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FARM MANAGEMENT HANDBOOK OF KENYA

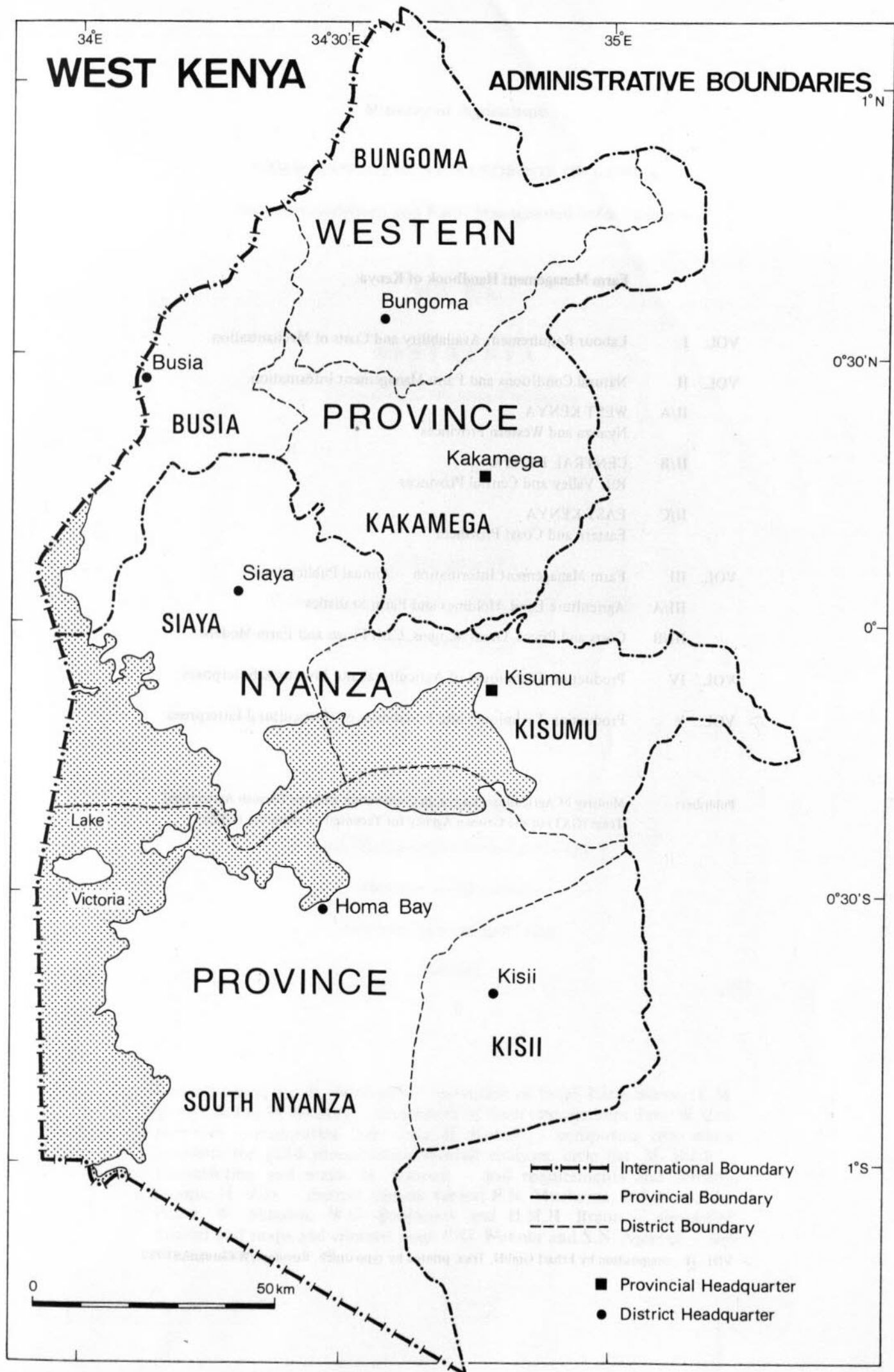
VOL. II

— Natural Conditions and Farm Management Information —

Part A

WEST KENYA

(Nyanza and Western Provinces)



Farm Management Handbook of Kenya:

- VOL. I Labour Requirement Availability and Costs of Mechanisation
- VOL. II Natural Conditions and Farm Management Information
 - II/A WEST KENYA
Nyanza and Western Provinces
 - II/B CENTRAL KENYA
Rift Valley and Central Provinces
 - II/C EAST KENYA
Eastern and Coast Provinces
- VOL. III Farm Management Information – Annual Publications
 - III/A Agriculture Land, Holdings and Farm Statistics
 - III/B Costs and Prices, Gross Margins, Cash Flows and Farm Models
- VOL. IV Production Techniques of Agricultural and Livestock Enterprises
- VOL. V Production Techniques and Economics of Horticultural Enterprises

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Ministry of Agriculture

FARM MANAGEMENT HANDBOOK OF KENYA

— Natural Conditions and Farm Management Information —

VOL. II/A

WEST KENYA

(Nyanza and Western Provinces)

by

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German Agricultural Team

Nairobi

Contributions by: R. Swoboda — execution of Small Farm Survey; C.M. Kang'e & J.G.M. Muasya — assessment of farm management data; W. Zetelmeyer — computing farm data; H. Kutsch — computing crop water relations for yield probabilities, rainfall analysis, crop list; M. Buch — transcribing soil maps; M. Kronen — soil requirements and fertility groups; H. Ritz — district climate tables; F.N. Muchema, B.J.A. van der Pouw, W. Siderius, W.G. Sombroek and H.M.H. Braun — simplified district soil maps and climatic map; C.G. Wenner and S.N. Njoroge — soil conservation

ACKNOWLEDGEMENT

In compiling this Handbook, we have relied on the support of many officers from a variety of institutions too numerous to mention, who made available their data and experience. We would like to thank them for their invaluable assistance.

I would also like to thank my colleagues, the Research Officers, the District Land and Farm Management Officers, for their cooperation, and a special thank you to those who typed the draft edition.

Our particular thanks go to Prof. Dr. Ralph Jaetzold, University of Trier, for his selfless support in compiling this Handbook and for his assessment of the natural conditions including land and population. His deep understanding of the needs of agricultural extension officers and farmers was a great asset. Our thanks also to Dr. H. Kutsch, University of Trier, who computerized a large and complex amount of information involved in establishing the AEZs.

Many thanks also to the staff of the Geographical Department of the University of Trier, Germany, for their major effort in drawing up maps of outstanding quality, the centrepiece of the work.

Nairobi, May 1982

Helmut Schmidt
Farm Management Research Officer

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Significance of the Evaluation of the Natural Potential

Method of the Agro-Ecological Zonation by Ralph Jaetzold

Calculation of Yield Potential out of Crop-Soil Water

Main Agro-Ecological Zones for Kenya

PREFACE

A sound knowledge of the natural conditions of a country is the basis for agriculture and a precondition for successful farming. Any research, planning or advising in agriculture requires clearly defined borders. The Agro-Ecological Zones (AEZ) have been delineated with this in mind, and show natural farming potential. Kenya's unique and diverse ecology is the reason for her very diverse land use system and the socio-cultural diversity of her rural population. The Handbook attempts to describe the conditions of the farming community as they are today.

A tremendous amount of agricultural and other research findings have been collected and compiled in this country by various institutions. If all this were readily available to the agricultural extension officer in the field, and thus to the farmer, it would provide a sound data base for decisions as to the most suitable types of crops to be grown and hence contribute to accelerated agricultural output. If used judiciously by the various Ministries in planning for rural development, it would provide a realistic base for decision making for the welfare of the rural population in general and the farmers in particular.

Due to growing diversification of life-styles, the urbanisation of the decision makers, and the advance in agricultural research, communication between various sections of the community has become increasingly inadequate, in particular between the farming community and the rest of the population. This unwelcome trend is very much at the expense of Kenya's farmers, the section of the population on which the wellbeing of the whole country depends. It is hoped that the definition and mapping of the Agro-Ecological Zones will provide better communication between research, planning and advisory work.

In compiling the Farm Management Handbook, the Ministry of Agriculture is taking a first step towards providing a common source of reference for all those working for rural development. I recommend all Ministries and Institutions dealing with the rural sector to use the AEZs in their work and communications.

The task involved in compiling the Handbook was a considerable one, as agriculture is practised under a wide range of conditions from sea level to 3 000 m above sea level and the natural conditions often vary within small areas. Rural life is constantly developing and changing; any description of it can never be complete, but the information made available in this Handbook is a big step forward and is a sound base for future developments in this field and in agricultural production. It is impossible to acknowledge all contributors individually. However, I should like to thank the staff of the Ministry of Agriculture, especially the Farm Management Branch, for their efforts in compiling the Handbook. I would like to thank Prof R. Jaetzold for the definition of the Agro-Ecological Zones; without his selfless efforts and outstanding knowledge of the subject, the work would not have been completed. In particular I would like to thank the German Agricultural Team (GAT) for its excellent cooperation and assistance with personnel and finance.

J.K. Muthama

DIRECTOR OF AGRICULTURE

Nairobi, May 1982

1. Farm Management Handbook - Nairobi - Kenya - 1982

2. Farm Management Handbook - Nairobi - Kenya - 1982

3. Farm Management Handbook - Nairobi - Kenya - 1982

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11. Farm Management Handbook - Nairobi - Kenya - 1982

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Vol. II of the Handbook covers the following areas:

VOL. II A WEST KENYA

Nyanza Province: Kisii, South Nyanza, Kisumu, Siaya Districts

Western Province: Busia, Bungoma, Kakamega Districts

VOL. II B CENTRAL KENYA

Rift Valley Province: Nandi, Kericho, Trans Nzoia, Uasin Gishu, West Pokot, Keiyo (Elgeyo) Marakwet, Baringo, Laikipia, Nakuru, Narok, Kajiado Districts

Central Province: Nyandarua, Kiambu, Murang'a, Nyeri, Kirinyaga Districts

VOL. II C EAST KENYA

Eastern Province: Embu, Meru, Machakos, Kitui Districts

Coast Province: Lamu, Tana River, Kilifi, Taita Taveta, Kwale Districts

The Handbook is supplemented by:

Large coloured district maps (mainly 1:250 000)

Transparent mother prints for large district maps (mainly 1:100 000)

Electronic data bank containing the rainfall data (1926-76)

Electronic data bank containing the farm management data

Agriculture Land Statistics obtained from Survey of Kenya

The information is kept by the Farm Management Research Officer, Ministry of Agriculture, Kilimo House, Nairobi.
In addition to that there exists an electronic programme packet for decadic water requirements of about 50 crops in different climates kept by Dr. H. Kutsch, Fachgruppe Geographie/Geowissenschaften, Universität Trier, West Germany

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List of Abbreviations

AEZ	= Agro-Ecological Zone	m	= medium
A	= Alpine	mat.	= maturing
add.	= additional	max.	= maximum
a. o.	= and others	min.	= minimum
av.	= average	NARS	= National Agricultural Research Station
b.	= beginning	norm.	= normally
bl.	= black	O.	= Office
br	= bimodal rainfall	p	= permanent
C.	= Cooperative	per.	= period
CAZRI	= Central Arid Zone Research Station (Jodhpur, India)	pl.	= planting
comp.	= composite	pr.	= precipitation
D.	= District	r.	= rains, rainy season
E _O	= evaporation of a water surface	res.	= resistant
e.	= end	R.	= Reserve
f. i.	= for instance	s	= short
For.	= Forest	sec.	= secondary
F.	= Farmer, Farmers	St.	= Station
H	= Highland; with crop name: hybrid	T	= Tropical
h.	= heavy	t	= temperature; with yields: tons
ha	= hectar	U	= Upper
i	= intermediate rains	ur	= unimodal rainfall
kc	= crop coefficient as potential evapotranspiration of a crop expressed in parts of E _O	v	= very
L	= Lowland, lower	var.	= variety
l	= long	y.	= year
LU	= Livestock unit of 300 kg	<	= less than
M	= Midland	>	= more than
		~	= about, nearly, around
		&	= and

INTRODUCTION

1. In general, the Kenyan farmer is well informed as to the potential of his own farm, the needs of his own family and the production techniques to be used when planting crops cultivated for generations. In the past, this was a perfectly satisfactory situation, but today, the farmer is called on to feed a rapidly increasing population and earn a major share of vital foreign currency through exports, i. e. he has to shoulder the costs of urbanisation in Kenya.

Traditional farming methods are no longer capable of meeting all the demands made on the farming community; widespread application of scientific methods is required, but knowledge of these methods is obtained, compiled and stored elsewhere, out of reach of the farmer.

The Handbook has been compiled primarily to assist the agriculture field advisor, who often has little scientific training but who is the most important officer in rural development. Extension work is organised within political units, i. e. division, location and district, and therefore information has been compiled according to AEZs per district, which in some cases has led to repetition. The layout and approach of the book has to be seen in this context.

A large number of officers working in many different Ministries and institutions for rural development are also increasingly in need of information about farming, as their contact with practical farming is often minimal.

It is a safe assumption that less than ten percent of relevant knowledge now available reaches the Technical Assistant and subsequently the farmer; it may also be assumed that a large number of planning officers spend more than two-thirds of their time in search of agricultural information, much of which is never uncovered, and/or has to be discovered again and again by each new, incoming officer.

On the research side, it is not always clear what the needs of the farming community are. This results in an increasing amount of irrelevant research, especially into rural socio-economics, which swallows scarce resources urgently needed to find answers to more pressing problems.

Information flow from research to the farmer, and vice versa, and among the various institutions involved in rural development is seriously hampered by the lack of a common source of reference.

Output of agricultural produce could be doubled if the knowledge already accumulated in Kenya were available to the farmer. The work output of the planning officer could also be doubled and its quality substantially improved if he had this knowledge on hand, which would go a long way towards improving the welfare of the rural population.

The increasing demand for information and communication calls for increased efforts to make the information accumulated available.

2. This transfer of "know-how" to those who need it is a major task and can not be achieved by the Farm Management Branch (FMB) of the Ministry of Agriculture alone — it requires a joint effort. The Farm Management Branch has now made a major effort to establish and compile information required by the farmers and those who work for the farming community.

This information will be published in five volumes of which Vol. II "Natural Conditions and Farm Management Information"¹⁾ is the centrepiece.

3. The Farm Management Approach is the most reliable method yet developed to assist farming. It is therefore very desirable that other institutions try to make use of this system. The use of Handbooks is compulsory for all officers of the Ministry of Agriculture.

Due to pressure of other work, the compilation of the Handbooks had to be done as a sideline job²⁾. Farm management information in particular is incomplete and there is much scope for improvement. Assistance and suggestions are most welcome, a new revised edition with improved farm management data is planned for the year 1990–91.

It is of course evident that the information given can not be blindly applied but requires assessment for its relevance to the actual case. Much of it, especially fertilizer recommendations, will be replaced within the next ten to twenty years. It is important to take note of these replacements.

The information is given per district and per AEZ, but the diversity of the farms in any one AEZ and the limitations of the data base make it essential to evaluate the data supplied i. e. it is most important to read the accompanying explanations.

4. The Farm Management Handbook (Vol. II) consists of the following parts.

- a) The three Volumes of the Handbook.
- b) Large AEZ district maps printed in colour (scale mainly 1:250 000)
- c) Transparent mother prints of large AEZ maps (scale mainly 1:100 000) from which black and white copies can be made.
- d) The Agro-Climatic Map of Kenya enclosed in the back cover of the Handbook.
- e) An electronic data bank containing rainfall data collected in Kenya from 1926 to 1976, readable at the Government main computer (IBM).
- f) An electronic data bank containing the findings of the Small Farm Survey (SFS), readable at the Ministry of Agriculture desk computer (Hewlett & Packard).

All items (a-f) are kept by the Farm Management Research Officer of the Ministry of Agriculture. They are available for further use provided the permission of the Ministry can be obtained. All items are owned by the Ministry of Agriculture.

5. It was not possible to compile a list of authors of the sources used as in most cases they were unknown. Practically all information used and/or included was established or compiled by persons working in the Kenyan Civil Service or for the Government; thus the product of their work is owned by the Kenyan Government.

EXPLANATION OF THE EVALUATION OF THE NATURAL POTENTIAL

METHOD OF THE AGRO-ECOLOGICAL ZONATION

by Ralph Jaetzold

Agro-ecological zones were established by FAO in 1978.¹⁾ They are suited to make decisions in international and long term agricultural policy. In order to give advice to farmers in the districts a more differentiated system showing yield probabilities and risks as well had to be developed:

1. The zone groups are **temperature belts** (Table I) defined according to the maximum temperature limits within which the main crops in Kenya can flourish; cashew and coconuts for the lowlands, sugar cane and cotton for the lower midlands, Arabica coffee for the upper midlands (usually known as "Highlands" — the term 'midlands' is used here to denote their central importance), tea for the lower highlands, pyrethrum for the upper highlands. The highest zone is high altitude rough grazing i.e. tropical alpine (or afro-alpine) vegetation. The threshold values of annual mean temperatures have been established along similar lines to those of H.M.H. BRAUN (see map on back cover)²⁾ but supplemented by limiting factors for many crops e.g. mean minimum temperature, frost etc.
2. The **main zones** (Table I) are based on their probability of meeting the temperature and water requirements of the main leading crops i.e. climatic yield potential, calculated by computer (see p. 19). The zones are roughly parallel with Braun's climatic zones of the Precipitation/Evaporation Index (see map in back cover), but there are differences according to the influence of the length and intensity of arid periods, a factor also considered by the computer programme.

The names of the main zones refer to the potentially leading crops there; many of them can be grown in some other zones, too (see p. 32)

The colours assigned to the main zones become lighter at higher altitudes (Table I). Additionally they become more red in the drier climates and at higher altitudes. This is due to the fact that with the same amount of water, the production of biomass is still less in cooler altitudinal climates. Also, the chances to ripe a crop before the end of the rainy seasons become smaller in these higher belts because of the increasing length of growing periods. Therefore, the Ranching Zone which covers Zone 6 in the Lowlands occurs already in Zone 5 in the Lower Highlands and even in Zone 4 in the Upper Highlands.

3. These main zones are divided into **subzones** according to the yearly distribution and the lengths of the *growing periods* on a 60 % probability factor i.e. the given length of the growing period should be reached or surpassed in at least 6 out of 10 years (Table II). "Growing periods" are defined as seasons with enough moisture in the soil to grow most crops, starting with a supply for plants to transpire more than $0.4 E_0$ (i.e. > 40 % of the open water evaporation), coming up to $> E_0$ (in the ideal case) during the time of peak demand, and then falling down in the maturity phase again. The length is normally given in decades (i.e. a ten day period) for medium soils. Figures are also available for heavy and light soils, and they are also considered in the computer programme for the yield potential of H. KUTSCH and H.J. SCHUH (see. p. 19)

This programme compares the water requirement curves of almost all the main crops (as provided by the FAO, 1977³⁾ and 1979⁴⁾, re-calculated by H. KUTSCH for 50 Kenyan varieties and adapted to the different agro-climates of R. JÄTZOLD⁵⁾ with all rainfall occurrences in Kenya from 1926 to 1976, in decades (10 day periods), and their effects on the water supply to the root zone for 3 soil groups and 3 plant population densities. On this basis, an ecological land use potential has been drawn up for each subzone, showing climatic yield expectations and risks.

The length of the growing period is the key to selecting the right annual crops within an agro-ecological zone. The symbols used for the lengths of the growing periods are straight-forward:

vl	=	very long
l	=	long
m	=	medium
s	=	short
vs	=	very short

These are further defined to give more detailed information by the use of "short to medium" "medium to long" etc. (Table II). If it is not desirable to subdivide the growing period in this way, the letter "f" for "fully" occurs before the symbol for the period.

The growing period formula is put in **brackets** if there is a weak performance i.e. although the moisture content is sufficient for growth, the peak demand which exceeds $0.8 E_0$ is not satisfied in the right time.

Where there are 2 rainy seasons per annum (bimodal rainfall areas), this is shown by a plus sign (+) between the two growing periods to show the yearly pattern.

If there is no distinct arid period of at least 3 decades (30 days) between humid growing periods, the sign — is introduced i.e. both periods are bridged together. Expressed in words, it means "... followed by".

TABLE I:

AGRO-ECOLOGICAL ZONES OF THE TROPICS¹⁾

Main Zones		AGRO-ECOLOGICAL ZONES OF THE TROPICS ¹⁾							
Belts of Z.		0	1	2	3	4	5	6	7
		(perhumid)	(humid)	(subhumid)	(semi-humid)	(transitional)	(semi-arid)	(arid)	(perarid)
TA	Tropical Alpine Zones Ann. mean 2-10° C	Glacier							
UH	Upper High- land Zones Ann. mean 10-15° Seasonal night frosts	Mountain swamps							
LH	Lower Highl. Zones Ann. mean 15-18° M. min. 8-11° norm. no frost								
UM	Upper Mid- land Zones Ann. mean 18-21° M. min. 11-14°								
LM	Lower Mid- land Zones Ann. mean 21-24° M. min. > 14°								
L	Lowland Zones IL Inner Lowland Z. Ann. mean > 24° Mean max > 31°								
CL	Coastal Lowl. Z. ⁵⁾ Ann. mean > 24° Mean max < 31°								
II. Sheep Zone									
I. Cattle-Sheep Zone									
		Sheep- Dairy Zone	Pyrethrum- Wheat Zone	Wheat- Barley Zone	U. Highland Ranching Zone	L. Highland Ranching Zone	U. H. Nomadism Zone ⁴⁾		
		Tea- Dairy Zone	Wheat/ Maize ²⁾ - Pyrethrum Zone	Wheat/(M) ²⁾ . Barley Zone	Cattle- Sheep- Barley Zone	Livestock- Sorghum Zone	L. H. Nomadism Zone ⁴⁾		
		Coffee- Tea Zone	Main Coffee Zone	Marginal Coffee Zone	Sunflower- Maize ³⁾ Zone	L. Midland Livestock- Millet Zone	U. Midland Ranching Zone	U. Midland Nom. Zone ⁴⁾	
		L. Midl. Sugar- cane Zone	Marginal Sugarcane Zone	L. Midland Cotton Zone	Marginal Cotton Zone ⁶⁾	Lowland Livestock- Millet Zone	L. Midland Ranching Zone	L. Midland Nom. Zone ⁴⁾	
		Rice- Taro Zone	* Lowland Sugarcane Zone	* Lowland Cotton Zone	* Groundnut Zone	Lowland Livestock- Millet Zone	Lowland Ranching Zone	Lowland Nom. Zone ⁴⁾	
		Cocoa- Oilpalm Zone	Lowland Sugarcane Zone	Coconut- Cassava Zone	Cashewnut- Cass. Zone	Lowland Livestock- Millet Zone	Lowland Ranching Zone	Lowland Nom. Zone ⁴⁾	

1) Inner Tropics, different zonation towards the margins. The T for Tropical is left necessary if other climates occur towards the margins.

1) Inner Tropics, different zonation towards the margins. The T for Tropical is left out in the thermal belts of zones (except at TA), because it is only necessary if other climates occur in the same country. The names of potentially leading crops were used to indicate the zones. Of course these crops can also be grown in some other zones, but they are then normally less profitable.

2) Wheat or maize depending on farm scale, topography, a.o.

3) Maize is a good cash crop here, but maize also in LH 1, UM 1-3, LM and L 1-4;

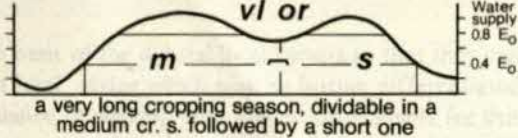
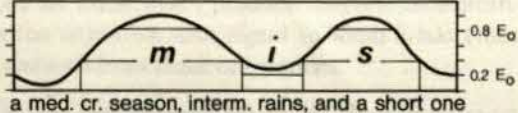
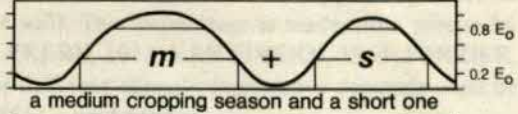
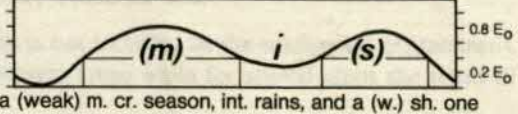
4) Nomadism, semi-nomadism and other forms of shifting grazing

5) An exception because of the vicinity of cold currents are the tropical cold Coastal Lowlands cCL in Peru and Namibia. Ann. mean there between 18 and 24°C

6) In unimodal rainfall areas growing periods may be already too short for cotton. Then the zone could be called Lower Midland Sunflower-Maize Zone.

* Not in Kenya

TABLE II: SUBZONES ACCORDING TO GROWING PERIODS FOR ANNUAL CROPS

Formula	Cropping seasons	Lengths of growing periods ¹⁾ exceeded in 6 out of 10 years	Samples of combination during the year in Kenya
<i>p</i>	Normally permanent	More than 364 days	
<i>vl</i>	Very long	285 - 364 days	
<i>vl/l</i>	Very long to long	235 - 284 "	a very long cropping season, dividable in a medium cr. s. followed by a short one
<i>l/vl</i>	Long to very long	215 - 234 "	
<i>l</i>	Long	195 - 214 "	
<i>l/m</i>	Long to medium	175 - 194 "	a med. cr. season, interm. rains, and a short one
<i>m/l</i>	Medium to long	155 - 174 "	
<i>m</i>	Medium	135 - 154 "	
<i>m/s</i>	Medium to short	115 - 134 "	a medium cropping season and a short one
<i>s/m</i>	Short to medium	105 - 114 "	
<i>s</i>	Short	85 - 104 "	
<i>s/vs</i>	Short to very short	75 - 84 "	a (weak) m. cr. season, int. rains, and a (w.) sh. one
<i>vs/s</i>	Very short to short	55 - 74 ²⁾ "	
<i>vs</i>	Very short	40 - 54 ³⁾ "	

Additional information: ur = unimodal rainfall, br = bimodal r., tr = trimodal r.

i = intermediate rains (at least 5 decades more than 0.2 E_0)⁴⁾

() = weak performance of growing period (most decades less than 0.8 E_0)

+ = Distinct arid period between growing periods

— = No distinct arid period between growing periods

f = full, i.e. no subdivision of grow. periods, for inst. fm means 115-174 days

1) Growing period = life of annual plants from seed to physical maturity. Figures show the time in which rain and stored soil moisture allow evapotranspiration of more than 0.4 E_0 (in medium soils of at least 60 cm depth), enough for most crops to start growing. During main growing time they need more, of course (>0.8 E_0).

2) Lowlands and lower midlands, in UM, LH and UH 65-74 days

3) Lowlands, in LM 45-54 days, in UM 50-64 days, in LH and UH 55-64 days

4) That means moisture conditions are above wilting point for most crops

In Rift Valley and Western Kenya, the rainfall is unimodal (i.e. one major rainy season p.a.) but the length of the vegetation periods allows for the planting of one late-maturing crop or two early-maturing crops. In this case the words ".... or two" are used after the symbol for the length of the season. In some cases 3 crops per vegetation period are possible, in which case the words ".... or three" occur after the length symbol.

In some areas, e.g. the Coast, the rains do not stop suddenly, and there is sufficient rainfall between the humid seasons to allow for the growth of some crops (cowpeas, simsim). However, this is not regarded as a real growing period; those "intermediate rains" are symbolized by an "i" if they last at least 5 decades (50 days) (see Table II, footnote 4).

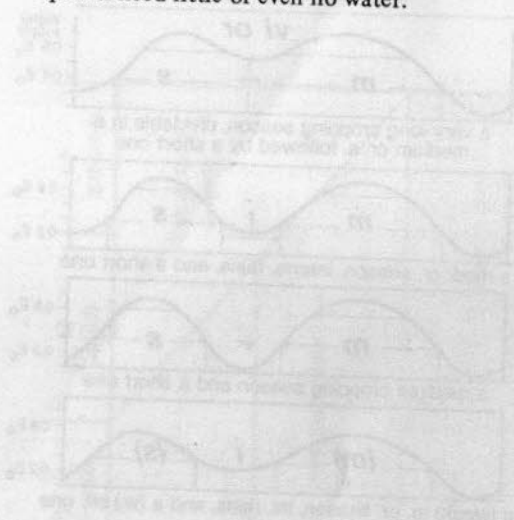
These complicated annual rainfall patterns make it difficult for the seasonal rainfall probability maps included for each district to set rigid limits for the start and the end of the rainfall. Then the most likely periods are chosen; in clear bimodal rainfall areas, the probabilities are given for the growing period itself.

4. The climatic agro-ecological zones are printed on soil maps derived from the Exploratory Soil Map of Kenya 1 : 1 Mio. (Kenya Soil Survey, 1982) to show agro-ecological mosaics within the zones. The soil units were roughly shaded on the basis of their natural fertility, in order to illustrate their potential and the inputs needed to improve them.

The soils should be considered as closely as possible. For many areas special reports from the Kenya Soil Survey already exist. The average yield expectations given for the Agro-ecological Zones of the district only show what is climatically possible (on prevailing soils) when other conditions are optimized.

Therefore, many other factors apart from soil and climate have to be considered as technologically standard, possibilities of additional irrigation⁶⁾ and so on. For drier areas of Kenya this is described in the volumes of the Kenya Marginal and Semi-arid Land Pre-investment Reports (Nairobi 1978). From the given agro-ecologically land use potential for each AEZ it has to be chosen carefully what is economically and sociologically reasonable for the time being.

5. The agro-ecological zones are illustrated by rainfall (water availability) and water requirement diagrams (see district descriptions). The curves in the diagrams are calculated – or if proper data are not available they are estimated – for optimum water requirements of crops from seeding to physical maturity. Harvest is later according to ripening stage, but then the plants need little or even no water.



- 1) FAO, 1978: Report on the Agro-ecological Zones Project. Methodology and Results for Africa. (= World Soil Resources Rep., 48/1), Rome
- 2) Kenya Soil Survey, 1982: Exploratory Soil Map and Agro-Climatic Zones Map of Kenya, scale 1 : 1 000 000. Rep. E 1, Nairobi
- 3) FAO, 1977: Crop Water Requirements.- (= Irrigation and Drainage Paper, 24), Rome
- 4) FAO, 1979: Yield Response to Water.- (= Irrigation and Drainage Paper, 33), Rome
- 5) JÄTZOLD, R., 1978: Klimageographie – Ostafrika. Afrika-Kartenwerk E 5, Berlin, Beiheft Berlin 1981
- 6) Artificial irrigation possibilities are normally not yet considered in the land use potentials of the Agro-ecological Zones, because they go beyond the climatic natural potential. Nevertheless, we are able to calculate if requested decadal water requirements of irrigated crops for defined sites.

CALCULATION OF YIELD PROBABILITIES FROM CROP-SOIL WATER RELATIONSHIPS

by Horst Kutsch

1. Introduction

Agro-ecological zones must be defined as zones of potential land-use on the basis of the natural local factors so that they can be employed as a fundamental element for agricultural advice on the district level, advice which may be further differentiated into small areas. Sufficiently precise possibilities of calculating the water balance of defined crop stands are available for this purpose. By using electronic data processing ecological simulation calculations are made which produce concrete recommendations for cultivation, such as the species, variety and crop density. Cultivation objectives with regard to water intake (root development) and water requirements (water requirement curves) can also be deduced from those calculations.

The basic framework for the calculations is provided by a balance between effective rainfall (see FAO, 1974) plus soil water on the one hand and, on the other hand, evaporation of crop stands (plants + soil). This initial stage is made more precise by employing suitable methods to calculate and measure plant transpiration (cf. EKERN, 1973; VAN EIMERN, 1964; PERRIER, 1975; STANHILL, 1965). It is felt that the soil's water holding capacity for different climatic evaporative demands must be incorporated. The proceeding developed by THORNTHWAITHE/MATHER (1955) is used for this.

One defect of many models of plants' water balances is that the root growth is not included in the mathematical statement. Yet a fixed quantity for the root-space is justified only in the case of permanent crops while for annual crops the result of the water balance calculations seems to be distorted to varying degrees.

So it was necessary to develop some mathematical form for covering the growth of the rhizosphere and thus the corresponding soil-water reserves. Recent biometric methods have been considered for this (CAUSTON/VENUS, 1981). In practice, a simplified model devised by the author for the growth of a root complex was used in the calculations. Apart from a more dynamic statement of the soil-water/plant relationship (FRANQUIN/FOREST, 1977) the water requirements had to be formulated more precisely than hitherto for more accurate calculations. Mean values over longish periods are unsuitable since considerable errors may be reproduced in models using short-term calculations (e.g. pentades, decades) of the water balance. On the basis of an approximation in graph form (FAO, 1977) KUTSCH/SCHUH (1980) have devised a mathematical formula for day-to-day calculations of the water requirement coefficient (kc).

A sophisticated model of soil-water dynamics including all climatic, soil-hydraulic and plant-physiological parameters was recently published by HILLEL (1977). Unfortunately, some of those required parameters are not available in every case and so the search for a simpler but still sufficiently accurate method of calculating plant-soil water relationships continues.

The model presented here calculates the theoretical water requirement curve and the actual water consumption curve in annual and decadal stages. The calculations relate first to a "normal" cultivated plant with specific ranges for kc and root values. Any cultivated plant whatsoever can then be processed in a second stage. In every case level cultivated land or operations to restrict run-off on slopes are assumed.

A final statistical process with the model produces detailed practical information. This model which is useful for simulation calculations enables us to answer a number of both theoretical and practical questions:

- How often does a specific growing period occur with defined characteristics regarding water requirements and roots and under given climatic and soil conditions?
- What is the frequency of a specific threshold value for water consumption over the individual decades? This makes it possible to define periods when the reliability of water supplies keeps within various ranges; this is particularly important for the peak water requirement phase which determines the yield.
- What is the best time for sowing or planting?
- How must the water holding capacity of the soil be improved so that plants with specific water requirements and root characteristics can exploit the given climatic conditions to the optimum?
- How should the development of the root complex appear if with a specific amplitude in the water requirement curve the plants are to exploit the given climatic and soil conditions to the optimum? or: How is the kc amplitude — an essential feature of the water requirement curve — to be procured so that, with specific root development, the plant may exploit the given climatic and soil conditions to the optimum?

The last two questions will not be examined further in this book. They should, however, be of interest with regard to experimental ecology for growing cultivated plants, and their answers could also provide plant breeders with properly-directed guidelines on selecting certain varieties of cultivated plants.

2. Structure of the programme

This programme is made up of three parts:

- A superordinate controlling part processes the 6 million or so items of climatic data, consisting of daily rainfalls in Kenya since 1926 and calculated evaporation figures (WOODHEAD, 1968), as well as the various scenarios (here: 50 crops and varieties with characteristic crop coefficients and root development characteristics).

- In the first section of the main programme (central algorithm) the annual length of the agro-humid period is calculated using a "normal" crop. In this context "normal" means that the general water-consumption curve of a crop (see Fig. 2) is taken as the basis. When adapted to the special agro-climatic conditions of Kenya, the initial value (kc/i) is then 0.4 when related to the mean daily PENMAN evaporation of 5-6 mm and the mean frequency of significant rainfalls of about 1 day in 3 at the beginning of the rainy season. The peak water requirements are indicated by the kc value 1.0 which corresponds to the maximum evaporation capacity of most cultivated crop stands. The final value (kc/m) is fixed at 0.4 and the mean root depth at 60 cm. The length of the agro-humid period (simply called growing period) can be very accurately determined by using this "normal" crop.

The principal parameter for estimating the lengths of agro-humid periods for the "normal" crop is the (actual) crop water supply (SUP). It is calculated as a ratio of available moisture (rainfall + soil moisture) to given (= potential) crop water requirements per decade. The following definition of this ratio is provided. The numbers correspond to an internal programme codification:

- "0": SUP < 0.2 (dying period for most crops),
- "1": SUP = 0.2 to 0.4 (survival period, especially for most perennial crops),
- "2": SUP = 0.4 to 0.8 (normal water supply in which the range of 0.4 to 0.6 could be described as sub-normal, tending more or less towards the survival period, especially during peak water requirements),
- "3": SUP > 0.8 (optimum water supply).

The year-to-year distribution of crop water supply gives us an approximate feature of the length of the growing period for the "normal" crop. The inter-annual water supply curve now enables us to calculate different probabilities (PROB):

- Probability for the best start ($\geq 60\%$) of sowing, defined by a water supply in the pre-phase of at least "1". In our example (Fig. 1) this probability (PROB₁) is 60% in the 3rd decade and 80% in the 4th.
- Probability for a selected and defined length of a growing period, irrespective of when the decades start. In our example we can select a length of 10 decades (without pre-phase) over all years and define a water supply of at least "2" in the initial decade and "2" or "3" in the following decades with no deficiency (= "0"). This pattern occurs in only 4 of the 10 years shown (2nd, 3rd, 7th and 8th year, decade 5 to 14, PROB₂ = 40%).
- Probability for a selected and defined length of a growing period as a function of a defined initial decade. In our example we can select a length of 11 decades over all years and define the 5th as the initial decade and the 4th decade as pre-phase; we can also define "2" or "3" in the following decades with, possibly, only one deficiency (= "0"). This occurs in 4 of the 10 years shown (PROB₃ = 40%).
- Probability per decade of a given water supply threshold. In our example we can define the threshold as "3". We then obtain a probability sequence which gives us some idea of more or less reliable seasons with the given water supply threshold. In our example a relatively reliable season includes decades 7, 8 and 9 with PROB₄ = 80-100%.
- Probability for any deficiencies (water supply = "0") in a defined growing period. In our example the probability (PROB₅) of a deficiency (= "0") occurs in several decades, mostly between the 12th and 15th decades.

Decade:	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
Year	1.	0	1	0	2	3	0	3	3	3	2	2	3	2	0	0	0	0
2.	1	0	0	1	2	3	3	3	3	3	3	3	3	2	1	0	0	0
3.	0	0	1	0	2	2	2	3	3	3	3	3	3	2	1	1	0	1
4.	1	0	1	1	2	0	3	3	3	3	2	2	2	2	0	1	0	0
5.	0	0	1	1	2	3	3	3	3	2	1	0	1	0	1	0	1	0
6.	0	1	0	2	3	0	3	3	3	2	2	3	2	0	0	0	0	0
7.	1	0	0	1	2	3	3	3	3	3	3	3	3	2	1	0	0	0
8.	0	0	1	0	2	2	2	3	3	3	3	3	3	2	1	0	0	0
9.	1	0	1	1	2	0	3	3	3	3	2	2	2	2	0	1	0	1
10.	0	0	1	1	2	3	3	3	3	2	1	0	1	0	1	0	1	0
a. s. o.																		

PROB₁ = 60 P₁ = 80 P₅ = 40
 PROB₅ = 40 P₅ = 20
 P₄ = 80 - 100
 P₅ = 20 P₅ = 40 P₅ = 40

Fig. 1: Example of the decadal distribution of water supply (SUP) for a "normal" crop with different probabilities (see text)

From the given water supply feature (Fig. 1) we can therefore deduce a very brief but fairly accurate picture:

- The best time for sowing (pre-phase) is the 4th decade, crops with a longer pre-phase could be sown yet in the 3rd decade; planting (of seedlings) recommended in the 5th decade (initial period);
- Relatively reliable situation for optimum water supply from the 7th to the 9th decade;
- Growing period to physical maturity normally to the 14th decade or to the 15th in the case of crops which are more adapted to drier conditions during their maturity;
- Short dry periods (not more than 10 days) are more frequent from the 12th decade.

In the second part of the main programme the water requirements, root development and – through the soil water balance – the actual water consumption of specific crops are calculated in line with the length of the growing period of a “normal” crop. As in the case of the “normal” crop, the calculations conclude with a determination of the crop water supply.

These values for the crop water supply are compared with yield reduction values (k_y ; FAO, 1979, specific to each crop). The water supply during the period of the plants’ peak water requirement ($SUP_{[peak]}$) is especially important as regards any possible yield reduction. The yield reduction (YR, in %) is calculated from the water supply deficit ($1 - SUP$) and the k_y values using the following simple equation:

$$YR = 100 \cdot k_y (1 - SUP_{[peak]}) \quad (1)$$

This value YR is corrected, if necessary, by our own regional experience in yieldings. The inter-annual distribution of this modified yield reduction for different crops provides us with some probabilities of yield expectations which finally enable us to establish the crop potential feature within a specific area (here for agro-ecological subzones). Yield expectations are given as a percentage of the potential optimum yield:

Probability of **very good** yield corresponding to 80–100 % of optimum

“ of good yield	“	60– 80 %	“
“ of fair yield	“	40– 60 %	“
“ of poor yield	“	20– 40 %	“
“ of total crop failure	“	0– 20 %	“

3. Central Algorithm

3.1 General structure of the water requirement curve for defined crops

Without going into details of the extremely complex agro-climatic problem concerning the determination of the water requirements of a defined crop stand (see Introduction), a general accepted approximation (FAO, 1977) will be employed here:

$$ET_{crop} [mm] = kc \cdot E_o \quad (2)$$

where ET_{crop} is the crops’ water requirement related to the evaporative demand of a given climate (E_o)¹⁾ over a specific length of time (month, decade, day). The coefficient kc expresses the actual water requirements of a crop stand in relation to E_o . This coefficient which can be ascertained only by empirical methods is governed by a large number of factors:

- a) General macro – and micro-climatic conditions,
- b) Species, variety and age of the cultivated plants,
- c) Vegetation stage,
- d) Crop density (plants per m^2 or ha),
- e) Any associated crops,
- f) Frequency of rainfall during the early stage of annual plants (or during the leaf development phase of deciduous tree-crops) because with a small amount of cover or shadow more account must be taken of the proportion of moistened soil in the crop evaporation.

Unfortunately the kc values given in the literature are not specified in detail and so the area in which they can be applied or transferred remains unclear. This is particularly true as regards (a), (d) and (f) above. The appropriate kc value can be selected only by taking all the climatological, biological and cultivation aspects into account. For this purpose the FAO (1977) has published water requirement coefficients for a wide range of cultivated plants and these are employed in this book. The FAO values are based primarily upon irrigation trials and relate to a few characteristic points or periods during the vegetation cycle (initial phase, peak water requirements and physical maturity). A graphic method of determining any mean kc value is also proposed for the purpose of practical calculations. For our more precise investigations, however, which require decadal values the course of the curve should be expressed mathematically. This needs seven parameters (see Fig. 2) which are also given in the appropriate tables of the FAO (1977, pp. 40–44):

1) E_o defined as evaporation from a free, i.e. theoretically unlimited water surface according to the formula of PENMAN (1948) modified here by McCULLOCH (1965). Other approaches are possible: Pan Class A, formula of BLANEY-CRIDDLE (1950).

- water requirement coefficient for the initial phase²⁾(k_c/i),
- water requirement coefficient for the peak water requirement period (k_c/p),
- water requirement coefficient for the time of physical maturity (k_c/m),
- duration of the initial phase (t_i),
- period from the end of the initial phase to the beginning of the peak water requirement (t_d),
- duration of peak water requirement (t_p),
- period from the end of the peak water requirement to the beginning of physical maturity (t_l).

The phenological data are obtained from pertinent regional observations in the planning area or have been deduced from comparable cultivation areas.

The general course of the curve for the water requirement coefficients (taken from FAO, 1977, p. 39) is shown in Fig. 2.

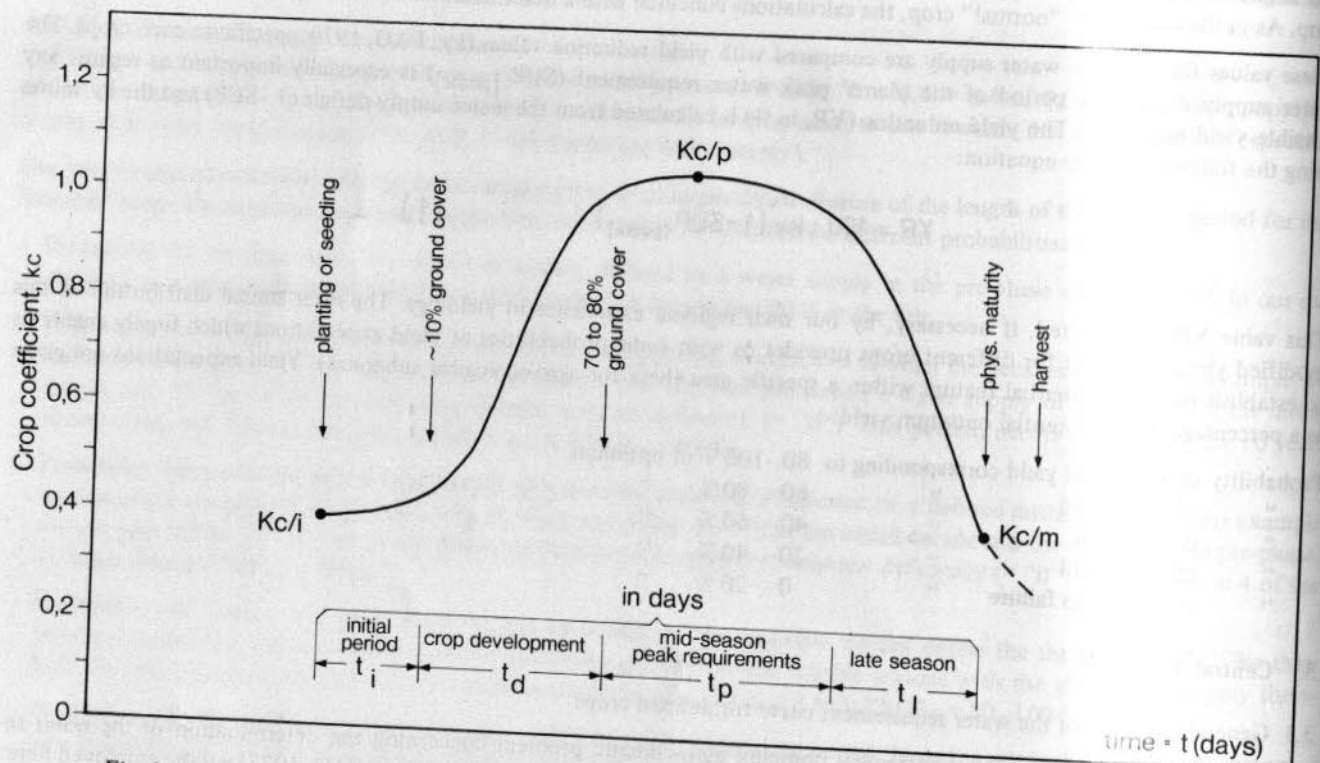


Fig. 2: General course of the curve for the water requirement coefficients, k_c (from FAO, 1977, p. 39, modified).

k_c : Crop coefficient as fraction of climatic evaporative demand (E_0); i = initial, p = peak, m = at physical maturity

3.2 Mathematical representation of the water requirement coefficients

3.2.1 Initial phase

Owing to the small amount of cover or shade obtaining at that time, the average daily k_c value during the initial phase of an annual or perennial crop depends upon the climatic evaporation capacity (E_0) and the interval between significant rainfalls³⁾ (λ). The mathematical representation of the relationships which have been empirically ascertained is based on the assumption of an e-characteristic of the corresponding curve.

- 2) Germination of seed or rooting of plantlets or resumption of plant activities in the case of perennial crops (e.g. rising sap in trees)
- 3) For tropical climates a threshold value of at least 1 mm/day can be assumed.

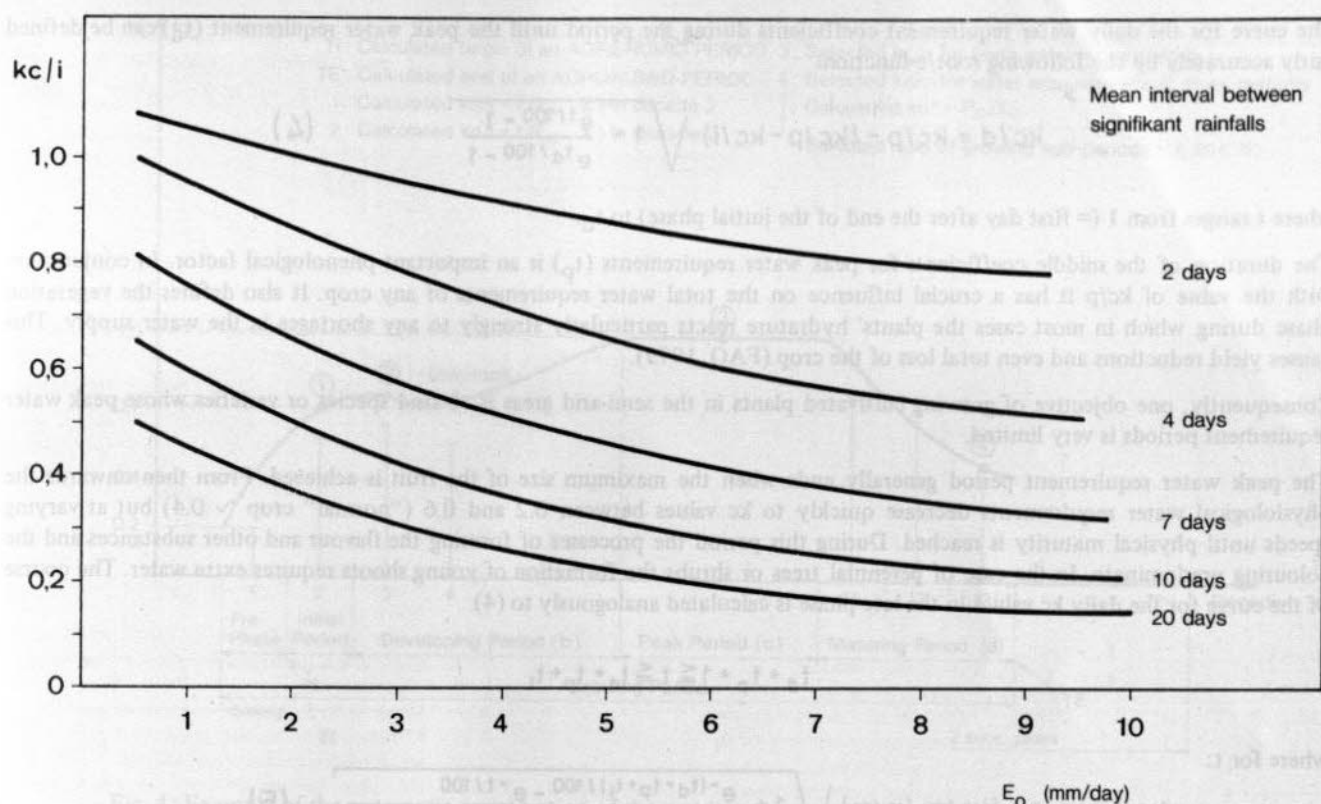


Fig. 3: General course of the curve for the water requirement coefficients in the initial phase kc/i (from FAO, 1977, p. 39)

The approximate mathematical expression is complex:

$$kc/i = a_1 \cdot e^{\text{exp1}} + a_2 \cdot e^{\text{exp2}} + b \quad (3)$$

The first exponent contains as a variable element the mean daily evaporative demand of the climate during the initial phase (E_o/day):

$$\text{exp 1} = -(0.2311 \cdot E_o + 0.2)$$

The second relates to the mean rainfall interval or irrigation interval (λ in days) during the same period:

$$\text{exp 2} = -(0.2385 \cdot \lambda + 0.2)$$

The coefficients occurring in the basic equation have the values 0.5447 (a_1) and 0.9971 (a_2); b is a constant with the value 0.185.

The mean kc/i value obtained by this means is also suitable for calculating the maximum evaporation of uncovered land (see FAO, 1977, p. 53). In that case, however, correcting factors would have to be incorporated to allow for the different evaporation behaviour of the various types of soil.

3.2.2 End of initial phase to physical maturity

The physiological water requirement of annual crops rises steadily from the end of the initial phase until the beginning of the peak water requirements. The amount of cover for the soil increases in parallel to about 80 %. Complete leaf development is reached during the period of peak water requirements which is critical for most cultivated plants.

In the case of perennial crops we must distinguish between deciduous species whose water requirement characteristics are comparable to those of annual plants, and the subtropical/tropical evergreens. The latter have a permanent physiological water requirement at a high but varying level. Certain fluctuations are caused by the sequence of phases in which transpiration is greater (flowering, formation of the ovaries) and lesser (maturing of the fruit), such as those found in coffee (cf. PEREIRA, 1957).

The curve for the daily water requirement coefficients during the period until the peak water requirement (t_d) can be defined fairly accurately by the following root/e-function:

$$kc/d = kc/p - (kc/p - kc/i) \sqrt{1 - \frac{e^{t/100} - 1}{e^{t_d/100} - 1}} \quad (4)$$

where t ranges from 1 (= first day after the end of the initial phase) to t_d .

The duration of the middle coefficients for peak water requirements (t_p) is an important phenological factor. In conjunction with the value of kc/p it has a crucial influence on the total water requirements of any crop. It also defines the vegetation phase during which in most cases the plants' hydrature reacts particularly strongly to any shortages in the water supply. This causes yield reductions and even total loss of the crop (FAO, 1979).

Consequently, one objective of growing cultivated plants in the semi-arid areas is to find species or varieties whose peak water requirement periods is very limited.

The peak water requirement period generally ends when the maximum size of the fruit is achieved. From then onwards the physiological water requirements decrease quickly to kc values between 0.2 and 0.6 ("normal" crop ~ 0.4) but at varying speeds until physical maturity is reached. During this period the processes of forming the flavour and other substances and the colouring predominate. In the case of perennial trees or shrubs the formation of young shoots requires extra water. The course of the curve for the daily kc values in the late phase is calculated analogously to (4)

$$t_d + t_p + 1 \leq t \leq t_d + t_p + t_l$$

where for t :

$$kc/l = kc/p - (kc/p - kc/m) \sqrt{1 + \frac{e^{-(t_d + t_p + t_l)/100} - e^{-t/100}}{e^{-(t_d + t_p)/100} - e^{-(t_d + t_p + t_l)/100}}} \quad (5)$$

3.3 Ascertaining the water requirements (kc curve) for "normal" crops

On a decadal and biannual basis the following relationship is formed between the measured rainfall (P_o) and the climatic evaporative demand (E_o): $kc^* = P_o/E_o$. These kc^* values are then projected in an enveloping curve with a selectable amplitude and a specific relationship between the various vegetation phases, whereby the envelope is automatically adjusted to the course of the general kc curve (see Fig. 2). The water requirement coefficient during the initial phase (kc/i), which is a function of the climatic evaporative demand (E_o) and frequency of rainfall (λ) (see Fig. 3), essentially determines the course of the curve until the peak water requirement is reached. One problem which has not yet been solved is the transition from the kc values for the initial period (kc/i) to the values for the developing period (kc/d); the kc/i value at the very end of the period as obtained from equation (3) is high and so, according to (4), this produces an excessively high branch of the curve until the peak water requirement is reached. In reality, however, the kc value may decrease after the initial period has been completed when (in the case of annual crops) a complete plant cover in the crop stand has been formed and the soil evaporation proportion of the crop evaporation has been reduced. Observations by the author justify the provisional approach to the effect that when the kc/i value at the end of the initial period is greater than 0.7 a virtual value of 0.7 should be employed for kc/i in equation (4).

The growing period is to be taken to begin (TI) at the point when the first kc/i value is equal to or greater than 0.4 and, at the same time, the corresponding values during the initial period are equal to or greater than 0.4. In some cases a pre-phase of mostly not more than one decade and with kc values below 0.4 could be of agronomic interest, especially for sowing. The end of the growing period (TE) can be taken as the point where the two kc^* values before the last one are above the selected kc/m value (in our case 0.4) and the last kc^* approaches it.

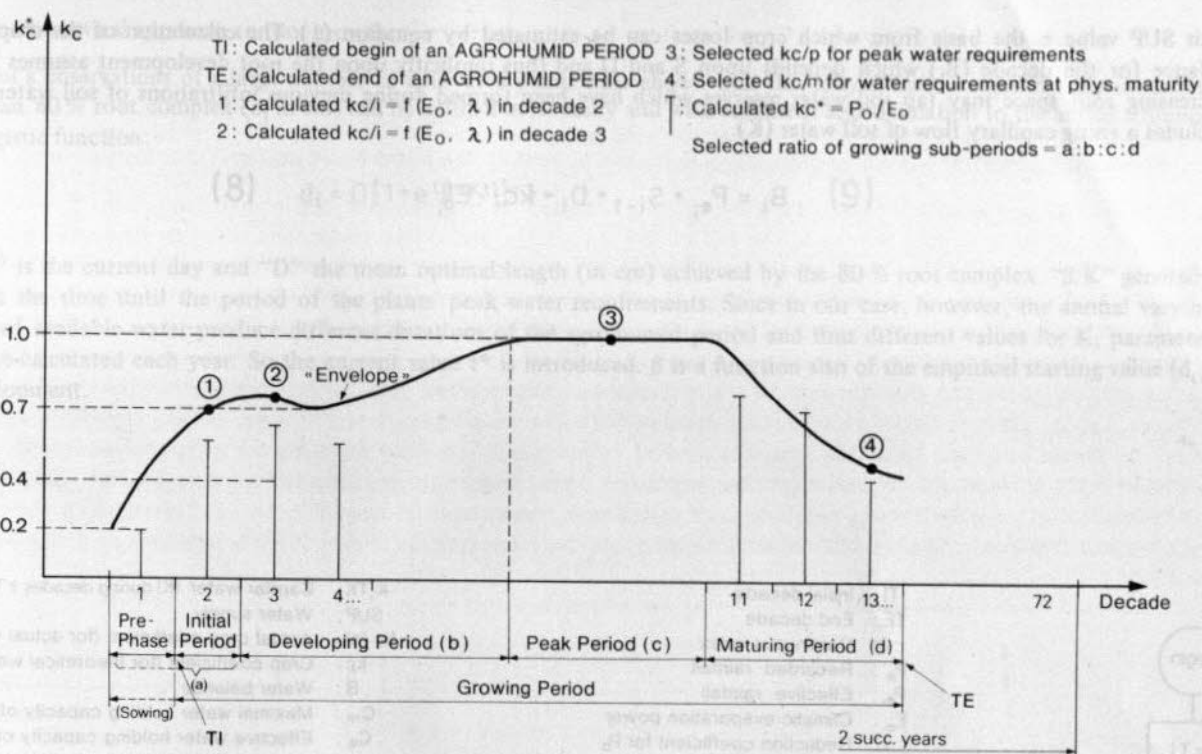


Fig. 4: Example of the automatic construction of the water requirement curve (kc curve) for a "normal" crop

3.4 Water consumption curve

3.4.1 Mathematical-logical structure of the water balance model for a defined crop stand

The actual water consumption between the beginning (TI) and end (TE) of the growing period can be defined by a coefficient "kc (a)". This is derived from calculation of the crop's water balance over a decade using the sub-factors of **effective rainfall** (P_{ei}), **stored soil water** brought forward from the previous decade (S_{i-1}), the **volume of soil water** tapped by **root growth** (D_i) and, finally, the **climatic evaporative demand** (E_{oi}). The FAO (1977) mentions the importance of correctly estimating the effective rainfall (P_{ei}) from the measured values (P_{oi}) with the help of empirical reduction coefficients (r). For the current decade (i) we obtain:

$$\left. \begin{aligned} P_{ei} &= r_i \cdot P_{oi} \\ kc(a)_i &= (P_{ei} + S_{i-1} + D_i) / E_{oi} \end{aligned} \right\} \quad (6)$$

A particular methodological problem is to determine the actual soil moisture at the beginning of a growing period, i.e. S_{i-1} for $i = TI$, while, for annual crops, D is omitted. Generally speaking, even the strata of the soil near the surface do not dry out completely if an insulating dry topsoil only a few centimetres thick protects the soils (cf. VERNET, 1963). Another problem is how to estimate the depth of the soil stratum involved in the evaporation process during the initial phase; this would be needed if we are to obtain a better definition of S_{TI-1} . The model presented here employs a variable "S*" for S_{TI-1} which is given in the scenario. In theory it also includes the proportion of capillary water rising from the underlying moist strata of the soil. The quantity of soil water rising by capillary processes from the strata below the root space cannot be calculated without further recourse to special parameters and calculation methods. So empirical or estimated values (K) are used here. Since the variable K is in the nature of a constant, it must be employed with great care. To prevent incorrect calculations at the beginning of the agro-humid period (shallow root depth) the point in time when K is taken into account in the calculations is given by the scenario variable TK.

The water supply per decade (SUP_i) is calculated from the relationship between the coefficients for the actual water consumption ($kc(a)_i$, see equation (6)) and the theoretical water requirements (kc_i):

$$SUP_i = kc(a)_i / kc_i \quad (7)$$

3.4.2 Calculating the actual soil moisture

The actual soil moisture and especially the storage values Z_1 and Z_2 (see Fig. 5) are calculated by referring to the "mathematical soil moisture model" given by KOITZSCH (1977). As in that model, the following factors are taken into account:

This SUP value is the basis from which crop losses can be estimated by equation (1). The calculation of the crop's water balance for the decade (B_i) which depends upon S and D and thus implicitly upon the root development assumes that the increasing root space may tap soil water reserves which have been formed during previous infiltrations of soil water. D also includes a rising capillary flow of soil water (K).

$$B_i = P_{e_i} + S_{i-1} + D_i - kc_i \cdot E_{o_i} \quad (8)$$

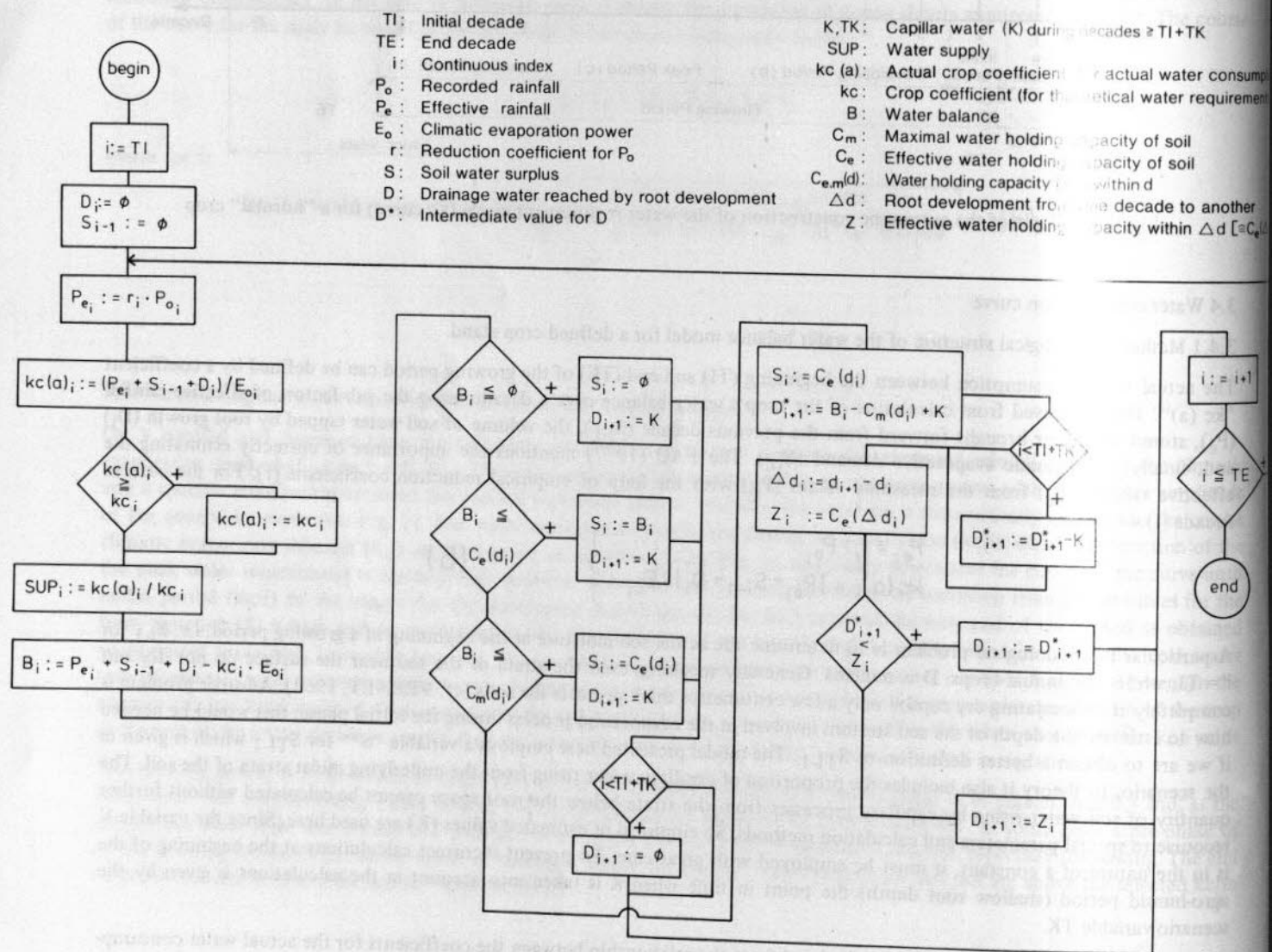


Fig. 5: Mathematical-logical model for the water balance of a defined crop stand

3.4.2 A mathematical approach to root growth

The author's observations of a large number of cultivated plants have shown that the daily situation regarding the increasing depth of an 80 % root complex (d_i in cm) can be defined most easily and with sufficient approximation to the actual situation by the logistic function:

$$d_i = D[1 + e^{(\beta - Kt)}]^{-1} \quad (9)$$

where "t" is the current day and "D" the mean optimal length (in cm) achieved by the 80 % root complex. " β/K " generally represents the time until the period of the plants' peak water requirements. Since in our case, however, the annual varying amounts of available water produce different durations of the agro-humid period and thus different values for K, parameter must be re-calculated each year. So the current value t^* is introduced. β is a function also of the empirical starting value (d_0) of d-development.

Fig. 6: Situation of the parameters D, d_0 and t^* of an 80 % root complex

The calculation is in two stages. We are given t, D, d_0 and t^* (= period from TI to begin of peak water requirements in days):

$$\left. \begin{aligned} t^* &= t_i + t_d \\ \beta &= \ln(D/d_0 - 1) \\ K &= \beta/t^* \end{aligned} \right\} \quad (10)$$

$$d_i = D[1 + e^{\beta(1 - t/t^*)}]^{-1}$$

A more sophisticated biometric method for calculating root growth was recently published by CAUSTON/VENUS (1981, pp. 234 ff.). They use given foliage estimates to predict the growth of stems and roots. In our case, however, we do not have such values available. Like CAUSTON/VENUS we too assume a linear allometric relationship between foliage growth, described as leaf area development by KUTSCH (1978, pp. 44/45), and root growth.

3.4.3 Calculating the actual soil moisture

The actual soil moisture and especially the storage values Z1 and Z2 (see Fig. 5) are calculated by referring to the "multi-strata soil moisture model" given by KOITZSCH (1977). As in that model, the following factors are taken into account:

- with optimum water supply the plants take water mainly from the soil strata near the surface;
- when water becomes short the water drawn from every sub-stratum is proportionate to the amounts of water in the sub-stratum which can still be used by the plants;
- after heavy rainfall the water requirements are initially met from the filled sub-strata;
- during the infiltration process the infiltration water can be used by the plants for as long as it is in the root area.

In the model presented here the soil moisture strata are obtained from the lengths developed by the 80 % root complex each decade. When drawing up the balance at the end of any decade the sum of the former soil moisture strata which were taken into account when preparing the water balance is set against the next stratum tapped by the advancing roots. By this means we discover whether any stored moisture exists which is carried forward to the next decade either as a straight forward transfer (S) or together with surplus infiltration water (D) which may be stored in the stratum tapped by the advancing roots. The amount of capillary water (K) which must be estimated or determined empirically is added to the transferred amount. This model is further refined by the fact that for each 10 cm of stratum a representative value can be given for the maximum (C_m) and the effective, i.e. the plant-available water holding capacity (C_e). The value for the effective water holding capacity must be determined by means of special tests. The value for rain-fed cultivation differs from the value for irrigation conditions. Since the availability of soil water also depends upon the vegetation (type, stage, root development) C_e must be determined in relation to the crop under consideration in each individual case. The C_e values have not been differentiated according to the vegetation stage because only comparatively few empirical data exist in this connection (cf. FAO, 1977) and there is no suitable biometric method.

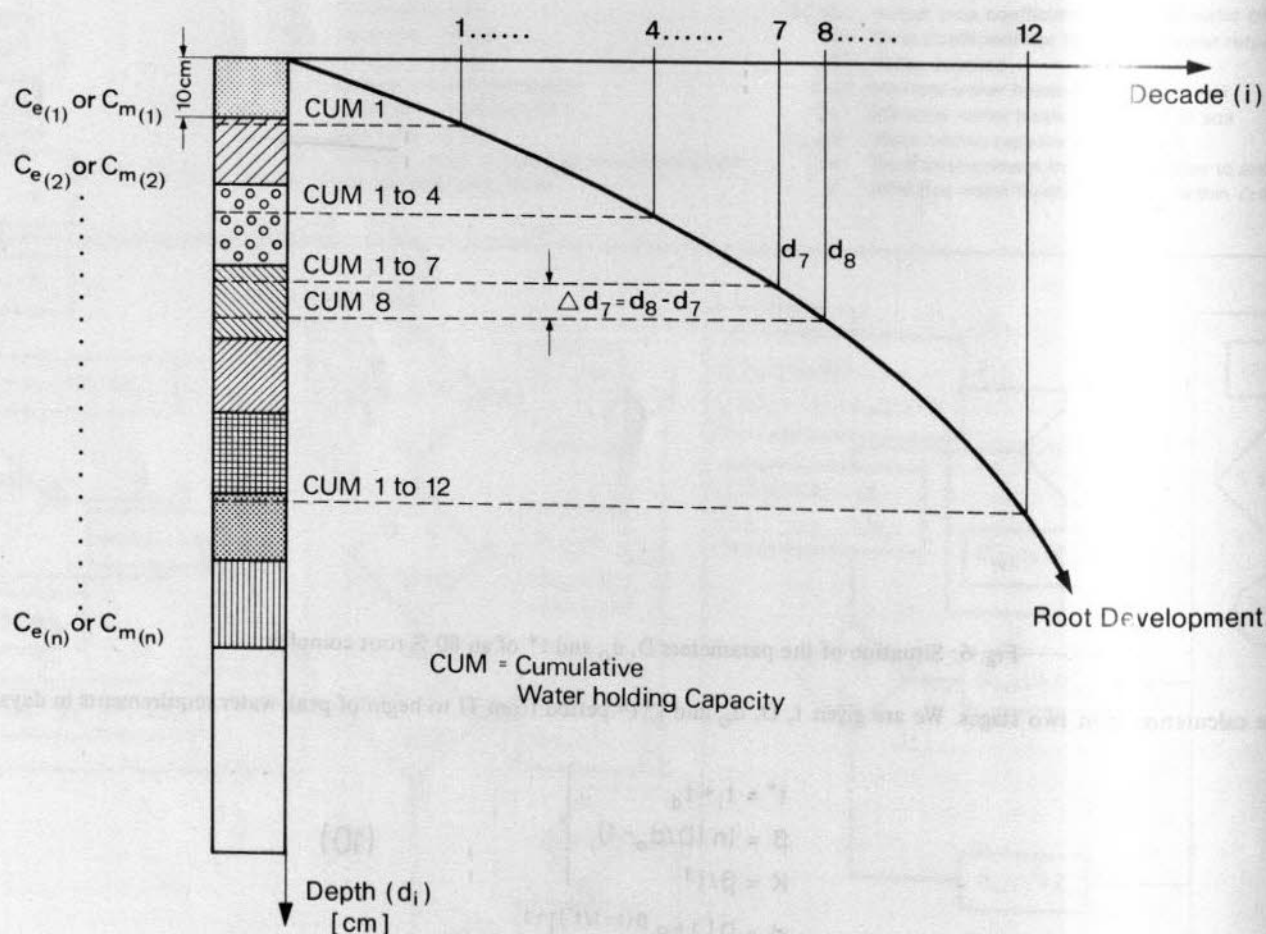


Fig. 7: Example of a multi-strata soil moisture model taking account of root growth and the different stored moisture in various strata

The given values for the water holding capacity are linked with the actual values for the root lengths (d_i) by a special algorithm (Fig. 8). The following are calculated for a specific decade i :

- The cumulative water holding capacity ($C_{m,e}(d_i)$), i.e. the capacity until root length d is reached, and
- the differential water holding capacity in the next stratum tapped by the advancing roots ($C_{m,e}(\Delta d_i)$), where

$$\Delta d_i = d_{i+1} - d_i$$

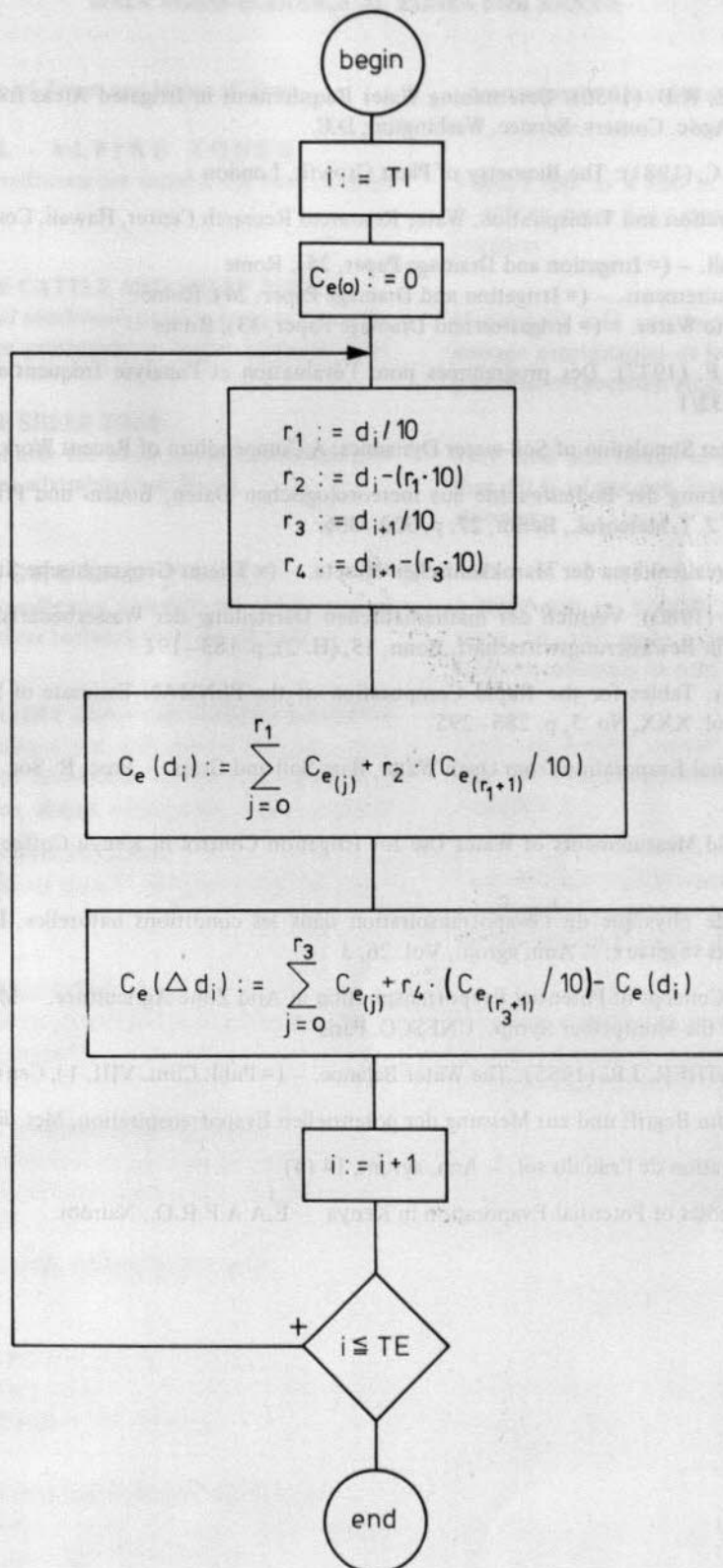


Fig. 8: Example for calculating the cumulative and differential effective water holding capacity using the multi-strata soil moisture model

TI, TE: Initial and final decade of calculation

d_i : Actual length of 80 % root complex

r : Intermediate value

$C_e(j)$: Effective water holding capacity for each layer of 10 cm (j)

$C_e(d_i)$: Cumulative effective water holding capacity

$C_e(\Delta d_i)$: Differential effective water holding capacity

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MAIN AGRO-ECOLOGICAL ZONES FOR KENYA

Formula in Map	Group of Zones and Name of Zone	Approximate Altitudes and Climatic Characteristics
TA	TROPICAL - ALPINE ZONES Temperature conditions not suitable for trees or crops	3 000/3 200 to 4 400 m. Cold, annual mean temp. 2–10° C; mean daily max. below 13° C; night frosts common
TA I	TROP.-ALPINE CATTLE AND SHEEP ZONE Climatic and soil conditions provide grazing for cattle, complete nature protection on slopes advisable (Nat. Park)	Moderately cold and humid to semi-humid; annual average precipitation at least more than 50 % of the potential evaporation (E_0)
TA II	TROP.-ALPINE SHEEP ZONE Grazing not suitable for cattle; complete nature protection on slopes advisable (Nat. Park)	Very cold and humid to arid; annual av. precip. less than 50 % of the pot. evaporation or more in higher altitudes
UH	UPPER HIGHLAND ZONES Temperature conditions suitable for frost-resistant crops, or for others between the frost periods	2 200/2 400 to 3 000/3 200 m. Cool, annual mean temp. 10–15°; mean nightly min. below 8° C; night frosts occasionally in cold seasons
UH 1	SHEEP AND DAIRY ZONE OR FOREST RESERVE Climatic conditions not well suited for grain crops except oats, but favourable for artificial pastures, if not forest is on slopes ecologically more advisable	Cool and humid; annual average precipitation more than 80 % of the potential evaporation. Dry seasons negligible
UH 2	PYRETHRUM-WHEAT ZONE Climatic conditions good ¹⁾ for pyrethrum and fair ²⁾ for wheat ⁴⁾	Cool and sub-humid; annual average precip. 65–80 % of the pot. ev. (or more to store enough soil moisture for dry seasons affecting pyrethrum)
UH 3	WHEAT-BARLEY ZONE Climatic conditions good for wheat and barley, fair to poor ³⁾ for pyrethrum ⁴⁾	Cool and semi-humid; annual av. precip. 50–65 % of the pot. ev. and growing periods must have at least 130 days in 6 out of 10 years
UH 4	UPPER HIGHLAND RANCHING ZONE Only marginal or not suitable for rainfed crops or dairy. Natural pasture for upgraded cattle and sheep, low density grazing ⁵⁾	Cool and transitional; annual av. precip. 40–50 % of the pot. ev.; 60 % probability of growing periods less than 130 days
UH 5	UPPER HIGHLAND NOMADISM ZONE Not in Kenya	Cool and semi-arid to arid
LH	LOWER HIGHLAND ZONES Temperature conditions very suitable for high quality tea and cold enough for pyrethrum	1 800/1 900 to 2 200/2 400 m. Moderately cool, annual mean temp. 15–18° C. Frost very rare and only limited to basins, valleys or holes
LH 1	TEA-DAIRY ZONE OR FOREST RESERVE Climatic conditions good for tea, dairy pastures, potatoes and vegetables, fair for maize	Moderately cool and humid; annual av. precip. at least 80 % of the pot. ev. (or more to store enough soil moisture for dry seasons affecting tea)
LH 2	WHEAT/MAIZE-PYRETHRUM ZONE⁶⁾ Climatic conditions fair–good for pyrethrum and wheat, fair for maize	Moderately cool and sub-humid; annual av. precip. 65–80 % of the pot. ev. (or more to store enough soil moisture for dry seasons affecting pyrethrum)
LH 3	WHEAT/(MAIZE)-BARLEY ZONE⁶⁾⁷⁾ Climatic conditions good for wheat and barley, fair–marginal for maize	Moderately cool and semi-humid; ann. av. precip. 50–65 % of the pot. ev.; growing periods must be well developed and at least 115 days in 6 out of 10 years

LH 4	CATTLE-SHEEP BARLEY ZONE Climatic conditions fair for barley and wheat. Natural pasture for medium density grazing	Moderately cool and transitional; annual av. precip. 40–50 % of the pot. ev. and growing periods must be at least 105 days in 6 out of 10 years
LH 5	LOWER HIGHLAND RANCHING ZONE Except of very early maturing barley not suited for rainfed crops or dairy. Nat. pasture for low density grazing	Moderately cool and semi-arid; annual av. precip. 25–40 % of the pot. ev.; 60 % probability of growing periods less than 105 days
LH 6	LOWER HIGHLAND NOMADISM ZONE Not in Kenya	Mod. cool and arid; annual av. precip. less than 25 % of the pot. evaporation
UM	UPPER MIDLAND ZONES Temperature conditions very suitable for Arabica coffee	1 300/1 500 to 1 800/1 900 m. Temperate, annual mean temp. 18–21° C. Absolutely no frost
UM 1	COFFEE-TEA ZONE Climatic conditions good to fair for Arabica coffee and tea, the same for maize	Temperate and humid; annual av. precip. at least 80 % of the pot. ev. (or more to store enough soil moisture for dry seasons affecting tea)
UM 2	MAIN COFFEE ZONE Climatic conditions good for Arabica coffee and maize	Temperate and sub-humid; annual av. precip. 65–80 % of the pot. ev. (or more to store enough soil moisture for dry seasons affecting coffee)
UM 3	MARGINAL COFFEE ZONE Moisture conditions fair to poor for coffee, then irrigation profitable; fair for maize ¹⁰⁾	Temperature and semi-humid; annual av. precipitation 50–65 % of the pot. ev. (or more to store enough soil moisture for survival of coffee in dry seasons)
UM 4	SUNFLOWER-MAIZE ZONE OR UPPER SISAL ZONE⁸⁾ With unimodal rainfall good for sunflower and maize, with bimodal rainfall mainly fair ¹⁰⁾ ; sisal good (large scale)	Temperature and transitional; annual av. precipitation 40–50 % of the pot. evaporation
UM 5	LIVESTOCK-SORGHUM⁹⁾ ZONE OR UPPER MARGINAL SISAL ZONE⁸⁾ Climatic conditions fair for sorghum, poor for maize. Natural pasture for low density grazing. Sisal fair to poor	Temperate and semi-arid; annual av. precip. 25–40 % of the pot. ev.; growing periods must be at least 65 days in 6 out of 10 years
UM 6	UPPER MIDLAND RANCHING ZONE Only marginally or not suitable for rainfed crops or dairy. Nat. pasture for low to very low density grazing	Temperate and arid; annual av. precip. 15–25 % of the pot. evaporation
LM	LOWER MIDLAND ZONES Temp. conditions suitable for cotton (nearly like low-land temperatures)	800 to about 1 300 m in Eastern Kenya and 1 500 m in Western. Warm, annual mean temp. 21–24° C, mean min. > 14° C
LM 1	LOWER MIDLAND SUGAR CANE ZONE Climatic conditions good for sugar cane, too wet for cotton, fair for maize	Warm and humid; annual av. precip. at least 80 % of the pot. ev. (or more to store enough soil moisture for dry season affecting sugar cane)
LM 2	LOWER MIDLAND MARGINAL SUGAR CANE ZONE Climatic conditions fair to marginal for sugar cane, good for maize	Warm and sub-humid; annual av. precip. 65–80 % of pot. ev. (or more to store enough soil moisture for dry seasons affecting sugar cane)
LM 3	COTTON ZONE Climatic conditions good to fair ⁹⁾ for cotton, fair for maize ¹⁰⁾	Warm and semi-humid; annual av. precip. 50–65 % of pot. ev. (or more to store enough soil moisture for dry seasons affecting cotton)

LM 4	MARGINAL COTTON ZONE OR MIDDLE SISAL ZONE⁸⁾ Climatic conditions fair to poor for cotton and maize ¹¹⁾ , fair for pigeon peas, good for sisal	Warm and transitional; annual av. precip. 40–50 % of pot. ev. (or more in bimodal rainfall areas for survival of cotton in dry season)
LM 5	LOWER MIDLAND LIVESTOCK-MILLET¹²⁾ ZONE OR MARGINAL MIDDLE SISAL ZONE⁸⁾ Climatic conditions fair to poor for millets, cowpeas and grams or sisal. Nat. pasture for low density grazing	Warm and semi-arid; annual av. precip. 25–40 % of pot. ev., or less or more because growing periods must be at least 45 days in 6 out of 10 years
LM 6	LOWER MIDLAND RANCHING ZONE Not suitable for rainfed crops. Nat. pasture for low to very low density grazing	Warm, semi-arid in areas with intermediate rainfall, arid in other areas
L	LOWLAND ZONES¹³⁾ Temp. conditions very suitable for coco- and cashew-nuts	0–800 m, in Rift Valley 1 000 m. Hot, annual mean temp. more than 24°C
L 1	COCOA ZONE Not in Kenya	Hot and humid
L 2	LOWLAND SUGAR CANE ZONE Climatic conditions good to poor for sugar cane, good for coconuts, cassava, and maize	Hot and sub-humid; annual av. precip. 65–80 % of pot. ev. (or more to store enough soil moisture for dry seasons affecting sugar cane)
L 3	COCONUT-CASSAVA ZONE Climatic conditions good to fair for coconuts and cassava, cotton fair (danger of rainfall in open bolls), maize fair	Hot and semi-humid; annual av. precip. 50–65 % of pot. ev. (or more to store enough soil moisture for coconuts and cassava)
L 4	CASHEW-NUT-CASSAVA ZONE OR LOWER SISAL ZONE⁸⁾ Climatic conditions good to fair for cashewnuts ¹⁴⁾ and cassava, good for sisal, marginal for coconuts; cotton in subzones with suitable growing periods	Hot and transitional; annual av. precip. 40–50 % of pot. ev. (or more to store enough soil moisture for cashewnuts and cassava)
L 5	LOWLAND LIVESTOCK-MILLET¹¹⁾ ZONE OR MARG. LOWER SISAL ZONE⁸⁾ Climatic conditions fair to marginal for millets, cowpeas and grams or sisal. Nat. pasture for low density grazing	Hot and semi-arid; annual av. precip. 25–40 % of pot. ev., or less or more because growing periods must be at least 40 days in 6 out of 10 years
L 6	LOWLAND RANCHING ZONE Not suitable for rainfed crops. Nat. pasture for low to very low density grazing	Hot, semi-arid in areas with intermediate rainfall, arid in other areas
L 7	LOWLAND NOMADISM ZONE Natural pasture for periodic low density grazing only	Hot and very arid (perarid), annual av. precip. < 15 % of pot. evaporation

1) Good = Average yield more than 60 % of the optimum on suitable soils

2) Fair = Average yield 40 to 60 % of the optimum on suitable soils

3) Poor = Average yield 20 to 40 % of the optimum on suitable soils

4) Modifications of the cropping chances, other crops or suitable varieties in all zones according to the combination with growing periods (see Table II) and to localities (see District Maps)

5) Low density means here more than 4 ha per livestock unit (LU). The most practical LU in Kenya is 300 kg, averaging indigenous cattle over 3 years, equivalent of adult sheep and goats: 7 (see PRATT AND GWYNNE: Rangeland Management and Ecology in East Africa. London 1977, p. 279). It should not be mixed up with standard stock units (SSU) of 450 kg used still by veterinaries.

6) Wheat or maize domination depending on farm scale and soils.

7) Maize normally less suitable, therefore in brackets

8) Sisal mainly in large scale farming areas

9) At present mainly maize, but with high risk; on the margin it should be very early mat. dwarf sorghum (cold tolerant) or early maturing like Serena

10) Depending on soils

- 11) Better and less risky with special early mat. varieties but they have lower yield capacities
- 12) At present mainly maize, but with high risk. On the margin only new very short maturing millet varieties
- 13) In Kenya differentiation in CL = Coastal Lowlands and IL = Inner Lowlands (Tab. 1) not necessary. L 1-4 are coastal, 5-7 inland (with few exceptions)
- 14) If the bimodal rainfall distribution is not endangering the flowers or fruits of cashewnuts

Regrouping of Main Agro-Ecological Zones of Kenya into Simplified Agro-Economic Zones for Statistics

TA I and II	Tropical Alpine Grazing or Conservation Zone, no agr. statistics
UH O	Forest Zone, no agr. statistics
UH 1	Sheep-Dairy Zone
UH 2 and LH 2	Pyrethrum Zone
UH 3 and LH 3	Wheat and Barley Zone
LH 4	Ranching and Barley Zone
LH 1	Tea Zone
UM 1	Coffee-Tea-Zone
UM 2 and 3	Coffee Zone
UM 4	Sunflower-Maize Zone or Upper Sisal Zone ¹⁾
UM 5	Ranching and Sorghum Zone or Upper Marginal Sisal Zone ¹⁾
LM 1 and 2	Sugar Cane Zone (Inland)
L 2	" " (Coast)
LM 3 and 4	Cotton Zone or Middle Sisal Zone ¹⁾
L 1	(not in Kenya)
L 2	(very small in Kenya)
L 3	Coconut Zone
L 4	Cashewnut Zone or Lower Sisal Zone ¹⁾
L 4 m	Coastal Cotton Subzone
L 5 and LM 5	Ranching and Millet Zone or Lower and Middle Marginal Sisal Zone ¹⁾
L6, LM 6, UM 6,	
LH 5 and UH 4	Ranching Zone
L 7	Nomadism Zone

The names in the zones are those of potentially leading crops there, of course they can be grown also in some other zones:

Maize in zones:	LH 1-3; UM 1-4; LM 1-4; L 2-4
Hybrid maize in zones:	LH 1-3; UM 1-3; LM 1-3
Wheat in zones:	UH 2-3; LH 2-4
Rice unirrigated in zones:	L 1-3; LM 1-2
Rice irrigated in zones:	L 1-6, (7); LM 1-6, (7)
Sorghum in zones:	UM (1-3), 4-5; LM (1-3), 4-5; L (1-3), 4-5
Finger millet in zones:	LH (1-3); UM (1-3), 4; LM (1-3), 4, (5); L (1-3), 4, (5)
Groundnuts in zones:	LM (1-2), 3-4; L (2-3), 4
Cotton in zones:	LM (2), 3-4; L (2), 3-4
Sunflower in zones:	LH (1-3); UM 1-4; LM 1-4, (5); L 2-4, (5)

Livestock is possible in all zones. Stocking rates decrease from zone 1 to zone 7.

() means that in this zone, the crop is normally not competitive to related crops (f.i. sorghum to maize)

1) Sisal in large scale farming areas

SUITABLE CROPS FOR KENYA AND THEIR REQUIREMENTS

The climatic requirements regarding temperature (expressed in altitude range) and rainfall for important possible crops are shown in the agro-climatological crop list. At first come food crops (cereals, pulses, tuber crops) then cash crops. The listing of varieties of annual crops is done according to their growing periods, perennials are listed alphabetically. Vegetables and many fruits were not included because of lack of space and information.

Also it was not possible to list all varieties of crops. There are new ones coming out, and others losing importance (see ACLAND 1971 and 1979).

Some new crops like jojoba (see FINK and EHRLER 1979), buffalo gourds (see BEMIS a.o. 1979 and Nat. Ac. of Science 1975), Maramba beans and Vigna (see Nat. Ac. of Science 1979), being still in experimental stage are mentioned, because they may become important in the future. Buffalo gourds have nutritious seeds and big tubers (but they need years to grow; their bitterness can be washed out).

If some crops are difficult to identify by their names, because they may be locally different, look for their scientific latin names which are mentioned in the adjoining soil requirement list (where there was more space to put them).

The growing periods are given for the time until physical maturity. The same is done in the water requirement diagrams in the districts. Only for maize, the difference to harvest time is so important and there is enough information available about it, so that it is included.

Altitude range is given according to ACLAND (1979), REHM and ESPIG (1976), and own observations. Rainfall requirements are calculated by a computer program developed by H. KUTSCH and H.J. SCHUH (see p. 19). For the farmers' purposes we adapted it to a 2/3 reliability of rainfall during the growing period, then they know they can expect this amount in at least 6 out of 10 years if they see that figure in the maps or tables of this book. We included average rainfall for perennials to compare it with the maps of annual rainfall. — Lower limit of optimum yield means very good yields in a field scale (with every other factor optimized), of course there may be higher yields on experimental stations.

The next list, which is that of **suitable grasses and fodder crops**, represents a first collection based on bioclimatological criteria. Therefore the list is still fairly long. It has to be further selected in each district due to local soil distribution, agrosocial conditions, herding habits, propagation possibilities and other factors. Important grasses and fodder crops are printed in darker letters.

There are also other possible fodder crops not mentioned here, especially trees, which are still in experimental stage, such as the salt tolerant *Acacia halosericea*. Apart from Government Research Stations valuable testing work is done for instance at the Catholic Mission at Kositei, Baringo District. It is impossible to mention all Government and other reports existing on the fodder question.

The **soil requirements list** is only an excerpt from what is laid down in literature (ACLAND 1975, REHM and ESPIG 1976, JACOB and UEXKÜLL 1963 and others). Further studies, especially about nutritional requirements, are necessary.

