pipe Line
Gitare
Shops
Muragari
KIANJOKOMA
Kianjokoma
Coffee Factory
Kathande
GITARE
Mukuuri
Shops
THENGENJERU
Kagaari
Kyeni
Mission Hosp
Gakwegore
Kathande
KIBOGI
SKP 223
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MUKUURI
Kirimiri
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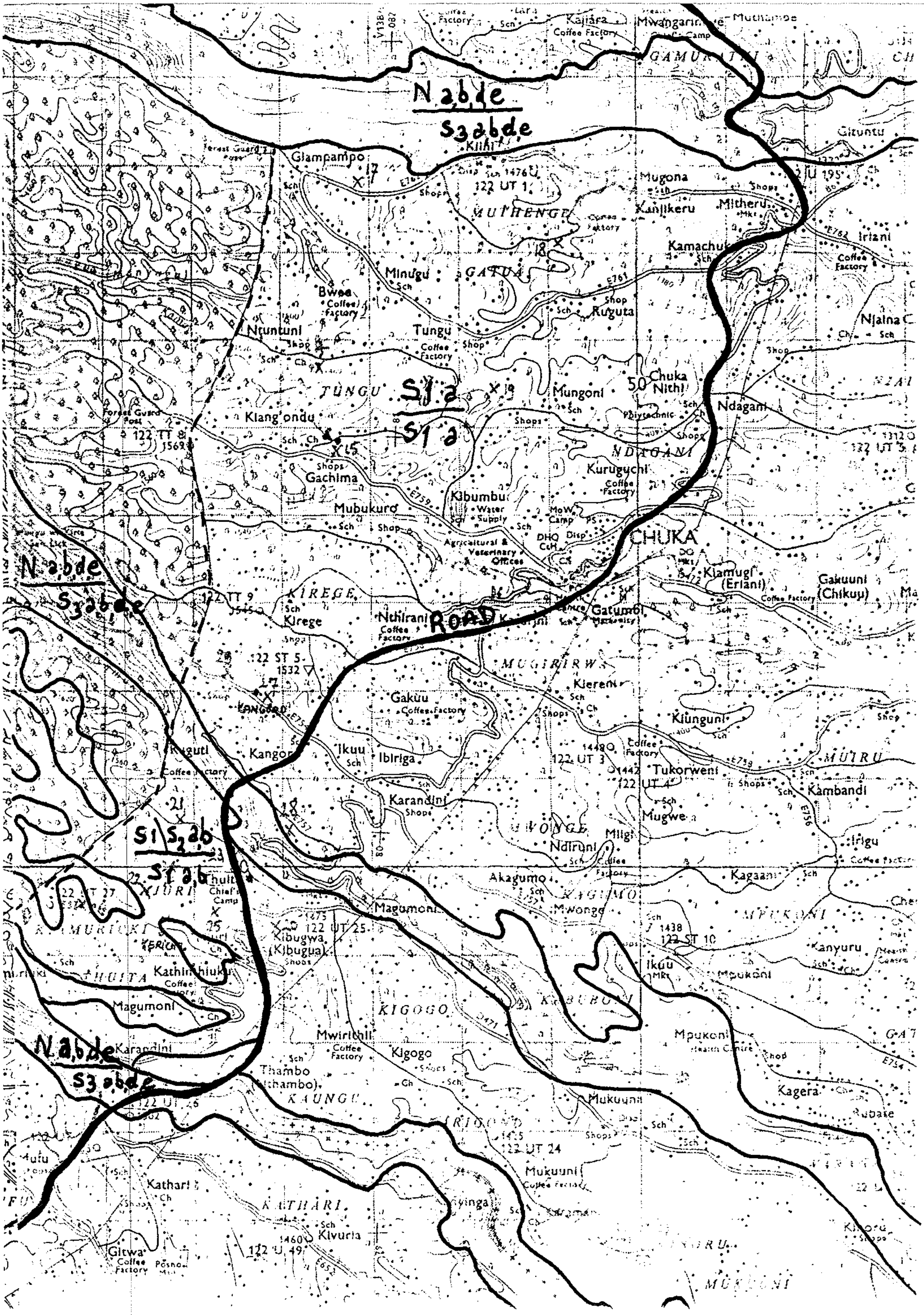
Ena
Coffee Factory
Mbiruri
Runyenjes
Chief's Camp
DHQ
Health Centre
Nduuri
Shops
Kevote
Kangaru
Coffee Factory
Kivurumwe
Coffee Factory
Makengi
KIANJUKI
Gikuuri
Coffee Factory
Nguire
Sch
122 S 13
1590
Karue
MAKENGI
Nthagalyia



Nabde
S3abde
S1a
S1a
ROAD
S1S2ab
S1ab
Mwangarini
Muthambe
Kajiara
Coffee Factory
GAMURATHI
Gituntu
Giampampo
Forest Guard Post
122 UT 1
Mugona
Kanjikeru
Mitheru
Irlani
MUTHENGE
Kamachuki
Minugu
GATUA
Bwee
Coffee Factory
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Coffee Factory
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1532
MUGIRIRWA
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Coffee Factory
Kiunguni
Kangoro
Ikuu
Ibiriga
Coffee Factory
122 UT 3
Tukorweni
122 UT 4
Kambandi
Kuguti
Coffee Factory
MUIRU
Karandini
Mugwe
Ndiruni
Irigu
Thuita
Chief's Camp
Akagumo
KAGUMO
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MFUKONI
122 UT 25
Kibugwa
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1438
122 ST 10
Kanyuru
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KAUNGU
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Kagera
122 UT 46
122 UT 24
Mukuuni
Coffee Factory
Kathari
KATHARI
Kiringa
Kivuria
122 U 49
Gitwa
Coffee Factory

CA 1:50,000 (KENYA)

CHUKA