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AGRO-CLIMATOLOGICAL CROP LIST FOR KENYA

Growing period (approx.)	Crop/Variety ¹⁾ (or place of breeding)	Av. number of days to phys. maturity/ to harvest	Altitudes according to growing periods ²⁾	Required well distrib. rainfall in growing per. ³⁾ (not av.!)	1 over limit optimum yield ⁴⁾
GRAIN CROPS					
Short to very short	MAIZE/v.e.mat.: Dry Land Composite	75- 85/ 85-100	700-1 500 m	240-430 mm	2 000 kg/ha
Short	MAIZE/e.mat.: Katumani, Composite B	85-105/100-120		260-450 mm	
Short to medium	" "	105-135/120-150	1 500-1 900 m	280-480 mm	3 500 kg/ha
Short	MAIZE/e.mat.: Taboran	90-110/105-125	0-1 200 m	380-600 mm	2 500 kg/ha
Short to medium	MAIZE/m.mat.: HX 105 A = Pioneer Hybrid	100-115/120-140		450-700 mm	
"	MAIZE/m.mat.: Coast Composite	105-120/120-150		550-700 mm	
Medium	MAIZE/m.mat.: H 511, 512	125-150/150-185	1 000-1 700 m	500-750 mm	5 000 kg/ha
Medium	MAIZE/m.mat.: H 622, 632	140-155/180-210	1 000-1 700 m	550-800 mm	4 500 kg/ha
Medium to long	MAIZE/l.mat.: H 612, 613 H 614	160-180/190-230	1 500-2 100 m	600-950 mm	6 000 kg/ha
Long to medium	MAIZE/l.mat.: H 611	180-200/225-245	1 800-2 100 m	600-900 mm	5 900 kg/ha
Long	" "	200-220/245-270	2 100-2 400 m	600-950 mm	5 800 kg/ha
Long to medium	MAIZE/l.mat.: H 7801	165-185/195-220	1 500-2 100 m	700-1 100 mm	7 800 kg/ha
Long to very long	MAIZE/v.l.mat.: High Alt. Composite	210-240/250-280	2 400-2 700 m (if frost-free)	650-1 000 mm	6 000 kg/ha
Very long	MAIZE/v.l.mat.: Cuzco-Hybrid	~ 250/up to 360	2 400-(2 800) m	700-1 100 mm	
Medium to short	WHEAT/e.mat.: Kenya Tembo, K. Fahari, K. Kiboko, K. Ngiri K. Nungu, K. Nyangumi, K. Kifaru, K. Paka, K. Zerbadi, K 6927-1 (= K. Paa), K 6928-1 (= K. Kongoni)	110-125 125-140	1 800-2 100 m 2 100-2 400 m	350-530 mm	3 300 kg/ha (most Kenya varieties, African Mayo, Bounty)
Medium	" "	140-165	2 400-2 800 m	350-550 mm	3 700 kg/ha (K. Fahari, K. Nyangumi & new varieties: K 6927/28-1
Medium to short	WHEAT/m.mat.: Afr. Mayo, K. Nyoka, K. Mamba, K. Nyati, R 199, R 200	115-130	1 800-2 100 m	400-600 mm	4 000 kg/ha (new varieties R 199/200
Medium	" and Bounty	130-145	2 100-2 400 m	400-620 mm	
"	"	145-165	2 400-2 800 m	450-650 mm	
Medium	WHEAT/m.mat.: K. Leopard, Fanfare	125-140 140-155	1 800-2 100 m 2 100-2 400 m	450-650 mm	
"	" & K. Kudu	155-175	2 400-2 800 m		

Growing period (approx.)	Crop/Variety ¹⁾ (or place of breeding)	Av. number of days to phys. maturity/ to harvest	Altitudes according to growing periods ²⁾	Required well distrib. rainfall in growing per. ³⁾ (not av.1)	Lower limit of optimum yields ⁴⁾
Medium to long	WHEAT/l.mat.: K. Bongo	160-180	2 200-2 400 m	500-750 mm	3 500 kg/ha
Long to medium	" "	180-200	2 400-2 800 m		
Very short to short	BARLEY/v.e.mat.: (Kashmir)	55-75	1 300-1 800 m	150-300 mm	2 000 kg/ha
Short	" "	75-115	1 800-2 800 m	180-350 mm	
Medium to short	BARLEY/e.mat.: Tumaini for malting, Amani for stockfeed	110-125	2 100-2 400 m	300-500 mm	3 500 kg/ha
Medium	" "	125-145	2 400-2 800 m		4 500 kg/ha (Amani)
Medium to short	BARLEY/m.mat.: Proctor & Kenya Research for malting, B 106 for stockfeed	120-135	2 100-2 400 m	400-600 mm	3 500 kg/ha
Medium	" "	135-155	2 400-2 800 m		4 500 kg/ha (B 106)
Medium to short	DURUM WHEAT/m.mat.: K. Mwewe, K. Njiwa, K. Kungewa	115-125	1 800-2 100 m	400-600 mm	3 000 kg/ha
"	" "	125-140	2 100-2 500 m		
"	TRITICALE ⁵⁾ e. and m.mat.: T 65, T74	115-140	1 600-2 100 m	400-620 mm	4 200 kg/ha
Medium	" "	140-155	2 100-2 400 m		
"	" "	155-175	2 400-2 800 m	450-650 mm	4 500 kg/ha
"	TRITICALE/l.mat.: T 50	125-155	1 600-2 100 m		
"	" "	155-170	2 100-2 400 m	450-650 mm	4 500 kg/ha
Medium to long	" "	170-190	2 400-2 800 m		
Medium	OATS/m.mat.: Suregrain, All 6	130-145	1 900-2 400 m	400-620 mm	2 500 kg/ha
"	" "	145-165	2 400-2 800 m		
Very short	FOXTAIL MILLET (Setaria italica) v.e.mat. (Jodhpur, CAZRI-Inst.)	45-55	0-800 m	160-290 mm	1 800 kg/ha
"	" "	55-75	800-1 300 m		
"	FOXTAIL MILLET/e.mat.: lSe 285	50-65	0-800 m	220-320 mm	3 000 kg/ha
"	" "	65-80	800-1 300 m		
"	" "	80-95	1 300-1 800 m	160-290 mm	1 500 kg/ha
"	HOG MILLET/v.e.mat. (Jodhpur)	40-50	0-800 m		
"	" "	50-70	800-1 300 m	200-280 mm	2 800 kg/ha
"	PROSO MILLET (Panicum miliac.)/e.mat.: Serere I	45-55	0-800 m		
"	" "	55-65	800-1 300 m	220-400 mm	2 000 kg/ha
Short	BULRUSH MILLET/e.mat. local	70-90	0-1 250 m		
"	BULRUSH MILLET/e.mat.: Serere Comp. II	75-90	0-1 250 m	250-450 mm	4 000 kg/ha
"	" "	" "	(short r.-1 500 m)		
Medium	BULRUSH MILLET/m.mat.	120-150	" "	380-800 mm	4 500 kg/ha
"	FINGER MILLET/e.mat. Ekalakala	75-110	0-2 100 m	230-500 mm	3 800 kg/ha
"	FINGER MILLET/m.mat. lokal	100-160	0-2 400 m	500-900 mm	4 000 kg/ha
Short to very short	SORGHUM/v.e.mat. IS 8595	75-105	0-1 500 m	200-430 mm	3 800 kg/ha
Short	SORGHUM/e.mat.: Serena	85-110	(warmer seasons and places up to 1 800 m)	220-480 mm	4 000 kg/ha
"	SORGHUM/e.mat.: 2KX 17	90-125		300-500 mm	5 000 kg/ha

Growing period (approx.)	Crop/Variety ¹⁾ (or place of breeding)	Av. number of days to physical maturity	Altitudes according to growing periods ²⁾	Required well distrib. rainfall in growing per. 3) (not av.1)	Lower limit or optimum yield ⁴⁾
Short to medium	SORGHUM/m.mat.: White	100-130	0-1 500 m (warmer seasons and places up to 1 800 m)	320-590 mm	5 0 kg/ha
Medium to long	SORGHUM/L.mat.: E 1291, for stockfeed mainly	160-180		400-800 mm	9 0 kg/ha
Long	SORGHUM/v.l.mat.	180-240		620-1 000 mm	6 5 kg/ha
Bimodal	SORGHUM/ratoon from 2KX 17 or others	f.i. 90-115 + 90-110		f.i. 280-500 mm +230-450 mm	4 5 kg/ha + 3 5 kg/ha
Long	SORGHUM/cold tolerant		(0-) 1800-2200 m	1981 still in experiment	
Short to medium	RICE/e.mat. = Sindano	95-130	0-1 200 m	750-1 070 mm	8 0 kg/ha
Medium	RICE/m.mat. = Faya S.L.	120-160	(in W-1 500 m)	(irr. water) 800-1 200 mm (irr. water)	(trans. L.) 9 00 kg/ha (trans. L.)
Short to long	GRAIN AMARANTH/ diff. species	90-180	0-2 900 m	190-800 mm	3 00 g
Medium to long	QUINOA/var. Sajama (Bolivia)	150-180	2 300-3 200 m	300-800 mm	3 50 g

LEGUMINOUS CROPS

Very short	BAMBARRA GROUNDNUTS/ v.e.mat. (Timbuktu)	50- 60	0- 800 m	180-350 mm	1 000 kg/ha
Very short to short	" "	60- 70	800-1 300 m		
Short	BAMBARRA GRDN./e.mat.	80-100	0- 800 m	250-500 mm	1 500 kg/ha
Short to med.	" "	100-120	800-1 300 m		
Short to medium	GROUNDNUTS/e.mat.: Valencia	90-120	0-1 500 m	280-550 mm	1 800 kg/ha
Medium to short	GROUNDNUTS/m.mat.: Spanish	100-135	0-1 500 m	300-600 mm	2 200 kg/ha
Medium	GROUNDNUTS/L.mat.: Mwitunde (partly Rosette resistant)	120-150	0-1 500 m	350-650 mm	2 500 kg/ha
Very short to short	TEPARY BEANS/v.e.mat.	60-75	600-1 500 m	180-300 mm	1 500 kg/ha
Very short to short	TEPARY BEANS, e.mat.: Kiboko (Botswana)	65- 80	600-1 300 m	200-320 mm	2 000 kg/ha
Very short to short	COWPEAS ⁶⁾ /v.e.mat.	60- 70	0-1 500 m	190-380 mm	1 200 kg/ha
Short to very short	COWPEAS/e.mat.: Katuli	70- 90	0-1 500 m	200-400 mm	1 900 kg/ha
Short to medium	COWPEAS/less e.mat.	90-120	0-1 500 m	220-450 mm	2 000 kg/ha
Medium	COWPEAS/m.mat.: Emma	120-150	0-1 500 m	250-500 mm	2 300 kg/ha
Long	COWPEAS/L.m.	180-240	0-1 500 m	300-700 mm	2 500 kg/ha
Very short to short	MOTH BEANS (India) ⁷⁾	60- 90	0-1 500 m	180-400 mm	1 600 kg/ha

Growing period (approx.)	Crop/Variety ¹⁾ (or place of breeding)	Av. number of days to phys. maturity/ to harvest	Altitudes according to growing periods ²⁾	Required well distrib. rainfall in growing per. ³⁾ (not av.!)	Lower limit of optimum yields ⁴⁾
Short to very short	GREEN GRAMS	75- 90	0-1 200 m	190-400 mm	1 500 kg/ha
Short	" "	90-100	1 200-1 500 m (W-Kenya)		
Short	BLACK GRAMS	85-100	0-1 200 m	200-400 mm	
"	" "	100-110	1 200-1 800 m (W-Kenya)		
Short	CHICK PEAS = YELLOW GRAMS	85-100	0-1 500 m	200-390 mm	1 500 kg/ha
Short to very short	BEANS/v.e.mat.: Mwezi moja	70- 80	700-1 500 m	230-430 mm	1 500 kg/ha
" "	" "	80- 90	1 500-1 800 m		
Short	BEANS/e.mat.: Canadian Wonder, Mex. 142, Rosecoco	80-100	700-1 500 m	250-450 mm	1 900 kg/ha
Short to medium	" "	100-120	1 500-1 800 m		1 600 kg/ha
Medium	" "	120-150	1 800-2 400 m		
Short to medium	BEANS/m.mat.: Cuarentino a.o.	90-110	800-1 500 m	250-450 mm	2 500 kg/ha
Medium to short	" "	110-130	1 500-1 800 m		1 800 kg/ha
Medium	" "	130-160	1 800-2 400 m		
Short to medium	BONAVIST BEANS = DOLICHOS LABLAB/ann. var.	100-140	0-1 200 m	200-700 mm	1 900 kg/ha
Medium to long	" "	140-180	1 200-2 100 m		
Perennial	BONAVIST BEANS = DOLICHOS LABLAB/per. var.	> 365	0-2 100 m	800-2 000 mm	2 100 kg/ha
Short to med.	HORSE BEANS	100-140	0-1 800 m	400-750 mm	2 500 kg/ha
Medium to long	" "	140-180	1 800-2 700 m	400-700 mm	2 000 kg/ha
Short to long	TROPICAL LIMA BEANS/diff. var.	90-270	0-2 400 m	400-1 200 mm	4 000 kg/ha
Long to very long	HORSE GRAMS	210-240	0-1 500 m	180-350 mm	1 500 kg/ha
Short to medium	GARDEN PEAS	90-120	1 800-2 300 m	250-450 mm	3 000 kg/ha
Medium to short	" "	120-140	2 300-2 700 m		
Short to medium	PIGEON PEAS/e.mat.: 422, 423	110-130	0-1 500 m	370-600 mm	1 400 kg/ha
Medium to short	PIGEON PEAS/m.mat.: Composite	120-140	0-1 500 m	400-650 mm	2 000 kg/ha
Long to very long	PIGEON PEAS/l.mat. (bimodal)	180-260	0-1 500 m	500-800 mm	2 300 kg/ha
Short	SOYA BEANS/e.mat.: Black Hawk, Hill	80-110	0-1 200 m	350-680 mm	2 300 kg/ha

Growing period (approx.)	Crop/Variety ¹⁾ (or place of breeding)	Av. number of days to physical maturity	Altitudes according to growing periods ²⁾	Required well distrib. rainfall in growing per. ³⁾ (not av.!)	Yield over limit optimum yields ⁴⁾
Medium to short	SOYA BEANS/e.mat.: Black Hawk, Hill	110-130	1 200-1 800 m	350-680 mm	2 000 kg/ha
"	SOYA BEANS/m.mat.	110-130	0-1 200 m	400-750 mm }	2 000 kg/ha
Medium	" "	130-150	1 200-1 800 m		2 000 kg/ha
Medium to very long	TARWI (Lupinus mutabilis, Andes) ⁸⁾	150-330	1 800-3 600 m	450-1 500 mm	2 800 kg/ha
Perennial	MARAMA BEANS ⁹⁾	more than 365	0-1 800 m	200-500 mm	still exp.
OIL SEED CROPS					
Short to very short	SUNFLOWER/v.e.mat.: Russ. dwarf var.	75-85	0-1 500 m	180-330 mm	1 100 kg/ha
Short	SUNFLOWER/e.mat.: Issanka	80-90	0-1 500 m	200-400 mm	1 200 kg/ha
Short	SUNFLOWER/e.mat.: 252	90-110	0-1 800 m	250-500 mm	high oil cont.
"	SUNFLOWER/e.mat.: Hybrid S 345	85-110	0-1 500 m	280-550 mm	1 900 kg/ha
Short to medium	SUNFLOWER/m.mat.: Vympel, Mayok, 067, Luci, Sputnik	110-120	0-1 500 m	300-600 mm }	very high oil c.
"	" "	120-135	1 500-2 300 m		
Medium	" "	135-150	2 300-2 600 m		1 900 kg/ha
Medium to short	SUNFLOWER/m.mat.: Comet	120-130	1 000-2 000 m	300-600 mm }	1 600 kg/ha
"	SUNFLOWER/m.mat.: Hybrid S 301 A	120-135	0-1 800 m		fair oil cont.
Medium to long	SUNFLOWER/l.mat.: Kenya White	140-175	1 500-2 300 m	350-700 mm	2 800 kg/ha
Medium	LINSEED	120-150	1 800-2 700 m	300-600 mm	2 200 kg/ha
Very short to short	RAI/v.e.mat. (Jodhpur, CAZRI) (Brassica juncea, also for Mustard)	60-80	800-2 000 m	180-380 mm	low oil cont.
Short to medium	RAPESEED/e.mat.: Turgot	110-125	1 800-2 700 m	250-500 mm	1 400 kg/ha
Medium	RAPESEED/m.mat.: Midas, SV 69/1229, SV Gulle	125-140	1 800-2 700 m	300-600 mm	1 350 kg/ha
Medium	RAPESEED/l.mat.: Nilla, SV 71/1225	140-155	1 800-2 700 m	350-700 mm	1 850 kg/ha
Short to medium	SIMSIM/e.mat.	90-120	0-1 300 m (E)	300-500 mm	2 100 kg/ha
Medium	SIMSIM/m.mat.	120-140	0-1 500 m (W)	350-600 mm	1 000 kg/ha
Medium	SAFFLOR	120-150	1 200-1 800 m	250-400 mm	1 300 kg/ha
Medium	CASTOR/Dwarf	130-170	500-1 500 m	350-800 mm	2 000 kg/ha
Perennial	CASTOR/C-15	more than 365	0-2 100 m	400-650 mm	1 200 kg/ha

Growing period (approx.)	Crop/Variety ¹⁾ (or place of breeding)	Av. number of days to physical maturity	Altitudes according to growing periods ²⁾	Required well distrib. rainfall in growing per. ³⁾ (and average)	Lower limit of optimum yields ⁴⁾
TUBER CROPS					
Very short to short	SWEET POTATOES/e.mat.	60–90	0–1 800 m	350–650 mm	8 t/ha
Medium to per.	“ “ /m.mat.	120–180	0–1 800 m	500–900 mm	20 t/ha
Very long to perennial	“ “ /m.mat.	270 and more	0–1 700 m	750–1 250 mm	35 t/ha
Long to very long	CASSAVA/e.mat.	180–270	0–1 500 m	500–1 000 mm	20 t/ha
Perennial	“ /l.mat.	540–720	0–1 500 m	1 100–3 000 mm (~850–1 700 mm ann. av.)	40 t/ha
Short to medium	POTATOES/e.mat.	100–130	1 800–2 900 m (if frost-free)	350–630 mm	20 t/ha
Medium to long	“ /m.mat.: Kenya Akiba, B 53 a.o.	140–170	1 800–2 900 m	450–750 mm	35 t/ha
Short to long	YAM BEAN (Mexico)	90–270	0–1 800 m	500–1 500 mm	60 t/ha
Perennial	TARO	more than 365	0–1 800 m	1 300–2 300 mm	20 t/ha
Long to perennial	WHITE GUINEA YAM	180–300	0–1 800 m	1 000–1 500 mm	30 t/ha
Very long to perennial	GREATHER YAM	240–300	0–1 800 m	1 400–1 800 mm	45 t/ha
Very long to perennial	YELLOW GUINEA YAM	300 and more	0–1 800 m	1 200–1 800 mm	40 t/ha
Perennial	BUFFALO GOURDS (Tucson)	more than 365	0–1 300 m	180–500 mm	still exp.
“	MARAMA BEAN (Kalahari) ⁹⁾	“ “ “	0–1 800 m	200–500 mm	“ “
“	VIGNA lobatifolia (Kalahari)	“ “ “	0–1 800 m	250–600 mm	“ “
FIBRE CROPS					
Long	COTTON/Unimodal var. long staple	170–210	0–1 250 m(E) 0–1 400 m(W)	550–950 mm	2 000 kg/ha
Very long to long	COTTON/Bimodal var. BPA	240–300	0–1 250 m		1 800 kg/ha
Medium to long	FLAX	150–220	1 800–2 700 m	450–900 mm	1 700 kg/ha
Short to medium	KENAF	70–140	0–2 000 m	500–700 mm	3 000 kg/ha
Perennial	NEW ZEALAND FLAX	more than 365	1 800–2 500 m	750–1 200 mm (~900–1 400 mm ann. av.)	
Medium to long	ROSELLE	130–180	0–1 500 m	1 000–1 800 mm	3 500 kg/ha
Perennial	SISAL	more than 365	0–1 800 m	550–900 mm (~650–1 050 mm ann. av.)	800 – 2 500 kg/ha 1–5. year

Growing period (approx.)	Crop/Variety ¹⁾ (or place of breeding)	Av. number of days to physical maturity	Altitudes according to growing periods ²⁾	Required well distrib. rainfall in growing per. ³⁾ (not av.!)	Lower limit of optimum yields ⁴⁾
OTHER CASH CROPS AND FRUITS					
Perennial	AVOCADOES/West Ind.	more than 365	0– 900 m	900–1 200 mm (1 000–1 900 mm ann. av.)	10.0 t/ha
"	" /Mex.	" "	1 000–2 400 m	800–1 200 mm (880–1 500 mm ann. av.)	8.0 t/ha
"	BANANAS	365–540	0–1 800 m	900–1 700 mm (~1 000–2 300 mm ann. av.)	30.0 t/ha
"	CASHEW NUTS	more than 365	0– 750 m	700–1 000 mm (800–1 200 mm ann. av.)	3.5 t/ha
"	CITRUS ¹⁰⁾	" "	0–2 000 m	800–1 400 mm (950–1 800 mm ann. av.)	30.0 t/ha
"	COCONUTS	" "	0– 700 m	900–1 800 mm (1 000–2 500 mm ann. av.)	3.2 t/ha
"	COFFEE/Arabica	" "	1 200–1 900 m (E) 1 500–2 100 m (W)	900–1 500 mm (1 050–1 800 mm ann. av.)	1.8 t/ha
"	" /Robusta	" "	600–1 500 m	1 100–2 000 mm (1 300–2 500 mm ann. av.)	3.0 t/ha
"	DECIDUOUS FRUIT TREES (Apples, peaches, pears)	" "	2 000–2 800 m	850–1 300 mm (950–1 500 mm ann. av.)	20.0 t/ha
"	JOJOBA	" "	0–1 250 m	(200) 380–700 mm (500– 900 mm ann. av.)	1.0 t/ha
"	MACADAMIA NUTS	" "	0–2 000 m	750–1 200 mm (850–1 400 mm ann. av.)	2.5 t/ha
"	PINEAPPLE	" "	0–1 700 m	500–1 300 mm (600–1 500 mm ann. av.)	40.0 t/ha
"	PYRETHRUM	" "	1 800–2 900 m	950–1 300 mm (1 100–1 450 mm ann. av.)	1.7 t/ha
"	SUGAR CANE	" "	0–1 600 m	1 250–1 800 mm (1 400–2 000 mm ann. av.)	190/160/140 t/ha/ratoon
"	TEA	" "	1 200–2 300 m	1 250–1 800 mm (1 400–2 000 mm ann. av.)	7.0 t/ha
Medium to long	TOBACCO/Virginia	150–170	1 200–1 600 m	400– 700 mm	1.5 t/ha
Perennial	TUNG OIL	more than 365	600–1 500 m	700–1 200 mm (750–1 500 mm ann. av.)	3.0 t seeds/ha
"	YEEB NUTS (bush) ¹¹⁾	" "	0–1 000 m	200– 400 mm (250– 500 mm ann. av.)	still exp.

1) v.e.mat. = very early maturing varieties

e.mat. = early " "

m.mat. = medium " "

l.mat. = late " "

v.l.mat. = very late " "

For some crops, esp. wheat, it is wise to use several varieties to spread the risk
(see recommendations of Nat. Research Stations)

- 2) Most suitable altitudes. Growing periods increase upwards and decrease downwards beyond the noted ranges until ecological limit is reached.
3) Lower figure for fair results, higher for very good results with some corrections due to rainfall distribution, evaporation and runoff losses. This rainfall should be reached in at least 6 out of 10 years.

4) Approximate figures on well suitable soils, with manure resp. fertilizer and good husbandry

5) Performs better than wheat in marginal wheat growing areas and acidic soils

6) Major germplasm center at the International Institute of Tropical Agriculture/Ibadan, Nigeria

7) Gives also very good fodder or hay (7–10 t hay/ha, see Nat. Ac. of Sc.: Trop. Legumes. Washington 1979, p. 77)

8) Information see Nat. Ac. of Sc.: Tropical Legumes. Washington 1979, p. 86–92

9) It produces tubers and beans. Information see Nat. Ac. of Sc.: Trop. Legumes. Washington 1979

10) By bioclimatological reasons no quality like in the cultivation regions of the Subtropics

11) Cordeauxia edulis from Somalia. Information see Nat. Ac. of Sc.: Trop. Legumes. Washington 1979, p. 103–107.

BIOCLIMATOLOGICALLY SUITABLE GRASSES AND OTHER FODDER CROPS FOR THE AGRO-ECOLOGICAL ZONES IN KENYA¹⁾

1. UPPER HIGHLAND ZONES (norm. above 2 300 m)

Grasses:

Kikuyu grass (<i>Pennisetum clandestinum</i>)	UH 1, (2)
Rye grass (<i>Lolium perenne</i>), except in wheat areas	UH 1, 2, 3, (4)
Cocksfoot (<i>Dactylis glomerata</i>)	UH 1, 2, 3, 4
Tall fescue (<i>Festuca arundinacea</i>)	UH 1, 2, 3, 4

Cereals:

Oats (<i>Avena sativa</i>)	UH 1, (2)
Fodder barley (<i>Hordeum vulgare</i>)/var. B 106	UH 2
Fodder barley (<i>Hordeum vulgare</i>)/var. Amani	UH 3, (4)

Legumes:

Lucerne (<i>Medicago sativa</i>), rust danger	UH 1, 2
Kenya white clover (<i>Trifolium semipilosum</i>)	UH 1, 2, 3
Tarwi (<i>Lupinus mutabilis</i>)	UH 1, 2, 3
Subterranean clover (<i>Trifolium subterraneum</i>)	UH 3, 4

2. LOWER HIGHLAND ZONES (norm. between 1 800 and 2 300 m)

a) Unimodal rainfall (1 900–2 300 m):

Grasses:

Kikuyu grass (<i>Pennisetum clandestinum</i>)	LH 1, 2
Napier grass (<i>Pennisetum purpureum</i>) up to 2 000 m	LH 1, 2
Nandi setaria (<i>Setaria sphacelata</i>)	LH 1, 2, 3
Rhodes grass (<i>Chloris gayana</i>) up to 2 050 m	
var. Pokot Rhodes	LH 1, 2
var. Mbarara Rhodes	LH 2, 3
var. Masaba Rhodes	LH 2, 3
var. Elmba Rhodes	LH 2, 3, 4
var. Boma Rhodes	LH 2, 3, 4
Teff (<i>Eragrostis tef</i>)	LH 2, 3, (4)

Root crops:

Fodder beets (<i>Beta vulgaris</i>)/var. alba DC.	LH 1, 2
Fodder radish (<i>Raphanus sativus</i>)	LH 1, 2
Yam bean ²⁾ (<i>Pachyrhizus tuberosus</i>), not above 2 000 m	LH 1, 2, 3, (4)

Legumes:

Louisiana white clover (<i>Trifolium repens</i>)	LH 1, 2
Green leaf desmodium (<i>Desmodium intortum</i>)	LH 1, 2
Silver leaf desmodium (<i>Desmodium uncinatum</i>)	LH 1, 2, (3)
Lotononis (<i>Lotononis bainesii</i>)	LH 2, 3, (4)
Subterranean clover (<i>Trifolium subterraneum</i>)	LH 3, 4

b) Bimodal rainfall (1 800 m – 2 200 m):

Grasses:

Kikuyu grass (<i>Pennisetum clandestinum</i>)	LH 1, (2)
Rhodes grass (<i>Chloris gayana</i>), var. Elmba and Boma, in lower places (up to 2 000 m)	LH 1, 2, (3)
Nandi setaria (<i>Setaria sphacelata</i>)	LH 1, 2, 3
Napier grass (<i>Pennisetum purpureum</i>), lower places (up to 2 000 m)	LH 1, 2, (3)
Congo grass (<i>Brachiara ruziziensis</i>)	LH 2, 3

Root crops:

Fodder beets (<i>Beta vulgaris</i>)/var. alba DC.	LH 1, 2
Fodder radish (<i>Raphanus sativus</i>)	LH 1, 2
Yam bean ²⁾ (<i>Pachyrhizus tuberosus</i>)	LH 1, 2
Yam bean/var. with short veg. cycle	LH 3, (4)

1) Based on informations supplied by P.K. Kusew, Ag. Director, N.A.R.S, Kitale, and other sources, esp. Nat. Ac. of Sc.: Trop. Legumes, Washington D.C., 1979. Selection according to soils and economic conditions still necessary.

2) Mainly for human nutrition but root also palatable to livestock (esp. for pigs). Seeds adapted to different altitudes and rainfall patterns available at Plant Tax. Lab., Plant Gen. and Germ Plasm Inst., Beltsville, Maryland (USA). Leaves and fruits may be toxic.

Legumes:

Brazilian lucerne (<i>Stylosanthes guyanensis</i>)	LH 1
Green leaf desmodium (<i>Desmodium intortum</i>)	LH 1
Silver leaf desmodium (<i>Desmodium uncinatum</i>)	LH 1 (3)
Louisiana white clover (<i>Trifolium repens</i>)	LH 1
Glycine (<i>Glycine wightii</i>)	LH 2 (4)
Subterranean clover (<i>Trifolium subterraneum</i>)	LH 2

3. UPPER MIDLAND ZONES (norm. between 1 300/1 500 and 1 800 m):

a) Unimodal rainfall:

Grasses:

Rhodes grass (<i>Chloris gayana</i>), in higher places	UM 1
var. Pokot Rhodes	UM 2, 3
var. Mbarara Rhodes	UM 2, 3, (4)
var. Masaba Rhodes	UM 2, 3, 4
var. Elmba Rhodes	UM 2, 3, 4
var. Boma Rhodes	UM 2, 3, 4
Nandi setaria (<i>Setaria sphacelata</i>), higher places	UM 1, 2, 3
Star grass (<i>Cynodon dactylon</i>)	UM 1, 2, 3
Napier grass (<i>Pennisetum purpureum</i>)	UM 1, 2, 3, (4)
Sudan grass (<i>Sorghum sudanense</i>)	UM 2, 3, 4
Bana grass (<i>Pennisetum purpureum</i> x <i>P. typhoides</i>)	UM 2, 3, 4
Guinea grass (<i>Panicum maximum</i>)/var. Makueni	UM 1, 2, 3, 4
Masai love grass (<i>Eragrostis superba</i>)	UM 3
Buffel grass (<i>Cenchrus ciliaris</i>)	UM 5

Root crops:

Flemingia vestita ³⁾	UM 1 (3)
Yam bean ²⁾ (<i>Pachyrhizus tuberosus</i>)	UM 1, 2, 3, 4
Psoralea patens/ <i>P. cinerea</i> ⁴⁾	UM 3, 4

Legumes:

Sirat (<i>Macroptilium atropurpureum</i>)	UM 2, 3, 4
Green leaf (<i>Denuodium intortum</i>)	UM 1, 2
Silverleaf desmodium (<i>Desmodium uncinatum</i>)	UM 1, 2, (3)
Brazilian lucerne (<i>Stylosanthes guyanensis</i>)	UM 1, 2, (3)
Butterfly pea (<i>Clitoria ternatea</i>)	UM 1, 2, (3)
Townsville lucerne (<i>Stylosanthes humilis</i>)	UM 2, 3, (4)
Glycine (<i>Glycine wightii</i>)	UM 2, 3, 4
Barrel medic (<i>Medicago truncatula</i>)	UM 3, 4, (5)
Moth bean (<i>Vigna aconitifolia</i>)	UM 4, 5

Trees and shrubs:

Horse tamarind (<i>Leucaena leucocephala</i>)	UM 3, 4
Saltbush (<i>Atriplex nummularia</i>)	UM 4, 5, (6)
Gao tree (<i>Acacia albida</i>)	UM 4, 5, (6)
Mesquite (<i>Prosopis juliflora</i>)	UM 5, 6
Algarrobo (<i>Prosopis chilensis</i>)	UM 5, 6

b) Bimodal rainfall:

Grasses:

Rhodes grass (<i>Chloris gayana</i>), in higher places	UM 1, (2)
var. Pokot Rhodes	UM 1, 2, (3)
var. Mbarara Rhodes	UM 1, 2, (3)
var. Masaba Rhodes	UM 1, 2, (3)
var. Elmba Rhodes	UM 2, 3, (4)
var. Boma Rhodes	UM 2, 3, (4)
Nandi setaria (<i>Setaria sphacelata</i>), higher places	UM 1, 2, 3
Star grass (<i>Cynodon dactylon</i>)	UM 1, 2, 3
Napier grass (<i>Pennisetum purpureum</i>)	UM 1, 2, 3, (4)
Bana grass (<i>Pennisetum purpureum</i> x <i>P. typhoides</i>)	UM 2, 3, 4
Guinea grass (<i>Panicum maximum</i>)	UM 2, 3
Guinea grass (<i>Panicum maximum</i>)/var. Makueni	UM 3, (4)
Coloured Guinea grass (<i>Panicum coloratum</i>)	UM 2, 3
Congo grass (<i>Brachiaria ruziziensis</i>)	UM 2, 3
Masai love grass (<i>Eragrostis superba</i>)	UM 3, 4
Buffel grass (<i>Cenchrus ciliaris</i>)	UM 4, (5)

³⁾ Also edible. 7 months to mature. Seeds available at Nat. Bur. of Plant Gen. Resources, I.A.R.I., New Delhi (India).

⁴⁾ Also edible. Seeds available at the Herbarium of the Northern Territory, Dept. of the Northern Territory, Alice Springs Australia). Bioclimatological research still needed.

Root crops:

Flemingia vestita ³⁾	UM 1, 2
Yam bean ²⁾ (<i>Pachyrhizus tuberosus</i>)	UM 1, 2, 3, (4)
Psoralea patens/P. cinerea ⁴⁾	UM 3, 4

Legumes:

Desmodium species	UM 1, 2
Brazilian lucerne (<i>Stylosanthes guyanensis</i>)	UM 1, 2
Townsville lucerne (<i>Stylosanthes humilis</i>)	UM 2, 3
Butterfly pea (<i>Clitoria ternatea</i>)	UM 1, 2
Glycine (<i>Glycine wightii</i>)	UM 2, 3, (4)
Siratro (<i>Macroptilium atropurpureum</i>)	UM 2, 3, (4)
Barrel medic. (<i>Medicago truncatula</i>)	UM 3, 4, (5)
Moth bean (<i>Vigna aconitifolia</i>)	UM 4, 5

Trees and shrubs:

Horse tamarind (<i>Leucaena leucocephala</i>)	UM 3, 4
Saltbush (<i>Atriplex nummularia</i>)	UM 4, 5, (6)
Gao tree, appler acacia (<i>Acacia albida</i>)	UM 4, 5, (6)
Mesquite (<i>Prosopis juliflora</i>)	UM 5, 6
Algarrobo (<i>Prosopis chilensis</i>)	UM 5, 6

4. LOWER MIDLAND ZONES (norm. between 800 and 1 300/1 500 m):

a) Unimodal rainfall:

Grasses:

Napier grass (<i>Pennisetum purpureum</i>)	LM 1, 2, 3, (4)
Bana grass (<i>Pennisetum purpureum</i> x <i>P. typhoides</i>)	LM 2, 3, 4
Guinea grass (<i>Panicum maximum</i>)	LM 2, (3)
Guinea grass (<i>Panicum maximum</i>)/var. Makueni	LM 3, 4
Masai love grass (<i>Eragrostis superba</i>)	LM 3, 4
Buffel grass (<i>Cenchrus ciliaris</i>)	LM 3, 4, (5)

Root crops:

<i>Vigna vexillata</i> ⁵⁾	LM 1, 2, 3
Flemingia vestita ³⁾	LM 1, 2, 3, (4)
Psoralea patens/P. cinerea ⁴⁾	LM 3, 4, (5)

Legumes:

Townsville lucerne (<i>Stylosanthes humilis</i>)	LM 2, 3, (4)
Butterfly pea (<i>Clitoria ternatea</i>)	LM 1, 2, (3)
Brazilian lucerne (<i>Stylosanthes guyanensis</i>)	LM 1, 2, 3
Centro (<i>Centrosema pubescens</i>)	LM 2, 3, 4
Glycine (<i>Glycine wightii</i>)	LM 2, 3, 4
Siratro (<i>Macroptilium atropurpureum</i>)	LM 2, 3, 4
Townsville lucerne (<i>Stylosanthes humilis</i>)	LM 2, 3, (4)
Moth bean (<i>Vigna aconitifolia</i>)	LM 4, 5
Cowpea (<i>Vigna unguiculata</i>)	LM 4, 5

Trees and shrubs:

Horse tamarind (<i>Leucaena leucocephala</i>)	LM 3, 4
Saltbush (<i>Atriplex nummularia</i>)	LM 4, 5, (6)
Gao tree, appler acacia (<i>Acacia albida</i>)	LM 4, 5, (6)
Mesquite (<i>Prosopis juliflora</i>)	LM 5, 6
Algarrobo (<i>Prosopis chilensis</i>)	LM 5, 6

b) Bimodal rainfall:

Grasses:

Napier grass (<i>Pennisetum purpureum</i>)	LM 1, 2, 3, (4)
Bana grass (<i>Pennisetum purpureum</i> x <i>P. Typhoides</i>)	LM 2, 3, 4
Guinea grass (<i>Panicum maximum</i>)	LM 2, (3)
Guinea grass (<i>Panicum maximum</i>)/var. Makueni	LM 3, (4)
Masai love grass (<i>Eragrostis superba</i>)	LM 3, 4
Buffel grass (<i>Cenchrus ciliaris</i>)	LM 3, 4, (5)
and others like Pakistani bajari ⁹⁾	

Root crops:

Psoralea patens/P. cinerea ⁴⁾	LM 3, 4
<i>Vigna vexillata</i> ⁵⁾	LM 1, 2

⁵⁾ Also edible tubers. Seeds available at: see top 6.

Legumes:

Brazilian lucerne (<i>Stylosanthes guyanensis</i>)	LM 1, 2
Butterfly pea (<i>Clitoria ternatea</i>)	LM 1, 2, 3, (4)
Townsville lucerne (<i>Stylosanthes humilis</i>)	LM 2, 3
Glycine (<i>Glycine wightii</i>)	LM 2, 3, (4)
Siratro (<i>Macroptilium atropurpureum</i>)	LM 2, 3, (4)
Moth bean (<i>Vigna aconitifolia</i>)	LM 4, 5

Trees and shrubs:

Horse tamarind (<i>Leucaena leucocephala</i>)	LM 3, 4
Saltbush (<i>Atriplex nummularia</i>)	LM 4, 5, (6)
Gao tree, appler acacia (<i>Acacia albida</i>)	LM 4, 5, (6)
Mesquite (<i>Prosopis juliflora</i>)	LM 5, 6
Algarrobo (<i>Prosopis chilensis</i>)	LM 5, 6

5. LOWLAND ZONES (norm. between 0 and 800 m):

Grasses:

Coloured Guinea grass (<i>Panicum coloratum</i>)	L 1, 2, 3
Guinea grass (<i>Panicum maximum</i>), also good under trees	L 2, 3
Napier grass (<i>Pennisetum purpureum</i>)	L 2, 3, (4)
Bana grass (<i>Pennisetum purpureum</i> x <i>P. typhoides</i>)	L 2, 3, 4
Masai love grass and other <i>Eragrostis</i> species	L 4, (5)
Buffel grass (<i>Cenchrus ciliaris</i>)	L 4, (5)
and others like Pakistani bajra, <i>Digitaria milanijana</i> , <i>Brachiaria brizantha</i> ⁹⁾	

Root crops:

Winged bean ⁷⁾ (<i>Psophocarpus tetragonolobus</i>)	L 1, 2
<i>Vigna lanceolata</i> ⁶⁾	L 2, 3
<i>Psoralea patens</i> / <i>P. cinerea</i>	L 3, (4)

Legumes:

Brazilian lucerne (<i>Stylosanthes guyanensis</i>)	L 1, 2
Calopo (<i>Calopogonium muconoides</i>)	L 1, 2, 3
Glycine (<i>Glycine wightii</i>), esp. on heavy soils	L 1, 2, 3
Macrotyloma (<i>Macrotyloma axillare</i>)	L 1, 2, 3, 4
Butterfly pea (<i>Clitoria ternatea</i>)	L 1, 2, 3 (4)
Townsville lucerne (<i>Stylosanthes humilis</i>)	L 2, 3
Siratro (<i>Macroptilium atropurpureum</i>)	L 2, 3, (4)
Centro (<i>Centrosema pubescens</i>)	L 2, 3, 4
Marama bean ⁸⁾ (<i>Tylosema esculentum</i>)	L 3, 4, 5, 6
Moth bean (<i>Vigna aconitifolia</i>)	L 4, 5
Mauritius bean (<i>Mucuna aterrima</i>)	L 4, 5

Trees and shrubs:

Horse tamarind (<i>Leucaena leucocephala</i>)	L 3, 4
Gao tree, appler acacia (<i>Acacia albida</i>)	L 4, 5, (6)
Saltbush (<i>Atriplex nummularia</i>)	L 4, 5, 6
Mesquite (<i>Prosopis juliflora</i>)	L 5, 6
Algarrobo (<i>Prosopis chilensis</i>)	L 5, 6

There are also other possible fodder crops not mentioned here, especially trees, which are still in experimental stage, such as the salt tolerant *Acacia halosericea*. Apart from Government Research Stations valuable testing work is done for instance at the Catholic Mission at Kositei, Baringo District. It is impossible to mention all Government and other reports existing on the fodder question. Further information see BOGDAN, A. V. (1977): Tropical Pasture and Fodder Plants. Longman - Tropical Agriculture Series, London. Grasses for reseedling see PRATT, D. J. & GWYNNE, M. D. (eds., 1977): Rangeland Management and Ecology in East Africa. Hodder and Stoughten, London.

6) Also edible tubers. Foliage palatable to livestock. Seeds available at Queensland Herbarium, Indooroopilly, Queensland (Australia).

7) Also edible. Very rich in protein (about 20 %). All parts of the plant palatable to livestock.

8) Still wild plant. Grows under extremely semi-arid conditions. Also edible. Seeds available at South West Africa Herbarium, Private Bag 13 184, Windhoek (Namibia).

9) Contact C.A.R.S. Kikambala and Mtwapa Research Station

SOIL REQUIREMENTS LIST FOR CROPS IN KENYA

Crops	Preferred texture	pH	Drainage	Remarks
GRAIN CROPS				
Maize (Zea mays)	(light to) medium	5.5–8.0	free draining soils	not on very acid soils, not on waterlogging soils, at least moderately fertile soils
Wheat (Triticum aestivum)	light to medium	6.5–8.0	moderately well to well drained soils	in waterlogging conditions very poor yields, moderately to highly fertile soils
Durum wheat (Triticum durum)	light to medium	6.5–8.0	well drained soils	moderately drought resistant
Seminal wheat (Triticum x secale)	medium (to heavy)	6.5–8.0	well drained soils	tolerates salinity, moderately drought resistant
Barley (Hordeum vulgare)	medium	5.5–8.0	well drained soils	intolerant of waterlogging, tolerates salinity (– 1 %), moderately fertile soils
Oats (Avena sativa)	medium	6.5–8.0	moderately drained soils	also on poor soils
Foxtail millet (Setaria italica)	medium	5.0–8.0	well drained soils	not very drought resistant
Proso millet (Panicum miliaceum)	medium	5.0–8.0	well drained soils	some varieties drought resistant
Bombus millet (Pennisetum typhoides)	light to medium	5.0–8.0	well drained soils	drought resistant, tolerates salinity
Guinea millet (Pennisetum coracana)	medium	6.5–8.0	moderately drained soils	Turkana varieties drought resistant
Sorghum (Sorghum vulgare)	medium to heavy	4.5–8.5	moderately well to well drained soils	low to moderately fertile soils
GUMINOUS CROPS				
Pigeon peas (Cajanus acutifolius)	medium	6.0–7.5	well drained soils	drought resistant
Cowpeas (Crotalaria unguiculata)	light	5.0–7.5	free draining soils	drought resistant
Black beans (Vigna aconitifolia)	medium to light	6.0–7.5	well drained soils	drought resistant
Green grams (Vigna aureus)	medium	6.0–7.5	well drained soils	drought resistant
Black grams (Vigna mungo)	medium	6.0–7.5	well drained soils	drought resistant
Chick peas = Yellow grams (Cicer arietinum)	heavy ("black cotton soils")	5.0–7.5	moderately to well drained soils	fairly drought resistant
Beans (Phaseolus vulgaris)	medium	6.0–7.5	free draining soils	not drought resistant, need moist soil throughout the growing period
Bonavist beans = Njahe (Dolichos lablab)	medium	6.0–7.5	well drained soils	very drought resistant
Trop. lima beans (Phaseolus lunatus)	various	6.0–7.0	well drained soils	grows well also on infertile soils
Horse beans medium (Vicia equina)	medium	5.5–7.5	moderately to well drained soils	drought resistant
Horse grams (Dolichos uniflorus)	medium	5.5–7.5	moderately to well drained soils	drought resistant
Groundnuts (Arachis hypogea)	light	6.2–7.5	well drained to somewhat excessively drained soils	until harvesting the soil must be moist, but sensitive to impeded drainage; moderately fertile soils

Crops	Preferred texture	pH	Drainage	Remarks
Bambara groundnuts (Voandzeia subterranea)	light	6.2-7.5	well drained soils	soil aeration must be adequate, not on heavy soils with pans; thrive better on groundnuts on poor soils
Garden peas (Pisum sativum)	medium	5.5-7.5 (see beans)	well drained soils	some N good for start
Pigeon peas (Cajanus cajan)	light	5.0-7.5 no inform.	free draining	fairly drought resistant
Soya beans (Glycine max.)	medium	5.5-7.5 (opt. 6.0-6.5)	moderately well to well drained soils	moderately fertile soils
OIL SEED CROPS				
Sunflower (Helianthus annuus)	medium (heavy)	6.0-8.0	moderately drained soils	very drought resistant
Linseed (Linum usitatissimum)	medium	5.5-7.5	moderately drained soils	drought resistant
Rai (Brassica juncea)	medium to heavy	6.0-8.0	moderately drained soils	drought resistant
Rapeseed (Brassica napus)	medium	5.5-7.0	moderately drained soils	not drought resistant
Simsim (Sesamum indicum)	light to medium	6.0-7.5	free draining soils	moderately drought resistant
Safflor (Carthamus tinctorius)	medium	6.0-8.0	moderately drained soils	tolerates salinity, moderately drought resistant
Castor (Ricinus communis)	medium	6.0-7.5	free draining soils	moderately drought resistant, not on saline soils
TUBER CROPS				
Sweet potatoes (Ipomea batatas)	various (wide range: swamps to eroded areas)	various	various but planted on ridges in swamps	drought resistant, need moderately fertile soils
Potatoes (Solanum tuberosum)	light to medium	4.5-8.0	free draining soils	not so drought resistant, need good supply of nutrients
Cassava (Manihot esculenta)	light to medium	various	free draining soils	very drought resistant, not on very stony or shallow soils, sensitive to impeded drainage, thrives also on less fertile soils
Taro-Cocoyam (Colocasia antiquorum)	light to medium	4.5-8.0	tolerates waterlogging	grows esp. well on riverbanks, demands a fertile soil
White Guinea yam (Dioscorea rotundata)	medium	4.5-7.0	moderately to weakly drained soils	moderately fertile soils
Greater yam (D. alata)	"	"	"	"
Yellow Guinea yam (D. cayenensis)	"	"	"	"
Buffalo gourds (Cucurbita foetidissima)	light	6.0-7.5	well drained soils	very drought resistant
Maramba beans (Tylosema esculentum)	medium	6.0-7.5	well drained soils	very drought resistant
Vigna (Vigna lobatifolia)	light to medium	6.0-7.5	well drained soils	very drought resistant

Crops	Preferred texture	pH	Drainage	Remarks
FIBRE CROPS				
Cotton (<i>Gossypium hirsutum</i>)	medium to heavy	6.0–8.0	well drained soils, sensitive to impeded drainage	tolerates salinity (0.5–0.6 %); moderately to highly fertile soils; should contain bor
Flax (<i>Linum usitatissimum</i>)	medium	5.5–7.5	moderately drained soils	
New Zealand flax (<i>Phormium tenax</i>)	medium	5.5–7.0	moderately drained soils	
Sisal (<i>Agave sisalana</i>)	medium	5.5–7.5	well to moderately drained soils	on heavy soils it is necessary to form cambered beds or to dig ditches for drainage
OTHER CASH CROPS AND FRUITS				
Avocadoes (<i>Persea americana</i>)	medium	6.0–7.5	well drained soils	not on saline soils
Bananas (<i>Musa paradisiaca</i>)	light to medium	5.0–7.0	well to moderately well drained soils	best places are fertile volcanic or alluvial soils. Tolerate short floods; soil aeration must be adequate, moderately to highly fertile soils
Cashew nuts (<i>Anacardium occidentale</i>)	light	5.0–7.5	unimpeded drainage	on dry and steep slopes against soil erosion; thrive also on poor soils
Citrus (<i>Citrus</i> spp.)	light to medium	5.0–7.0	well drained soils	soil aeration must be adequate, sensitive to impeded drainage, moderately to highly fertile soils
Coconuts (<i>Cocos nucifera</i>)	light	4.0–7.0	free draining soils	tolerate high salinity (– 1 %), soil aeration must be adequate. In arid regions groundwater should be available in 1–2.5 m depth.
Coffee/Arabica (<i>Coffea arabica</i>)	medium	5.3–6.0	free draining soils	soil must allow reasonable water retention; very sensitive to CaCO_3 (more than 1 % of the fine earth) and CaSO_4 (> 0.5 % of the fine earth), moderately to highly fertile soils
Coffee/Robusta (<i>Coffea canephora</i> var. <i>robusta</i>)	medium	5.0–6.0	well drained soils	grows well in a wide range of various soils if they are well drained; sensitive to CaCO_3 and CaSO_4 like Arabica coffee
Deciduous fruit trees (apples, peaches, pears)	medium	4.5–7.0	well drained soils	if the soil is deep they tolerate also lighter or heavier soils
Macadamia nuts (<i>Macadamia</i> spp.)	medium	5.0–6.0	free draining soils	
Pyrethrum (<i>Chrysanthemum cinerariaefolium</i>)	medium	5.6–7.5	well drained soils	
Sugarcane (<i>Saccharum</i> spp.)	light to medium	5.0–7.0	moderately well to well drained soils	sensitive to waterlogging; groundwater should be below 1 m depth. On heavy soils cambered beds, ditches or furrows must be formed for drainage. Moderately fertile soils
Tea (<i>Camellia sinensis</i>)	medium	4.0–6.0 (4.5–5.5)	free draining soils	soil with good water retaining capacity is essential, very sensitive to CaCO_3 (0 %) and CaSO_4 (0 %), grows also on less fertile soils
Tobacco (<i>Nicotiana tabacum</i>)	medium	(5.0) 5.5–6.5	well drained soils	not on heavy or/and saline soils, very sensitive to CaCO_3 (> 1 % of the fine earth) and CaSO_4 (> 0.5 % of the fine earth)
Tung oil (<i>Aleurites fordii</i>)	medium	4.5–6.5	well drained soils	
Ye-eb nuts (<i>Cordeauxia edulis</i>)	medium	no inf.	well drained soils	very drought tolerant

A BROAD ESTIMATE OF THE DOMINANT CHARACTERISTICS
OF THE MAJOR SOIL CLASSIFICATION UNITS IN KENYA

(variable = more than 3 classes)

Major Soil Class, Unit	texture subsoil	texture topsoil	depth	organic matter content of topsoil	pH (water)	drainage	workability	fertility	water holding capacity	Remarks
<u>Ferralsols</u>	clay	clay	variable	variable	variable	good	moderate to good	low	moderate	
<u>Luvissols</u>	clay	variable	variable	variable	above 5.5	moderate	moderate to good	low to moderate	moderate	
<u>Acrisols</u>	clay	variable	variable	variable	below 5.5	moderate to good	moderate to good	low	moderate	
<u>Arenosols</u>	sand	sand	variable	low	variable	good	good	low to very low	low to very low	
<u>Nitisols</u>	clay	clay	deep	moderate to high	variable	good	good	moderate to high	moderate to high	Kikuyu Red loam
<u>Phaeozems</u>	clay	variable	variable	high	above 5.5	good	good	high	high	Prairie soils
<u>Andosols</u>	clay	clay	deep	moderate to high	variable	good	good	high	high	Volcanic Ash Soils
<u>Rendzinas</u>	clay	clay	variable	high	above 5.5	good	good	high	high	
<u>Cambisols</u>	variable	variable	variable	variable	variable	moderate to good	moderate to good	moderate to high	variable	young soils
<u>Fluvisols</u>	variable	variable	variable	variable	variable	variable	variable	moderate to high	variable	Alluvial soil
<u>Vertisols</u>	clay	clay	variable	low to moderate	variable	poor	poor	moderate to high	high	Black Cotton soils cracking clay Vlei soils
<u>Planosols</u>	clay	variable	variable	low to moderate	variable	poor	moderate to poor	low to moderate	moderate to low	
<u>Xerosols</u>	clay	variable	variable	variable	above 5.5	variable	variable	variable	variable	non saline or sodic soils of dry regions
<u>Solonchaks</u>	clay	variable	variable	variable	above 7	variable	variable	variable	variable	saline soils
<u>Solonetzs</u>	clay	variable	variable	variable	above 7	poor	poor	low	variable	sodic (alkali) soils
<u>Regosols</u>	clay	variable	variable	moderate to high	variable	variable	variable	variable	variable	
<u>Rankers</u>	clay	variable	variable	variable	below 5.5	variable	variable	variable	variable	
<u>Lithosols</u>	rock	variable	very shallow	variable	variable	variable	variable	variable	very low	very shallow soils
<u>Gleysols</u>	clay	clay	variable	moderate to high	variable	poor	poor	variable	moderate	poorly drained soils
<u>Greyzems</u>	clay	variable	variable	moderate to high	variable	moderate	moderate	moderate	moderate	
<u>Histosols</u>	peat-clay	peat	variable	very high	below 5.5	moderate to poor	variable	moderate to high	moderate to high	peat soils

EXPLANATORY NOTES ON FARM MANAGEMENT INFORMATION

Sound farm management, advice and planning must take into consideration the natural conditions of soil and climate, the socio-economic situation of the farm and cost/price developments.

Volume II of the Handbook describes these natural conditions¹⁾ i.e. the AEZ is the key to which crop can be grown with which degree of success in which part of the district.

Any planning done, operation undertaken or communication made must refer to a particular area of uniform natural conditions. The most economic and exact way to do so is by using maps.

All officers and institutions dealing in any way with rural development have been supplied with the Handbook and with large and small AEZ maps. All officers involved in rural development are requested to refer to the particular political unit (location, division etc.) and the AEZ into which the area under discussion falls. This can be done by using the charts which can be obtained from the maps without difficulty.

The fertility of the soils often differs widely within one agro-ecological zone. The extension officer must therefore study the information given and compare the soil conditions with the soil requirements of the crops before making any definite recommendations.²⁾ A steep increase in fertilizer use is necessary but fertilizer is one of the most expensive inputs. It is therefore essential to study the explanations for the input/output table. Information about the use of plant protective agents is forwarded to you annually;³⁾ the costs of inputs and prices for agricultural produce are also given. It will be most important to observe the fertilizer use recommendations which will become available from new research towards the year 1985–90.

The conservation of the fertility of the soil or its improvement should be a major part of farm management advice, because it is the basis for successful farming, in particular when using large amounts of inputs. Soil conservation is probably one of the best investments a farmer can make and should always be included in overall farm budgets. Studying the advice on soil conservation included in Vol. II will help you to give technically sound advice and assist in cost calculation.

1) Vol. I supplies labour data, Vol. IV production techniques; information about farm organisation and profitability is published annually by the FMB.

2) Additional information about the soils of your region can be obtained from the National Soil Map of Kenya available at the DAO's office.

3) Farm management publication: „Yields, Costs and Prices“

GENERAL STATISTICS

Land Area¹⁾

As important as the knowledge of the potential of land is the knowledge of the actual land area available for production. Complete and exact land statistics exist only for those areas where land adjudication has been completed and for the former scheduled areas.²⁾ The statistics have been compiled per sub-location, location, division, etc. The land areas of the political units below district level are constantly changing because of subdivision of sub-locations and reallocation of land areas etc. It is however advisable to use the statistics given in the Handbook.³⁾

The land areas of the former scheduled areas are recorded according to land reference numbers and cadastral sheet number. The land area of a farm can easily be established by identifying the land reference numbers belonging to one farm and adding up the areas belonging to each land reference number.

The creation of new land reference numbers is a legal act which requires measurement of the newly created area unit and can therefore be traced easily. Space is given in the land statistic tables to enter any future major changes by hand.

The land: population ratio is most important. For this reason the maps used for the 1979 census were used as base maps for the large AEZ maps. In order to find out the amount of land available, the land area which falls into the respective AEZ has been measured and the average land area per household and person calculated and printed in table. This table is the most suitable statistic for the production potential of particular areas. When using it together with the information on cropping patterns and yields, it is possible to calculate a fairly exact output statistic per area unit.

Population statistics

The land: population ratio is an important basis for land use recommendations etc. The total population and the household composition has been included.

Note: The number of households depends very much on the particular location, but is rapidly changing at present (1981/82) towards one extended household per farm, entered into the table as „total number of persons per household“. The statistics were obtained from the 1979 census; the annual population growth rate is approximately 3.9 % p.a.

Other statistics

Statistics of the four most important industrial crops, pyrethrum, tea, coffee and cotton are published by the respective boards and the KTDA. Other information is compiled by the CBS. The Farm Management Research Officer will forward this information to the DAO in future, who should then enter it in the respective column by hand.

- 1) Official agricultural land statistics will be included in the annual publication of the Handbook Vol. III/A.
- 2) Land area statistics are compiled in two different departments: a) Survey of Kenya, b) Department of Lands. The Land statistics are not always consistent, but it was not always possible to detect the errors.
- 3) Area transfer is usually done for political reasons and is legalised by the establishment of the new boundaries by the Survey of Kenya; the time lag is usually 10 years.

TABLES COMPILED FROM THE SMALL FARM SURVEY (SFS)

The Small Farm Survey was carried out during 1977. A well trained group of ten enumerators interviewed 1,600 smallscale farmers asking each the same set of questions. The enumerators were closely guided by a supervisor and the team leader was an experienced agricultural economist. The investigation area was chosen according to its ecological potential and the socio-economic situation of the farming community. The farmers were selected at random from the members' register of the co-operative societies of the particular area.

Co-operative society members are usually involved in the cash economy and farmers who are co-op members usually practise somewhat more advanced farm management. It is a safe assumption that *the production level reflected in the tables will be reached by the average farmer towards the year 1985.*

The information obtained from the farmers is comprehensive, but in using the data, one should, however, keep in mind that data obtained in interviews has certain limitations.

The data is shown as obtained from the farmers and only obvious recording errors have been excluded. The aim of SFS was to get information about the average structure of family farms and the know-how and opinion of the farmer about his operation. In addition, *information obtained from two individual farms is included: Upper Quartile and Lower Quartile.* In a few cases, the information may seem illogical e.g. high input, low yield, but the overriding aim in compilation was to present the information as far as possible as it had been supplied by the farmer.

The tables are self-explanatory; possible exceptions are the table a) „Inputs and Yields of Major Crops” and b) the graph „Distribution of Farming Activities”.

to a) As stated above, the information is printed as supplied by the farmer. The input/output relation in many cases does not seem logical. Besides purchased inputs there are however a large number of yield influencing factors like fertility, state of the soil, timely availability of the inputs etc. For example, a clear correlation between early planting of maize and grain yield was one of the outcomes of the survey, but it was not possible to establish a production function for fertilizer input. What the table clearly shows is that *Kenya's family farmers¹⁾ know that the use of improved seeds, fertilizer and plant protective agents helps to increase the yield, but they are in urgent need of information as to how to use them best;* the table also shows that field preparation is a major bottleneck on the small farms.

to b) The income of a family farm is the return on the work input of the farmer and his family. The vegetation period is roughly equal to the production period i.e. the time when the farmer can generate income through work. Practically nothing is produced during the dry season, thus the farmer cannot work and has very little income. The smaller the farm, the more crucial is the length of the vegetation-production period for the farmer's employment opportunities.

An ideal employment situation for the family farmer exists only in AEZs LH 1, UM 1 + 2, but in all other zones, labour peaks reduce his employment possibilities throughout the rest of the year. Planning and farm advice which does not consider labour management can only be incorrect and is of little value.

The graphs indicate the time of the year in which various operations are executed on the farms. They also reflect the constraints to which a farmer is subject e.g. cultivation can only be started after a certain amount of rain has softened the soil but must be stopped before the remaining vegetation period gets too short, otherwise the returns on his efforts become marginal.²⁾

It is advisable to compare the distribution of farming activities with the precipitation graphs shown in this book, in order to detect possibilities of making better use of the full vegetation period. The graph does not give any information about the amount of work (mh) involved in the different operations.³⁾

- 1) „Family farm” is a holding where more than 50 % of the manual labour input is done by the farmer and his family – the aim of the operation is to generate income through self-employment.

Large-scale farms are operated by employing labourers for practically all manual work; the income of the operation is a return on management and capital invested.

- 2) For example, 3 weeks delay in maize planting reduces hybrid maize yield in UM 3–4 West of the Rift by 25 %.
- 3) For this, see Vol. I Labour Study. It is planned to compile two more labour studies, one for the bimodal rainfall region. It is hoped that they will be available towards 1985–90.

PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONE OUTPUT & NUTRIENT INPUT

Remarks

The input: output ratio is probably the most important single piece of information required by the farm management extension and agricultural planning officer.

Almost every enterprise yields more than one product, e.g. maize produces grain plus straw, legumes produce seeds, straw and enrich the soil with nitrogen etc. Therefore the actual value of the output can only be arrived at after assessing the sum of the individual values of the different products. However, most crops are planted in order to produce one major product which can be sold and/or consumed on the farm. This product is generally referred to as the yield of the enterprise.

Likewise a number of different inputs are required to grow a crop. The kind, variety, amount and number of inputs used depends on a large number of circumstances and therefore can only be assessed properly on an individual basis. There are, however, two major inputs: (a) the work input, (b) the nutrient supply. Work execution on smaller family farms is usually done by hand, while large farms use tractors. These input components have already been dealt with in the Farm Management Handbook Vol. 1¹⁾ and for this reason Table 15 gives information on the nutrient requirement of the different crops only.

The kinds of nutrients needed by each individual crop are many and the amount required depends on a large number of circumstances and conditions. An attempt has been made to include the three most important factors — climate, soils and yields — in the table.

The table provides details on the yields and fertilizer requirement ($N + P_2O_5$) of the most important crops, for the AEZ where the individual crop is or can be grown, and for the soil type which covers the largest portion of land within the particular AEZ.

Yields and $N + P_2O_5$ requirement are shown for **three production levels** and for a yield achievable without nutrient application. The proportions of farmers achieving any one of the three yield levels is so far known only *very* approximately²⁾ and should be assessed as soon as possible using the yield figures given.

Production Level I —

reflects traditional production techniques — farmers apply a regionally developed and relatively wide variation of production techniques; they do not apply fertilizer and/or plant protective agents (except for coffee and tea). They use their own seed, with the exception of maize where 75 % plant purchased hybrid maize. Cultivation is done by hand hoeing (in AEZ LH 1 + 2, UM 1 + 2 and L 2 + 3 + 4) (up to 60 %) and with the help of draught animals in LM 1–4 (65 %).

Production Level I includes small family farms only; when large farms achieve Level I yields only, this is usually because they fail to apply improved technology properly. It seems feasible that ± 60 % of the family farms of Production Level I will reach Production Level II by the year 2 000.

Production Level II —

Farmers apply the recommended husbandry methods, use fertilizer, new seed and plant protection methods within the constraints of practical farming. The larger family farms (above 5 ha) within AEZ LH 1–4, UM 1–4 and LM 1–2 in the Rift Valley, Western and Nyanza Province hire tractors for the first ploughing (± 50 %); farmers in AEZ LM 3–4–5 use draught animals (± 65 %) for ploughing.

Production Level II includes family farms and practically all large mechanised farms.

Production Level III —

reflects the yield level which can be achieved under optimal conditions in practical farming, i.e. if the objective (natural) and subjective (management) conditions are optimal. Yield Level III shows the actual potential which can be reached if the knowledge available at present is put into practice. Although the yields shown are now being achieved by some farmers, a significant proportion (± 25 %) will not reach this Production Level III before the year 2 000.

The approximate distribution of family farms within the three Production Levels is at present (1981/82) as follows:

Production Level ³⁾	Enterprises	
	Major Food and Cash Crops	Other Crops and Cotton
I	75%	85%
II	23%	15%
III	2%	—

1) Labour Requirement/Availability and Economics of Mechanisation

2) For some guidance, see table 9

3) rainfed agriculture only

Assessment of the Data

Yields:

The only exact method of establishing reliable information on crop yields in non-book-keeping farms is to harvest and weigh the crop of an exactly measured area by a specially employed team over a number of years (crop cutting). This method has never been employed, thus exact on-farm yield figures are not available.

On the other hand, a large number of relatively small investigations have been carried out to acquire information about yields of some crops. Comparatively long term information is available from farms keeping books, and the results of approximately 30 years of agricultural research work give some insight into present yield levels and the production potential of Kenya's agriculture.

Practically all information on yields available in Kenya has been analysed to assess the yield figures shown in Table ... The climatological yield potential for the individual crops within the different agro-ecological zones has become available through work on the AEZs, and information about the approximate soil fertility has been supplied by the K.S.S.. The Small Farm Survey (S.F.S.), executed to obtain basic farm management data for the Handbook, supplied additional information about the yield level in the smallholder sector at present.

The yield figures obtained from, or based on this considerable amount of data have been discussed thoroughly and repeatedly with the agricultural extension and research officers. The author of the table was able to base his assessments on 10 years' experience with agriculture in Kenya. He was therefore in a position to assess the magnitude of the impact of socio-economic constraints on yields in particular.

However, it is more difficult to predict **yield developments**, which depend on a large number of factors and constellations, many of them still unknown at present. On the other hand some likely development trends are visible. For example, a farmer will always produce enough food for his family and those who help to cultivate his farm, if he has sufficient land at his disposal, and the natural conditions are suitable. This is the case in AEZs: LH 1-2, UM 1-4, LM 1-2 and L 2-3. It is therefore a safe assumption that agricultural output in this region will, in line with the population increase, increase by + 4 % p.a., but there is very little or no scope for increasing agricultural production in arid/semi-arid regions, employing the technology available at present. Food is also needed for the urban population and agricultural products required for export. The additional amount of products required can only be produced in the high rainfall areas (AEZ: LH,UM,LM 1-3) - thus an overall output increase of approximately 8 % p.a. is required. The natural potential of the high rainfall areas allows for a doubling of the present yields of most enterprises, employing the technology available at present.

The yield figures shown for the three Production Levels have been established in three steps:

a) **Establishing the present Level** using mainly the results of:

- the Small Farm Survey,
- the demonstration trials in the farmer's field,
- other socio-economic surveys and research results.

Based on this information, the yields per AEZ per district have been established. From these data, average yield figures for eleven zones of similar ecological and socio-economic potential have been compiled. These data have been used in turn to assess the impact of the socio-economic constraints by comparison with the deviation in yields in different localities of similar natural potential from the average yield of the particular zone.

b) **Establishing the yield potential** using mainly the results of:

- the work on the agro-ecological zones,
- the work on the Kenya soil maps,
- top farmers in national competitions and from various surveys,
- agricultural research.

c) **Establishing a likely possible development path** using information from:

- advanced farms in advanced districts,
- book-keeping farms,
- past developments, and predicting future trends using the future possibilities and constraints presently known.

The yields given refer to the harvested, saleable product; storage losses etc. have not been accounted for. **Gross yields** are given in kg of total digestible nutrients (TDN) because green matter and/or dry matter figures are less informative and difficult to compare. The figures have been arrived at by analysing the yield data, stocking rates, etc. available. The following formula has been used:

Feed Value of Grass¹⁾

Grass	GM	DM of GM in %	TDN of DM ²⁾ in %	DCP in DM ²⁾ in %
Natural Pasture and Leys	100	20	65	25
Napier and Bana Grass	100	20	55	15

1) refers to AEZ: LH 1 – pasture grazed, napier grass = zero grazing

2) the digestibility of the DM has been reduced by 20 % – from 65 % in LH 1 to 45 % in LM, L 2–5 using a straight line function in order to make up for the influence of the temperature; average of the crop when grazed and/or fed etc.

Nutrient/Fertilizer required

Apart from climate, the fertility of the soil, in the broadest sense, is the most important production factor in agriculture. Natural fertility has been reduced through intensive cropping – nutrients stored in the soil are absorbed by the crops grown and are removed with the harvest from the field and often from the farm because of selling the crop.

In traditional agriculture, land was left fallow in order to allow for a restoration of soil fertility, or in large commercial farms, leys were planted for the same reason. This rest period of 4–5 years was generally enough to maintain a fairly good nutritional balance. Both practices are no longer, or only occasionally practised today as the rapid population increase has led to continuous cropping. Furthermore, in traditional agriculture only the fertile lands were cultivated, while today all kinds of often extremely infertile soils are utilised.

Only three to four soil types in Kenya have good natural fertility, but most are extremely infertile, and for all these reasons, the natural fertility of agricultural land is declining quickly. Therefore the nutrient which is taken out of the soil must be given back to it. The amount of nutrient to be applied must be equal to the amount which is taken away with the harvested yield. Agricultural output must increase by roughly 10 % p.a. in order to keep pace with demand; thus the amount of nutrients applied should increase by 10 % p.a. as well.

The only realistic way to achieve this is in the application of synthetic fertilizer. Kenyan farmers purchase fertilizer for approximately KShs. 250 million p.a. at present (1981/82) and urgently need advice on its correct use.

Correct advice for fertilizer application can be based only on scientifically proven data. Good farm management advice on fertilizer use must be based on correctly assessed *production functions*. The advisor must know how much additional yield he can expect per additional amount of nutrient applied to a particular crop in a particular location. However, no scientifically proven data basis for such information is available yet.¹⁾

On the other hand, some research work and a large number of fertilizer trials and demonstrations on farms have been implemented to get an insight into the fertilizer requirements and response of the major crops to nutrient application. Almost all data available on fertilizer application response in Kenya has been studied for the compilation of the data shown in table ... The data available indicate that there is very little response to K₂O application and therefore no information is given for this nutrient.

1) A large soil testing and fertilizer trial programme is presently planned; comprehensive results will be available towards 1990–95.

Assessment of the Data

The data available on fertilizer use and response are insufficient for the compilation of proper fertilizer recommendations. In addition, research has concentrated on particular areas and crops, while other areas, and the so-called subsistence crops, have been virtually neglected. In order to arrive at some information for all areas suitable for rainfed agriculture, and for the most common crops, the assessment had to be done in two steps (a and b) and a number of assumptions had to be made.

- The results of research work, demonstrations on the farm, results of book-keeping farms, etc. have been analysed to assess fertilizer response.
- The nutrient **removal** per weight unit of the different crops has been compiled. The amount of nutrient to be applied has then been assessed by using a set of nutrient *recovery rates* for the three major ecological regions, as shown below:

**Recovery Rate of Nutrients
in %**

Region	Nutrients		
	N	P ₂ O ₅	K ₂ O
Upper-Lower Highlands, Upper Midlands and Lower Midlands in W. Kenya	60	15	70
Lower Midlands (East Kenya)	70	20	50
Lowlands (Coast)	50	20	50

The recovery rate of different plants varies, but this variation has been ignored because it is largely unknown. The data arrived at by way of these calculations have been altered somewhat according to (a) the natural fertility of the (20) most important soil types in the particular AEZ, (b) the length of the vegetation period and the *kind* of rainfall (c) the knowledge of fertilizer use on the part of the farmers of the particular region.

For **coffee** the recommendation of research stations has been included as published, the nutrient requirements for **tea** have been based on production function figures supplied by the tea research station.

The **legumes** included in the table produce approximately 25 kg N/ha per crop. This nutrient has been ignored as it is only partly available for the particular legume crop.

Note: The fertilizer recommendations given in district tables 15 can be a guide only. They will be replaced by the information obtained by the fertilizer use research programme within the next 10–15 years.

An underlying assumption is that farmers who apply more fertilizer apply improved husbandry as well. This is the yield increase per amount of nutrient applied is due to both factors – better nutrient availability for the plant and better husbandry for its protection.

YIELD TABLES

Results of Crop Cuttings – Variety and Crop Fertilizer Trials in Farmers' Fields and Research Stations

MAIZE YIELDS^{a)}

RESULTS OF CROP CUTTINGS IN FARMERS FIELD

(First Rains only)

Province/District	Ecological Zones of		Yields ^{c)} measured in:					5 years average ^{c)}	
			1975 kg/ha	1976 kg/ha	1977 kg/ha	1978 kg/ha	1979 kg/ha	kg/ha	bags/ha
M&PB									
AEZ ^{b)}									
NYANZA									
Kisii	1	LH 1	3,879	4,195	3,581	3,300	3,858	3,762	42
"	2	UM 1	4,502	3,739	-	3,500	3,997	3,935	44
South Nyanza	3	LM 2	2,990	-	-	2,540	-	2,765	30
"	2	LM 3	3,777	2,384	2,093	2,340	2,979	2,715	30
Kisumu	3	LM 3-4	3,194	2,664	2,604	2,400	3,187	2,810	31
Siaya	3	LM 3-4	4,037	2,782	2,392	2,600	3,469	3,056	34
WESTERN									
Kakamega	2	UM 1	3,697	3,033	2,802	2,700	2,724	2,991	33
"	1	LM 1-2	3,862	3,623	3,936	2,950	2,089	3,092	34
Busia	2	LM 1-2	2,647	2,950	1,747	2,100	2,132	2,315	26
Bungoma	1	LH 1 - UM 1	4,524	3,559	4,402	3,540	3,256	3,856	43
"	2	LM 1-2	2,986	2,564	2,662	2,310	2,250	2,554	28
RIFT VALLEY (Large Farms)									
Trans Nzoia	7	UM 4	4,390	4,236	4,625	3,748	2,853	3,970	44
Uasin Gishu	1	LH 3	3,399	3,500	-	2,500	-	3,133	35
"	7	UM 4	3,005	2,699	3,175	2,520	3,202	2,902	32
Nakuru	7	UM 3-4	4,116	3,672	4,416	3,450	-	3,913	43
Laikipia	8		-	2,248	2,863	2,180	1,600	2,223	25
(Small Farms)									
Kericho	1	LH 1 - UM 2	-	4,349	4,506	3,770	-	4,208	47
"	2	LH 1	6,600	4,549	4,327	4,390	-	4,966	55
Elgeyo Marakwet	1	UH 1-2	4,938	-	3,125	3,430	-	3,831	42
CENTRAL									
Nyandarua	8	LH 3	3,535	2,194	2,972	2,460	1,581	2,548	28
Nyeri	5	UM 3	3,018	2,733	2,027	2,110	1,469	2,271	25
Kirinyaga	5	UM 1-2	3,759	4,548	1,717	2,840	1,800	2,932	33
"	4	LM 4	2,397	1,658	-	1,710	1,447	1,803	20
Muranga	5	UM 1	3,403	2,914	1,649	2,270	3,497	2,747	31
"	4	LM 3-4	2,782	2,346	-	2,170	1,285	2,146	24
Kiambu	5	UM 2-3	3,026	2,423	2,269	2,190	2,438	2,469	27
"	4	LM 4	-	-	1,169	1,000	1,770	1,313	15
EASTERN									
Embu	5	UM 2-3	4,611	2,704	2,227	2,700	-	3,060	34
"	4	LM 3	2,479	1,742	1,733	1,690	-	1,911	21
"	6	LM 3	1,937	-	1,298	1,480	-	1,572	17
Meru	5	LH 1 - UM 1	4,104	3,763	-	3,350	-	3,739	42
"	4	LM 3	2,707	3,384	2,174	2,340	-	2,651	29
"	6	LM 3	3,625	-	1,784	2,300	-	2,570	29
Machakos	6	LM 3-4	1,094	939	1,082	880	1,838	1,057	12
Kitui	6	LM 4-5	-	-	1,121	950	1,760	1,277	14
COAST									
Kwale	9	L 3-4	2,068	1,389	1,251	1,340	938	1,397	16
Kilifi	9	L 3-4	2,774	1,894	1,477	1,440	1,650	1,847	21

a) Source: Maize & Produce Board (M & PB)

b) Approximate – AEZ established later than M & PB sample areas

c) Results of crop cutting to arrive at farmers yields, 5 % for harvesting and 10–15 % for storage losses still be deducted

NATIONAL MAIZE PERFORMANCE TRIAL (1979)
1ST YEAR RESULTS FROM 6 LOCATIONS

/Site	N.A.R.S. KITALE	NSQCS LANET	P.B.S. NJORO	E.D. FARM ENDEBESS	EMBU RESEARCH STATION	KAKAMEGA RESEARCH STATION	MEAN
Date Planted	11/ 4/79	3/ 4/79	19/ 4/79	10/ 4/79	5/ 4/79	12/ 4/79	
Date Harvested	31/10/79	18/10/79	26/10/79	1/10/79	15/10/79	1/10/79	
Altitude in m	1891	1920	2170	1891	1436	1647	
Rainfall in mm (cropping period)	945	521	491	355	653	869	
Hybrid/Yield in kg/ha							
H. 7801	6465	6734	3771	5051	5522	6869	5735
H. 7701	6465	7138	3906	4444	5926	5657	5589
H. 7802	7273	6195	3003	5118	5522	5253	5394
H. 614 C	6599	6869	3502	4310	2761	5926	4994
H. 612 C	5899	5791	3252	3771	3367	5253	4555
H. 613 C	5926	5222	2492	3367	3737	4983	4287
H. 512	4444	5118	2896	4983	3232	4983	4276
H. 511	3232	6465	2828	5158	3064	4040	4126
H. 622	3906	4983	2788	3502	4208	4175	3927
H. 632	5118	4714	2559	2828	2929	4983	3855
Pioneer X 105A	3636	3502	1279	2963	3300	2290	2828
Coast Composite	2828	4444	1515	2761	2458	2559	2760
Katamani Comp. B	1481	3771	1010	4040	1380	2222	2317
Station Mean	4867	5457	2677	4022	3644	4553	4203

YIELDS FROM 1ST MAIZE CONTEST IN FARMERS' FIELDS (1972)

Name	Farm	Yield of grain at 13%	
		Kg/Ha	Bags/Ac.
C. T. Rose	A.D.C., Sabwani	10,342	46.1
—	Endebess Estates	8,783	39.2
L.W. McDouall	A.D.C., Chorlim	8,699	38.8
O.A.S. Vorster	A. D. C., Japata	8,594	38.3
S.E.W. Andersen	A. D. C., Zea	8,124	36.2
J.H. Wickham	A.D.C., Ol Ngantongo	7,892	35.2
P. S. Long	Marrow Down	7,798	34.8
G.T. Luck	Saboti	7,054	31.5
F. Pereira	N.A.R.S., Kitale	6,796	30.3
Kerita Pyr. & Veg.	Co-op. Society	6,716	30.0
R. A. Barbour	Bletchley	5,691	25.4
J. Kogo	Nai	5,514	24.6
J.H.F. Megson	D'acre	5,243	23.4
Averages		7,479	33.4

DETAILS OF THE 3 BEST CROPS

Operations, etc.	C. Rose	Endebess Estates	L. McDouall
Previous Crop	Perm. grass	Sunflower	Grass Ley
Ploughed	Sept. 71 Dec. 71	Dec. 71	Nov. 71 Jan. 72 Mar. 72
Harrowed	Nov. 71 Jan. 72 Mar. 72	March 72 April 72	Apr. 72
Planted	Mar. 16	April 20	Apr. 28
Plants at harvest	15,487 38,270	15,455 38,141	13,552 33,488
Fertilizer Kg/ha.	67 119	65 109	95 117
Hand Weeded	May 9	May June	May 21 June 24
Cultivated	-	-	May 20
Herbicide	24D - Am. April 6	-	-
Insecticide	5% D.D.T. May, June	5% D.D.T. May	Dipterex June
Harvested	Oct. 12	Nov. 16	Jan. 13
Moisture % at harvest	27.0	29.9	15.4
Yield, Bags/Acre	46.1	39.2	38.8

RESULTS OF FERTILIZER TRIALS IN FARMERS FIELD
NYANZA AND WESTERN PROVINCES

Province/District		C R O P S												Sunflower			
		Maize			Sorghum			Groundnuts									
		0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0				
Nyanza	Kisii	fertilizer treatment	3,515	4,130	5,000	1,790	2,710	3,470	1,570	1,820	2,450						
		incremental	-	615	1,485	-	920	1,680	-	250	880						
		per kg nutrient	-	10	25(+15)	-	23	42(19)	-	6	22(16)						
S. Nyanza	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0				
		2,530	3,350	4,540	2,170	2,500	3,660	820	920	1,550	730	100	730				
		-	820	210	-	330	1,490	-	-	2	18(16)	2	18(16)				
Kisumu	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0				
		2,250	3,120	3,920	2,680	2,690	3,100	500	680	1,100	600	180	600				
		-	870	1,670	-	10	420	-	-	5	15(10)	5	15(10)				
Siaya	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0				
		3,160	3,910	4,930	1,340	2,100	2,800	820	1,150	1,400	580	330	580				
		-	750	1,770	-	760	1,460	-	-	8	15(7)	8	15(7)				
Average Nyanza	yield	2,650	3,460	4,460	2,000	2,500	3,260	930	1,140	1,630	70	210	70				
		incremental	-	810	1,810	-	500	1,260	-	-	5	18(13)	5	18(13)			
		per kg nutrient	-	14	30(16)	-	13	32(19)	-	-	-	-	-	-			
Western Busia	Crop	0-0-0	0-60-0	60-60-0	0-0-0	Soya Beans											
		3,400	4,300	5,620	530	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-40-0	0-40-0	40-40-0	40-40-0
		incremental	-	-	-	-	700	950	650	900	1,160	1,760	250	510	150	510	510
Bungoma	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-40-0	0-40-0	40-40-0	40-40-0
		3,160	4,060	4,980	1,020	1,360	1,640	790	1,100	1,370	750	310	580	320	940	1,690	1,690
		incremental	-	900	1,820	-	340	620	-	-	8	24(16)	8	24(16)	8	24(16)	24(16)
Kakamega	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-40-0	0-40-0	40-40-0	40-40-0
		3,800	5,000	6,100	760	1,100	1,400	860	1,200	1,430	840	340	780	360	780	1,620	1,620
		incremental	-	1,200	2,300	-	340	640	-	-	9	14(5)	9	14(5)	9	20(11)	20(11)
Average Western	yield	3,450	4,450	5,570	770	1,050	1,330	770	1,070	1,320	950	300	555	270	740	1,690	1,690
		incremental	-	1,000	2,120	-	280	560	-	-	8	14(6)	8	14(6)	7	19(12)	19(12)
		per kg nutrient	-	17	35(18)	-	7	14(7)	-	-	-	-	-	-	-	-	-

**RESULTS OF FERTILIZER TRIALS IN FARMERS FIELD
RIFT VALLEY PROVINCE**

District:	Fertilizer Treatment	C R O P S											
		Maize			Beans			Sunflower			Potatoes		
		0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	0-40-40	0-0-0	0-40-0	40-40-0	0-0-0	60-60-0	60-60-60
Nandi	yield	3,550	4,600	5,700							11,850	17,500	18,050
	increase over		1,050	2,150								5,650	6,200
	per kg nutrient		18	36(18)								94	103(9)
Kericho	yield	2,920	3,730	4,800				1,780	1,980	2,270			
	increase over		810	1,880					200	490			
	per kg nutrient		14	31(17)					5	12(7)			
Trans Nzoia	yield				640	700	770						
	increase over					60	130						
	per kg of nutrient					2	3(1)						
Uasin Gishu	yield							1,020	1,700	1,650	2,840	16,400	24,700
	increase over								680	660		13,560	21,860
	per kg nutrient								17	17(0)		226	364(138)
Laikipia	yield	3,060	3,450	4,250		750	880						
	increase over		390	1,190		120	130						
	per kg nutrient		7	20(17)		3	3(0)						
Nakuru	yield	3,320	4,160	5,000				670	800	1,200	6,770	9,970	11,920
	increase over		840	1,680					130	530		3,200	5,150
	per kg nutrient		14	28(14)					3	13(10)		80	86(6)
Narok	yield	3,060	3,450	4,250							3,170	4,000	4,800
	increase over		390	1,190								830	1,630
	per kg nutrient		7	20(13)								14	27(13)
Kajiado	yield	2,850	3,550	4,300							5,900	8,880	9,820
	increase over		700	1,450								2,980	3,920
	per kg nutrient		18	36(18)								50	65(15)
W. Pokot	yield	3,160	3,760	5,230				1,030	1,470	1,750	7,600	8,750	9,870
	increase over		600	2,070					440	720		1,150	2,270
	per kg nutrient		10	35(25)					11	18(7)		19	38(19)
Elgeyo Marakwet	yield	4,000	5,150	6,240							7,700	10,800	12,000
	increase over		1,150	2,240								3,100	4,300
	per kg nutrient		19	37(18)								52	72(20)
Baringo	yield	3,760	4,460	5,500							8,320	10,320	15,320
	increase over		700	1,740								2,000	7,000
	per kg nutrient		11	29(18)								33	117(84)
Average	yield	3,300	4,030	5,030	700	790	830	1,130	1,490	1,720	6,770	10,830	13,310
	increase over		730	1,730		90	130		360	590		4,060	6,540
	per kg nutrient		12	29(17)		2	3(1)		9	15(6)		68	109(41)

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District:	Fertilizer Treatment	C R O P																	
		Maize			Katumani Maize			Sorghum			Beans			Sunflower			Potatoes		
		0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0	0-0-0	0-40-0	40-40-0
Nyahururu	yield incremental per kg nutrient																		
Kiambu	yield incremental per kg nutrient	3,150	4,140	5,130	2,030	2,940	3,560												
	yield incremental per kg nutrient		990	1,980		910	1,530												
	yield incremental per kg nutrient		25	50(25)		23	38(15)												
Nyeri	yield incremental per kg nutrient	2,670	3,400	4,700	900	1,800	3,600												
	yield incremental per kg nutrient		730	2,030		900	1,800												
	yield incremental per kg nutrient		18	50(32)		23	45(22)												
Murang'a	yield incremental per kg nutrient	3,640	4,600	5,720	3,000	3,520	5,450												
	yield incremental per kg nutrient		960	2,080		520	2,450												
	yield incremental per kg nutrient		24	52(28)		13	61(48)												
Kirinyaga	yield incremental per kg nutrient	4,000	4,670	5,490															
	yield incremental per kg nutrient		670	1,490															
	yield incremental per kg nutrient		17	37(20)															
Average	yield incremental per kg nutrient	3,370	4,200	5,260	1,980	2,750	4,200												
	yield incremental per kg nutrient		830	1,890		770	2,220												
	yield incremental per kg nutrient		21	47(26)		19	56(37)												
Embu	yield incremental per kg nutrient	2,590	3,400	4,300	970	1,410	2,040												
	yield incremental per kg nutrient		810	1,710		440	1,030												
	yield incremental per kg nutrient		20	43(23)		11	26(15)												
Meru	yield incremental per kg nutrient	2,870	3,610	4,400	1,060	1,440	2,140												
	yield incremental per kg nutrient		740	1,530		380	1,080												
	yield incremental per kg nutrient		19	38(19)		10	27(17)												
Machakos	yield incremental per kg nutrient				1,520	2,110	2,250												
	yield incremental per kg nutrient					590	730												
	yield incremental per kg nutrient					15	18(3)												
Average	yield incremental per kg nutrient	2,730	3,510	4,350	1,180	1,650	2,130												
	yield incremental per kg nutrient		780	1,620		470	950												
	yield incremental per kg nutrient		20	41(21)		12	24(12)												
Taita	Crop																		
	Fertilizer treatment																		
	yield incremental per kg nutrient	3,480	4,450	5,500	1,100	1,500	2,040												
Kwale	yield incremental per kg nutrient		970	2,020		400	940												
	yield incremental per kg nutrient		24	51(27)		10	24(14)												
	yield incremental per kg nutrient																		
Kilifi	Fertilizer treatment																		
	yield incremental per kg nutrient																		
	yield incremental per kg nutrient																		
Average	yield incremental per kg nutrient	3,480	4,450	5,500	1,100	1,500	2,040												
	yield incremental per kg nutrient		970	2,020		400	940												
	yield incremental per kg nutrient		24	51(27)		10	24(14)												

Kind of: Pasture Use Variety	Production of:	Kisii UM 1 p or 1-m					Kakamega UM 1 p					Baraton/Kapsabet LH 2 vl i					Kitale UM 4 l/vl					
		I		II		Total per year	I		II		Total per year	I		II		Total per year	I		II		Total per year	
		J-M	A-S	O-D	III		J-M	A-S	O-D	III		J-M	A-S	O-D	III		J-A	M-A	S-D			
<u>Planted</u>																						
<u>Zero Grazing:</u>																						
French Cameroon	DM	2.0	6.8	2.2		11.0	3.5	10.1	8.1		21.7	1.2	1.9	2.5		5.6	3.2	4.1	4.4		11.7	
	TDN					7.2					14.1					2.8					5.6	
Bana Grass	DM	3.1	10.7	4.4		18.2	4.7	9.0	6.3		20.0	1.4	3.7	3.2		8.3	4.2	7.5	4.6		16.3	
	TDN					11.8					13.0					4.2					8.2	
Giant Setaria	DM	1.9	7.4	3.6		12.9	1.2	9.0	4.6		14.8	0.4	3.1	2.9		6.4	1.7	4.4	2.2		8.3	
	TDN					8.4					9.6					3.2					4.2	
Guatemala	DM	1.2	4.7	2.2		8.1	0.7	5.0	2.5		8.2	1.3	3.0	2.7		7.0	1.6	2.8	1.9		6.3	
	TDN					5.3					5.3					3.5					3.2	
<u>Natural Pasture</u>																						
<u>Grazing:</u>																						
Stargrass	DM	0.4	2.7	1.3		4.4	8.8	2.8	1.8		5.4	0.1	0.7	1.6		2.4	0.9	1.5	1.4		3.8	
	TDN					2.8					3.5					1.2					1.9	
Kikuyu Grass	DM	0.7	3.0	2.0		5.7	0.7	2.9	1.3		4.9	1.0	0.6	1.6		3.2	0.4	0.6	0.9		1.9	
	TDN					3.7					3.2					1.6					1.0	
<u>Planted Leys</u>																						
<u>Grazing:</u>																						
Makueni Guinea	DM	1.4	2.5	3.8		7.3	1.3	3.1	2.5		6.9	0.1	1.3	1.3		2.7	0.6	2.0	1.0		3.6	
	TDN					4.7					4.5					1.4					1.8	
Coloured Guinea	DM	0.5	3.2	1.6		5.3	0.8	4.2	1.9		6.9	1.0	1.3	0.9		3.2	0.7	2.6	1.9		5.2	
	TDN					3.4					4.5					1.6					2.6	
Narsetaria	DM	1.3	4.8	2.3		8.4	1.8	5.9	2.0		9.7	0.1	1.6	1.4		3.1	0.6	2.7	1.9		5.2	
	TDN					5.5					6.4					1.5					2.6	
Mandi Setaria	DM	1.2	4.7	2.4		8.3	1.4	5.1	2.6		9.1	1.0	2.2	1.4		4.6	0.4	2.7	1.7		4.8	
	TDN					5.4					5.9					2.3					2.4	
Boma Rhodes	DM	1.1	5.0	2.5		8.6	1.5	6.1	3.0		10.6	0.2	1.9	1.4		3.5	0.80	2.8	1.6		5.2	
	TDN					5.6					6.7					1.8					2.6	
Elaba Rhodes	DM	0.7	3.5	2.0		6.2	1.6	6.0	2.9		10.5	0.2	1.7	2.1		4.0	1.1	3.3	2.0		6.4	
	TDN					4.0					6.8					2.0					3.2	
Maamba Rhodes	DM	0.9	4.2	2.3		7.4	1.2	4.4	2.4		8.0	0.1	1.6	1.9		3.6	0.8	3.3	1.8		5.9	
	TDN					4.8					5.2					1.8					3.0	
Mbara Rhodes	DM	0.9	4.0	2.5		7.4	1.1	4.3	2.4		7.8	0.2	1.3	1.8		3.3	1.2	2.3	2.0		5.5	
	TDN					4.8					5.1					1.7					2.8	
Fokot Rhodes	DM											0.2	1.6	1.6		3.4						
	TDN															1.7						

a) Yield at 0 fertilizer input. Therefore soils cause big differences in the same AEZ.

Based on field trials of NARS-Kitale carried out during 1975-78, other research work and observation in farmers' fields. Not fully representative because of wet years.

To arrive at yield levels on farmers' fields for zero grazing 10 % and for grazing 40 % has been deducted from the trial yields.

b) Kisii, Kakamega, Oljo-Orok, Embu = 65 % TDN in DM, Barton, Eldoret, Lanet, Naivasha = 50 % TDN in DM

THE PRODUCTIVITY OF GRASSLANDS IN MIXED FARMING AREAS
in t/ha^a

Kind of: pasture use variety	Eldoret LH 3 (1/vl)				Lanet LH 4 (1)				Naivasha UM 5 s/vs+1				Oljo-Orok UM 4 uri				Embu UM 3 m/s+s			
	I		II		III		Total		I		II		III		Total		I		II	
	J-A	M-S	O-D	per year	J-A	M-S	O-D	per year	F-M	J-S	O-J	per year	F-M	J-S	O-J	per year	J-A	M-S	O-D	per year
<u>Planted</u>																				
Zero Grazing:																				
French Cameroon	3.3	5.3	2.8	12.4	3.2	6.8	2.6	9.4	0.9	6.4	2.6	9.9	1.3	2.7	1.7	5.7	3.2	5.8	4.7	13.7
DM				6.2				4.7				5.0				3.7				8.9
TN				10.4				12.9				6.5				8.0				16.5
Bana Grass	2.9	5.0	2.5	5.2	3.2	6.9	2.8	6.5	2.3	8.0	2.7	6.5	2.1	3.3	2.6	5.2	5.8	7.1	3.6	10.7
DM																				
TN																				
Giant Setaria	0.8	2.5	1.5	4.6	0.2	3.4	2.8	6.4	0.10	2.4	1.1	3.6	1.1	2.3	1.2	4.6	1.8	6.3	3.1	11.2
DM				2.3				3.2				1.8				3.0				7.3
TN																				
Gustemala	0.9	2.6	1.7	5.2	1.5	2.0	0.5	4.0	0.10	1.2	0.1	1.40	1.2	1.9	1.3	4.4	1.1	4.6	2.6	8.3
DM				2.6				2.0				0.7				2.9				5.4
TN																				
<u>Natural pasture</u>																				
Grazing:																				
Stargrass	0.1	1.7	0.5	2.3	0.8	3.6	0.5	4.9	0.3	2.1	1.3	3.7	0.10	2.7	1.1	3.9	1.2	2.4	1.2	4.8
DM				1.2				2.5				1.9				2.5				3.1
TN																				
Kikuyu Grass	0.1	0.6	0.2	0.9	0.7	3.1	0.1	3.9	0.1	2.0	1.2	3.3	0.10	0.6	1.0	1.7	1.3	2.0	1.0	3.3
DM				0.5				2.0				1.7								2.1
TN																				
<u>Planted Leys</u>																				
Grazing:																				
Makueni Guinea	1.0	1.3	1.0	3.3	0.4	3.3	1.9	5.6	0.2	1.4	0.2	1.8	0.2	1.5	0.3	2.0	2.9	2.7	2.1	7.7
DM				1.7				2.8				0.9				1.3				5.0
TN																				
Coloured "	0.7	3.1	1.1	4.9	0.1	2.4	0.7	3.2	0.2	2.0	0.9	3.1	0.7	2.9	1.1	4.7	0.4	2.9	2.0	5.3
DM				2.5				1.60				1.6				3.0				3.4
TN																				
Marsetetaria	0.7	1.7	0.7	3.1	0.7	3.6	0.7	5.0	0.10	0.9	0.4	1.4	0.2	3.6	0.6	4.4	0.3	2.4	2.7	5.4
DM				1.5				2.5				0.7				2.9				3.5
TN																				
Nandi Setaria	0.6	1.6	1.2	3.4	0.8	1.8	1.8	4.4	0.10	0.10	0.10	0.3	0.1	3.0	0.5	3.6	0.2	1.8	1.8	3.8
DM				1.7				2.2				0.2				2.3				2.5
TN																				
Boma Rhodes	0.7	2.4	1.7	4.8	1.3	4.0	1.9	7.2	1.1	5.2	2.9	9.2	1.0	2.8	2.2	6.0	1.1	4.5	2.6	8.2
DM				2.4				3.6				4.6				3.9				5.3
TN																				
Kimba Rhodes	0.4	1.7	1.5	3.6	1.7	4.0	2.3	8.0	0.7	2.0	2.2	5.1	0.6	2.9	1.9	5.4	0.7	3.9	2.0	6.6
DM				1.8				4.0				2.6				3.5				4.3
TN																				
Masaba Rhodes	0.5	1.8	1.6	3.9	1.3	3.2	1.7	6.2	0.7	4.7	2.2	7.6	1.0	2.9	2.2	6.1	1.4	4.6	2.3	8.3
DM				2.0				3.1				3.8				4.0				5.4
TN																				
Mbara Rhodes	0.6	1.8	1.5	3.9	1.2	4.0	0.8	6.0	0.7	4.6	2.6	7.9	0.6	2.9	1.6	5.1	0.7	3.3	1.8	5.8
DM				2.0				3.0				4.0				3.3				3.8
TN																				

a) Yield at 0 fertilizer input. Therefore soils cause big differences in the same AEZ.

Based on field trials of NARS-Kitale carried out during 1975-78, other research work and observation in farmers' fields. Not fully representative because of wet years.

To arrive at yield levels on farmers' fields for zero grazing 10 % and for grazing 40 % has been deducted from the trial yields.

b) Production of DM/TDN: Oljo-Orok, Embu = 65 % TDN in DM; Eldoret, Lanet, Naivasha = 50 % TDN in DM

RESULTS OF FERTILIZER TRIALS IN MAIZE (NARS - KITALE)

Area	Year	Variety	Treatments/Yields at 0				Area	Year	Variety	Treatments/Yields at 0			
			0	40	80	120				0	40	80	120
Kisii, Research Station (incremental of + 1 kg N 0.750 kg P ₂ O ₅)	1973	(N) (P ₂ O ₅) H 613 C	3320	3770	5130	5510	South Nyanza, Rongo I	1973	(N) (P ₂ O ₅) H 622	2560	3010	4010	4900
	1974		6550	6860	6950	6510	Rongo II	1973		1350	3150	4200	5160
	1974		3940	6960	6480	7440	average			1955	3580	3660	4965
	1974		5920	8260	8420	8340	incremental				1625	1705	3010
	1976		7830	8070	8230	8610					41	21(1)	25(32)
average incremental			5512	6784	7242	7282	South Nyanza, Rongo	1975	H 512	1620	1700	2630	3370
				1272	1730	1770	average	1976		4210	6140	6000	5610
				32	22(12)	15(1)	incremental			2915	3920	4315	4490
Kisii, Keumbu I	1973	H 613 C	790	900	3120	3100	South Nyanza, Rongo	1974	H 512	7790	6920	7820	6860
II	1973		990	2350	2320	2340	average				870	-	-
average			890	1625	2720	2720	incremental				22	-	-
incremental			-	735	1830	1830	South Nyanza, Homa Bay FTC				5560	4860	6000
				18	23(24)	8(-)	incremental	1974	H 622	2860	5910	6720	6330
Kisii, Karoka I	1973	H 613 C	3500	3920	4400	4800	average	1975		3680	5735	5790	6165
II	1973		1730	3350	3930	2540	incremental				2055	2110	2485
III	1973		4370	5500	4350	5110					50	26(-)	21(3)
IV	1973		2390	2290	3190	3500	South Nyanza, Pa-Hill						
average			2998	3765	3963	3988	average	1974	H 622	2810	3900	4150	5530
incremental				767	965	990	incremental	1974		2960	4900	6030	6600
				19	12(5)	8(6)		1975	H 512	2260	4070	3880	5630
South Nyanza, Oyani	1973	H 622	1570	4310	3960	4410	South Nyanza, Rakwaro			2543	4290	4680	5920
	1974		5920	8260	8420	8340	" "				1747	2137	3377
	1975		3520	2560	4250	4330	average				44	27(5)	28(31)
	1976		3520	4760	4620	4660	incremental						
average			3633	4973	5313	5435							
incremental				1340	1680	1802	Narok, Kilgoris I	1974	H 622	3370	4260	6090	5970
				34	21(9)	15(3)	" "	1974		3420	4800	5520	5710
South Nyanza, Oyugis	1973	H 622	1360	850	1650	1290	Kilgoris II	1974	H 512	3080	3740	4070	5270
				-	10	-	average				1186	2147	2570
				-	-	-	incremental				30	27(12)	21(4)
South Nyanza, Nigori I	1973	H 622	1040	1030	1520	1020	(incremental of 1 kg N and 0.5 kg of P ₂ O ₅)						
II			2730	2690	2540	3380	Kakamega, Luvambi	1972	H 613 C	5850	6080	6340	6640
III			5200	5930	7150	7140	" "	1973		5100	4900	5920	6640
average			2990	3217	3707	3847	average			5475	5490	6130	6640
incremental				227	717	857	incremental				15	555	1165
				6	9(12)	7(4)					-	7(7)	8
South Nyanza, Awendo I		H 622	5020	4890	5540	6180							
Awendo II			2100	3940	4860	4830							
Awendo III			1650	1790	1350	1150							
average			2923	3540	3917	4053							
incremental				617	994	1130							
				15	12(9)	9(3)							

RESULTS OF FERTILIZER TRIALS IN SUNFLOWER BY NARS – KITALE

Area	Year	Crop	Variety	Yields in Kg/Ha	Fertilizer Treatments in kg/ha			
					N-P-K	N-P-K	N-P-K	N-P-K
Elgon down	1979	Sunflower	S 301 A	Response Increase in yield Increase per kg P ₂ O ₅	0-0-0	26-0-0	26-69-0	26-138-0
					2206	2568	2648	2950
						362	442	744
"	1979	Sunflower	Hungarian White	Response Increase in yield Increase per kg P ₂ O ₅		-	6	5
					1918	2200	2337	2662
						282	419	744
"	1979	Sunflower	Kenya White	Response Increase in yield Increase per kg P ₂ O ₅		-	6	5
					2563	2365	2154	2292
						-	-	-
Japata	1979	Sunflower	S 301 A	Response Increase in yield Increase per kg P ₂ O ₅	1061	603	844	599
						-	-	-
						-	-	-
"	1979	Sunflower	Hungarian White	Response Increase in yield Increase per kg P ₂ O ₅	1357	1315	1390	1508
						-	33	151
						-	-	1
"	1979	Sunflower	Kenya White	Response Increase in yield Increase per kg P ₂ O ₅	1734	2040	1555	2092
						306	179	358
						-	2	3

**RESULTS OF FERTILIZER TRIALS IN MAIZE
AT APPLICATION OF
178 KG N + 104 KG OF P₂O₅ PER HA
WEST KENYA AND RIFT VALLEY
in kg/ha**

Variety	Year	Siaya	Kakamega	Webuye	Kapsabet	Kericho	Kitala	Eldama Ravine	Lanet
Katumani	1978			6440			5770		3200
H 511	1978			5560			8440		4220
H 622	1978			7250			6530		4670
H 632	1978			7420			7560		3820
H 612	1978			7690			8710		5690
H 613	1978			7470			8800		4440
H 614	1978			7240			8890		5780
H 5020	1978			8000			10310		6890
H 7701	1978			9380			10130		7330
Katumani	1979	830					2360	2000	
H 511	1979	670					3000	3020	
H 622	1979	2330	8450				7110	5690	
H 632	1979	2440					7690	5420	
H 612	1979		6220		3070	3560	8760	4040	
H 614			10670		8310	8910	10150	5110	
H 613			9440		2390	3960	9470	4130	
H 7701			12000		5280	4800	10270	5770	
H 7801			14220		7490	8230	10130	7560	

RESULTS OF FERTILIZER TRIALS IN MAIZE^{a)}
IN MACHAKOS AND KITUI DISTRICTS

Area	Year	Variety	Treatments, Yields at 0 application & incremental			
			0	40	70	100
Machakos, Katumani Research	1974	Katumani	0	40	70	100
		Composite	0	30	30	30
incremental		B		5920	520	5140
Machakos, Karigundo	1974		not measured	3860	430	5210
incremental						
Machakos, Kisau	1974			1060	120	1610
incremental						
Kitui, Ithookwe	1974			3370	290	2940
incremental						
Kitui, Kampi ya Mawe	1974			2680	270	2720
incremental						
Kitui, Yatta	1974			3120	230	2080
incremental						
Kitui, Kitungu	1974			1980	1940	2660
incremental						
			0	40	70	100
			0	60	60	60
Machakos, Katumani Research	1974	Katumani		4670	5630	5330
incremental		Composite	not measured			
Machakos, Karigundo		B		4310	4170	3960
incremental						
Machakos, Kisau	1974			1890	2490	1610
incremental						
Kitui, Ithookwe	1974			3440	3440	3480
incremental						
Kitui, Kampi ya Mawe	1974			2510	2920	2730
incremental						
Kitui, Yatta	1974			2080	2930	1690
incremental						
Kitui, Kitungu	1974			2120	2110	2040
incremental						

a) no yield increase or even depressed yields as a result of fertilizer application

RESULTS OF FERTILIZER TRIALS IN MAIZE AND SORGHUM

1977/78

Area	Variety	Treatment		Yield
		N	P2O5	
Kisii, Research Station	H 613	120	90	5510
		80	60	6950
		120	90	3440
		120	90	8610
Kitale, NAR Station		170	110	7000
			+ 60 K ₂ O	
Thika, Hort. Research Station	H 511	46	119	4640
Embu, Research Station	H 511	50	50	7500
Embu, Research Station	H 512	50	50	7200
Machakos, Katumani Research Station	Katumani Comp. B	40	30	5920
Kilifi, Mtwapa Research Station	Coast Comp.	100	100	2500
Kilifi, Mtwapa Research Station	Pioneer Hybrid	100	100	2800
Sorghum				
Nakuru, Lanet Beef Research Station	E 1291	62	67	7300
Nakuru, Lanet Beef Research Station	E 6518	62	67	4200
Kilifi, Mtwapa Research Station	H. 57	100	100	1800
Kilifi, Mtwapa Research Station	Serena	100	100	900
Siaya	Serena	178	104	1560

RESULTS OF FERTILIZER TRIALS IN WHEAT BY NARS - NJORO (1)

Area	Year	Crop	Variety	Yields in kg/ha	Fertilizer Treatments in kg/ha			
					N-P-K	N-P-K	N-P-K	N-P-K
					0-0-0	0-20-0	0-40-0	0-80-0
Njoro (old land)	1975	Wheat		Response	2340	2420	2780	2700
				Increase in yield		80	440	360
				Increase per kg P ₂ O ₅		2	11	4
Eldoret (old land)	1975	Wheat		Response	1300	1130	1220	1250
				Increase in yield		-	-	-
				Increase per kg P ₂ O ₅		-	-	-
Endebaan (old land)	1975	Wheat		Response	2070	2120	2390	2640
				Increase in yield		50	320	560
				Increase per kg P ₂ O ₅		3	8	7
Kaptaget (old land)	1975	Wheat		Response	2310	2130	2460	2740
				Increase in yield		-	150	430
				Increase per kg P ₂ O ₅		-	4	5
Londiani (old land)	1975	Wheat		Response	1260	1550	2210	2740
				Increase in yield		290	950	1480
				Increase per kg P ₂ O ₅		14	23	18
Ngore Ngore (old land)	1975	Wheat		Response	1950	1510	1810	1790
				Increase in yield		-	-	-
				Increase per kg P ₂ O ₅		-	-	-
Mau Harok (new land)	1975	Wheat		Response	3750	3850	3620	3600
				Increase in yield		100	-	-
				Increase per kg P ₂ O ₅		5	-	-
Limuru Ndelya (old land)	1968	Wheat		Response	5730		6020	6240
				Increase in yield			290	510
				Increase per kg P ₂ O ₅			7	6
Tinau (old land)	1968	Wheat		Response	2770		4020	4000
				Increase in yield			1250	1230
				Increase per kg P ₂ O ₅			31	15

Area	Year	Crop	Variety	Yields in Kg/Ha	Fertilizer Treatments in kg/ha									
					N-P-K	N-P-K	N-P-K	N-P-K	N-P-K	N-P-K	N-P-K	N-P-K	N-P-K	N-P-K
					0-0-0	20-0-0	20-10-0	20-20-0	20-40-0	20-60-0	20-80-0	20-100-0		
Njoro (old land)	1975	Wheat		Response	2340	2740	2630	2590	2920	2850	2970	3130		
				Increase in yield		400	290	250	580	510	630	790		
				Increase per kg P ₂ O ₅		-	29	13	14	8	7	8		
Eldoret (old land)	1975	Wheat		Response	1300	1270	1280	1620	1500	1330	1710	1400		
				Increase in yield		-	-	320	200	30	410	100		
				Increase per kg P ₂ O ₅		-	-	16	5	1	5	1		
Endebess (old land)	1975	Wheat		Response	2070	2140	2440	2220	2540	2440	2450	2720		
				Increase in yield		70	370	150	470	370	380	650		
				Increase per kg P ₂ O ₅		-	37	8	11	6	4	7		
Keptagat (old land)	1975	Wheat		Response	2310	2210	2010	1970	2270	2690	2630	2790		
				Increase in yield		-	-	-	-	380	320	480		
				Increase per kg P ₂ O ₅		-	-	-	-	6	4	5		
Londiani (old land)	1975	Wheat		Response	1260	1080	1700	1690	2180	2540	2740	2610		
				Increase in yield		-	440	430	920	1280	1480	1350		
				Increase per kg P ₂ O ₅		-	44	21	23	21	18	14		
Ngore Ngore (old land)	1975	Wheat		Response	1950	1540	1670	1540	1820	1790	1700	1520		
				Increase in yield		-	-	-	-	-	-	-		
				Increase per kg P ₂ O ₅		-	-	-	-	-	-	-		
Njoro (old land)	1975	Wheat		Response	40-0-0	2810	3060	3180	2930	2720	3230	2730		
				Increase in yield		-	250	370	120	-	420	-		
				Increase per kg P ₂ O ₅		-	25	18	3	-	5	-		
Eldoret (old land)	1975	Wheat		Response	1050	1050	1050	1600	1710	1290	1400	1920		
				Increase in yield		-	-	550	660	240	350	870		
				Increase per kg P ₂ O ₅		-	-	27	16	4	4	9		
Endebess (old land)	1975	Wheat		Response	1950	2300	2300	2750	2780	3300	3650	2460		
				Increase in Yield		350	350	800	830	1350	1700	510		
				Increase per kg P ₂ O ₅		35	35	40	20	22	21	5		

RESULTS OF FERTILIZER TRIALS IN WHEAT BY NARS - NJORO (3)

Area	Year	Crop	Variety	Yields in Kg/Ha	Fertilizer Treatments in kg/ha					
					N-P-K	N-P-K	N-P-K	N-P-K	N-P-K	N-P-K
Nairegia Nkare (new land)	1976	Wheat		Response	0-0-0	0-20-0	0-40-0	0-60-0	0-80-0	0-100-0
				Increase in yield	2130	2400	2700	1940	2590	2520
				Increase per kg P ₂ O ₅		270	570	-	460	390
Eldoret (new land)	1976	Wheat		Response	720	1060	1150	1390	1100	1420
				Increase in yield		340	430	670	380	700
				Increase per kg P ₂ O ₅		17	11	11	4	7
Eldoret (old land)	1976	Wheat		Response	870	1170	1270	1480	1660	1430
				Increase in yield		300	400	610	790	560
				Increase per kg P ₂ O ₅		15	10	10	10	6
Endebess (old land)	1976	Wheat		Response	3240	3280	2980	3250	2940	3560
				Increase in yield		40	-	10	-	320
				Increase per kg P ₂ O ₅		2	-	-	-	3
Ol jor Orok (old land)	1976	Wheat		Response	3570	3890	3950	3610	4240	3720
				Increase in yield		320	380	40	670	150
				Increase per kg P ₂ O ₅		16	10	1	8	2
NARS Njoro (old land)	1976	Wheat		Response	1150	1500	1950	1570	1760	1920
				Increase in yield		350	800	420	610	770
				Increase per kg P ₂ O ₅		18	20	7	8	8
Mau Narok (old land)	1976	Wheat		Response	1910	1760	2090	1980	1940	2450
				Increase in yield		-	180	70	30	540
				Increase per kg P ₂ O ₅		-	5	1	-	5
Grand mean of all sites	(1968-1973)	Wheat		Response	2440	2920	2710	2960	2880	3120
				Increase in yield		480	270	520	440	680
				Increase per kg P ₂ O ₅		24	7	9	6	7

RESULTS OF FERTILIZER TRIALS IN TRITICALE AND BARLEY BY NARS - NJORO

Area	Year	Crop	Variety	Yields in Kg/Ha	Fertilizer Treatments in kg/ha			
					N-P-K	N-P-K	N-P-K	N-P-K
Njoro (new land)	1975	Triticale		Response Increase in yield Increase per kg P ₂ O ₅	0-0-0	0-40-0	0-80-0	
					2490	3380	3860	3830
						890	1370	1340
Eldoret (old land)	1975	Triticale		Response Increase in yield Increase per kg P ₂ O ₅	2419	2630	1920	2290
						211	-	-
							-	-
Rongai (old land)	1975	Triticale		Response Increase in yield Increase per kg P ₂ O ₅	3850	4560	3760	4370
						710	-	520
						36	-	7
Njoro (new land)	1975	Triticale		Response Increase in yield Increase per kg P ₂ O ₅	40-0-0	40-20-0	40-40-0	40-80-0
					3520	3750	4450	3820
						230	930	300
Eldoret (old land)	1975	Triticale		Response Increase in yield Increase per kg P ₂ O ₅	2160	12	23	4
						2460	2600	2310
						300	440	150
Rongai (old land)	1975	Triticale		Response Increase in yield Increase per kg P ₂ O ₅	4320	15	11	2
						4530	5180	4790
						210	860	470
Njoro (new land)	1975	Barley		Response Increase in yield Increase per kg P ₂ O ₅	0-0-0	0-20-0	0-40-0	0-80-0
					1220	1360	1230	1510
						140	10	290
Eldoret (old land)	1975	Barley		Response Increase in yield Increase per kg P ₂ O ₅		7	-	4
					1900	1650	1870	2050
						-	-	150
								2

RESULTS OF FERTILIZER TRIALS IN DIFFERENT CROPS
DURING 1977-1979, in kg/ha

Area	Crop	Variety	Treatment			Yield	Area	Crop	Variety	Treatment			Yield
			N	P ₂ O ₅	K ₂ O					N	P ₂ O ₅	K ₂ O	
Kiambu, Thika Research Station	Potatoes	B53	0	0	0	16,250	Sugarcane Belt	Sugar	CO 421	0	30	50	57,100
" " "	"	"	0	150	0	21,440	Seregititi	-cane	CO 421	100	30	50	69,500
Incremental						5,190		"	CO 421				
per 1 kg P ₂ O						35		"	CO 421				
Incremental	Potatoes	B53	75	300	0	26,637		"	CO 421	200	30	50	69,800
per 1 kg N 4 kg P ₂ O ₅						10,387		"	CO 421				
Incremental	Potatoes	B53	150	300	0	34,162		"	CO 421	300	30	50	70,000
per 1 kg N 2 kg P ₂ O ₅						17,912		"					12,900
	No response to K ₂ O applications					119(100)							43
Kiambu, Thika Research Station	Potatoes	Rosilin Emburu	72	184	0	18,593	Nyansa Sugar Belt		CO 421	150	0	50	171,300
Embu, Research Station	"	"	72	184	0	18,445	Region		CO 421	150	60	50	172,500
Nairobi, Tigon Station	"	"	72	184	0	27,778	"		CO 421	150	120	50	175,800
Nyambini RTC	"	"	72	184	0	25,978	"		CO 421	150	180	50	184,000
Kiambu, Thika Research Station	"	Kenya Rakaka	72	184	0	18,667	Nyansa Sugar Belt		CO 421	150	30	0	127,000
Embu, Research Station	"	"	72	184	0	25,407	"		CO 421	150	30	65	145,300
Nairobi, Research Station	"	"	72	184	0	29,481	"		CO 421	150	30	130	170,500
Nyambini RTC	"	"	72	184	0	33,822	"		CO 421	150	30	195	175,500
Kiambu, Thika Research Station	"	Annet	72	184	0	19,778	Incremental		CO 421				48,500
Embu, Research Station	"	"	72	184	0	15,464	per 1 kg K ₂ O		CO 421	0	-	-	367,500
Nairobi, Tigon Station	"	"	72	184	0	14,029	South Nyansa, Ransen		CO 421	100	-	-	401,300
Nyambini RTC	"	"	72	184	0	39,844	(red clay loam)		CO 421	150	-	-	389,200
Embu, Research Station	Sweet	Gikanda	60	0	0	23,000	"		CO 421	300	-	-	393,200
"	Potatoes	Bisale	60	0	0	34,000	Incremental		CO 421				25,700
"	"	Muibai	60	0	0	22,000	per 1 kg of N						85
"	"	Musinga	60	0	0	15,000	planted crop			0	-	-	90,000
"	"	Muibai	150	30	50	8,000	Incremental			60	-	-	96,000
"	"	Musinga	150	30	50	10,000	per 1 kg of N			0	-	-	6,000
Kilifi, Mtwapa Research Station	Cassava	5543/156	-	-	-	35,625	1st ratoon			0	-	-	100
" (yields in wet tubers)	"	50284/33	-	-	-	30,900	Incremental			60	-	-	83,000
"	"	37244/E	-	-	-	29,250	Incremental						92,000
"	"	F 279	-	-	-	28,875	per 1 kg of N			0	-	-	9,000
"	"	46106/27	-	-	-	26,400	2nd ratoon			0	-	-	150
							Incremental						63,000
							Kisumu, Kibos			70	100	-	150
							"			100	50	-	100,000
							"			100	-	-	90,000
							Kwale, Ransisi			200	100	-	80,000
							"			200	100	-	70,000
							"			200	100	-	27,000
							"			200	100	-	45,000

Other sources at Kibos linear yield increase

RESULTS OF FERTILIZER TRIALS IN DIFFERENT CROPS
DURING 1977-1979 (2)
in kg/ha

Area	Crop	Variety	Treatment			Yield
			N	P ₂ O ₅	K ₂ O	
Kisii, Research Station	Beans	K.74	27	69	-	2000
Kakamega, Research Station	"	K.74	27	69	-	1650
Kiambu, Thika Research Station	"	K.74	27	69	-	1200
Kiambu, Thika Research Station	"	K.74	36	92	-	2500
Embu, Research Station	"	K.74	27	69	-	1300
Kisii, Research Station	"	G.L.P.-2	27	69	-	2750
Kakamega, Research Station	"	G.L.P.-2	27	69	-	2000
Kiambu, Thika Research Station	"	G.L.P.-2	27	69	-	1850
Kiambu, Thika Research Station	"	G.L.P.-2	36	92	-	2200
Kiambu, Thika Research Station	"	G.L.P.-24	27	69	-	2000
Embu, Research Station	"	G.L.P.-24	27	69	-	2400
Machakos, Katumani Res. Station	"	Moja Wezi	27	69	-	2200
Kitui, Ithookwe	Cowpeas	Emma 60	-	60	-	2556
Kitui, Kampi ya Mawe	"	Katuli 107	-	60	-	2320
Machakos, Katumani Res. Station	Pigeon Peas	short maturity Composite		90		2212
Nakuru, Beef Research Station	Sunflower	Kenya White	61.5	67		1900
Nakuru, Beef Research Station	"	Grey Striped	61.5	67		1200
South Nyanza, Homa Bay FTC	Groundnuts	Homa Bay	30	30	20	900
Kilifi, Mtwapa Research Station	"	Homa Bay	30	30	20	1600
South Nyanza, Homa Bay FTC	"	Asitiye Mwitunde	30	30	20	2700
South Nyanza, Homa Bay FTC	"	Makule Red	30	30	20	2500
South Nyanza, Homa Bay FTC	Soya Beans	B.-Congo	35	30	50	2335
South Nyanza, Homa Bay FTC	"	Hill	35	30	50	2064

SOIL CONSERVATION

by

C.G. Wenner and S.N. Njoroge

CLASSIFICATION OF LAND

The land of a farm can be classified as to slope and soil, with the different classifications needing different considerations:

- 1) Flatland, **sloping less than 2 %**, can usually be farmed without any special soil conservation measures except contour farming.
- 2) On gentle slopes **between 2 and 12 %** terracing is not obligatory according to the present Agriculture Act, but terracing is usually desirable on slopes exceeding 5 %. In semi-arid areas and in areas with erodible soils, even slopes less than 5 % (2–5 %) usually need to be terraced.
- 3) On slopes **exceeding 12 %**, but not exceeding 55 %, terraces (preferably developed bench terraces) should be used if the depth of the soil is more than about 0.75 m. For very steep slopes modified bench terraces are recommended, i.e. narrow ledges cut into the slope, suitable for fruit trees, fodder trees, forest trees and coffee.
- 4) Slopes **exceeding approximately 55 %** should be covered with grass and/or forest. Under certain conditions it might be permissible to cultivate tea, sugar cane or bananas with a layer of trash on the ground.
- 5) Soils which are **rocky, stony or shallow**, should be used as pasture or for forest or they should have stone terraces.

SOIL CONSERVATION IN GENERAL

The basic protection of soil against erosion is good farm management:

- 1) Ploughing and planting along the contour
- 2) Rotation of crop and grass
- 3) Manure favouring the growth of crops
- 4) Leaving crop residue on the ground.

On slopes, good farm management by itself is not sufficient and it has to be combined with terraces.

TERRACES

Terraces can be made by machinery or, usually, by hand.

Terraces made by machinery

Mechanized soil conservation can only be used on slopes which are not too steep (preferably 2–12 %). Two types of terraces are used 1) The channel terrace and 2) the ridge terrace. See Figs. 1 and 3 on opposite page. The V-shaped channel, on one or both sides of a ridge, will usually be filled up by sediment and will thus develop into a bench terrace. But this could as well have developed from a grass strip.

Terraces made by hand

Terraces can develop from 1) unploughed strips, or 2) grass planted in one or two rows, or 3) trash lines laid along the terrace line. In the strips, water flows will be distributed between the grass stems and most of the water will be infiltrated into the ground.

To hasten the formation of a bench terrace you can make a ridge by digging a channel (2 feet wide, 2–3 feet deep) and throwing the soil uphill, using the so-called „Fanya Juu” method.

Bench terraces are usually preferable to channel terraces, as the benches change the degree of slope (Fig. 2 opposite page). They also retain eroded soil, moisture and nutrients.

Length of terraces

Terraces should not, if possible, be many hundreds of metres long. More than 400 m should be avoided.

Gradient of terraces

Terraces can be level or graded. Level terraces should be constructed on gentle slopes in permeable soils in dry areas. For graded terraces the following gradients are recommended: in erosion resistant soils (clay) 1 %, normally 0.5 % and in erodible soils (silty, sandy) 0.25 %.

TYPES OF TERRACES

Fig. 1
Channel terraces

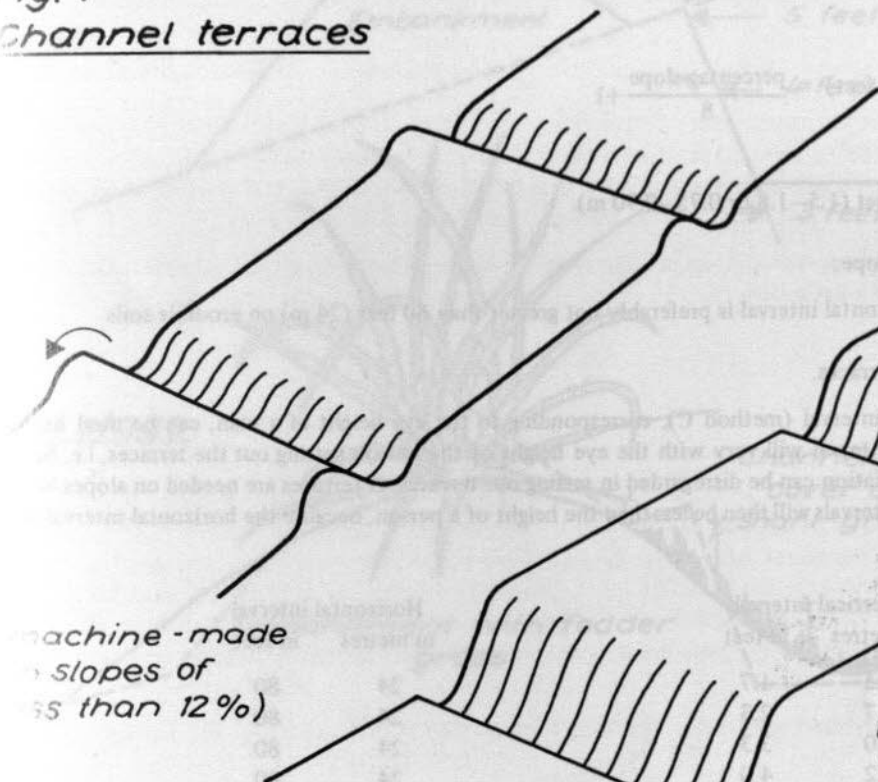


Fig. 2
Bench terraces

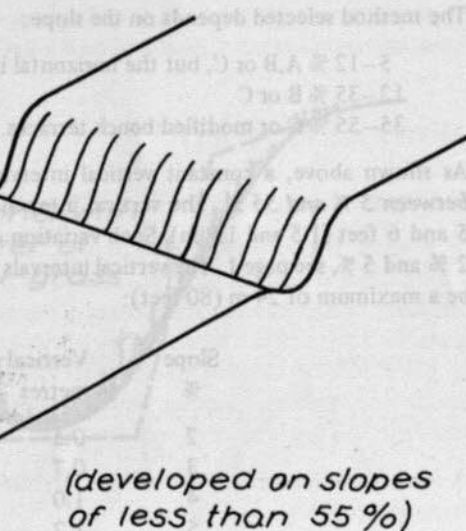


Fig. 3
Edge terrace
excavated from two sides

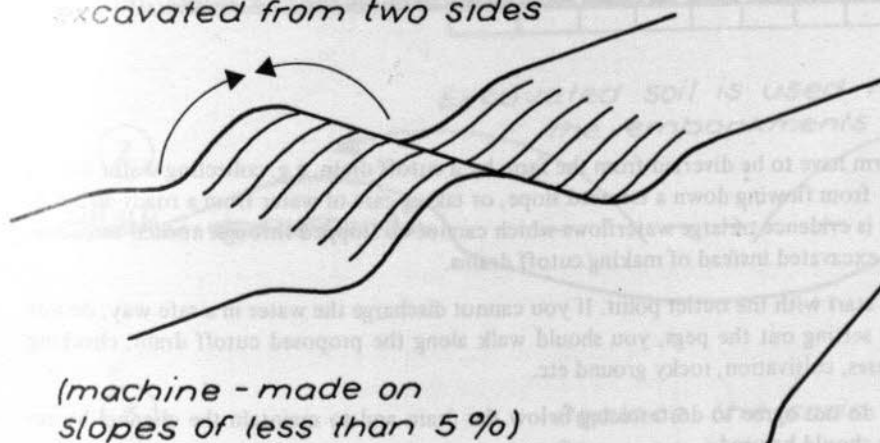
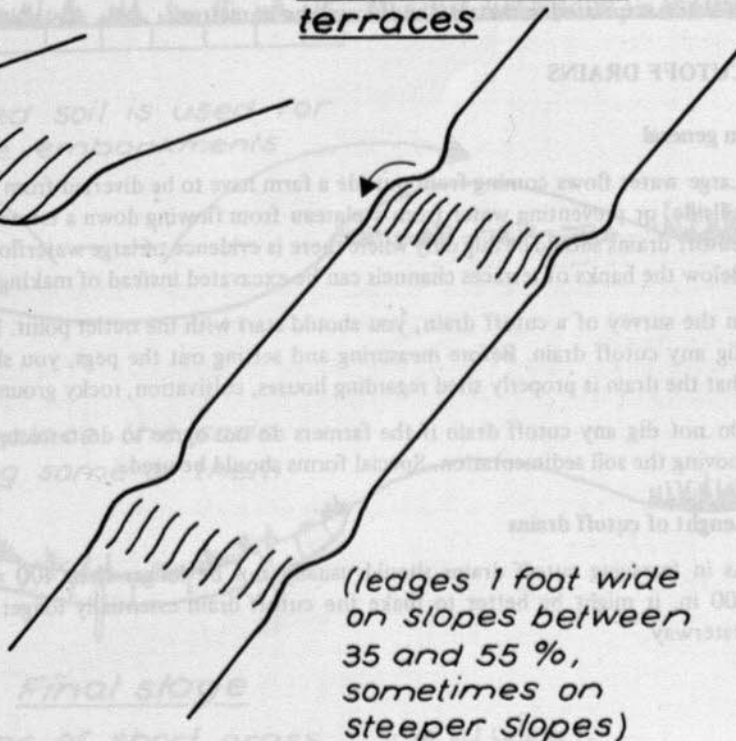


Fig. 4
Modified bench terraces



Vertical interval between terraces

The vertical interval (V.I.) between terraces depends on the slope and has been calculated in three different ways in Kenya:

A/ The ordinary formula – V.I. (in feet) = $\frac{\text{percentage slope}}{4} + 2$

B/ The bench formula – V.I. (in feet) = $\frac{\text{percentage slope}}{8} + 1$

C/ A constant V.I. of 5–6 or 2.5–3 feet (1.5–1.8 or 0.75–0.90 m).

The method selected depends on the slope:

- 5–12 % A, B or C, but the horizontal interval is preferably not greater than 80 feet (24 m) on erodible soils
- 12–35 % B or C
- 35–55 % C or modified bench terraces.

As shown above, a constant vertical interval (method C), corresponding to the eye height of a man, can be used on slopes between 5 % and 55 %. The vertical interval will vary with the eye height of the person setting out the terraces, i.e. between 5 and 6 feet (1.5 and 1.8 m). Such variation can be disregarded in setting out terraces. If terraces are needed on slopes between 2 % and 5 %, see page 1. The vertical intervals will then be less than the height of a person, because the horizontal interval should be a maximum of 24 m (80 feet):

Slope %	Vertical interval		Horizontal interval	
	in metres	in feet	in metres	in feet
2	0.5	1.7	24	80
3	0.7	2.3	24	80
4	1.0	3.3	24	80
5	1.2	4.0	24	80

Horizontal interval between terraces

The horizontal interval (H.I.) between terrace edges (grass strips) is calculated as $H.I. = \frac{V.I. \times 100}{\% \text{ slope}}$

If the V.I. is expressed in feet, the H.I. will be in feet.

If V.I. is expressed in metres, the H.I. will be in metres.

CUTOFF DRAINS

In general

Large water flows coming from outside a farm have to be diverted from the farm by a cutoff drain, e.g. collecting water from a hillside, or preventing water from a plateau from flowing down a terraced slope, or taking care of water from a roadside ditch. Cutoff drains should be dug only where there is evidence of large waterflows which cannot be stopped through normal terracing. Below the banks of terraces channels can be excavated instead of making cutoff drains.

In the survey of a cutoff drain, you should start with the outlet point. If you cannot discharge the water in a safe way, do not dig any cutoff drain. Before measuring and setting out the pegs, you should walk along the proposed cutoff drain, checking that the drain is properly sited regarding houses, cultivation, rocky ground etc.

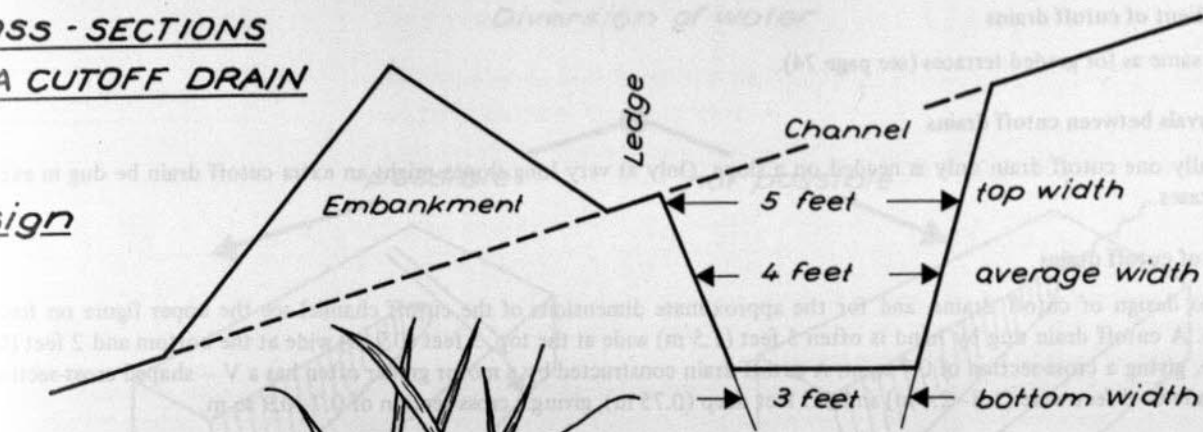
Do not dig any cutoff drain if the farmers do not agree to do terracing below the drain and to maintain the channel by removing the soil sedimentation. Special forms should be used.

Length of cutoff drains

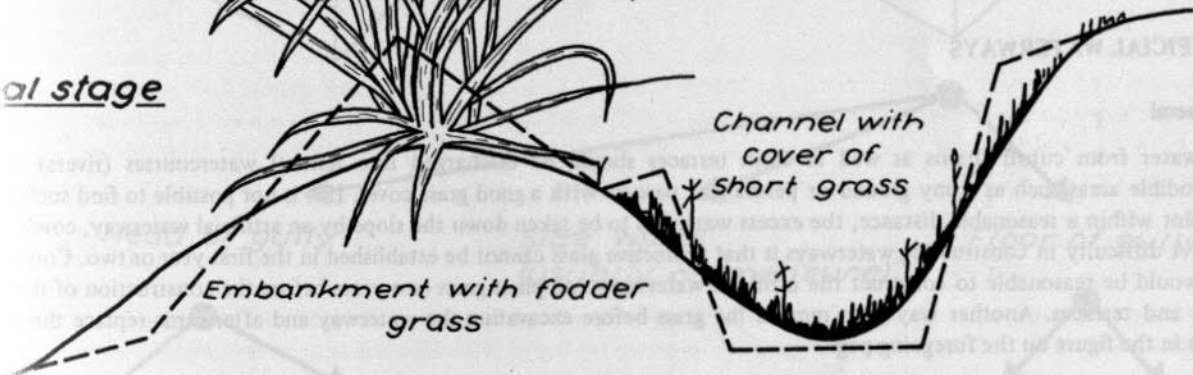
As in terracing cutoff drains should usually not be longer than 400 m. If it is difficult to find a natural waterway within 400 m, it might be better to make the cutoff drain essentially longer than 400 m instead of digging an expensive artificial waterway.

**CROSS - SECTIONS
OF A CUTOFF DRAIN**

Design



Final stage



**CROSS - SECTIONS OF
ARTIFICIAL WATERWAY**

Start

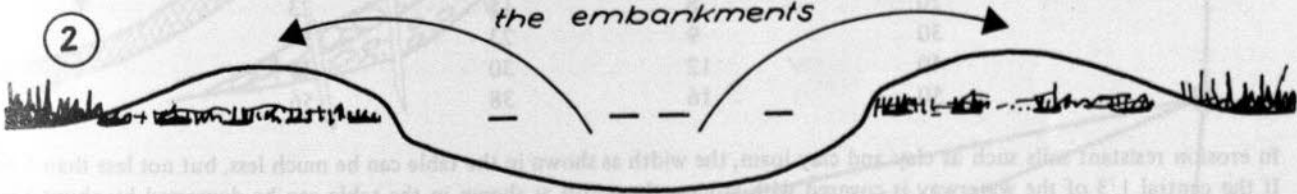
①

by cutting out the sods



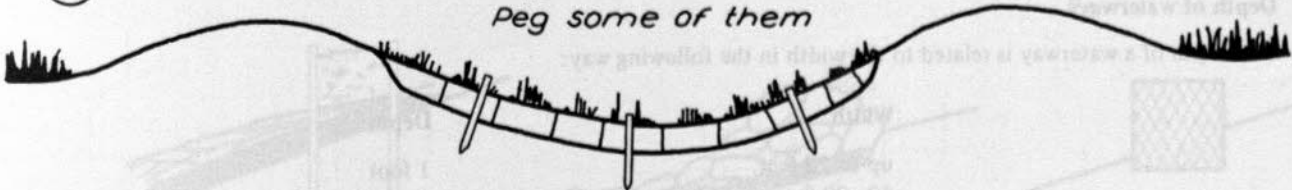
②

Excavated soil is used for the embankments



③

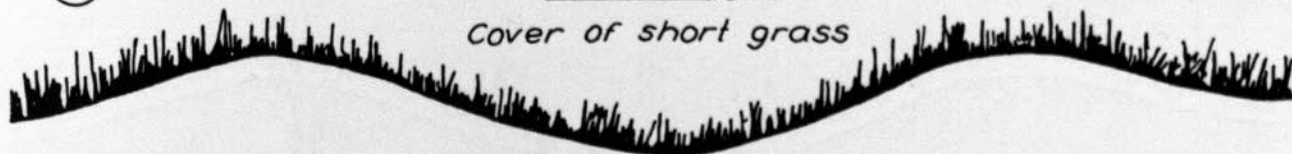
Replace the sods
Peg some of them



④

Final stage

Cover of short grass



Gradient of cutoff drains

The same as for graded terraces (see page 74).

Intervals between cutoff drains

Usually one cutoff drain only is needed on a slope. Only at very long slopes might an extra cutoff drain be dug in exceptional cases.

Size of cutoff drains

As to design of cutoff drains, and for the approximate dimensions of the cutoff channel see the upper figure on foregoing page. A cutoff drain dug by hand is often 5 feet (1.5 m) wide at the top, 3 feet (0.9 m) wide at the bottom and 2 feet (0.6 m) deep, giving a cross-section of 0.7 sq.m. A cutoff drain constructed by a motor grader often has a V – shaped cross-section and is made 6–8 feet wide (1.8–2.4 m) and 2.5 feet deep (0.75 m), giving a cross-section of 0.7–0.9 sq.m.

In semi-arid overgrazed areas cutoff drains, especially in silt and sandy soils, are useless without grazing control and establishment of grass cover on the ground round the gullies.

ARTIFICIAL WATERWAYS

In general

The water from cutoff drains as well as from terraces should be discharged into natural watercourses (rivers) or onto nonerodible areas such as stony ground or permanent pasture with a good grass cover. If it is not possible to find such an outlet point within a reasonable distance, the excess water has to be taken down the slope by an artificial waterway, covered with grass. A difficulty in constructing waterways is that protective grass cannot be established in the first year or two. Consequently it would be reasonable to construct the artificial waterways and plant grass two years before the construction of the cutoff drains and terraces. Another way is to remove the grass before excavating the waterway and afterwards replace the grass as shown in the figure on the foregoing page.

A waterway should be wide (5 feet at least) and shallow (1 foot deep) to minimize erosion (see the lower figure on the foregoing page).

Width of waterways

The width can be varied depending on the size of the catchment area and the steepness of the slope. The necessary width in feet of an artificial waterway in erodible soils can be read from the table below:

Catchment area of the waterways in acres	Steepness of the slope		
	less than 6%	6–12%	more than 12%
5	5	6	8
10	6	8	10
15	7	11	17
20	8	15	23
30	9	23	34
40	12	30	44
50	16	38	56

In erosion resistant soils such as clay and clay loam, the width as shown in the table can be much less, but not less than 5 feet. If the central 1/3 of the waterway is covered with stones, the width as shown in the table can be decreased by about a half.

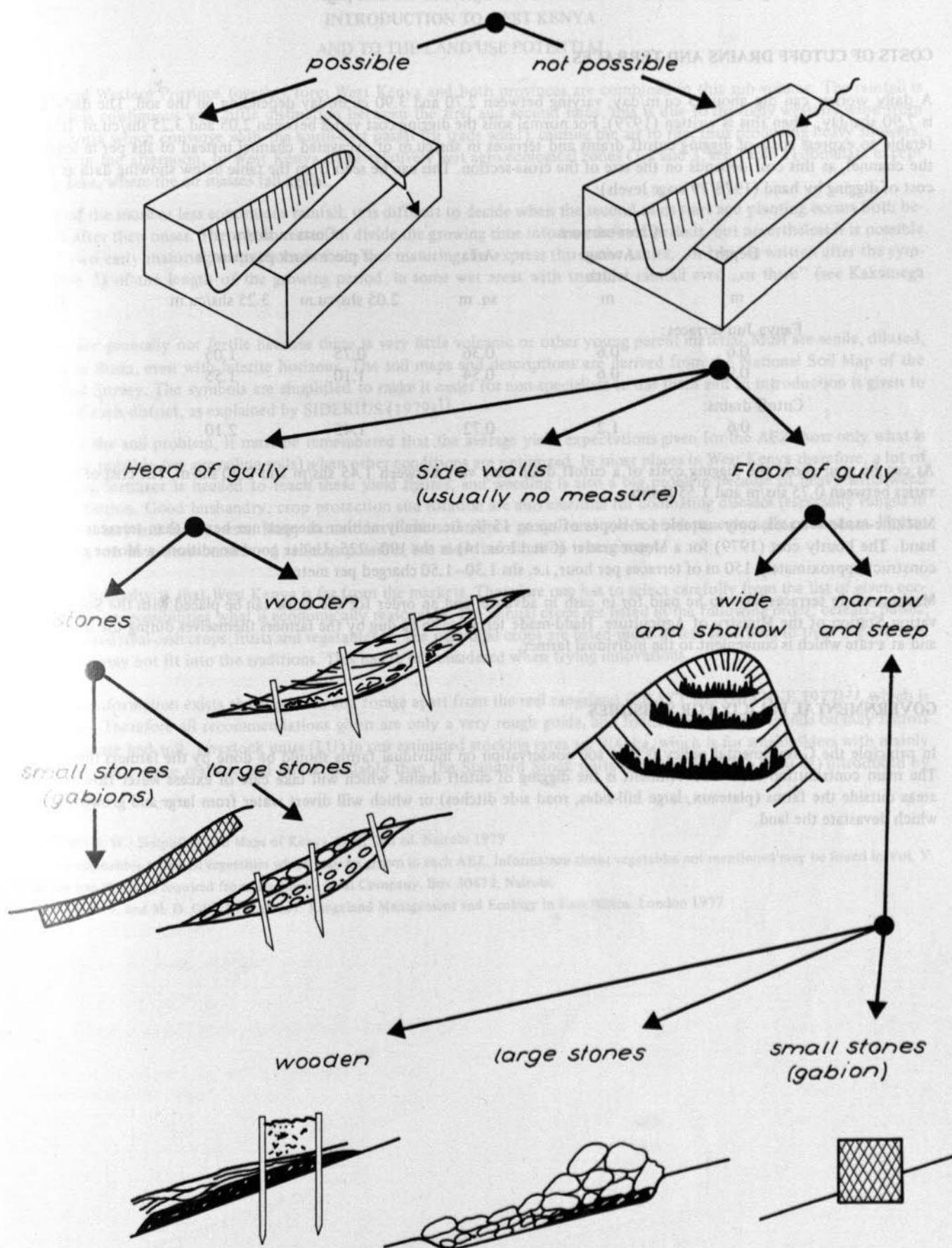
Experience has shown that farmers hesitate to accept even half of the widths recommended. An alternative then is to construct check dams as recommended for the floor in gully control (see the figure on the next page).

Depth of waterways

The depth of a waterway is related to the width in the following way:

Width	Depth
up to 10 feet	1 foot
10–20 feet	1 1/4 feet
more than 20 feet	1 1/2 feet

Diversion of water



GULLY CONTROL

The right measure for gully control can be selected from the figures on the next page.

COSTS OF CUTOFF DRAINS AND TERRACES

A daily worker can dig about 3 cu.m/day, varying between 2.70 and 3.90 cu.m/day depending on the soil. The daily wage is 7.90 shs/day, when this is written (1979). For normal soils the digging cost varies between 2.05 and 3.25 shs/cu.m. It is preferable to express costs of digging cutoff drains and terraces in shs/cu.m. of excavated channel instead of shs per m length of the channel, as this cost depends on the size of the cross-section. This can be seen from the table below showing data as to the cost of digging by hand (1978/79 wage levels):

Depth	Cross-sections	Area	Costs in shs/m	
	Average width		if piece work payment is	
m	m	sq. m	2.05 shs/cu.m	3.25 shs/cu.m
Fanya Juu terraces:				
0.6	0.6	0.36	0.75	1.05
0.9	0.6	0.54	1.10	1.55
Cutoff drains:				
0.6	1.2	0.72	1.45	2.10

As can be seen above the digging costs of a cutoff drain may vary between 1.45 shs/m and 2.90 shs/m. The cost of terracing varies between 0.75 shs/m and 1.55 shs/m.

Machine-made terraces, only suitable for slopes of up to 15 %, are usually neither cheaper nor better than terraces made by hand. The hourly cost (1979) for a Motor grader (Cat 12 or 14) is shs 190–225. Under good conditions a Motor grader can construct approximately 150 m of terraces per hour, i.e. shs 1.30–1.50 charged per metre.

Machine-made terraces have to be paid for in cash in advance, and an order for the work can be placed with the Soil Conservation Station of the Ministry of Agriculture. Hand-made terraces can be dug by the farmers themselves during the off-season, and at a rate which is convenient to the individual farmer.

GOVERNMENTAL POLICY FOR SUBSIDIES

In principle the Governmental policy is that soil conservation on individual farms should be done by the farmers themselves. The main contribution of the Government is the digging of cutoff drains, which will take care of excess water flowing from areas outside the farms (plateaux, large hill-sides, road side ditches) or which will divert water from large and growing gullies which devastate the land.

DISTRICT INFORMATION AND STATISTICS

KISEI DISTRICT

INTRODUCTION TO WEST KENYA AND TO THE LAND USE POTENTIAL

Nyanza and Western Province together form West Kenya and both provinces are combined in this sub-volume. The rainfall is more or less continuous with little distinction between the first and second rains; this is due to the daily westerly wind from Lake Victoria which converge with the south-east passat (or trade wind), causing the air to rise, thus producing heavy showers, especially in the afternoon. In West Kenya these relatively wet agro-ecological zones (1,2 and 3, see Table 1) dominate except near the lake, where the air masses fall again.

Because of the more or less continuous rainfall, it is difficult to decide when the second rains start and planting occurs both before and after their onset. There is no reason to divide the growing time into two defined periods, but nevertheless it is possible to plant two early maturing crops instead of one late maturing. To express this in the tables, „or two” is written after the symbol (Table 2) of the length of the growing period, in some wet areas with trimodal rainfall even „or three” (see Kakamega District).

The soils are generally not fertile because there is very little volcanic or other young parent material. Most are senile, diluted, some, as in Busia, even with laterite horizons. The soil maps and descriptions are derived from the National Soil Map of the Kenya Soil Survey. The symbols are simplified to make it easier for non-specialists to use them and an introduction is given to the soils of each district, as explained by SIDERIUS (1979)¹⁾

Because of the soil problem, it must be remembered that the average yield expectations given for the AEZ show only what is climatically possible (on prevailing soils) when other conditions are optimized. In most places in West Kenya therefore, a lot of manure and fertilizer is needed to reach these yield figures, and weeding is also a big problem because of heavy witchweed (Striga) infection. Good husbandry, crop protection and rotation are also essential for combating diseases (especially fungus in the wet climate) and insect pests. Many nematodes in the soil reduce growth and yields of crops, especially of bananas. Phytosanitary aspects have been considered as far as possible, but more information is necessary.

A further difficulty is that West Kenya is far from the markets. Therefore one has to select carefully from the list of given ecological land-use possibilities what is economically reasonable. The annual crops are listed in the following order: cereals; pulses; tubers; oil seed; real cash crops; fruits and vegetables²⁾. The perennial crops are listed more or less according to their importance. Some crops may not fit into the traditions. This has to be considered when trying innovations.

Very little information exists about pasture and forage apart from the real rangeland (PRATT and GWYNNE 1977)³⁾, which is scarce here. Therefore all recommendations given are only a very rough guide, and fodder cultivation depends on many factors besides climate and soil. Livestock units (LU) in our estimated stocking rates are 300 kg, which is for smallholders with mainly indigenous cattle more realistic and understandable than the Standard Stock units (SSU) of 1 000 lb (450 kg) introduced by the British.

1) SIDERIUS, W.: Simplified Soil Maps of Kenya. KSS, 2nd ed. Nairobi 1979

2) It was impossible to list all vegetables which may be grown in each AEZ. Information about vegetables not mentioned may be found in Vol. V of the handbook or required from Kirchhoffs Seed Company, Box 30472, Nairobi.

3) PRATT, D. J. and M. D. GWYNNE (Eds.): Rangeland Management and Ecology in East Africa. London 1977

NYANZA PROVINCE KISII DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

The Kisii Highlands may be divided into a few agro-ecological zones only, most of which are high potential. This is important, because the district is very densely populated (some locations have more than 750 people per sqkm). More tea in the Tea-Coffee Zone is one of the development possibilities to support a high population density.

The climate of this district is one of the wettest in Kenya due to the fact, that it is situated in the center of the local convergence of the daily lakewinds with the easterlies during the generally dry seasons in Kenya. Therefore the rainy seasons are extended to a more or less continuous period of water availability. Annual rainfall is not only high, averaging 1 200 to 2 100 mm, but also reliable (1 100 to 1 750 reached or surpassed in at least 6 out of 10 years). The rainy seasons of the year are not easy to distinguish because there are normally no real dry seasons in between. First rains start at about middle of February. In August there is a second increase followed by a small third one in November (see Diagr. Kisii, D.O., and Singoiwek Farm).

The growing periods in the Tea-Dairy and in the Coffee-Tea Zone are normally permanent. They are dividable into a period of 215–230 days (which may be surpassed by late maturing crops), followed by a 135–150 day growing period. Rainfall reliability during these periods is high. At least 800–1 000 mm or more can be expected in the first period, and at least 400–700 mm in the following one in 6 out of 10 years.

In the West of the district, temperatures are higher than those normally found at this altitude, but they reach normal altitude temperatures in the East (see Climate Tables). Humidity of the air is relatively high. Evaporation is low, normally between 1 650 mm (at 2 100 m) and 2 000 mm (at 1 500 m) per year.

KISII DISTRICT

TABLE 1: RAINFALL FIGURES FROM VARIOUS STATIONS
having at least 10 years of records up to 1976

No. and altitude	Name of Station	Years of rec.	Kind of rec.	Ann. rainf. mm	Monthly rainfall in mm											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
9034001 1 740 m	Kisii, District Office	64	Average	1 784	70	89	176	265	220	146	111	151	171	138	141	107
			60 % prob. ¹⁾	1 602	45	70	126	238	198	126	83	134	131	107	104	78
9034005 1 500 m	Kamagambo Training School	36	Average	1 600	57	101	148	236	206	123	82	113	128	126	165	115
			60 %	1 435	46	64	131	197	124	85	56	75	148	109	115	109
9034024 1 920 m	Singoiwet Farm	36	Average	1 429	87	95	156	190	157	132	78	132	101	81	104	161
			60 %	1 281	64	61	129	159	103	100	63	103	81	62	65	61
9034031 1 680 m	Nyanturago F. Coop. Society	27	Average	2 089	94	108	146	333	260	198	127	179	185	171	151	137
			60 %	1 397	47	58	110	196	133	98	67	100	120	138	80	73
903432 1 890 m	Moromba F. Coop. Society	34	Average	2 056	83	96	169	307	255	180	127	190	191	161	167	132
			60 %	1 716	51	71	150	231	196	116	76	103	139	126	136	90
9034042 1 620 m	Nyathegogi F. Coop. Society	29	Average	1 826	71	80	187	287	221	161	90	134	146	143	170	130
			60 %	1 647	17	50	129	197	180	107	51	90	104	107	138	69
9034046 1 710 m	N.Mugirango Nyabomite F.C. Society	26	Average	1 902	44	85	181	321	223	150	117	143	183	175	175	107
			60 %	1 719	26	38	155	243	192	108	72	109	154	139	116	73
9034056 1 500 m	Nyakoe, Kisii F.C. Society	21	Average	1 741	79	87	162	256	222	124	96	141	161	130	165	118
9034072 1 500 m	Kiamokama Agric. Holding	15	Average	1 622	68	93	173	220	182	87	65	132	109	155	211	127
9034080 1 680 m	Kisii, Coffee Sub-Station	33	Average	1 952	72	103	194	290	238	155	104	169	193	148	165	122
9034088 1 680 m	Kisii, Exp. Station	11	Average	2 677	110	125	234	474	338	227	178	184	143	217	240	208

1) These figures of rainfall reliability should be exceeded normally in 6 out of 10 years

KISII DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ ¹⁾	Kind of records	Temperature in °C												Y. of rec.	
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Year
9034080 1 766 m	Kisii, Coffee Sub-Station	UM 1 hp	Mean. max.	27,2	27,4	26,7	25,6	25,8	25,3	25,0	25,4	26,0	26,5	25,4	25,9	26,0	18
			Mean. temp.	19,4	20,2	19,8	19,4	19,6	18,9	18,4	18,8	19,1	19,5	18,7	19,1	19,2	
			Mean. min.	11,8	12,9	12,2	13,1	13,3	12,4	11,8	12,1	12,1	12,4	12,0	12,2	12,3	
			Absol. min.	6,7	7,9	9,9	7,1	7,5	6,7	7,4	7,8	8,0	7,2	7,5	5,5	5,5	
9034088 1 765 m	Kisii, Experimental Station	UM 1 hp	Mean. max.	25,8	(24,5)	(24,6)	(23,2)	23,6	23,8	23,4	23,8	23,9	24,7	23,6	23,9	24,1	5
			Mean. temp.	20,5	(19,6)	(19,8)	(19,0)	19,2	19,0	18,5	18,8	18,9	19,5	18,9	19,2	19,2	
			Mean. min.	15,2	(14,7)	(14,9)	(14,7)	14,7	14,1	13,5	13,7	13,8	14,2	14,1	14,4	14,3	
			Absol. min.	11,1	11,7	13,3	12,2	13,3	11,1	11,1	11,1	11,1	11,1	11,1	10,0	10,0	

1) AEZ = Agro-ecological zone; lp = lower places, hp = higher places within the zone

KISII DISTRICT

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall 1)		60 % reliability of growing period		Total ³⁾ in days
					1st rains in mm	2nd rains in mm	1st rains ²⁾ in days	2nd rains in days	
LH 1 Tea-Dairy Zone	p or l m	~ 1 900-2 211	18.0°-16.2°	1 400-2 100	800-1 000	400-700	215 or more	about 150	365
LH 2 Wheat/Maize-Pyrethrum Zone	vl i or l m (m)i	~ 1 800-2 165	18.0°-16.5°	1 300-1 600	700-900	350-450	200 or more	130-140	330-340
UM 1 Coffee-Tea Zone	p or l m	1 500-1 900 ⁴⁾	20.5°-18.0°	1 400-2 100	800-1 000	450-700	215 or more	about 150	365
UM 2-3 Coffee Zone	vl i or two	1 550-1 750	20.2°-18.5°	< 1 200	700-800	400-500	180 or more	110-130	290-310
LM 1 L. Midland Sugar Cane Zone	See	South	Nyanza						
LM 2 Marg. Sugar Cane Zone	l/m (m/s)i	1 440-1 500	21.0°-20.5°	1 400-1 600	800-1 000	500-700	180 or more	115-140	295-320

1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants.

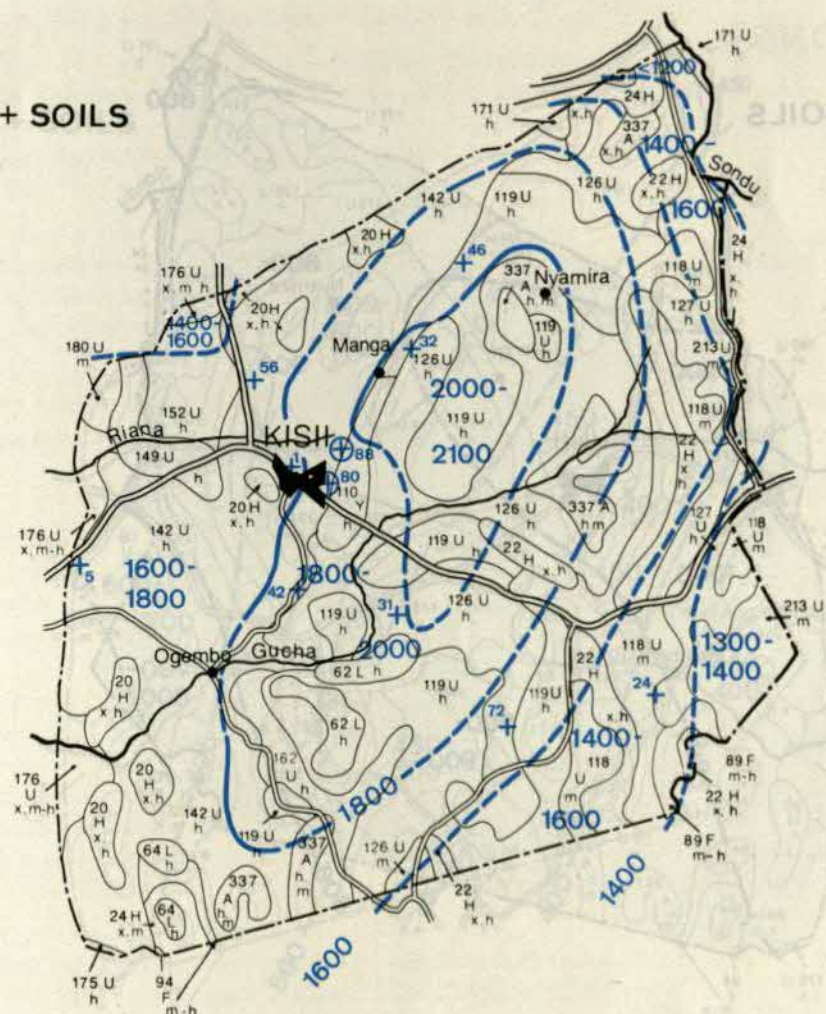
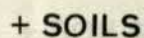
2) More if growing cycle of cultivated plants continues into the period of second rains.

3) Only added if rainfall continues at least for survival ($< 0.2 E_0$) of most long term crops.

4) In 1980 the economic altitudinal limit between coffee and tea was about 1 700 m (± 100 m).

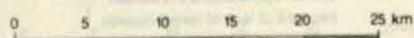
AVERAGE ANNUAL RAINFALL

in mm



- | | |
|------|---|
| ⊕ | Temperature recording station,
operating 1976 |
| + | Rainfall recording station, operating 1976
and having at least 10 years of records |
| 56 | Station number in grid |
| 3490 | Grid number |

Broken boundaries are uncertain because of lack of rainfall records

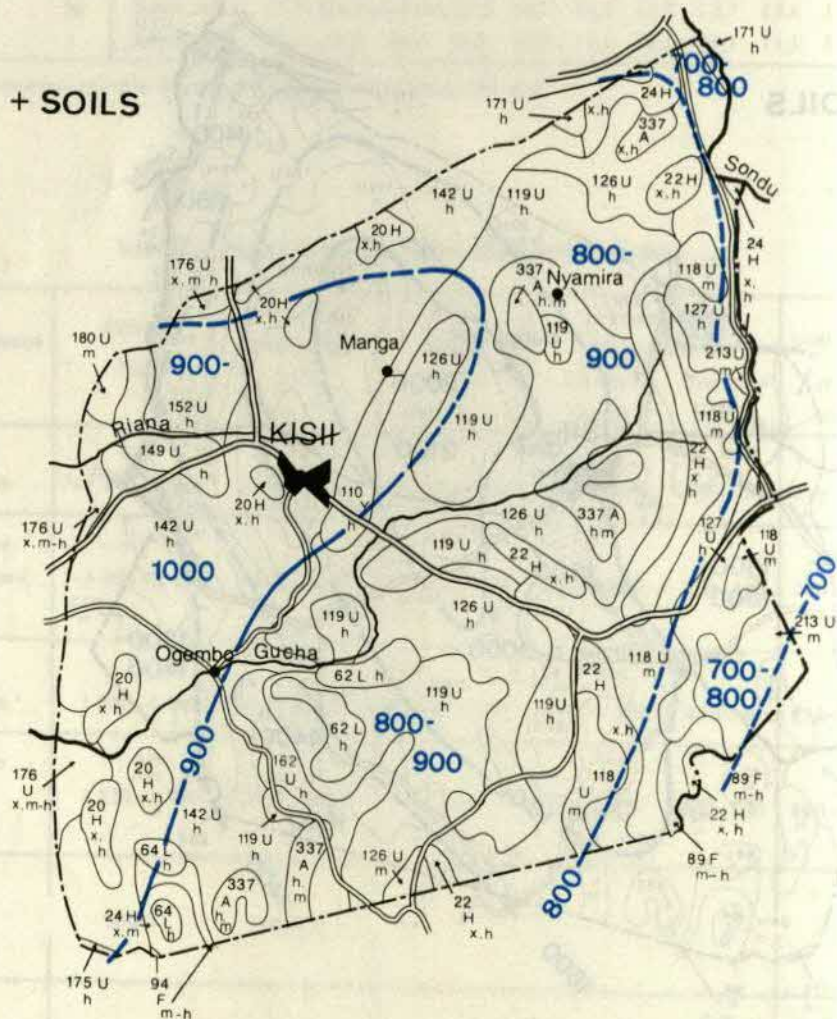


Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

KISII

(mid Febr. - beg. Aug.)

+ SOILS

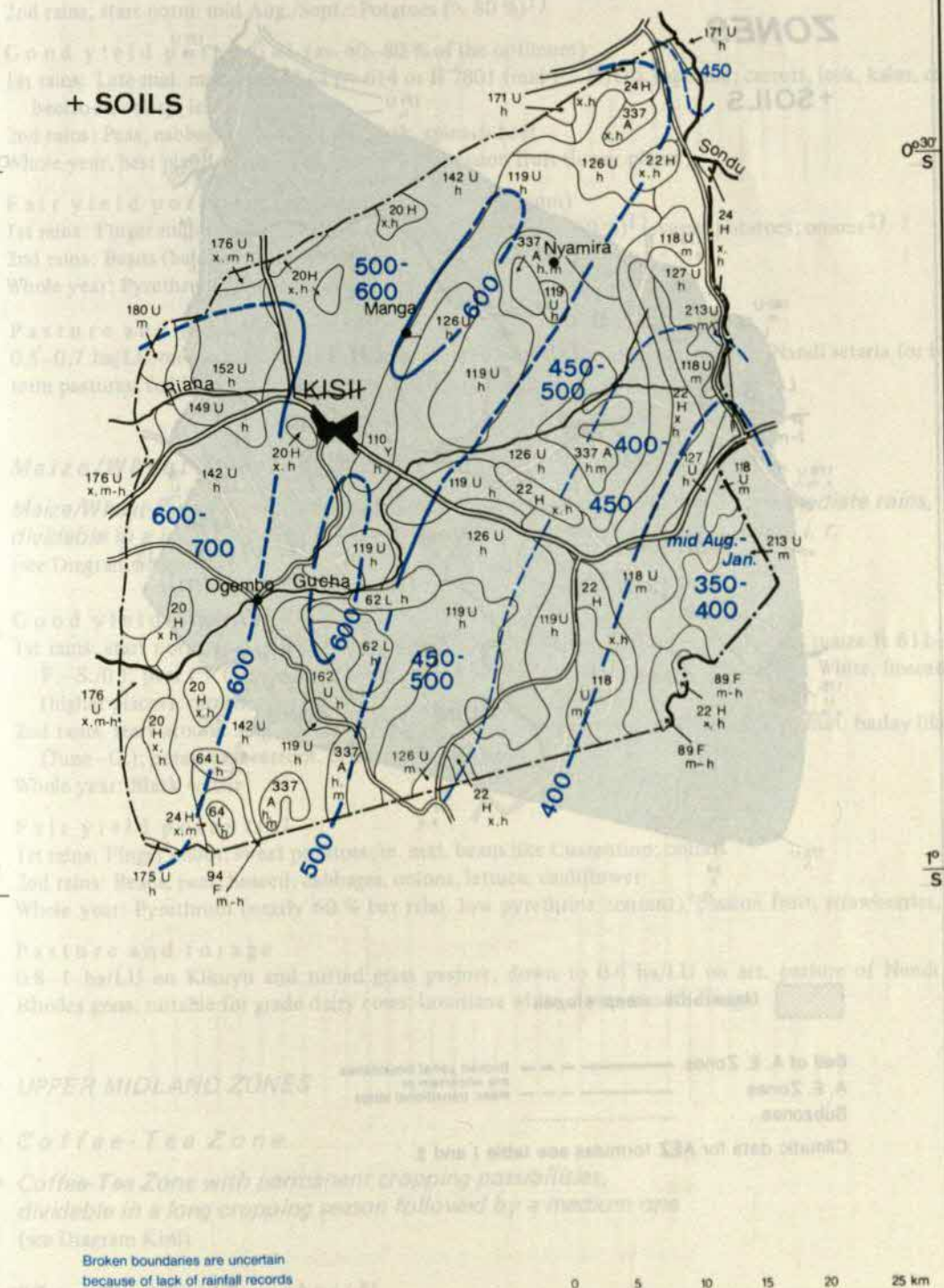


Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

(mid Aug.- beg. Feb. or less)

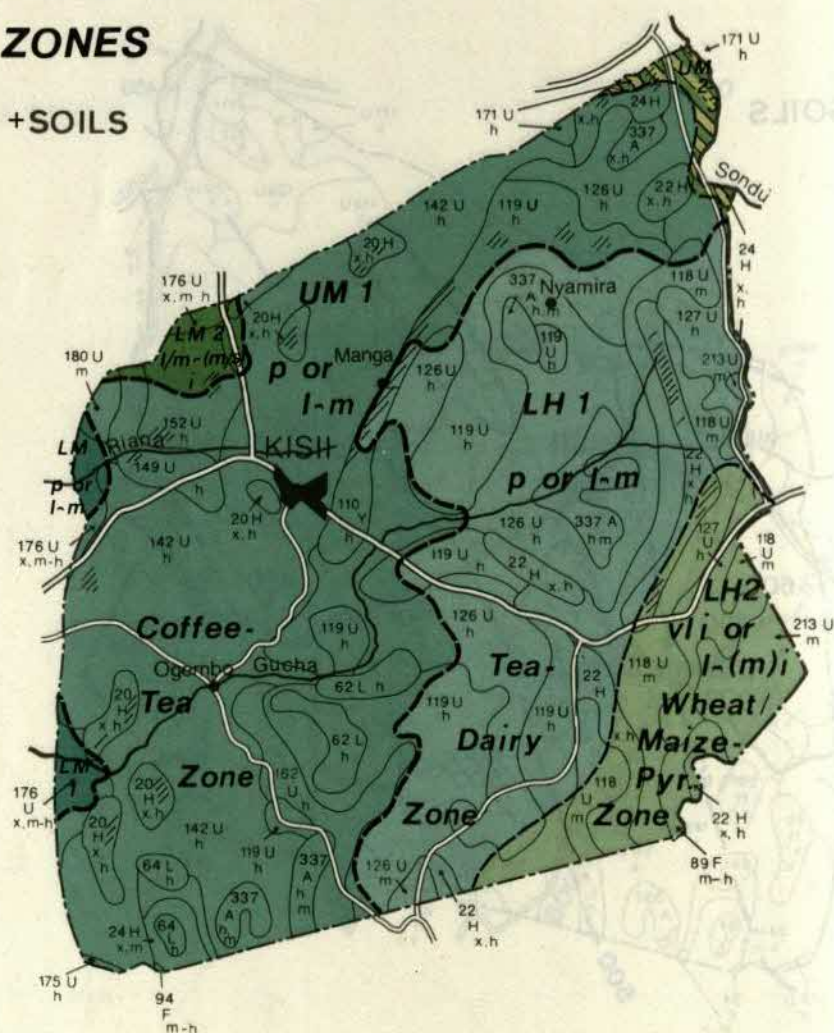
Amounts in mm, surpassed
norm. in 6 out of 10 years

+ SOILS



Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

+SOILS

 *Unsuitable steep slopes*

Belt of A. E. Zones ——— Broken zonal boundaries
A. E. Zones ——— are uncertain or
Subzones mean transitional strips

Climatic data for AEZ formulas see table I and II

Min. of Agr., German Agr. Team

0 5 10 15 20 25 km
AEZ R. Jätzold '81 Soils KSS

AGRO-ECOLOGICAL ZONES

LH = LOWER HIGHLAND ZONES

LH 1 = Tea-Dairy Zone

LH 1
p or
l-m = Tea-Dairy Zone with permanent cropping possibilities,
dividable in a long cropping season followed by a medium one

Very good yield potential (av. above 80 % of the optimum)

1st rains, start norm. mid. Febr.: Peas; cabbages, spinach,

2nd rains, start norm. mid Aug./Sept.: Potatoes (~ 80 %)¹).

Good yield potential (av. 60–80 % of the optimum)

1st rains: Late mat. maize like H 611–614 or H 7801 (mid F.–S./O.); rapeseed; carrots, leek, kales, cauliflower, beetroot, celery, lettuce

2nd rains: Peas; cabbages, carrots, kales, leek, spinach beet

Whole year, best planting time mid March: Tea, passion fruit (lower places)

Fair yield potential (av. 40–60 % of the optimum)

1st rains: Finger millet; beans (below 2 000 m); potatoes (50–60 %)¹, sweet potatoes; onions²)

2nd rains: Beans (below 2 000 m); onions²)

Whole year: Pyrethrum (too wet), avocados

Pasture and forage

0.5–0.7 ha/LU on sec. pasture of Kikuyu grass, well suitable for grade dairy cows; Nandi setaria for better long-term pastures; fodder crops of temperate zone, f. i. clover

LH 2 = Maize/Wheat-Pyrethrum Zone³

LH 2
p or
l-m = Maize/Wheat-Pyrethrum Zone with a very long cropping season and intermediate rains,
dividable in a long cropping season followed by a (weak) medium one and i. r.
(see Diagram Singoiwet)

Good yield potential

1st rains, start norm. mid. F.: Late mat. wheat like Kenya Bongo, late mat. triticale, maize H 611–614 (mid. F.–S./O.); peas (~ 60 %), horse beans; potatoes¹); late mat. sunflower like Kenya White, linseed, rapeseed (higher places); carrots, spinach

2nd rains, start around Aug. or earlier: E. mat. wheat like K. Tembo (June–O.), m. mat. barley like Research (June–O.); potatoes; beetroot, celery, carrots, kales

Whole year: Black wattle

Fair yield potential

1st rains: Finger millet; sweet potatoes; m. mat. beans like Cuarentino; onions

2nd rains: Beans, peas; linseed; cabbages, onions, lettuce, cauliflower

Whole year: Pyrethrum (nearly 60 % but relat. low pyrethrine content), passion fruit, strawberries, avocados

Pasture and forage

0.8–1 ha/LU on Kikuyu and tufted grass pasture; down to 0.6 ha/LU on art. pasture of Nandi Setaria or Rhodes grass; suitable for grade dairy cows; Louisiana white clover as add. forage

UM = UPPER MIDLAND ZONES

UM 1 = Coffee-Tea Zone

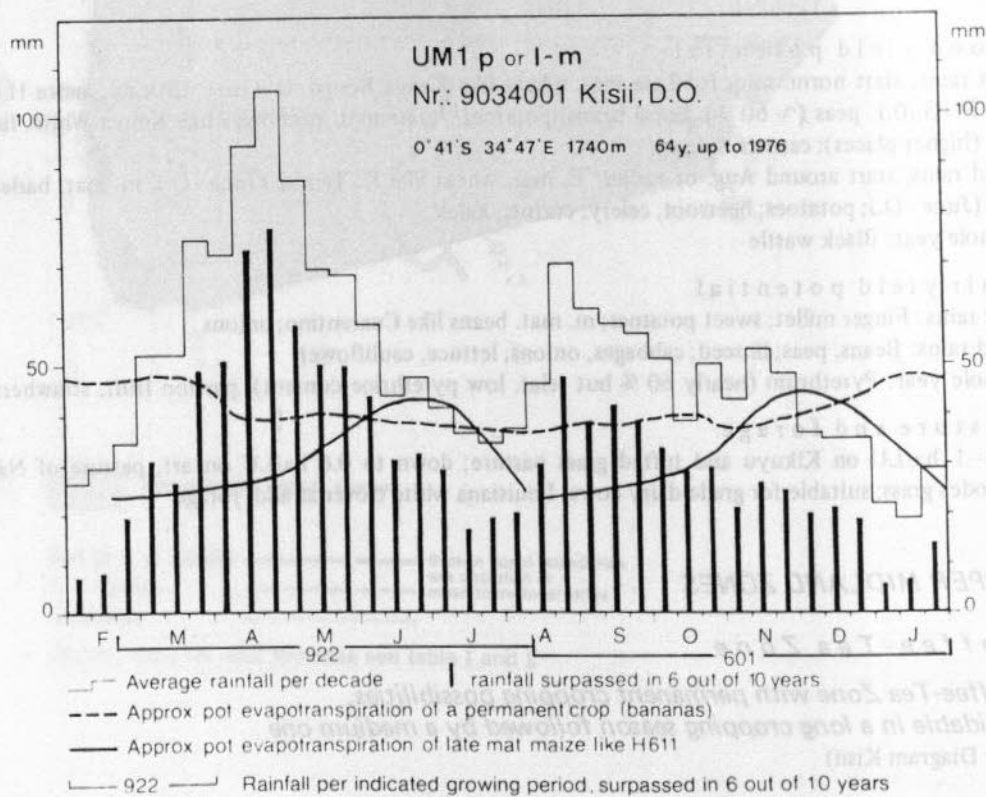
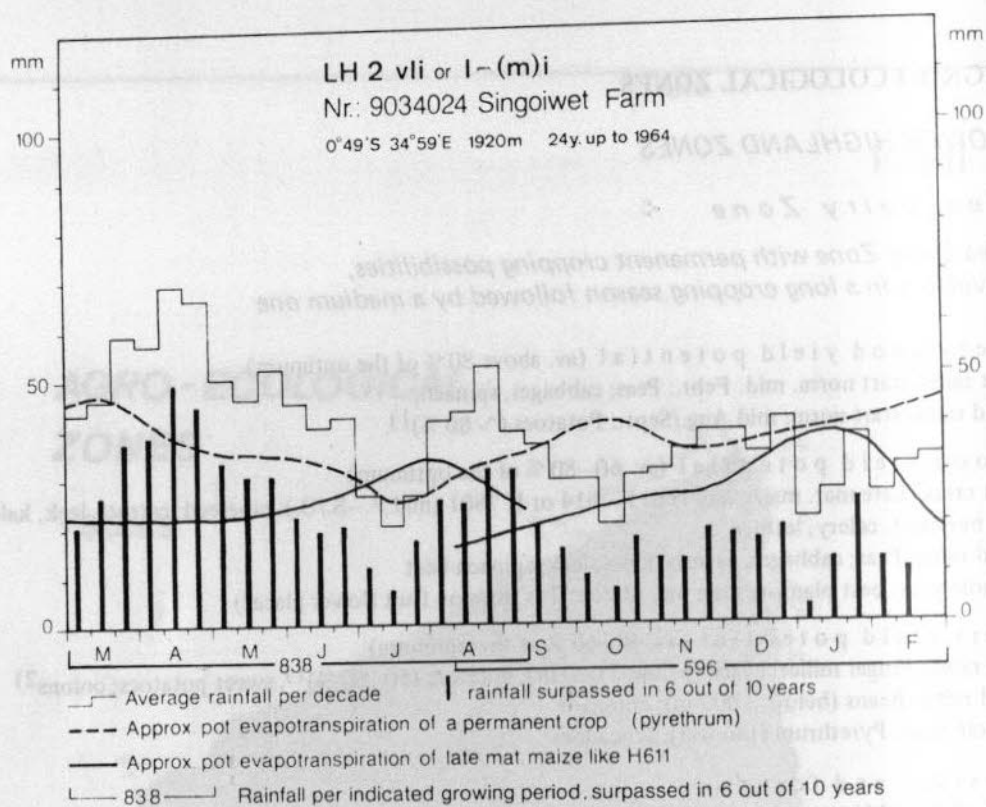
UM 1
p or
l-m = Coffee-Tea Zone with permanent cropping possibilities,
dividable in a long cropping season followed by a medium one
(see Diagram Kisii)

Very good yield potential

1st rains, start norm. end F.: Sweet potatoes; cabbages, kales, rinogu⁴)

2nd rains, start around Aug.: M. mat. sunflower like Hybrid S 301 A (~ 80 %)

Whole year: Pawpaws, guavas



Good yield potential

1st rains: Maize H 612–614, 7801 (higher places), 622 and 632 (below 1 700 m), finger millet, late mat. sorghum (~ 60 % below 1 600 m); late mat. sunflower, soya beans (below 1 600 m); Chinese cabbages, onions, spinach
 2nd rains: M. mat. maize like H 511, m. mat. sorghum; beans; sweet potatoes; e. mat. soya beans; kales, onions
 spinach, rinogu⁴), tomatoes (below 1 600 m, above fair)
 Whole year: Tea (best above 1 700 m, below lower quality), bananas, taro, yams, egg plant, passion fruit, avocados, loquats

Fair yield potential

1st rains: Beans (50–60 %); potatoes (above 1 500 m); tomatoes, carrots (above 1 600 m), sweet pepper (below 1 600 m)
 2nd rains: Maize H 622 and 632 (below 1 700 m), finger millet; potatoes (above 1 500 m); cabbages
 Whole year: Arabica coffee (below 1 700 m, above marginal because too wet), citrus

Pasture and forage

0.6–0.8 ha/LU on star grass; down to 0.15 ha/LU feeding Napier or Bana grass, forage legumes, banana leaves and stems, maize stalks

UM 2–3 = Coffee Zone (undifferentiated, partly marginal)

Potential see Kericho District UM 2 (for higher parts) and UM 3 (lower parts)

LM = LOWER MIDLAND ZONES**LM 1 = Lower Midland Sugar Cane Zone**

Very small, potential see South Nyanza (= Homa Bay) District

LM 2 = Marginal Sugar Cane Zone

Small, potential see South Nyanza District. Late mat. groundnuts and soya beans good yield potential

1) spraying against fungus diseases important. Use against blight and bacterial wilt resistant varieties

2) grow onions mainly (shallots)

3) Wheat or maize mainly depending on farm scale, here more maize

4) Local spinach (*Solanum nigrum*)

FLATMONT PLAINS

Soils developed on alluvium from undifferentiated Basement System rocks

moderately well drained, very deep, dark yellowish brown to brown brown, friable, slightly to moderately calcareous and slightly loamy, soil to sandy clay loam texture, pH 5.5–6.5, low to medium fertility

GENERAL FERTILITY GROUPS**LOWLANDS****SERIOUS LIMITATIONS**

(according to soil test)

Soils developed on acid igneous rocks (granite, etc.) with volcanic ash intercalations

moderately well drained, deep to very deep, reddish brown to reddish yellow, friable, slightly to moderately calcareous and slightly loamy, soil to sandy clay loam texture, pH 5.5–6.5, low to medium fertility

Soils developed on intermediate igneous rocks (andesite, trachyte, etc.) with volcanic ash intercalations

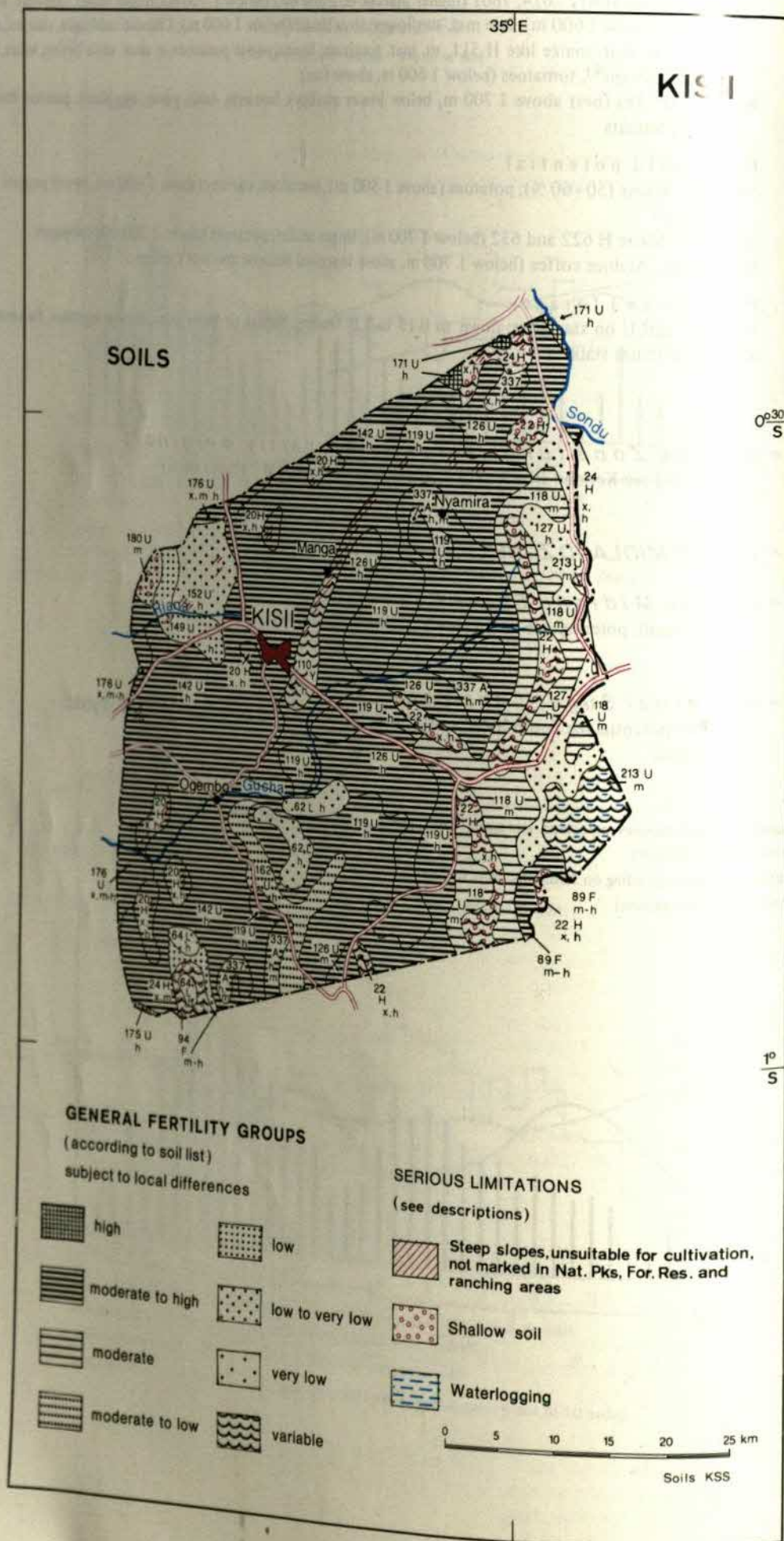
moderately well drained, deep to very deep, reddish brown to reddish yellow, friable, slightly to moderately calcareous and slightly loamy, soil to sandy clay loam texture, pH 5.5–6.5, low to medium fertility

Soils developed on intermediate igneous rocks (andesite, trachyte, etc.) with volcanic ash intercalations

moderately well drained, deep to very deep, reddish brown to reddish yellow, friable, slightly to moderately calcareous and slightly loamy, soil to sandy clay loam texture, pH 5.5–6.5, low to medium fertility

Soils developed on intermediate igneous rocks (andesite, trachyte, etc.) with volcanic ash intercalations

moderately well drained, deep to very deep, reddish brown to reddish yellow, friable, slightly to moderately calcareous and slightly loamy, soil to sandy clay loam texture, pH 5.5–6.5, low to medium fertility



SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

The majority of the land in the district belongs to the south-western highlands with undulating topography. Several levels, which are occasionally separated from each other by scarps, can be distinguished. The parent rock is mainly volcanic and outcrops in a few hills.

Some hill soils (units H) are extremely shallow (units 22 H, 24 H) while others may be shallow (30 H) or moderately deep (20 H). The major soil units in the district are upland soils (119 U, 126 U, 142 U) with topsoils rich in organic matter. These soils have moderately high natural fertility and are intensively farmed. Soils similar to unit 119 U also occur on footslopes (89 F).

In the eastern and northern part of the area, soils of very low fertility (127 U) are found. In the extreme southeastern corner dark cracking soils (213 U, fertile if well drained) occur together with soils with a deep organic topsoil (like 118 U); the latter have a moderate to high natural fertility.

In the bottomlands alluvial soils (A) are clayly with distinct changes in texture and they are subject to flooding (337 A).

SOILS ON HILLS AND MINOR SCARPS

- Soils developed on basic igneous rocks (serpentinites, basalts, nepheline phonolites; older basic tuffs included)
- 20 H = somewhat excessively drained, shallow to moderately deep, dark reddish brown, friable, gravelly clay, with acid humic topsoil
x, h¹⁾ (humic CAMBISOLS, partly paralithic phase)
- Soils developed on acid igneous rocks (rhyolites, aplites), with recent volcanic ash admixture
- 22 H = somewhat excessively drained, shallow, dark reddish brown, friable, gravelly clay; in places with humic topsoil, partly acid
x, h (RANKERS; with ando-haplic PHAEZEMS, lithic phase and LITHOSOLS)
- Soils developed on quartzites
- 24 H = somewhat excessively drained, shallow, dark brown, very friable, rocky, sandy loam to clay loam; in many places with acid humic
x, h topsoil (RANKERS; with LITHOSOLS and Rock Outcrops)

SOILS ON PLATEAUS AND HIGH LEVEL STRUCTURAL PLAINS

- Soils developed on intermediate igneous rocks (syenites, trachytes, phonolites, etc.)
- 62 L = well drained, very deep, dark reddish brown to dark red,
h friable clay (nito-rhodic FERRALSOLS)
- Soils developed on quartzites
- 64 L = well drained, deep to very deep, reddish brown, friable clay,
h with acid humic topsoil (humic FERRALSOLS)

SOILS ON FOOTSLOPES

- Soils developed on colluvium from acid igneous rocks (rhyolites), with volcanic ash admixture
- 89 F = moderately well drained to imperfectly drained, deep, dark reddish brown, mottled, friable clay loam, with humic topsoil
x-h and deeper subsoil of compact clay (gleytic PHAEZEMS)
- Soils developed on colluvium from quartzites
- 94 F = well drained, deep to very deep, reddish brown to yellowish red, friable, sandy loam to clay, often with acid humic topsoil
m-h (humic ACRISOLS; with luvic ARENOSOLS)

SOILS ON PIEDMONT PLAINS

- Soils developed on alluvium from undifferentiated Basement System rocks
- 110 Y = moderately well drained, very deep, dark yellowish brown to strong brown, friable, lightly to moderately calcareous and slightly
h sodic, loamy sand to sandy clay loam (haplic XEROSOLS, sodic phase; with calcarocambic ARENOSOLS)

SOILS ON UPLANDS

- Soils developed on acid igneous rocks (rhyolites), with volcanic ash admixture
- 118 U = well drained, deep to very deep, dark reddish brown, friable and slightly smeary silty clay loam, with thick humic topsoil (ando-
m luvic PHAEZEMS)
- Soils developed on intermediate igneous rocks (syenites, trachytes, andesites), with volcanic ash admixture
- 119 U = well drained, deep to extremely deep, reddish brown, friable clay, with thick humic topsoil ((dystro-) mollic NITOSOLS and
h chromo-luvic PHAEZEMS)
- Soils developed on intermediate igneous rocks (syenites, andesites, etc.), with volcanic ash admixture
- 126 U = well drained, extremely deep, reddish brown, friable clay, with thick humic topsoil ((dystro-) mollic
h NITOSOLS)

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Soils developed on acid igneous rocks (rhyolites), with volcanic ash admixture

- 127 U = well drained, very deep, dark red to dark reddish brown,
h friable, sandy clay to clay (nito-rhodic FERRALSOLS)

Soils developed on basic igneous rocks (basalts, etc.)

- 142 U = well drained, deep to extremely deep, dark red, friable clay, with thick humic topsoil
h (mollic NITOSOLS; with nito-luvic PHAEZOZEMS)

Soils developed on granites

- 149 U = well drained, deep, dark red, friable clay, with acid humic
h topsoil (humic ACRISOLS)

Soils developed on biotite/hornblende granites

- 152 U = well drained, very deep, reddish brown to red, friable clay,
h with thick acid humic topsoil (nito-humic FERRALSOLS)

Soils developed on acid igneous rocks

- 176 U = complex of predominantly well drained, moderately deep to deep, reddish brown to brown, friable, granular clay loam to clay,
x, m-h often with a humic topsoil; in many places shallow over petroplinthite (chromo-luvic PHAEZOZEMS at orthic and chromic LUVISOLS; with "murram cuirass" soils)

Soils developed on granites

- 180 U = complex of:
m - well drained, deep, reddish brown, friable, sandy clay loam, with acid humic topsoil (humic ACRISOLS)
- moderately well drained, shallow, dark reddish brown soils over petroplinthite (about 20%) ("murram cuirass" soils)

Soils developed on acid igneous rocks (rhyolites), with volcanic ash admixture

- 213 U = association of:
m - poorly drained, deep, very dark grey, very firm, cracking clay, often abruptly underlying a topsoil of friable humic loam;
on flat parts (eutric PLANOSOLS; with chromic VERTISOLS)
- well drained, moderately deep, dark reddish brown, firm clay loam, with humic topsoil; on slopes (chromo-luvic PHAEZOZEMS)

1) Soil texture-classes

- h = heavy
m = medium
l = light
x = stony, bouldery
v = varying texture
m-h = medium to heavy
m,h = medium and heavy (e.g. abruptly underlying a topsoil of different texture)

Soil description from Kenya Soil Survey: Exploratory Soil Map and Agro-climatic Zones Map of Kenya, scale 1 : 1 000 000, Rep. E 1, Nairobi 1982.
See this map also for colours; symbols simplified here.

POPULATION AND LAND

The population of Kisii District counted, according to the Census of September 1979, 869 512 people (Table 4). Of this figure almost 30 000 people lived in Kisii Township, mainly not depending on agriculture. That is to say, about 840 000 people had to live on only 215 200 ha agricultural land. That means, per average household of nearly 6 people (Table 5), there was only 1.50 ha agricultural land available and per rural person not more than 0.26 ha (Table 6). In the zones of good tea potential (UM 1 and LH 1) this is still enough for a small farmer to do fairly well, but in the Wheat/Maize-Pyrethrum Zone (LH 2) it should be more than 1.8 ha per average household.

Regarding the population growth, agricultural intensification is absolutely necessary. The most critical location is Central Kitutu (LH 1 – UM 1) with 0.11 ha per person in 1979 (Table 6), less than 0.1 ha today.

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

KISII DISTRICT

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Central Kitutu	16 256	17 289	33 545	5 661	43	764
Eronge	20 793	22 692	43 485	6 844	87	495
West Kitutu	25 359	26 915	52 274	8 882	121	431
North Kitutu	21 789	24 100	45 889	7 326	110	415
Kitulu (East Kitutu)	18 819	20 696	39 515	6 423	92	427
Manga Division	103 016	111 692	214 707	35 136	455	471
Borabu	17 010	14 577	31 587	4 591	238	132
West Mugirango	45 108	46 598	91 706	13 754	183	501
North Mugirango	36 854	38 161	75 015	12 241	218	342
Nyamira Division	98 972	99 336	198 308	30 586	640	309
Nyaribari/Chache	24 624	26 153	50 777	8 770	116	437
Nyaribari Masaba	32 283	34 698	66 981	10 541	163	409
Kisii Township	15 102	14 559	29 661	5 410	35	844
Irianyi Division	72 009	75 410	147 419	24 721	314	468
Wanjare	23 788	25 388	49 176	9 574	123	398
South Mugirango Chache	17 163	19 003	36 166	6 333	114	315
South Mugirango Borabu	15 777	17 039	32 816	5 089	86	379
Bosongo Division	56 728	61 430	118 158	20 996	324	364
Majoge Chache	21 702	23 065	44 767	7 771	105	422
Majoge Borabu	24 426	25 888	50 314	7 785	112	446
Bassi Chache	25 125	25 991	51 116	8 190	127	400
Bassi Borabu	21 472	23 250	44 722	6 422	114	390
Ogembo Division	92 725	98 194	190 919	30 168	461	414
Kisii District	423 450	446 062	869 512	141 607	2 196	395

KISII DISTRICT

TABLE 5: COMPOSITION OF HOUSEHOLDS
PER
LOCATION AND DIVISION^{a)}

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Persons per Households total ^{b)}
		Adults >15 years	Children < 15 years	Other Relatives		
Location:						
Central Kitutu	5914	3.13	1.73	0.61	0.19	5.66
Eronge	7376	3.15	1.80	0.71	0.21	5.89
West Kitutu	9243	3.15	1.52	0.81	0.17	5.65
North Kitutu	6693	3.12	1.90	0.63	0.24	5.88
Kitulu	7708	3.13	1.95	0.64	0.22	5.95
Division: Manga	36934	3.15	1.76	0.69	0.20	5.81
Location:						
Borabu	5004	3.21	1.62	0.79	0.65	6.27
West Mugirango	14459	3.44	2.05	0.52	0.32	6.33
North Mugirango	12762	3.30	1.86	0.53	0.18	5.87
Division: Nyamira	32225	3.33	1.93	0.57	0.32	6.14
Location:						
Nyaribari/Cache	9115	3.08	1.72	0.52	0.23	5.55
Nyaribari Masaba	11086	3.18	2.04	0.49	0.32	6.04
Kisii Township	5569	2.87	1.10	0.84	0.29	5.10
Division Irianyi	25770	3.08	1.72	0.58	0.28	5.66
Location:						
Wanjare	9909	3.00	1.34	0.44	0.18	4.95
South Mugirango Cache	6604	3.15	1.65	0.44	0.20	5.45
South Mugirango Borabu	5478	3.22	1.84	0.67	0.24	5.98
Division Bosongo	21991	3.11	1.55	0.50	0.20	5.36
Location:						
Majoge Cache	8142	3.01	1.64	0.55	0.27	5.48
Majoge Borabu	8160	3.25	1.93	0.54	0.45	6.16
Bassi Cache	8726	3.14	1.69	0.66	0.34	5.82
Bassi Borabu	6822	3.28	2.05	0.81	0.40	6.55
Division: Ogembo	31850	3.15	1.83	0.63	0.36	5.98
DISTRICT: KISII	148770	3.17	1.78	0.60	0.27	5.82

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, includes one and two person households as well

KISII DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION
AND PER
HOUSEHOLD AND PERSON

	in '00 ha = sqkm					in '00 ha = sqkm						in ha	
Location/Division without townships	Area total	Non-agricultural land			Agri- cultural land	Area in agro-ecological zones						Agric. land	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home- steads, rivers...)		A E Z						per	
	Census 79				LH 1	LH 2	UM 1	UM 2-3	LM 1	LM 2	household	person	
Central Kitutu	43	3		8	32	11		21				0.64	0.11
Eronge	87			18	69	20		49				1.14	0.18
West Kitutu	121	1		24	96			75		21		1.22	0.21
North Kitutu	110			22	88	80	8					1.54	0.25
Kitulu (East Kitutu)	92			18	74	68	2	4				1.29	0.21
Manga Division	455	4		91	360	179	10	149		21		1.02	0.17
Borabu	238	2		24	212	43	169					4.62	0.67
West Mugirango	183			36	147	104	3	40				1.19	0.18
North Mugirango	218	3		44	171	60		92				1.58	0.26
Nyamira Division	639	5		104	530	207	172	132	19			2.46	0.37
Nyaribari/Cache	116			24	92	25		67				1.19	0.21
Nyaribari Masaba	163			32	131	82	49					1.39	0.22
Iryianyi Division	279			56	223	107	49	67				1.29	0.21
Wanjare	123	1		24	98			91		6	1	1.15	0.22
South Mugirango	114	1		22	91			87		4		1.61	0.28
Cache													
South Mugirango	86	1		18	67			64		3		1.49	0.23
Borabu													
Bosongo Division	323	3		64	256			242		13		1.42	0.24
Majoge Cache	105			22	83			83				1.21	0.21
Majoge Borabu	112			22	90	2		88				1.29	0.21
Bassi Cache	127			26	101			101				1.39	0.22
Bassi Borabu	114			22	92	66	6	20				1.60	0.23
Ogembo Division	461			93	367	68	6	292				1.22	0.19
Total rural area	2 152	12		215	1 925	623	245	995	22	16	24	1.50	0.26

For official land statistics see supplementary publication to FM-Handbook, Vol. III A: Agriculture Land Statistics.

AGRICULTURAL STATISTICS¹⁾

Production and marketing of tea, coffee, pyrethrum and cotton is organised and controlled by statutory boards. Because of this, fairly exact information exists on these crops, which is not the case for almost all other crops.¹⁾

The area planted with tea has increased at a rate of approximately 7 % per year in the last 5 years, with roughly 40,000 producers – the average area per farms is about 0.35 ha. The yield per ha ranges from 1,500 kg to 4,100 kg of green leaves per ha. Roughly 7,000 ha are planted with coffee; the average yield of 400 kg/ha reflects the fact that the Kisumu climate is not very

KISII DISTRICT

TABLE 7 a:

TEA

Small Farmers

Area – Production – Growers – Yields – Returns^{a)}

Division	Item	Unit	Year				
			1975/76	1976/77	1977/78	1978/79	1979/80
Keunbu Keninbu	Area	ha	2,861	3,513	3,739	4,000	4,395
	Production	t	4,709	6,117	9,079	10,239	11,929
	Value	'000 Shs	7,346	18,719	18,158	18,478	13,929
	Growers	No	9,780	11,837	12,336	12,684	13,662
	Yield per ha	kg	1,646	1,741	2,428	2,610	2,710
	Value per ha	Shs	2,568	5,328	4,856	4,620	4,820
	Area per Grower	ha	0.29		0.61	0.31	
	Returns per Grower	Shs	751	1,581	4,856	1,657	
Kitutu	Area	ha	2,056	2,259	2,464	2,605	2,781
	Production	t	5,693	7,163	9,075	9,614	7,295
	Value	'000 Shs	9,393	25,499	19,745	20,836	17,800
	Growers	No	6,818	7,503	8,001	8,286	8,605
	Yield per ha	kg	2,824	3,171	3,676	3,652	2,623
	Value per ha	Shs	4,569	11,288	8,013	7,998	6,400
	Area per Grower	ha	0.30	0.30	0.31	0.31	0.32
	Returns per Grower	Shs	1,378	3,399	2,467	2,545	2,069
Nyamira	Area	ha	2,198	2,380	2,574	2,687	2,847
	Production	t	5,758	7,469	9,206	10,309	7,713
	Value	'000 Shs	9,558	26,141	22,002	21,855	19,052
	Growers	No	6,924	7,549	8,034	8,175	8,528
	Yield per ha	kg	2,620	3,138	3,576	3,837	2,709
	Value per ha	Shs	4,348	10,984	8,547	8,134	6,692
	Area per Grower	ha	0.32	0.32	0.32	0.32	0.33
	Returns per Grower	Shs	1,380	3,463	2,739	2,673	2,234
West Sotik	Area	ha	928	943	965	985	1,007
	Production	t	1,899	2,805	3,544	4,128	3,131
	Value	'000 Shs	2,962	10,088	8,045	9,082	6,889
	Growers	No	1,102	1,160	1,209	1,292	1,418
	Yield per ha	kg	2,046	2,975	3,673	4,191	3,109
	Value per ha	Shs	3,192	10,698	8,336	9,220	6,840
	Area per Grower	ha	0.84	0.81	0.80	0.76	0.71
	Returns per Grower	Shs	2,688	8,697	6,654	7,029	4,856

a) Source: K.T.D.A.

1) Fairly reliable statistics exist for industrial crops only, for more detailed and up to date information see FMHB Vol. III A.

suitable for coffee arabica, that farmers can choose between a number of enterprises and shift their attention to other crops during years when coffee prices are low. Pyrethrum production stabilized during recent years at between 4,000 and 5,000 t p.a. of dried flowers; the pyrethrin content however declined from 1.2% to 1%. The use of low content plant material and cultivation in relatively warm areas are reasons for this negative development.

KISII DISTRICT

TABLE 7 b: COFFEE
AREA - PRODUCTION - YIELDS^{a)}

Co-operatives

Item	Unit	Year					
		74/75	75/76	76/77	77/78	78/79	79/80
Area	ha	6745	6745	6745	6745	6700	6745
Production	t	4920	2551	3321	2330	3380	2213
Yield	kg/ha	729	378	492	345	504	328

TABLE 7 c: PYRETHRUM
TRENDS IN PRODUCTION AND QUALITY^{b)}

Item	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Production in t dried flowers	8916	6529	4138	3360	5028
Pyrethrin content %	1.22	1.21	1.16	1.14	1.09

a) C.B.K.

b) Pyrethrum Board

SMALL FARM SURVEY¹⁾

The SFS was carried out in order to provide planners and extension officers with a set of key data. It is important to keep in mind the limitations of the survey when making use of the data. More detailed information is included in FMHB Vol. III B and III C.

Table 8 and 9 reflect the high development standard of the farms. Roughly one quarter of the land is used for annual crops and one quarter for perennial crops, while one third is under pasture. The arable land is intensively cropped (LH 1 = 1 crop, UM = 1.5 crops p.a.); roughly 2.5 LU are kept per ha of grazing land. Practically all land is used but considerable output increase is possible through increased use of fertilizer, manure, and improved plant protection.

Table 10 shows the large cropping diversification possible in small farms under ideal natural conditions. Maize and beans, the staple food, occupy roughly half of the annual crop area in both AEZs. The colder climate in AEZ LH 1 limits the number of crops which can be cultivated during one year. Roughly 80 % of grazing LU are cattle and 20 % are goats and/or sheep. The proportion of relatively unproductive male cattle (40 % of total) indicates that there is much scope for improvement of the dairy enterprise (table 11). It is a safe assumption that the crop sold at the local market is consumed within the region; the district depends increasingly on other regions for supplies of basic food (table 13). Although the labour profiles of annual crops show labour peaks during the planting and harvesting period (Graphs in table 14), the labour requirement of the total farms is well distributed over the whole year (FMHB Vol. I). The output and nutrient input figures of table 15 are based on a large number of sources.²⁾ They reflect the considerable, still untapped, production potential under the ideal natural conditions of the district, which can be realised if scientific farming is introduced and the necessary economic preconditions created. Intensive small-scale farming based entirely on manual cultivation will continue to form the basis for a good and reliable income for the farming population of the district.

1) See also FMHB Vol. III B

2) See also notes on farm management information, output/nutrient input page 51

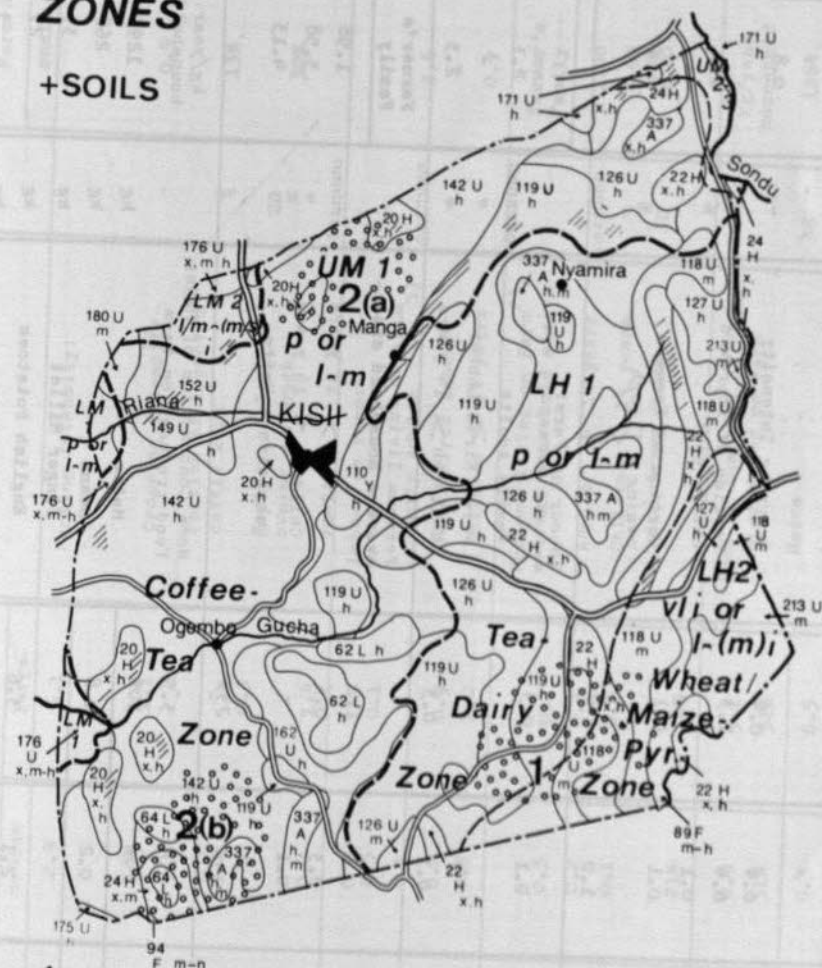
Table 15		Trends in Production and Quality		Trends in Production and Quality	
Product	Unit	1970/71	1971/72	1972/73	1973/74
Maize	kg/ha	1,200	1,200	1,200	1,200
Beans	kg/ha	1,200	1,200	1,200	1,200
Wheat	kg/ha	1,200	1,200	1,200	1,200
Barley	kg/ha	1,200	1,200	1,200	1,200
Oats	kg/ha	1,200	1,200	1,200	1,200
Peas	kg/ha	1,200	1,200	1,200	1,200
Lentils	kg/ha	1,200	1,200	1,200	1,200
Chickpeas	kg/ha	1,200	1,200	1,200	1,200
Groundnuts	kg/ha	1,200	1,200	1,200	1,200
Soybeans	kg/ha	1,200	1,200	1,200	1,200
Other pulses	kg/ha	1,200	1,200	1,200	1,200
Vegetables	kg/ha	1,200	1,200	1,200	1,200
Fruit	kg/ha	1,200	1,200	1,200	1,200
Other crops	kg/ha	1,200	1,200	1,200	1,200
Total	kg/ha	1,200	1,200	1,200	1,200

35°E

KISII

SMALL FARM SURVEY AREAS (1977) and AGRO-ECOLOGICAL ZONES

+SOILS



1 ^{F m-n} **National Number of Survey Area**



Survey Area, sample size 30 per number

 Unsuitable steep slopes

Belt of A. E. Zones ——— Broken zonal boundaries
A. E. Zones ——— are uncertain or
Subzones ——— mean transitional strips

Climatic data for AEZ formulas see table I and II

Min. of Agr., German Agr. Team

KISHI DISTRICT

AEZ: LH 1-2

TABLE 8a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 01

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.1	5.9	10.2	Farming Intensity:				
Land Use: Annual Crops ¹⁾ First Season									
Maize	ha	0.1	0.4	0.4	Cropping Intensity	-	0.8	0.7	0.5
Maize & Beans	ha	0.3	0.4	1.3	Portion of improved cattle kept	%	21%	30%	29%
Beans	ha	-	0.1	-	Portion of Farmers owning a plough	%	40%	50%	90%
Finger Millet	ha	-	0.1	0.1					
Total	ha	0.4	1.0	1.8					
Second Season ¹⁾ Beans	ha	0.1	0.1	0.3	Labour on Farm:	persons	2.1	3.1	2.4
	ha				Family Adults	"	-	0.3	0.4
	ha				Perm. Hired Labour	"	2.3	2.9	6.4
Total	ha	0.1	0.1	0.3	Children > 14 years				
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
Pyrethrum	ha	0.3	0.6	1.2	Adults > 14 years	persons	1.98	0.32	2.30
Tea	ha	0.1	0.3	0.6	Children < 14 years	"	3.58	-	3.58
Coffee	ha	-	0.1	-	Subsistence Units	SU	4.13	0.32	4.45
portion of total	%	39%	33%	23%					
Grazing & Forage	ha	0.1	0.8	3.5	Home Consumption of Major Food produced on Farm	kg/year household	1295	2087	
portion of total	%	9%	29%	10%	Maize	kg	268	426	
Other Land Use	ha	0.2	0.2	0.8	Beans	kg	39	61	
Livestock on Farm:					Finger Millet	kg	27	9	
Cattle: local	LU	2.2	2.1	3.6	English Potatoes	kg	3	2	
improved	LU	6.6	0.9	1.4	Sweet Potatoes	kg	12	1	
Sheep & Goats	LU	1.2	0.3	0.3	Cabbage	kg			
Total	LU	4.0	3.3	4.3					

Other Crops cultivated: English Potatoes, Sweet Potatoes, Cabbage

1) Major crops only considered

TABLE 8 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: UM 1

Survey Area 02

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.4	2.9	6.1	Farming Intensity:				
Land Use:									
Annual Crops ¹⁾									
First Season									
Maize & Beans	ha	0.5	0.7	1.1	Cropping Intensity	-	0.9	0.9	0.6
Maize	ha	-	0.3	-	Portion of improved cattle kept	%	13%	23%	14%
Finger Millet	ha	-	0.1	-	Portion of Farmers owning a Plough	%	30%	50%	100%
Beans	ha	-	-	0.3					
Total	ha	0.5	1.1	1.4					
Second Season¹⁾					Labour on Farm:	persons			
Maize & Beans	ha	0.3	0.5	0.1	Family Adults	"	2.6	1.9	3.3
Maize	ha	0.1	0.1	-	Perm. Hired Labour	"	-	-	-
Beans	ha	-	0.2	0.9	Children > 14 years	"	0.9	2.6	2.1
Total	ha	0.4	0.8	1.0					
Permanent Crops¹⁾					Persons living on Farm²⁾		Farmer's Family	Non-related Persons	Total
Coffee	ha	0.2	0.3	0.2	- average household size -				
Bananas	ha	0.1	0.2	0.3	Adults > 14 years	persons	1.98	0.15	2.13
Sugarcane	ha	-	0.1	0.5	Children < 14 years	"	3.69	-	3.69
Portion of total	ha				Subsistence Units	SU	4.20	0.15	4.35
	%	29%	21%	16%					
Grazing & Forage	ha	0.4	0.9	3.2	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Portion of total	%	29%	31%	52%	Maize	kg	1264	2037	
Other Land Use	ha	0.2	0.3	0.5	Beans	kg	204	324	
					Finger Millet	kg	23	36	
Livestock on Farm:					English Potatoes	kg	96	32	
Cattle: local	LU	1.4	1.7	4.3	Sweet Potatoes	kg	32	18	
improved	LU	0.2	0.5	0.7	Cabbage	kg	13	1	
Sheep & Goats	LU	0.1	0.3	0.3	Cooking Bananas	kg	50	20	
Total	LU	1.7	2.5	5.3					
Other Crops cultivated: Sweet Potatoes, Pyrethrum, Tea, Rice Uplands Cabbage, Tomatoes, Pineapples									

1) Major crops only considered
2) Based on 1979 Census figures

KISH DISTRICT

TABLE 9 a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: LH 1-2

Survey Area 01

Range	Assets			People on Farm			Children > 14 No.
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children	
Avg. 0	3.7	11.7	0.8	2.7	0.2		3.6
Avg. 1	3.7	13.0	1.2	2.7	1.4		3.7
Up. Qu.	3.6	11.0	1.0	3.0	0.0		3.0
Lo. Qu.	1.8	4.0	0.0	2.0	0.0		3.0

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		h	Other Use %
	ha	%	ha	%	ha	%	ha	%	ha	%		
Avg. 0	1.0	28	1.0	28	1.3	35	-	-	0.1	4	0	5
Avg. 1	1.0	25	1.0	24	1.4	35	0.1	3	0.4	9	0	5
Up. Qu.	1.2	37	1.2	38	1.2	33	-	-	0.4	8	0	10
Lo. Qu.	0.6	25	0.5	24	0.2	14	-	-	-	-	0	2
Total	30.5		30.4		37.7		0.1		3.9		5	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.0	1.0	2.9	17.2
Avg. 1			2.6	41.7
Up. Qu.	1.1	1.9	6.0	41.2
Lo. Qu.	0.9	0.6	0.3	-

Inputs Applied

Range	Improved Seed Used % of area	Inputs Applied								Plant Protection			
		Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	46.7	1.2	2.9	8.6	1.1	-	0.4	-	-	-	-	-	-
Avg. 1	48.4	18.3	7.4	14.2	3.8	1.0	2.2	-	-	-	-	-	-
Up. Qu.	100.0	-	4.2	16.4	-	-	-	-	-	0.5	0.1	-	-
Lo. Qu.	33.3	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm,
 50% of all sample cases lie between these points
 AC, PC = AC - annual crops; PC - perennial crops

KISH DISTRICT

TABLE 9 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: UM 1

Survey Area 02

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	3.0	6.5	0.7	2.5	-	1.8
Avg. 1	3.0	6.7	1.4	2.8	-	2.9
Up. Qu.	3.7	9.0	1.0	3.0	-	3.0
Lo. Qu.	1.6	3.0	-	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	0.9	32	0.6	18	1.2	40	-	-	0.2	6	0.1	4
Avg. 1	0.9	28	0.6	16	1.2	35	0.2	5	0.4	12	0.1	4
Up. Qu.	1.4	48	0.7	27	1.4	45	-	-	0.3	11	0.1	7
Lo. Qu.	0.5	23	0.2	8	0.4	20	-	-	-	-	0.1	2
Total	28.5		16.6		36.1		0.2		5.0		3.9	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.5	0.9	2.2	9.7
Avg. 1			2.2	88.4
Up. Qu.	2.0	1.1	5.3	-
Lo. Qu.	1.0	0.5	1.3	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	51.0	1.8	1.5	7.3	0.2	0.3	-	0.1	-	0.2	0.7	-	1.0
Avg. 1	52.5	11.1	9.4	14.9	3.8	2.0	2.5	0.3	0.4	1.8	1.1	-	1.3
Up. Qu.	100.0	-	-	12.8	-	-	-	0.1	-	-	0.3	-	2.0
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	0.3

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

KISII DISTRICT

TABLE 10 a: CROPPING PATTERN

Survey Area 01

AEZ: LH 1-2

First Rains

Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.3	0.7	0.60	0.00	10.2	20.4
Fingermillet	0.0	0.3	0.00	0.00	1.1	2.2
Beans	0.0	0.1	0.04	0.00	1.0	2.1
Beans IPC	0.0	0.2	0.00	0.00	0.2	0.4
Engl. Potatoes	0.0	0.2	0.00	0.00	0.6	1.3
Cabbage	0.0	0.2	0.00	0.00	0.4	0.8
Sweet Potatoes	0.0	0.2	0.00	0.00	0.2	0.4
Sugarcane	0.0	0.1	0.00	0.00	0.1	0.2
Pyrethrum	0.6	0.7	1.20	0.20	19.3	38.7
Maize & FMilt	0.0	0.1	0.00	0.00	0.2	0.5
Maize & Beans	0.5	1.1	1.00	0.00	16.5	33.0
Total					50.0	100.0

Second Rains

Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Beans	0.1	0.4	0.28	0.00	3.6	15.3
Engl. Potatoes	0.0	0.2	0.00	0.00	0.2	0.9
Sugarcane	0.0	0.1	0.00	0.00	0.1	0.5
Pyrethrum	0.6	0.7	1.20	0.20	19.3	82.1
Others	0.0	0.3	0.00	0.00	0.3	1.2
Total					23.5	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Coffee	0.0	0.4	0.00	0.00	0.8	7.5
Tea	0.3	0.6	0.40	0.00	9.8	92.5
Total					10.6	100.0

Avg 0 = average of all sample farms

Avg 1 = average of all farms excluding zero entries

Up. Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points

% columns = % of total farm land

KISHI DISTRICT

TABLE 10 b: CROPPING PATTERN

Survey Area 02

AEZ: UM 1

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.1	0.8	0.00	0.00	3.1	9.0
Fingermillet	0.0	0.1	0.00	0.00	0.6	1.6
Beans	0.1	1.6	0.00	0.00	1.6	4.6
Beans IPC	0.0	0.2	0.00	0.00	0.2	0.6
Cabbage	0.0	0.2	0.00	0.00	0.2	0.6
Tomatoes	0.0	0.2	0.00	0.00	0.2	0.6
Sweet Potatoes	0.0	0.1	0.00	0.00	0.1	0.2
Sugarcane	0.1	0.5	0.08	0.00	3.8	11.0
Pyrethrum	0.1	0.2	0.04	0.00	1.6	4.8
Pineapples	0.0	0.1	0.00	0.00	0.1	0.2
Others	0.0	0.5	0.00	0.00	0.5	1.5
Maize & Beans	0.0	0.5	0.00	0.00	22.5	65.1
Maize & Others	0.7	0.8	1.20	0.40	0.0	0.1
Total	0.0	0.0	0.00	0.00	34.5	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.0	0.3	0.00	0.00	1.0	3.7
Fingermillet	0.0	0.2	0.00	0.00	0.3	1.2
Rice Upland	0.0	0.4	0.00	0.00	0.4	1.5
Beans	0.2	0.9	0.40	0.00	7.4	27.7
Tomatoes	0.0	0.1	0.00	0.00	0.1	0.4
Sugarcane	0.0	0.5	0.08	0.00	3.8	14.2
Pyrethrum	0.1	0.2	0.04	0.00	1.6	6.1
Pineapples	0.1	0.2	0.04	0.00	0.1	0.3
Maize & Beans	0.0	0.1	0.00	0.00	0.1	0.3
Maize & Others	0.4	0.9	0.80	0.00	11.9	44.5
Total	0.0	0.0	0.00	0.00	0.0	0.1

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sweet Bananas	0.0	0.2	0.00	0.00	0.2	1.5
Cookng Bananas	0.1	0.2	0.16	0.00	3.8	36.5
Coffee	0.2	0.2	0.28	0.08	5.8	55.5
Tea	0.0	0.2	0.00	0.00	0.7	6.5
Total					10.5	100.0

- Avg 0 = average of all sample farms
 Avg 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points
 % columns = % of total farm land

KISH DISTRICT

TABLE 11 a: HERD COMPOSITION (GRAZING LIVESTOCK)

Oct. '77, Survey Area 01

- in Head and Livestock Units -

AEZ: LH 1-2

Improved Livestock											
	Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average	0.03	-	-	0.20	-	-	-	0.06	-	-	0.06
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average	0.03	-	-	0.17	-	-	-	0.10	-	-	0.10
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average	-	-	-	-	0.47	-	-	0.47	-	-	0.47
Upper Qu.	-	-	-	-	1	-	-	1.0	-	-	1.0
Subtotal(improved) Total	2	-	-	11	14	-	-	18.8	-	-	18.8
Average	0.07	-	-	0.37	0.47	-	-	0.62	-	-	0.62
Upper Qu.	-	-	-	-	1	-	-	1.0	-	-	-
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 4.0 % of total cattle, # Calves + Heifers = 78.6 % of dairy cows											
Unimproved Livestock:											
Under 1 year, Average	0.17	-	-	0.70	-	0.30	2.07	0.41	0.67	-	0.51
Upper Qu.	-	-	-	1	-	1	-	0.3	-	-	0.3
1 - 2 years, Average	0.30	-	-	0.33	-	-	-	0.28	-	-	0.28
Upper Qu.	1	-	-	-	-	-	-	0.5	-	-	0.5
Over 2 years, Average	0.33	-	0.93	-	1.80	1.90	1.30	2.31	-	12.80	2.31
Upper Qu.	-	-	2	-	2	2	1	0.7	-	7	0.7
Subtotal (unimp.) Total	24	-	28	31	54	66	101	90.3	20	384	93.3
Average	0.80	-	0.93	1.03	1.80	2.20	3.37	3.01	0.67	12.80	3.11
Upper Qu.	1	-	2	1	2	3	2	3.9	-	19	3.9
Lower Qu.	-	-	-	-	1	-	-	0.9	-	7	0.9
LU Male Cattle = 40.4 % of total cattle, # Calves + Heifers = 57.4 % of dairy cows											
LU Goats + Sheep = 18.5 % of total Grazing Livestock											
Improved + Unimproved											
Grazing L/Stock Total	26	-	28	42	68	66	101	109.0	20	384	112.0
Average	0.87	-	0.93	1.40	2.27	2.20	3.37	3.63	0.67	12.80	3.73
Upper Qu.	1	-	2	2	3	3	2	5.3	-	19	5.9
Lower Qu.	-	-	-	-	1	-	-	1.9	-	7	0.9
LU Male Cattle = 33.0 % of total cattle, # Calves + Heifers = 61.8 % of dairy cows											
LU Goats + Sheep = 15.3 % of total Grazing Livestock Units											

KISII DISTRICT

TABLE 11 b: HERD COMPOSITION (GRAZING LIVESTOCK)

Oct. '77, Survey Area 02

- in Head and Livestock Units -

AEZ: UM 1

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		-	-	-	0.03	-	-	-	0.01	-	-	-
Upper Qu.		-	-	-	-	-	-	-	0.03	-	-	0.03
1 - 2 years, Average		0.03	0.03	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	0.21	-	-	0.21
Over 2 years, Average		-	-	0.10	-	0.13	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	7.7	-	-	7.7
Subtotal(improved) Total		1	1	3	1	4	-	-	0.25	-	-	0.25
Average		0.03	0.03	0.10	0.03	0.13	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		44.4 % of total cattle,						Calves + Heifers = 25.0 % of dairy cows				
Unimproved Livestock:												
Under 1 year, Average		0.47	-	0.03	0.33	-	0.20	0.23	0.22	-	-	0.22
Upper Qu.		1	-	-	-	-	-	-	0.2	-	-	0.2
1 - 2 years, Average		0.10	0.03	0.03	0.47	-	-	-	0.23	-	-	0.23
Upper Qu.		-	-	-	1	-	-	-	0.5	-	-	0.5
Over 2 years, Average		0.20	0.10	0.77	-	1.57	1.03	0.50	1.86	-	13.43	1.86
Upper Qu.		-	-	-	-	2	2	1	-	-	5	-
Subtotal (unimp.) Total		23	4	25	24	47	40	22	71.1	-	403	71.1
Average		0.77	0.13	0.83	0.80	1.57	1.53	0.73	2.37	-	13.43	2.37
Upper Qu.		1	-	2	1	2	2	1	3.2	-	13	3.2
Lower Qu.		-	-	-	-	-	-	-	0.9	-	5	0.9
LU Male Cattle =		40.1 % of total cattle,						Calves + Heifers = 51.1 % of dairy cows				
LU Goats + Sheep =		6.7 % of total Grazing Livestock Units										
Improved + Unimproved		24	5	23	25	51	40	22	78.8	-	403	78.8
Grazing L/Stock Total		0.30	0.17	0.93	0.83	1.70	1.23	0.73	2.62	-	13.43	2.62
Average		1	-	2	1	2	2	1	3.4	-	13	3.2
Upper Qu.		-	-	-	-	1	-	-	0.9	-	5	0.9
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		40.6 % of total cattle,						Calves + Heifers = 49.0 % of dairy cows				
LU Goats + Sheep =		7.9 % of total Grazing Livestock Units										

Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

KISHI DISTRICT

TABLE 12 a: INPUTS AND YIELDS OF MAJOR CROPS

Survey Area 01

AEZ: LH 1-2

AEZ: LH 1-2

Crop		Inputs					Chemicals		Yield kg/ha
		Imp- roved Seeds %	Nutrients			Manur t/ha	Insec. g/ha	Fung- icide kg/ha	
			N kg/ha	P2O5 kg/ha	K2O kg/ha				
<u>First Rains</u>									
Maize	Avg.	93	3	37	-	0.01	-	-	2,790
	UpQu	100	-	58	-	-	-	-	3,700
	LoQu	100	-	-	-	-	-	-	1,500
Beans	Avg.	-	6	-	1	-	-	-	1,000
	UpQu	-	-	-	-	-	-	-	1,500
	LoQu	-	-	-	-	-	-	-	300
Engl. Potatoes	Avg.	-	-	2	-	-	-	-	3,571
<u>Maize & Beans</u>									
Maize	Avg.	92	-	26	-	0.01	-	-	2,448
									521
Beans	Avg.	-	-	32	-	0.01	-	-	2,250
									400
Maize	UpQu	100	-	46	-	-	-	-	1,350
									113
Beans	UpQu	-	-	-	-	-	-	-	
	LoQu	100	-	-	-	-	-	-	
Beans	LoQu	-	-	-	-	-	-	-	
<u>Second Rains</u>									
Maize	Avg.	100	-	18	-	-	-	-	2,250
									640
Beans	Avg.	-	3	2	1	-	-	-	700
	UpQu	-	-	-	-	-	-	-	250
	LoQu	-	-	-	-	-	-	-	
<u>Maize & Beans</u>									
Maize	Avg.	100	-	14	-	0.25	-	-	2,250
									300
Beans	Avg.	-	-	-	-	-	-	-	
<u>Perennial Crops</u>									
Sugarcane	Avg.	-	-	-	-	-	-	-	4,000
									1,614
Pyrethrum	Avg.	-	-	-	-	-	-	-	1,500
	UpQu	-	-	-	-	-	-	-	500
	LoQu	-	-	-	-	-	-	-	
Tea	Avg.	-	43	18	6	-	-	-	5,140
	UpQu	-	54	-	6	-	-	-	6,905
	LoQu	-	-	-	-	-	-	-	1,410

KISHI DISTRICT

TABLE 12 b: INPUTS AND YIELDS OF MAJOR CROPS

Survey Area 01

AEZ: UM 1

AEZ: UM 1

Crop		Inputs							Yield kg/ha
		Imp- roved Seeds %	Nutrients				Chemicals		
			N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	80	-	17	-	0.08	-	-	2,603
	UpQu	100	-	-	-	-	-	-	4,163
	LoQu	-	-	-	-	-	-	-	750
Fingermillet	Avg.	-	-	-	-	-	-	-	1,450
Maize & Beans									2,445
Maize	Avg.	92	4	10	-	0.19	-	-	759
Beans	Avg.	4	-	6	-	0.08	-	-	3,150
Maize	UpQu	100	-	29	-	0.25	-	-	1,000
Beans	UpQu	-	-	12	-	-	-	-	1,688
Maize	LoQu	100	-	-	-	-	-	-	400
Beans	LoQu	-	-	-	-	-	-	-	
<u>Second Rains</u>									
Maize	Avg.	75	-	22	-	-	-	-	3,231
	UpQu	100	-	-	-	-	-	-	4,050
	LoQu	-	-	-	-	-	-	-	1,000
Beans	Avg.	-	-	-	-	-	-	-	875
	UpQu	-	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	450
Maize & Beans									2,181
Maize	Avg.	93	5	17	-	0.04	-	-	525
Beans	Avg.	7	-	6	-	-	1	1	3,308
Maize	UpQu	100	-	39	-	-	-	-	800
Beans	UpQu	-	-	-	-	-	-	-	1,125
Maize	LoQu	100	-	-	-	-	-	-	300
Beans	LoQu	-	-	-	-	-	-	-	
<u>Perennial Crops</u>									
Sugarcane	Avg.	-	-	-	-	-	-	-	3,872
	UpQu	-	-	-	-	-	-	-	5,000
	LoQu	-	-	-	-	-	-	-	-
Pyrethrum	Avg.	-	-	3	-	-	-	2	1,482
	UpQu	-	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	150
Cookng Bananas	Avg.	-	-	-	-	0.31	-	-	14,058
	UpQu	-	-	-	-	-	-	-	12,500
	LoQu	-	-	-	-	-	-	-	2,000
Coffee	Avg.	-	8	-	-	0.82	6	14	7,867
	UpQu	-	-	-	-	-	6	21	5,000
	LoQu	-	-	-	-	-	-	4	1,875
Tea	Avg.	-	26	3	5	-	-	-	1,967
	UpQu	-	-	-	-	-	-	-	1,667
	LoQu	-	-	-	-	-	-	-	1,500

KISII DISTRICT

AEZ: LH 1-2

TABLE 13 a: DISPOSAL OF CROPS

Survey Area 01

Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
First Rains							
Maize	19,045	0	0	5,750	30	13,295	70
Maize & Beans	38,305	0	0	11,860	31	26,445	69
Maize & FMilt	370	0	0	0	0	370	100
Beans	620	7	1	140	23	473	76
Fingermillet	1,220	0	0	300	25	920	75
Engl. Potatoes	1,200	0	0	1,080	90	120	10
Sweet Potatoes	300	0	0	200	67	100	33
Cabbage	360	0	0	0	0	360	100
Second Rains							
Maize	900	0	0	0	0	900	100
Maize & Beans	4,080	0	0	80	2	4,000	98
Beans	1,690	0	0	290	17	1,400	83
Beans IPC	320	0	0	240	75	80	25
Fingermillet	180	0	0	0	0	180	100
Engl. Potatoes	1,100	0	0	0	0	700	64
Tea	2,000	2,000	100	0	0	0	0
Permanent Crops							

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TABLE 13 b: DISPOSAL OF CROPS

Survey Area 02

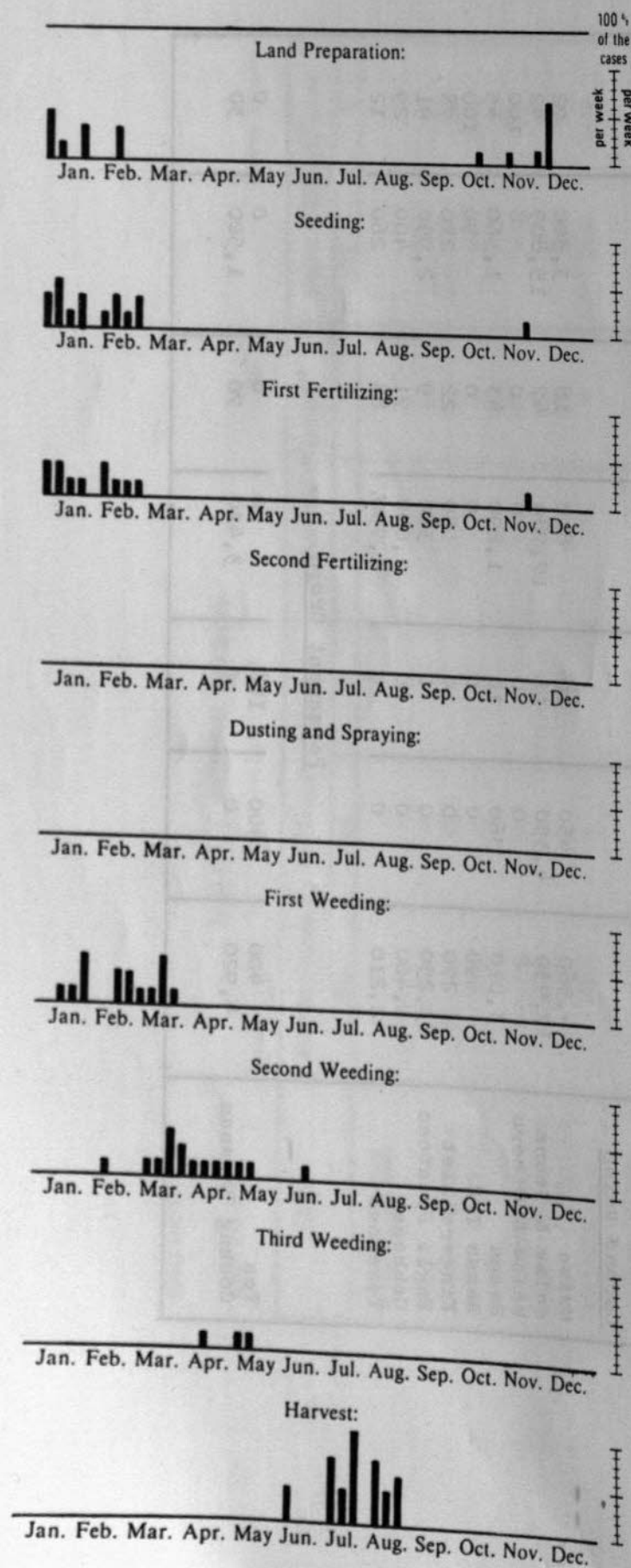
AFZ: UM 1

Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize & Beans	8,730	2,700	31	14,400	165	-8,370	-96
Maize & Others	71,503	9,680	14	24,055	34	37,768	53
Maize	193	0	0	0	0	193	100
Beans	160	0	0	0	0	160	100
Finger millet	630	90	14	75	12	465	74
Sweet Potatoes	1,080	0	0	120	11	960	89
<u>Second Rains</u>							
Maize	4,560	450	10	810	18	3,300	72
Maize & Beans	37,939	4,350	11	17,780	47	15,809	42
Maize & Others	8	0	0	0	0	8	100
Beans	3,010	360	12	1,290	43	1,360	45
Beans IPC	90	0	0	0	0	90	100
Finger millet	270	0	0	60	22	210	78
Engl. Potatoes	3,250	0	0	300	9	2,950	91
Cabbage	1,400	0	0	1,000	71	400	29
Tomatoes	2,210	0	0	1,950	88	260	12
<u>Permanent Crops</u>							
Tea	400	400	100	0	0	0	0
Cooking Bananas	4,920	0	0	3,420	70	1,500	30

KISII DISTRICT

TABLE 14 a: DISTRIBUTION OF FARMING ACTIVITIES

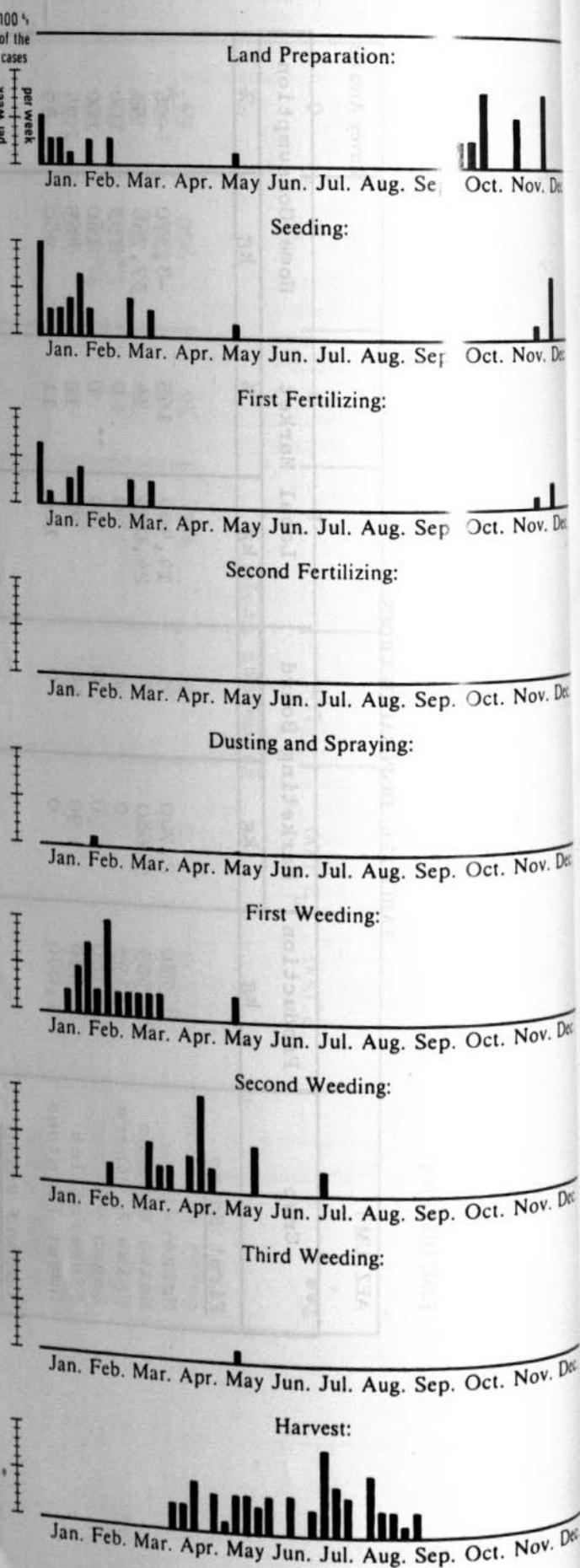
Crop 1 Maize Cases: 15
 AEZ: LH 1-2 Survey Area 01 Sample Size: 30



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TABLE 14 b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 34
 AEZ: LH 1-2 Survey Area 01 Sample Size: 30



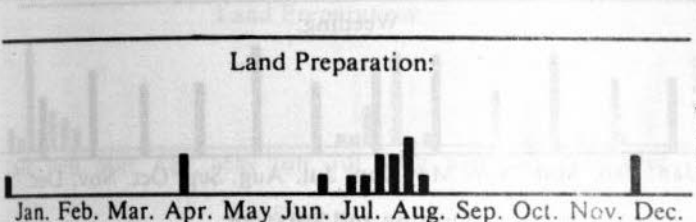
KISH DISTRICT

TABLE 14 c: DISTRIBUTION OF FARMING ACTIVITIES

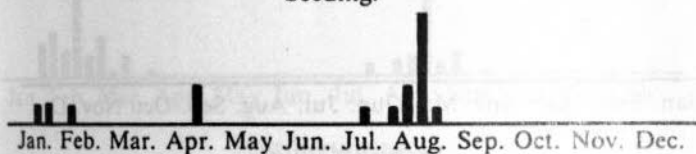
Crop 10 Beans Cases: 16

AEZ: LH 1-2 Survey Area 01 Sample Size: 30

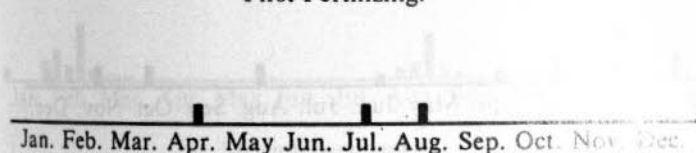
Land Preparation:



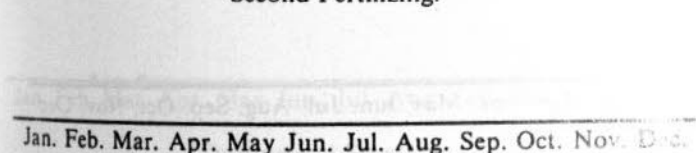
Seeding:



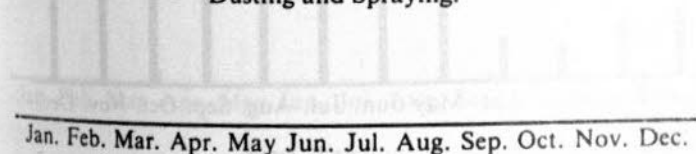
First Fertilizing:



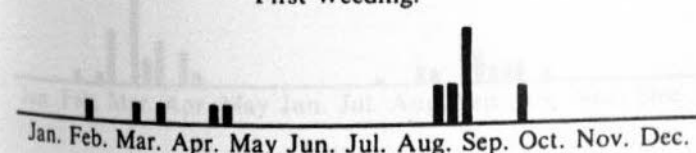
Second Fertilizing:



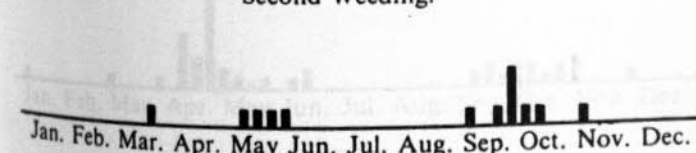
Dusting and Spraying:



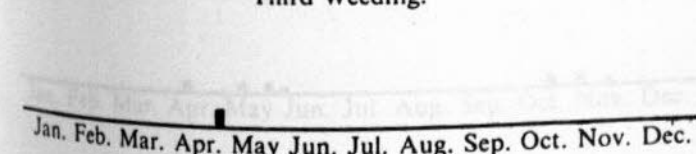
First Weeding:



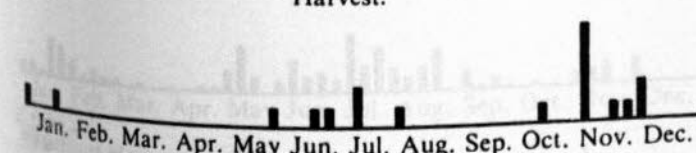
Second Weeding:



Third Weeding:



Harvest:



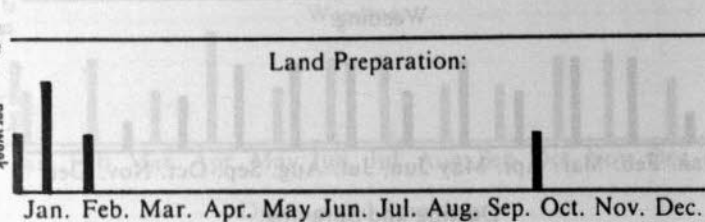
KISH DISTRICT

TABLE 14 d: DISTRIBUTION OF FARMING ACTIVITIES

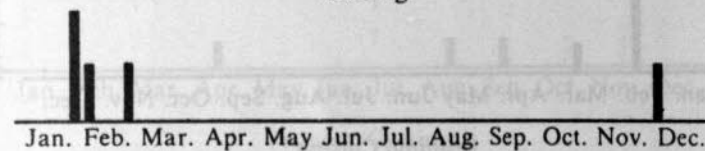
Crop 12 Fingermillet Cases: 5

AEZ: LH 1-2 Survey Area 01 Sample Size: 30

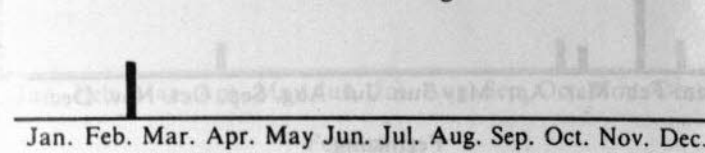
Land Preparation:



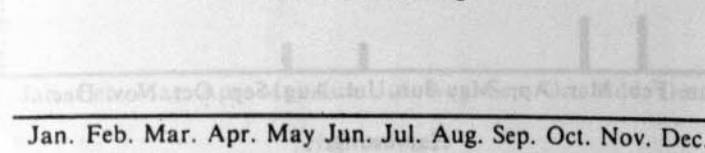
Seeding:



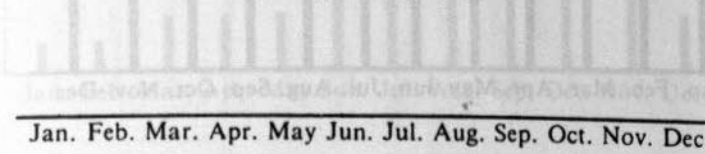
First Fertilizing:



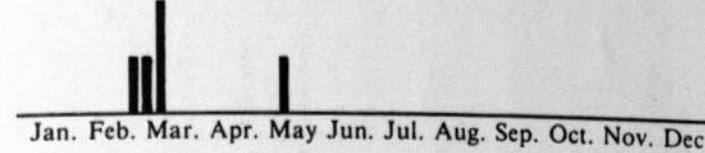
Second Fertilizing:



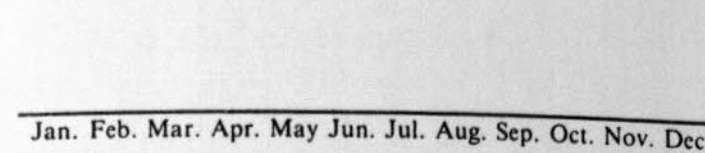
Dusting and Spraying:



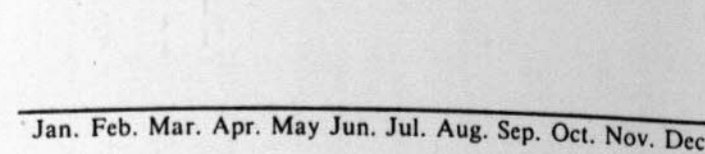
First Weeding:



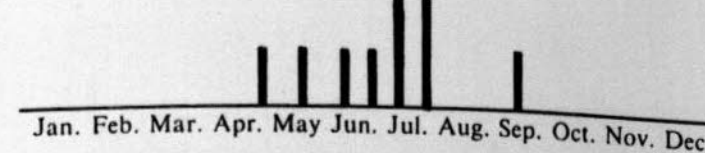
Second Weeding:



Third Weeding:



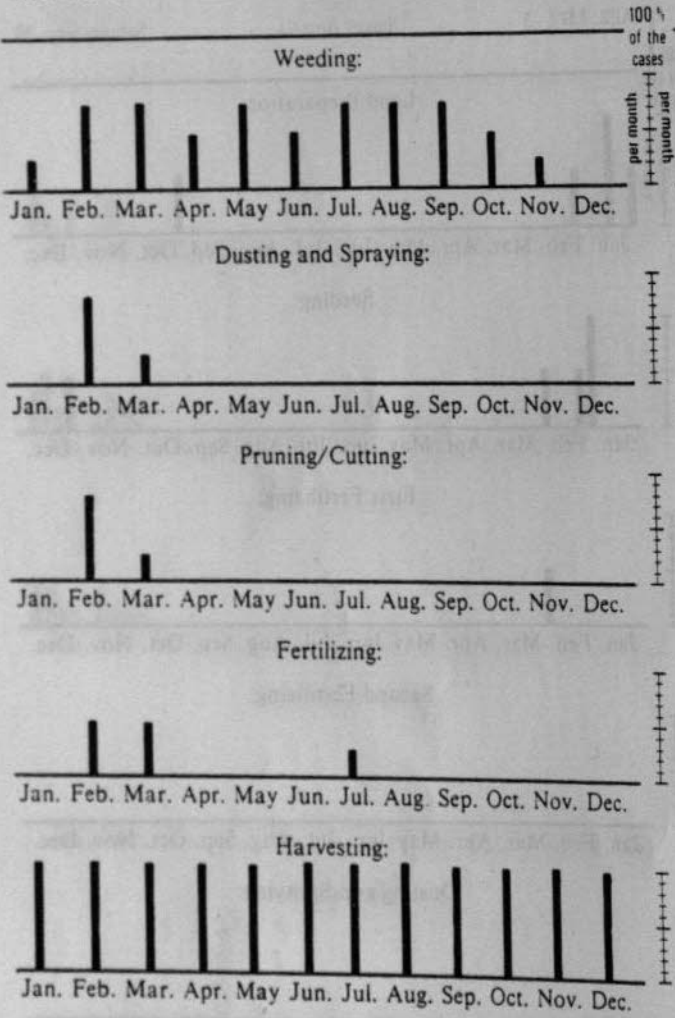
Harvest:



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TABLE 14 e: DISTRIBUTION OF FARMING ACTIVITIES

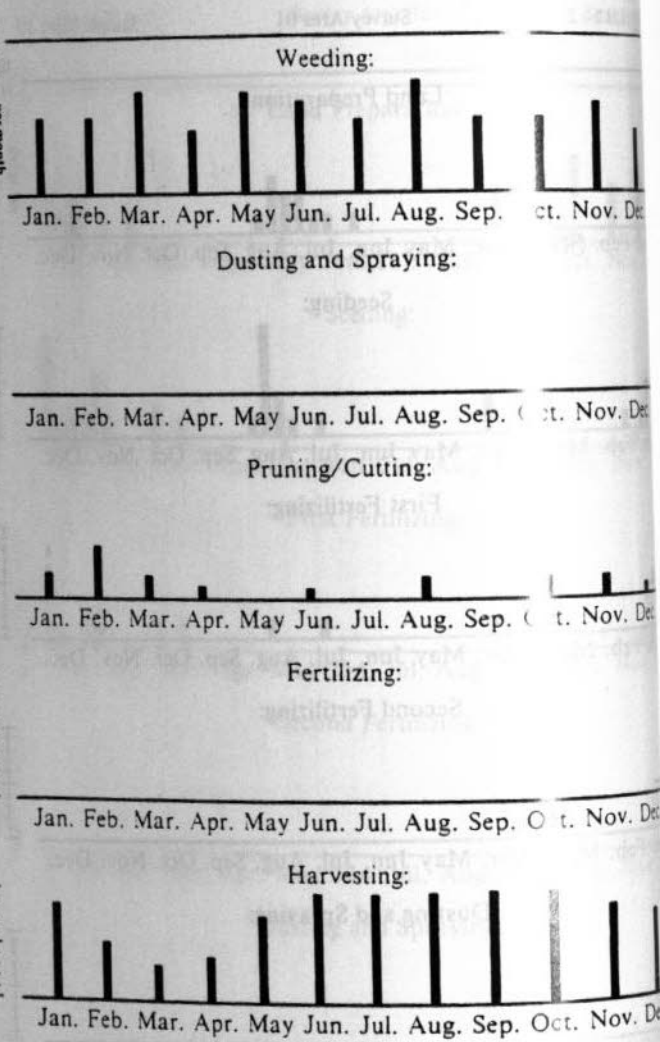
Crop 50 Tea Cases: 4
AEZ: LH 1-2 Survey Area 01 Sample Size: 30



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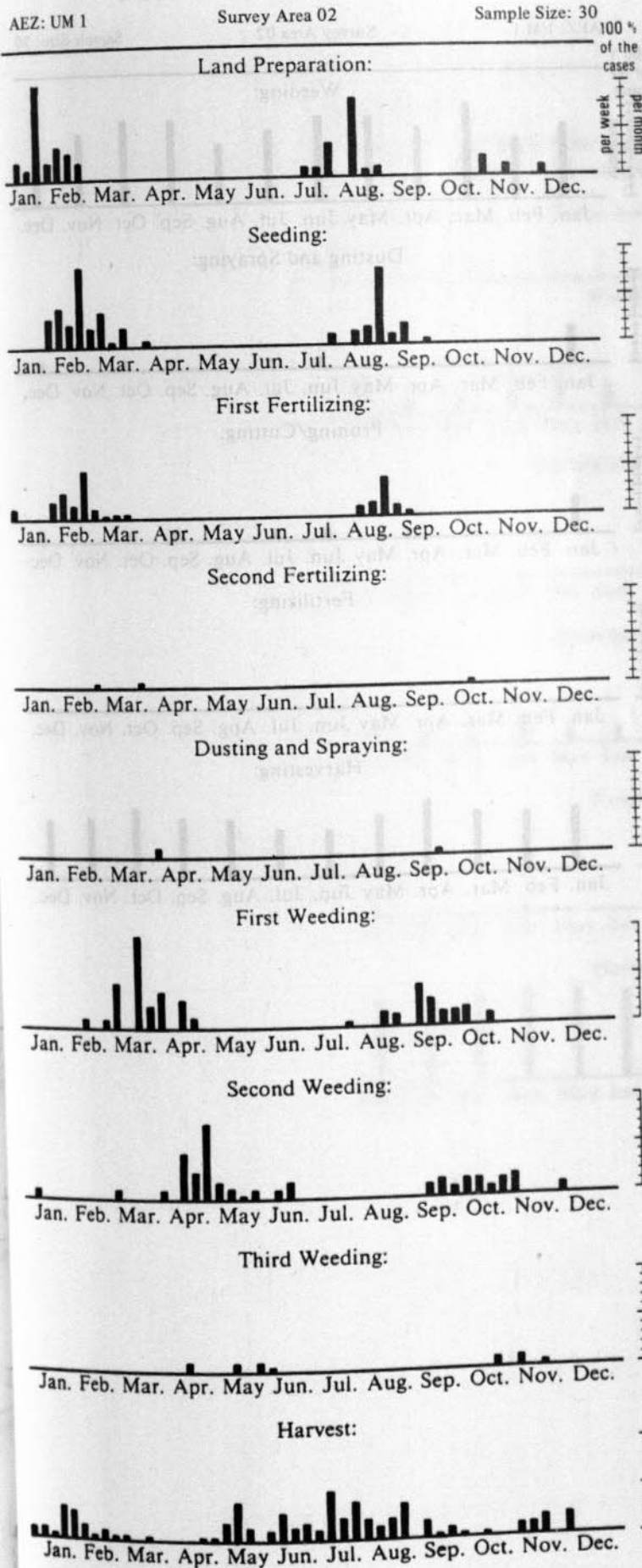
TABLE 14 f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 52 Pyrethrum Cases: 10
AEZ: LH 1-2 Survey Area 01 Sample Size: 30



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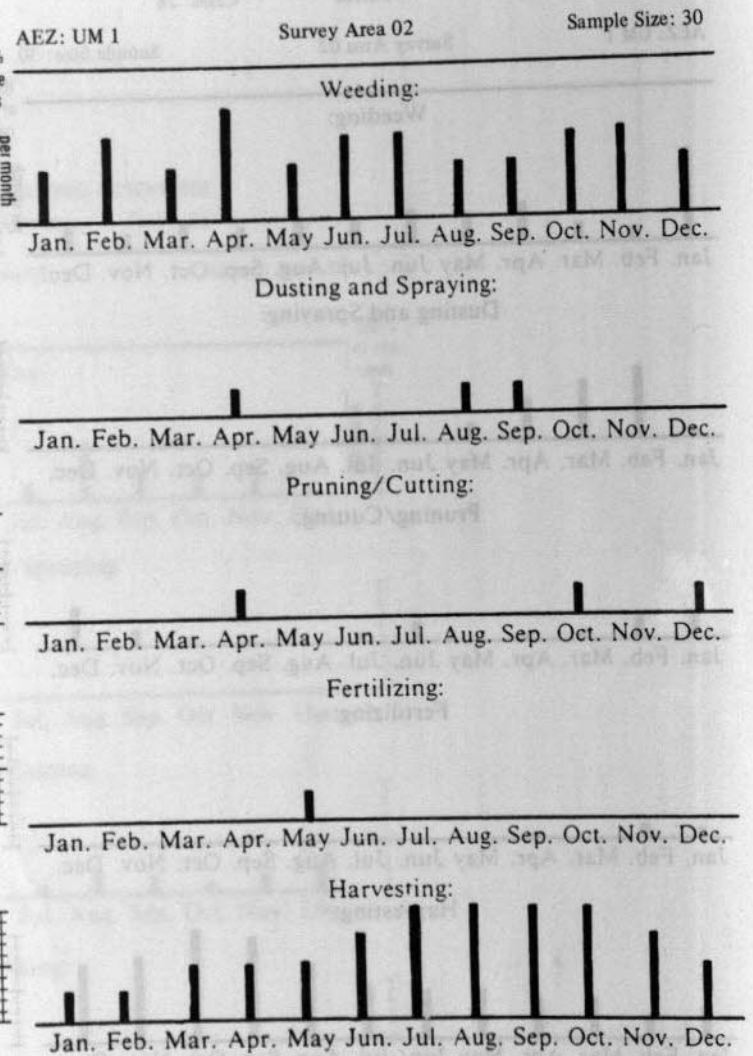
TABLE 14 g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 60¹⁾¹⁾ Maximum 30 per crop and season

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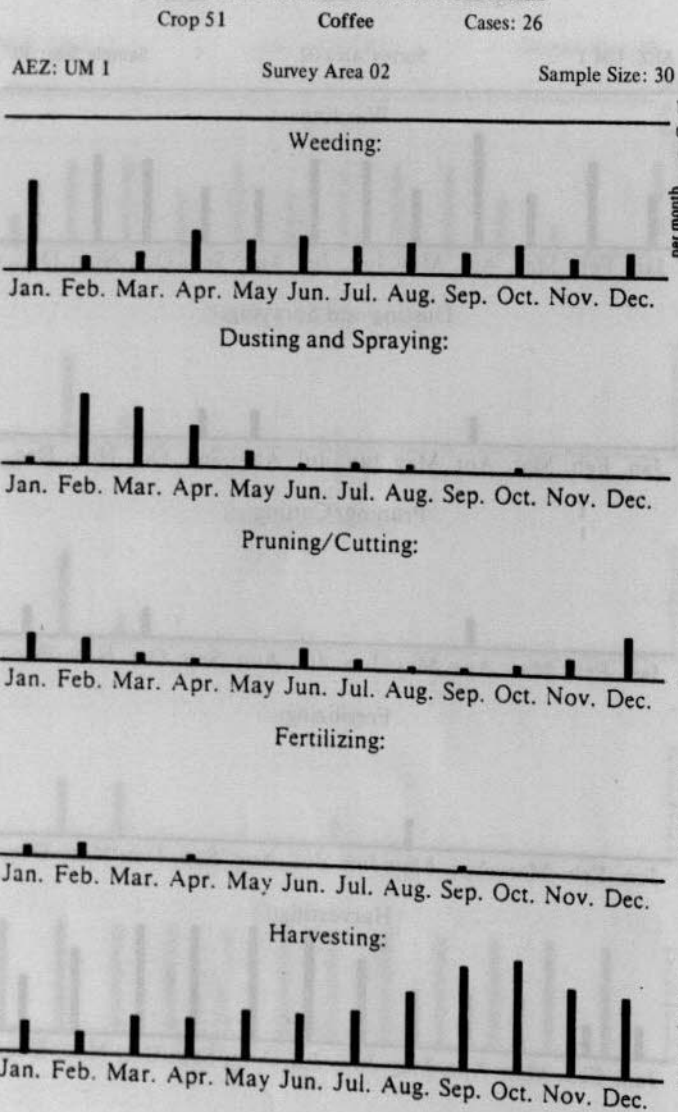
TABLE 14 h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 50 Tea Cases: 4



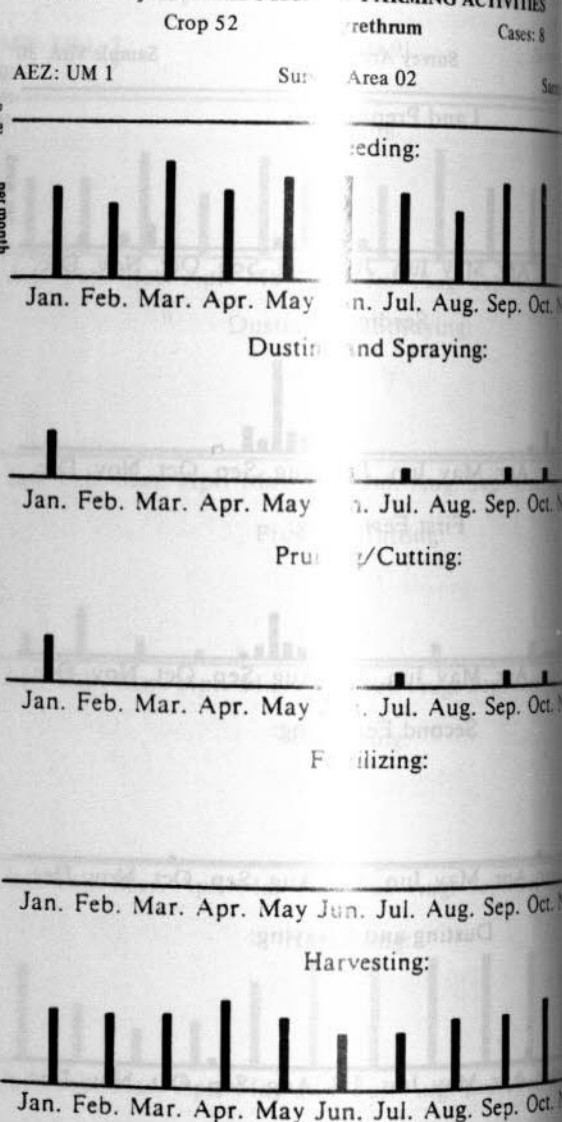
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TABLE 14 i: DISTRIBUTION OF FARMING ACTIVITIES



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TABLE 14 j: DISTRIBUTION OF FARMING ACTIVITIES



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TABLE 14 k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 16

AEZ: UM 1

Survey Area 02

Sample Size: 30

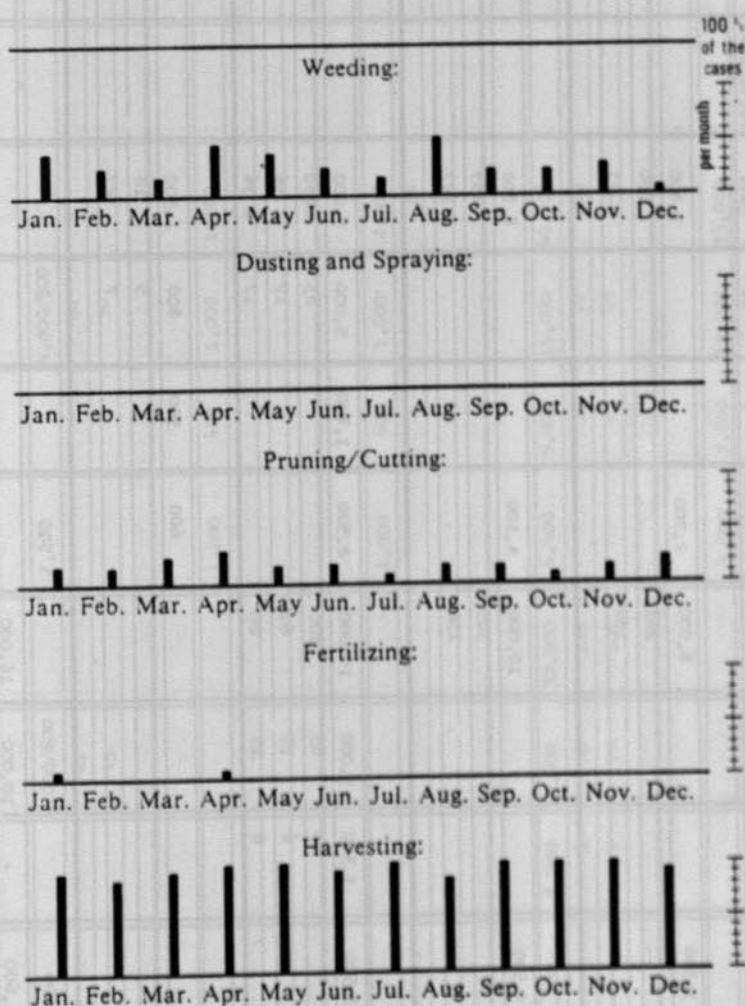


TABLE 15 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

OUTPUT AND NUTRIENT INPUT									
A.E.Z.: LH 1 TEA-DAIRY ZONE				A.E.Z.: LH 2 WHEAT/MAIZE-PYRETHRUM ZONE					
Veg. Period		2nd:		total:		130-140		330-340	
1st + 2nd:		150		(365)		200 or more			
in Days, 1st:		215 or more							
Soil:		NITOSOLS		NITOSOLS		NITOSOLS		NITOSOLS	
CROP: N. PASTURE/LEYS Farmers in Production Level	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III
	Yields	TDN	kg	3,300	8,000	2,700	5,400	150	75
Fertilizer N	kg				261				
P ₂ O ₅	kg				130				
K ₂ O	kg								
CROP: NAPIER/BANA GRASS Farmers in Production Level	Yields	kg	4,500	10,000	305	4,100	8,700	255	127
	Fertilizer N	kg							
	P ₂ O ₅	kg							
	K ₂ O	kg							
CROP: TEA Farmers in Production Level	Yields	kg	2,500	3,500	5,000	10,000	2,500	1,400	5,000
	Fertilizer N	kg		33	83	300		83	180
	P ₂ O ₅	kg		6	17	60		17	36
	K ₂ O	kg		6	17	60		17	36
CROP: PYRETHRUM Farmers in Production Level	Yields	kg							
	Fertilizer N	kg					600	500	800
	P ₂ O ₅	kg						5	18
	K ₂ O	kg						7	27
CROP: PASSION FRUIT Farmers in Production Level	Yields	kg	3,600	-	10,000	16,000			
	Fertilizer N	kg			102	198			
	P ₂ O ₅	kg			134	260			
	K ₂ O	kg							
CROP: MAIZE Farmers in Production Level	Yields	kg	2,500	1,700	4,000	5,500	2,200	2,000	4,000
	Fertilizer N	kg			38	75		45	6,000
	P ₂ O ₅	kg			56	72		45	95
	K ₂ O	kg						45	95

TABLE 15 b: PRODUCTION LEVELS PER FARMER IN 1990-1991

A.E.Z.: LH 1 TEA-DAIRY ZONE																
Veg. Period 1st + 2nd: p or l-m in Days, 1st: 215 or more		2nd: 150		total: (365)		v1 i or l-(m)1 200 or more		130-140		330-340						
Soil:		NITOSOLS				NITOSOLS				NITOSOLS						
	Unit	Production Level			Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer	Production Level		
		I	II	III		I	II	III		I	II	III				
CROP: MAIZE & BEANS																
Farmers in Production Level	%															
Yields	kg	2,500	4,000/600		2,200			4,000/500	-							
Fertilizer N	kg		61					64	-							
P2O5	kg		45					50	-							
K2O	kg															
CROP: BEANS																
Farmers in Production Level	%															
Yields	kg				1,200		400	1,000	1,100							
Fertilizer N	kg								-							
P2O5	kg								-							
K2O	kg								-							
CROP: SUNFLOWER																
Farmers in Production Level	%															
Yields	kg				1,000		400	1,000	2,000							
Fertilizer N	kg								34							
P2O5	kg								28							
K2O	kg															
CROP: POTATOES																
Farmers in Production Level	%															
Yields	kg	7,200	8,000	15,000	30,000	6,400	9,000	16,000	40,000							
Fertilizer N	kg		8	78	228		21	77	269							
P2O5	kg		7	70	208		23	86	302							
K2O	kg															
CROP: SUKUMAWIKI																
Farmers in Production Level	%															
Yields	kg					4,000	5,000	10,000	35,000							
Fertilizer N	kg						7	42	217							
P2O5	kg						6	36	186							
K2O	kg															
CROP: CABBAGE																
Farmers in Production Level	%															
Yields	kg	4,500	6,000	15,000	44,000	4,000	5,000	18,000	40,000							
Fertilizer N	kg		12	84	316		7	98	252							
P2O5	kg		9	63	237		6	84	216							
K2O	kg															

KISHI DISTRICT

TABLE 15 c: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

OUTPUT AND NUTRIENT INPUT									
A.E.Z.: UM 1 COFFEE-TEA ZONE					A.E.Z.: UM 2-3 COFFEE ZONE				
Vegt. Period 1st + 2nd: p or 1-m in Days, 1st: 215 or more					total: (365)				
Soil:					110-130 290-310				
NITOSOLS									
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TABLE 15 d: PRODUCTION LEVELS PER CROP AND AGRICULTURAL ZONES

A.E.2.: UM 1 COFFEE-TEA ZONE											
Vegt. Period 1st + 2nd: p or l-m in Days, 1st: 215 or more		2nd: 150		total: (365)		NITROSOLS					
Soil:		Without Fertilizer		Production Level		Without Fertilizer		Production Level		Without Fertilizer	
Unit		I		II		I		II		I	
		III		III		III		III		III	
CROP: MAIZE											
Farmers in Production Level											
Yields		%									
		kg		2,500		2,000		3,500		6,000	
Fertilizer N		kg						25		88	
P ₂ O ₅		kg						24		84	
K ₂ O		kg									
CROP: FINGER MILLET											
Farmers in Production Level		%									
Yields		kg									
Fertilizer N		kg									
P ₂ O ₅		kg									
K ₂ O		kg									
CROP: MAIZE & BEANS											
Farmers in Production Level		%		2,500		2,500/400		2,800/400		4,000/400	
Yields		kg								94	
Fertilizer N		kg						31		88	
P ₂ O ₅		kg						28		88	
K ₂ O		kg									
CROP: SUNFLOWER											
Farmers in Production Level		%									
Yields		kg		1,100		400		800		1,800	
Fertilizer N		kg								24	
P ₂ O ₅		kg								29	
K ₂ O		kg									
CROP: SOYA BEANS											
Farmers in Production Level		%									
Yields		kg		1,500		875		1,400		2,250	
Fertilizer N		kg								30	
P ₂ O ₅		kg								25	
K ₂ O		kg									
CROP:											
Farmers in Production Level		%									
Yields		kg									
Fertilizer N		kg									
P ₂ O ₅		kg									
K ₂ O		kg									

KISII DISTRICT

TABLE 15 c: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

A.E.2.: UM 1 COFFEE-TEA ZONE									
Vegt. Period		1st + 2nd:		2nd:		total:			
in Days		1st: 215 or more		150		(365)			
Soil:									
NITOSOLS									
	Unit	Without Fertilizer		Production Level		Without Fertilizer		Production Level	
		I	II	I	II	I	II	I	II
CROP: POTATOES									
Farmers in Production Level	%								
Yields	kg	7,200	8,000	12,000	25,000				
Fertilizer N	kg		6	38	143				
P2O5	kg		7	43	160				
K2O	kg								
CROP: SWEET POTATOES									
Farmers in Production Level	%								
Yields	kg	9,000	8,000	16,000	35,000				
Fertilizer N	kg			56	208				
P2O5	kg			42	156				
K2O	kg								
CROP: CABBAGE									
Farmers in Production Level	%								
Yields	kg	4,500	3,000	10,000	35,000				
Fertilizer N	kg			39	214				
P2O5	kg			33	183				
K2O	kg								
CROP: SUKUNAWIKI									
Farmers in Production Level	%								
Yields	kg	4,500	5,000	10,000	30,000				
Fertilizer N	kg		4	39	179				
P2O5	kg		3	33	153				
K2O	kg								
CROP:									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P2O5	kg								
K2O	kg								
CROP:									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P2O5	kg								
K2O	kg								

SOUTH NYANZA DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

Formerly the South Nyanza District was named Homa Bay after the District Capital. Population density is about 150 people per sqkm (1981), population pressure is starting in some locations already. The contrasts of the agro-ecological zones range from dry ones with only one cropping season near the lake Victoria to wet ones with permanent cultivation possibilities in the eastern parts. Thus sugar cane cultivation as one of the main development aims becomes marginal westward, although also in the Marginal Sugar Cane Zone there are areas for fair cultivation chances on very suitable soils with a good water holding capacity and without water logging.

The contrasts in rainfall due to the local circulation (see page 81) are tremendous: Annual averages between 700 and 800 mm, 60 % reliability of first rains 250–1 000 mm, second rains 50–700 mm. First rains start undistinctly in beginning March. Planting may be done earlier although in the northern part the probability of February rains is very low (see Diagram Marinde). The second rains are feeble near the lake. They start in November and are too short for growing crops. Eastward they start earlier (see Diagram Macalder), and „middle rains“ around August–September are finally connecting both rainy periods, making a good cropping season.

The Marginal Sugar Cane Zone (LM 2) has a growing period of 180 or more days followed by a second one of 115–130 days. Rainfall reliability during these periods is high, expecting at least 700–950 mm or more in the first period, and at least 400–650 mm in the following one, in 6 out of 10 years. According to the declining 60 % reliability of seasonal rainfall there are 3 different subzones in the Cotton Zone (see Climate Tables). West of the Cotton Zone there is a Marginal Cotton Zone (LM 4). As in the Cotton Zone, also here rainfall declines further to the West, so that 2 subzones exist there: a 135–145 day growing period followed by a 65–75 day period and further to the West a 115–135 day growing period followed by a 55–65 day period. Rainfall reliability during these periods is much lower than in the East of the district, expecting 350–500 mm in the first period, and 150–250 mm in the following one. Still further to the West the 60 % reliability of rainfall is 250–350 mm during 1st rains and 50–150 mm during 2nd rains.

In the East of the district temperatures are about 1.5° C (near the lake even about 3° C) higher than those normally at this altitude. Therefore the cultivation of Arabica coffee starts above 1 400 m. Only the climate is relatively wet so that a lot of diseases occur. Due to the fact that the soils are also inadequate, the Coffee Zone tends to be marginal (UM 2–3) or even may be classified as a Coffee to Maize-Sunflower Zone (UM 3–4).

Relative humidity is high. Evaporation is about 2 000–2 200 mm per year, which is high too because of local winds.

SOUTH NYANZA DISTRICT

TABLE 1: RAINFALL FIGURES FROM VARIOUS STATIONS
having at least 10 years of records up to 1976

No. and altitude	Name of Station	Years of rec.	Kind of rec.	Ann. rainf. mm	Monthly rainfall in mm											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
9034005 1 523 m	Kamagambo	36	Average	1 600	57	101	148	236	206	123	82	113	128	126	165	115
			60% prob. ¹⁾	1 350	46	64	131	197	124	85	56	75	105	109	135	90
9034006 1 422 m	Asumbi	37	Average	1 629	58	106	161	217	214	96	74	118	147	141	183	114
			60%	1 460	50	55	145	198	186	80	50	100	102	126	138	89
9034041 1 370 m	Marinde	30	Average	1 776	59	56	149	288	266	117	77	124	140	191	172	137
			60%	1 481	24	31	100	235	229	82	52	64	139	130	94	67
9034045 1 370 m	Kosele	29	Average	1 133	43	68	112	192	181	81	58	88	94	71	62	84
			60%	1 020	14	74	99	160	121	42	53	65	62	70	50	39
9034047 1 493 m	Uriri	24	Average	1 367	66	73	192	217	179	90	52	81	97	127	141	111
			60%	1 228	40	62	131	214	111	71	25	56	77	99	120	74
9034049 1 309 m	Mbeta Agr. Holding	23	Average	931	28	57	113	167	123	53	39	43	35	68	112	94
			60%	841	10	50	69	142	102	32	24	42	22	41	56	33
9034059 1 218 m	Macalder-Nyanza Mines	14	Average	1 116	39	92	122	201	142	64	37	42	56	89	148	84
			60%	1 000	21	51	98	165	123	50	31	35	43	63	109	67
9034063 1 218 m	Lambwe Valley	23	Average	1 327	59	65	141	238	185	69	67	61	101	129	143	71
			60%	1 201	34	50	116	179	140	50	51	38	62	108	102	50
9034073 1 309 m	Chief's Camp	17	Average	1 653	37	89	163	277	187	85	43	80	152	197	243	100
			60%	1 223	5	19	79	187	126	54	23	57	76	98	169	61
9134009 1 218 m	Hydromet. Station	22	Average	813	48	59	104	142	121	47	20	28	22	56	92	74
			60%	709	24	33	90	128	92	39	13	17	15	47	61	53
9134010 1 370 m	Migori, Agr. Office	28	Average	1 371	55	87	122	245	195	89	35	59	93	125	148	119
			60%	1 228	40	64	85	169	132	60	17	61	93	91	109	89
9134012 1 523 m	Tarananya School	12	Average	1 414	78	92	188	187	181	88	43	64	97	116	143	138

¹⁾ These figures of rainfall reliability should be exceeded normally in 6 out of 10 years

SOUTH NYANZA DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ ¹⁾	Kind of records	Temperature in °C												Y. of rec.
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year
9034059 1 218 m	Macakler Nyanza Mines	LM 3	Mean max.	30.0	30.3	30.2	29.4	29.1	29.3	29.0	29.1	29.7	30.0	30.0	29.3	29.6
			Mean temp.	23.5	24.0	23.9	23.4	23.2	23.1	22.1	22.7	23.0	23.2	23.2	22.9	23.2
			Mean min.	16.9	17.6	17.6	17.3	17.2	16.8	16.1	16.2	16.3	16.4	16.4	16.5	16.8
			Absol. min.	11.7	12.8	13.9	13.9	12.2	12.8	12.2	11.1	13.3	9.4	12.8	12.8	9.4
9034084 1 218 m	Homa Bay, DC.	LM 3	Mean max.	34.7	34.8	34.6	33.1	33.2	32.8	32.4	33.4	33.7	32.9	(33.2)	(33.9)	33.6
			Mean temp.	26.3	26.4	26.4	25.5	25.2	25.2	25.1	26.0	25.7	26.0	25.4	25.7	25.8
			Mean min.	17.9	18.0	18.2	17.9	17.1	17.5	17.8	18.6	17.6	19.1	17.6	17.5	17.9
			Absol. min.	10.0	13.9	12.2	15.6	11.1	15.6	15.6	13.9	14.4	15.6	11.1	15.6	10.0

¹⁾ AEZ = Agro-ecological zone

SOUTH NYANZA DISTRICT

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

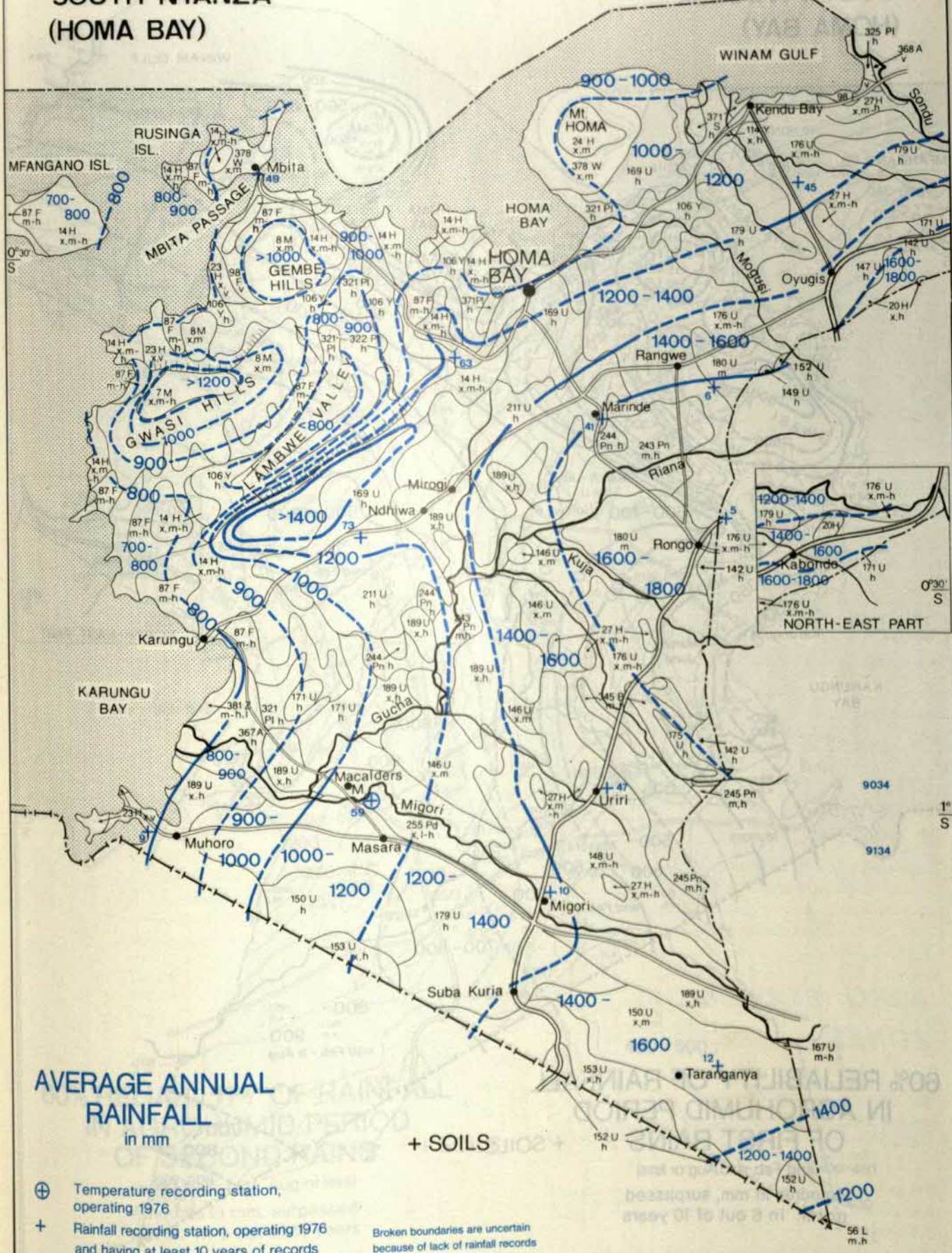
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall ¹⁾		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains ²⁾ in days	2nd rains in days	Total ³⁾ in days
UM 1 Coffee-Tea Zone	p or l-m	1 500-1 600 ⁴⁾	20.5°-19.9°	1 600-1 800	850-1 000	500-700	215 or more	about 10	365
UM 2-3 Coffee Zone	vli or two vli or l/m ~ (m)i	1 450-1 700	21.1°-19.3°	1 400-1 600	800-900	450-500	190 or more	120-1	310-330
							180 or more	115-1	295-310
UM 3 (Marginal Coffee Zone)	Steep slopes,	unsuitable for cultivation							
UM 3-4 Coffee to Sunflower-Maize Z.	vli or two mi(s)	1 450-1 700	20.5°-19.3°	1 200-1 400	800-850	450-500	170 or more	110-1	280-290
				> 1 400	600-700	300-400	135-155	85-10	220-260
UM 4 Sunflower Maize Zone	Very small,	unimportant							
LM 1 L. Midland Sugar Cane Zone	p or l-m/l l-mi	1 300-1 500	21.7°-20.5°	1 600-1 800	900-1 000	500-700	200 or more	about 16	365
							190 or more	140-16	330-355
LM 2 Marginal Sugar Cane Zone	l/m ~ (m/s)i or (m)i	1 300-1 500	21.7°-20.5°	1 300-1 700	700-950	400-650	180 or more	115-140	295-320
LM 3 L. Midland Cotton Zone	l/m ~ (s/m) m/l i (s) mi (s/vs)	1 140-1 450	22.7°-20.8°	1 000-1 500	600-900	350-450	175 or more	105-115	280-290
				1 000-1 400	500-800	230-400	155-175	85-105	240-280
				900-1 200	430-700	200-350	145-155	75-85	220-240
LM 4 Marginal Cotton Zone	(m)i (vs/s) (m/s)i (vs)	1 140-1 350	22.7°-21.4°	900-1 300	400-500	150-250	135-145	65-75	200-220
				800-1 000	350-450	150-200	115-135	45-65	170-200
LM 5 L. Midland Livestock-Millet Zone	(s/m)+i (s)+i	1 135-1 300	22.7°-21.7°	750-900	300-360	80-150	105-115	< 45	
				700-800	250-300	50-100	85-105	< 45	

- 1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants.
 2) More if growing cycle of cultivated plants continues into the period of second rains.
 3) Only added if rainfall continues at least for survival ($> 0.2 E_0$) of most long term crops.
 4) In 1980 the economic altitudinal limit between coffee and tea was about 1 700 m (± 100 m). Therefore the district was out of competitive tea cultivation.

34°E

34°30'E

SOUTH NYANZA (HOMA BAY)



**AVERAGE ANNUAL
RAINFALL**
in mm

+ SOILS

- ⊕ Temperature recording station, operating 1976
- + Rainfall recording station, operating 1976 and having at least 10 years of records
- 12 Station number in grid
- 9034 Grid number

Broken boundaries are uncertain because of lack of rainfall records

0 5 10 15 20 25 km

Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

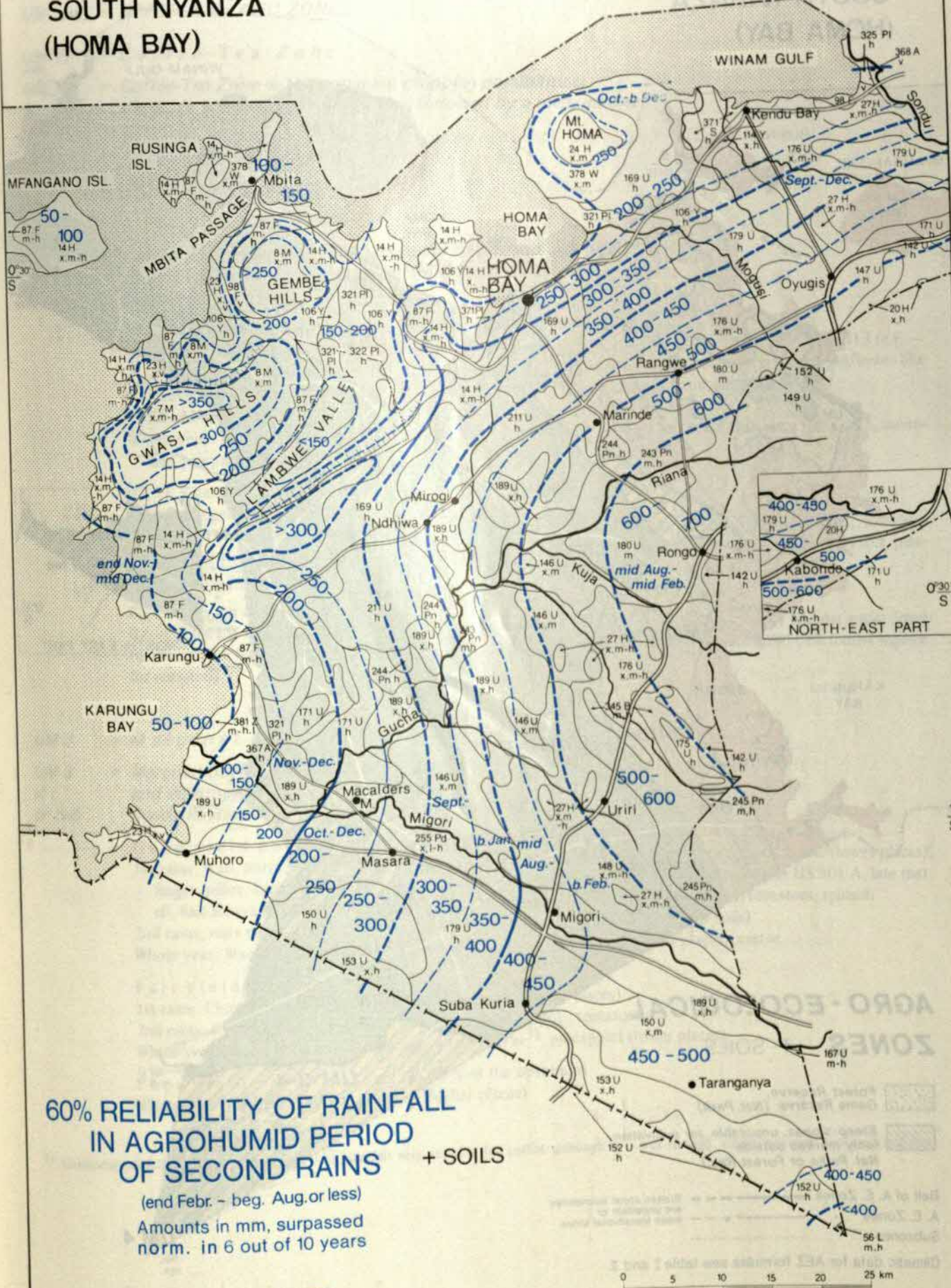
[illegible]

Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

34° E

34° 30' E

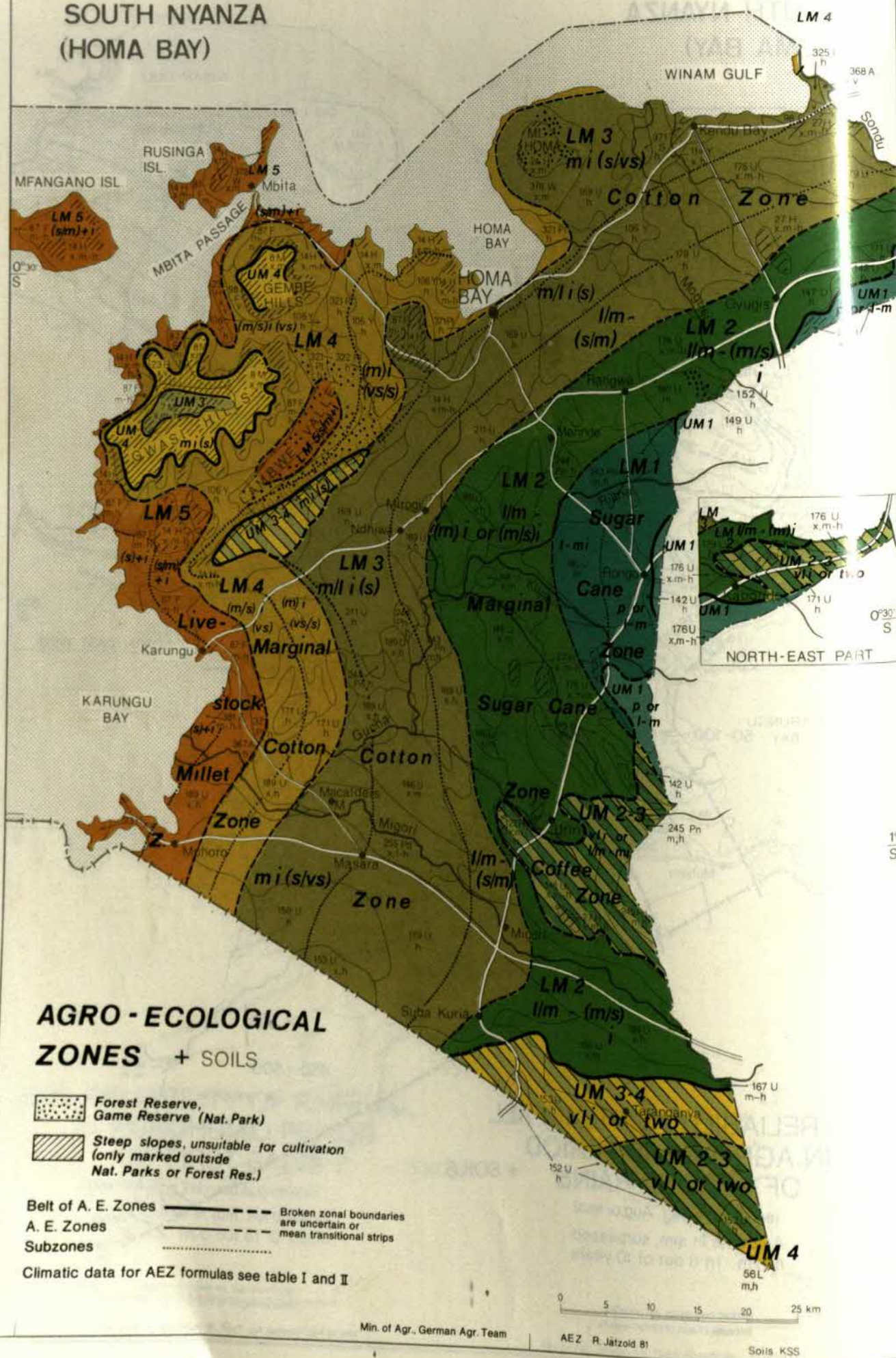
SOUTH NYANZA (HOMA BAY)



34°E

34°30'E

SOUTH NYANZA (HOMA BAY)



AGRO-ECOLOGICAL ZONES

UM = UPPER MIDLAND ZONES

UM 1 = Coffee-Tea Zone

UM 1 = Coffee-Tea Zone with permanent cropping possibilities,
p or dividable in a long cropping season followed by a medium one
l-m

Very small, potential see Kisii District

UM 2 = Coffee Zone¹⁾

UM 2 = Coffee Zone with a very long cropping season and intermediate rains,
v i or dividable in a long to medium cropping season
l/m - m i followed by a medium one and i.r.

Good yield potential (av. 60–80 % of the optimum)

1st rains, start norm. e.F.: Maize H 612–14 (higher places), H 622 & 633 (e.F. – b.S.) or H 511–513 (e.F. – e. Au.), (lower places), finger millet; m. mat. beans (lower places)²⁾; sweet potatoes; late mat. sunflower like Kenya White (Apr. – S.), m. mat. soya beans, onions, spinach, tomatoes, cabbages and kales

2nd rains, start norm. b. Aug.: E. mat. beans (~ 60 %, S. – D.), onions (on light soils)

Whole year: Bananas (in valleys), Macadamia nuts, passion fruit, avocados, perennial castor like C-15, mountain pawpaws, guavas

Fair yield potential (av. 40–60 % of the optimum)

1st rains: Pigeon peas (to 2nd r.)

2nd rains: Maize H 511–513 (50–60 %), 622 & 632 (~ 50 %); sweet potatoes; cabbages, kales, tomatoes

Whole year: Arabica Coffee¹⁾, Bananas (outside valleys), Virginia tobacco, citrus, taro (in valleys), yams, pineapples (on pediments)

Pasture and forage

0.6–1.1 ha/LU on sec. pasture of high grass savanna; around 0.5 ha/LU on art. pasture of Rhodes grass; down to about 0.15 ha/LU feeding Napier or Bana grass and Silver leaf (*Desmodium uncinatum*, best fodder legume for rotation)

UM 3 = Marginal Coffee Zone, here (Coffee-) Maize Zone¹⁾

UM 3 = Marginal Coffee Zone with a very long cropping season
v i and intermediate rains,
or two dividable in two variable cropping seasons and i.r.

Good yield potential

1st rains, start norm. begin of March: Maize H 612–614 (higher places), H 511–513, 622, 632 (lower places), finger millet, high alt. sorghum; m. mat. beans²⁾, sweet potatoes; m. mat. sunflower like HS 301 A, late mat. sfl. like Kenya White (~ 60 %), soya beans; cabbages, kales, onions (on light soils), tomatoes, spinach

2nd rains, start norm. Au./S.: V.e. mat. beans (~ 60 %); onions (~ 60 % on light soils)

Whole year: Macadamia nuts, mountain pawpaws, sisal, black wattle (higher places), castor

Fair yield potential

1st rains: Chick peas (on heavy black soils); potatoes (higher places)

2nd rains: Finger millet; potatoes (higher places), sweet pot.; tomatoes

Whole year: Bananas (on deep soils), avocados, citrus³⁾, pineapples (lower places)

Poor yield potential (av. 20–40 % of the optimum)

Whole year: Arabica coffee, pyrethrum (higher places)

¹⁾ Unimodal rainfall distribution and poor soils are not very suitable for coffee although it is wet enough, sometimes even too wet (leaf rust)

Pasture and forage

1–1.2 ha/LU on sec. pasture, around 0.6 ha/LU on art. pasture of Rhodes grass; down to 0.25 ha/LU feeding Bana and Napier grass and planting Silverleaf (*Desmodium uncinatum*) or Siratro (*Macroptilium atropurpureum*) as fodder legumes

UM 4 = Sunflower-Maize Zone

UM 4 = Sunflower-Maize Zone with a medium cropping season,
mi(s) intermediate rains, and a (weak) short cropping season

Good yield potential

1st rains, start norm. F./Mch.: M. mat. maize like H 512–514, 622, 633 (~ 60 %), m. mat. high alt. sorghum, finger millet (~ 60 %); beans, chick peas (on heavy black soils, ~ 60 %); sweet potatoes; m. mat. sunflower, m. mat. soya beans (~ 60 %); onions (~ 60 %, on light soils)

Whole year: Sisal, castor

Fair yield potential

1st rains: Potatoes (higher places); tomatoes, cabbages, kales, spinach

2nd rains; start norm. Nov.: E. mat. sorghum, finger millet (~ 40 %); v.e. and e. mat. beans, chick peas (on heavy black soils); kales

Whole year: Pineapples, mountain pawpaws (~ 40 %), Macadamia nuts

Pasture and forage

1–1.5 ha/LU on mixed savanna pasture, around 1 ha on vlel soils; down to about 0.3 ha/LU feeding Bana grass and planting horse tamarind (*Leucaena leucocephala*) and saltbush (*Atriplex nummularia*) as best suitable fodder shrubs on free draining soils, Siratro and moth bean vines as fodder legumes

LM = LOWER MIDLAND ZONES

LM 1 = Lower Midland Sugar Cane Zone

LM 1 = Lower Midland Sugar Cane Zone with permanent cropping possibilities,
p or dividable in a long cropping season
l-m/l followed by a medium to long one

Very good yield potential (av. > 80 % of the optimum)

1st rains, start norm. e. of F.: Late mat. sorghum; m. mat. sunflower like Hybrid S 301 A, late mat soya beans

Whole year, best planting b. March: Pawpaws, yam beans, guavas

Good yield potential

1st rains: Maize H 622 and 632 (60–70 %), finger millet; late mat. beans²⁾; yellow yams (end F.–b.N.), sweet potatoes, sweet pepper, kales, Chinese cabbage, spinach, cabbage, chillies, egg plants (to 2nd r.) pumpkins

2nd rains, start undistinctly around Aug.: Maize H 622 and 632 (~ 60 %, Aug.–e. Jan.), H 511 (b.S.–e. Jan.), finger millet, m. mat. sorghum; beans²⁾, sweet potatoes; m. mat. soya beans, m. mat. sunflower like H S 301 A; cabbage, kales, Chinese cabbage, spinach, onions

Whole year: Sugar cane, bananas (nematodes danger), Robusta coffee (~ 60 %), cassava (on sandy soils), pigeon peas, avocados, tea (upper places, nearly 80 % but medium to low quality)

Fair yield potential

2nd rains: Late mat. groundnuts and late mat. bambarra groundnuts (both in light soils), cowpeas

Whole year: Taro, mangoes⁴⁾, citrus⁴⁾

Pasture and forage

Around 0.5 ha/LU on secondary pasture where originally there has been a moist submontane forest; down to 0.13 ha/LU feeding Napier and Bana grass, banana leaves and fodder legumes

2) Sometimes rotting because of too wet conditions

3) With add. irr. (D. – F.) well growing

LM 1 = Lower Midland Sugar Cane Zone with a long cropping season followed by a medium one and intermediate rains

Very good yield potential

1st rains, start norm. mid F.: M. mat. sorghum; sweet potatoes; m. mat. sunflower like H S 301 A, m. mat. soya beans

Whole year, best planting time b. March: Pawpaws, yam beans, guavas

Good yield potential

1st rains: Maize H 622 and 632 (60–70 %); late mat. beans, pigeon peas (March–F.); yellow yams (F.–O./N.); sweet pepper, kales, Chinese cabbage, spinach, cabbage, chillies, egg plants (to 2nd r.), pumpkins

2nd rains, start norm. e. of Aug.: Maize H 511, m. mat. sorghum; beans (~60 %), cowpeas; sweet potatoes; m. mat. soya beans, e. mat. sunflower like 252; kales, Chinese cabbage, spinach, onions

Whole year: Sugar cane, bananas (nematodes danger), cassava, tea in upper places (70–80 %, but medium to low quality), Robusta coffee (~60 %)¹⁾, avocados

Fair yield potential

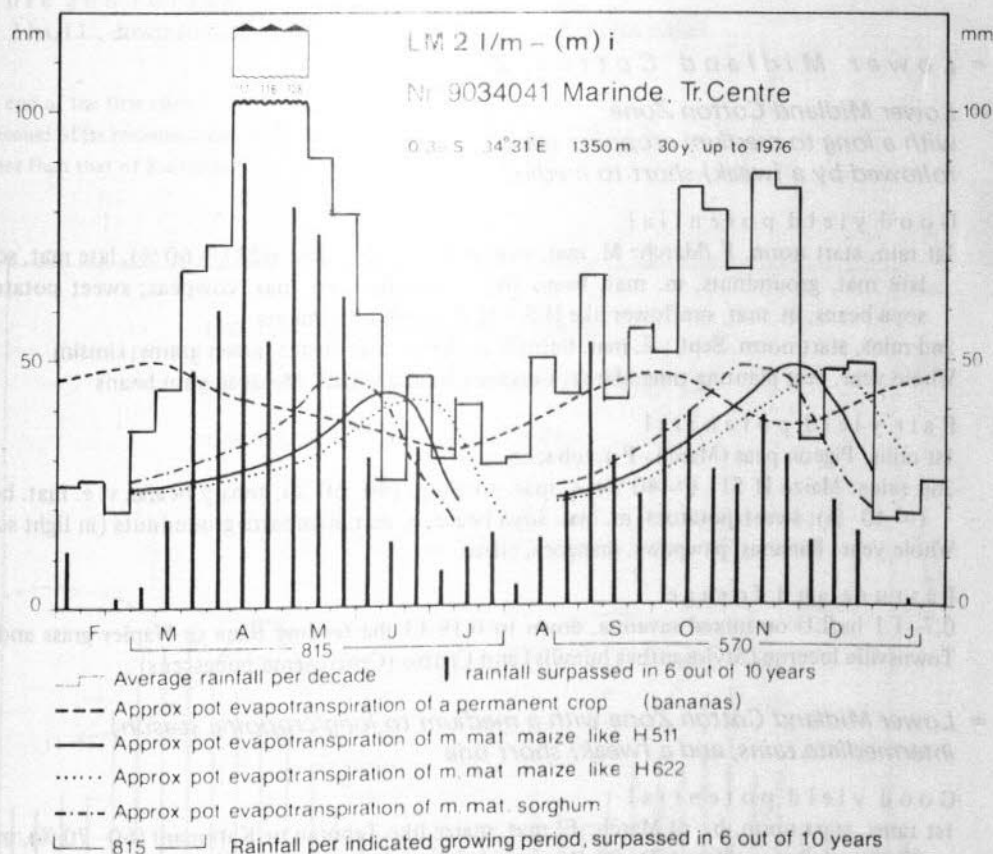
2nd rains: Maize H 622, 632, finger millet; late mat. groundnuts and late mat. bambarra groundnuts (both in light soils); cabbage

Whole year: Mangoes⁴⁾, taro, citrus⁴⁾

Pasture and forage

Around 0.6 ha/LU on sec. pasture (where orig. there has been a moist submontane forest); down to 0.14 ha/LU feeding Napier and Bana grass, banana leaves & stems and fodder legumes

4) Danger of fungus diseases



LM 2 = Marginal Sugar Cane Zone

LM 2 = Marginal Sugar Cane Zone with a long cropping season
l/m $\curvearrowright$ *(m)* *i* followed by a (weak) medium or medium to short one
 or *(m/s)* *i* and intermediate rains
 (see Diagram Marinde)

Very good yield potential

1st rains, start norm. e. of Febr.: M. mat. sorghum, e. mat. bulrush millet (awned ear.); sweet potatoes, soya beans, e. mat. sunflower like 252; sweet pepper, chillies, pumpkins

Good yield potential

1st rains: M. mat. maize like H 511–513 (60–70%) and H 622 (~60%), late mat. sorghum, finger pigeon peas; late mat. groundnuts (rosette resistant); late mat. soya beans, m. mat. sunflower like 252, tomatoes, onions, roselle

2nd rains, start norm. e. of Aug.: Green grams (up to 1 250 m); e. mat. sunflower (~60%)

Whole year, best pl. time e. of F.: Cassava, pawpaws (70–80%), bananas (~60%) on deep soils, sisal, guavas

Fair yield potential (av. 40–60 % of the optimum)

1st rains: Rice in mbugas; cowpeas; tobacco (on sandy soils), cotton (50–60 %, low quality, downy mildew open bolls); cabbages, kales, egg plants (to 2nd r.)

2nd rains: M. mat. sorghum, m. mat. maize (40–50 %), bulrush millet (awned variety), beans (high quality), peas (lower places), bambarra groundnuts (in light soils); sweet potatoes (~60 %); cotton (planted in maize of first rains)

Whole year: Sugar cane, pineapples, sisal, citrus (low quality), mangoes⁴)

Pasture and forage

0.6–1.0 ha/LU on sec. high grass savanna with Zebra grass (*Hyparrhenia rufa*) and Guinea grass (*Panicum maximum*) down to about 0.15 ha/LU feeding Napier and Bana grass, Banana leaves & stems and fodder legumes

LM 3 = Lower Midland Cotton Zone

LM 3 = Lower Midland Cotton Zone
l/m $\curvearrowright$ *(s/m)* with a long to medium cropping season,
 followed by a (weak) short to medium one

Good yield potential

1st rain, start norm. F./March: M. mat. maize H 511–513 and 622 (~60 %), late mat. sorghum, late mat. groundnuts, m. mat. beans like Cuarentino, m. mat. cowpeas; sweet potatoes; c. mat. soya beans, m. mat. sunflower like H S 301 A, tomatoes, onions

2nd rains, start norm. Sept.: E. mat. bulrush millet; e. mat. beans, green grams; simsim

Whole year, best planting time March: Cassava (~60 %), sisal, Mexican yam beans

Fair yield potential

1st rains: Pigeon peas (March–F.); tobacco

2nd rains: Maize H 511 (~40 %), e. mat. sorghum (50–60 %); tepary beans, v. e. mat. beans like 252 (~40 %); sweet potatoes; m. mat. soya beans, e. mat. bambarra groundnuts (in light soils); d. mat. soya beans

Whole year: Bananas, pawpaws, mangoes, citrus

Pasture and forage

0.7–1.1 ha/LU on mixed savanna, down to 0.18 LU/ha feeding Bana or Napier grass and fodder lucerne (*Stylosanthes humilis*) and Centro (*Centrosema pubescens*)

LM 3 = Lower Midland Cotton Zone with a medium to long cropping season,
m/l *i* *(s)* intermediate rains, and a (weak) short one

Good yield potential

1st rains, start norm. b. of March: E. mat. maize like Taboran or Katumani (60–70 %), m. mat. maize (80 %), e. mat. millets (70–80 %); m. mat. beans, green grams⁵), cowpeas; groundnuts and (both in light soils), simsim⁵); sweet pot.; cotton (~60 %), m. mat. soya beans, m. mat. Vympel or H S 301 A; tomatoes, onion; chick peas (on heavy black soils); dwarf castor⁶)

2nd rains, start norm. Sept.: Ratoon of sorghum; simsim, green grams; sweet potatoes in swampy areas

Whole year, best pl. time March: Cassava (~60 %), sisal, Mexican yam beans
 Near swamps with water regulation resp. additional irrigation: Rice, bananas (on dams), Chinese vegetables and other vegetables

Fair yield potential

1st rains: Maize H 511-513 (50-60 %)⁷⁾, H 622, finger millet (50-60 %); pigeon peas (March-F.); tobacco (higher places);

2nd rains: Early mat. proso or foxtail millet (O.-N., 50-60 %), dwarf sorghum (40-50 %), e. mat. bulrush millet (bird rejecting awned var. best); mwezi moja beans, e. mat. bambarra groundnuts (in light soils); dwarf sunflower

Whole year: Pawpaws, mangoes, citrus (~40 %)

Poor yield potential

2nd rains: E. mat. maize

Pasture and forage

0.7-1.1 ha/LU on mixed savanna with star grass (*Cynodon dactylon*); down to about 0.2 ha/LU feeding Bana and Napier grass and planting legumes like *Stylosanthes* or *Centro* for pasture and soil improvement

LM 3

m i

(s/vs)

= Lower Midland Cotton Zone with a medium cropping season, intermediate rains, and a (weak) short to very short one (see Diagram Macalder Ny. M.)

Good yield potential

1st rains like LM 3 m/l ~ (s) less 5-10 % (cotton then fair, sunflower Hybrid S 345 better than H S 301 A)

2nd rains like LM 3 m/l ~ (s) less 10 %

Whole year: Sisal

Fair yield potential

1st rains: Maize H 511-513, finger millet; cotton, pigeon peas (March-F.)

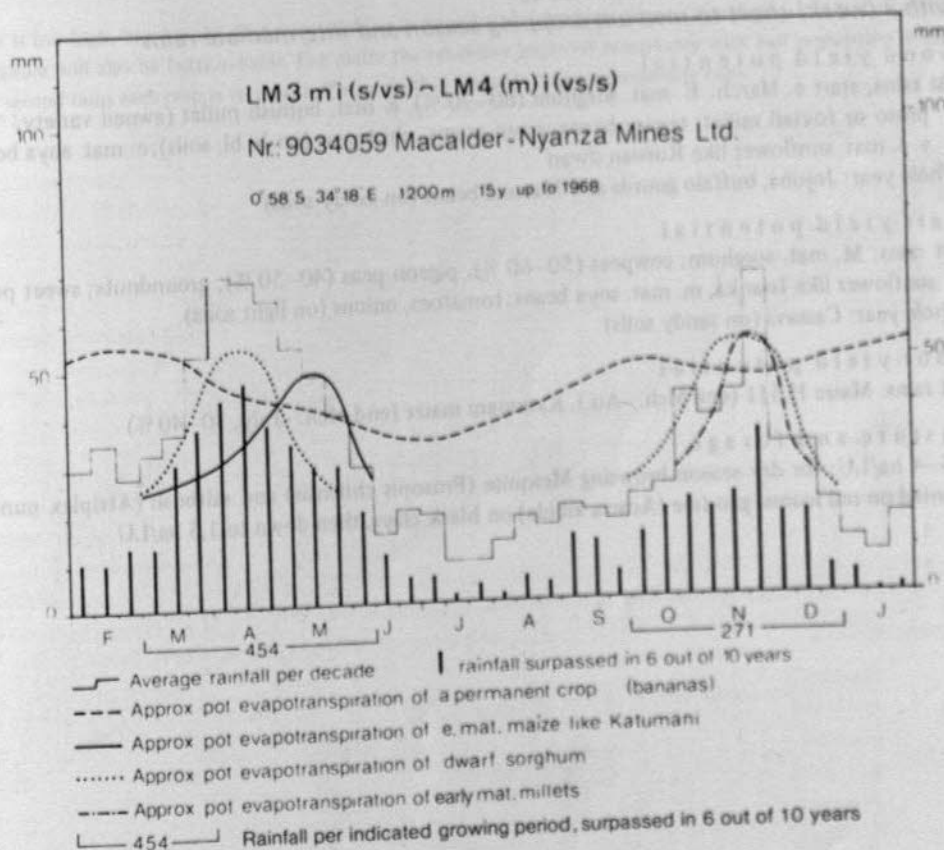
2nd rains, start norm. S./Oct.: E. mat. proso or other minor millet, dwarf sorghum (~40 %); green grams, sim-sim; sweet pot. near water

Whole year: Cassava

Pasture and forage

0.9-1.2 ha/LU, down to 0.25 ha/LU feeding Bana grass and *Stylosanthes*

- 5) Planting towards the end of the first rains
- 6) Good for rotation because of its resistance against *Striga*
- 7) Yield in kg/ha is higher than that of Katumani



LM 4 = *Marginal Cotton Zone*

LM 4 = *Marginal Cotton Zone with a (weak) medium cropping season,
(m) i intermediate rains, and a (weak) very short to short one
(vs/s)*

(see Diagram Macalder Ny. M.)

Good yield potential

1st rains, start norm. March: M. mat. sorghum (60–70 %) and bulrush millet (~ 60 %), e. mat. sorghum (80 %) and millets (~ 70 %); tepary beans, green grams, m. mat. cowpeas (60–70 %), chick peas (on heavy soils), e. mat. sunflower like 252 (60–70 %)

Whole year: Chinese cabbage and other vegetables near swamps; sisal

Fair yield potential

1st rains: M. mat. maize like H 511 (40–50 %); m. mat. beans, pigeon peas (to 2nd r.); sweet pot.; m. mat. groundnuts (50–60 %), simsim (50–60 %); cotton on very suitable heavy soils; rice in seasonal flooded and irrigated areas

2nd rains, start norm. O.: E. mat. proso or foxtail millet; tepary beans; sweet potatoes (near water)

Whole year: Bananas on dams in swampy areas

Poor yield potential

1st rains (to 2nd r.): Cotton on less suitable light soils

2nd rains: E. mat. bulrush millet; green grams, cowpeas for leaves, chick peas

Pasture and forage

1.3–2.0 ha/LU; down to 0.3 ha/LU feeding Bana grass, siratro, moth bean vines, centro, and horse tamar (Leucaena leucocephala)

LM 4 = *Marginal Cotton Zone
(m/s) i with a (weak) medium to short cropping season,
(vs) intermediate rains, and a (weak) very short one*

The same like LM 4 (m) i (vs/s) less about 10 % of yield expectations; stocking rates about 20 % lower

LM 5 = *Lower Midland Livestock-Millet Zone*

LM 5 = *Lower Midland Livestock-Millet Zone
(s/m) + i with a (weak) short to medium cropping season and intermediate rains*

Good yield potential

1st rains, start e. March: E. mat. sorghum (60–70 %), e. mat. bulrush millet (awned variety, ~ 60 %), e. mat. proso or foxtail millet; tepary beans, green grams, chickpeas (on h. bl. soils); e. mat. soya beans (60–70 %); v. e. mat. sunflower like Russian dwarf

Whole year: Jojoba, buffalo gourds and Marama beans (on sandy soils)

Fair yield potential

1st rains: M. mat. sorghum; cowpeas (50–60 %), pigeon peas (40–50 %), groundnuts; sweet potatoes; e. mat. sunflower like Issanka, m. mat. soya beans; tomatoes, onions (on light soils)

Whole year: Cassava (on sandy soils)

Poor yield potential

1st rains: Maize H 511 (end Mch.–Au.), Katumani maize (end Mch.–July, 30–40 %)

Pasture and forage

2.5–4 ha/LU; for dry season browsing Mesquite (*Prosopis chilensis*) and saltbush (*Atriplex nummularia*) to be planted on red loams, gao tree (*Acacia albida*) on black clays, then down to 1.5 ha/LU

LM 5 (s) + i = Lower Midland Livestock-Millet Zone
with a (weak) short cropping season and intermediate rains

Good yield potential

1st rains, start e. March: E. mat. sorghum (~ 60 %), e. mat. proso or foxtail millet; v. e. mat. tepary beans (60–70 %), green grams (~ 60 %), chick peas (on h. bl. soils); v. e. mat. sunflower (60–70 %)

Whole year: Jojoba, buffalo gourds and Marama beans (on sandy soils); vegetables on lakeshore with add. irrigation

Fair yield potential

1st rains: M. mat. sorghum, e. mat. bulrush millet (50–60 %); e. mat. cowpeas like Katuli; sweet pot. (on valley floors); e. mat. soya beans, e. mat. sunflower (40–50 %)

Whole year: Cassava (on sandy soils, 40–50 %)

Poor yield potential

1st rains: Taboran maize (30–40 %)

Pasture and forage

More than 4 ha/LU in uplands, less in floodplains; trees and shrubs for browsing see LM 5(s/m) + i

SOUTH NYANZA DISTRICT

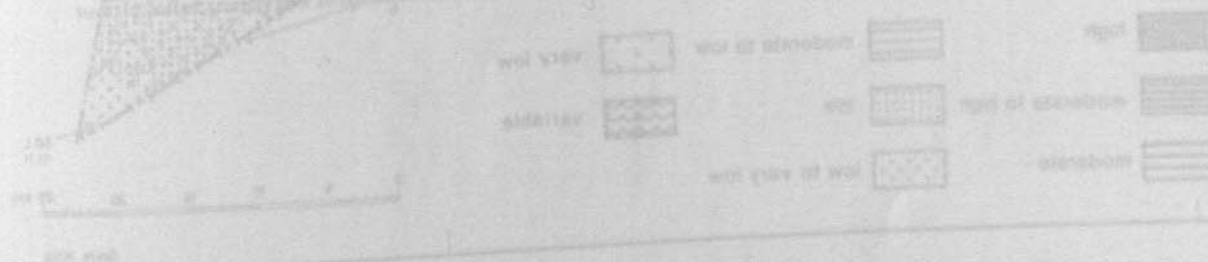
TABLE 4: RISK OF TOTAL CROP FAILURE IN THE LIVESTOCK-MILLET ZONE LM 5 (s)+i

Calculated for No. 91.34.009, Hydromet. Station at Lake Victoria

The figures mean number of seasons with no yield out of 100

Crop variety	First Rains Plant population density						Second Rains Plant population density					
	100%			50%			100%			50%		
	Light soils	Medium soils	Heavy soils	LS	MS	HS	LS	MS	HS	LS	MS	HS
Early maturing maize (100 d.)	33	33	30	30	17	13	47	47	47	43	43	43
Early maturing millet (75 d.)	7	4	4	4	2	2	47	47	47	49	49	44

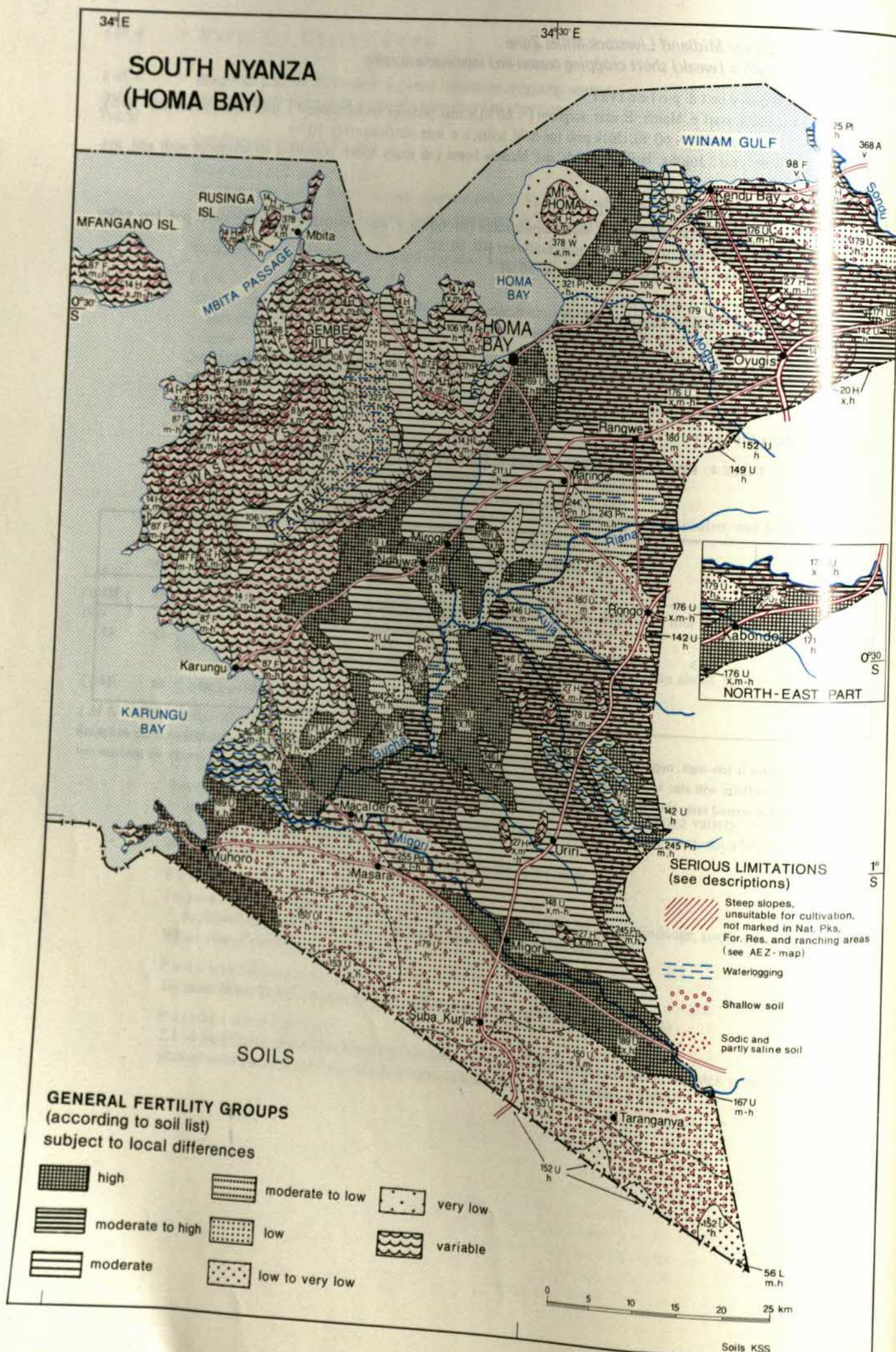
The risk for maize is too high, because the first rains allow only a weak short growing period. Therefore it is a millet zone (bulrush and proso millet). Dwarf sorghum will also be fairly reliable. For maize the reliability improves remarkably with half population density on medium and heavy soils. In the second rains each crop is very risky. Therefore they are only called intermediate rains.



34°E

34°30'E

SOUTH NYANZA (HOMA BAY)



SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

The topography of this district is varied, ranging from uplands of various levels to plains and alluvial valleys in the central and western part. Steep topography is found along the shores of Lake Victoria, as the Gwasi and Gembe Hills and various other mountains (viz Mt. Homa). The majority of the district is underlain by relatively „acid“ parent rock and only small areas with basaltic rock types occur.

Mountain soils (M) have little profile development, and vary greatly in texture. They often occur together with rock outcrops and stones (units 7 M, 8 M).

Hill soils of unit 14 H are similar, but topography is more subdued. On some of the hills soils of varying depth and stoniness (20 H) are found.

On the associated footslopes soils have moderate fertility (87 F). On similar topography soils of sandier texture (98 F) occur. The sloping piedmont plains (106 Y) carry soils similar to those of unit 87 F.

On the uplands, a variety of soils occur. Soils of units 169 U, 171 U, 180 U are found in large areas. They have a deep topsoil rich in organic matter. Some of these soils may be shallow (180 U) or also moderately deep (189 U). They occur additionally with soils of unit 176 U. The latter has moderately high natural fertility.

Less suitable soils of unit 150 U are extensive in the southern part. On the eastern and southern district boundary soils of units 142 U, 152 U occur. Unit 142 U has moderately high natural fertility, 152 a lower one. In the southern and northern part of the district, there are soils of low fertility (179 U). In some cases these soils are moderately deep.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on olivine basalts and ashes of major older volcanoes

- 7 M = well drained, shallow to moderately deep, dark reddish brown to dark brown, rocky and bouldery, clay loam to clay; in places
x, m-h¹⁾ with humic topsoil (nito-chromic CAMBISOLS with haplic PHAEZOZEMS, lithic phase, LITHOSOLS, eutric REGOSOLS and Rock Outcrops)
- 8 M = well drained, shallow, dark brown, firm, rocky and stony, clay loam
x, m (eutric REGOSOLS; with Rock Outcrops)

SOILS ON HILLS AND MINOR SCARPS

Soils developed on undifferentiated Tertiary volcanic rocks (olivine basalts, rhyolites, andesites)

- 14 H = complex of well drained to moderately well drained, shallow to moderately deep, dark brown, firm, stony, clay loam to clay;
x, m-h in places with humic topsoil (eutric REGOSOLS; with verto-luvic PHAEZOZEMS, partly lithic phase)

Soils developed on basic igneous rocks (serpentinites, basalts, nepheline phonolites; older basic tuffs included)

- 20 H = somewhat excessively drained, shallow to moderately deep, dark reddish brown, friable, gravelly clay, with acid humic topsoil
x, h (humic CAMBISOLS, partly paralithic phase)

Soils developed on granites

- 23 H = complex of somewhat excessively drained, shallow, stony and rocky soils of varying colour, consistence and texture (dystric
x, v REGOSOLS; with ferralic CAMBISOLS, lithic phase and Rock Outcrops)

Soils developed on quartzites

- 24 H = somewhat excessively drained, shallow, dark brown, very friable, rocky, sandy loam to clay loam; in many places with acid
x, m humic topsoil (RANKERS; with LITHOSOLS and Rock Outcrops)

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

- 27 H = complex of excessively drained to well drained, shallow, dark red to brown, friable, sandy clay loam to clay; in many places
x, m-h rocky, bouldery and stony and in places with acid humic topsoil (dystric REGOSOLS; with LITHOSOLS, humic CAMBISOLS lithic phase and Rock Outcrops)

SOILS ON FOOTSLOPES

Soils developed on colluvium from various volcanic rocks (mainly basalts)

- 87 F = complex of well drained to moderately well drained, deep, reddish brown to very dark greyish brown, firm, sandy clay loam to
m-h clay; partly with humic topsoil and/or cracking; often moderately calcareous (LUVISOLS, undifferentiated, luvic PHAEZOZEMS and chromic VERTISOLS)

Soils developed on colluvium from undifferentiated Basement System rocks

- 98 F = complex of well drained, deep to very deep, dark reddish brown to dark yellowish brown soils of varying consistence and tex-
v ture, in places gravelly and stratified (ferralic ARENOSOLS; with ferralo-chromic, orthic LUVISOLS)

SOILS ON PIEDMONT PLAINS

- Soils developed on alluvium from Tertiary/Quaternary volcanic rocks (mainly basalts)
- 106 Y = well drained, deep to very deep, dark brown, firm clay; in places cracking and/or calcareous and sodic (vertic LUVISOLS)
h with calcic LUVISOLS, sodic phase and chromic VERTISOLS, sodic phase)
- Soils developed on alluvium from volcanic ashes and other pyroclastic rocks of recent volcanoes
- 114 Y = imperfectly drained, very deep, very dark grey to black, very firm, cracking, gravelly clay to clay, with calcareous deeper subsoil
x, h in places gravelly (verto-eutric PLANOSOLS)
- 116 Y = complex of moderately well drained to poorly drained, very deep, dark brown to dark grey, firm to very firm, sandy clay
h clay, in places stratified, sodic and/or cracking (PLANOSOLS, GLEYSOLS, SOLONCHOKS, VERTISOLS and FLUVISOLS)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

- Soils developed on basic igneous rocks (basalts, etc.)
- 142 U = well drained, deep to extremely deep, dark red, friable clay, with thick humic topsoil (ferralic NITOSOLS; with nitro-humic PHAEZOZEMS)
h
- Soils developed on intermediate igneous rocks (andesites, etc.)
- 146 U = well drained, shallow to moderately deep, reddish brown to yellowish red, friable, gravelly clay loam to clay loam, over soft rock (ferralic CAMBISOLS, paralithic phase)
x, m
- Soils developed on acid igneous rocks (rhyolites, etc.)
- 147 U = well drained, deep to extremely deep, reddish brown, friable clay, with humic topsoil (chromic PHAEZOZEMS; with mollic NITOSOLS)
h
- 148 U = well drained, moderately deep to deep, reddish brown to brown, friable, gravelly clay loam to clay loam; in many places with a humic topsoil (chromo-luvic PHAEZOZEMS and orthic LUVISOLS)
x, m-h
- Soils developed on granites
- 150 U = imperfectly drained, moderately deep, brown to dark yellowish brown, mottled, friable, gravelly sandy clay loam, in places rocky and shallow (gleytic ACRISOLS, partly paralithic and rocky phase)
x, m
- Soils developed on biotite/hornblende granites
- 152 U = well drained, very deep, reddish brown to red, friable clay, with thick acid humic topsoil (nitro-humic FERRALSOLS)
h
- 153 U = well drained, moderately deep to deep, yellowish red to red, friable to firm, clay, partly with acid humic topsoil; in places shallow and rocky (humic to chromic ACRISOLS; with LITHOSOLS and Rock Outcrops)
x, h

SOILS ON LOWER-LEVEL UPLANDS

- Soils developed on basic igneous rocks (basalts, etc.)
- 169 U = moderately well drained, shallow to moderately deep, dark brown, firm clay (verto-luvic PHAEZOZEMS, lithic phase)
h
- 171 U = well drained, moderately deep, red, firm clay, with humic topsoil; with inclusions of imperfectly drained, deep, dark grey mottled, very firm clay (chromo-luvic PHAEZOZEMS; with gleyic LUVISOLS)
h
- Soils developed on acid igneous rocks
- 175 U = well drained to moderately well drained, moderately deep to deep, reddish brown to dark grey, friable clay, with humic topsoil (gleytic and haplic PHAEZOZEMS)
h
- 176 U = complex of predominantly well drained, moderately deep to deep, reddish brown to brown, friable, gravelly clay loam to clay loam; often with a humic topsoil; in many places shallow over petroplinthite (chromo-luvic PHAEZOZEMS and orthic and chromic LUVISOLS; with „murrum cuirass” soils)
x, m-h
- Soils developed on granites
- 179 U = complex of:
h – well drained, moderately deep to very deep, reddish brown to yellowish brown, friable clay, over petroplinthite (orthic FERRALSOLS, partly petroferric phase; with orthic ACRISOLS)
– moderately well drained, shallow, brown to dark brown soils over petroplinthite (about 30 %) („murrum cuirass” soils)
- 180 U = complex of:
m – well drained, deep, reddish brown, friable, sandy clay loam, with acid humic topsoil (humic ACRISOLS)
– moderately well drained, shallow, dark reddish brown soils over petroplinthite (about 20 %) („murrum cuirass” soils)
- Soils developed on various rocks (Kavirondian sediments, often mudstones)
- 189 U = moderately well drained, moderately deep, dark brown to dark greyish brown, friable gravelly clay, over petroplinthite, with humic topsoil; in places shallow over petroplinthite (haplic PHAEZOZEMS, petro-ferric phase; with murrum cuirass soils (10–40 %))
x, h

SOILS ON UPLAND-PLAIN TRANSITIONAL LANDS

is developed on basic igneous rocks (basalts, etc.)

- 211 U = moderately well drained to imperfectly drained, moderately deep to very deep, very dark grey to dark greyish brown, firm clay
h (verto-eutric PLANOSOLS and chromic VERTISOLS)

SOILS ON DISSECTED EROSIONAL PLAINS

is developed on various rocks (Kavirondian sediments, often mudstones)

- 243 Pn = imperfectly drained to poorly drained, deep, dark grey, firm clay, abruptly underlying a topsoil of friable silt loam; in many
m, h places with a sodic deeper subsoil (eutric and solodic PLANOSOLS)
244 Pn = imperfectly drained, very deep, very dark brown to black, firm, moderately sodic clay
h (luvo-orthic SOLONETZ)
245 Pn = complex of: — poorly drained, deep, dark grey, mottled, firm clay, abruptly underlying a topsoil of friable silt loam (eutric
m, h PLANOSOLS)
— moderately well drained to imperfectly drained, shallow soils over petroplinthite („murrum cuirass" soils)

SOILS ON DISSECTED EROSIONAL PLAINS

is developed on undifferentiated Basement System rocks

- 255 Pd = well drained, shallow, dark red to yellowish red, stony loamy sand to clay (chromic CAMBISOLS, paralithic and stony phase;
x, l-h with ferralic ARENOSOLS, lithic phase)

SOILS ON LACUSTRINE PLAINS

is developed on sediments from volcanic ashes and other sources

- 321 Pl = imperfectly drained to poorly drained, very deep, dark grey to dark greyish brown, very firm, slightly calcareous, non to slightly
h saline but moderately sodic, cracking clay (upper level of Lambwe valley) (chromic VERTISOLS, sodic phase)
322 Pl = very poorly drained, very deep, very dark grey, very firm, slightly to moderately calcareous, gypsiferous, slightly saline but
h strongly sodic clay, with humic topsoil (lower level of Lambwe valley) (mollic SOLONETZ)
is developed on sediments from lacustrine mudstones
325 Pl = poorly drained, very deep, very dark grey to black, very firm, slightly sodic, cracking clay, with calcareous deeper subsoil
h (lower level of Kano plains) (pellic VERTISOLS, sodic phase)

SOILS ON BOTTOMLANDS

is developed on infill mainly from undifferentiated Basement System rocks

- 345 B = complex of imperfectly drained to poorly drained, very deep, very dark grey to brown, mottled, friable to firm, sandy clay
m, h to clay, often abruptly underlying a topsoil of friable, sandy clay loam; in places saline and sodic (dystric PLANOSOLS; with
pellic VERTISOLS, vertic and humic GLEYSOLS and plinthic ACRISOLS)

SOILS ON FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

- 367 A = poorly drained, deep, dark greyish brown, mottled, firm clay, with acid humic topsoil
h (humic GLEYSOLS)
368 A = complex of well drained to imperfectly drained, very deep, dark greyish brown to dark reddish brown, stratified soils of vary-
v ing consistence and texture (eutric FLUVISOLS)

SOILS ON SWAMPS

is developed on sediments from various sources (recent floodplains)

- 371 S = very poorly drained, very deep, dark grey to black, firm clay, with acid humic topsoil; in many places peaty (permanent swamps)
h (humic GLEYSOLS and dystric HISTOSOLS)

SOILS ON BADLANDS

Badlands developed on various older lacustrine and volcanic rocks

- 378 W = excessively drained, reddish brown, strongly calcareous, slightly to moderately saline and strongly sodic, silt loam to clay loam
x, m of varying depth; strongly crusting and often with gravel or stone surface (SOLONETZ, undifferentiated; with calcic XERO-
SOLS, LITHOSOLS, acid; stone-mantle phase)

SOILS ON PIEDMONT PLAINS

- Soils developed on alluvium from Tertiary/Quaternary volcanic rocks (mainly basalts)
- 106 Y = well drained, deep to very deep, dark brown, firm clay; in places cracking and/or calcareous and sodic (vertic LUVISOLS; with calcic LUVISOLS, sodic phase and chromic VERTISOLS, sodic phase)
- h
- Soils developed on alluvium from volcanic ashes and other pyroclastic rocks of recent volcanoes
- 114 Y = imperfectly drained, very deep, very dark grey to black, very firm, cracking, gravelly clay to clay, with calcareous deep subsoil; in places gravelly (verto-eutric PLANOSOLS)
- x, h
- 116 Y = complex of moderately well drained to poorly drained, very deep, dark brown to dark grey, firm to very firm, sandy clay to clay, in places stratified, sodic and/or cracking (PLANOSOLS, GLEYSOLS, SOLONETZ, VERTISOLS and FLUVISOLS)
- h

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

- Soils developed on basic igneous rocks (basalts, etc.)
- 142 U = well drained, deep to extremely deep, dark red, friable clay, with thick humic topsoil (mollic NITOSOLS; with nito-luvic PHAEOZEMS)
- h
- Soils developed on intermediate igneous rocks (andesites, etc.)
- 146 U = well drained, shallow to moderately deep, reddish brown to yellowish red, friable, gravelly sandy clay loam to clay, over soft rock (ferralic CAMBISOLS, paralithic phase)
- x, m
- Soils developed on acid igneous rocks (rhyolites, etc.)
- 147 U = well drained, deep to extremely deep, reddish brown, friable clay, with humic topsoil (chromo-luvic PHAEOZEMS; with mollic NITOSOLS)
- h
- 148 U = well drained, moderately deep to deep, reddish brown to brown, friable, gravelly clay loam to clay; in many places with a humic topsoil (chromo-luvic PHAEOZEMS and orthic LUVISOLS)
- x, m-h
- Soils developed on granites
- 150 U = imperfectly drained, moderately deep, brown to dark yellowish brown, mottled, friable, gravelly sandy clay loam, in places rocky and shallow (gleytic ACRISOLS, partly paralithic and rocky phase)
- x, m
- Soils developed on biotite/hornblende granites
- 152 U = well drained, very deep, reddish brown to red, friable clay, with thick acid humic topsoil (nito-humic FERRALSOLS)
- h
- 153 U = well drained, moderately deep to deep, yellowish red to red, friable to firm, clay, partly with acid humic topsoil; in places shallow and rocky (humic to chromic ACRISOLS; with LITHOSOLS and Rock Outcrops)
- x, h

SOILS ON LOWER-LEVEL UPLANDS

- Soils developed on basic igneous rocks (basalts, etc.)
- 169 U = moderately well drained, shallow to moderately deep, dark brown, firm clay (verto-luvic PHAEOZEMS, lithic phase)
- h
- 171 U = well drained, moderately deep, red, firm clay, with humic topsoil; with inclusions of imperfectly drained, deep, dark grey, mottled, very firm clay (chromo-luvic PHAEOZEMS; with gleyic LUVISOLS)
- h
- Soils developed on acid igneous rocks
- 175 U = well drained to moderately well drained, moderately deep to deep, reddish brown to dark grey, friable clay, with humic topsoil (gleytic and haplic PHAEOZEMS)
- h
- 176 U = complex of predominantly well drained, moderately deep to deep, reddish brown to brown, friable, gravelly clay loam to clay, often with a humic topsoil; in many places shallow over petroplinthite (chromo-luvic PHAEOZEMS and orthic and chromic LUVISOLS; with „murram cuirass“ soils)
- x, m-h
- Soils developed on granites
- 179 U = complex of:
- well drained, moderately deep to very deep, reddish brown to yellowish brown, friable clay, over petroplinthite (orthic FERRALSOLS, partly petroferric phase; with orthic ACRISOLS)
 - moderately well drained, shallow, brown to dark brown soils over petroplinthite (about 30 %) („murram cuirass“ soils)
- h
- 180 U = complex of:
- well drained, deep, reddish brown, friable, sandy clay loam, with acid humic topsoil (humic ACRISOLS)
 - moderately well drained, shallow, dark reddish brown soils over petroplinthite (about 20 %) („murram cuirass“ soils)
- m
- Soils developed on various rocks (Kavirondian sediments, often mudstones)
- 189 U = moderately well drained, moderately deep, dark brown to dark greyish brown, friable gravelly clay, over petroplinthite, with humic topsoil; in places shallow over petroplinthite (haplic PHAEOZEMS, petro-ferric phase; with murram cuirass soils (10–40 %)).
- x, h

SOILS ON UPLAND-PLAIN TRANSITIONAL LANDS

Soils developed on basic igneous rocks (basalts, etc.)

- 211 U = moderately well drained to imperfectly drained, moderately deep to very deep, very dark grey to dark greyish brown, firm clay
h (verto-eutric PLANOSOLS and chromic VERTISOLS)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

Soils developed on various rocks (Kavirondian sediments, often mudstones)

- 243 Pn = imperfectly drained to poorly drained, deep, dark grey, firm clay, abruptly underlying a topsoil of friable silt loam; in many
m, h places with a sodic deeper subsoil (eutric and sodic PLANOSOLS)
- 244 Pn = imperfectly drained, very deep, very dark brown to black, firm, moderately sodic clay
h (luvo-orthic SOLONETZ)
- 245 Pn = complex of:
m, h — poorly drained, deep, dark grey, mottled, firm clay, abruptly underlying a topsoil of friable silt loam (eutric PLANOSOLS)
— moderately well drained to imperfectly drained, shallow soils over petroplinthite („murram cuirass” soils)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated Basement System rocks

- 255 Pd = well drained, shallow, dark red to yellowish red, stony loamy sand to clay (chromic CAMBISOLS, paralithic and stony phase;
x, l-h with ferralic ARENOSOLS, lithic phase)

SOILS ON LACUSTRINE PLAINS

Soils developed on sediments from volcanic ashes and other sources

- 321 Pi = imperfectly drained to poorly drained, very deep, dark grey to dark greyish brown, very firm, slightly calcareous, non to slightly
h saline but moderately sodic, cracking clay (upper level of Lambwe valley) (chromic VERTISOLS, sodic phase)
- 322 Pi = very poorly drained, very deep, very dark grey, very firm, slightly to moderately calcareous, gypsiferous, slightly saline but
h strongly sodic clay, with humic topsoil (lower level of Lambwe valley) (mollic SOLONETZ)

Soils developed on sediments from lacustrine mudstones

- 325 Pi = poorly drained, very deep, very dark grey to black, very firm, slightly sodic, cracking clay, with calcareous deeper subsoil
h (lower level of Kano plains) (pellic VERTISOLS, sodic phase)

SOILS ON BOTTOMLANDS

Soils developed on infill mainly from undifferentiated Basement System rocks

- 345 B = complex of imperfectly drained to poorly drained, very deep, very dark grey to brown, mottled, friable to firm, sandy clay
m, h to clay, often abruptly underlying a topsoil of friable, sandy clay loam; in places saline and sodic (dystric PLANOSOLS; with pellic VERTISOLS, vertic and humic GLEYSOLS and plinthic ACRISOLS)

SOILS ON FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

- 367 A = poorly drained, deep, dark greyish brown, mottled, firm clay, with acid humic topsoil
h (humic GLEYSOLS)
- 368 A = complex of well drained to imperfectly drained, very deep, dark greyish brown to dark reddish brown, stratified soils of vary-
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SOILS ON SWAMPS

- 371 S = very poorly drained, very deep, dark grey to black, firm clay, with acid humic topsoil; in many places peaty (permanent swamps)
h (humic GLEYSOLS and dystric HISTOSOLS)

SOILS ON BADLANDS

Badlands developed on various older lacustrine and volcanic rocks

- 378 W = excessively drained, reddish brown, strongly calcareous, slightly to moderately saline and strongly sodic, silt loam to clay loam
x, m of varying depth; strongly crusting and often with gravel or stone surface (SOLONETZ, undifferentiated; with calcic XERO-SOLS, LITHOSOLS, acid; stone-mantle phase)

East Kavirond	10 500	10 500	10 500	10 500	10 500
Central Kavirond	10 500	10 500	10 500	10 500	10 500
West Kavirond	10 500	10 500	10 500	10 500	10 500
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SOILS ON COASTAL OR LAKE-SIDE BEACH RIDGES

Soils developed on beach ridges along Lake Victoria

381 Z = imperfectly drained, very deep, dark brown to greyish brown, friable, sandy loam to sandy clay of varying salinity and sodicity; with inclusions of loose sand to loamy sand soils (SOLONCHAKS, undifferentiated; with ARENOSOLS undifferentiated)

1) Soil texture-classes

- h = heavy
- l = light
- m = medium
- x = stony or bouldery
- v = varying texture
- m-h = medium to heavy
- m, h = medium and heavy (e. g. abruptly underlying a topsoil of different texture)

Soil description from Kenya Soil Survey: Exploratory Soil Map and Agro-climatic Zones Map of Kenya, scale 1:1 000 000. Rep. E1, Nairobi 1982. See this map also for colours; symbols simplified here.

POPULATION AND LAND

According to the results of the Census in September 1979, more than 817 000 people lived in the South Nyanza District. A little over 10 000 people were registered in the three townships of the district. For the rural population of about 807 000, there were altogether only 453 300 ha of agricultural land available (Table 7). That is to say, an average household of 6 people (Table 6) had not more than 3.38 ha of agricultural land and 0.56 ha were available per person (Table 7). This is not much, but still sufficient to do fairly well on a small farm. The figure of the lower quartile of the Small Farm Survey 1977 was here 4.0 per farm (Table 9a) in the Lower Midland Sugar Cane Zone and Marginal Sugar Cane Zone (LM 1-2), but in the Lower Midland Cotton Zone and Marginal Cotton Zone (LM 3-4) an increasing need of pasture to support the small farms is obvious. In this Zone, West Karachuonjo with 1.98 ha per household is the most striking negative example of all the locations.

Regarding the population growth since 1977, it becomes clear that the shortage of agricultural land is becoming worse, and that means, agricultural intensification is now and for the future a matter of growing importance.

SOUTH NYANZA DISTRICT

TABLE 5: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Kanyanda	19 532	20 251	39 783	7 160	182	217
North Nyokal	14 840	15 824	30 664	5 911	142	215
Gem	10 380	11 198	21 878	4 606	125	174
North Sakwa	14 150	14 273	29 475	4 366	158	185
South Sakwa	7 662	8 013	15 675	2 670	100	156
Kamagambo	19 560	20 463	40 963	7 036	211	193
Central Division	86 124	87 874	178 438	31 749	921	193
Kaksingri	5 917	6 274	12 341	1 876	183	67
Rusinga	4 805	5 110	9 905	1 303	43	229
Mgangano	3 246	3 510	6 876	1 350	66	103
Gembe	8 755	9 010	17 705	2 569	158	111
Gwassi	11 008	11 310	23 402	3 225	253	92
Lambwe	7 049	7 410	14 459	2 405	334	43
Mbita Division	40 780	43 901	84 688	12 728	1 039	81
Kabuoch	14 217	13 393	29 610	5 406	225	131
Kanyamwa	12 364	13 511	25 885	4 667	234	110
Karungu	6 927	7 762	14 629	2 315	156	93
West Nyokal	12 299	13 344	25 643	4 680	231	110
Ndhiwa Division	45 807	49 960	95 767	17 068	848	112
Kanyamkago	22 214	23 855	46 069	7 008	373	123
Suna East	19 030	20 255	39 285	6 765	199	197
Migori Division	41 244	44 110	85 354	13 773	572	149
Suna West	12 872	14 507	27 379	4 804	256	106
South Kadem	15 686	17 531	33 217	6 054	360	92
North Kadem	7 041	7 732	14 773	2 723	205	71
Macalder Division	35 599	39 770	75 369	13 581	822	91
Nyabasi	11 656	10 847	22 503	2 499	134	167
Bukira	12 384	12 276	24 660	2 924	201	122
Bwiregi	6 229	6 309	12 538	1 738	53	233
Bugumbe	12 948	12 433	25 381	3 457	185	137
Kihancha Division	43 217	41 865	85 082	10 618	574	148
Kabondo	14 550	16 558	31 108	5 830	140	222
West Kasipul	11 508	12 910	24 418	4 968	123	198
Central Kasipul	12 739	14 059	26 798	4 730	133	200
East Kasipul	11 800	12 871	24 671	3 961	107	228
Oyugis Division	50 597	56 398	106 995	19 489	504	212
Central Karachuonyo	11 136	12 317	23 453	3 870	96	242
Kanyaluo	6 653	7 227	13 880	1 457	60	230
Wang Chieng	9 711	10 242	19 953	3 291	92	216
West Karachuonyo	24 254	24 368	48 622	6 777	180	269
Kendu Division	51 754	54 154	105 908	15 395	429	246
South Nyanza District	395 122	422 479	817 601	134 401	5 714	143

SOUTH NYANZA DISTRICT

TABLE 6: COMPOSITION OF HOUSEHOLDS
PER
LOCATION AND DIVISION^{a)}

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Pers Hous tota	per 1d ^{b)}
		Adults >15 years	Children <15 years	Other Relatives			
Location:							
Kanyanda	7131	3.24	1.16	0.68	0.37	5	5
North Nyokai	5908	3.30	1.34	0.26	0.28	5	9
Gem	4687	2.96	1.06	0.33	0.30	4	5
North Sakwa	4344	3.53	1.35	1.14	0.72	6	4
South Sakwa	2670	3.38	1.30	0.63	0.56	5	7
Kamagambo	7030	3.36	1.43	0.63	0.37	5	7
Division Central	31770	3.29	1.28	0.60	0.41	5	7
Location:							
Kaksingri	1872	3.51	1.54	0.69	0.85	6	7
Rusinga	1296	3.89	1.78	1.01	0.96	5	1
Mjangano	1343	3.17	1.06	0.79	0.40	5	1
Gembe	2564	3.77	1.41	0.64	1.08	6	1
Gwasssi	3210	4.04	1.86	0.76	0.61	7	1
Lambwe	2400	3.46	1.52	0.41	0.59	5	1
Division Mbita	12685	3.65	1.57	0.69	0.75	6	1
Location:							
Kabuoch	5400	3.26	1.19	0.62	0.40	5	1
Kanyamwa	4660	3.33	1.26	0.58	0.38	5	1
Karungu	2314	3.60	1.56	0.58	0.59	6	1
West Nyokai	4681	3.41	1.38	0.37	0.31	5	4
Division Ndhiwa	17055	3.37	1.31	0.53	0.39	5	6
Location:							
Kanyamkago	7016	3.59	1.53	0.78	0.66	6	56
Suna East	6765	3.19	1.33	0.72	0.52	5	77
Division Migori	13781	3.41	1.42	0.75	0.59	1	99
Location:							
Suna West	4798	3.30	1.29	0.52	0.59	5	70
South Kadem	6044	3.31	1.28	0.34	0.55	5	47
North Kadem	2720	3.34	1.25	0.28	0.54	5	41
Division Macalder	13562	3.31	1.28	0.39	0.56	5	54
Location:							
Nyabasi	2483	4.84	3.03	0.60	0.58	9	04
Bukira	2908	4.24	2.41	1.14	0.67	8	46
Bwiregi	1733	3.65	2.04	1.13	0.42	7	23
Bugumbe	3453	3.85	2.02	0.68	0.80	7	35
Division Kihancha	10577	4.15	2.38	0.86	0.65	8	03
Location:							
Kabondo	5815	2.94	1.35	0.56	0.49	5	35
West Kasipul	4961	2.91	1.26	0.47	0.28	4	91
Central Kasipul	4730	3.32	1.50	0.54	0.20	5	66
East Kasipul	3956	3.23	1.51	1.08	0.39	6	21
Division Oyugi's	19462	3.09	1.39	0.66	0.35	5	49

SOUTH NYANZA DISTRICT

TABLE 6: (continued)

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Persons per Households ^{b)} total
		Adults > 15 years	Children < 15 years	Other Relatives		
Location:						
Central Karachuonyo	3863	3.11	1.42	0.98	0.42	6.01
Kanyaluo	1451	4.41	2.15	2.61	0.37	9.54
Wang-Chieng	3283	3.29	1.35	1.03	0.40	6.07
West Karachuonyo	6752	3.80	1.81	0.98	0.59	7.18
Division Kendu	15349	3.60	1.65	1.14	0.49	6.87
DISTRICT: SOUTH NYANZA	134241	3.43	1.46	0.69	0.49	6.07

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, includes one and two person households as well.

SOUTH NYANZA DISTRICT

TABLE 7: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION
AND PER
HOUSEHOLD AND PERSON

Location/Division without townships	in '00 ha = sqkm					in '00 ha = sqkm										in ha	
	Area total	Non-agricultural land			Agri- cultural land	Area in agro-ecological zones										Agricultural land per house- hold	person
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home- steads, rivers...)		AEZ											
						UM 1	UM 2	UM 3	UM 4	LM 1	LM 2	LM 3	LM 4	LM 5			
Kanyanda	170			20	150						51	91	8		2.11	0.38	
North Nyokal	142			24	118						18	97	3		1.99	0.38	
Gem	125			21	104	3				36	65				2.26	0.48	
North Sakwa	158			24	134	3				52	79				3.07	0.45	
South Sakwa	100			15	85	5	36			8	36				3.18	0.54	
Kamagambo	211			32	179	48				124	7				2.54	0.44	
Central Division	907			136	771	59	36			220	256	189	11		2.50	0.45	
Kaksingri	183	20	38	18	107				16				59		5.70	0.87	
Rusinga	43	12		7	24										1.84	0.24	
Mfangano	66	18		10	38										2.81	0.55	
Gembe	158	16	20	19	103								81		4.00	0.58	
Gwassie	253	12	83	30	128								61		3.97	0.55	
Lambwe	334	29	160	15	130							40	90		5.40	0.90	
Mbita Division	1 039	107	301	530					16			40	291	1	4.16	0.63	
Kabuoch	225			30	195					24	171				3.53	0.65	
Kanyamwa	234	4		26	204										4.43	0.80	
Karungu	156	8		16	132			12			59	133			5.70	0.90	
West Nyokal	231			25	206								73		4.34	0.79	
Ndhiwa Division	846	12		97	737			34			12	143	17		4.50	0.79	
Kanyamkago	373			37	336			46		24	242	276	90		4.79	0.73	
Suna East	199			32	167		86				136	114			2.47	0.43	
Migori Division	572			69	503		51				56	60			3.65	0.59	
Suna West	256				230			137			192	174			4.79	0.84	
South Kadem	360			36	324							230			5.35	0.98	
North Kadem	205			21	184							169	69	86	6.76	1.25	
Macalder Division	822			83	738							29	108	47	5.63	1.02	
Nyabassi	134			13	121							428	177	133	4.84	0.54	
Bukira	201			20	181		52	45			24				6.19	0.73	
Bwiregi	53			8	45		11	85			85				2.59	0.36	
Bugumbe	185			19	166		37	1	7						4.80	0.65	
Kihancha Division	573			60	513			29			103	34			4.61	0.57	
Kabondo	140			24	116		100	160			212	34			1.99	0.37	
West Kasipul	123			21	97	1	47				46	22			2.00	0.40	
Central Kasipul	133		5	23	110						71	26			2.33	0.41	
East Kasipul	106			21	85	11						44	55		2.15	0.34	
Oyugis Division	502		5	89	408	35					39	11			2.12	0.38	
Central Karachuonyo	96			16	80	47	47				156	103	55		2.07	0.34	
Kanyaluo	60			8	52							80			3.56	0.37	
Wang-Chieng	92	9		16	67						52				2.04	0.34	
West Karachuonyo	180	3	12	31	134						66	1			2.00	0.40	
Kendu Division	429	12	12	71	333						107	27			2.42	0.36	
Total rural area	5 693	131	318	715	4 533	106	320	206 23	1 058	1 549	652	375			3.38	0.56	

For official land statistics see supplementary publication to FM-Handbook, Vol. III A: Agriculture Land Statistics

For official land statistics see supplementary publication to
FM-Handbook, Vol. III A: Agriculture Land Statistics.

AGRICULTURAL STATISTICS 1)

Approximately 1,500 ha of coffee are cultivated in one region bordering the Kisii district, yielding roughly 220 kg of clean coffee per ha only. The ginneries in Kendu and Homa Bay have an intake of roughly 4,000 t of seed cotton most of which is grown in the district. Although exact figures are not available, it is estimated that roughly 8–10,000 ha of cotton are planted within the district p.a., of which 80–90 % is intersown into maize during August, yielding approximately 200 kg/ha. Commercial sugar cane planting is expanding in AEZ LM 1 and there is much scope for soya bean production, but previous attempts failed because of marketing difficulties.

SOUTH NYANZA DISTRICT

TABLE 8 a: COFFEE
AREA – PRODUCTION – YIELDS^{a)}

Co-operatives

Item	Unit	Year				
		74/75	75/76	76/77	77/78	79/80
Area	ha	747	747	747	747	1473
Production	t	213	114	201	137	176
Yield	kg/ha	285	153	269	183	119

TABLE 8 b: COTTON PRODUCTION^{b)}

Ginnery Zone	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Kendu					
Seed Cotton in t	2476	878	2204	2563	1961
Bales	4344	1542	3868	4498	3441
Homa Bay					
Seed Cotton in t	598	incl- uded above	1415	2095	1976
Bales	1050		2484	3676	3468

a) Source: C.B.K.

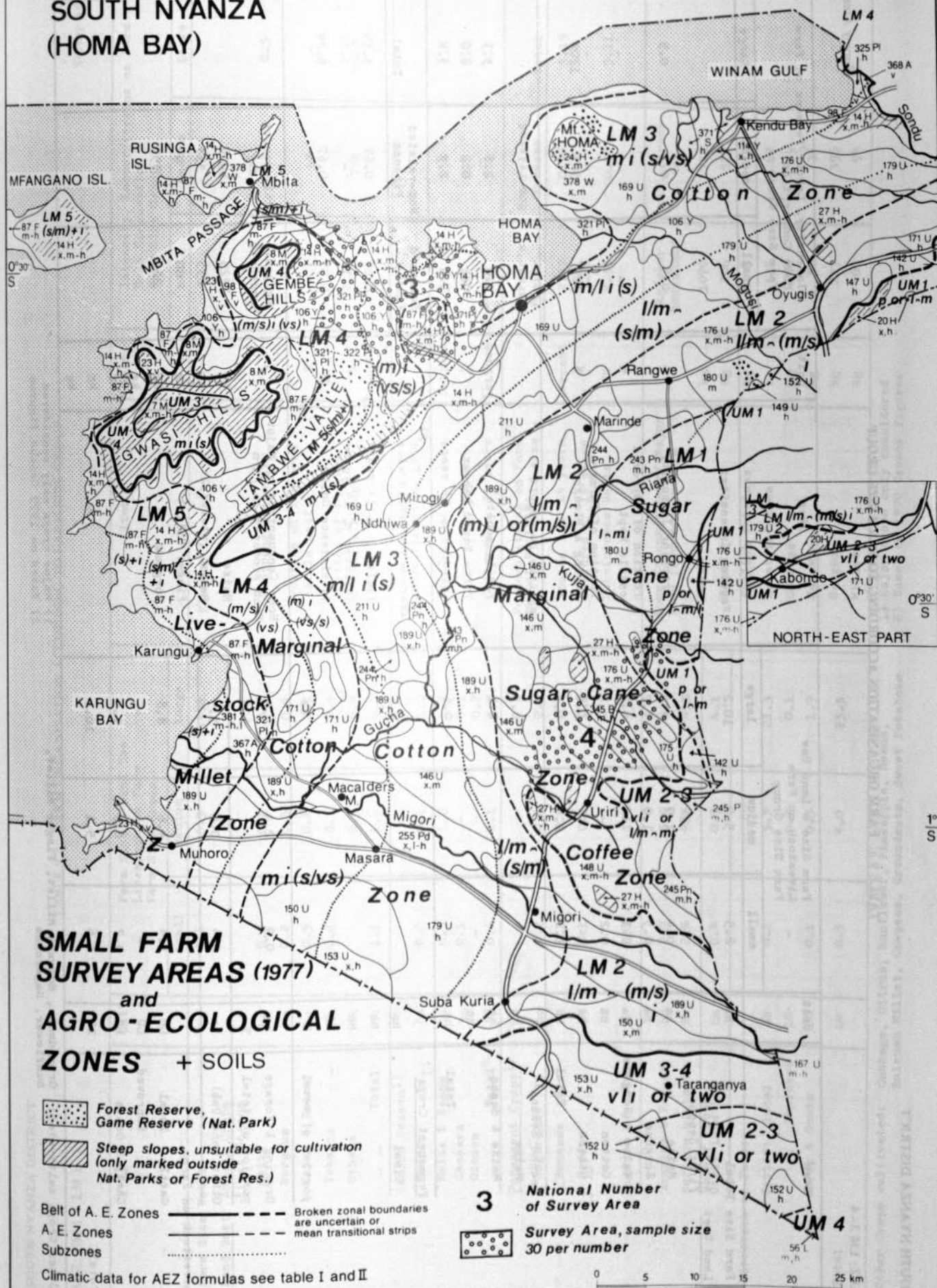
b) Source: C.L. & S.M.B., does not refer to district area only

1) Fairly reliable statistics exist for the so-called industrial crops only; for more detailed information see FMHB Vol. III A

34°E

34°30'E

SOUTH NYANZA (HOMA BAY)



SOUTH NYANZA DISTRICT

AEZ: LM 3-4

TABLE 9 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total									
Land Use: Annual Crops ¹⁾	ha	2.5	5.9	10.2	Farming Intensity:				
First Season									
Maize	ha	0.4	1.9	1.3	Cropping Intensity	-	0.5	0.5	0.5
Sorghum	ha	0.3	1.0	1.2	Portion of improved cattle kept	%	-	-	-
Maize & Sorghum	ha	0.3	-	0.2	Portion of Farmers owning a Plough	%	30%	50%	120%
Cotton	ha	0.2	-	0.8					
Others	ha	-	-	0.6					
Total	ha	1.2	2.9	4.1					
Second Season¹⁾									
Maize	ha			0.5	Labour on Farm:				
Maize & Beans	ha			0.1	Family Adults	persons	3.0	2.6	3.3
	ha				Perm. Hired Labour	"	0.1	0.2	0.6
Total	ha			0.6	Children > 14 years	"	1.8	2.7	3.4
Permanent Crops¹⁾									
Sisal	ha			0.1	Persons living on Farm ²⁾	persons	2.67	0.67	3.34
	ha				- average household size -	"	3.17	-	3.17
	ha				Adults > 14 years	su	4.57	0.67	5.24
	ha				Children < 14 years				
portion of total	%			6%	Subsistence Units				
Grazing & Forage	ha	0.9	2.4	4.3	Home Consumption of Major Food produced on Farm				
portion of total	%			42%	Maize	kg/year household	1225	1974	
Other Land Use	ha	0.4	0.6	1.5	Beans	kg	235	333	
					Finger Millet	kg	60	94	
					Sorghum	kg	229	359	
Livestock on Farm:									
Cattle: local	LU	3.4	4.6	8.8					
improved	LU	-	-	-					
Sheep & Goats	LU	0.2	0.5	1.3					
Total	LU	3.6	5.1	10.1					
Other Crops cultivated: Groundnuts, Bulrush Millet, Finger Millet, Sunflower, Sugarcane									

1) Major crops only considered
2) Based on 1979 Census figures

TABLE 9 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	2.6	6.3	19.4	Farming Intensity:				
Land Use: Annual Crops ¹⁾					Cropping Intensity	-	0.7	0.6	0.5
First Season					Portion of improved cattle kept	%	-	6%	-
Maize	ha	0.2	0.1	0.6	Portion of Farmers owning a Plough	%	-	70%	200%
Sorghum	ha	0.2	0.3	0.4					
Maize & Beans	ha	0.5	0.8	2.3					
Tobacco	ha	0.2	0.1	0.5					
Others	ha		0.3	0.9					
Total	ha	1.1	1.6	4.7					
Second Season¹⁾					Labour on Farm:				
Maize	ha	0.2	0.1	1.0	Family Adults	persons	3.3	2.8	3.6
Maize & Beans	ha	0.3	1.0	1.7	Perm. Hired Labour	"	0.3	0.4	3.0
Cassava	ha	0.1	-	0.1	Children > 14 years	"	1.7	5.1	4.1
Others	ha	-	-	0.2					
Total	ha	0.6	1.1	3.0					
Permanent Crops¹⁾					Persons living on Farm ²⁾				
Sugarcane	ha	0.2	0.6	2.0	- average household size -				
Bananas	ha	0.1	0.1	0.4	Adults > 14 years	persons	2.37	0.78	3.15
Coffee	ha	0.1	0.1	0.2	Children < 14 years	"	3.28	-	-
portion of total	%	23%	17%	13%	Subsistence Units	SU	4.33	0.78	5.11
Grazing & Forage	ha	0.7	3.0	8.0	Home Consumption of Major Food produced on Farm				
portion of total	%	27%	48%	41%	Maize	kg/year household	1070	1725	
Other Land Use	ha	0.4	0.9	4.1	Beans	kg	206	327	
Livestock on Farm:					English Potatoes	kg	8	3	
Cattle: local	LU	0.2	3.3	21.3	Sweet Potatoes	kg	122	69	
improved	LU	-	0.2	0.1	Cabbage	kg	40	4	
Sheep & Goats	LU	0.1	0.5	1.9	Cassava	kg	50	28	
Total	LU	0.3	4.0	23.3	Sorghum	kg	227	356	
					Millet	kg	60	94	

1) Major crops only considered
2) Based on 1979 Census figures

Other Crops cultivated: Cabbage, Citrus, Sunflower, Pineapple, Beans, Bulrush Millet, Cowpeas, Groundnuts, Sweet Potatoes

SOUTH NYANZA DISTRICT

TABLE 10 a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: LM 3-4

Survey ea 03

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > No.
Avg. 0	6.7	19.6	1.2	3.0	0.3	2.7
Avg. 1	6.7	20.3	2.0	3.0	1.3	3.2
Up. Qu.	10.0	26.0	1.0	4.0	1.0	4.0
Lo. Qu.	3.2	7.0	-	2.0	-	1.0

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	3.0	45	0.1	1	2.8	41	-	-	0.6	9	0.3	4
Avg. 1	3.0	39	0.5	6	2.8	36	-	-	1.1	15	0.3	4
Up. Qu.	4.0	53	-	-	4.4	50	-	-	1.0	16	0.2	5
Lo. Qu.	1.4	34	-	-	1.6	25	-	-	-	-	0.1	2
Total	89.7		1.9		83.2		-	-	18.0		8.0	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.9	1.0	2.4	0.1
Avg. 1			2.4	25.0
Up. Qu.	1.0	1.4	4.4	-
Lo. Qu.	0.7	0.4	1.4	-

Inputs Applied

Inputs Applied													
Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	32.8	-	-	0.3	-	-	-	-	-	1.0	-	-	-
Avg. 1	45.2	-	-	7.5	-	-	-	-	-	2.2	-	-	-
Up. Qu.	42.9	-	-	-	-	-	-	0.1	-	-	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	1.6	-	-	-
		-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all

Notes: Avg. 0

= average of all sample farms

Avg. 1

= average of all farms excluding zero entries

Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points

AC = Annual Crops

PC = Perennial Crops

SOUTH NYANZA DISTRICT

TABLE 10 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: UM 1 - LM 1-2

Survey Area 04

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	9.0	24.5	1.7	3.1	1.1	4.2
Avg. 1	9.0	29.4	2.6	3.2	3.0	4.8
Up. Qu.	10.4	27.0	3.0	4.0	1.0	4.0
Lo. Qu.	4.0	4.0	-	2.0	-	2.0

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	2.3	27	1.2	14	3.9	44	-	-	1.0	12	0.3	3
Avg. 1	2.3	24	1.8	18	4.0	41	-	-	1.4	14	0.3	3
Up. Qu.	2.8	35	1.0	20	5.2	56	-	-	2.0	17	0.4	6
Lo. Qu.	0.8	20	-	-	0.6	19	-	-	0.2	5	0.1	1
Total	69.5		35.6		119.5		-		31.4		8.7	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.1	0.9	2.2	1.5
Avg. 1			2.2	13.2
Up. Qu.	1.5	1.1	3.2	-
Lo. Qu.	1.0	0.2	0.3	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	56.1	3.7	2.0	9.2	0.1	-	-	0.1	-	0.4	-	-	-
Avg. 1	63.2	3.9	3.7	16.3	0.4	-	0.1	0.3	0.1	1.1	0.1	-	0.2
Up. Qu.	-	2.2	-	15.7	-	-	-	-	-	0.1	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms

Avg. 1 = average of all farms excluding zero entries

Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points

AC = Annual Crops

PC = Perennial Crops

SOUTH NYANZA DISTRICT

TABLE 11 a: CROPPING PATTERN

AEZ: LM 3-4

Survey Area 03

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper quartile ha	Lower quartile ha	Total Sample Area	
					ha	%
Maize	1.0	1.5	1.60	0.00	29.4	32.5
Sorghum	0.9	1.3	1.60	0.00	25.7	28.4
Fingermillet	0.0	0.6	0.00	0.00	1.2	1.3
Bulrushmillet	0.0	0.1	0.00	0.00	0.1	0.1
Pigeonpeas	0.0	0.6	0.00	0.00	0.6	0.7
Groundnuts	0.0	0.3	0.00	0.00	0.5	0.6
Sunflower	0.0	0.3	0.00	0.00	1.0	1.1
Cotton	0.5	0.8	1.00	0.00	15.7	7.4
Sugarcane	0.0	0.2	0.00	0.00	0.2	0.2
Others	0.0	0.4	0.00	0.00	0.4	0.4
Maize & Sorghum	0.1	0.8	0.00	0.00	4.0	4.4
Maize & Beans	0.3	1.3	0.00	0.00	8.0	8.8
Maize & Others	0.1	0.8	0.00	0.00	1.6	1.8
Maize int.oth.	0.1	2.0	0.00	0.00	2.0	2.2
Total					90.5	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper quartile ha	Lower quartile ha	Total Sample Area	
					ha	%
Maize	0.2	1.3	0.00	0.00	5.2	74.3
Sugarcane	0.0	0.2	0.00	0.00	0.2	2.9
Maize & Beans	0.1	1.6	0.00	0.00	1.6	22.9
Total					7.0	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper quartile ha	Lower quartile ha	Total Sample Area	
					ha	%
Sisal	0.0	0.6	0.00	0.00	1.1	100.0
Total					1.1	100.0

Avg 0 = average of all sample farms
 Avg 1 = average of all farms excluding zero entries
 Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points
 % columns = % of total farm land

SOUTH NYANZA DISTRICT

TABLE 11 b: CROPPING PATTERN

AEZ: UM 1 - LM 1-2

Survey Area 04

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.7	2.7	1.60	0.00	21.2	22.4
Sorghum	0.1	0.5	0.00	0.00	3.0	3.2
Bulrushmillet	0.0	0.8	0.00	0.00	0.8	0.8
Beans	0.1	1.0	0.00	0.00	4.0	4.2
Cowpeas	0.0	1.4	0.00	0.00	1.4	1.5
Groundnuts	0.0	0.1	0.00	0.00	0.1	0.1
Sunflower	0.0	0.4	0.00	0.00	0.4	0.4
Engl. Potatoes	0.0	0.4	0.00	0.00	0.4	0.4
Cabbage	0.1	0.7	0.00	0.00	2.0	2.1
Tobacco	0.2	0.7	0.40	0.00	6.6	7.0
Cassava	0.0	0.2	0.00	0.00	0.9	0.9
Sweet Potatoes	0.0	0.3	0.00	0.00	0.6	0.6
Sugarcane	0.9	2.3	1.20	0.00	27.2	28.7
Pineapples	0.0	0.3	0.00	0.00	0.8	0.9
Maize & Sorghm	0.0	0.8	0.00	0.00	0.8	0.8
Maize & Beans	0.8	1.3	1.20	0.00	24.6	25.9
Total					94.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.6	1.8	0.80	0.00	18.4	25.1
Beans	0.1	1.1	0.00	0.00	3.2	4.4
Cabbage	0.0	0.8	0.00	0.00	0.8	1.1
Cassava	0.0	0.2	0.00	0.00	0.9	1.2
Sugarcane	0.9	2.3	1.20	0.00	27.2	37.1
Pineapples	0.0	0.3	0.00	0.00	0.8	1.1
Maize & Beans	0.7	1.3	1.20	0.00	22.0	30.0
Total					73.3	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sweet Bananas	0.0	0.4	0.00	0.00	0.4	6.0
Cookng Bananas	0.1	0.4	0.12	0.00	3.6	54.2
Coffee	0.1	0.3	0.12	0.00	2.6	39.3
Citrus	0.0	0.0	0.00	0.00	0.0	0.6
Total					6.7	100.0

Avg 0 = average of all sample farms

Avg 1 = average of all farms excluding zero entries

Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points

% columns = % of total farm land

SOUTH NYANZA DISTRICT

AEZ: LM 3-4

TABLE 12a: HERD COMPOSITION (GRAZING LIVESTOCK)

- in Head and Livestock Units -

Oct. '77, Survey Area 03

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		-	-	-	0.03	-	-	-	0.01	-	-	0.3
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total		-	-	-	1	-	-	-	-	-	-	-
Average		-	-	-	0.03	-	-	-	0.3	-	-	0.3
Upper Qu.		-	-	-	-	-	-	-	0.01	-	-	0.01
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 0.0 % of total cattle, Calves + Heifers = 0.0 % of dairy cows												
Unimproved Livestock:												
Under 1 year, Average		1.20	-	-	1.47	-	0.73	1.67	0.77	-	-	0.77
Upper Qu.		1	-	-	3	-	1	3	1.2	-	-	1.2
1 - 2 years, Average		0.73	-	0.23	2.03	-	-	-	1.35	-	-	1.35
Upper Qu.		2	-	-	3	-	-	-	2.3	-	-	2.3
Over 2 years, Average		1.00	0.13	1.97	-	3.17	2.07	3.20	4.60	-	22.73	4.60
Upper Qu.		2	-	4	-	5	2	6	0.7	-	8	0.7
Subtotal (unimp.) Total		88	4	66	105	95	84	146	201.7	-	682	201.7
Average		2.93	0.13	2.20	3.50	3.17	2.80	4.87	6.72	-	22.73	6.72
Upper Qu.		4	-	4	5	5	4	7	10.2	-	26	10.2
Lower Qu.		-	-	-	-	1	-	-	1.8	-	8	1.8
LU Male Cattle = 45.2 % of total cattle, Calves + Heifers = 110.5 % of dairy cows												
LU Goats + Sheep =		11.4 % of total Grazing Livestock Units										
Improved + Unimproved												
Grazing L/Stock Total		88	4	66	106	95	84	146	202.0	-	682	202.0
Average		2.93	0.13	2.20	3.53	3.17	2.80	4.87	6.73	-	22.73	6.73
Upper Qu.		4	-	4	5	5	4	7	10.2	-	26	10.2
Lower Qu.		-	-	-	1	1	-	-	1.8	-	8	1.8
LU Male Cattle = 45.1 % of total cattle, Calves + Heifers = 111.6 % of dairy cows												
LU Goats + Sheep =		11.4 % of total Grazing Livestock Units										

SOUTH NYANZA DISTRICT

AEZ: UM 1 - LM 1-2

- in Head and Livestock Units -

TABLE 12 b: HERD COMPOSITION (GRAZING LIVESTOCK)

Oct. '77, Survey Area 04

Improved Livestock	Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average	-	-	-	-	-	-	-	-	-	-	-
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average	-	-	-	0.03	-	-	-	0.02	-	-	0.02
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average	0.07	-	0.07	-	-	-	-	0.11	-	-	0.11
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Subtotal (improved) Total	2	-	2	1	-	-	-	3.7	-	-	3.7
Average	0.07	-	0.07	0.03	-	-	-	0.12	-	-	0.12
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 86.5 % of total cattle,	Calves + Heifers = 0.0 % of dairy cows										
Unimproved Livestock:											
Under 1 year, Average	2.37	-	-	1.20	-	1.27	1.87	1.03	1.27	-	1.22
Upper Qu.	1	-	-	2	-	2	1	0.9	-	-	0.9
1 - 2 years, Average	0.27	0.13	0.13	2.33	-	-	-	1.29	-	-	1.29
Upper Qu.	-	-	-	2	-	-	-	0.9	-	-	0.9
Over 2 years, Average	0.70	0.73	2.17	-	4.80	3.67	1.37	5.96	0.10	26.10	5.98
Upper Qu.	1	-	4	-	4	4	2	-	-	9	-
Subtotal (unimp.) Total	100	26	69	106	144	148	97	248.4	41	783	254.6
Average	3.33	0.87	2.30	3.53	4.80	4.93	3.23	8.28	1.37	26.10	8.48
Upper Qu.	2	-	4	4	4	7	4	10.4	-	39	10.4
Lower Qu.	-	-	-	-	-	-	-	0.6	-	9	0.6
LU Male Cattle = 40.9 % of total cattle,	Calves + Heifers = 73.6 % of dairy cows										
LU Goats + Sheep = 9.9 % of total Grazing Livestock Units											
Improved + Unimproved											
Grazing L/Stock	102	26	71	107	144	148	97	252.1	41	783	258.3
Total	3.40	0.87	2.37	3.57	4.80	4.93	3.23	8.40	1.37	26.10	8.61
Average	2	-	4	4	4	7	4	10.4	-	39	10.4
Upper Qu.	-	-	-	-	-	-	-	0.6	-	9	0.6
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 41.7 % of total cattle,	Calves + Heifers = 74.3 % of dairy cows										
LU Goats + Sheep = 9.7 % of total Grazing Livestock Units											

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

SOUTH NYANZA DISTRICT

TABLE 13 a: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LM 3-4

Survey Area 03

Crop		Improved Seeds %	Inputs						Yield kg/ha
			N	Nutrients			Chemicals		
				P ₂ O ₅	K ₂ O	Manure	Insec.	Fungicide	
			kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
<u>First Rains</u>									
Maize	Avg.	45	-	1	-	0.02	1	-	2,26
	UpQu	100	-	-	-	-	-	-	2,02
	LoQu	-	-	-	-	-	-	-	1,18
Sorghum	Avg.	-	-	-	-	-	-	-	1,33
	UpQu	-	-	-	-	-	-	-	1,35
	LoQu	-	-	-	-	-	-	-	63
Fingermillet	Avg.	-	-	-	-	-	-	-	52
Groundnuts	Avg.	-	-	-	-	-	-	-	1,12
Sunflower	Avg.	100	-	-	-	-	-	-	54
	UpQu	100	-	-	-	-	-	-	73
	LoQu	100	-	-	-	-	-	-	20
Cotton	Avg.	58	-	-	-	-	15	-	589
	UpQu	100	-	-	-	-	17	-	750
	LoQu	-	-	-	-	-	-	-	306
Maize & Sorghm									
Maize	Avg.	-	-	-	-	-	-	-	900
Sorghm	Avg.	-	-	-	-	-	-	-	769
Maize & Beans									
Maize	Avg.	40	-	12	-	0.10	-	-	3,825
Beans	Avg.	-	-	-	-	-	-	-	467
Maize	UpQu	100	-	-	-	-	-	-	6,750
Beans	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	-	-	-	-	-	-	-	1,125
Beans	LoQu	-	-	-	-	-	-	-	133
<u>Second Rains</u>									
Maize	Avg.	50	-	-	-	-	-	-	1,240
	UpQu	100	-	-	-	-	-	-	833
	LoQu	-	-	-	-	-	-	-	450
<u>Perennial Crops</u>									
Sisal	Avg.	-	-	-	-	-	-	-	3,583

SOUTH NYANZA DISTRICT

TABLE 13 b: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: UM 1 - LM 1-2

Survey Area 04

Crop		Imp- roved Seeds %	Inputs					Chemicals		Yield kg/ha
			N kg/ha	Nutrients		Manure t/ha	Insec. kg/ha	Fung- icide kg/ha		
				P ₂ O ₅ kg/ha	K ₂ O kg/ha					
<u>First Rains</u>										
Maize	Avg.	100	14	23	-	0.33	1	-	-	2,790
	UpQu	100	16	58	-	-	-	-	-	3,375
	LoQu	100	-	-	-	-	-	-	-	1,575
Sorghum	Avg.	-	-	10	-	-	-	-	-	1,947
	UpQu	-	-	-	-	-	-	-	-	2,500
	LoQu	-	-	-	-	-	-	-	-	333
Tobacco	Avg.	100	33	37	-	-	1	-	-	1,211
	UpQu	100	65	58	-	-	2	-	-	1,643
	LoQu	100	-	-	-	-	-	-	-	625
<u>Maize & Beans</u>										
Maize	Avg.	69	126	141	-	0.13	1	-	-	2,756
Beans	Avg.	6	-	-	-	-	-	-	-	638
Maize	UpQu	100	-	40	-	0.20	-	-	-	3,750
Beans	UpQu	-	-	-	-	-	-	-	-	650
Maize	LoQu	-	-	-	-	-	-	-	-	1,350
Beans	LoQu	-	-	-	-	-	-	-	-	200
<u>Second Rains</u>										
Maize	Avg.	90	1	18	-	0.33	1	1	-	2,579
	UpQu	100	-	29	-	-	1	1	-	3,375
	LoQu	100	-	-	-	-	-	-	-	1,350
Beans	Avg.	-	-	-	-	-	-	-	-	792
<u>Maize & Beans</u>										
Maize	Avg.	75	10	14	-	0.14	1	1	-	2,563
Beans	Avg.	5	-	-	-	-	-	-	-	487
Maize	UpQu	100	-	30	-	0.20	-	-	-	3,375
Beans	UpQu	-	-	-	-	-	-	-	-	800
Maize	LoQu	-	-	-	-	-	-	-	-	1,575
Beans	LoQu	-	-	-	-	-	-	-	-	240
<u>Perennial Crops</u>										
Sugarcane	Avg.	-	4	-	-	-	-	-	-	15,691
	UpQu	-	-	-	-	-	-	-	-	7,417
	LoQu	-	-	-	-	-	-	-	-	-
Cookng Bananas	Avg.	-	-	-	-	0.24	-	-	-	14,595
	UpQu	-	-	-	-	-	-	-	-	22,500
	LoQu	-	-	-	-	-	-	-	-	1,250
Coffee	Avg.	-	11	21	-	0.44	1	9	-	4,619
	UpQu	-	-	-	-	-	-	10	-	5,833
	LoQu	-	-	-	-	-	-	-	-	2,500

SOUTH NYANZA DISTRICT

TABLE 14 a: DISPOSAL OF CROPS

AEZ: LM 3-4

Survey Area 03

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	46,458	3,060	7	11,535	25	31,863	69
Maize & Beans	40,380	0	0	5,970	15	34,410	85
Maize & Sorghm	7,885	0	0	970	12	6,915	88
Maize & Others	5,847	1,500	26	610	10	3,737	64
Maize int.oth.	3,850	1,600	42	1,120	29	1,130	29
Beans	10,134	0	0	0	0	10,134	100
Fingermillet	600	0	0	80	13	520	87
FHlt & Sorghum	3,840	0	0	0	0	3,840	100
Bulrushmillet	200	0	0	0	0	200	100
Sorghum	28,280	0	0	9,800	35	18,480	65
Groundnuts	670	0	0	460	69	210	31
Sunflower	432	432	100	0	0	0	0
Cotton	9,757	9,517	98	0	0	240	2
<u>Second Rains</u>							
Maize	4,150	1,170	28	900	22	2,080	50
Maize & Beans	3,260	0	0	0	0	3,260	100
<u>Permanent Crops</u>							
Nil							

SOUTH NYANZA DISTRICT

TABLE 14 b: DISPOSAL OF CROPS

AEZ: UM 1 - LM 1-2

Survey Area 04

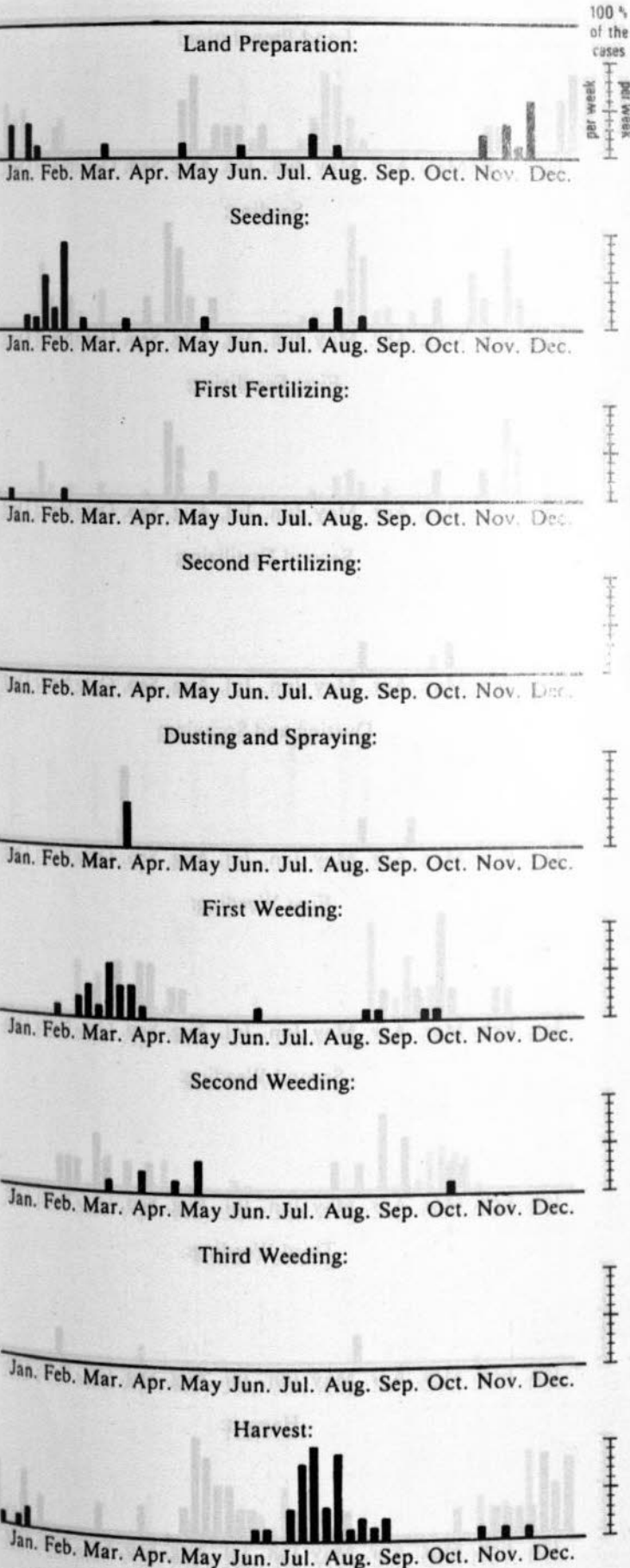
Survey Area

Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	59,531	97,010	163	7,290	12	-44,769	-75
Maize & Beans	86,770	36,405	42	25,460	29	24,905	29
Maize & Sorghm	2,760	0	0	0	0	2,760	100
Beans	3,910	540	14	2,340	60	1,030	26
Bulrushmillet	1,800	0	0	0	0	1,800	100
Sorghum	6,960	0	0	700	10	6,260	90
Engl. Potatoes	1,440	0	0	1,200	83	240	17
Sweet Potatoes	4,540	0	0	880	19	3,660	81
Sunflower	400	400	100	0	0	0	0
Tobacco	7,379	7,379	100	0	0	0	0
Cabbage	22,800	0	0	21,800	96	1,000	4
<u>Second Rains</u>							
Maize	38,100	13,530	36	4,610	12	19,960	52
Maize & Beans	78,590	15,440	20	19,675	25	43,475	55
Beans	2,620	320	12	1,530	58	770	29
Tobacco	500	500	100	0	0	0	0
Cabbage	900	0	0	700	78	200	22
<u>Permanent Crops</u>							
Cassava	1,500	0	0	0	0	1,500	100
Citrus	500	0	0	475	95	25	5

SOUTH NYANZA DISTRICT

TABLE 15 a: DISTRIBUTION OF FARMING ACTIVITIES

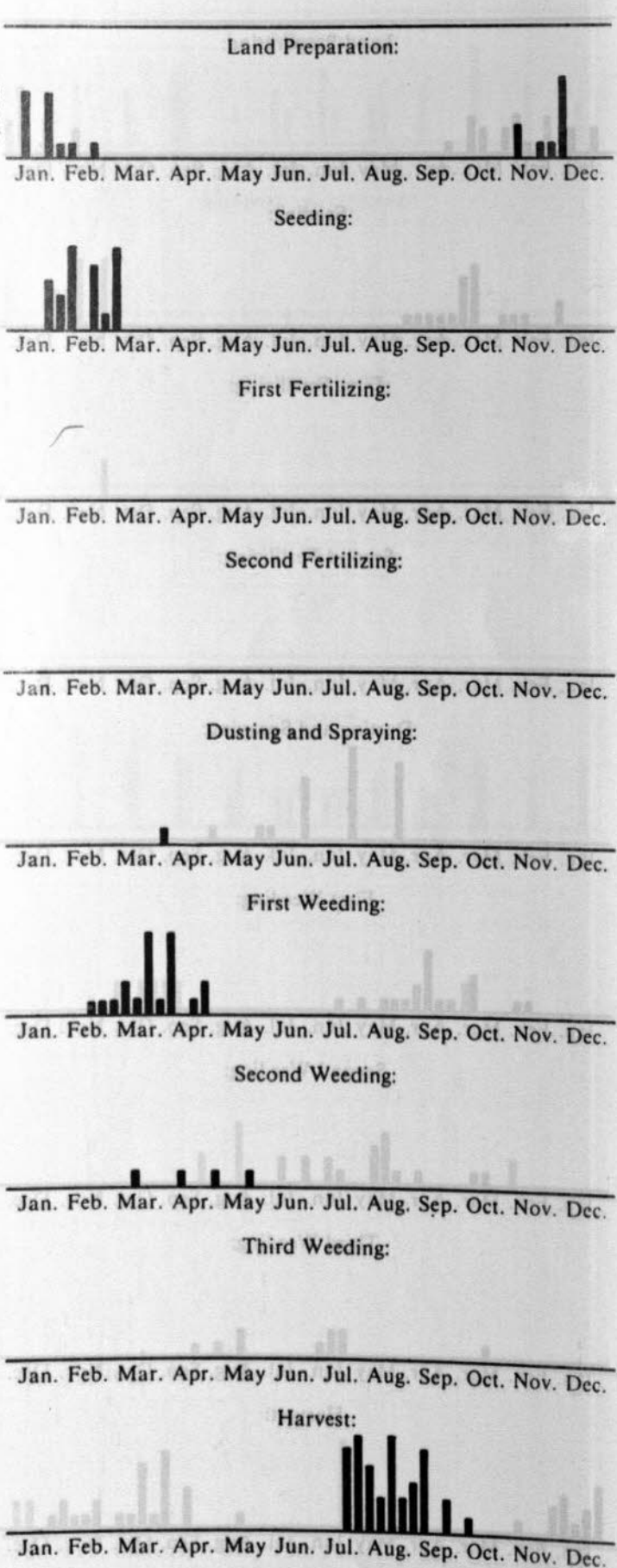
Crop 1 Maize Cases: 24
AEZ: LM 3-4 Survey Area 03 Sample Size: 30



SOUTH NYANZA DISTRICT

TABLE 15 b: DISTRIBUTION OF FARMING ACTIVITIES

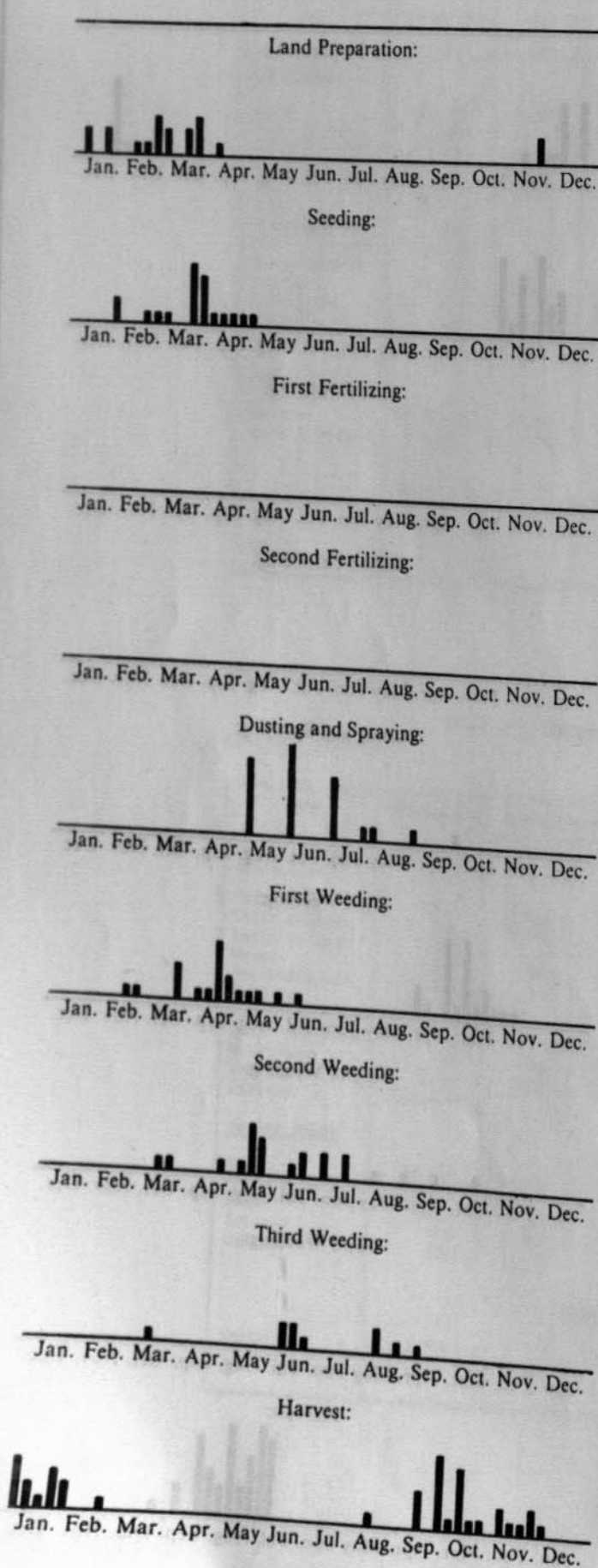
Crop 18 Sorghum Cases: 20
AEZ: LM 3-4 Survey Area 03 Sample Size: 30



SOUTH NYANZA DISTRICT

TABLE 15 c: DISTRIBUTION OF FARMING ACTIVITIES

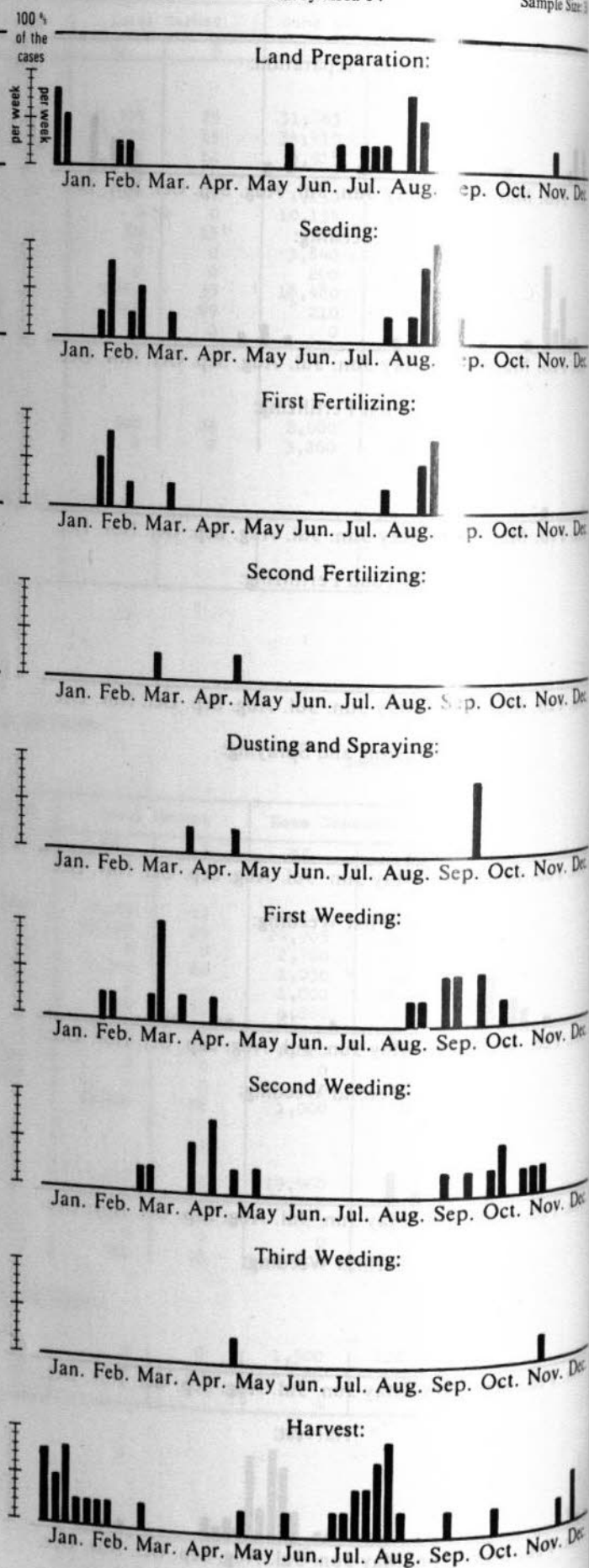
Crop 35 Cotton Cases: 19
 AEZ: LM 3-4 Survey Area 03 Sample Size: 30



SOUTH NYANZA DISTRICT

TABLE 15 d: DISTRIBUTION OF FARMING ACTIVITIES

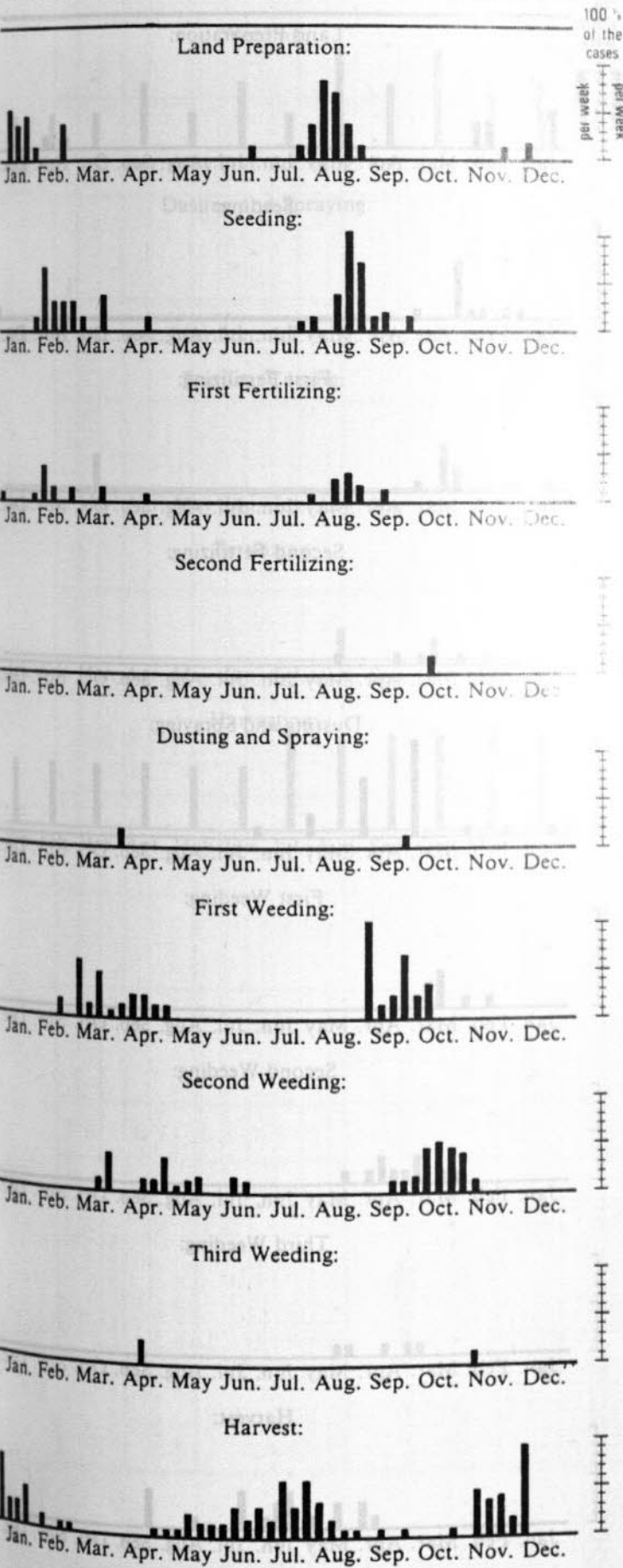
Crop 1 Maize Cases: 18
 AEZ: UM 1 - LM 1-2 Survey Area 04 Sample Size: 30



SOUTH NYANZA DISTRICT

TABLE 15 e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 60¹⁾
AEZ: UM 1 - LM 1-2 Suvey Area 04 Sample Size: 30

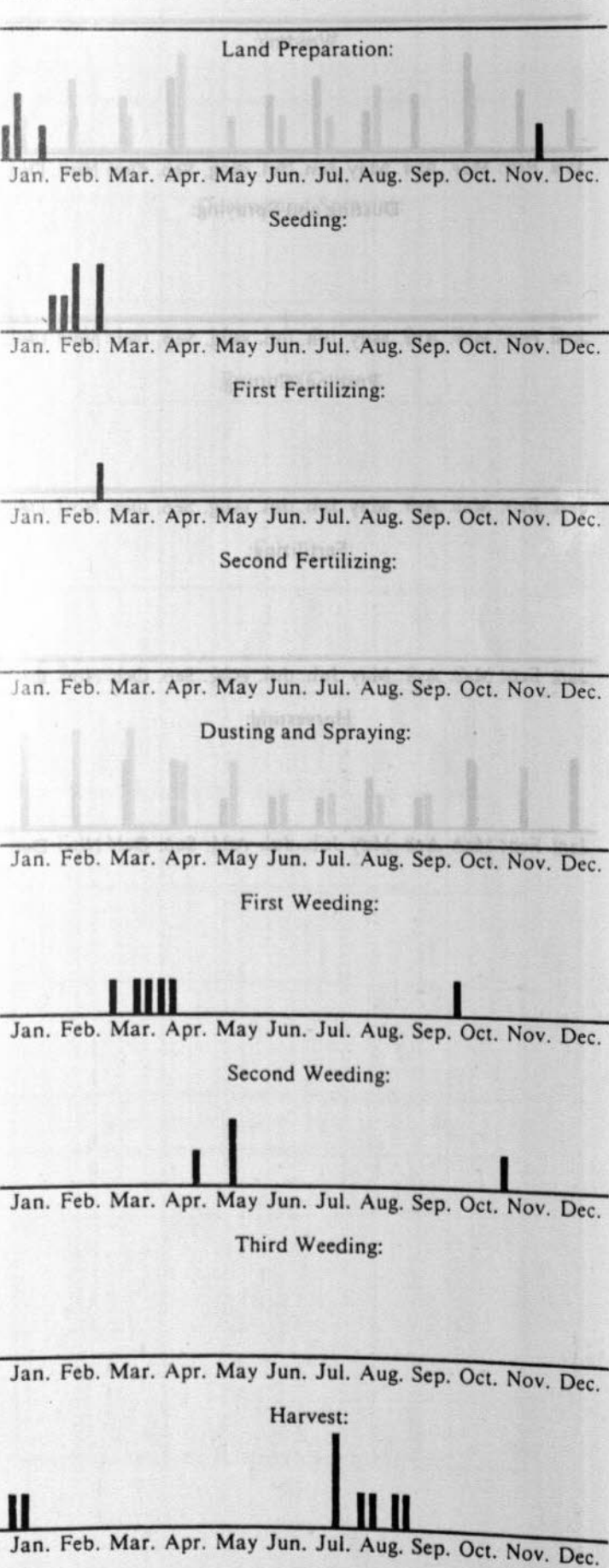


1) Maximum 30 per crop and season

SOUTH NYANZA DISTRICT

TABLE 15 f: DISTRIBUTION OF FARMING ACTIVITIES

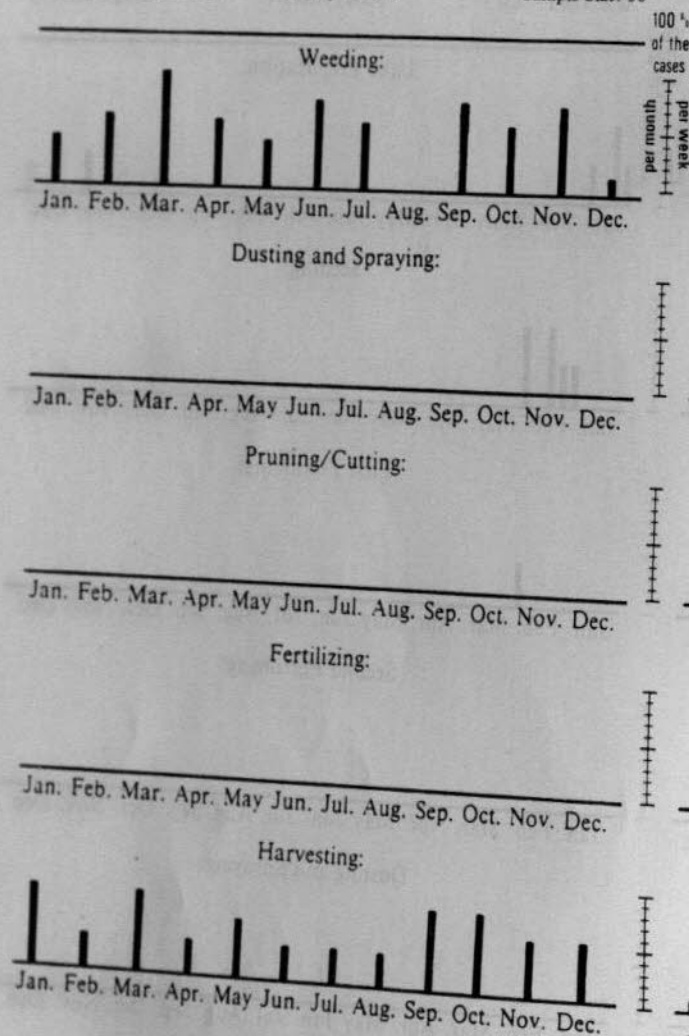
Crop 18 Sorghum Cases: 6
AEZ: UM 1 - LM 1-2 Survey Area 04 Sample Size: 30



SOUTH NYANZA DISTRICT

TABLE 15 g: DISTRIBUTION OF FARMING ACTIVITIES

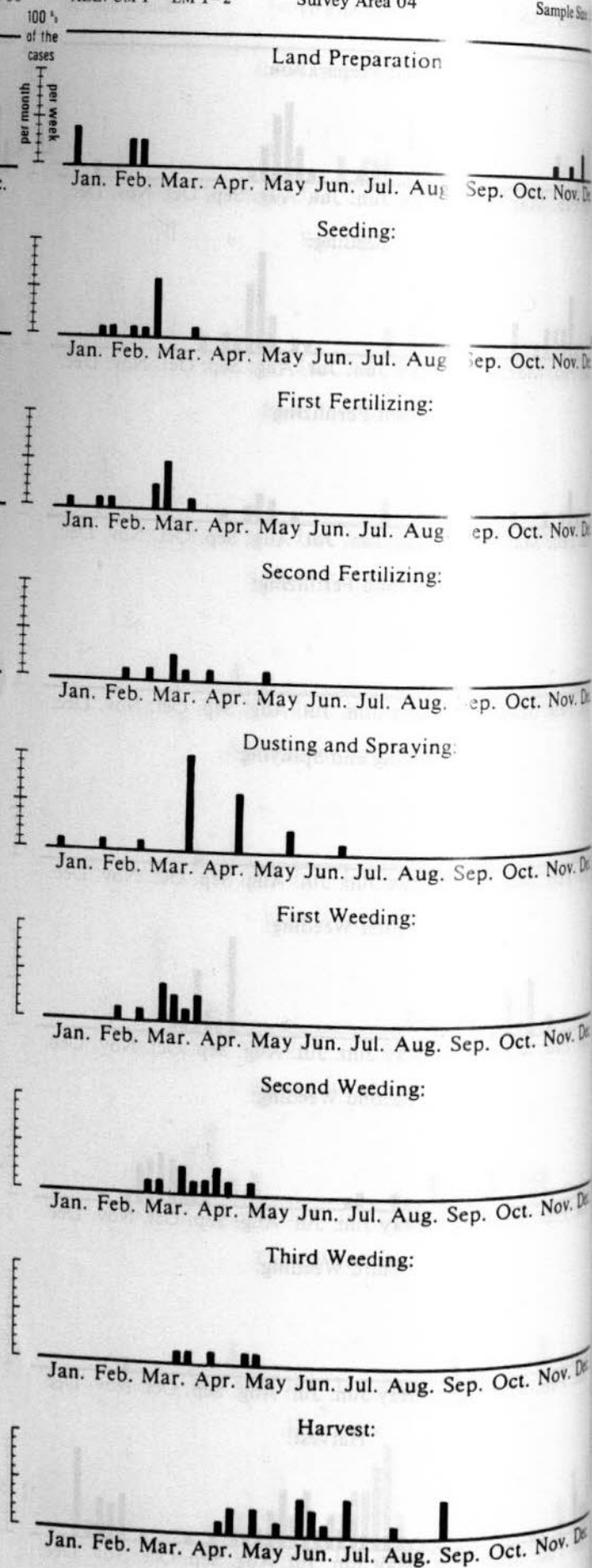
Crop 63 Sugarcane Cases: 18
 AEZ: UM 1 - LM 1-2 Survey Area 04 Sample Size: 30



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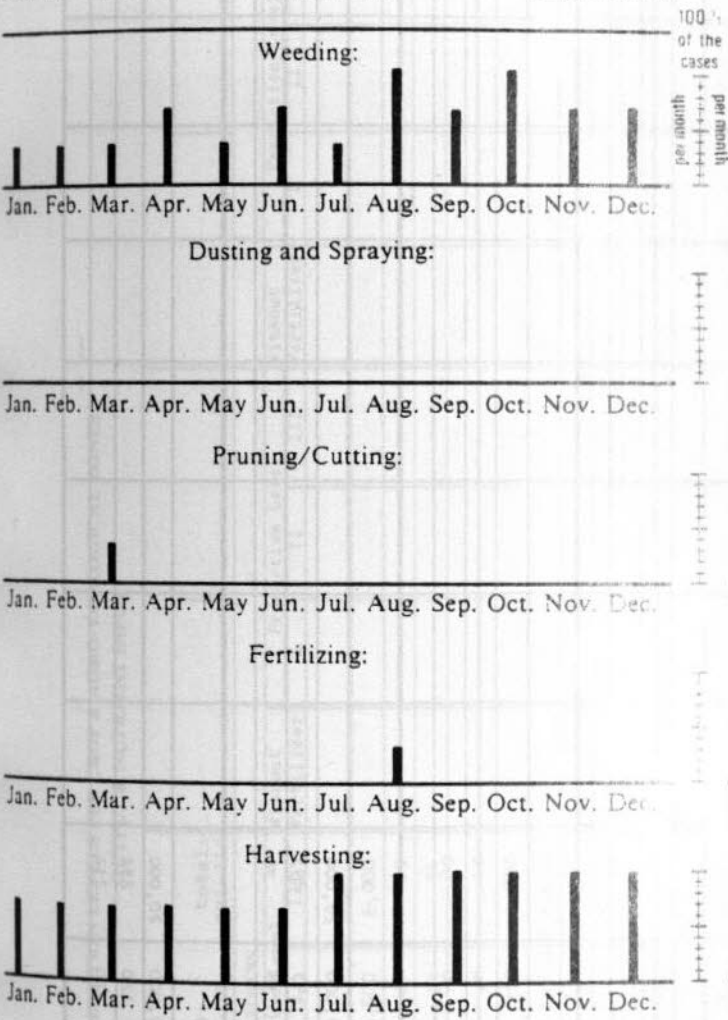
TABLE 15 h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 39 Tobacco Cases: 11
 AEZ: UM 1 - LM 1-2 Survey Area 04 Sample Size: 11



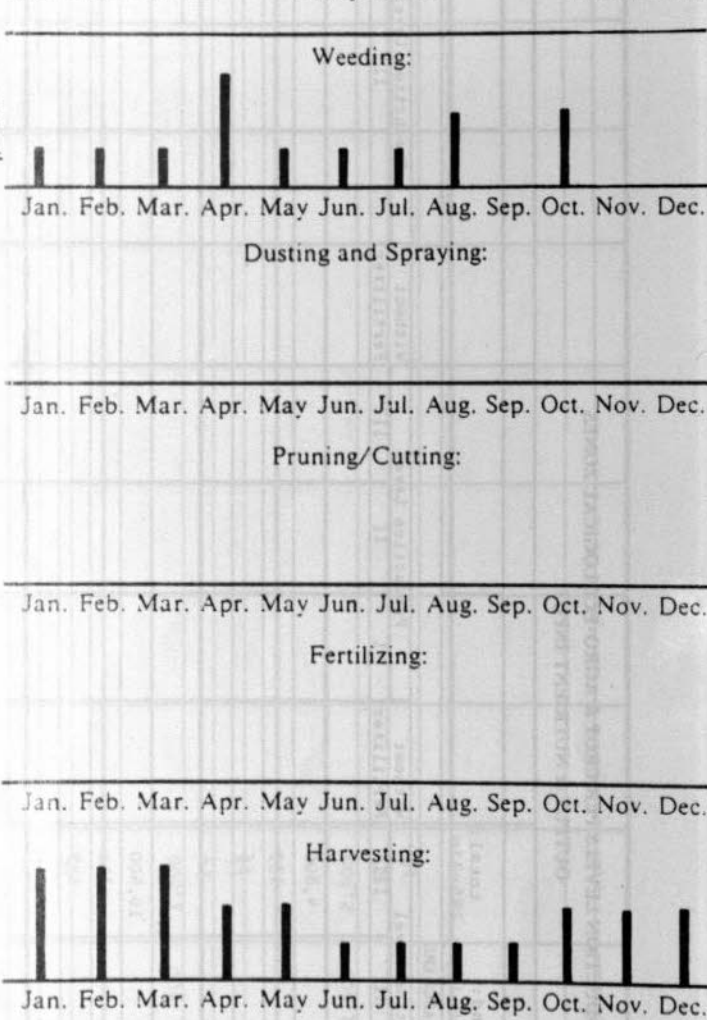
SOUTH NYANZA DISTRICT

TABLE 15 i: DISTRIBUTION OF FARMING ACTIVITIES
Crop 57 Pineapples Cases: 3
AEZ: UM 1 – LM 1-2 Survey Area 04 Sample Size: 30



SOUTH NYANZA DISTRICT

TABLE 15 k: DISTRIBUTION OF FARMING ACTIVITIES
Crop 64 Cassava Cases: 4
AEZ: UM 1 – LM 1-2 Survey Area 04 Sample Size: 30



S. NYANZA DISTRICT

TABLE 16a: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

CROP: NAT. PASTURE/LEYS Farmers in Production Level	A.E.Z.: U4 2-3 COFFEE ZONE									
	Vegt. Period 1st + 2nd: v1 i or 1/m-(m) i in Days, 1st:180 or more		2nd: 115-130		total: 295-310		PHAEZEMS			
	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
Yields	%									
Fertilizer N	kg	2,400			4,800					
P2O5	kg				133					
K2O	kg				66					
CROP: NAPIER GRASS Farmers in Production Level										
Yields	%									
Fertilizer N	kg	4,800			10,400					
P2O5	kg				311					
K2O	kg				155					
CROP: Farmers in Production Level										
Yields	%									
Fertilizer N	kg									
P2O5	kg									
K2O	kg									
CROP: COFFEE Farmers in Production Level										
Yields	%									
Fertilizer N	kg		300	400	600					
P2O5	kg		30	40	60					
K2O	kg		90	90	90					
CROP: BANANAS Farmers in Production Level										
Yields	%									
Fertilizer N	kg	8,500	6,000	18,000	28,000					
P2O5	kg			143	293					
K2O	kg			38	78					
CROP: PASSION FRUIT Farmers in Production Level										
Yields	%									
Fertilizer N	kg	3,400		12,000	20,000					
P2O5	kg			120	232					
K2O	kg			120	232					

TABLE 16 b: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

A.E.Z.: UM 2-3 COFFEE ZONE														
Vegt. Period		2nd:		total:										
1st + 2nd: v1 i or 1/m-(m) i		115-130		295-310										
in Days, 1st: 180 or more														
Soil: PHAEZOZEMS														
Unit	Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer	Production Level				
		I	II	III		I	II	III		I	II	III		
CROP: MAIZE														
Farmers in Production Level	%													
Yields	kg	2,600	2,500	3,500	6,000									
Fertilizer N	kg			23	85									
P2O5	kg			14	54									
K2O	kg													
CROP: MAIZE & BEANS														
Farmers in Production Level	%													
Yields	kg	2,600	2,000/300	2,500/400	3,500/400									
Fertilizer N	kg				101									
P2O5	kg				60									
K2O	kg													
CROP: BEANS														
Farmers in Production Level	%													
Yields	kg	1,500	400	800	1,300									
Fertilizer N	kg				15									
P2O5	kg				12									
K2O	kg													
CROP: SUNFLOWER														
Farmers in Production Level	%													
Yields	kg	1,100	400	800	1,800									
Fertilizer N	kg				24									
P2O5	kg				19									
K2O	kg													
CROP: SOYA BEANS														
Farmers in Production Level	%													
Yields	kg	1,500	900	1,500	2,300									
Fertilizer N	kg				27									
P2O5	kg				18									
K2O	kg													
CROP:														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P2O5	kg													
K2O	kg													

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TABLE 16 c: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

A.E.Z.: UN 2-3 COFFEE ZONE									
Vest. Period 1st + 2nd: vi i or i/m-(m) i in Days, 1st: 180 or more		2nd: 115-130		total: 295-310					
Soil: PHAEZEMES									
CROP: SWEET POTATOES									
Farmers in Production Level									
Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
Yields									
Fertilizer N	8,500	4,000	8,000	22,000					
P2O5				108					
K2O				54					
CROP: CABBAGE									
Farmers in Production Level									
Yields									
Fertilizer N	4,200	3,000	5,000	22,000					
P2O5			6	125					
K2O			3	71					
CROP: SUKUMAWIKI									
Farmers in Production Level									
Yields									
Fertilizer N	4,200	3,500	7,500	20,000					
P2O5			23	111					
K2O			13	63					
CROP:									
Farmers in Production Level									
Yields									
Fertilizer N									
P2O5									
K2O									
CROP:									
Farmers in Production Level									
Yields									
Fertilizer N									
P2O5									
K2O									
CROP:									
Farmers in Production Level									
Yields									
Fertilizer N									
P2O5									
K2O									

TABLE 16 d: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

A.E.Z.: LM 1			SUGAR CANE ZONE			A.E.Z.: LM 2			MARGINAL SUGAR C. ZONE			A.E.Z.: LM 3			COTTON ZONE																				
Vegt. Period 1st + 2nd: in Days, 1st: 200 or more			2nd: 160			total: (360)			1/m ² -(m/s) or (m) i 180 or more			115-140			295-320			m/li (a) 155-175			85-105			240-280											
Soil:			FERRALSOLS			GREYZEMS			PLANOSOLS																										
Unit			Production Level			Production Level			Production Level			Production Level			Production Level			Production Level			Production Level			Production Level											
Without Fertilizer			I			II			III			Without Fertilizer			I			II			III			Without Fertilizer			I			II			III		
CROP: NAT. PASTURE/LEYS																																			
Farmers in Production Level																																			
Yields																																			
Fertilizer N																																			
P2O5																																			
K2O																																			
CROP: NAPIER GRASS																																			
Farmers in Production Level																																			
Yields																																			
Fertilizer N																																			
P2O5																																			
K2O																																			
CROP: TEA																																			
Farmers in Production Level																																			
Yields																																			
Fertilizer N																																			
P2O5																																			
K2O																																			
CROP: BANANAS																																			
Farmers in Production Level																																			
Yields																																			
Fertilizer N																																			
P2O5																																			
K2O																																			
CROP: SUGAR CANE																																			
Farmers in Production Level																																			
Yields - year																																			
Fertilizer N																																			
P2O5																																			
K2O																																			
CROP: COTTON																																			
Farmers in Production Level																																			
Yields																																			
Fertilizer N																																			
P2O5																																			
K2O																																			

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TABLE 16 e: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

	SUGAR CANE ZONE				MARGINAL SUGAR C. ZONE				LM 3 COTTON ZONE			
	A.E.Z.: LM 1		A.E.Z.: LM 2		A.E.Z.: LM 3		A.E.Z.: LM 4		A.E.Z.: LM 5		A.E.Z.: LM 6	
	Unit	Without Fertilizer	With Fertilizer	2nd: 160	total: (360)	Without Fertilizer	With Fertilizer	115-140	295-320	Without Fertilizer	With Fertilizer	115-175
CROP: MAIZE												
Farmers in Production Level	%											
Yields	kg											
Fertilizer N	kg	1,200	1,100	2,000	4,000	1,600	1,200	2,800	4,000	1,600	1,300	2,000
P ₂ O ₅	kg			24	84			30	60			12
K ₂ O	kg			22	78			34	67			11
CROP: SORGHUM												
Farmers in Production Level	%											
Yields	kg											
Fertilizer N	kg	2,000	1,200	2,500	3,800	2,400	1,300	2,000	4,000	2,400	1,300	2,200
P ₂ O ₅	kg			22	70				50			45
K ₂ O	kg			16	57				48			43
CROP: MAIZE & BEANS												
Farmers in Production Level	%											
Yields	kg											
Fertilizer N	kg	1,200	1,100/200	2,000/400	4,000/500	1,600	1,200/300	2,800/500	4,000/500	1,600	1,300/200	2,000/400
P ₂ O ₅	kg			40	105			42	72			12
K ₂ O	kg			33	93			40	73			17
CROP: BEANS												
Farmers in Production Level	%											
Yields	kg											
Fertilizer N	kg					950	600	1,000	1,600	1,000	400	800
P ₂ O ₅	kg							3	39			18
K ₂ O	kg							2	23			11
CROP: SUNFLOWER												
Farmers in Production Level	%											
Yields	kg			600	1,200							
Fertilizer N	kg	700										
P ₂ O ₅	kg				17							
K ₂ O	kg				25							
CROP: SOYA BEANS												
Farmers in Production Level	%											
Yields	kg	800	600	900	1,400	1,100	600	900	1,600			
Fertilizer N	kg			4	24				25			
P ₂ O ₅	kg			4	23				19			
K ₂ O	kg											

TABLE 16 f: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

A.E.Z.: LM 1 SUGAR CANE ZONE			A.E.Z.: LM 2 MARGINAL SUGAR C. ZONE			A.E.Z.: LM 3 COTTON ZONE				
Vest. Period 1st + 2nd: in Days, 1st: 200 or more	p or 1-m/1 in Days, 1st: 200 or more	2nd: 160	total: (360)	Without Fertilizer		Production Level		m/li (s) 155-175	Production Level	
				I	II	I	II		I	II
Soil:										
FERRALSOLS										
CROP: GROUNDNUTS Farmers in Production Level Yields Fertilizer N P ₂ O ₅ K ₂ O	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
	%									
	kg	900	600	1,000	1,500	1,000	600	800	1,600	1,100
	kg			3	18				19	
	kg			3	18				18	
CROP: BAMBARA GROUNDNUTS Farmers in Production Level Yields Fertilizer N P ₂ O ₅ K ₂ O	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
	%									
	kg									
	kg									
	kg									
CROP: SIMSIM Farmers in Production Level Yields Fertilizer N P ₂ O ₅ K ₂ O	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
	%									
	kg									850
	kg									
	kg									
CROP: SWEET POTATOES Farmers in Production Level Yields Fertilizer N P ₂ O ₅ K ₂ O	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
	%									
	kg	5,000	6,000	10,000	26,000	6,000	6,000	10,000	30,000	5,000
	kg		10	50	210			40	240	
	kg		7	35	147			28	168	
CROP: CASSAVA Farmers in Production Level Yields - year Fertilizer N P ₂ O ₅ K ₂ O	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
	%									
	kg	6,500	3,000	4,000	12,000	7,000	4,000	7,000	12,000	6,000
	kg				22				20	
	kg				29				35	
CROP: CABBAGE Farmers in Production Level Yields Fertilizer N P ₂ O ₅ K ₂ O	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer
	%									
	kg	4,000	2,000	6,000	18,000					
	kg			14	98					
	kg			14	98					

TABLE 16 g: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

A.E.Z.: LM 4 MARGINAL COTTON ZONE									
Veg. Period		1st + 2nd:		2nd:		total:			
in Days		(a) i (v a/s)		65-75		200-220			
Soil:		135-145							
REGIONS									
Unit		Without Fertilizer		I		II		III	
		Production Level		I		II		III	
		Without Fertilizer		I		II		III	
CROP: NATURAL PASTURE									
Farmers in Production Level									
Yields									
Fertilizer N		750							
P2O5									
K2O									
CROP: NAPIER/BANA GRASS									
Farmers in Production Level									
Yields									
Fertilizer N		1,500							
P2O5									
K2O									
CROP: SORGHUM									
Farmers in Production Level									
Yields		1,200		800		1,600		2,500	
Fertilizer N						15		42	
P2O5						10		36	
K2O									
CROP: MILLET									
Farmers in Production Level									
Yields									
Fertilizer N									
P2O5									
K2O									
CROP:									
Farmers in Production Level									
Yields									
Fertilizer N									
P2O5									
K2O									
CROP: COTTON									
Farmers in Production Level									
Yields		300		150				850	
Fertilizer N								67	
P2O5								50	
K2O									

TABLE 16 h: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

A.E.2.: LM 4 MARGINAL COTTON ZONE									
Vegt. Period 1st + 2nd: (m)1 (v s/a) in Days, 1st: 135-145		2nd: 65-75		total: 200-220					
Soil: REGOSOLS									
Unit	Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer
		I	II	III		I	II	III	
CROP: BEANS									
Farmers in Production Level									
Yields	kg	500	400	650					
Fertilizer N	kg			9					
P2O5	kg			5					
K2O	kg								
CROP: GROUNDNUTS									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P2O5	kg								
K2O	kg								
CROP: SUNFLOWER									
Farmers in Production Level	%								
Yields	kg	400	350	800					
Fertilizer N	kg			7					
P2O5	kg			10					
K2O	kg			20					
CROP:									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P2O5	kg								
K2O	kg								
CROP:									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P2O5	kg								
K2O	kg								
CROP:									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P2O5	kg								
K2O	kg								

KISUMU DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

The district is well known for its long-established sugar industry, but development proposals must recognise the fact, that the area is not so good for sugar cane because of relatively low rainfall. At Kisumu Bay, the shore of Lake Victoria curves nearly 100 km eastward and for that reason the zone of low rainfall near the lake – the belt of falling winds of the local circulation (see p. 81) – makes a huge eastward bend over the Kano Plains. There, the average annual rainfall is only 1 100–1 500 mm, while 1 500 mm are considered as the lower limit for sugar cane cultivation in the Tropics¹⁾. Here, we can state slightly lower (about 1 350 mm) because of the lower evaporation compared to tropical lowlands (2 000 mm annual average in LM 2, in L 2 of the lowlands 2 150 mm). Nevertheless, the sugar area had to be classified mainly as “Marginal Sugar Cane Zone” (LM 2). That means, on good soils the average yields are fair, otherwise they are poor.

Water stress occurs especially after the second rains which are feeble and not very reliable (450–600 mm). Therefore, there is only little storable surplus for the real dry season with its peak being in January (see Diagram Miwani).

Further towards the plains, the reliability of the second rains becomes so low and they are so scattered, that even with a figure of 300–500 mm in the Cotton Zone, cultivation of a second annual crop is very difficult (see Diagram Kisumu). It is also difficult to define clearly the second growing period.

This is an area for additional irrigation (see AEZ map) giving possibilities of very good cotton crops even in the Marginal Cotton Zone. Thus, and rice is also a possibility. Its cultivation in the swamps (marked as “Rice or Swamp Zone” in the AEZ map) is risky due to irregular flooding.

The Coffee-Tea Zone (UM 1) and the Main Coffee Zone (UM 2) are very small and therefore relatively unimportant for this district. In its two subzones, the Marginal Coffee Zone (UM 3) has two growing periods: A growing period of 180 days or more days followed by a 120–130 day period, and a growing period of 180 days or more, followed by a 80–90 day period. The annual average rainfall is about 1 000–1 600 mm, with 700 mm expected during the 1st. rains and about 500 mm during the 2nd. rains in at least 6 out of 10 years. Because of the altitude (1 500–1 600 m), the annual mean temperature in the Marginal Coffee Zone is about 20° to 21° C, slightly lower than in the other zones of the district.

1) REHM, S. and G. ESPIG: Die Kulturpflanzen der Tropen und Subtropen. Stuttgart 1976, p. 74.

KISUMU DISTRICT

TABLE 1: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ ¹⁾	Kind of records	Temperature in °C												Y. of rec.	
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Year
9034025 1 145 m	Kisumu Met. Station	LM 3	Mean max.	30,2	30,1	29,7	28,3	27,9	27,5	27,3	27,9	28,9	29,9	29,7	29,4	28,9	64
			Mean temp.	23,9	23,9	23,9	23,2	22,8	22,2	22,0	22,2	22,8	23,7	23,7	23,4	23,1	
			Mean min.	17,5	17,7	18,1	18,1	17,6	16,9	16,6	16,5	16,7	17,4	17,6	17,4	17,3	
			Abs. min.	11,0	11,7	11,1	11,7	13,9	12,7	11,9	12,1	12,2	11,1	12,8	12,0	11,0	
9034081 1 171 m	Kibos Cotton Research Stat.	LM 2-3	Mean max.	31,0	30,9	29,5	27,8	27,6	27,8	27,7	28,2	28,7	29,3	29,0	29,4	28,9	9
			Mean temp.	23,1	23,2	22,8	22,2	22,0	21,4	21,3	21,5	21,8	22,4	22,4	22,3	22,2	
			Mean min.	15,1	15,5	16,1	16,6	16,3	15,0	14,9	14,7	14,8	15,4	15,8	15,1	15,4	
			Abs. min.	10,0	11,1	13,3	13,3	11,7	11,1	10,0	11,1	11,1	11,1	11,1	11,1	10,0	
9034086 1 218 m	Kano Irrigation Station	LM 3	Mean max.	31,6	31,7	30,6	28,8	28,8	28,9	28,8	29,2	30,6	30,5	30,4	30,2	30,0	7
			Mean temp.	23,4	23,7	23,7	22,8	22,7	22,2	23,3	22,3	22,8	23,1	23,1	22,9	22,9	
			Mean min.	15,1	15,7	16,8	16,7	16,6	15,5	17,7	15,4	15,0	15,7	15,7	15,6	15,8	
			Abs. min.	10,0	10,0	12,2	12,8	12,8	11,7	10,6	10,0	10,0	11,1	11,1	11,1	10,0	
9035230 1 559 m	Koru Coffee Research Station	UM 3 lp	Mean max.	29,8	29,9	29,0	26,9	26,9	26,8	27,0	27,0	27,9	28,1	28,1	28,6	28,0	6
			Mean temp.	21,5	22,0	21,5	20,8	20,5	20,2	20,2	20,0	20,5	20,8	20,9	20,9	20,8	
			Mean min.	13,2	14,0	13,9	14,6	14,0	13,5	13,3	13,0	13,0	13,4	13,6	13,1	13,5	
			Abs. min.	9,7	11,0	10,3	10,1	6,9	10,0	10,1	10,0	10,0	11,1	10,0	10,0	6,9	

¹⁾ AEZ = Agro-ecological zone.

1) AEZ = Agro-ecological zone; lp = lower places, hp = higher places within the zone

KISUMU DISTRICT

TABLE 2: RAINFALL FIGURES FROM VARIOUS STATIONS

having at least 10 years of records up to 1976

No. and altitude	Name of Station	Years of rec.	Kind of rec.	Ann. rainf. mm	Monthly rainfall in mm											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
9034004 1 135 m	Kisumu, P.C's Office	72	Average 60% prob. ¹⁾	1 041 931	43 18	71 44	127 115	184 156	140 111	72 50	53 43	70 45	59 44	55 38	86 31	82 56
9034008 1 206 m	Miwani, The Mill	52	Av. 60%	1 341 1 202	63 39	85 62	137 119	216 195	164 128	100 80	83 64	104 92	86 74	90 77	116 62	98 69
9034011 1 463 m	Maseno, Vet. Farm	42	Av. 60%	1 678 1 510	64 40	81 42	142 132	262 240	211 186	98 84	87 67	131 116	159 128	173 146	160 120	110 76
9034012 1 219 m	Miwani, Sugar Section I	40	Av. 60%	1 381 1 242	57 46	88 57	141 120	228 185	166 141	103 88	77 68	111 97	92 74	97 80	126 85	103 60
9034025 1 148 m	Kisumu, Met. Station	37	Av. 60%	1 353 1 212	56 32	99 67	148 133	236 200	174 148	73 46	64 52	88 72	87 76	88 72	143 104	98 73
9034060 1 219 m	Kisumu, New Prison	23	Av. 60%	1 343 1 161	41 26	86 45	140 108	247 217	192 108	63 34	62 40	82 60	96 70	91 83	146 118	97 44
9034078 1 515 m	Maseno, Gov. Training Institute	16	Av.	1 853	71	105	157	298	216	111	80	134	161	191	180	151
9034081 1 172 m	Kibos Cotton Exp.St.	24	Av. 60%	1 320 1 181	46 20	91 62	156 139	223 200	164 123	67 52	66 43	102 71	91 86	84 67	137 100	94 52
9034085 1 180 m	Kisumu Town Hall	14	Av.	1 588	78	116	160	243	168	92	43	68	81	89	121	93
9034086 1 219 m	Ahero, Kano Irr. Stat.	14	Av.	1 219	82	98	152	204	124	82	72	57	60	81	11	94
9035046 1 229 m	Chemelil Plantations	44	Av. 60%	1 396 1 253	76 64	98 65	124 109	192 161	155 134	106 91	82 72	97 83	97 78	105 92	173 87	92 45
9035148 1 706 m	Koru Mission	13	Av.	1 650	115	99	183	208	159	146	134	126	62	105	176	116
9035220 1 493 m	Koru Homa Lime Co.	15	Av.	1 059 ²⁾	63	72	129	151	123	94	82	92	71	58	84	71
9035230 1 574 m	Koru, Coffee Board Substat.	16	Av.	1 742 ³⁾	111	91	199	270	150	143	133	134	96	103	137	125

1) These figures of rainfall reliability should be exceeded normally in 6 out of 10 years

2) Extraordinary low values, probably record errors

3) Extraordinary high value, due to very wet years in short observation period

KISUMU DISTRICT

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

Agro-Ecological Zone	Subzone	Altitudes in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall ¹⁾		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains ²⁾ in days	2nd rains in days	Total ³⁾ in days
UM 1 Coffee-Tea Zone	Very	small,	unimportant						
UM 2 Main Coffee Zone	Very	small,	unimportant						
UM 3 Marginal Coffee Zone	vii or two I is	1 500-1 600	20.8°-20.2°	1 400-1 600	> 700	450-550	180 or more	120-130	300-310
				1 000-1 400	600-700	350-450	180 or more	80-90	260-270
LM 1 L. Midland Sugar Cane Zone									
See Siaya District									
LM 2 Marginal Sugar Cane Zone	$l \sim (m/s)i$ $l/m \sim (m/s \text{ or } s/m)$ $l/m \sim (s/m)i$	1 200-1 500	22.3°-20.9°	1 400-1 600	600-700	450-600	180 or more	110-120	290-300
				1 200-1 580	550-700	450-600	170 or more	105-110	275-290
				1 200-1 400	600-700	450-500	170 or more	100-110	270-280
LM 3 L. Midland Cotton Zone	$m/li(s \text{ or } s/vs)$ $m/li \sim (s \text{ or } s/vs)$ $m+f(vs)$	1 140-1 450	22.7°-21.0°	1 000-1 400	450-650	330-500	155-175	75-105	230-280
				1 100-1 350	500-650	330-450	155-165	75-100	230-265
				1 000-1 200	380-550	200-400	135-155	45-75	
LM 4 Marginal Cotton Zone	(m/s)+i	1 135-1 200	32.1°-22.3°	1 000-1 100	350-500	<150-250	115-135	< 45	

- 1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants
 2) More if growing cycle of cultivated plants continues into the period of second rains
 3) Only added if rainfall continues at least for survival ($> 0.2 E_0$) of most long term crops

34°30' E

35° E

AVERAGE ANNUAL RAINFALL in mm

+ SOILS

8934 8935

KISUMU



+ Rainfall recording station, operating 1976 and having at least 10 years of records

60 Station number in grid

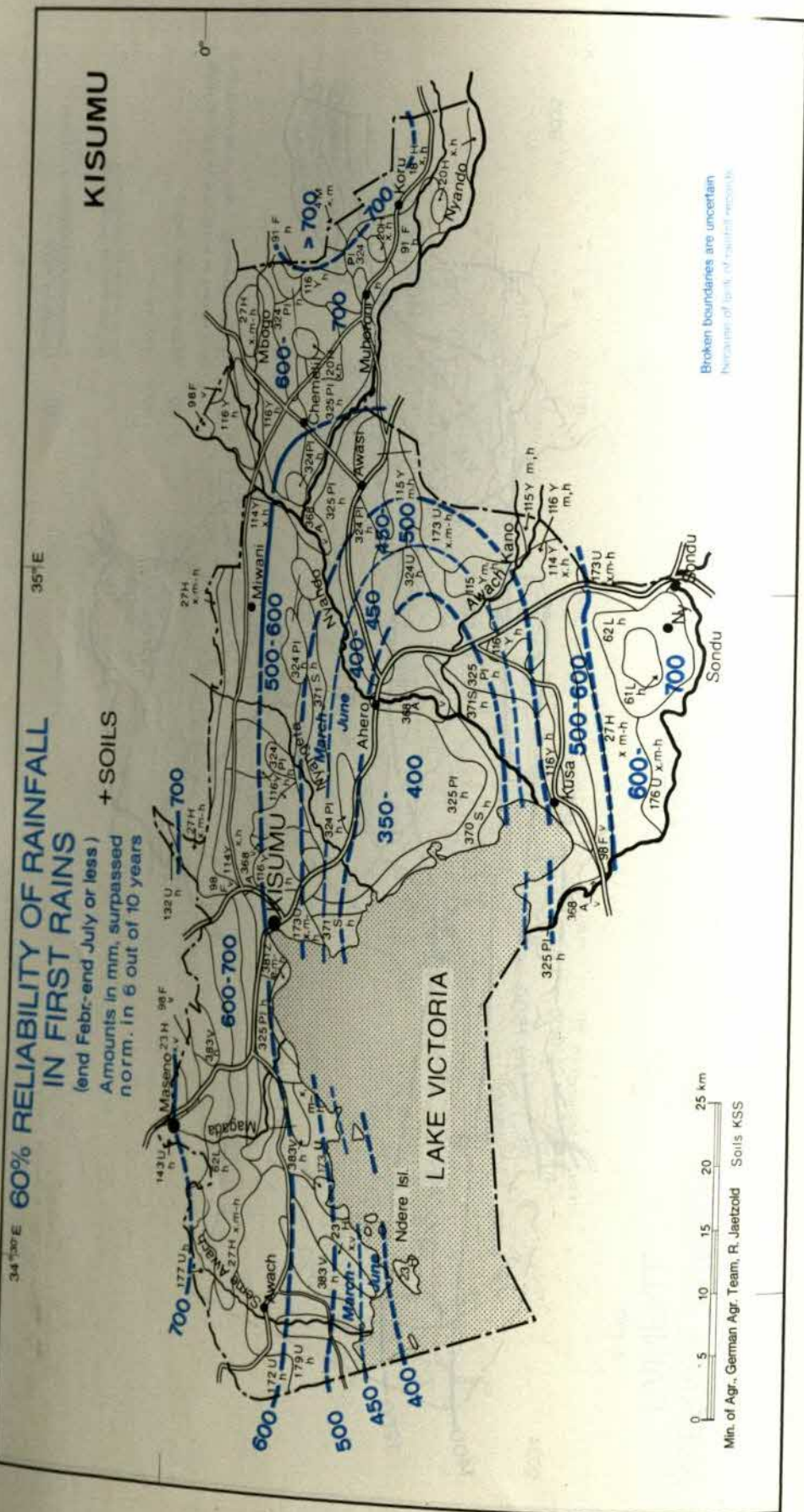
9034 Grid number

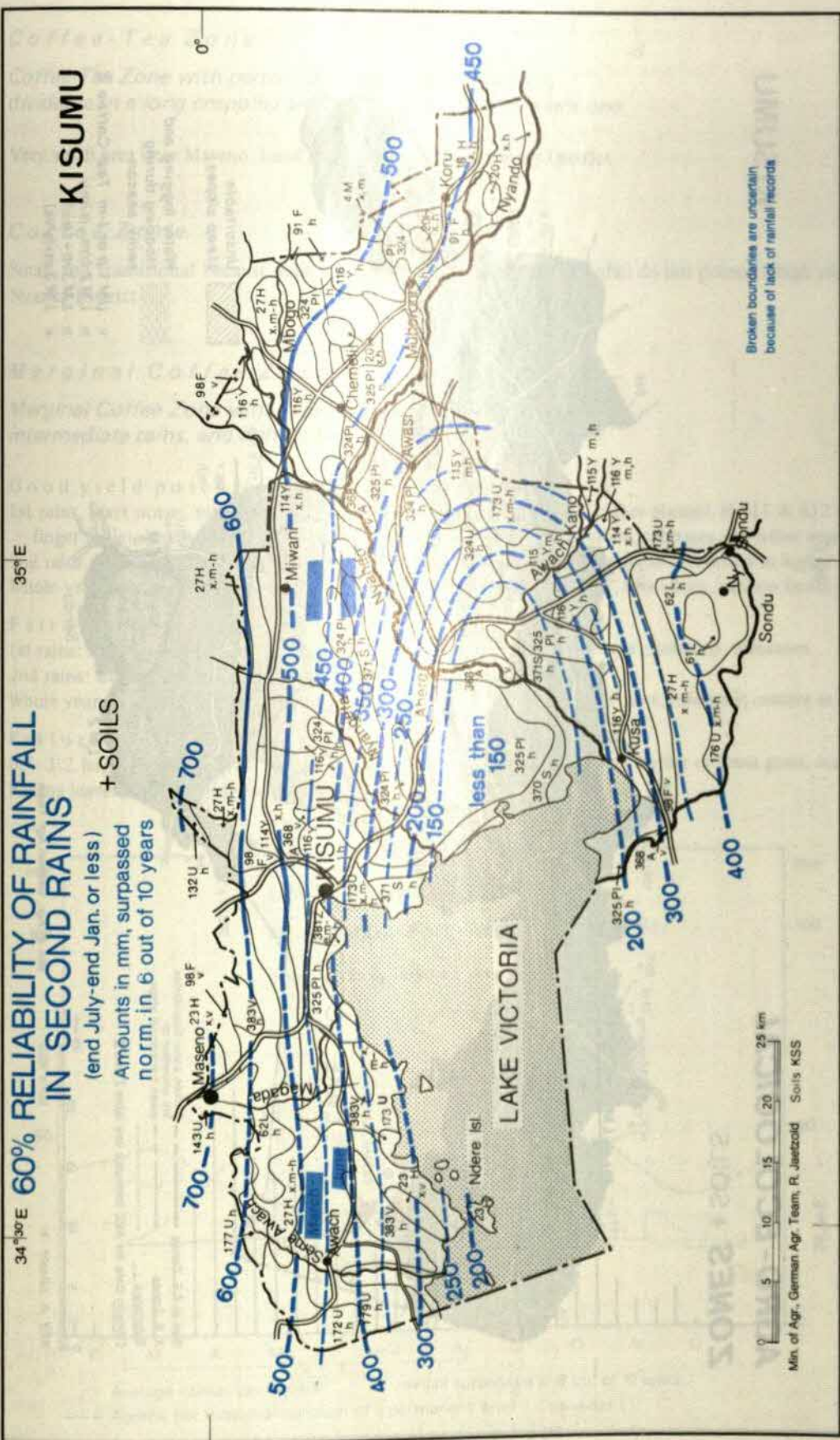
Broken boundaries are uncertain because of lack of rainfall records

⊕ Temperature recording station, operating 1976

25 km

Min. of Agr. German Agr. Team, R. Jaetzold Soils KSS





AGRO- ECOLOGICAL ZONES + SOILS

KISUMU



AGRO-ECOLOGICAL ZONES

UM = UPPER MIDLAND ZONES

UM 1 = Coffee-Tea Zone

UM 1 = Coffee-Tea Zone with permanent cropping possibilities,
p or dividable in a long cropping season followed by a medium one
l-m

Very small area near Maseno. Land use potential see Kakamega District

UM 2 = Coffee Zone

Small and transitional because soils and unimodal distribution of rainfall do not promote high yields, see South Nyanza District

UM 3 = Marginal Coffee Zone

UM 3 = Marginal Coffee Zone with a medium to long cropping season,
m/l i intermediate rains, and a short to medium one
s/m

Good yield potential (av. 60-80% of the optimum)

1st rains, start norm. mid Febr.: M. mat. maize like H 622 & 632 (higher places), H 511 & 512 (lower places), finger millet; beans; sweet potatoes; e. mat. sunflower like 252; onions, cabbages and other vegetables

2nd rains, start norm. end July (planting up to S.); E. mat. sorghum; beans and potatoes in higher places

Whole year, best planting time end F.: Pineapples like Smooth Cayenne, avocados, passion fruits (higher places)

Fair yield potential (av. 40-60% of the optimum)

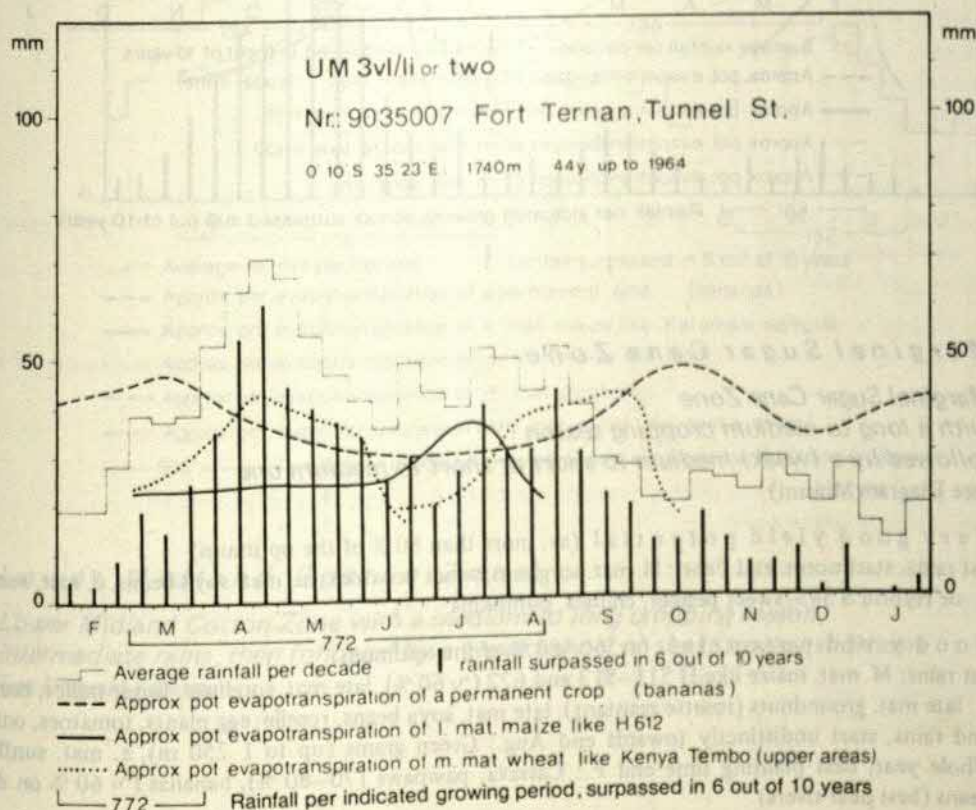
1st rains: Pigeon peas and cowpeas in lower places; potatoes (higher places); tobacco; tomatoes

2nd rains: Beans (lower places); sweet potatoes; cowpeas for leaves

Whole year: Arabica coffee (on bad soils marginal) citrus, bananas, pawpaws, mangoes; cassava in lower places

Pasture and forage

0.7-1.2 ha/LU on high grass sec. savanna, down to 0.15 ha/LU feeding Napier or Bana grass, maize stalks, and banana leaves, and planting fodder legumes



UM 3 = Marginal Coffee Zone with a very long to long cropping season and intermediate rains, dividable in two variable cropping seasons and i.r.
 vl/i i
 or two (see Diagram Ft. Ternan)

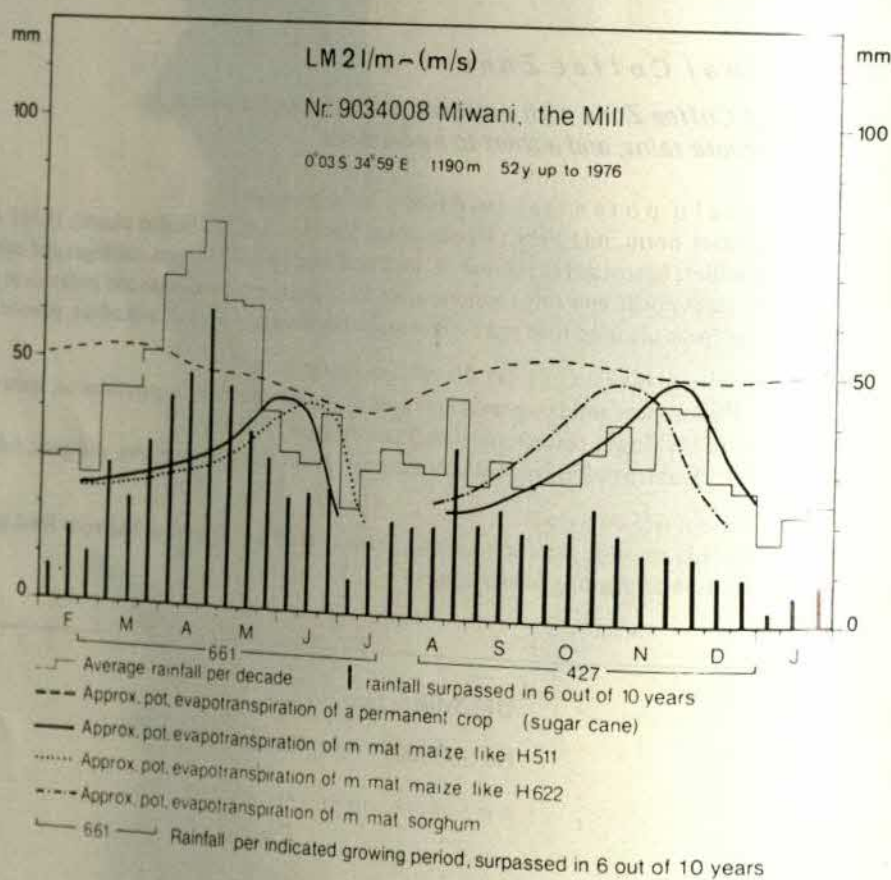
Small, potential 1st rains nearly like above except preferring maize H 612, but second rains start undistinctly around July with fair chances for m. mat. maize like H 511-12. Marginal for coffee also on good soils

LM = LOWER MIDLAND ZONES

LM 1 = Lower Midland Sugar Cane Zone

LM 1 = Lower Midland Sugar Cane Zone with a long cropping season followed by a medium one and intermediate rains
 l-m i

Very small, land use potential see Siaya District



LM 2 = Marginal Sugar Cane Zone

LM 2 = Marginal Sugar Cane Zone
 l/m —
 (m/s or s/m)
 with a long to medium cropping season followed by a (weak) medium to short or short to medium one
 (see Diagram Miwani)

Very good yield potential (av. more than 80 % of the optimum)
 1st rains, start norm. end Febr.: M. mat. sorghum; sweet potatoes; m. mat. soya beans, e. mat. sunflower like 252 or Hybrid S 345; sweet pepper, chillies, pumpkins

Good yield potential (av. 60-80 % of the optimum)
 1st rains: M. mat. maize like H 511-513 and 622 (~ 60 %), late mat. sorghum, finger millet; beans, pigeon peas, late mat. groundnuts (rosette resistant); late mat. soya beans, roselle; egg plants, tomatoes, onions
 2nd rains, start undistinctly towards end Aug.: Green grams (up to 1 250 m), e. mat. sunflower (~ 60 %)
 Whole year, best planting time end F.: Cassava, pawpaws (70-80 %), bananas (~ 60 % on deep soils), yam beans (best near rivers)

Fair yield potential (av. 40–60 % of the optimum)

1st rains: Rice in mbugas; cowpeas; tobacco (on sandy soils), cotton (50–60 %, low quality → danger of rain in open bolls); cabbages, kales, egg plants

2nd rains: M. mat. sorghum (50–60 %)¹⁾, m. mat. maize (40–50 %), bulrush millet (awned var.); beans (higher places), cowpeas (lower places), bambarra groundnuts (light soils); sweet potatoes (~40 %); cotton (July–F., relayplanted in maize of first rains)

Whole year: Sugar cane, pineapples, sisal, citrus (low qual.), mangoes (endangered by fungus diseases)

Pasture and forage

0.6–1.2 ha/LU on sec. high grass savanna with Hyparrhenia and Panicum dominating; down to 0.15 ha/LU feeding Napier or Bana grass, maize stalks, and Banana leaves, and planting fodder legumes

LM 2 = Marginal Sugar Cane Zone with a long cropping season

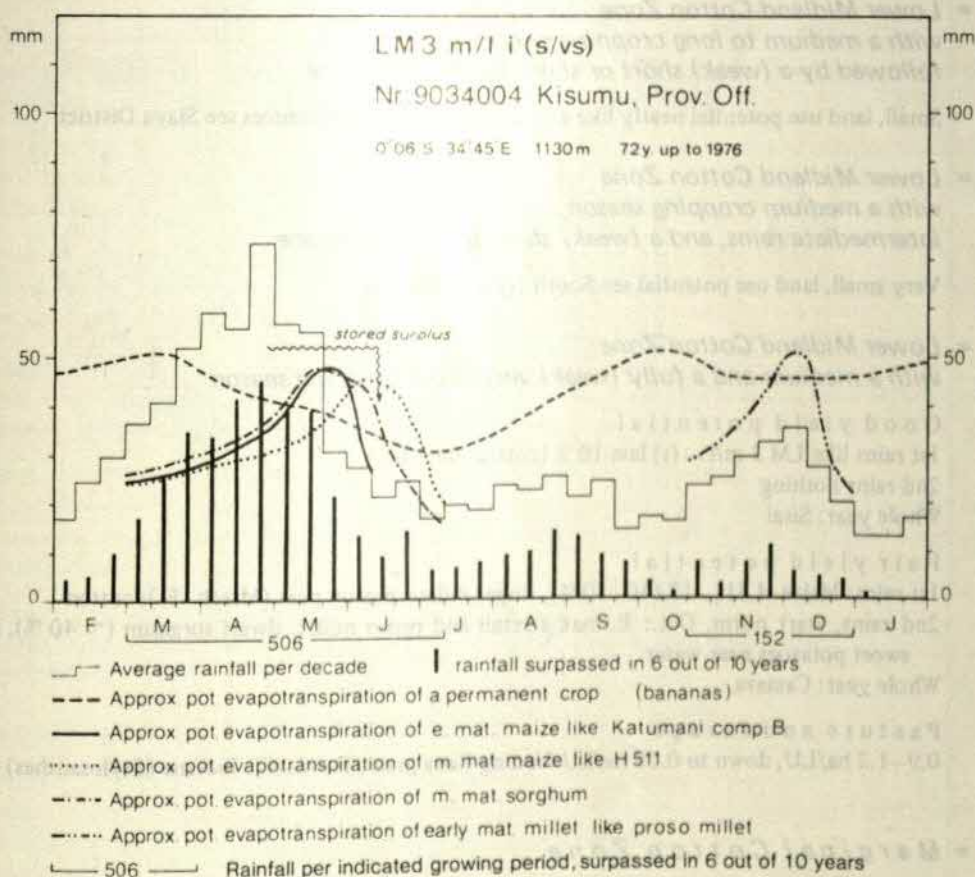
l-(m/s) followed by a (weak) medium to short one
i and intermediate rains

Small, potential see Siaya District

LM 2 = Marginal Sugar Cane Zone with a long to medium cropping season

l/m- followed by a (weak) short to medium one
(s/m) i and intermediate rains

Very small, potential see Siaya District



LM 3 = Lower Midland Cotton Zone

LM 3 = Lower Midland Cotton Zone with a medium to long cropping season,
m/l i (s or s/vs) intermediate rains, then followed by a (weak) short or short to very short one
(see Diagram Kisumu)

Good yield potential

1st rains, start norm. begin March: E. mat. maize like Taboran or Katumani (60–70 %)²; n. mat. sorghum (70–80 %), e. mat. bulrush millet (70–80 %); m. mat. beans, green grams, cowpeas; groundnuts and bambara gr. (both in light soils), simsim³; sweet potatoes; cotton (~ 60 %), m. mat. soya beans, e. mat. sunflower like 52; tomatoes, onions; chick peas (on heavy bl. soils), dwarf castor⁴, kales, muskmelons

2nd rains, start undistinctly after middle rains of Jy.–S. in Oct.: Ratoon of sorghum; simsim (start Aug.), green grams; sweet potatoes in swampy places

Whole year, best pl. time March: Cassava (~ 60 %), sisal, Mexican yam beans

Near swamps with water regulation resp. add. irrigation: Rice, bananas (on dams), Chinese cabbage (on ridges) and other vegetables

Fair yield potential

1st rains: Maize H 511–12 (50–60 %), H 622, finger millet (50–60 %); pigeon peas (March–F.); tobacco (on well drained soils in higher places)

2nd rains: Early mat. proso millet (O.–N.), dwarf sorghum (40–50 %), e. mat. bulrush millet (bird rejecting awned var. best); mwezi moja beans, e. mat. bambara groundnuts (in light soils); dwarf sunflower

Whole year: Pawpaws, mangoes, citrus

Poor yield potential (av. 20–40 % of the optimum)

2nd rains: E. mat. maize

Pasture and forage

0.7–1.0 ha/LU on mixed savanna with star grass (*Cynodon dactylon*); down to 0.2 ha/LU feeding Bana and Napier grass; fodder legumes like Townsville lucerne (*Stylosanthes humilis*) for pasture and soil improvement

LM 3 = Lower Midland Cotton Zone

m/l – with a medium to long cropping season,
(s or s/vs) followed by a (weak) short or short to very short one

Small, land use potential nearly like above. Unimportant differences see Siaya District

LM 3 = Lower Midland Cotton Zone

m i with a medium cropping season,
(s/vs) intermediate rains, and a (weak) short to very short one

Very small, land use potential see South Nyanza District

LM 3 = Lower Midland Cotton Zone

m + f (vs) with a medium and a fully (weak) very short cropping season

Good yield potential

1st rains like LM 3 m/l – (s) less 10 % (cotton then fair)

2nd rains nothing

Whole year: Sisal

Fair yield potential

1st rains: Maize H 511–13 (40–50 %), finger millet; pigeon peas (March–F.); cotton

2nd rains, start norm. Oct.: E. mat. foxtail and proso millet, dwarf sorghum (~ 40 %); green grams, simsim; sweet potatoes near water

Whole year: Cassava

Pasture and forage

0.9–1.2 ha/LU, down to 0.25 ha/LU feeding Bana grass, Townsville lucerne (*Stylosanthes*) and others

LM 4 = Marginal Cotton Zone

LM 4 = Marginal Cotton Zone with a (weak) medium to short cropping season
(m/s) + i and intermediate rains

Good yield potential

1st rains, start norm. mid March: E. mat. sorghum (~ 60 %), e. mat. foxtail or proso millet (60–70 %); e. mat. beans (~ 60 %), tepary beans (70–80 %), green grams, cowpeas, chick peas (on h. black soils); e. mat. sunflower like Issanka (~ 60 %), simsim

Whole year: Sisal

Near swamps: Like LM 3

Fair yield potential

1st rains: E. mat. maize (40–50 %) and bulrush millet (50–60 %); pigeon peas (~40 %), soya beans (40–50 %), e. mat. groundnuts and e. mat. bambarra gr. (both in light soils); onions

Poor yield potential

1st rains: Cotton

Pasture and forage

1–2 LU/ha; horse tamarind (*Leucaena*) and other palatable shrubs to plant in order to improve fodder situation during dry season

- 1) Best planting time mid of August
- 2) Plant only small part for safety, yield in kg is less than that of H 511–13 whose percentage of the optimum puts these varieties only in the fair class.
- 3) Planting end of May
- 4) Good for rotation because of its resistance against *Striga*



KISUMU

GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences

SERIOUS LIMITATIONS
(see descriptions)
Steep slopes unsuitable for cultivation not marked in Nat. Pks.
For. Res. and ranching areas

Shallow soil

Waterlogging

0 5 10 15 20 25 km

Soils KSS

high

moderate to high

moderate

low

low to very low

very low

variable

GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences

SERIOUS LIMITATIONS
(see descriptions)

Steep slopes unsuitable for cultivation, not marked in Nat. Pks., For. Res. and ranching areas

Shallow soil

Waterlogging

Soils KSS

SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

Due to the fact that there is a rift valley stretching west-east, the physiography of the district is varied; it ranges from pronounced scarps in the North, East and South and from associated footslopes and piedmont plains to the Kano plains, which occupy the major part of the district.

Here, plain soils on former lake sediments occur (units 324 Pl and 325 Pl) having a high to moderate fertility, but subject to waterlogging. In the western part of the plain, these soils are associated with swampy areas where soils are mottled (370 S, 371 S). They have a variable fertility and also show waterlogging. On the slightly higher topography, on piedmont plains, alluvial soils of units 114 Y, 115 Y, 116 Y of moderate to low fertility with some drainage problems are dominant.

Above the plains, upland soils with variable topsoil and moderate to low fertility are found (172 U, 173 U). In the far north-western area are the soils of the rocky Southern Kakamega Uplands (unit 179 U) which are soils of low fertility underlain by murrum or rock within 80 cm of the surface (cf. to W. SIDERIUS: Simplified Soil Maps of Kenya. KSS, 2nd ed. Nairobi 1979).

Along the Winam Gulf, soils on lake-side beach ridges can be found (unit 381 Z) which are variable fertile and partly water-logging.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on olivine basalts and ashes of major older volcanoes

- 4 M = well drained, shallow to moderately deep, dark reddish brown, friable, humic, rocky and stony clay loam (nito-humic CAMBISOLS, rocky phase)
x, m¹⁾

SOILS ON HILLS AND MINOR SCARPS

Soils developed on intermediate igneous rocks (syenites, trachytes, etc.)

- 18 H = well drained to moderately well drained, shallow to moderately deep, dark reddish brown to dark brown, firm, bouldery or stony clay, with humic topsoil (verto-luvic PHAEZOZEMS, lithic and bouldery phase)
x, h

Soils developed on basic igneous rocks (serpentinites, basalts, nepheline phonolites; older basic tuffs included)

- 20 H = somewhat excessively drained, shallow to moderately deep, dark reddish brown, friable, gravelly clay, with acid humic topsoil (humic CAMBISOLS, partly paralithic phase)
x, v

Soils developed on granites

- 23 H = complex of somewhat excessively drained, shallow, stony and rocky soils of varying colour, consistence and texture (dystric REGOSOLS; with ferralic CAMBISOLS, lithic phase and Rock Outcrops)
x, v

Soils developed on quartzites

- 24 H = somewhat excessively drained, shallow, dark brown, very friable, rocky, sandy loam to clay loam; in many places with acid humic topsoil (RANKERS; with LITHOSOLS and Rock Outcrops)
x, m

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

- 27 H = complex of excessively drained to well drained, shallow, dark red to brown, friable sandy clay loam to clay; in many places rocky, bouldery and stony and in places with acid humic topsoil (dystric REGOSOLS; with LITHOSOLS, humic CAMBISOLS lithic phase and Rock Outcrops)
x, m-h

Soils developed on Jurassic sandstones, grits and conglomerates

- 30 H = well drained, shallow, brown, friable, rocky and stony, sandy clay loam (on hills and plateau rests) (eutric REGOSOLS)
m

SOILS ON PLATEAUS AND HIGH-LEVEL STRUCTURAL PLAINS

Soils developed on intermediate igneous rocks (syenites, trachytes, phonolites, etc.)

- 61 L = well drained, moderately deep to deep, dark red, friable clay, over petroplinthite; with inclusions of small bottomlands of mollic GLEYSOLS, partly petro-ferric phase (rhodic FERRALSOLS, petroferric phase)
h
62 L = well drained, very deep, dark reddish brown to dark red, friable clay (nito-rhodic FERRALSOLS)
h

1) Soil texture-classes

- h = heavy
l = light
m = medium
x = stony or bouldery
v = varying texture
m-h = medium to heavy
m, h = medium and heavy (e. g. abruptly underlaying a topsoil of different texture)

SOILS ON FOOTSLOPES

Soils developed on colluvium from basic igneous rocks (serpentinites, basalts, etc.)

- 91 F = well drained, deep to very deep, dusky red to dark reddish brown, friable clay, often with humic topsoil (nitro-rhodic FERRALSOLS, with verti-mollic NITOSOLS)

Soils developed on colluvium from undifferentiated Basement System rocks

- 98 F = complex of well drained, deep to very deep, dark reddish brown to dark yellowish brown soils of varying consistence and texture, in places gravelly and stratified (ferralic ARENOSOLS; with ferralo-chromic, orthic LUVISOLS)

SOILS ON PIEDMONT PLAINS

Soils developed on alluvium from undifferentiated Basement System rocks

- 114 Y = imperfectly drained, very deep, very dark grey to black, very firm, cracking, gravelly clay to clay, with calcareous deeper subsoil; in places gravelly (verto-eutric PLANOSOLS)
- 115 Y = poorly drained, very deep, dark greyish brown to very dark grey, mottled, firm to very firm, clay, abruptly underlying a topsoil of friable, sandy clay loam; in places with a sodic deeper subsoil (eutric PLANOSOLS; with solodic PLANOSOLS)
- 116 Y = complex of moderately well drained to poorly drained, very deep, dark brown to dark grey, firm to very firm, sandy clay to clay, in places stratified, sodic and/or cracking (PLANOSOLS, GLEYSOLS, SOLONETZ, VERTISOLS and FLUVISOLS)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

Soils developed on basic igneous rocks (basalts, etc.)

- 142 U = well drained, deep to extremely deep, dark red, friable clay, with thick humic topsoil (mollic NITOSOLS; with nito-luvic PHAEZOZEMS)
- 143 U = well drained, extremely deep, dark reddish brown, friable clay (dystric NITOSOLS)

SOILS ON LOWER-LEVEL UPLANDS

Soils developed on basic igneous rocks (basalts, etc.)

- 171 U = well drained, moderately deep, red, firm clay, with humic topsoil; with inclusions of imperfectly drained, deep, dark grey, mottled, very firm clay (chromo-luvic PHAEZOZEMS; with gleyic LUVISOLS)

Soils developed on intermediate igneous rocks (andesites, etc.)

- 172 U = well drained, moderately deep to deep, dark reddish brown, friable clay; in many places over petro-plinthite (chromic LUVISOLS, partly petroferric phase; with „murram cuirass“ soils)
- 173 U = well drained, shallow, dark reddish brown to brown, sandy clay loam to gravelly clay, partly over petroplinthite („murram cuirass“ soils (50–75%) and eutric CAMBISOLS, lithic or petroferric phase; with orthic LUVISOLS)

Soils developed on acid igneous rocks

- 176 U = complex of predominantly well drained, moderately deep to deep, reddish brown to brown, friable, gravelly clay loam to clay, often with a humic topsoil; in many places shallow over petroplinthite (chromo-luvic PHAEZOZEMS and orthic and chromic LUVISOLS; with „murram cuirass“ soils)

Soils developed on granites

- 179 U = complex of: – well drained, moderately deep to very deep, reddish brown to yellowish brown, friable clay, over petro-plinthite (orthic FERRALSOLS, partly petroferric phase; with orthic ACRISSOLS)
- moderately well drained, shallow, brown to dark brown soils over petroplinthite (about 30%) („murram cuirass“ soils)

SOILS ON LACUSTRINE PLAINS

Soils developed on sediments from lacustrine mudstones

- 324 Pi = poorly drained, shallow to deep, very dark brown to very dark grey, firm to very firm, slightly sodic, cracking clay (upper level of Kano plains) (chromic VERTISOLS, sodic and partly lithic phase)
- 325 Pi = poorly drained, very deep, very dark grey to black, very firm, slightly sodic, cracking clay, with calcareous deeper subsoil (lower level of Kano plains) (pellic VERTISOLS, sodic phase)

SOILS ON FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

- 368 A = complex of well drained to imperfectly drained, very deep, dark greyish brown to dark reddish brown, stratified soils of varying consistence and texture (eutric FLUVISOLS)

POPULATION AND LAND

The population of the Kisumu District was more than 482 000 at the time of the Census September 1979 (Table 4). About 152 000 people lived in the Kisumu Municipality. Rural population outside the municipality would then be about 330 000 including 7 000 living in trading centers (possible not dependant on farming). The available agricultural land per average household of 5 people (Table 5) is 2.42 ha, per rural person 0.48 ha (Table 6). In the AEZ UM 1-3 and LM 1-3 this is still adequate, but in LM 4 too small. In view of the fact that a large part of the population of the municipality also depend partly or mainly on rural earnings, and considering the population increase, agricultural intensification is necessary. Most critical is South Nyakach Location with 0.25 ha per person (Table 6).

KISUMU DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Kisumu East/West	15 897	17 724	33 621	6 623	125	284
Seme East	14 841	17 239	32 080	6 072	115	229
Seme West	12 603	14 884	27 487	5 546	115	224
Maseno Division	43 341	49 847	93 188	18 241	385	245
North East Kano	20 042	21 651	41 693	8 421	205	205
South East Kano	17 645	19 208	36 853	6 646	295	124
North Nyakach	15 959	18 170	34 129	6 489	185	186
South Nyakach	11 092	12 847	23 939	4 233	75	301
West Nyakach	8 995	10 062	19 057	4 025	95	195
Nyando Div.	73 733	81 938	155 671	29 814	859	181
West Kano	15 608	16 697	32 305	5 173	144	223
Winam Div.	15 608	16 697	32 305	5 173	144	223
Muhoroni	6 043	4 250	10 293	2 818	76	134
Koru	3 994	3 571	7 565	1 687	78	96
Miwani	6 068	3 432	9 500	2 603	102	92
Chemelil	11 533	9 629	21 162	4 817	182	116
Muhoroni Div.	27 638	20 882	48 520	11 925	439	110
Kisumu Municipality	77 722	74 921	152 643	32 458	270	565
Kisumu District	238 042	244 285	482 327	97 611	2 093	230

KISUMU DISTRICT

TABLE 5: COMPOSITION OF HOUSEHOLDS
PER
LOCATION AND DIVISION^{a)}

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Persons per Household total ^{b)}
		Adults > 15 years	Children < 15 years	Other Relatives		
Location:						
Kisumu East/West	6609	2.83	1.25	0.80	0.16	5.03
Seme East	6041	3.01	1.20	0.89	0.17	5.27
Seme West	5478	2.85	1.07	0.87	0.22	5.01
Division Maseno	18128	3.63	0.44	0.85	0.18	5.11
Location:						
N.E. Kano	8410	2.99	1.03	0.67	0.27	4.96
S.E. Kano	6604	3.12	1.24	0.80	0.24	5.40
North Nyakach	6514	2.95	1.22	0.87	0.20	5.24
South Nyakach	4222	3.04	1.48	0.87	0.21	5.60
West Nyakach	4026	2.89	1.26	0.40	0.18	4.73
Division Nyando	29776	3.00	1.22	0.76	0.23	5.18
Location:						
West Kano	5171	3.26	1.36	1.34	0.27	6.23
Division Winam	5171	3.26	1.36	1.34	0.27	6.23
Location:						
Muhoroni	2820	2.34	0.59	0.62	0.09	3.64
Koru	1682	2.68	0.87	0.59	0.24	4.39
Miwani	2594	2.27	0.37	0.43	0.34	3.38
Chemelil	4842	2.69	0.84	0.54	0.29	4.37
Division Muhoroni	11938	2.52	0.67	0.54	0.25	3.98
Location:						
Kisumu Municipality	32426	2.67	0.86	0.74	0.28	4.55
DISTRICT: KISUMU	97439	2.83	1.02	0.77	0.24	4.87

^{a)} Source: Central Bureau of Statistics (CBS)

^{b)} Average figures, includes one and two persons per household as well

KISUMU DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION
AND PER
HOUSEHOLD AND PERSON

	in '00 ha = sqkm					in '00 ha = sqkm								in ha	
Location/Division without townships	Area total Census 79	Non-agricultural land			Agricultural land	Area in agro-ecological zones								Agricultural land per house- hold person	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home- steads, rivers...)		A E Z									
						UM 1	UM 2	UM 3	LM 1	LM 2	LM 3	LM 4			
Kisumu East	226	7		22	197	13			24	63	97		2.97	0.59	
Kisumu West	139			13	126				2	67	57		2.08	0.39	
Seme East	122		sw. 2	12	108					19	82	7	1.95	0.39	
Seme West	487	7	sw. 2	47	431	13			26	149	236	7	2.02	0.39	
Maseno Division	202		sw. 15	20	167					17	150		2.27	0.46	
North East Kano	296		sw. 29	30	237					6	143	88	3.81	0.68	
South East Kano	183		sw. 37	18	128						88	40	1.97	0.38	
North Nyakach	79	10		8	61								1.44	0.25	
South Nyakach	97	10	F. 2	10	72	8	31			20	2		1.79	0.38	
West Nyakach			sw. 3				16			7	48	1			
Nyando Division	859	20		86	86	667	8	47		52	431	129	2.23	0.42	
West Kano	144		sw. 36	14	94						38	56	1.82	0.29	
Winam Division	144		36	14	94						38	56	1.82	0.29	
Muhoroni	76	2		8	66								1.99	0.54	
Koru	78	9		8	61		10			56			3.62	0.80	
Miwani	102	10		10	82		11			50			3.65	1.01	
Chemelil	182	6		18	164			6		76			3.30	0.73	
Muhoroni Division	438	27		44	356		24	6		155			3.15	0.77	
Total rural area	1 926	38	124	191	1 573	13	8	71	32	552	729	192	2.42	0.48	

For official land statistics see supplementary publication to FM - Handbook, Vol. III A: Agriculture Land Statistics.

AGRICULTURAL STATISTICS

Approximately 1,000 t of seed cotton are ginned at the ginnery of Kibos annually, but this cotton is not grown exclusively within the district. It is estimated that roughly 2,000 ha of cotton are planted annually producing on average yields of 200 kg of seed cotton per ha. Much of it is interplanted during August/September,¹⁾ a method which requires little or no cash and little labour because weed growth or pest infestation is negligible during the second half of the year.

Sugar cane is the most important cash crop of the area, although the natural conditions are not very suitable for this crop within the district.²⁾

KISUMU DISTRICT

TABLE 7 a: COFFEE
AREA – PRODUCTION – YIELDS^{a)}

Co-operatives

Item	Unit	Year				
		74/75	75/76	76/77	77/78	79/80
Area	ha	117	117	117	117	117
Production	t	19	11	17	7	8
Yield	kg/ha	162	94	145	60	68

TABLE 7 b: COTTON
PRODUCTION^{b)}

Ginnery Zone	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Kibos					
Seed Cotton in t	285	669	842	759	1346
Bales	500	1174	1478	1333	2362

a) Source: C.B.K.

b) Source: C.L. & S.M.B., does not refer to district area only

1) Investigations of Cotton Research Station, Kibos; the labour profile does take late planted cotton into consideration

2) Fairly exact data exist for industrial crops only; for more detailed information see FMHB Vol. III A

SMALL FARM SURVEY (SFS)¹⁾

A glance at the soil and the AEZ maps of the district makes it clear that more than 75 % of the district is unsuitable for economically successful small-scale farming. Extremely heavy soils combined with a warm climate, relatively low annual rainfall and repeated flooding makes farming a heavy burden. The SFS was carried out in AEZ LM 1-3 and LM 3-4.

The farms investigated are relatively small in size: 2.2 to 4.4 ha; half of the land is used for crops and half for grazing. There are however still comparatively large areas of commonly owned grazing grounds available. Therefore the stocking rates given of 3.8-5.4 LU/ha do not reflect the carrying capacity of the pasture. Most of the fertilizer used is applied to sugar cane (tables 9 a and 12 a). A very wide range of crops is grown, which is partly a result of the farmers' desire to spread the risk and also reflects the marketing possibilities in nearby Kisumu town (table 10).

Table 12 indicates that the farmers harvest very small yields and consider purchased inputs an uneconomic investment. Almost no farmers keep improved cattle and 10 % of the grazing livestock are sheep and goats (table 11). Fifty per cent of the maize harvested in AEZ LM 1-3 is sold to the Marketing Board, while in LM 3-4 all food produced is consumed locally (table 13). Graph 14 - Distribution of Farming Activities - reflects in part the difficulties farmers face when working the heavy black cotton soils. The yields indicated for Level II and III in table 15 can only be achieved if the field preparation is mechanised.²⁾

Lasting improvement of the socio-economic situation of most small-scale farmers of the district can only be achieved through large investment in drainage and irrigation by the Government. The sugar belt yields returns mostly to larger farms only.

- 1) November 1977, sample size 30. For more detailed and up to date information see FMHB Vol. III B
- 2) See also notes on farm management information, output and nutrient input, page 51

Crop	Yield (kg/ha)				Remarks
	1976	1977	1978	1979	
Maize	1200	1100	1000	900	
Sugar Cane	500	400	300	200	
Wheat	100	100	100	100	
Other	100	100	100	100	

34°30' E

35° E

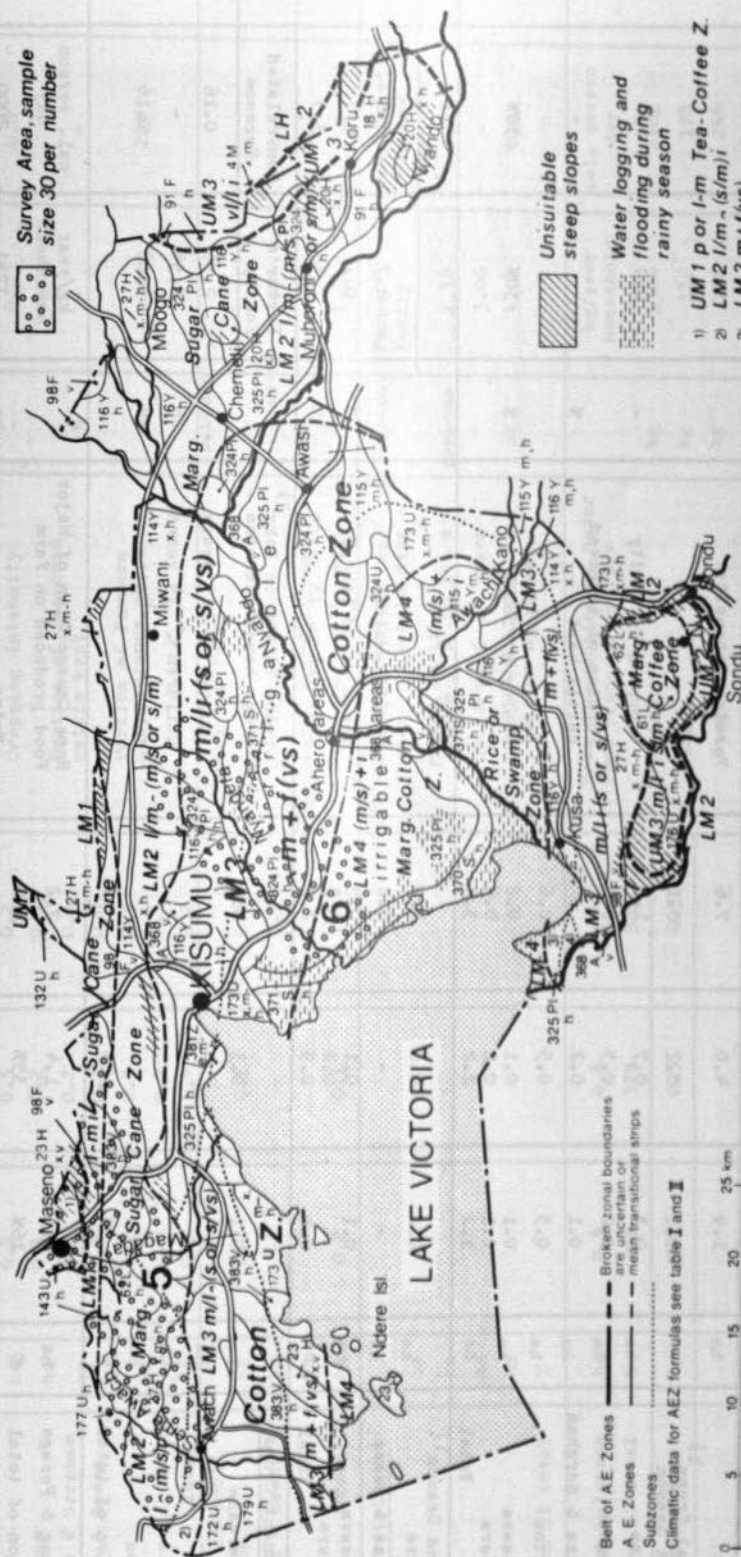
SMALL FARM SURVEY AREAS (1977) and AGRO - ECOLOGICAL ZONES + SOILS

KISUMU

5 National Number of
Survey Area

Survey Area, sample
size 30 per number

0°



Belt of A.E. Zones
A.E. Zones
Subzones
Climatic data for AEZ formulas see table I and II

0 5 10 15 20 25 km
AEZ R Jarzold 81
Soils KSS

Min. of Agr., German Agr. Team

Unsuitable
steep slopes

Water logging and
flooding during
rainy season

- 1) UM 1 por l-m Tea-Coffee Z.
- 2) LM 2 l-m - (s/m) i
- 3) LM 3 m + f (vs)
- 4) LM 3 m (s/vs)

KISUMU DISTRICT

AEZ: UM 1 - LM 1-3

TABLE 8.4: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.9	4.0	7.6	Farming Intensity:				
Land Use:					Cropping Intensity	-	0.9	0.8	0.8
Annual Crops 1)	ha	0.1	0.2	0.1	Portion of improved cattle kept	%	-	-	-
Maize	ha	0.3	0.7	1.8	Portion of Farmers owning a Plough	%	30%	30%	110%
Sorghum	ha	0.2	0.3	0.4					
Maize & Sorghum	ha	0.1	0.2	-					
Cotton	ha	0.3	0.5	0.6					
Caesava	ha	0.1	0.1	0.2					
Others	ha	0.1	0.2	0.7					
Total	ha	1.2	2.2	3.8					
Second Season 1)									
Maize	ha	0.2	0.6	1.0	Labour on Farm:				
Maize & Beans	ha	-	-	0.2	Family Adults	persons	2.7	3.3	3.2
Caesava	ha	0.1	0.1	0.2	Perm. Hired Labour	"	0.1	0.7	0.7
Others	ha	0.4	0.9	2.2	Children > 14 years	"	2.4	3.3	2.2
Total	ha	0.5	0.3	0.5					
Permanent Crops 1)					Persons living on Farm 2)				
Sugarcane	ha	0.1	0.3	0.5	- average household size -				
	ha				Adults > 14 years	persons	2.56	0.16	2.72
	ha				Children < 14 years	"	2.54	-	2.54
	ha				Subsistence Units	SU	4.08	0.16	4.24
portion of total	%	5%	8%	7%					
Grazing & Forage	ha	0.3	1.4	2.2	Home Consumption of Major				
portion of total	%	16%	35%	29%	Food produced on Farm	kg/year household			
Other Land Use	ha	0.3	0.1	1.1	Maize	kg	1241	2000	
Livestock on Farm:					Beans	kg	71	113	
Cattle: local	LU	1.9	3.8	5.1	Cabbage	kg	4	395	
improved	LU	-	-	-	Sorghum	kg	252	23	
Sheep & Goats	LU	0.3	0.8	1.4	Cowpeas	kg	14	23	
Total	LU	2.2	4.6	6.5	Groundnuts	kg	22	33	

Other crops cultivated: Beans, Sweet Potatoes, Groundnuts, Cowpeas, Onions, Tomatoes

- 1) Major crops only considered
 2) Based on 1979 Census figures

TABLE 8 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 06

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.4	2.5	4.2	Farming Intensity:				
Land Use: ¹⁾ Annual Crops First Season					Cropping Intensity	-	0.7	0.6	0.8
Maize	ha	0.2	0.3	0.2	Portion of improved cattle kept	%	-	-	-
Sorghum	ha	0.1	0.2	0.1	Portion of Farmers owning a plough	%	10%	20%	80%
Maize & Sorghum	ha	0.2	0.2	0.6					
Maize & Beans	ha	0.1	0.2	0.8					
Cotton	ha	0.2	0.3	0.5					
Others	ha	-	0.2	-					
Total	ha	0.8	1.4	2.2					
Second Season¹⁾					Labour on Farm:				
Cotton	ha	0.2	0.1	0.6	Family Adults	persons	2.7	2.5	2.5
Maize & Beans	ha	-	-	0.7	Perm. Hired Labour	"	-	0.2	0.5
	ha	0.2	0.1	1.3	Children > 14 years	"	1.3	2.8	1.8
Total	ha	0.2	0.1	1.3					
Permanent Crops¹⁾					Persons living on Farm²⁾		Farmer's Family	Non-related Persons	Total
Portion of total	ha				- average household size -				
	ha				Adults > 14 years	persons	2.18	0.33	2.51
	ha				Children < 14 years	"	3.06	-	3.06
	ha				Subsistence Units	SU	4.01	0.33	4.34
	%								
Grazing & Forage	ha	0.4	0.8	1.5	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Portion of total	%	29%	32%	36%	Maize	kg	1304	2102	
Other Land Use	ha	0.2	0.3	0.5	Beans	kg	112	178	
					Sorghum	kg	156	244	
Livestock on Farm:									
Cattle: local	LU	1.0	3.4	9.6					
Improved	LU	-	-	-					
Sheep & Goats	LU	0.4	0.5	2.4					
Total	LU	1.4	3.9	12.0					

1) Major crops only considered

2) Based on 1979 Census figures

Other Crops cultivated: Sunflower, Cassava

KISUMU DISTRICT

TABLE 9a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: UM 1 - LM 1-3

Survey Area 05

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	4.4	15.2	1.1	3.1	0.5	2.7
Avg. 1	4.4	16.3	2.0	3.3	1.4	3.6
Up. Qu.	6.0	24.0	2.0	4.0	1.0	4.0
Lo. Qu.	2.4	6.0	-	2.0	-	-

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	2.3	54	0.3	7	1.2	27	-	-	0.3	7	0.1	6
Avg. 1	3.5	46	0.7	13	1.2	24	-	-	0.6	12	0.5	5
Up. Qu.	2.9	67	0.5	11	1.8	35	-	-	0.4	13	0.5	7
Lo. Qu.	1.2	40	-	-	0.4	17	-	-	-	-	0.1	2
Total	59.3		3.5		35.1		-	-	8.7		7.2	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.3	1.0	3.3	-
Avg. 1			3.8	-
Up. Qu.	1.4	1.3	6.5	-
Lo. Qu.	1.1	0.6	1.6	-

Inputs Applied

Inputs Applied													
Range	Improved Seeds Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	56.2	2.7	-	20.9	-	-	-	0.2	-	2.2	-	-	-
Avg. 1	61.7	16.2	-	33.6	-	-	-	1.1	-	2.9	-	0.1	-
Up. Qu.	83.3	-	-	15.0	-	-	-	0.1	-	3.0	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0

Notes: Avg. 0

= average of all sample farms

Avg. 1

= average of all farms excluding zero entries

Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points

AC = Annual Crops

PC = Perennial Crops

KISUMU DISTRICT

TABLE 9 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: LM 3-4

Survey Area 06

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	2.2	17.9	0.5	2.6	0.1	1.6
Avg. 1	2.2	24.5	2.3	2.6	1.0	2.5
Up. Qu.	3.0	10.0	-	3.0	-	3.0
Lo. Qu.	1.6	-	-	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	1.2	56	-	1	0.7	32	-	-	0.1	7	0.1	5
Avg. 1	1.2	45	0.1	5	0.8	27	-	-	0.5	18	0.1	4
Up. Qu.	1.6	71	-	-	1.0	48	-	-	0.3	8	0.2	7
Lo. Qu.	0.8	45	-	-	0.3	17	-	-	-	-	-	2
Total	37.5		0.4		21.3		-		4.5		3.2	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.1	1.8	5.5	-
Avg. 1			5.4	-
Up. Qu.	1.0	1.8	6.7	-
Lo. Qu.	1.0	-	-	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	50.3	-	-	3.0	-	-	-	-	-	2.0	-	-	-
Avg. 1	53.6	-	-	25.8	-	-	-	-	0.2	4.3	-	-	-
Up. Qu.	100.0	-	-	-	-	-	-	-	-	2.5	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0

= average of all sample farms

Avg. 1

= average of all farms excluding zero entries

Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points

AC = Annual Crops

PC = Perennial Crops

KISUMU DISTRICT

TABLE 10 a: CROPPING PATTERN

AEZ: UM 1 - LM 1-3

Survey Area 05

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	1.0	1.3	1.20	0.00	29.0	37.1
Sorghum	0.3	0.7	0.80	0.00	9.4	12.0
Beans	0.0	0.3	0.00	0.00	1.2	1.5
Cowpeas	0.0	0.4	0.00	0.00	0.4	0.5
Groundnuts	0.1	0.4	0.40	0.00	4.2	5.4
Sunflower	0.2	0.7	0.40	0.00	5.6	7.2
Cabbage	0.0	0.1	0.00	0.00	0.1	0.2
Onions	0.0	0.2	0.00	0.00	0.2	0.3
Tomatoes	0.0	0.2	0.00	0.00	0.2	0.3
Cotton	0.5	0.6	0.60	0.20	14.5	18.5
Cassava	0.2	0.5	0.40	0.00	5.2	6.7
Sweet Potatoes	0.0	0.2	0.00	0.00	0.7	0.9
Sugarcane	0.1	0.7	0.00	0.00	2.6	3.3
Pineapples	0.0	0.0	0.00	0.00	0.0	0.1
Others	0.0	0.4	0.00	0.00	0.4	0.5
Maize & Sorghm	0.1	0.9	0.00	0.00	2.7	3.5
Maize & Beans	0.0	0.3	0.00	0.00	1.0	1.3
Maize & Others	0.0	0.3	0.00	0.00	0.6	0.8
Total					78.1	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.7	1.0	1.20	0.00	19.6	47.5
Beans	0.1	4.0	0.00	0.00	4.0	9.7
Cowpeas	0.0	0.4	0.00	0.00	0.4	1.0
Sunflower	0.2	1.0	0.00	0.00	4.8	11.6
Cotton	0.0	0.6	0.00	0.00	0.6	1.5
Cassava	0.2	0.5	0.40	0.00	5.2	12.7
Sugarcane	0.1	0.7	0.00	0.00	2.6	6.3
Pineapples	0.0	0.0	0.00	0.00	0.	0.1
Others	0.0	0.3	0.00	0.00	1.0	2.4
Maize & Beans	0.1	0.7	0.00	0.00	2.0	4.8
Maize & Others	0.0	0.5	0.00	0.00	1.0	2.4
Total					41.3	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Coffee	0.0	0.2	0.00	0.00	0.2	100.0
Total					0.2	100.0

Avg. 0 = average of all sample farms

Avg. 1 = average of all farms excluding zero entries

Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points

% columns = % of total farm land

KISUMU DISTRICT

TABLE 10 b: CROPPING PATTERN

AEZ: LM 3-4

Survey Area 06

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.2	0.5	0.40	0.00	5.7	15.1
Maize IPC	0.0	0.2	0.00	0.00	0.2	0.5
Sorghum	0.1	0.4	0.12	0.00	3.1	8.3
Beans	0.0	0.2	0.00	0.00	0.2	0.5
Sunflower	0.0	0.4	0.00	0.00	0.4	1.1
Cotton	0.3	0.6	0.40	0.00	8.3	22.0
Cassava	0.0	0.2	0.00	0.00	0.2	0.5
Others	0.0	0.4	0.00	0.00	0.4	1.1
Maize & Sorghm	0.3	1.0	0.40	0.00	8.6	22.8
Maize & Beans	0.2	0.8	0.40	0.00	6.6	17.5
Maize & Others	0.1	0.6	0.40	0.00	4.0	10.6
Total					37.7	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cotton	0.2	1.0	0.00	0.00	6.0	68.2
Cassava	0.0	0.2	0.00	0.00	0.2	2.3
Maize & Beans	0.1	2.6	0.00	0.00	2.6	29.5
Total					8.8	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sweet Bananas	0.0	0.1	0.00	0.00	0.2	100.0
Total					0.2	100.0

Avg 0 = average of all sample farms

Avg 1 = average of all farms excluding zero entries

Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points

% columns = % of total farm land

KISUMU DISTRICT

TABLE 11a: HERD COMPOSITION (GRAZING LIVESTOCK)
— in Head and Livestock Units —

AEZ: UM 1 - LM 1-3

Survey Area 05
Nov. '77, Sample Size: 30

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total		-	-	-	-	-	-	-	-	-	-	-
Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		0.0 % of total cattle,						Calves + Heifers = 0.0 % of dairy cows				
Unimproved Livestock:		0.0 % of total cattle,						0.0 % of dairy cows				
Under 1 year, Average		0.40	0.07	-	1.03	-	1.63	0.97	0.56	-	-	0.56
Upper Qu.		1	-	-	2	-	2	1	0.9	-	-	0.9
1 - 2 years, Average		0.33	-	0.13	1.07	-	-	-	0.69	-	-	0.69
Upper Qu.		1	-	4	2	-	-	-	1.4	-	-	1.4
Over 2 years, Average		0.43	0.10	1.00	-	2.43	3.27	2.37	3.14	-	22.13	3.14
Upper Qu.		-	-	2	-	3	5	2	0.7	-	10	0.7
Subtotal (unimp.) Total		35	5	34	63	73	147	100	131.8	-	664	131.8
Average		1.17	0.17	1.13	2.10	2.43	4.90	3.33	4.39	-	22.13	4.39
Upper Qu.		1	-	2	3	3	7	3	6.6	-	30	6.6
Lower Qu.		-	-	-	-	1	-	-	2.5	-	10	2.5
LU Male Cattle =		36.4 % of total cattle,						Calves + Heifers = 86.3 % of dairy cows				
LU Goats + Sheep =		18.7 % of total Grazing Livestock Units										
Improved + Unimproved		Grazing Livestock Units										
Grazing L/Stock Total		35	5	34	63	73	147	100	131.8	-	664	131.8
Average		1.17	0.17	1.13	2.10	2.43	4.90	3.33	4.39	-	22.13	4.39
Upper Qu.		1	-	2	3	3	7	3	6.6	-	30	6.6
Lower Qu.		-	-	-	-	1	-	-	2.5	-	10	2.5
LU Male Cattle =		36.4 % of total cattle,						Calves + Heifers = 86.3 % of dairy cows				
LU Goats + Sheep =		18.7 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

TABLE II b: HERD COMPOSITION (GRAZING LIVESTOCK)
— in Head and Livestock Units —

AEZ: LM 3-4

Survey Area 06
Nov. '77, Sample Size: 30

Improved Livestock	Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average	-	-	-	-	-	-	-	-	-	-	-
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average	-	-	-	-	-	-	-	-	-	-	-
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average	-	-	-	-	-	-	-	-	-	-	-
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total	-	-	-	-	-	-	-	-	-	-	-
Average	-	-	-	-	-	-	-	-	-	-	-
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 0.0 % of total cattle, Calves + Heifers = 0.0 % of dairy cows											
Unimproved Livestock:											
Under 1 year, Average	3.20	-	-	0.67	-	1.07	2.17	1.10	2.67	-	1.50
Upper Qu.	-	-	-	1	-	1	-	0.3	-	-	0.3
1 - 2 years, Average	0.50	0.07	-	0.97	-	-	-	0.69	-	-	0.69
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average	0.23	0.07	0.73	-	1.63	2.23	1.73	2.13	-	21.70	2.13
Upper Qu.	-	-	-	-	2	3	1	-	-	8	-
Subtotal (unimp.) Total	113	4	22	49	49	99	117	117.5	80	651	129.5
Average	3.93	0.13	0.73	1.63	1.63	3.30	3.90	3.92	2.67	21.70	4.32
Upper Qu.	1	-	-	1	2	4	1	3.4	-	25	3.4
Lower Qu.	-	-	-	-	-	-	-	-	-	8	-
LU Male Cattle = 49.0 % of total cattle, Calves + Heifers = 100.0 % of dairy cows											
LU Goats + Sheep =											
Improved + Unimproved											
Grazing L/Stock	113	4	22	49	49	99	117	117.5	80	651	129.5
Total	3.93	0.13	0.73	1.63	1.63	3.30	3.90	3.92	2.67	21.70	4.32
Average	1	-	-	1	2	4	1	3.4	-	25	3.4
Upper Qu.	-	-	-	-	-	-	-	-	-	8	-
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 49.0 % of total cattle, Calves + Heifers = 100.0 % of dairy cows											
LU Goats + Sheep =											
Improved + Unimproved											
Grazing L/Stock	113	4	22	49	49	99	117	117.5	80	651	129.5
Total	3.93	0.13	0.73	1.63	1.63	3.30	3.90	3.92	2.67	21.70	4.32
Average	1	-	-	1	2	4	1	3.4	-	25	3.4
Upper Qu.	-	-	-	-	-	-	-	-	-	8	-
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

KISUMU DISTRICT

TABLE 12 a: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: UM 1 - LM 1-3

vey Area 05

Crop		Imp- roved Seeds %	Inputs					Chemicals		Yield
			N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fun ici kg/	kg/ha	
<u>First Rains</u>										
Maize	Avg.	87	9	26	-	1.07	4	-	-	1,850
	UpQu	100	-	60	-	-	5	-	-	2,025
	LoQu	100	-	-	-	-	-	-	-	1,125
Sorghum	Avg.	-	-	-	-	0.21	-	-	-	861
	UpQu	-	-	-	-	-	-	-	-	900
	LoQu	-	-	-	-	-	-	-	-	400
Groundnuts	Avg.	20	-	-	-	0.15	-	-	-	840
	UpQu	-	-	-	-	-	-	-	-	900
	LoQu	-	-	-	-	-	-	-	-	300
Sunflower	Avg.	100	-	33	-	0.31	-	-	-	917
	UpQu	100	-	60	-	-	-	-	-	1,050
	LoQu	100	-	-	-	-	-	-	-	533
Cotton	Avg.	68	-	8	-	-	11	-	-	674
	UpQu	100	-	-	-	-	8	-	-	1,000
	LoQu	-	-	-	-	-	-	-	-	300
Sweet Potatoes	Avg.	33	-	-	-	-	-	-	-	8,333
<u>Second Rains</u>										
Maize	Avg.	75	7	15	-	0.23	4	4	-	1,607
	UpQu	100	-	30	-	-	10	10	-	1,969
	LoQu	-	-	-	-	-	-	-	-	788
Sunflower	Avg.	100	-	38	-	-	-	-	-	782
	UpQu	100	-	60	-	-	-	-	-	1,050
	LoQu	100	-	-	-	-	-	-	-	533
Cotton	Avg.	50	-	-	-	1.38	7	7	-	375
<u>Perennial Crops</u>										
Cassava	Avg.	-	-	-	-	-	-	-	-	3,639
	UpQu	-	-	-	-	-	-	-	-	2,000
	LoQu	-	-	-	-	-	-	-	-	533
Sugarcane	Avg.	-	-	-	-	-	-	-	-	5,500
	UpQu	-	-	-	-	-	-	-	-	7,500
	LoQu	-	-	-	-	-	-	-	-	-

KISUMU DISTRICT

TABLE 12 b: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LM 3-4

Survey Area 06

Crop		Imp- roved Seeds %	Inputs						Yield kg/ha
			Nutrients				Chemicals		
			N	P ₂ O ₅	K ₂ O	Manure	Insec.	Fung- icide	
kg/ha	kg/ha		kg/ha	t/ha	kg/ha	kg/ha			
<u>First Rains</u>									
Maize	Avg.	82	-	13	-	-	1	-	1,701
	UpQu	100	-	-	-	-	-	-	2,250
	LoQu	-	-	-	-	-	-	-	675
Sorghum	Avg.	-	-	-	-	-	-	-	1,149
	UpQu	-	-	-	-	-	-	-	1,400
	LoQu	-	-	-	-	-	-	-	125
Cotton	Avg.	68	-	2	-	-	7	-	838
	UpQu	100	-	-	-	-	5	-	850
	LoQu	-	-	-	-	-	-	-	463
Maize & Sorghm									
Maize	Avg.	50	-	-	-	-	-	-	998
Sorghm	Avg.	-	-	-	-	-	-	-	1,030
Maize	UpQu	100	-	-	-	-	-	-	1,350
Sorghm	UpQu	-	-	-	-	-	-	-	1,250
Maize	LoQu	-	-	-	-	-	-	-	675
Sorghm	LoQu	-	-	-	-	-	-	-	150
Maize & Beans									
Maize	Avg.	86	-	7	-	-	3	-	2,402
Beans	Avg.	-	-	-	-	-	-	-	650
Maize	UpQu	100	-	-	-	-	10	-	3,150
Beans	UpQu	-	-	-	-	-	-	-	1,400
Maize	LoQu	100	-	-	-	-	-	-	1,667
Beans	LoQu	-	-	-	-	-	-	-	200
<u>Second Rains</u>									
Nil									
<u>Perennial Crops</u>									
Sweet Bananas	Avg.	-	-	-	-	1.25	-	-	4,458

KISUMU DISTRICT

TABLE 13 a: DISPOSAL OF CROPS

AEZ: UM 1 - LM 1-3

Survey Area 05

Crop	Production	Marketing Board		Local Market		Home Consum		on
	kg	kg	%	kg	%	kg		
<u>First Rains</u>								
Maize	72,180	38,070	53	5,900	8	28,210		
Maize & Beans	2,620	0	0	0	0	2,620		1
Maize & Sorgm	3,864	90	2	560	14	3,214		
Maize & Others	777	0	0	0	0	777		1
Beans	640	0	0	75	12	565		
Sorghum	6,960	0	0	500	7	6,460		
Cowpeas	180	0	0	0	0	180		1
Groundnuts	4,505	2,950	65	900	20	655		
Sweet Potatoes	3,900	0	0	2,100	54	1,800		
Sunflower	6,135	6,135	100	0	0	0		
Cotton	9,437	9,037	96	0	0	400		
Cabbage	120	0	0	0	0	120		1
Onions	2,400	0	0	2,400	100	0		
Tomatoes	800	0	0	800	100	0		
<u>Second Rains</u>								
Maize	42,020	21,330	51	1,560	4	19,130		
Maize & Beans	5,355	0	0	2,080	39	3,275		
Maize & Others	835	0	0	90	11	745		
Beans	8,000	6,800	85	800	10	400		
Sorghum	450	0	0	0	0	450		1
Cowpeas	240	0	0	0	0	240		1
Sunflower	4,250	4,250	100	6	0	-6		
Cotton	375	375	100	0	0	0		
<u>Permanent Crops</u>								
Nil								

KISUMU DISTRICT

TABLE 13 b: DISPOSAL OF CROPS

AEZ: LM 3-4

Survey Area 06

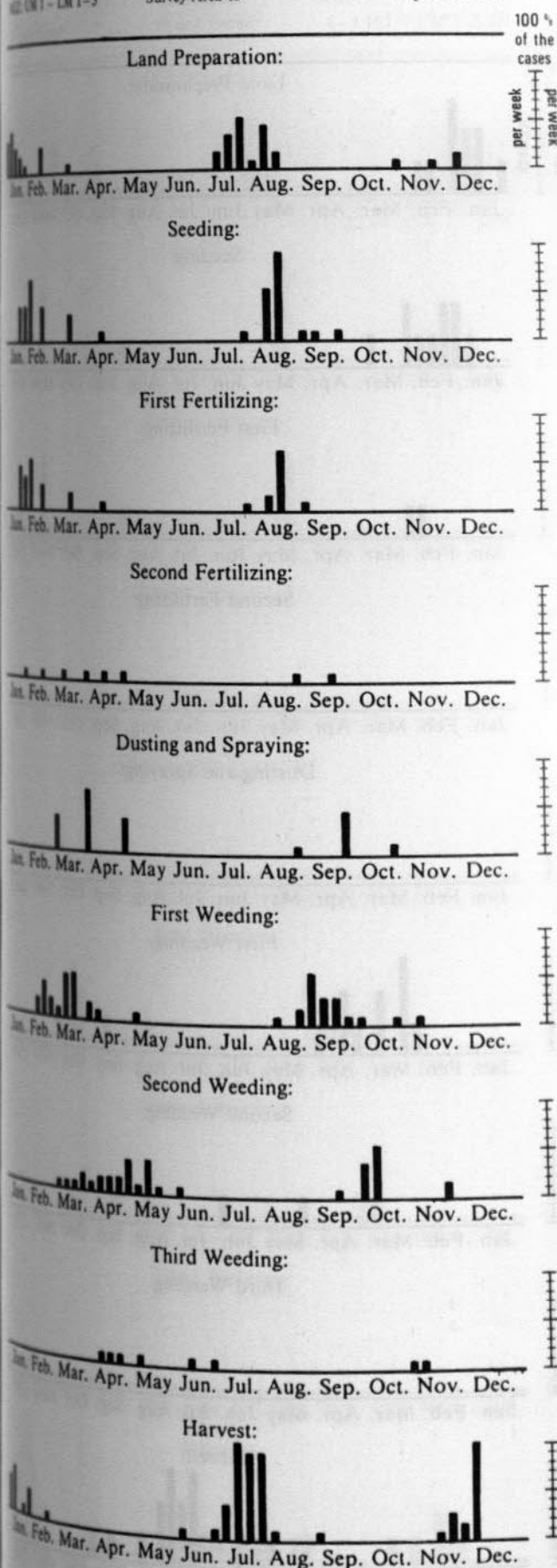
Survey Area 06

Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	10,180						
Maize & Beans	20,180	750	7	1,600	16	7,830	77
Maize & Sorghm	17,865	800	4	2,746	14	16,634	82
Maize & Others	7,567	0	0	4,365	24	13,500	76
Maize IPC	60	1,895	25	217	3	5,455	72
Beans	200	0	0	0	0	60	100
Sorghum	2,235	0	0	160	80	40	20
Sunflower	1,200	0	0	244	11	1,991	89
Cotton	13,796	1,200	100	0	0	0	0
		12,156	88	370	3	1,270	9
<u>Second Rains</u>							
Maize & Beans	3,445	0	0	0	0	3,445	100
<u>Permanent Crops</u>							
Nil							

KISUMU DISTRICT

TABLE 14: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 43¹⁾
 Survey Area 05 Sample Size: 30

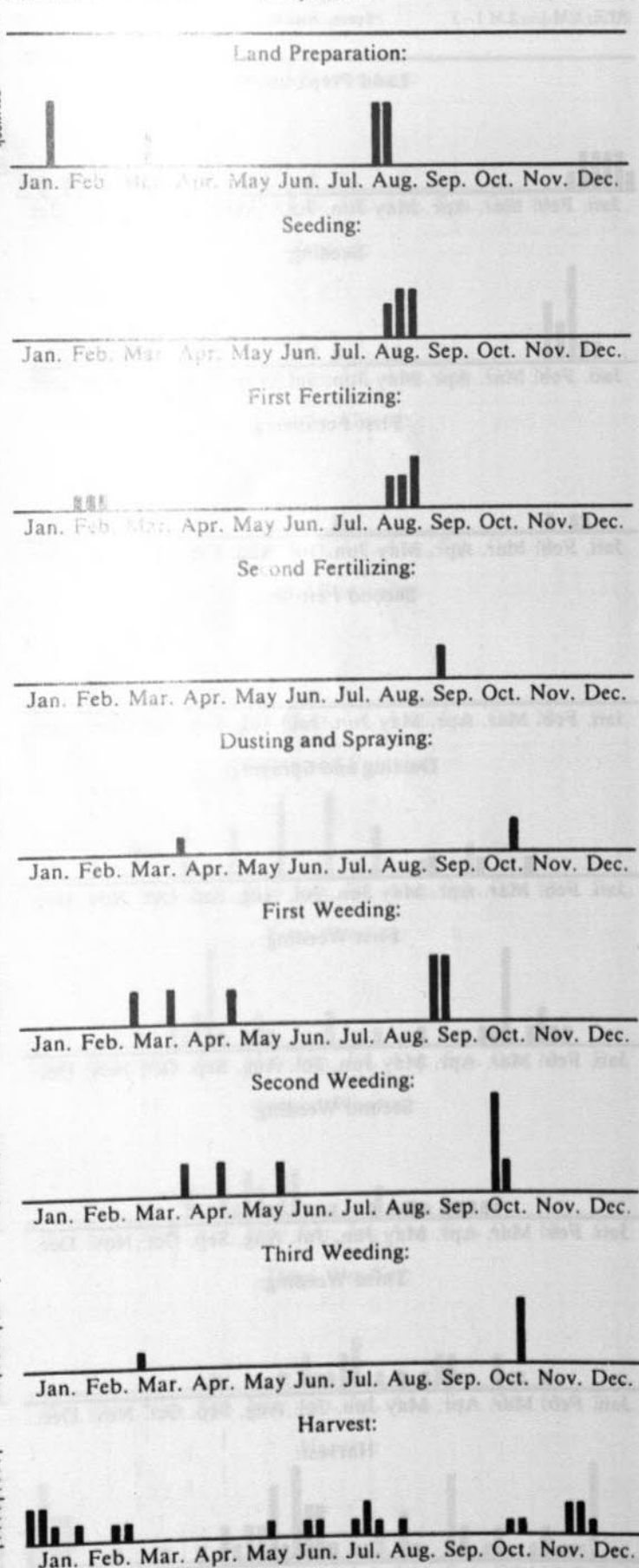


Maximum 30 per crop and season

KISUMU DISTRICT

TABLE 15: DISTRIBUTION OF FARMING ACTIVITIES

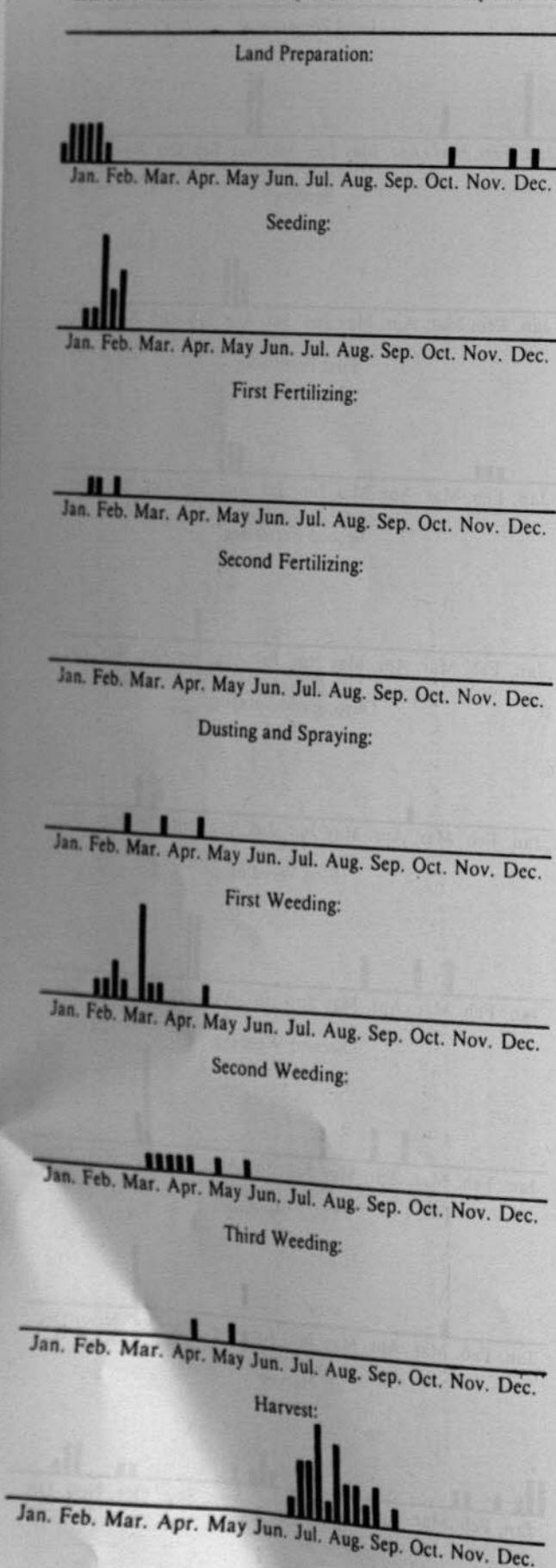
Crop 2 Maize & Beans Cases: 14
 Survey Area 05 Sample Size: 30



KISUMU DISTRICT

TABLE 14 c: DISTRIBUTION OF FARMING ACTIVITIES

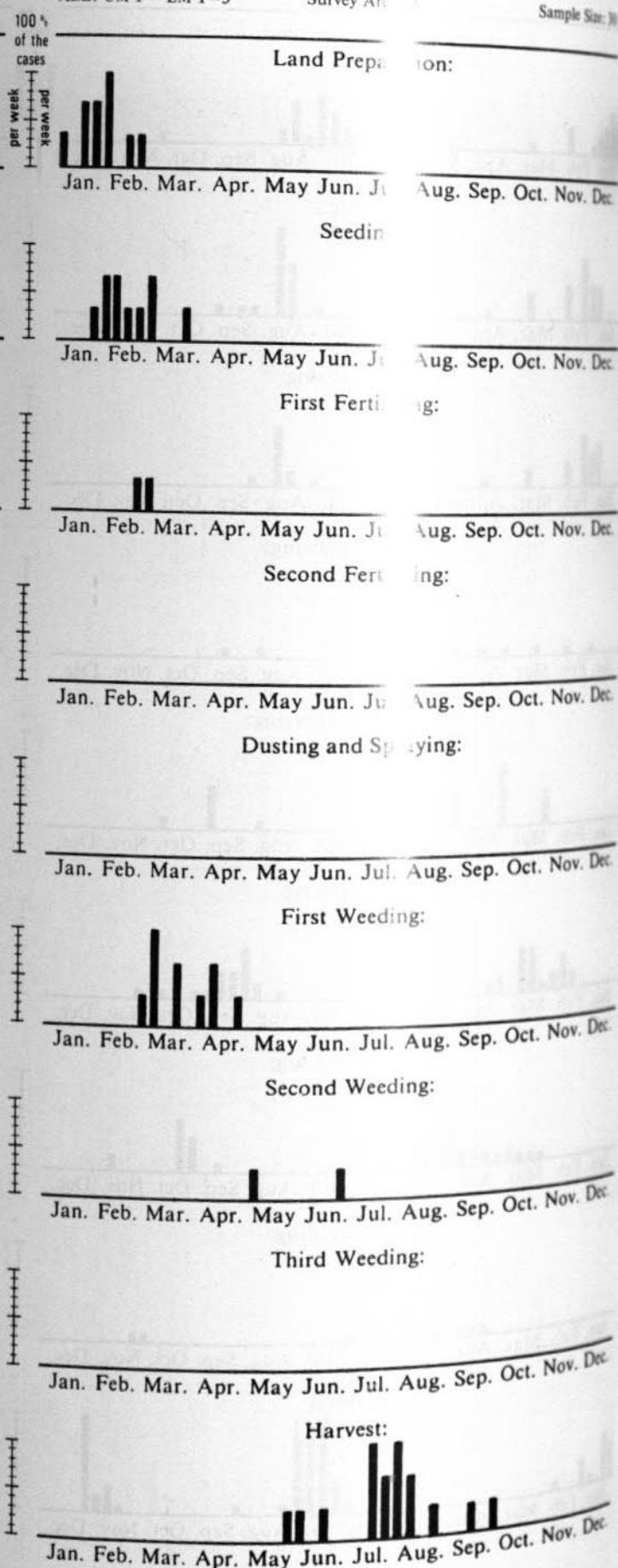
Crop 18 Sorghum Cases: 13
 AEZ: UM 1 - LM 1-3 Survey Area 05 Sample Size: 30



KISUMU DISTRICT

TABLE 14 d: DISTRIBUTION OF FARMING ACTIVITIES

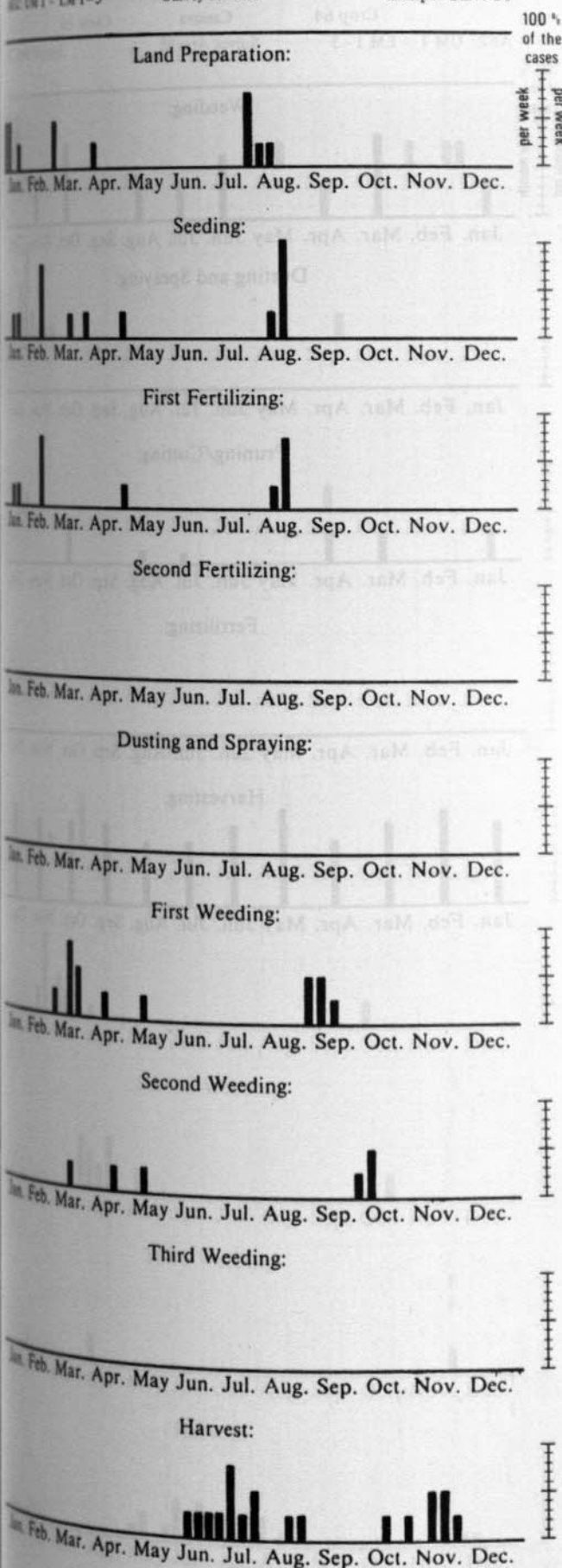
Crop 24 Groundnut Cases: 10
 AEZ: UM 1 - LM 1-3 Survey Area 05 Sample Size: 30



KISUMU DISTRICT

TABLE 14 e: DISTRIBUTION OF FARMING ACTIVITIES

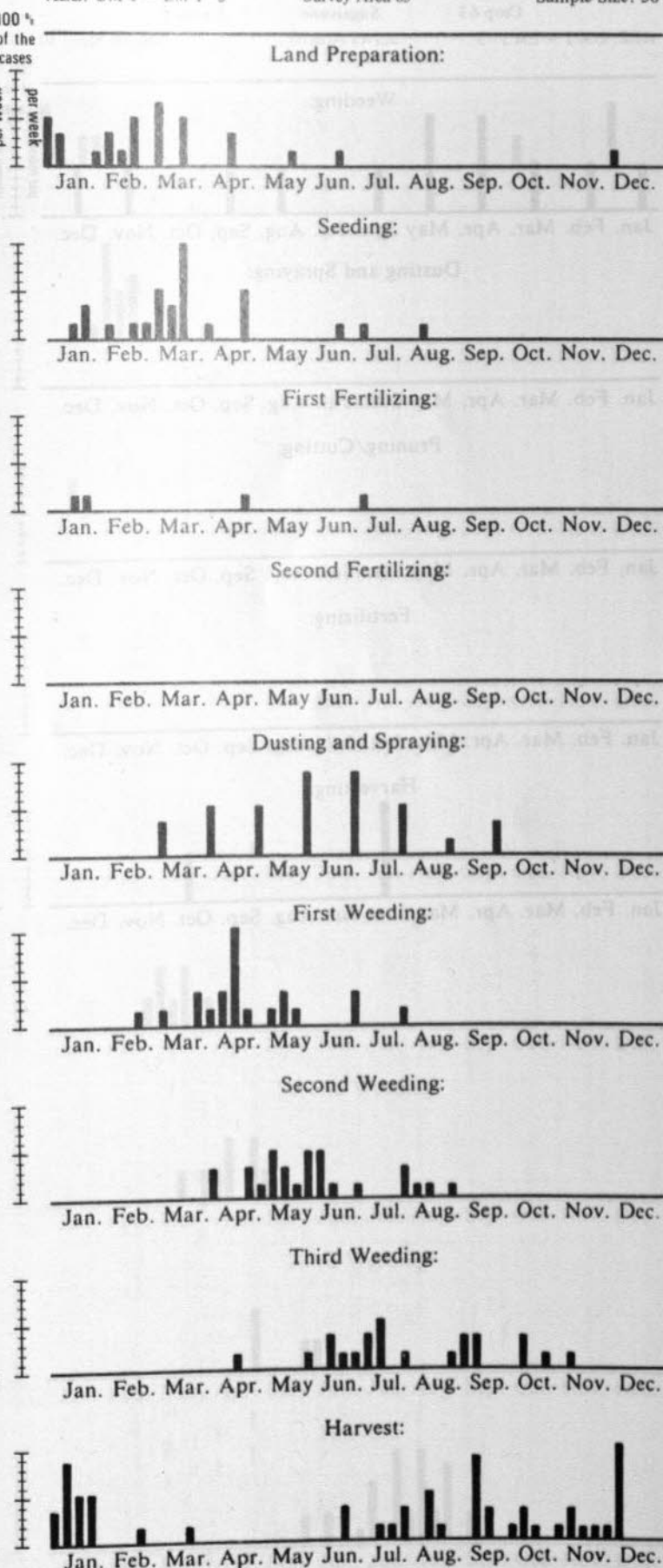
Crop 34 Sunflower Cases: 13
Survey Area 05 Sample Size: 30



KISUMU DISTRICT

TABLE 14 f: DISTRIBUTION OF FARMING ACTIVITIES

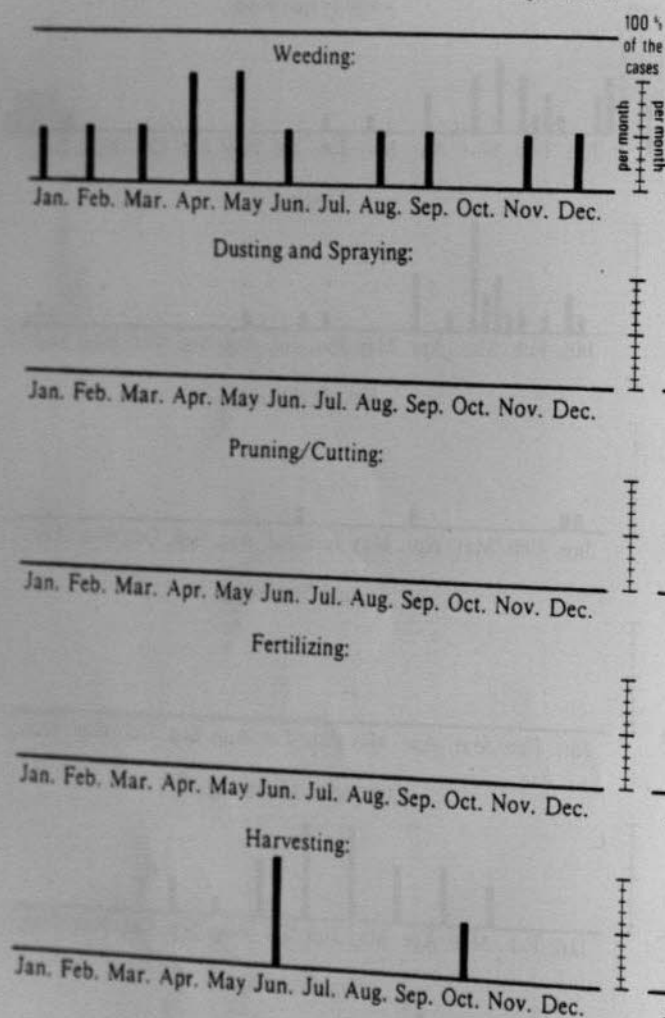
Crop 35 Cotton Cases: 24
AEZ: UM 1 - LM 1-3 Survey Area 05 Sample Size: 30



KISUMU DISTRICT

TABLE 14 g: DISTRIBUTION OF FARMING ACTIVITIES

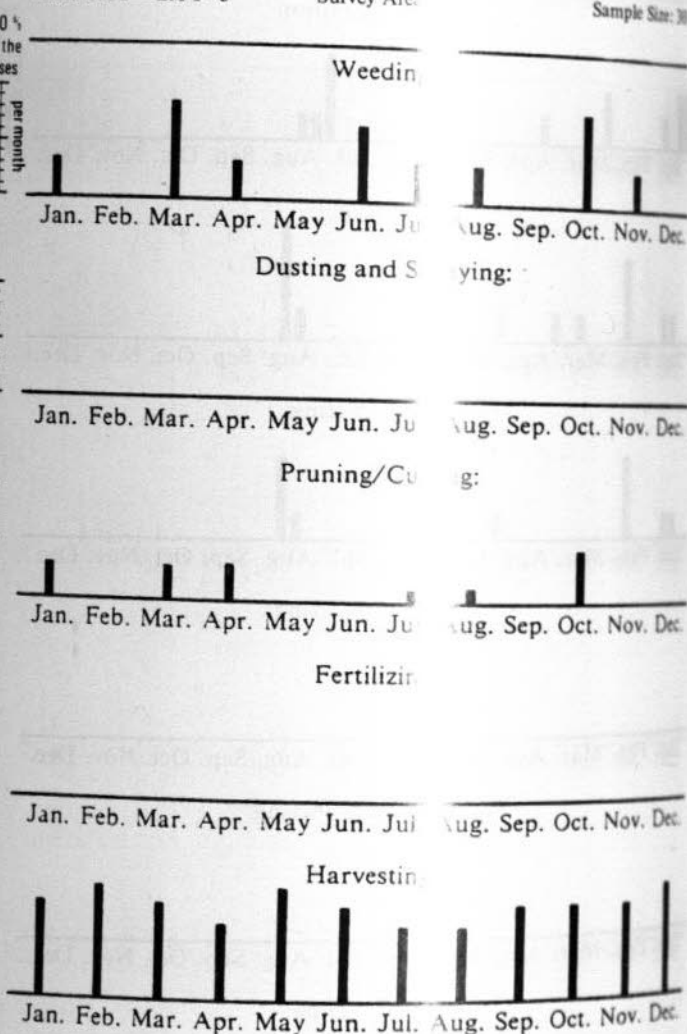
Crop 63 Sugarcane Cases: 5
 AEZ: UM 1 - LM 1-3 Survey Area 05 Sample Size: 30



KISUMU DISTRICT

TABLE 14 h: DISTRIBUTION OF FARMING ACTIVITIES

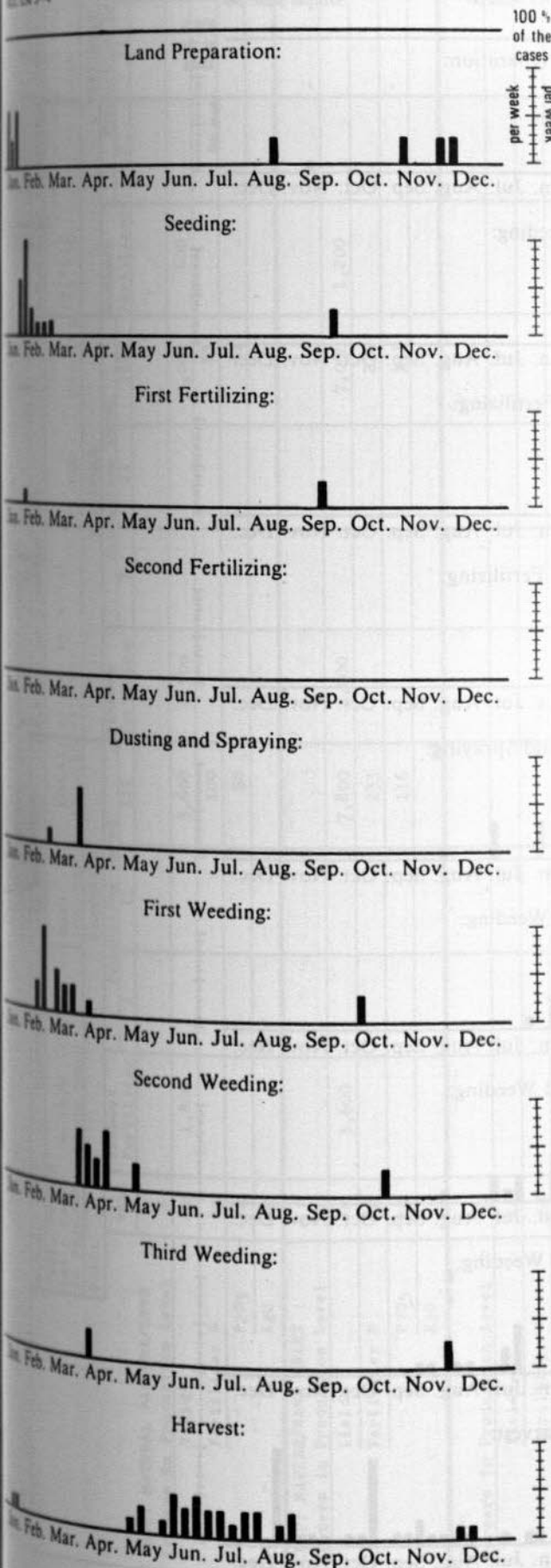
Crop 64 Cassava Cases: 10
 AEZ: UM 1 - LM 1-3 Survey Area Sample Size: 30



KISUMU DISTRICT

TABLE 14.1: DISTRIBUTION OF FARMING ACTIVITIES

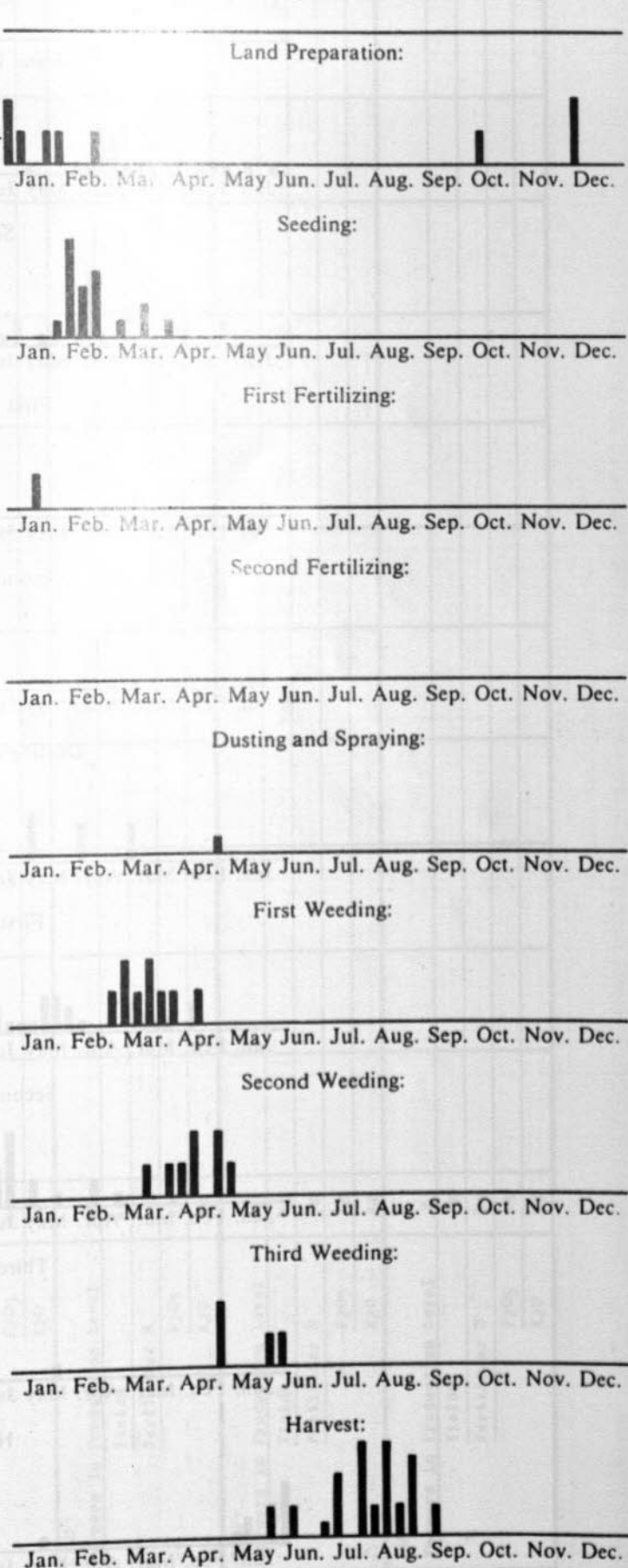
Crop 2 Maize & Beans Cases: 18
Survey Area 06 Sample Size: 30



KISUMU DISTRICT

TABLE 14.2: DISTRIBUTION OF FARMING ACTIVITIES

Crop 5 Maize & Sorghum Cases: 18
AEZ: LM 3-4 Survey Area 06 Sample Size 30



KISUMU DISTRICT

TABLE 14 k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 35 Cotton Cases: 22
 AEZ: LM 3-4 Survey Area 06 Sample Size: 30

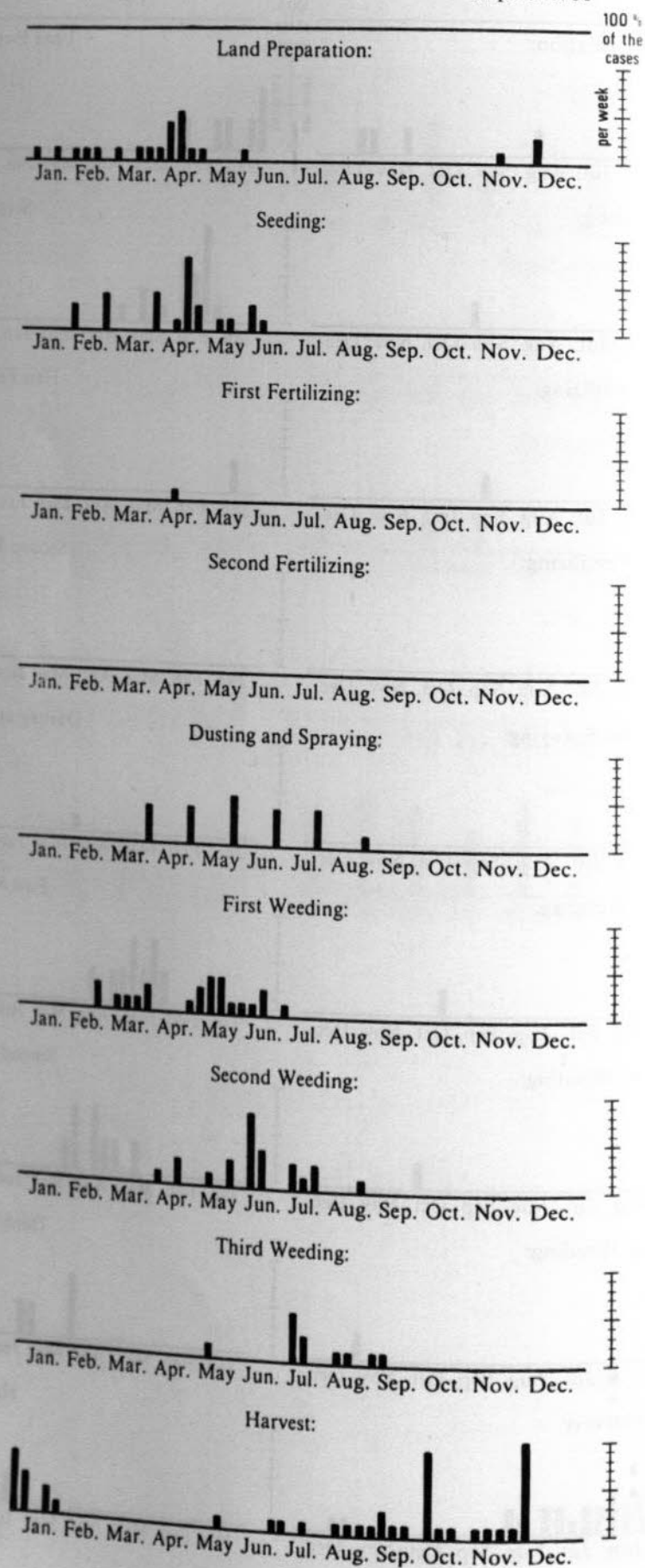


TABLE 15 b: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

REDUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES																			
OUTPUT AND NUTRIENT INPUT																			
A.E.2.1: LM 2 MARGINAL SUGAR CANE ZONE				A.E.2.2: LM 3 COTTON ZONE				A.E.2.3: LM 4 MARGINAL COTTON ZONE											
Veg. Period		1st + 2nd: 1/m--(m/n or n/m)		2nd: 105-120		total: 275-290		m/1--(n or n/va) 155-165		75-100		(m/n)+1 115-135							
in Days/1st: 170 or more		Soil:		PLAGOSOLS								VERTISOLS							
		Unit		Without Fertilizer		Production Level I		Production Level II		Production Level III		Without Fertilizer		Production Level I		Production Level II		Production Level III	
CROP: BANANAS																			
Farmers in Production Level																			
Yields		%		kg		5,000		6,000		10,000		18,000							
Fertilizer N		kg						18		90		234							
P2O5		kg						7		35		91							
K2O		kg																	
CROP: SUGAR CANE																			
Farmers in Production Level																			
Yields		%		kg		3,000		8,000		30,000		50,000							
Fertilizer N		kg						10		54		94							
P2O5		kg						34		186		324							
K2O		kg																	
CROP: COTTON																			
Farmers in Production Level																			
Yields		%		kg								450		200		-		1,300	
Fertilizer N		kg																94	
P2O5		kg																50	
K2O		kg																	
CROP: MAIZE																			
Farmers in Production Level																			
Yields		%		kg		1,600		1,200		2,800		4,000		1,600		1,200		2,000	
Fertilizer N		kg								30		60						12	
P2O5		kg								34		67						10	
K2O		kg																21	
CROP: SORGHUM																			
Farmers in Production Level																			
Yields		%		kg		2,400		1,300		2,000		4,000		2,400		1,200		2,000	
Fertilizer N		kg										50						46	
P2O5		kg										50						46	
K2O		kg																	
CROP: MILLET																			
Farmers in Production Level																			
Yields		%		kg															
Fertilizer N		kg																	
P2O5		kg																	
K2O		kg																	

A-E-E-1 LM 2 MARGINAL SUGAR CANE SCORE										A-E-E-1 LM 3 COTTON SCORE										A-E-E-1 LM 4 MARGINAL COTTON SCORE									
Veget. Period 1st + 2nd: In Days/1st: 170 or more Soil:										m/1-(m or s/vs) 155-165										(m/s)+1 115-135									
PLANOSOLS										VERTISOLS										VERTISOLS									
Production Level										Production Level										Production Level									
Without Fertilizer										Without Fertilizer										Without Fertilizer									
I										I										I									
II										II										II									
III										III										III									
Yields										Yields										Yields									
Fertilizer N										Fertilizer N										Fertilizer N									
P2O5										P2O5										P2O5									
K2O										K2O										K2O									
CROP: MAIZE & BEANS										CROP: BEANS										CROP: SUNFLOWER									
Farmers in Production Level										Farmers in Production Level										Farmers in Production Level									
Yields										Yields										Yields									
Fertilizer N										Fertilizer N										Fertilizer N									
P2O5										P2O5										P2O5									
K2O										K2O										K2O									
CROP: SOYA BEANS										CROP: GROUNDNUTS										CROP: SIMSIN									
Farmers in Production Level										Farmers in Production Level										Farmers in Production Level									
Yields										Yields										Yields									
Fertilizer N										Fertilizer N										Fertilizer N									
P2O5										P2O5										P2O5									
K2O										K2O										K2O									

KISUMU DISTRICT

TABLE 15d: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

	A.E.2.1: LM 2 MARGINAL SUGAR CANE ZONE				A.E.3.1: LM 3 COTTON ZONE				A.E.2.1: LM 4 MARGINAL COTTON ZONE			
	Veg. Period 1st + 2nd: in Days; 1st: 170 or more		1/m ² -(m/s or s/m) 2nd: 105-120		Total m/1-(m or s/va) 155-165		75-100		(m/s)+1 115-135		545	
	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer	I	III
CROP: SWEET POTATOES												
Farmers in Production Level	%											
Yields	kg	6,000	5,000	12,000	30,000	5,000	5,000	8,000	16,000			
Fertilizer N	kg			60	240			30	110			
P ₂ O ₅	kg			42	168			18	66			
K ₂ O	kg											
CROP: CASSAVA												
Farmers in Production Level	%											
Yields/year	kg	6,500	3,000	7,000	13,000	6,000	3,000	4,000	6,000			
Fertilizer N	kg			2	26				-			
P ₂ O ₅	kg			4	46				-			
K ₂ O	kg											
CROP:												
Farmers in Production Level	%											
Yields	kg											
Fertilizer N	kg											
P ₂ O ₅	kg											
K ₂ O	kg											
CROP:												
Farmers in Production Level	%											
Yields	kg											
Fertilizer N	kg											
P ₂ O ₅	kg											
K ₂ O	kg											
CROP:												
Farmers in Production Level	%											
Yields	kg											
Fertilizer N	kg											
P ₂ O ₅	kg											
K ₂ O	kg											

SIAYA DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

The area systematically shows the typical zoning of West Kenya: It is dry near Lake Victoria, and wet about 50 km away from there, with many transitions in between. The reason is the increase of rainfall due to local convergence of the daily lake winds with the South-east passat being in a generally low pressure area over the heated uplands (see p.81). Thus, annual average rainfall increases from 800 mm at the lake shore to 2 000 mm near the border of Kakamega. Therefore, it is understandable that the agro-ecological zones extend from a poor Livestock-Millet Zone to a good Sugar cane Zone. The contrasts in the zones of 60 % rainfall probability¹⁾ for the cropping seasons are even higher, in first rains from 350 mm to 900 mm, and in second rains from 50 mm to 800 mm!

For this reason, maize cultivation is very risky near the lake during the first rains and impossible during the second ones. Both rains are well distinguishable up to 25 km away from the lake (see Diagram Usigu Disp.), although the peaks are not very well pronounced. Therefore, Katumani maize is not advisable in the dry zones, because it needs a pronounced peak of water supply to yield well. Sorghum and millets do better there (possibilities for sorghum are included, of course, in the Livestock-Millet Zone). In the better Cotton Zone, two maize crops of H 511 are possible (see Diagram in Busia Distr.). In the more unreliable second rains, some fields should be planted with less demanding local maize varieties and with sorghum to bring down the risk. The start of the second rains is somehow difficult to define the more we approach the northeastern part of the district. This is because of the middle rains becoming bigger as a result of the convergence mentioned above. The advantage is that planting and growing may continue there from one season to the other.

In the Cotton Zone there are still chances for development with additional irrigation and swamp cultivation in the bottomlands, apart from the difficulties which the Yala Irrigation Scheme has faced.

There are no long-term temperature records, but we can be sure — by geographical extrapolation — that temperatures are similar to those in the South Nyanza district.

Serious problems are caused by leached soils of low fertility if humus is lost. Soil conservation must start early and compost is essential especially in the wet areas and on soils with murram cuirass in shallow depths. Nematodes are another reason why climatically possible yields are not yet reached here.

The great contrasts in the annual average rainfall and in the 60 % reliability of rainfall can also be seen in the 60 % reliability of the duration of the growing period (see Climate Tables). The Marginal Cotton Zone (LM 4) only has a growing period of 130 days followed by a less than 45 day period; the Sugar Cane Zone (LM 1), however, has 200 or more days during 1st rains and 120–130 days during 2nd rains.

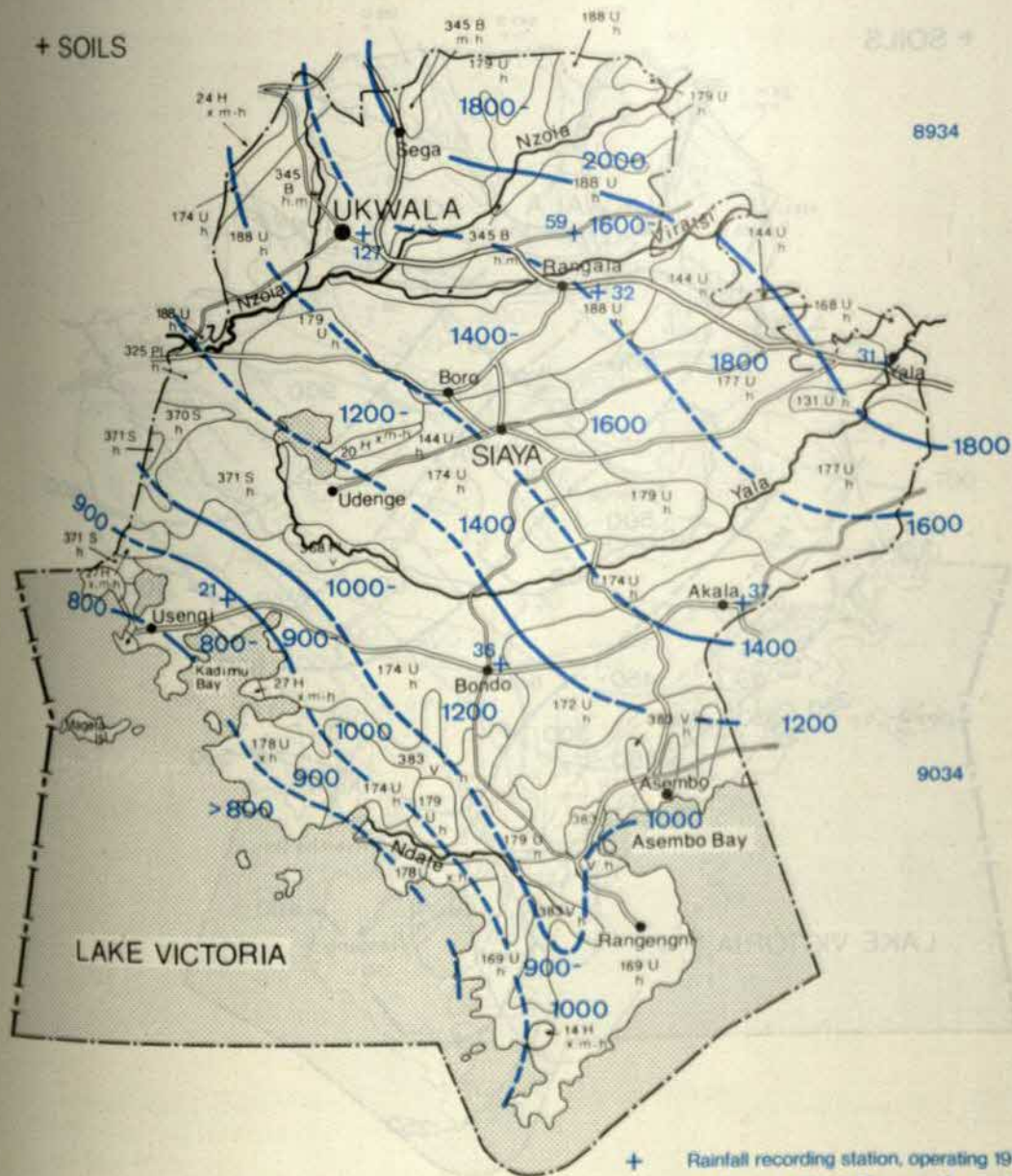
Near Lake Victoria the annual average temperature is about 22.5° C — in the northeastern part of the district it is 21° C. Humidity of the air is relatively high. For the entire district, evaporation is 1 800–2 000 mm per year.

¹⁾ 60 % means that the amounts will be reached or surpassed norm. in 6 out of 10 years

in mm

+ SOILS

SIAYA



- | | |
|------|--|
| + | Rainfall recording station, operating 1976 and having at least 10 years of records |
| 127 | Station number in grid |
| 9034 | Grid number |

Broken boundaries are uncertain because of lack of rainfall records

Wk. of Agr. German Agr. Team, R. Jaetzold Soils KSS

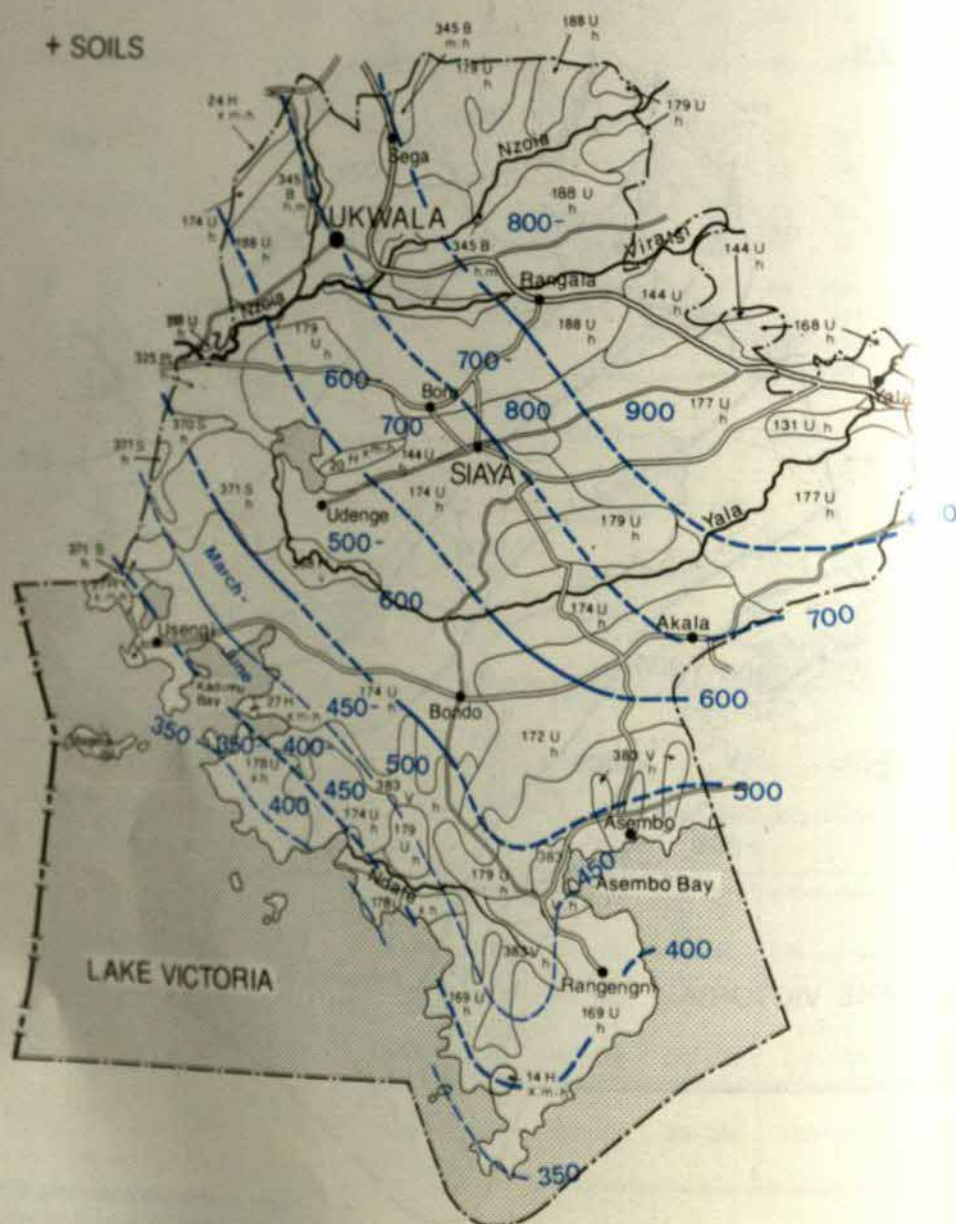
34° E

34° 30' E

SIYA

Amounts in mm, surpassed norm. in 6 out of 10 years

+ SOILS



Age Group (Min. of Age)	Number of Athletes
0-5	1
5-10	2
10-15	3
15-20	4
20-25	5

Min. of Age, German Agr. Team, R. Jettobold Scale X100

Broken boundaries are uncertain because of lack of rainfall records

34° E

34° 30' E

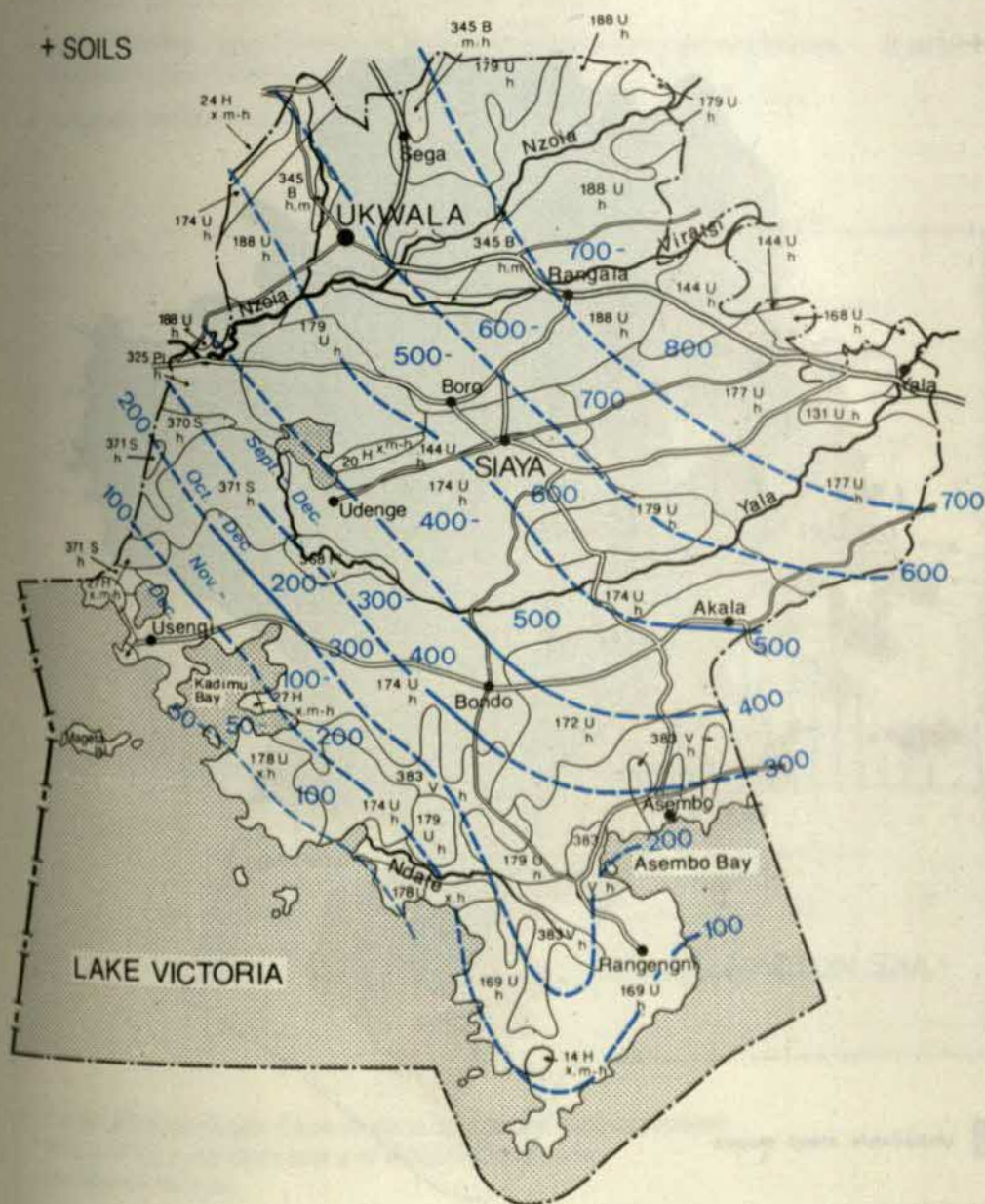
60% RELIABILITY OF RAINFALL IN SECOND RAINS

(Aug. - Jan. or less)

Amounts in mm, surpassed norm, in 6 out of 10 years

SIAYA

+ SOILS



03

 $0^{\circ}30'$

Broken boundaries are uncertain because of lack of rainfall records



Min. of Agr., German Agr. Team, R. Jaetzold Soils & SS

34 E

34°30'E

SI YA

Belt of A. E. Zones ————— Broken zonal boundaries
A. E. Zones ———— are uncertain or
Subzones ———— mean transitional strips

Climatic data for AEZ formulas see table I and II



Min. of Agr., German Agr. Team

34° 30' E

AGRO-ECOLOGICAL ZONES

= UPPER MIDLAND ZONES

= Coffee-Tea Zone

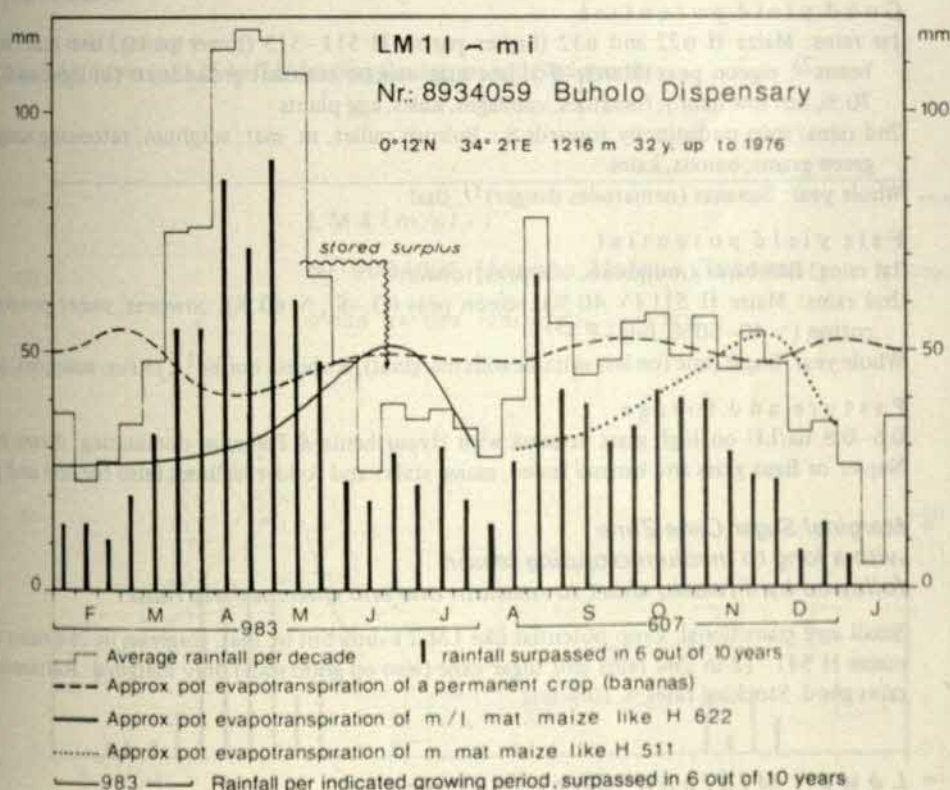
Very small, see Kakamega

= LOWER MIDLAND ZONES

= Lower Midland Sugar Cane Zone

= Lower Midland Sugar Cane Zone with permanent cropping possibilities, dividable in two variable cropping seasons

Very small, see Kakamega District



= Lower Midland Sugar Cane Zone with a long cropping season followed by a medium one and intermediate rains (see Diagram Buholo)

Very good yield potential (av. > 80 % of the optimum)

1st rains, start norm. mid F.: M. mat. (120 days) sorghum; sweet potatoes; m. mat. (115 days) sunflower like

Vympel or Hybrid S 301 A, m. mat. (120 days) soya beans

Whole year, best planting time b. March: Yam beans, pawpaws, guavas

Good yield potential (av. 60–80 % of the optimum)

1st rains: Maize H 622 and 632 (60–70 %), late mat. (150 days) sorghum (70–80 %), finger millet; late mat beans, pigeon peas (March–F.); sweet pepper, kales, Chinese cabbage, spinach, cabbage, chillies, yellow yams (F.–O./N.), egg plants (to 2nd r.), pumpkins

2nd rains, start undistinctly b. S.: Maize H 511, m. mat. sorghum; beans (~ 60 %), cowpeas; sweet potatoes; m. mat. soya beans, e. mat. sunflower like 252; kales, Chinese cabbage, spinach, onions

Whole year: Sugar cane, bananas (nematodes danger¹), cassava, tea in upper places (70–80 %, but medium to low quality), Robusta coffee (~ 60 %¹), avocados

Fair yield potential (av. 40–60 % of the optimum)

2nd rains: Maize H 622 and 632, finger millet; late mat. groundnuts and late mat. bambarra groundnuts (both in light soils), cabbage

Whole year: Mangoes, taro, citrus

Pasture and forage

Around 0.5 ha/LU on sec. pasture where orig. there has been a moist submontane forest; down to 0.13 ha/LU feeding Napier or Bana grass and banana leaves and others

LM 2 = Marginal Sugar Cane Zone

LM 2 = Marginal Sugar Cane Zone with a long cropping season

l-m/s) i followed by a (weak) medium to short one and intermediate rains

Very good yield potential

1st rains, start norm. mid F.: M. mat. sorghum; sweet potatoes; m. mat. sunflower like Vypel or Hybrid S 301 A, m. mat. soya beans; onions, chillies, pumpkins, sweet pepper

Whole year, best planting time mid F.: Cassava, pawpaws, yam beans (best near rivers)

Good yield potential

1st rains: Maize H 622 and 632 (higher parts), H 511–513 (lower parts), late mat. sorghum, finger millet; beans²), pigeon peas (March–F.); late mat. rosette resistant groundnuts (in light soils); melle, cotton (60–70 %, but low qual.); tomatoes, cabbages, kales, egg plants

2nd rains, start undistinctly towards S.: Bulrush millet, m. mat. sorghum, ratooning sorghum (S.–Au.); beans, green grams; onions, kales

Whole year: Bananas (nematodes danger)¹), sisal

Fair yield potential

1st rains: Bambarra groundnuts, cowpeas; tobacco

2nd rains: Maize H 511 (~ 40 %); pigeon peas (O.–S., ~ 60 %), cowpeas; sweet potatoes; simsim; cabbages; cotton (~ 40–50 %, July–F.)³

Whole year: Sugar cane (on less suitable soils marginal), Robusta coffee¹), citrus, mangoes, pineapples

Pasture and forage

0.6–0.8 ha/LU on high grass savanna with Hyparrhenia & Panicum dominating; down to 0.15 LU/ha feeding Napier or Bana grass and banana leaves, maize stalks and fodder legumes (also for soil and pasture improvement)

LM 2 = Marginal Sugar Cane Zone

l/m– followed by a (weak) short to medium one and intermediate rains

(s/m) i

Small and transitional. Crop potential like LM 2 l-m/s but m. mat. sorghum in 2nd rains and bananas only fair, maize H 511–12 in 2nd rains and sugar cane (also on good soils) only marginal. Ratooning sorghum 1st to 2nd rains good. Stocking rates ~ 10 % less

LM 3 = Lower Midland Cotton Zone

LM 3 = Lower Midland Cotton Zone

m/l–(s) with a medium to long cropping season

or s/vs) followed by a (weak) short or short to very short one

Good yield potential

1st rains, start norm. b. to mid March: E. mat. maize like Taboran or Katumani, m. mat. like H 511–13 (~ 60 %), m. mat. sorghum (70–80 %), ratooning sorghum 1st to 2nd rains, e. mat. millets (70–80 %); m. mat. beans, green grams⁴), cowpeas; groundnuts and bambarra gr. (both in light soils), simsim⁴); sweet pot.; cotton (~ 60 %), m. mat. soya beans, m. mat. sunflower like Vypel; tomatoes, onions; chick peas (on h. bl. soils), dwarf castor⁵), muskmelons

2nd rains, start norm. Sept.: Simsim, green grams; sweet potatoes in swampy places

Whole year, best planting time March: Cassava (~ 60 %), sisal, yam beans

Near swamps with water regulation resp. add. irrigation: Rice, bananas (on dams), Chinese cabbage (on ridges) and other vegetables

Fair yield potential

1st rains: Med. mat. maize H 622, finger millet (50–60 %); pigeon peas (March–F.); Virginia tobacco (higher places)

2nd rains: Early mat. proso millet (O.–N., 50–60 %), e. mat. sorghum (40–50 %), e. mat. bulrush millet (bird rejecting awned var. best); mwezi moja beans, e. mat. bambarra groundnuts (in light soils); dwarf sunflower

Whole year: Pawpaws, mangoes, citrus (~ 40 %)

Poor yield potential

2nd rains: E. mat. maize

Pasture and forage0.7–1.1 ha/LU on mixed savanna with star grass (*Cynodon dactylon*); down to 0.2 ha/LU feeding Bana or Napier grass and fodder legumes like *Stylosanthes* (also for pasture and soil improvement)**LM3 = Lower Midland Cotton Zone**
with a medium and a fully (weak) very short cropping season**Good yield potential**

1st rains like LM 3 m/l-(s) less 10 % (H 511–13 and cotton then fair)

2nd rains nothing

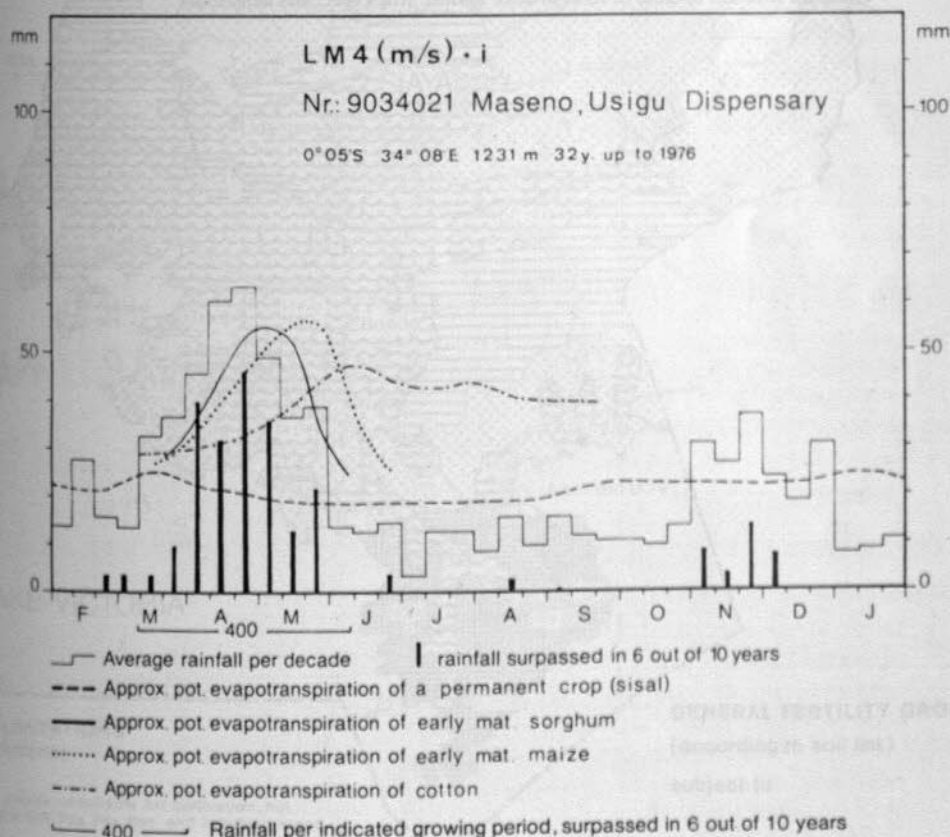
Whole year: Sisal

Fair yield potential

1st rains: Maize H 511–12 (40–50 %), finger millet; pigeon peas (March–F.); cotton

2nd rains, start norm. Oct.: E. mat. proso millet, dwarf sorghum (~40 %); green grams; simsim; sweet potatoes near water

Whole year: Cassava

Pasture and forage0.9–1.2 ha/LU, down to 0.25 ha/LU feeding Bana grass and *Stylosanthes***LM4 = Marginal Cotton Zone****LM4 = Marginal Cotton Zone with a (weak) medium to short cropping season and intermediate rains**

(see Diagram Maseno, Usigu Dispensary)

Good yield potential

1st rains, start norm. end March: E. mat. sorghum (~60 %), e. mat. proso millet (60–70 %); e. mat. beans (~60 %), tepary beans (70–80 %), green grams, cowpeas, chick peas (on h. bl. soils); e. mat. sunflower like Issanka (~60 %), simsim

Whole year: Sisal

Near swamps: Like LM 3

Fair yield potential

1st rains: E. mat. maize (40–50 %), e. mat. bulrush millet (50–60 %); pigeon peas (~40 %), soya beans (40–50 %), e. mat. groundnuts and e. mat. bambarra grdn. (both in light soils); onions

Poor yield potential

1st rains: Cotton

Pasture and forage

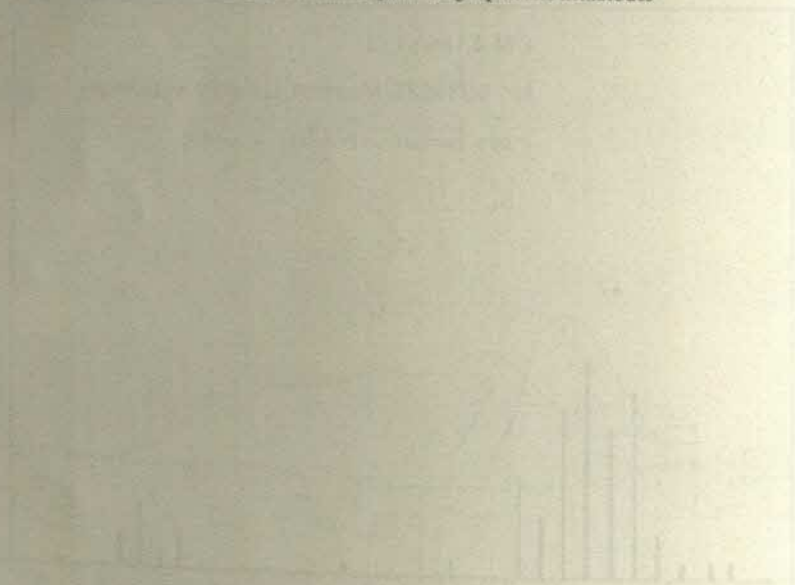
1–2 ha/LU; less than 0.8 ha/LU if horse tamarind (*Leucaena leucocephala*) and other edible shrubs are planted in order to improve fodder situation during dry season

LM 5 = Lower Midland Livestock-Millet Zone**LM 5 = Lower Midland Livestock-Millet Zone**

(s/m) + i with a (weak) short to medium cropping season and intermediate rains

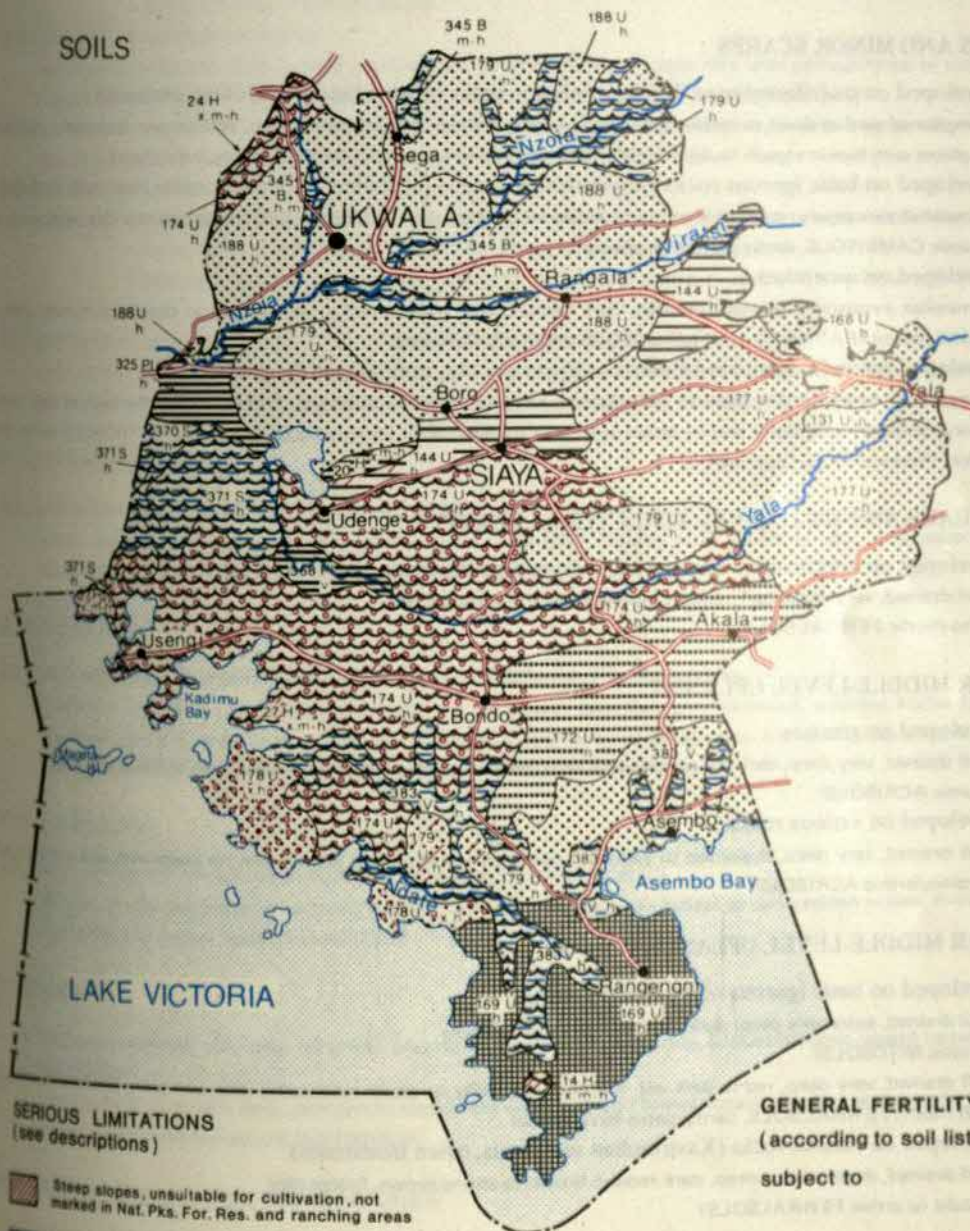
Very small on lakeside. Potential see South Nyanza District. Bulrush millet (bird rejected, awned variety) should be introduced. No protein crop necessary because of good fish supply

- 1) See Busia
- 2) Should be intercropped with maize because of hail storm danger
- 3) See Busia
- 4) Planting towards the end of the long rains
- 5) Good for rotation because of its resistance against *Striga* spec. and nematodes



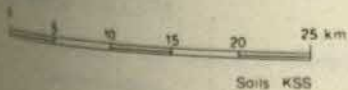
SIAYA

SOILS



SERIOUS LIMITATIONS (see descriptions)

- Steep slopes, unsuitable for cultivation, not marked in Nat. Pks. For. Res. and ranching areas
- Waterlogging
- Shallow soil



GENERAL FERTILITY GROUPS (according to soil list) subject to

- | | |
|------------------|----------|
| high | low |
| moderate to high | variable |
| moderate | |
| moderate to low | |

0° 30' S

34° E

34° 30' E

SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

The land is mainly a peneplain and slopes very gently from the east to the west. Dominant soils are soils on lower-level uplands (172 U, 174 U, 177 U). Unit 177 U has a limited fertility. Also, water holding capacity is small because it occurs above „murram cuirass“. In addition to that, there are soils with a topsoil rich in organic matter (169 U). Some of the upland soils are moderately deep. Inselbergs have shallow soils.

In the southern parts of the district a variety of soils occur in the valley bottoms (383 V). These soils are mainly poorly drained, often mottled and subject to flooding.

Along the Yala river young alluvial soils are found. They usually vary greatly in texture and colour over short distances, but may have a relatively high natural fertility (368 P1).

SOILS ON HILLS AND MINOR SCARPS

Soils developed on undifferentiated Tertiary volcanic rocks (olivine basalts, rhyolites, andesites)

- 14 H = complex of well drained to moderately well drained, shallow to moderately deep, dark brown, firm stony, clay loam to clay;
x, m-h¹⁾ in places with humic topsoil (eutric REGOSOLS; with verto-luvic PHAEOZEMS, partly lithic phase)

Soils developed on basic igneous rocks (serpentinites, basalts, nepheline phonolites; older basic tuffs included)

- 20 H = somewhat excessively drained, shallow to moderately deep, dark reddish brown, friable, gravelly clay, with acid humic topsoil
x, m-h (humic CAMBISOLS, partly paralithic phase)

Soils developed on quartzites

- 24 H = somewhat excessively drained, shallow, dark brown, very friable, rocky, sandy loam to clay loam; in many places with acid
x, m-h humic topsoil (RANKERS; with LITHOSOLS and Rock Outcrops)

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

- 27 H = complex of excessively drained to well drained, shallow, dark red to brown, friable, sandy clay loam to clay; in many places
x, m-h rocky, bouldery and stony and in places with acid humic topsoil (dystric REGOSOLS; with LITHOSOLS and humic CAMBISOLS lithic phase and Rock Outcrops)

SOILS ON PLATEAUS AND HIGH-LEVEL STRUCTURAL PLAINS

Soils developed on intermediate igneous rocks (syenites, trachytes, phonolites, etc.)

- 62 L = well drained, very deep, dark reddish brown to dark red, friable clay
h (luto-rhodic FERRALSOLS)

SOILS ON UPPER MIDDLE-LEVEL UPLANDS

Soils developed on granites

- 131 U = well drained, very deep, dark red to yellowish red, friable to firm, sandy clay to clay, with acid humic topsoil
h (humic ACRISOLS)

Soils developed on various rocks

- 139 U = well drained, very deep, dusky red to yellowish red, friable to firm, clay loam to clay; in places with acid humic topsoil (ferrallo-
h chromic/orthic ACRISOLS)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

Soils developed on basic igneous rocks (basalts, etc.)

- 143 U = well drained, extremely deep, dark reddish brown, friable clay
h (dystric NITOSOLS)

- 144 U = well drained, very deep, red to dark red, friable to firm, clay; in places moderately deep over petro-plinthite (eutric NITOSOLS;
h with rhodic FERRALSOLS, partly petro-ferric phase)

Soils developed on various rocks (Kavirondian sediments, often mudstones)

- 168 U = well drained, deep to very deep, dark reddish brown to strong brown, friable clay
h (rhodic to orthic FERRALSOLS)

1) Soil texture-classes

h = heavy

m = medium

l = light

x = stony, bouldery

v = varying texture

m-h = medium to heavy

m, h = medium and heavy (e.g. abruptly underlying a topsoil of different texture)

SOILS ON LOWER-LEVEL UPLANDS

Soils developed on basic igneous rocks (basalts, etc.)

- moderately well drained, shallow to moderately deep, dark brown, firm clay (vertic-luvic PHAEZEMES, lithic phase)

Soils developed on intermediate igneous rocks (andesites, etc.)

- well drained, moderately deep to deep, dark reddish brown, friable clay; in many places over petro-plinthite (chromic LUVISOLS, partly petroferric phase; with „murram cuirass“ soils)
- association of: well drained to moderately well drained, shallow soils over petroplinthite (about 50 %); on interfluvies („murram cuirass“ soils)
- well drained, very deep, dark reddish brown to strong brown, friable clay; on valley sides (dystric/ettric NITOSOLS and orthic FERRALSOLS)

Soils developed on acid igneous rocks

- well drained, moderately deep to deep, yellowish red to strong brown, friable clay, over petroplinthite or rock; in places shallow over petroplinthite (orthic FERRALSOLS, partly petroferric phase; with „murram cuirass“ soils)
- well to moderately well drained, shallow, dark reddish brown, stony to gravelly clay over petroplinthite; in places moderately deep to deep („murram cuirass“ soils (80 %); with ferralo-chromic ACROSOLS)

Soils developed on granites

- complex of: well drained, moderately deep to very deep, reddish brown to yellowish brown, friable clay, over petro-plinthite (orthic FERRALSOLS, partly petroferric phase; with orthic ACROSOLS)
- moderately well drained, shallow, brown to dark brown soils over petroplinthite (about 30 %) („murram cuirass“ soils)

Soils developed on various rocks (Kavirondian sediments, often mudstones)

- well drained, moderately deep to very deep, dark red to strong brown, friable clay; in places shallow over petro-plinthite (orthic to rhodic FERRALSOLS, partly petro-ferric phase; with „murram cuirass“ soils (10–40 %)

SOILS ON LACUSTRINE PLAINS

Soils developed on sediments from lacustrine mudstones

- poorly drained, very deep, very dark grey to black, very firm, slightly sodic, cracking clay, with calcareous deeper subsoil (lower level of Kano plains) (pellic VERTISOLS, sodic phase)

SOILS ON BOTTOMLANDS

Soils developed on infill mainly from undifferentiated Basement System rocks

- complex of imperfectly drained to poorly drained, very deep, very dark grey to brown, mottled, friable to firm, sandy clay to clay, often abruptly underlying a topsoil of friable sandy clay loam; in places saline and sodic (dystric PLANOSOLS; with pellic VERTISOLS, vertic and humic GLEYSOLS and plinthic ACROSOLS)

SOILS ON FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

- complex of well drained to imperfectly drained, very deep, dark greyish brown to dark reddish brown, stratified soils of varying consistence and texture (eutric FLUVISOLS)

SOILS ON SWAMPS

• very poorly drained, very deep, very dark grey to black, firm, cracking clay, with acid humic topsoil (seasonal swamps) (humic GLEYSOLS)

• very poorly drained, very deep, dark grey to black, firm clay; with acid humic topsoil; in many places peaty (permanent swamps) (humic GLEYSOLS and dystric HISTOSOLS)

SOILS ON COASTAL OR LAKE-SIDE BEACH RIDGES

Soils developed on beach ridges along Lake Victoria

- imperfectly drained, very deep, dark brown to greyish brown, friable, sandy loam to sandy clay of varying salinity and sodicity; with inclusions of loose sand to loamy sand soils (SOLONCHAKS, undifferentiated; with ARENOSOLS, undifferentiated)

SOILS IN MINOR VALLEYS

• complex of well drained to poorly drained, deep, dark reddish brown to black, firm, silty clay to clay; in places calcareous and/or cracking.

Soil description from Kenya Soil Survey: Exploratory Soil Map and Agro-Climatic Zones Map of Kenya, scale 1:1 000 000, Rep. E1, Nairobi 1962. See this map also for colours; symbols simplified here.

POPULATION AND LAND

At the time of the Census in September 1979, more than 474,000 people lived in Siaya District (Table 3). Only 1 % (4,877 people) of the total population lived in the two townships of the district. The rural population of nearly 470,000 had to share a total area of 251,700 ha, i.e. 0.39 ha agricultural land per person, and for an average household of a little more than 5 people, 2.14 ha were available (Table 5). In LM 1, the Sugar Cane Zone, less land was available (1.6 resp. 0.3 ha). This is a serious situation as the figure of the lower quartile of the samples of the Small Farm Survey 1977 (Table 8b) was 2.0 ha per person. In the Cotton Zones (LM 3-4), the average size is about 3 ha (per head 0.5). A comparison with the figure of the lower quartile with 3.2 ha shows that here the shortage of land is starting. Especially in the Marginal Cotton Zone (LM 4), there is an increasing necessity for pasture.

In the Sugar Cane Zone (LM 1), the most critical location is South Ugenya with less than 1 ha agricultural land per household (Table 5). This figure gives an idea of the critical situation in this area. Regarding the population growth, agricultural mechanization is absolutely necessary in the whole district to improve the situation of the small farmers.

SIAYA DISTRICT

TABLE 3: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
East Ugenya	9 380	10 081	19 461	2 934	113	171
West Ugenya	8 894	10 098	18 992	2 812	109	173
West Achenko	8 274	9 808	18 082	2 961	93	193
East Achenko	8 499	9 884	18 383	3 320	83	220
South Sakwa	11 973	13 788	25 761	4 102	226	113
North Sakwa	8 849	10 652	19 501	2 987	161	120
Tatwe	9 426	10 647	20 073	3 448	187	107
Arado Division	65 295	74 958	140 253	22 784	975	143
South Gera	12 808	15 288	28 096	6 319	150	187
North Gera	12 879	15 216	28 095	6 350	111	251
East Gera	17 518	20 321	37 839	8 118	145	260
Tala Division	43 205	50 825	94 030	20 787	407	230
East Alago	21 687	26 282	47 969	8 705	242	197
Central Alago	16 313	20 100	36 413	6 935	179	203
West Alago	10 691	13 574	24 265	3 501	117	207
Tanga	4 015	5 154	9 169	1 569	74	123
Ben Division	52 706	65 110	117 816	20 710	613	192
South Ugenya	11 697	14 865	26 562	5 399	95	277
East Ugenya	12 248	15 745	27 993	6 258	138	202
North Ugenya	18 801	23 826	42 627	8 275	184	231
Tatwe	11 106	14 129	25 235	5 489	108	232
Ugenya Division	53 852	68 565	122 417	25 421	526	232
Siaya District	215 058	259 458	474 516	89 702	2 522	188

SIAYA DISTRICT

TABLE 4: COMPOSITION OF HOUSEHOLDS
PER
LOCATION AND DIVISION^{a)}

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Persons per household total ^{b)}
		Adult >15 years	Children < 15 years	Other Relatives		
Location:						
East Uyoma	2954	3.32	1.35	1.18	0.74	6.59
West Uyoma	2824	3.28	1.35	1.58	0.49	6.72
West Asenbo	2970	3.32	1.28	1.22	0.30	6.05
East Asenbo	3339	3.00	0.86	1.09	0.36	5.51
South Sakwa	4331	3.25	1.23	1.18	0.26	5.92
North Sakwa	2973	3.20	1.29	1.37	0.55	6.44
Yimbo	3505	3.02	1.12	1.20	0.40	5.73
Division Bondo	22896	3.19	1.24	1.25	0.42	6.10
Location:						
South Gem	6399	3.18	0.45	0.51	0.26	4.39
North Gem	6370	2.66	1.02	0.46	0.27	4.40
East Gem	8140	2.67	1.05	0.64	0.28	4.64
Division Yala	20909	2.65	1.02	0.55	0.27	4.49
Location:						
East Alego	8748	2.79	1.05	1.27	0.33	5.40
Central Alego	6950	2.76	1.00	1.12	0.03	5.19
West Alego	3520	3.02	1.04	2.43	0.40	6.89
Usonga	1569	2.93	0.94	1.38	0.54	5.79
Division Boro	20784	2.82	1.03	1.42	0.35	5.44
Location:						
South Ugenya	5410	2.58	1.04	1.07	0.19	4.88
East Ugenya	6298	2.58	1.04	0.66	0.15	4.44
North Ugenya	8393	2.68	1.04	1.14	0.18	5.04
Uholo	5505	2.54	0.97	0.90	0.15	4.56
Division Ukwalu	25606	2.62	1.02	0.96	0.17	4.48
DISTRICT: SIAYA	90195	1.72	1.06	1.04	0.30	5.25

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, includes one and two person per household as well

TABLE 5: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION
AND PER
HOUSEHOLD AND PERSON

Location/Division without townships	in '00 ha = sqkm					in '00 ha = sqkm						in ha	
	Area total Census 79	Non-agricultural land			Agri- cultural land	Area in agro-ecological zones						Agric. land	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home- steads, rivers...)		A E Z						per house- hold	person
						UM 1	LM 1	LM 2	LM 3	LM 4	LM 5		
East Oyama	113	2		11	100				6	94		3.48	0.52
West Oyama	109			11	98				48	50		3.52	0.52
West Kambo	93			9	84				77	7		2.84	0.47
East Kambo	83			8	75			4	67	4		2.26	0.41
North Sakwa	226	13	sw. 4	23	186				63	103	20	4.33	0.71
South Sakwa	161	8	sw. 2	16	135			6	110	19		4.54	0.69
Yalo	187	10	sw. 33 lake 7	19	118				36	82		3.47	0.60
Imbo Division	975	33	46	97	799			10	407	359	20	3.49	0.56
North Gem	150			15	135		56	79				2.14	0.48
South Gem	88 (111) ¹⁾			9	79		79					1.21	0.27
East Gem	145			15	130	30	100					1.61	0.35
Yalo Division	383 (407) ¹⁾			39	344	30	235	79				1.65	0.37
East Alago	242		sw. 4	24	214		12	98	104			2.45	0.44
Central Alago	179	6	sw. 5 lake 5	18	151		13	98	34			2.18	0.41
West Alago	117		sw. 12 lake 5	12	88			16	72			2.54	0.37
Uanga	74		sw. 39	7	28				28			1.78	0.31
Imbo Division	612	6	70	61	481		25	212	238			2.32	0.41
North Ugenya	62 (95) ¹⁾			6	56		56					0.96	0.20
East Ugenya	138			13	125		122	3				1.99	0.45
South Ugenya	184			18	166		13	103	50			2.01	0.39
Uthiru	108			11	97		96	1				1.77	0.38
Uthiru Division	492 (526) ¹⁾			48	444		287	107	50			1.75	0.36
Total rural area	2 517	39	116	264	2 098	30	547	408	695	359	20	2.14	0.39

¹⁾ = Census areas differing from measured areas in older maps

For official land statistics see supplementary publication to
the Handbook, Vol. III A: Agriculture Land Statistics.

AGRICULTURAL STATISTICS

Cotton is the major and so far the only important cash crop grown in the district. It is estimated that 3-4,000 ha are planted annually yielding between 220 and 500 kg of seed cotton per ha. Ninety percent of the cotton crop is interplanted into maize.¹⁾ A cash crop gaining in importance is sugar cane, although the generally low soil fertility within the district makes sugar cane growing costly.²⁾

SIAYA DISTRICT

TABLE 6: COTTON PRODUCTION^{a)}

Ginnery Zone	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Ndere					
Seed Cotton in t	1172	1055	1565	1564	1790
Bales	2057	1852	2746	3745	3142

a) Source: C.L. & S.M.B., does not refer to district area only

SMALL FARM SURVEY (SFS)³⁾

The farms investigated are above average in size. They are not very intensively cultivated and no improved cattle are kept; the high stocking rate of 2.4 LU/ha does not consider the commonly used grazing areas. Fertilizer is almost exclusively applied to sugar cane (tables 7 and 8). Besides subsistence crops like maize and sorghum, cotton (in LM 3-4) and sugar cane (in LM 1) are the most important crops (table 9). Extremely low yields and little input level characterise the farming system (table 11). Widespread cattle diseases prevent the successful introduction of improved livestock; roughly 85 % of the grazing stock are cattle and 15 % are sheep and goats (table 10).

Practically all food produced is consumed locally (table 12). There is considerable potential for output increase (table 14) but a lasting improvement in soil fertility requires the introduction of a proper mixed farming system and the use of increasing amounts of fertilizer.⁴⁾ The introduction of a mechanisation system based on the use of draught animals is feasible and would help to improve the labour productivity considerably.

- 1) Cotton Research Station investigation - the farm activities shown in Graph of the SFS do not fully support these statistics
- 2) No exact agricultural statistics are available; for more detailed and up to date information see FMHB Vol. III A
- 3) November 1977, sample size 30. For more detailed and up to date information see FMHB Vol. III B
- 4) See also notes on farm management information, output and nutrient input, page 51

SIAYA DISTRICT

AEZ: UM 1 - LM 1

TABLE 7-4: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.7	3.7	3.5	Farming Intensity:				
Annual Crops ¹⁾	ha				Cropping Intensity	-	0.9	0.7	0.6
First Season: Others	ha				Portion of improved cattle kept	%	-	-	14%
Maize	ha	0.3	0.3	0.1	Portion of Farmers owning a Plough	%	30%	30%	30%
Maize & Beans	ha	0.4	0.5	1.2					
Beans	ha	0.1	0.2	0.2					
Sunflower	ha	0.1	0.1	-					
Sorghum	ha	-	0.3	0.3					
Total	ha	0.9	1.4	2.4					
Second Season¹⁾	ha				Labour on Farm:				
Maize	ha	0.1	0.4	0.1	Family Adults	persons	2.3	3.3	3.3
Maize & Beans	ha	0.2	0.2	1.1	Perm. Hired Labour	"	0.3	0.8	0.8
Sunflower	ha	0.1	0.1	0.2	Children > 14 years	"	1.8	2.6	2.9
Total	ha	0.4	0.7	1.4					
Permanent Crops¹⁾	ha				Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
Coffee	ha	0.1	0.1	0.1	Adults > 14 years	persons	2.02	0.34	2.36
Sugarcane	ha	0.1	0.4	1.4	Children < 14 years	"	2.37	-	2.37
Bananas	ha	-	0.1	0.1	Subsistence Units	SU	3.44	0.34	3.78
portion of total	%	12%	16%	19%					
Grazing & Forage	ha	0.3	1.2	3.1	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	18%	14%	36%	Maize	kg	1071	1726	
Other Land Use	ha	0.3	0.5	1.4	Beans	kg	219	348	
					Sweet Potatoes	kg	100	57	
Livestock on Farm:					Sorghum	kg	79	124	
Cattle: local	LU	2.3	4.1	2.4					
improved	LU	-	-	-					
Sheep & Goats	LU	0.3	0.3	0.3					
Total	LU	2.5	4.4	3.1					

Other Crops cultivated: Maize & Sorghum, Onions, Groundnuts, Tea, Cassava, Sweet Potatoes

1) Major crops only considered

2) Based on 1979 Census figures

TABLE 7.5: FARM ORGANIZATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	2.7	6.0	15.9	Farming Intensity:				
Land Use:									
Annual Crops ¹⁾	ha				Cropping Intensity	-	0.6	0.5	0.4
First Season	ha	0.4	0.5	1.3	Portion of improved cattle kept	%	-	-	-
Maize	ha	0.4	0.2	1.3	Portion of Farmers owning a Plough	%	30%	30%	120%
Sorghum	ha	-	0.3	0.3					
Beans	ha	0.1	0.6	0.7					
Cotton	ha	0.1	0.3	1.2					
Maize & Beans	ha	0.4	0.5	1.3					
Others	ha	1.4	2.4	6.1					
Total	ha								
Second Season¹⁾					Labour on Farm:				
Cassava	ha	-	0.1	0.1	Family Adults	persons	2.6	2.9	3.8
	ha				Perm. Hired Labour	"	0.2	0.4	1.8
	ha				Children > 14 years	"	1.4	1.7	7.2
Total	ha								
Permanent Crops¹⁾					Persons living on Farm²⁾				
Bananas	ha	0.1	0.2	-	- average household size -				
	ha				Adults > 14 years	persons	1.96	0.10	2.06
	ha				Children < 14 years	"	2.02	-	2.02
	ha				Subsistence Units	SU	3.17	0.10	3.27
portion of total	%	4%	3%						
Grazing & Forage	ha	0.6	2.7	7.2	Home Consumption of Major Food Products on Farm				
portion of total	%	22%	45%	45%	Maize	kg	1147	1849	
Other Land Use	ha	0.6	0.7	2.8	Beans	kg	132	210	
					Finger Millet	kg	61	72	
Livestock on Farm:					Sweet Potatoes	kg	127	420	
Cattle: local	LU	5.1	2.8	14.1	Sorghum	kg	268	8	
improved	LU	-	-	-	Cowpeas	kg	5	14	
Sheep & Goats	LU	0.7	0.7	2.3	Groundnuts	kg	9		
Total	LU	5.8	3.5	16.4					

1) Major crops only considered
2) Based on 1979 Census figures

Other Crops cultivated: Finger Millet, Finger Millet & Sorghum, Cowpeas, Groundnuts, Maize & Cowpeas

SIAYA DISTRICT

TABLE 8 a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: UM 1 - LM 1

Survey Area 08

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	4.1	8.9	1.3	2.9	0.6	2.3
Avg. 1	4.1	10.3	1.9	2.9	1.5	3.3
Up. Qu.	5.6	10.0	2.0	3.0	1.0	4.0
Lo. Qu.	2.0	3.0	-	2.0	-	-

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	1.5	37	0.7	17	1.3	32	-	-	0.3	-	2	6
Avg. 1	1.5	32	1.0	20	1.3	28	0.1	3	0.5	12	3	6
Up. Qu.	2.0	60	0.8	20	1.2	46	-	-	0.5	13	4	10
Lo. Qu.	0.7	29	-	-	0.3	13	-	-	-	-	1	4
Total	45.0		20.2		38.9		0.1		9.9		2	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved % of Total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.2	0.8	2.5	3
Avg. 1			2.5	54
Up. Qu.	1.6	1.1	6.9	-
Lo. Qu.	0.9	0.3	0.7	-

Inputs Applied

Inputs Applied													
Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	46.4	4.5	2.4	14.7	-	-	-	0.2	-	0.8	-	-	0.3
Avg. 1	50.3	19.2	15.6	25.8	-	-	-	0.7	0.1	2.2	0.2	-	1.2
Up. Qu.	83.3	12.0	-	36.0	-	-	-	0.2	-	1.9	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0

= average of all sample farms

Avg. 1

= average of all farms excluding zero entries

Up. Qu./Lo. Qu.

= Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points

AC = Annual Crops

PC = Perennial Crops

SIAYA DISTRICT

TABLE 8 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Survey Area 07

AEZ: LM 3-4

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children >14 No.
avg. 0	6.9	21.3	0.6	3.0	0.6	2.7
avg. 1	6.9	30.4	1.5	3.0	1.9	4.5
Up. Qu.	8.4	31.0	1.0	4.0	1.0	3.0
Lo. Qu.	3.2	-	-	2.0	-	-

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
avg. 0	2.8	40	0.1	2	2.7	39	0.2	3	0.8	12	0.2	3
avg. 1	2.8	24	0.8	7	3.0	25	3.4	29	1.4	12	0.3	2
Up. Qu.	3.2	55	-	-	4.2	60	-	-	1.2	20	0.4	8
Lo. Qu.	1.4	27	-	-	0.5	15	-	-	-	-	0.1	1
Total	83.2		4.2		79.8		6.8		24.6		7.0	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
avg. 0	0.8	1.0	2.4	-
avg. 1			2.2	-
Up. Qu.	1.0	1.5	3.1	-
Lo. Qu.	0.7	-	-	-

Inputs Applied

Inputs Applied													
Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
avg. 0	38.6	0.4	-	2.5	-	-	-	0.1	-	1.1	-	-	-
avg. 1	52.9	3.9	-	7.6	-	-	-	0.2	-	1.7	-	-	-
Up. Qu.	66.7	-	-	-	-	-	-	-	-	1.0	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0

= average of all sample farms

Avg. 1

= average of all farms excluding zero entries

Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points

AC = Annual Crops

PC = Perennial Crops

SIAYA DISTRICT

TABLE 9a: CROPPING PATTERN

AEZ: UM I - LM I

Key Area 08

First Rains
Annual & Semipermanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total	Sample
	ha	ha	ha	ha	ha	%
Maize	0.4	1.0	0.80	0.00	11.4	19.1
Sorghum	0.1	0.7	0.00	0.00	4.2	7.1
Beans	0.1	0.5	0.20	0.00	4.0	6.8
Beans IPC	0.0	0.2	0.00	0.00	0.4	0.7
Groundnuts	0.0	0.2	0.00	0.00	0.2	0.3
Sunflower	0.1	0.4	0.00	0.00	2.2	3.7
Onions	0.0	0.2	0.00	0.00	0.3	0.5
Cassava	0.0	0.3	0.00	0.00	0.6	1.0
Sugarcane	0.5	1.1	0.80	0.00	16.0	26.9
Maize & Sorghm	0.0	0.4	0.00	0.00	0.4	0.7
Maize & Beans	0.7	0.9	0.80	0.00	19.8	33.2
Total					59.6	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total	Sample
	ha	ha	ha	ha	ha	%
Maize	0.2	0.6	0.20	0.00	5.4	13.9
Beans	0.1	0.9	0.00	0.00	1.8	4.7
Beans IPC	0.0	0.1	0.00	0.00	0.1	0.3
Sunflower	0.1	0.4	0.00	0.00	1.8	4.7
Cassava	0.0	0.3	0.00	0.00	0.6	1.6
Sweet Potatoes	0.0	0.2	0.00	0.00	0.2	0.5
Sugarcane	0.5	1.1	0.80	0.00	16.0	41.4
Maize & Beans	0.4	1.0	0.60	0.00	12.8	33.1
Total					38.7	100.0

Permanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total Sample	
	ha	ha	ha	ha	ha	%
Sweet Bananas	0.0	0.2	0.00	0.00	0.2	4.1
Cookng Bananas	0.1	0.3	0.00	0.00	1.8	36.4
Coffee	0.1	0.3	0.24	0.00	2.7	55.4
Tea	0.0	0.2	0.00	0.00	0.2	4.1
Total					4.8	100.0

- Avg 0 = average of all sample farms
 Avg 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points
 % columns = % of total farm land

SIAYA DISTRICT

TABLE 9 b: CROPPING PATTERN

AEZ: LM 3-4

Survey Area 07

First Rains
Annual & Semipermanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total Sample Area	
	ha	ha	ha	ha	ha	%
Maize	0.8	1.4	1.40	0.00	24.6	28.2
Sorghum	0.7	1.3	1.20	0.00	21.4	24.6
Fingermillet	0.0	0.3	0.00	0.00	0.8	0.9
Beans	0.2	0.7	0.40	0.00	5.4	6.2
Cowpeas	0.0	0.5	0.00	0.00	1.0	1.1
Groundnuts	0.1	0.3	0.00	0.00	1.5	1.7
Sunflower	0.0	0.8	0.00	0.00	0.8	0.9
Cotton	0.5	1.0	0.80	0.00	14.0	16.1
Cassava	0.1	1.0	0.00	0.00	4.0	4.6
Sweet Potatoes	0.0	1.2	0.00	0.00	1.2	1.4
Others	0.0	0.5	0.00	0.00	4.4	1.6
Maize & Beans	0.2	0.9	0.00	0.00	4.2	6.0
Maize & Cowps	0.0	0.2	0.00	0.00	0.2	0.3
Maize & Others	0.1	0.7	0.00	0.00	4.4	5.0
FMIt & Sorghum	0.0	0.6	0.00	0.00	1.2	1.4
Total					87.2	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total Sample Area	
	ha	ha	ha	ha	ha	%
Maize	0.0	0.4	0.00	0.00	0.8	12.9
Cassava	0.1	1.0	0.00	0.00	4.0	64.5
Maize & Beans	0.0	1.4	0.00	0.00	1.4	22.6
Total					6.2	100.0

Permanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total Sample Area	
	ha	ha	ha	ha	ha	%
Sweet Bananas	0.0	0.2	0.00	0.00	0.2	100.0
Total					0.2	100.0

- Avg 0 = average of all sample farms
 Avg 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points
 % column = % of total farm land

SIAYA DISTRICT

AEZ: UM 1 - LM 1

TABLE 10 E: HERD COMPOSITION (GRAZING LIVESTOCK)
- in Head and Livestock Units -

Nov. '77, Survey Area 08

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		-	-	-	0.07	-	-	-	0.02	-	-	0.02
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average		-	-	-	0.03	-	-	-	0.02	-	-	0.02
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	0.03	-	-	0.07	-	-	0.09	-	-	0.09
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Subtotal(Improved) Total		-	1	-	3	2	-	-	3.8	-	-	3.8
Average		-	0.03	-	0.10	0.07	-	-	0.13	-	-	0.13
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		21.1 % of total cattle, Calves + Heifers = 150.0 % of dairy cows										
Unimproved Livestock:												
Under 1 year, Average		0.77	-	-	0.73	-	0.70	0.20	0.39	0.27	-	0.43
Upper Qu.		-	-	-	1	-	1	-	0.3	-	-	0.3
1 - 2 years, Average		0.30	0.03	0.07	0.53	-	-	-	0.42	-	-	0.42
Upper Qu.		-	-	-	1	-	-	-	0.5	-	-	0.5
Over 2 years, Average		0.60	0.03	0.93	-	1.70	1.30	0.57	2.31	-	16.97	2.31
Upper Qu.		1	-	-	-	3	1	-	-	-	4	-
Subtotal (unimp.) Total		50	2	30	23	51	60	23	93.6	8	509	94.3
Average		1.67	0.07	1.00	1.27	1.70	2.00	0.77	3.12	0.27	16.97	3.16
Upper Qu.		1	-	-	2	3	2	-	4.0	-	25	4.0
Lower Qu.		-	-	-	-	-	-	-	0.7	-	4	0.7
LU Male Cattle =		47.5 % of total cattle, Calves + Heifers = 71.5 % of dairy cows										
LU Goats + Sheep =		8.9 % of total Grazing Livestock Units										
Improved + Unimproved												
Grazing L/Stock Total		50	3	30	41	53	60	23	97.4	8	509	98.6
Average		1.67	0.10	1.00	1.37	1.77	2.00	0.77	3.25	0.27	16.97	3.29
Upper Qu.		1	-	-	2	3	2	-	4.0	-	25	4.0
Lower Qu.		-	-	-	-	-	-	-	0.7	-	4	0.7
LU Male Cattle =		46.4 % of total cattle, Calves + Heifers = 77.4 % of dairy cows										
LU Goats + Sheep =		3.5 % of total										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

TABLE 10: HERD COMPOSITION (GRAZING LIVESTOCK)
— in Head and Livestock Units

Nov. '77, Survey Area 07

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total		-	-	-	-	-	-	-	-	-	-	-
Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		0.0 % of total cattle,			Calves + Heifers =			0.0 % of dairy cows				
Unimproved Livestock:												
Under 1 year, Average		0.97	0.03	0.13	1.30		1.17	3.10	0.91	-		0.91
Upper Qu.		-	-	-	2		-	5	0.9	-		0.9
1 - 2 years, Average		0.53	0.10	0.10	1.10				0.82			0.82
Upper Qu.		-	-	-	2				0.9			0.9
Over 2 years, Average		0.40	0.10	2.30		4.13	1.57	4.27	5.09	-	33.57	5.59
Upper Qu.		-	-	4		6	1	5	-	-	10	-
Subtotal (unimp.) Total		54	7	76	72	124	82	221	204.9	-	1007	204.9
Average		1.90	0.23	2.53	2.40	4.13	2.73	7.37	6.83	-	33.57	6.83
Upper Qu.		2	-	4	4	6	2	11	11.8	-	23	11.8
Lower Qu.		-	-	-	-	-	-	-	-	-	10	-
LU Male Cattle =		40.3 % of total cattle,			Calves + Heifers =			58.1 % of dairy cows				
LU Goats + Sheep =		14.3 % of total Grazing Livestock Units										
Improved + Unimproved												
Grazing L/Stock Total		57	7	76	72	124	82	221	204.9	-	1007	204.9
Average		1.90	0.23	2.53	2.40	4.13	2.73	7.37	6.83	-	33.57	6.83
Upper Qu.		2	-	4	4	6	2	11	11.8	-	23	11.8
Lower Qu.		-	-	-	-	-	-	-	-	-	10	-
LU Male Cattle =		40.3 % of total cattle,			Calves + Heifers =			58.1 % of dairy cows				
LU Goats + Sheep =		14.3 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

SIAYA DISTRICT

TABLE 11 a: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: UM 1 - LM 1

Survey 08

Crop		Im- proved Seeds %	Inputs						Yl kg
			Nutrients				Chemicals		
			N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	90	13	37	-	1.36	2	-	1,
	UpQu	100	26	60	-	-	4	-	2,
	LoQu	100	-	-	-	-	-	-	
Sorghum	Avg.	-	-	20	-	-	2	-	
	UpQu	-	-	-	-	-	-	-	
	LoQu	-	-	-	-	-	-	-	
<u>Maize & Beans</u>									
Maize	Avg.	80	12	29	-	0.90	2	-	2,
Beans	Avg.	10	-	3	-	0.09	-	-	
Maize	UpQu	100	33	60	-	0.60	5	-	3,
Beans	UpQu	-	-	-	-	-	-	-	
Maize	LoQu	100	-	-	-	-	-	-	1,
Beans	LoQu	-	-	-	-	-	-	-	
<u>Second Rains</u>									
Maize	Avg.	57	5	20	-	0.77	1	1	1,
	UpQu	100	-	40	-	-	-	-	2,
	LoQu	-	-	-	-	-	-	-	
Beans	Avg.	-	-	4	-	-	2	2	
	UpQu	-	-	-	-	-	-	-	1,
	LoQu	-	-	-	-	-	-	-	
<u>Maize & Beans</u>									
Maize	Avg.	50	8	17	-	0.15	3	3	1,
Beans	Avg.	-	-	-	-	-	-	-	4,
Maize	UpQu	100	-	58	-	-	-	-	2,2
Beans	UpQu	-	-	-	-	-	-	-	60
Maize	LoQu	-	-	-	-	-	-	-	1,1
Beans	LoQu	-	-	-	-	-	-	-	12
<u>Perennial Crops</u>									
Sugarcane	Avg.	-	11	-	-	-	-	-	32,175
	UpQu	-	-	-	-	-	-	-	42,000
	LoQu	-	-	-	-	-	-	-	-
Cooking Bananas	Avg.	-	-	-	-	0.15	-	-	3,299
	UpQu	-	-	-	-	-	-	-	2,250
	LoQu	-	-	-	-	-	-	-	-
Coffee	Avg.	-	23	-	-	0.71	-	16	1,232
	UpQu	-	-	-	-	-	-	13	1,635
	LoQu	-	-	-	-	-	-	-	313

SIAYA DISTRICT

TABLE 11 b: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LM 3-4

Survey Area 07

Crop		Inputs							Yield kg/ha
		Imp- roved Seeds %	Nutrients				Chemicals		
			N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	67	3	13	-	0.02	1	-	2,121
	UpQu	100	-	20	-	-	-	-	2,250
	LoQu	-	-	-	-	-	-	-	1,500
Sorghum	Avg.	-	-	-	-	0.01	-	-	997
	UpQu	-	-	-	-	-	-	-	1,125
	LoQu	-	-	-	-	-	-	-	600
Beans	Avg.	-	-	-	-	1.14	1	-	871
	UpQu	-	-	-	-	-	-	-	1,125
	LoQu	-	-	-	-	-	-	-	400
Groundnuts	Avg.	20	-	-	-	-	-	-	638
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	113
Cotton	Avg.	57	-	-	-	0.35	-	-	694
	UpQu	100	-	-	-	-	-	-	750
	LoQu	-	-	-	-	-	-	-	375
<u>Maize & Beans</u>									
Maize	Avg.	20	-	4	-	0.03	-	-	2,085
Beans	Avg.	-	-	-	-	0.03	-	-	440
Maize	UpQu	-	-	-	-	-	-	-	2,250
Beans	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	-	-	-	-	-	-	-	1,200
Beans	LoQu	-	-	-	-	-	-	-	160
<u>Second Rains</u>									
Maize	Avg.	-	-	-	-	0.63	-	-	1,913
<u>Perennial Crops</u>									
Cassava	Avg.	-	-	-	-	-	-	-	3,125
	UpQu	-	-	-	-	-	-	-	-
	LoQu	-	-	-	-	-	-	-	-

SIAYA DISTRICT

TABLE 12 a: DISPOSAL OF CROPS

AEZ: UM 1 - LM 1

Survey Area 08

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	17,320	2,070	12	3,240	19	12,010	6
Maize & Beans	57,037	4,400	8	14,930	26	37,707	6
Maize & Sorghum	180	0	0	0	0	180	10
Beans	2,420	240	10	1,080	45	1,100	1
Beans IPC	620	80	13	120	19	420	6
Sorghum	2,940	0	0	620	21	2,320	7
Groundnuts	100	0	0	80	80	20	2
Sweet Potatoes	3,000	0	0	0	0	3,000	10
Sunflower	1,166	1,166	100	0	0	0	0
Cabbage	600	0	0	580	97	20	3
Onions	350	0	0	300	86	50	14
Tomatoes	280	0	0	200	71	80	28
<u>Second Rains</u>							
Maize	8,695	1,285	15	270	3	7,140	8
Maize & Beans	30,440	380	1	11,580	38	18,480	6
Beans	1,390	40	3	1,000	72	350	2
Beans IPC	80	60	75	0	0	20	2
Sunflower	1,955	8,910	456	0	0	-6,955	-35
Onions	720	0	0	720	100	0	0
<u>Permanent Crops</u>							
Cooking Bananas	450	0	0	400	89	50	11

SIAYA DISTRICT

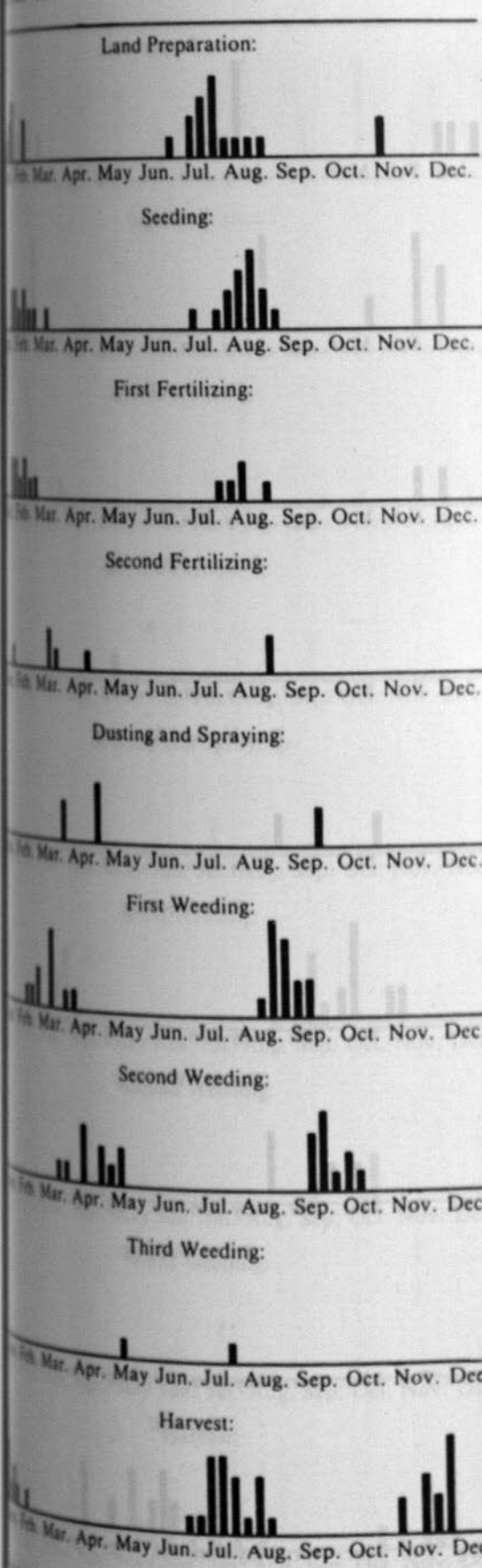
TABLE 12 b: DISPOSAL OF CROPS

AEZ: LM 3-4

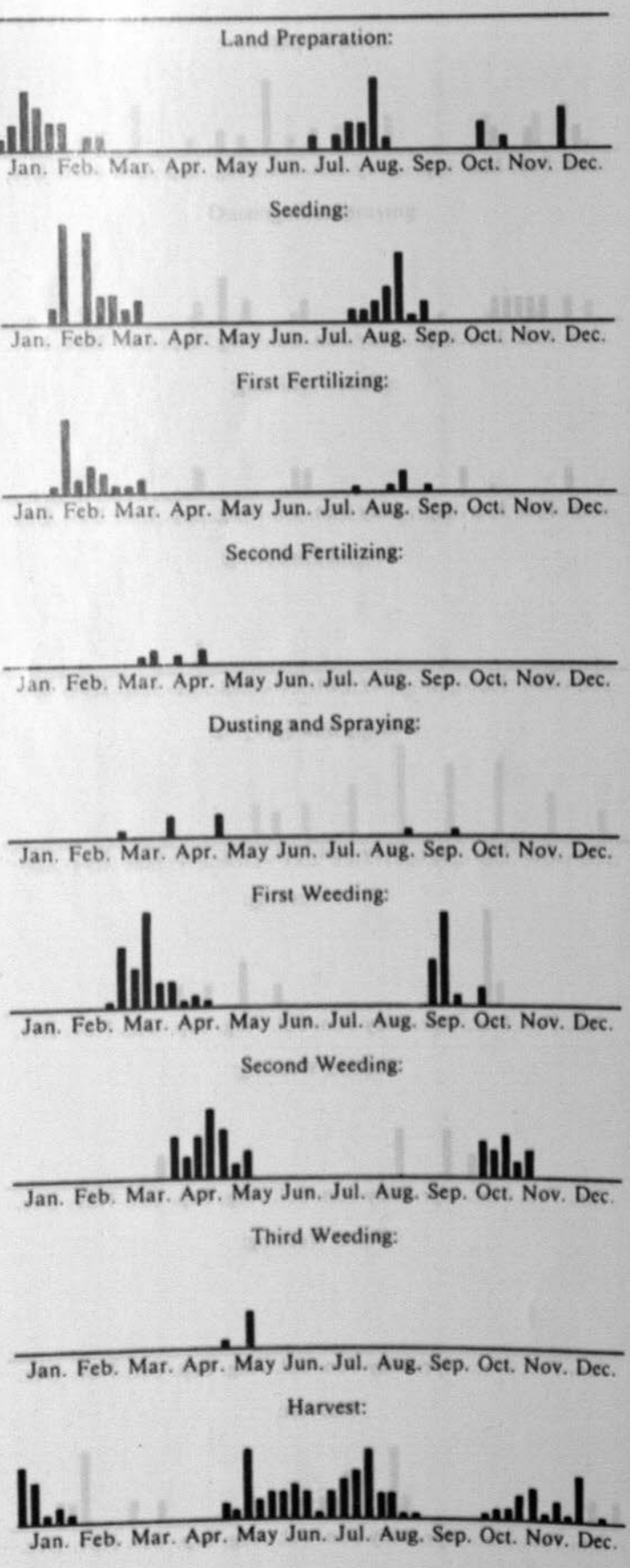
Survey Area 07

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	60,255	7,620	13	13,510	22	39,125	65
Maize & Beans	18,945	6,020	32	3,740	20	8,785	47
Maize & Cowpeas	490	0	0	90	18	400	82
Maize & Others	9,711	2,391	25	1,710	18	5,610	58
Beans	3,420	0	0	1,390	41	2,030	59
Finger Millet	350	140	40	70	20	140	40
PHU & Sorghum	1,380	0	0	80	6	1,300	94
Sorghum	21,180	0	0	5,830	28	15,350	72
Cowpeas	180	0	0	100	56	80	44
Groundnuts	765	190	25	305	40	270	35
Sweet Potatoes	18,000	0	0	0	0	18,000	100
Sweet Pot. IPC	20,020	0	0	0	0	20,020	100
Sunflower	950	950	100	0	0	0	0
Cotton	8,360	8,360	100	0	0	0	0
<u>Second Rains</u>							
Maize	1,530	0	0	765	50	765	50
Maize & Beans	843	0	0	0	0	843	100
<u>Permanent Crops</u>							
Nil							

DISTRICT
 DISTRIBUTION OF FARMING ACTIVITIES
 Crop 1 Maize Cases: 24
 Survey Area 08 Sample Size: 30



SIAYA DISTRICT
 TABLE 13. DISTRIBUTION OF FARMING ACTIVITIES
 Crop 2 Maize & Beans Cases: 60¹⁾
 AEZ: UM 1 - LM 1 Survey Area 08 Sample Size: 30

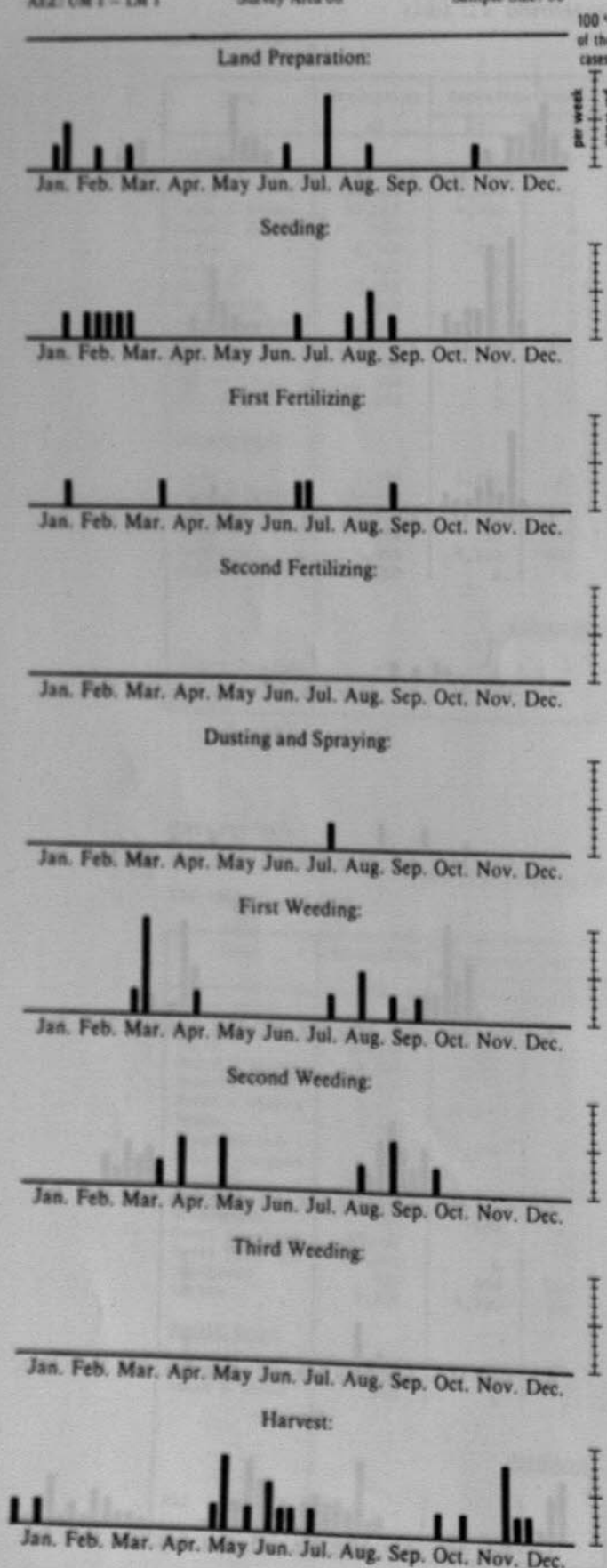


¹⁾ 100% per crop and season

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TABLE 13 c: DISTRIBUTION OF FARMING ACTIVITIES

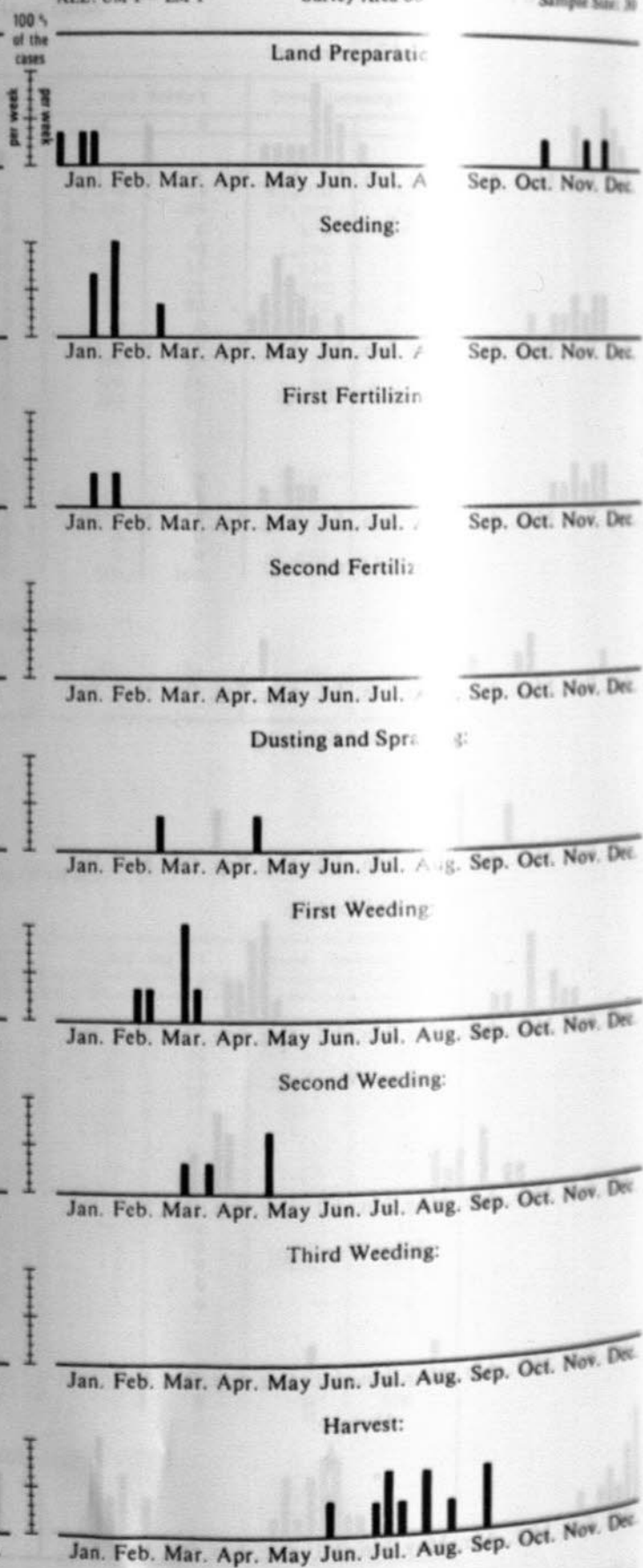
Crop 10 Beans Cases: 11
AEZ: UM 1 - LM 1 Survey Area 08 Sample Size: 30



SIAYA DISTRICT

TABLE 13 d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 18 Sorghum Cases: 6
AEZ: UM 1 - LM 1 Survey Area 08 Sample Size: 30

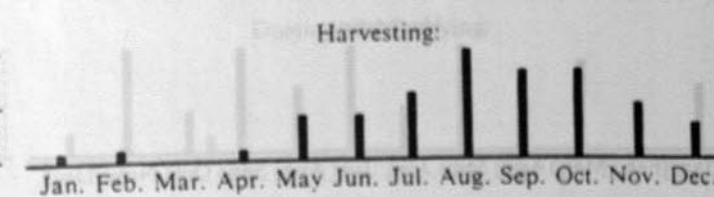
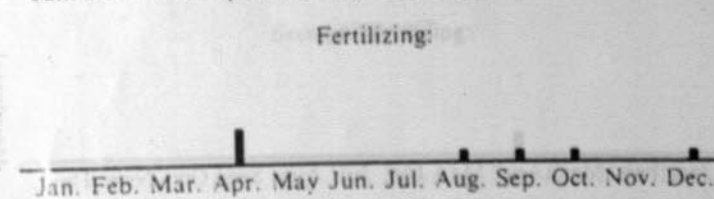
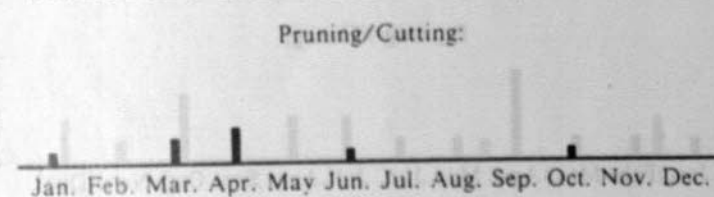
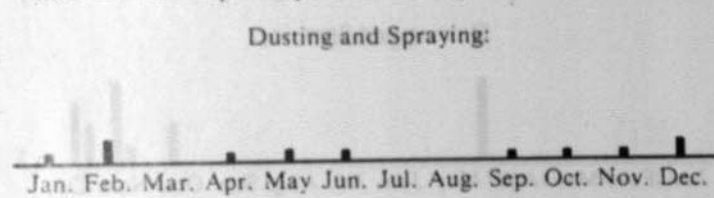
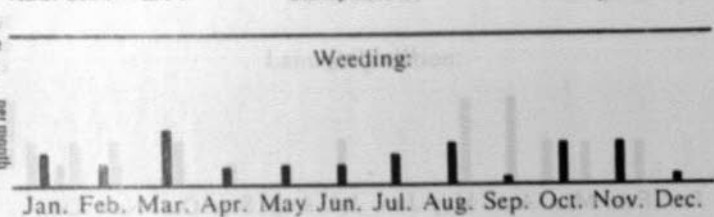
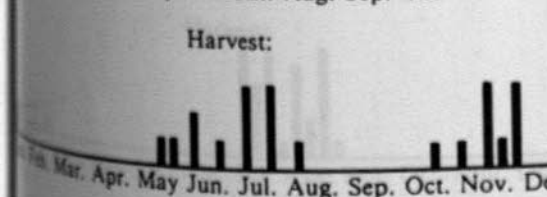
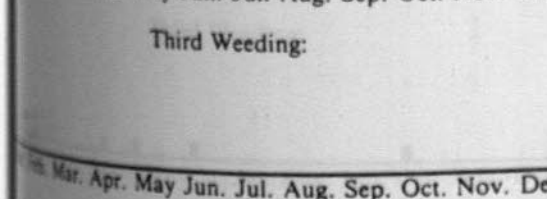
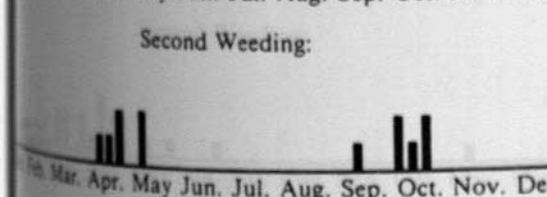
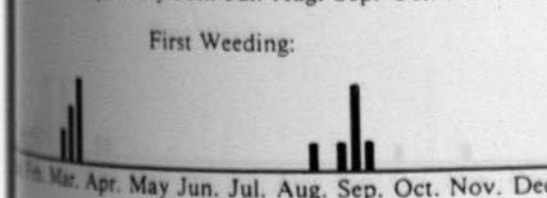
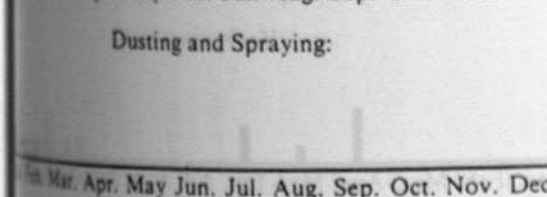
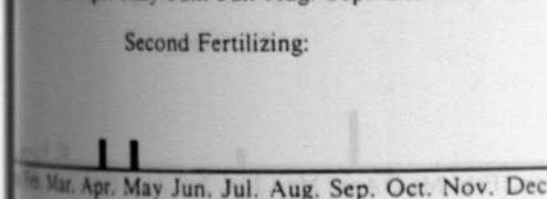
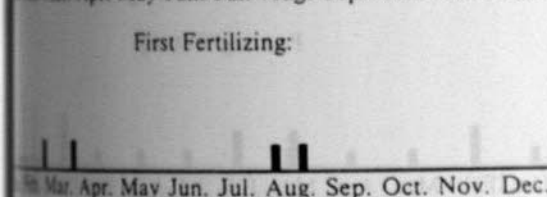
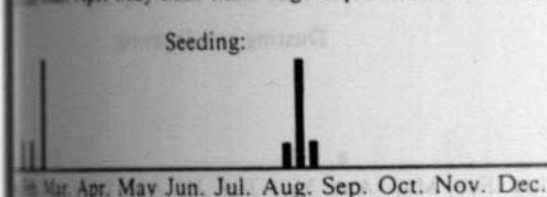
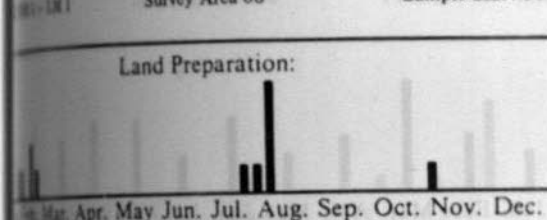


SIAYA DISTRICT

TABLE 13 f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee (Robusta) Cases: 11
AEZ: UM 1 - LM 1 Survey Area 08 Sample Size: 30

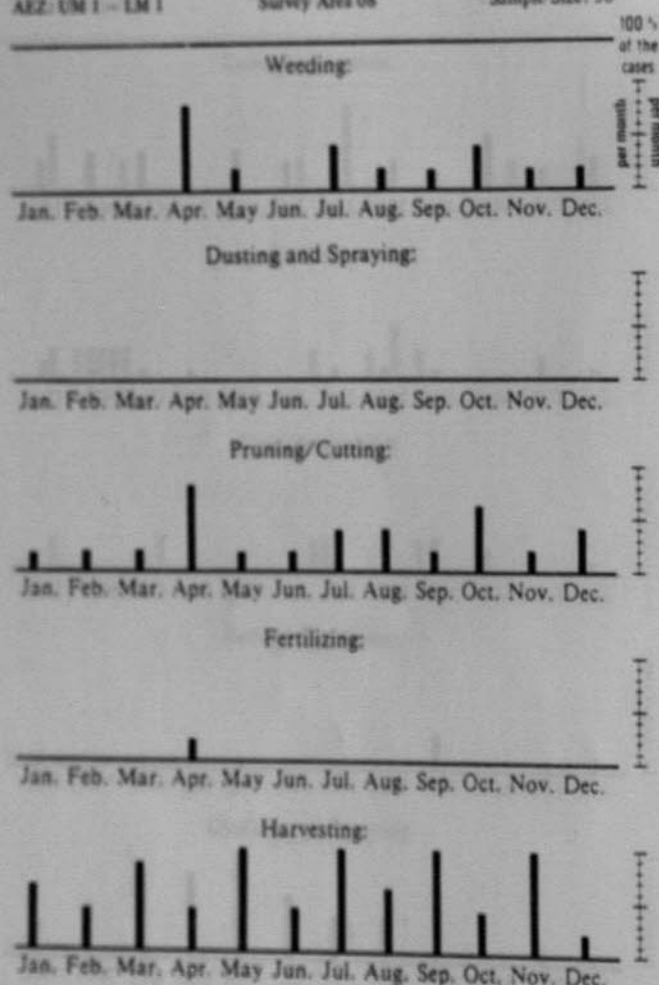
Crop 34 Sunflower Cases: 12
Survey Area 08 Sample Size: 30



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TABLE 13 g: DISTRIBUTION OF FARMING ACTIVITIES

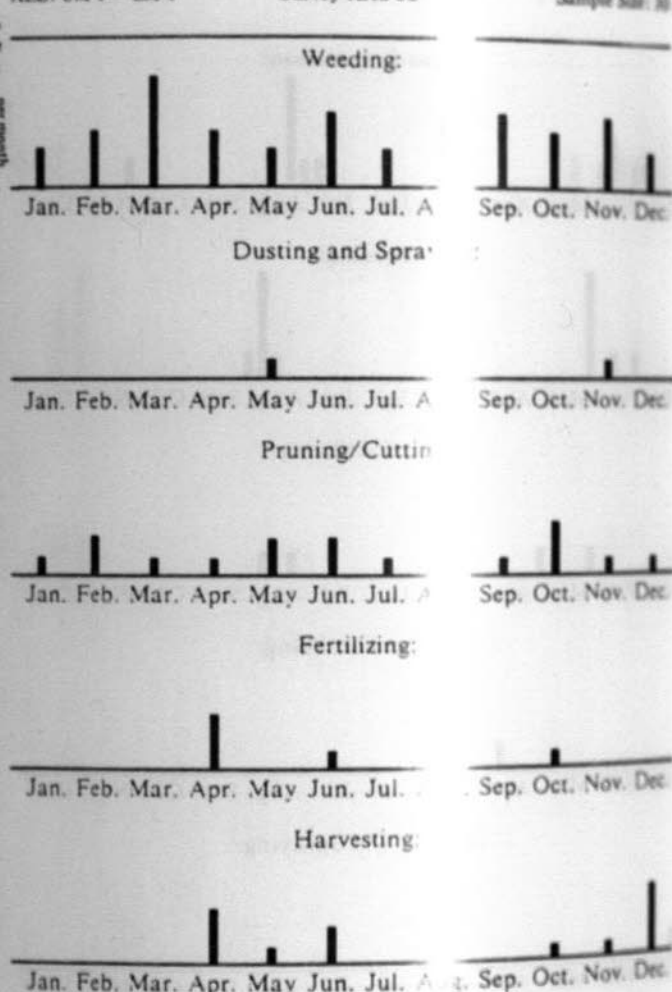
Crop 56 Cooking Bananas Cases: 6
AEZ: UM 1 - LM 1 Survey Area 08 Sample Size: 30



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TABLE 13 h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 63 Sugarcane Cases: 14
AEZ: UM 1 - LM 1 Survey Area 08 Sample Size: 30

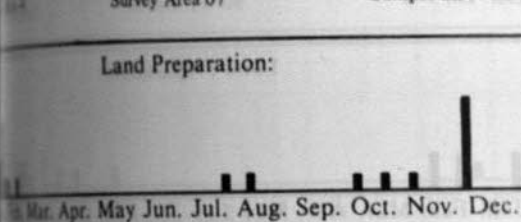


SIAYA DISTRICT

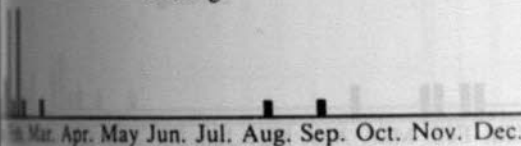
DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 20
Survey Area 07 Sample Size: 30

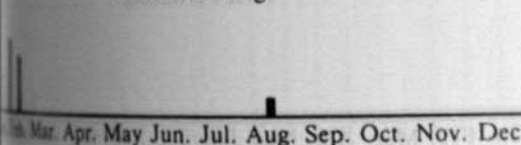
Land Preparation:



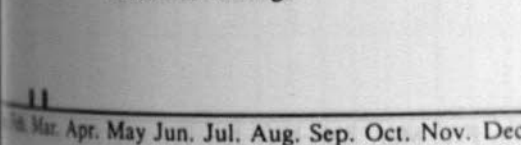
Seeding:



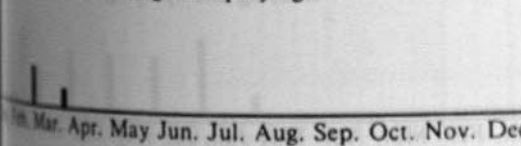
First Fertilizing:



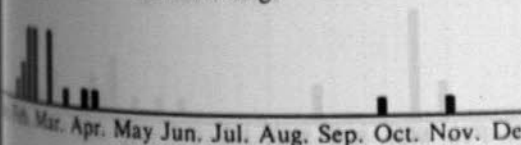
Second Fertilizing:



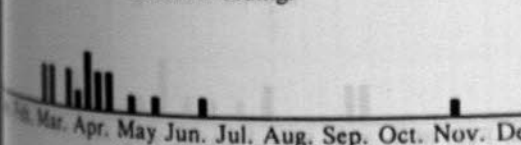
Dusting and Spraying:



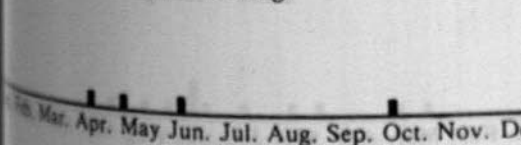
First Weeding:



Second Weeding:



Third Weeding:



Harvest:

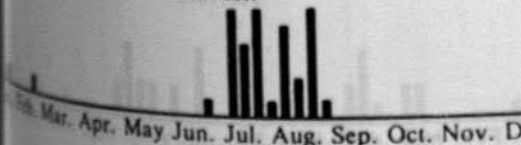
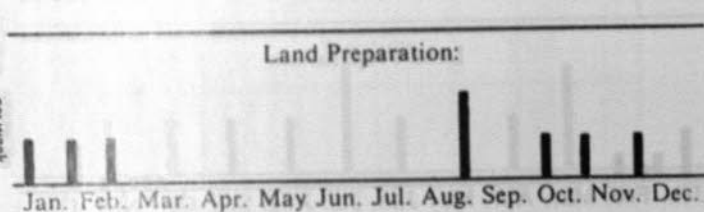


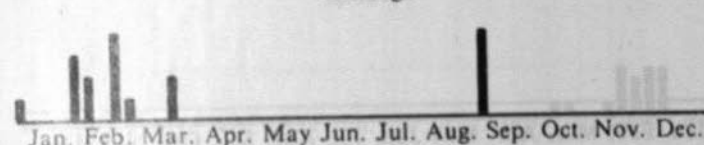
TABLE 13: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 17
AEZ: LM 3-4 Survey Area 07 Sample Size: 30

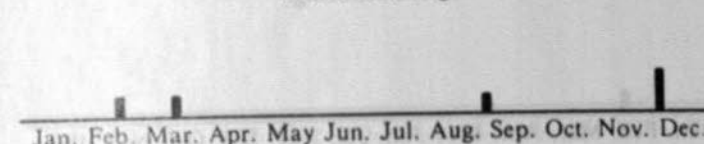
Land Preparation:



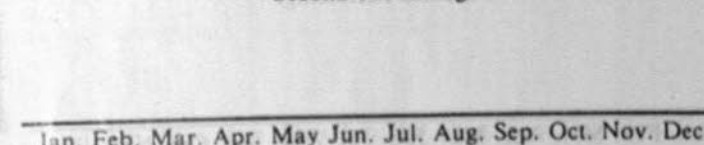
Seeding:



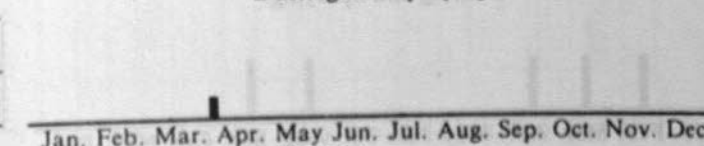
First Fertilizing:



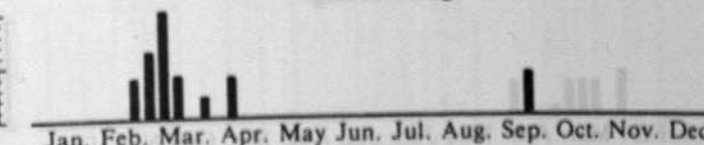
Second Fertilizing:



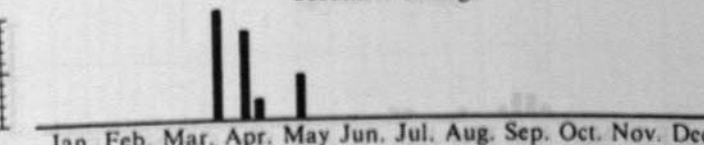
Dusting and Spraying:



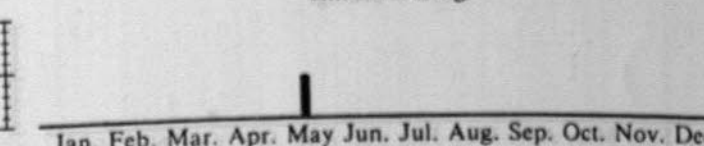
First Weeding:



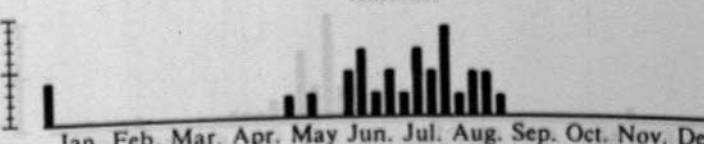
Second Weeding:



Third Weeding:



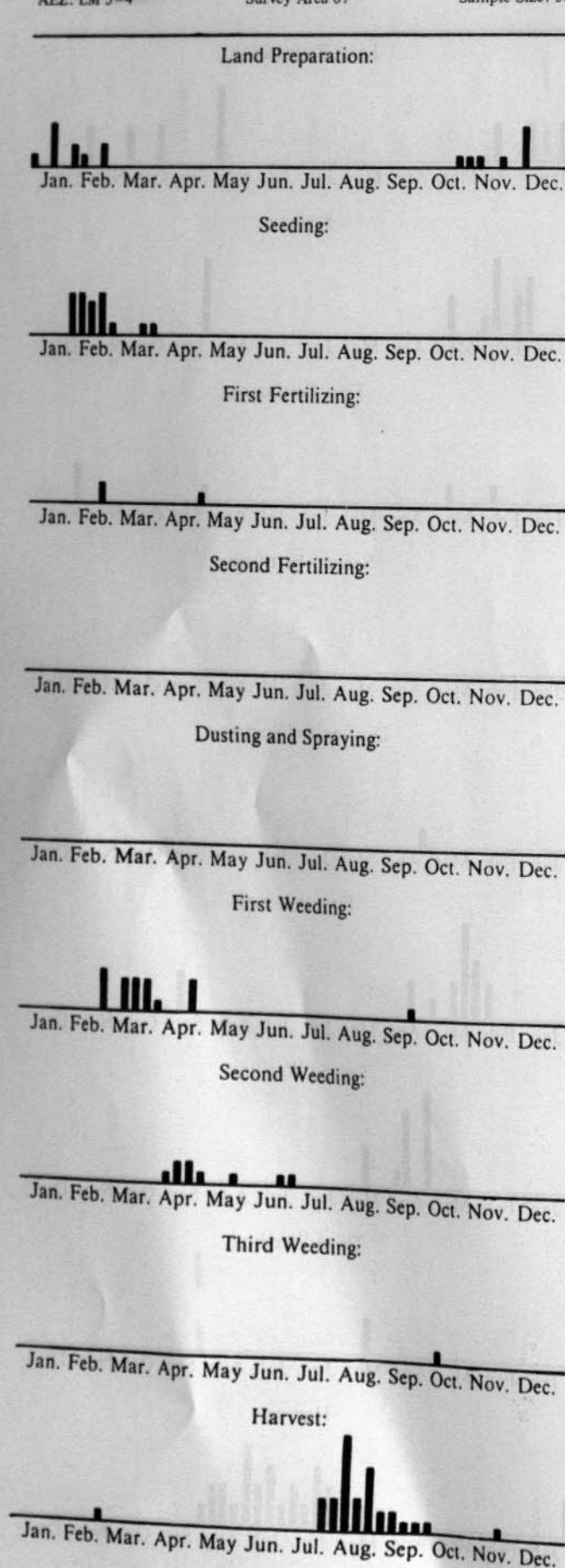
Harvest:



SIAYA DISTRICT

TABLE 13 k: DISTRIBUTION OF FARMING ACTIVITIES

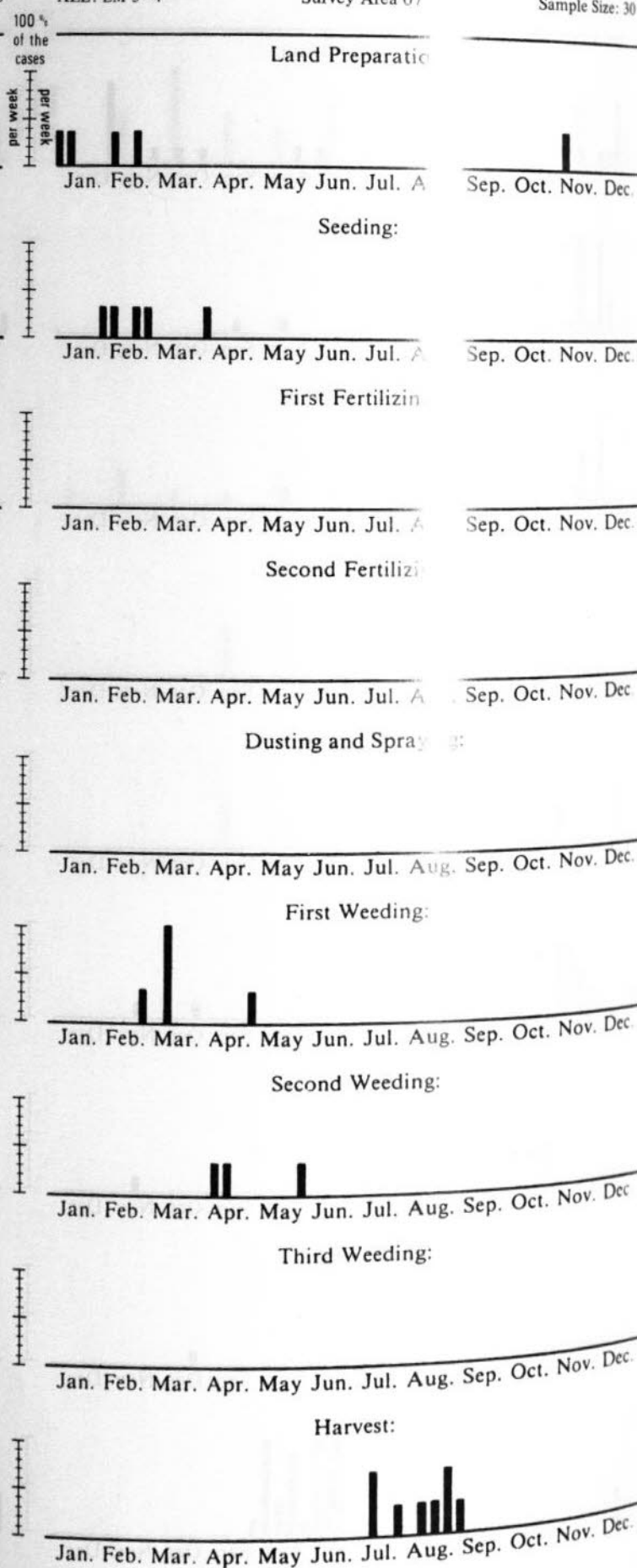
Crop 18 Sorghum Cases: 18
AEZ: LM 3-4 Survey Area 07 Sample Size: 30



SIAYA DISTRICT

TABLE 13 l: DISTRIBUTION OF FARMING ACTIVITIES

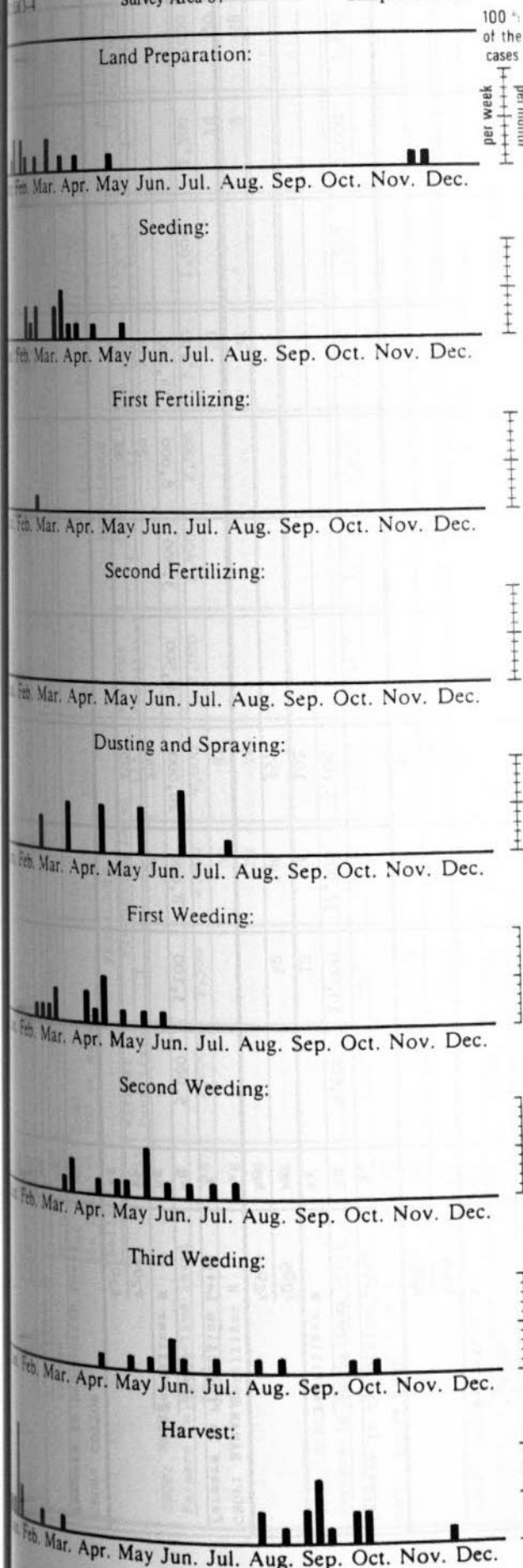
Crop 24 Groundnuts Cases: 5
AEZ: LM 3-4 Survey Area 07 Sample Size: 30



SIAYA DISTRICT

TABLE 13 n: DISTRIBUTION OF FARMING ACTIVITIES

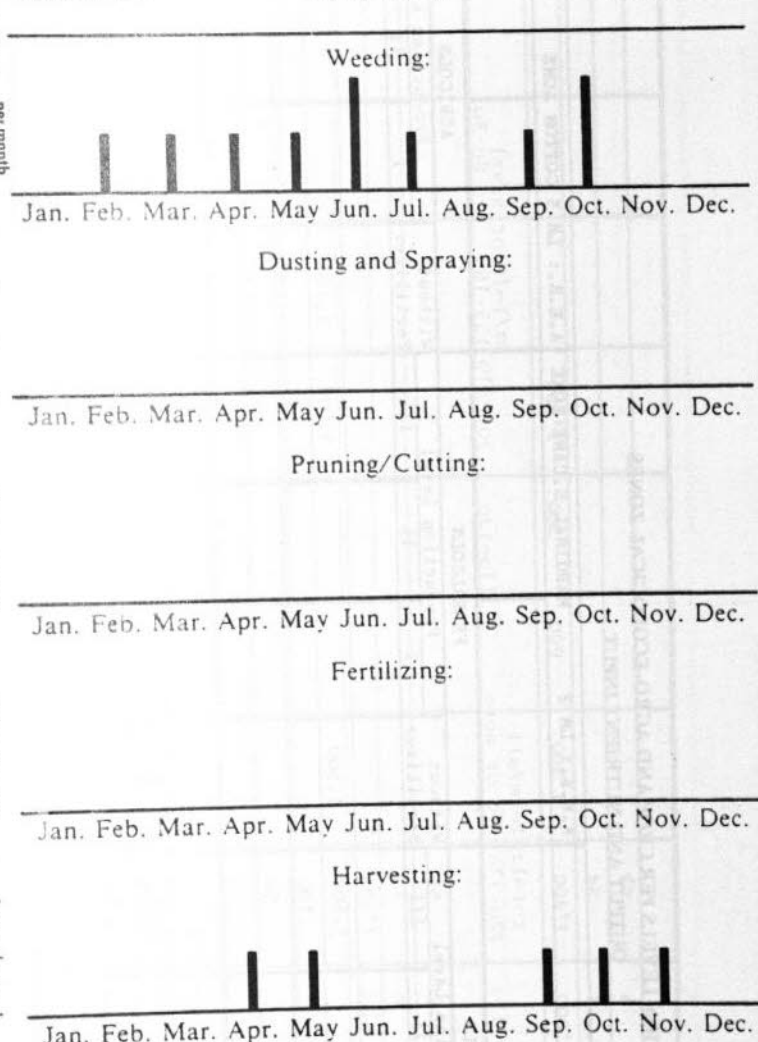
Crop 35 Cotton Cases: 14
Survey Area 07 Sample Size: 30



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TABLE 13 n: DISTRIBUTION OF FARMING ACTIVITIES

Crop 64 Cassava Cases: 4
AEZ: LM 3-4 Survey Area 07 Sample Size: 30



SIAYA DISTRICT

TABLE 14: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

[illegible]

CROP: MAIZE									
Farmers in Production Level									
Soil:	Unit	FERRALSOLS			FERRALSOLS			ACRISOLS	
		Without Fertilizer	I	II	III	Without Fertilizer	I	II	III
Yields	kg	1,200	1,500	2,200	4,000	2,000	1,400	3,100	2,000
Fertilizer N	kg			30	84			10	30
P ₂ O ₅	kg			28	78			8	28
K ₂ O	kg								
CROP: SORGHUM									
Farmers in Production Level									
Yields	kg	2,000	1,000	2,000	3,800	2,100	1,000	4,200	1,800
Fertilizer N	kg				78			70	10
P ₂ O ₅	kg				57			50	8
K ₂ O	kg								43
CROP: MAIZE & BEANS									
Farmers in Production Level									
Yields	kg	1,200	1,500/200	2,200/400	4,000/500	2,000	1,400/300	3,100/500	2,000/350
Fertilizer N	kg			49	108			36	22
P ₂ O ₅	kg			42	96			27	47
K ₂ O	kg								40
CROP: BEANS									
Farmers in Production Level									
Yields	kg					1,000	600	400	300
Fertilizer N	kg								
P ₂ O ₅	kg								
K ₂ O	kg								
CROP: SUNFLOWER									
Farmers in Production Level									
Yields	kg	700	600	850	1,200				
Fertilizer N	kg			5	17				
P ₂ O ₅	kg			6	20				
K ₂ O	kg								
CROP: SOYA BEANS									
Farmers in Production Level									
Yields	kg	800	700	1,000	1,400	1,200	600	700	1,100
Fertilizer N	kg			8	24				
P ₂ O ₅	kg			7	23				
K ₂ O	kg								

TABLE 14 c: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

A.E.S.: LM 1 SUGAR CANE ZONE														A.E.S.: LM 2 MARGINAL S. CANE ZONE														A.E.S.: LM 3 COTTON ZONE																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				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Period 1st + 2nd: 1-ml in Days, 1st: 200 or more														2nd: 120-130 320-330														1st: 1-ml/a 110-120 190 or more														m/1-1m or n/ys 155-165 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A. K. 2. 1. 1. IN A. MARSHAL COTTON HOME									
Yield: Period		1st + 2nd		2nd + 3rd		3rd + 4th		4th + 5th	
in Days, Total: 130		(m/m) + 1		(m/m) + 1		(m/m) + 1		(m/m) + 1	
Soil: BEGOGOLS									
Unit	Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer
		I	II	III		I	II	III	
CROP: NATURAL PASTURE									
Farmers in Production Level	%								
Yields	kg			3,000					
Fertilizer N	kg			83					
P ₂ O ₅	kg			41					
K ₂ O	kg								
CROP: BANA GRASS									
Farmers in Production Level	%								
Yields	kg			5,800					
Fertilizer N	kg			167					
P ₂ O ₅	kg			83					
K ₂ O	kg								
CROP: MAIZE									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P ₂ O ₅	kg								
K ₂ O	kg								
CROP: SORGHUM									
Farmers in Production Level	%								
Yields	kg			1,700					
Fertilizer N	kg			30					
P ₂ O ₅	kg			30					
K ₂ O	kg								
CROP: MILLET									
Farmers in Production Level	%								
Yields	kg								
Fertilizer N	kg								
P ₂ O ₅	kg								
K ₂ O	kg								
CROP: SUNFLOWER									
Farmers in Production Level	%								
Yields	kg			800					
Fertilizer N	kg			900					
P ₂ O ₅	kg			500					
K ₂ O	kg			1,200					

WESTERN PROVINCE BUSIA DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

The agro-ecological zonation of the Busia district is nearly the same as in Siaya because of the similar climatic conditions (see Table 3) except for the area near the lake. Here, it is not so dry because the shore lies near the northern end of the area and is moderated by the lake wind. Therefore, the difference concerning rainfall between the lake shore and the interior is less, it is still 900 to 2 000 mm when comparing the annual averages. Regarding the 60 % reliability, it is 400 to 900 mm during the first rains and between 80 and nearly 800 mm during the second rains, dropping again slightly in the northern parts. In the wetter areas it is difficult to divide the seasons (see Diagram Butula) because there is no clear gap between them. If we write in the LM 11—mi this means that "a long season followed by a medium one" is one possibility to divide the more or less continuous growing period provided that second planting is intended to start in beginning of September. The planting may start when fields are already empty, or it starts later if crops of the first rains continue into the second rains. In the wetter subzone of LM 1 this is usual, therefore "or two" is written to express the various possibilities of growing cycles included.

Busia is the most westerly district of Kenya but no longer remote due to the excellent new tarmac road from Kisumu. There are large sugar cane zones to be developed¹⁾ and potential cotton areas.

The poor soils are the main problem, often underlain by hard-pans. Cassava, which is a new crop common, should not be the only answer to the poor soil conditions. More legumes, i.e. bambarra groundnuts which grow on very poor soils and accumulate nitrogen, more cattle manure and compost are essential. Nematodes are a serious danger for banana. There are important, well-known crops resistant to nematodes, i.e. roselle. Striga (whitchweed) is a problem for cotton. The chance to fight it is more promising in order to sow a trap crop (sorghum) and to plough it in with the upspring Striga plant.

The differences in the annual average rainfall and in the 60 % reliability of rainfall can also be seen in the 60 % reliability of the duration of the growing periods (see Table 3): The Marginal Cotton Zone (LM 4) has a growing period of 130 days and one of 60 days or less; the wetter subzone of the Sugar Cane Zone (LM 1), however, has a growing period of 215 days or more followed by a 130–150 days period. The annual average temperature is between 21 and 22°C. Humidity of the air is relatively high near the lake. The evaporation is 1 800–2 000 mm per year for the entire district.

BUSIA DISTRICT

TABLE 1: RAINFALL FIGURES FROM VARIOUS STATIONS
having at least 10 years of records up to 1976

Stn. and altitude	Name of Station	Years of rec.	Kind of rec.	Ann. rainf. mm	Monthly rainfall in mm											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1940126 210 m	Port Victoria Cath. Mission	32	Average	925	49	57	133	189	137	48	29	45	46	69	88	34
1940130 229 m	Nangina Cath. Mission	37	Av. 60% prob. ¹⁾	1 420 1 278	41	59	124	246	155	79	72	108	151	160	156	70
1940137 319 m	Lukoli Dispensary	21	Av. 60%	1 613 1 473	38	58	143	241	234	116	96	118	106	140	214	110
1940139 235 m	Butula Cath. Mission	29	Av. 60%	1 990 1 786	64	124	155	289	311	172	122	175	167	163	145	107
1940105 220 m	Busia, Cotton Exp. Station	19	Av.	1 766	70	80	156	278	245	102	84	141	157	182	172	100

¹⁾ These figures of rainfall reliability should be exceeded normally in 6 out of 10 years

¹⁾ LM 1 and 2 on suitable soils, see Mbuvi, J.P.: A preliminary evaluation on the suitability of the area of Busia District for Sugar cane development. Kenya Soil Survey P 18, Nairobi 1975.

NATURAL POTENTIAL

INTRODUCTION

BUSIA DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ ¹⁾	Kind of records	Temperature in °C												Y. of rec.	
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Year
8934105 1 220 m	Busia Cotton Experimental Station	LM 1 hp	Mean max.	29.7	29.3	29.0	27.7	27.3	27.0	26.7	26.7	27.3	27.8	27.4	27.9	27.8	10
			Mean temp.	22.6	22.6	22.7	22.2	21.9	21.3	21.2	21.0	21.4	22.1	21.8	21.8	21.9	
			Mean min.	15.5	15.9	16.4	16.7	16.4	15.6	15.6	15.4	15.5	16.4	16.1	15.7	15.9	
			Abs. min.	10.6	12.2	11.7	14.4	14.4	12.2	12.2	12.2	12.8	13.9	12.2	12.8	10.6	

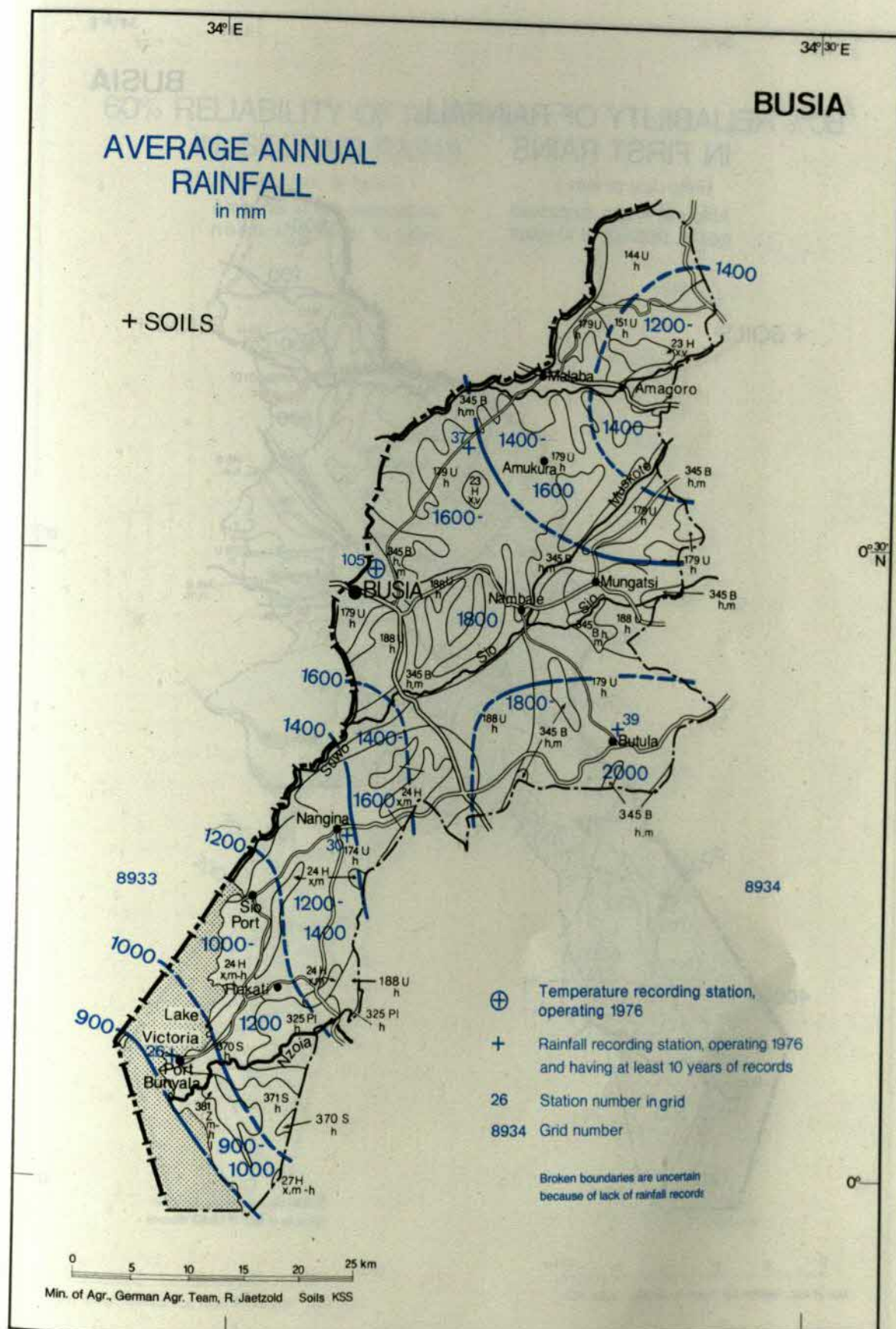
1) AEZ = Agro-ecological zone; hp = higher places within the zone

BUSIA DISTRICT

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall ¹⁾		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains ²⁾ in days	2nd rains in days	Total ³⁾ in days
LM 1 L. Midland Sugar Cane Zone	p or two	1 300–1 500	21.7–20.5	1 800–2 000	800–900	650–800	215 or more	130–150	345–365
	1 ~ m i			1 650–2 000	750–900	550–750	195 or more	120–130	315–325
LM 2 Marginal Sugar Cane Zone	l ~ (m/s)i	1 200–1 350	22.3–21.4	1 550–1800	650–800	480–650	190 or more	110–120	300–310
	l/m ~ (s/m)i			1 450–1 550	650–700	550–580	180 or more	105–120	285–300
	l/m ~ (s/m)			1 420–1 450	600–650	460–480	170 or more	105–115	275–285
LM 3 L. Midland Cotton Zone	m/l ~ (s)	1 140–1 250	22.7–22.0	1 200–1 420	500–650	400–460	155–175	85– 95	240–270
	m/l ~ (s or s/vs)			1 200–1 450	530–650	300–550	150–170	80– 90	230–260
	m+f(vs)			1 100–1 200	480–530	200–300	135–155	45– 75	
LM 4 Marginal Cotton Zone	(m/s)+i	1 135–1 200	22.7–22.3	900–1 100	<400–480	<100–220	125–135	<45	

- 1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants
2) More if growing cycle of cultivated plants continues into the period of second rains
3) Only added if rainfall continues at least for survival (> 0.2 E₀) of most long term crops



34° E

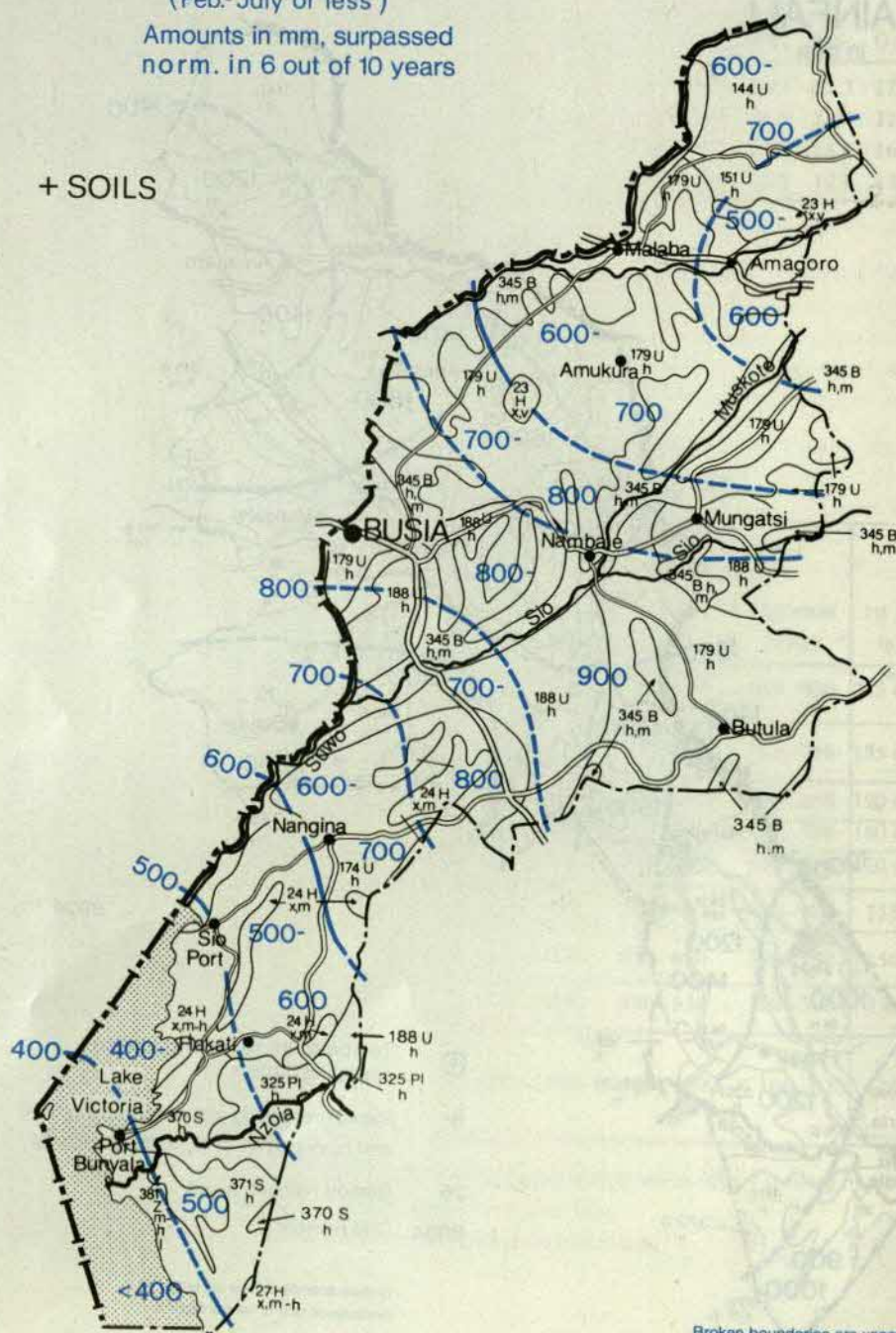
34° 30' E

BUSIA**60% RELIABILITY OF RAINFALL
IN FIRST RAINS**

(Feb.-July or less)

Amounts in mm, surpassed
norm. in 6 out of 10 years

+ SOILS



Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

60% RELIABILITY OF RAINFALL IN SECOND RAINS

(Aug. - Jan. or less)

Amounts in mm, surpassed
norm. in 6 out of 10 years

+ SOILS

BUSIA



Broken boundaries are uncertain
because of lack of rainfall records

0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils: KSS

34° E

34° 30' E

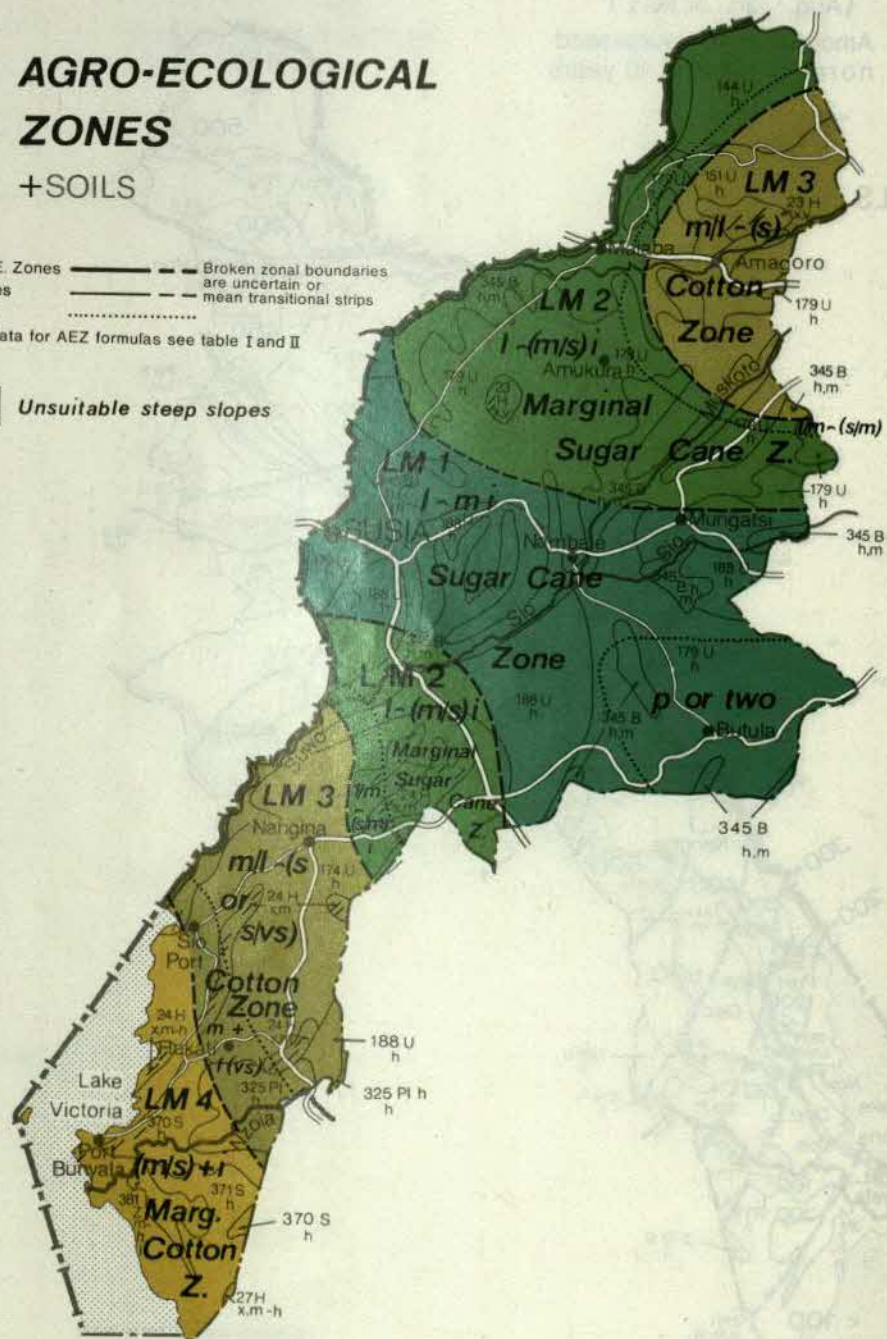
BUSIA

AGRO-ECOLOGICAL ZONES

+SOILS

Belt of A.E. Zones ——— Broken zonal boundaries
are uncertain or
A. E. Zones ——— mean transitional strips
Subzones
Climatic data for AEZ formulas see table I and II

 Unsuitable steep slopes



0 5 10 15 20 25 km

AEZ R. Jätzold '81

Soils KSS

Min. of Agr., German Agr. Team

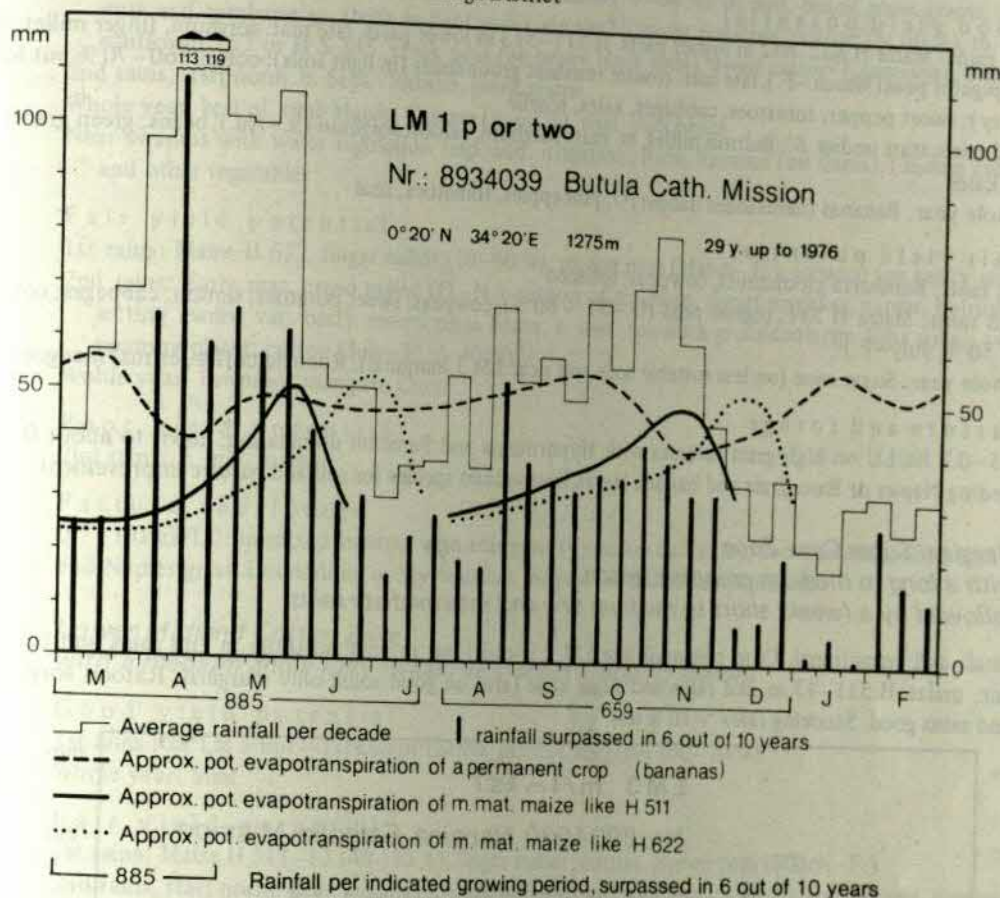
AGRO-ECOLOGICAL ZONES

LM = LOWER MIDLAND ZONES

LM 1 = Lower Midland Sugar Cane Zone

LM 1 p or two = Lower Midland Sugar Cane Zone with permanent cropping possibilities, dividable in two variable cropping seasons

Relatively small, potential see Kakamega District



LM 1 l-m i = Lower Midland Sugar Cane Zone with a long cropping season followed by a medium one and intermediate rains

Very good yield potential (av. > 80 % of the optimum)

1st rains, start norm. mid F.: M. mat. (120 days) sorghum; m. mat. (115 days) sunflower like Vympel or Hybrid S 301 A, m. mat. (120 days) soya beans; sweet potatoes

Whole year, best planting time b. March: Pawpaws, guavas, yam beans

Good yield potential (av. 60–80 % of the optimum)

1st rains: M. mat. maize H 622 and 632 (60–70 %), late mat. (150 days) sorghum (70–80 %), finger millet; late mat. beans, pigeon peas (March–F.); yellow yams (F.–O./N.); sweet pepper, kales, Chinese cabbage, spinach, cabbage, chillies, egg plants (to 2nd r.), pumpkins

2nd rains, start undistinctly end Au./begin S.: Maize H 511, m. mat. sorghum; beans (~ 60 %), cowpeas, sweet potatoes; m. mat. soya beans, e. mat. sunflower like H S 345 or Kensun 252; kales, Chinese cabbage, spinach, onions

Whole year: Sugar cane, bananas (nematodes danger)¹⁾, tea in upper places (70–80 %, but medium to low quality), Robusta coffee (~ 60 %)¹⁾, avocados, cassava

Fair yield potential (av. 40–60 % of the optimum)

2nd rains: Maize H 622, 632, finger millet; late mat. groundnuts and late mat. bambarra groundnuts (both in light soils); cabbage

Whole year: Mangoes, taro, citrus

Pasture and forage

Around 0.5 ha/LU on sec. pasture where orig. there has been a moist submontane forest; down to 0.13 ha/LU feeding Napier or Bana grass, banana leaves and others

¹⁾ Windbreaks against the daily winds from the lake, light shade and mulching or compost are necessary to re-establish the former forest ecosystem, otherwise bananas and coffee grow poorly. Hardpan soils should be avoided. Best planting time for bananas begin Oct.

LM 2 = Marginal Sugar Cane Zone

LM 2 = Marginal Sugar Cane Zone with a long cropping season

l-(m/s) i followed by a (weak) medium to short one and intermediate rains

Very good yield potential

1st rains, start norm. mid F.: M. mat. sorghum; m. mat. sunflower like Vympel or H S 301 A, m. mat. soya beans; sweet potatoes, onions

Whole year: Cassava, pawpaws, yam beans

Good yield potential

1st rains: Maize H 622, 632 in higher parts, H 511-513 in lower parts, late mat. sorghum, finger millet; beans²⁾, pigeon peas (March-F.), late mat. rosette resistant groundnuts (in light soils); cotton (60-70 % but low quality); sweet pepper, tomatoes, cabbages, kales, roselle

2nd rains, start undist. S.: Bulrush millet, m. mat. sorghum, ratoon sorghum (S.-Au.); beans, green grams; onions, kales

Whole year: Bananas (nematodes danger)¹⁾, pineapples, tomatoes, sisal

Fair yield potential

1st rains: Bambarra groundnuts, cowpeas; tobacco

2nd rains: Maize H 511; pigeon peas (O.-S., ~ 60 %), cowpeas; sweet potatoes; simsim; cabbages; cotton (40-50 %, July-F.)³⁾

Whole year: Sugar cane (on less suitable soils and near LM 3 marginal), Robusta coffee, citrus, mangoes

Pasture and forage

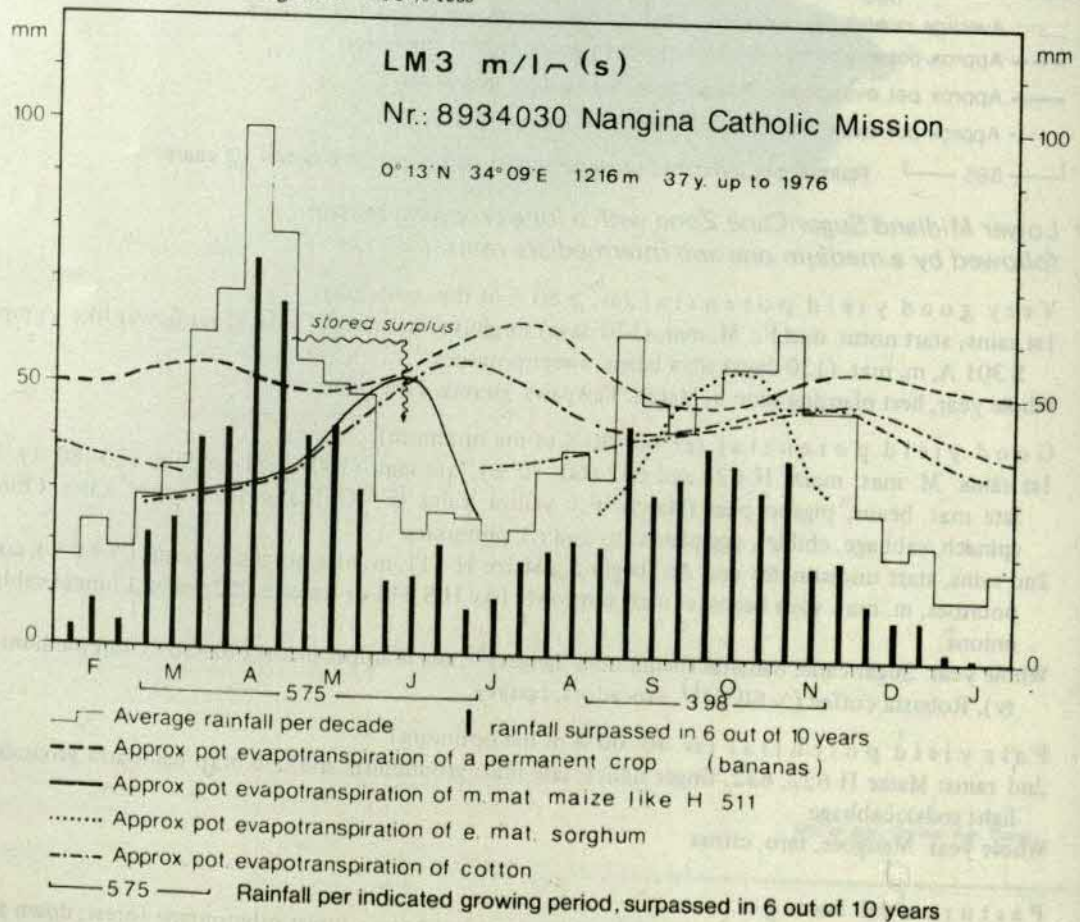
0.5-0.7 ha/LU on high grass savanna with Hyparrhenia and Panicum dominating; down to about 0.15 LU/ha feeding Napier or Bana grass and banana leaves. Desmodium species for soil and pasture improvement

LM 2 = Marginal Sugar Cane Zone

l/m- with a long to medium cropping season

(s/m) i followed by a (weak) short to medium one and intermediate rains

Small and transitional. Crop potential like LM 2 l-m/s i but m. mat. sorghum in 2nd rains and bananas only fair, maize H 511-13 in 2nd rains and sugar cane (also on good soils) only marginal. Ratoon sorghum 1st to 2nd rains good. Stocking rates ~ 10 % less



2) Should be intercropped with maize because of hail storm danger

3) Although nearly marginal, cotton is mainly planted in 2nd rains because of more labour availability. It can be interplanted in maize already during July.

LM 3 = Lower Midland Cotton Zone

LM 3 = Lower Midland Cotton Zone
m/l—(s) with a medium to long cropping season
or s/vs) followed by a (weak) short or short to very short one
 (see Diagram Nangina)

Good yield potential

1st rains, start norm. begin of March: E. mat. maize like Taboran or Katumani, m. mat. maize like H 511–513 (~ 60 %), mat. sorghum (70–80 %), e. mat. millets (70–80 %); m. mat. beans, green grams, cowpeas, groundnuts and bambarra gr. (both in light soils); simsim⁴); sweet potatoes; cotton (~ 60 %), m. mat. soya beans, sunflower 252 or H S 345, chick peas (on heavy black soils), dwarf castor⁵); tomatoes, onions, muskmelons

2nd rains, start norm. b. Sept.: Simsim, green grams

Whole year, best pl. time March: Cassava (~ 60 %), sisal, yam beans

Near swamps with water regulation resp. add. irrigation: Rice, bananas (on dams), Chinese cabbage (on ridges) and other vegetables

Fair yield potential

1st rains: Maize H 622, finger millet (50–60 %); pigeon peas (March–F.), tobacco (on sandy soil, higher places)

2nd rains: Early mat. proso millet (O.–N.), ratoon of sorghum, dwarf sorghum, e. mat. bulrush millet (bird rejecting awned var. best); mwezi moja beans, e. mat. bambara groundnuts (in light soils); sweet potatoes in swampy places; cotton (July–F., ~ 40 %)³)

Whole year: Pawpaws, mangoes, citrus

Poor yield potential

2nd rains: E. mat. maize

Pasture and forage

0.7–1.0 ha/LU on mixed savanna with star grass (*Cynodon dactylon*); down to about 0.18 ha/LU feeding Bana and Napier grass; *Desmodium* or *Stylosanthes* for pasture and soil improvement

LM 3 = Lower Midland Cotton Zone
m + f vs) with a medium and a fully (weak) very short cropping season

Good yield potential

1st rains like LM 3 m/l — (s) except cotton, m. mat. sorghum (60–70 %)

Whole year: Sisal

Fair yield potential

1st rains: Maize H 511–13 (40–50 %), finger millet; cotton, pigeon peas (March–F.)

2nd rains, start norm. Oct.: V.e. mat. foxtail millet, dwarf sorghum (~ 40 %); green grams, simsim; sweet potatoes near water

Whole year: Cassava

Pasture and forage

0.9–1.2 ha/LU, ~ 0.25 ha/LU feeding Bana grass and *Stylosanthes*

LM 4 = Marginal Cotton Zone

LM 4 = Marginal Cotton Zone
(m/s) + i with a (weak) medium to short cropping season and intermediate rains

Good yield potential

1st rains, start norm. mid March: E. mat. sorghum (~ 60 %), e. mat. foxtail or proso millet (60–70 %); e. mat. beans (~ 60 %), e. mat. tepary beans (70–80 %), green grams, cowpeas, chick peas (on h. bl. soils); e. mat. sunflower like Issanka (~ 60 %), simsim

Whole year: Sisal

Near swamps: Like LM 3

Fair yield potential

1st rains: E. mat. maize (40–50 %), e. mat. bulrush millet; pigeon peas (~ 40 %), soya beans (40–50 %), e. mat. groundnuts and e. mat. bambara groundnuts (both in light soils); onions

Poor yield potential

1st rains: Cotton

Pasture and forage

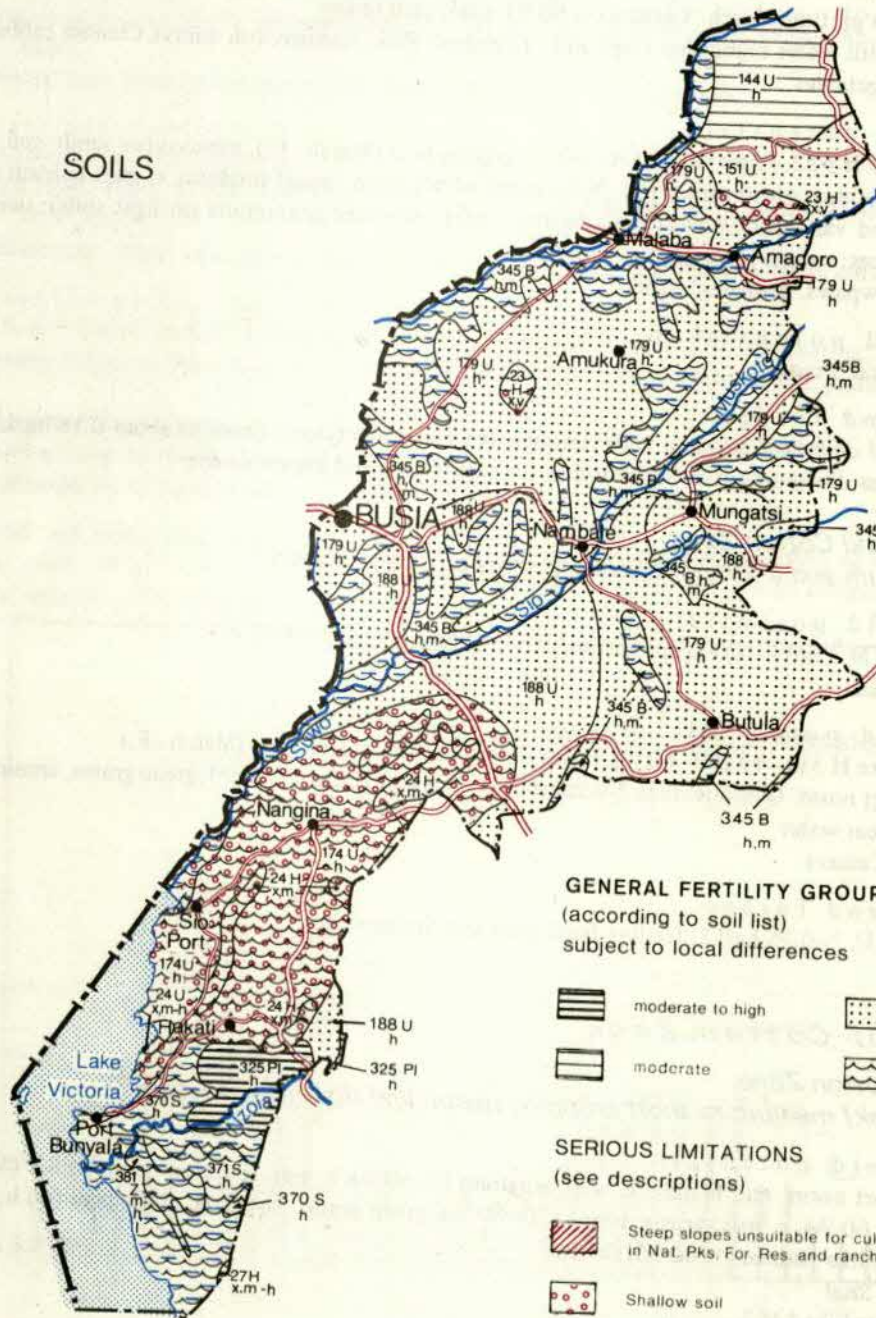
1–2 ha/LU; horse tamarind (*Leucaena leucocephala*) and other palatable shrubs to plant in order to improve fodder situation during dry season

⁴) Planting towards the end of the long rains

⁵) Good for rotation because of its resistance against *Striga* and nematodes

34° E

34°30' E

BUSIA**SOILS**

0°30' N

GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences

	moderate to high		low
	moderate		variable

SERIOUS LIMITATIONS
(see descriptions)

	Steep slopes unsuitable for cultivation; not marked in Nat. Pks. For Res. and ranching areas
	Shallow soil
	Waterlogging

0°

0 5 10 15 20 25 km
Soils KSS

SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

The district is characterized by undulating terrain with higher lands intersected by numerous valleys. The main river is the Sio which drains into Lake Victoria. Rock exposures are common between Bunyala and Sio and consist of precambrian gneisses and granites. The majority of the soils are moderately deep (soil depth 50–80 cm to murram or parent material).

Soils of the hills are shallow (units 23 H, 14 H, 17 H). They are generally rocky and/or stony. Soils of the uplands (179 U, 188 U) have low natural fertility, in most of the district they are moderately deep.

On the uplands, soils of unit 144 U also occur with a little higher natural fertility than soils of the unit 151 U. The topsoils of these units vary, but in general they are darker in the higher areas because of a higher humus content.

In the flood plains soils of unit 345 B occur. They may additionally include soils which show great differences in texture depending on depth.

Very dark cracking clay soils occur in the neighbouring plains around the Yala swamp (unit 325 Pl). In the swamp, soils tend to have very high (371 S) to moderately high organic matter content (370 S); sandy soils, having developed on beach ridges, occur along the Lake (381 Z).

SOILS ON HILLS AND MINOR SCARPS

Soils developed on granites

- 23 H
x, v¹ = complex of somewhat excessively drained, shallow, stony and rocky soils of varying color, consistence and texture (dystric REGOSOLS; with ferralic CAMBISOLS, lithic phase and Rock Outcrops)

Soils developed on quartzites

- 24 H
x, m = somewhat excessively drained, shallow, dark brown, very friable, rocky, sandy loam to clay loam; in many places with acid humic topsoil (RANKERS; with LITHOSOLS and Rock Outcrops)

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

- 27 H
x, m = complex of excessively drained to well drained, shallow, dark red to brown, friable sandy clay loam to clay; in many places rocky, bouldery and stony and in places with acid humic topsoil (dystric REGOSOLS; with LITHOSOLS, humic CAMBISOLS lithic phase and Rock Outcrops)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

Soils developed on basic igneous rocks (basalts, etc.)

- 144
h = well drained, very deep, red to dark red, friable to firm, clay; in places moderately deep over petro-plinthite (eutric NITOSOLS; with rhodic FERRALSOLS, partly petro-ferric phase)

Soils developed on granites

- 151 U
h = well drained, deep to very deep, brown to dark brown, friable, sandy clay to clay (ferralo-orthic ACRISOLS)

SOILS ON LOWER-LEVEL UPLANDS

Soils developed on intermediate igneous rocks (andesites, etc.)

- 174 U
h = association of: — well drained to moderately well drained, shallow soils over petroplinthite (about 50 %); on interfluvies („murram cuirass" soils)
— well drained, very deep, dark reddish brown to strong brown, friable clay; on valley sides (dystric/eutric NITOSOLS and orthic FERRALSOLS)

Soils developed on granites

- 179 U
h = complex of: — well drained, moderately deep to very deep, reddish brown to yellowish brown, friable clay, over petro-plinthite (orthic FERRALSOLS; partly petro-ferric phase; with orthic ACRISOLS)
— moderately well drained, shallow, brown to dark brown soils over petro-plinthite (about 30%) („murram cuirass" soils)

Soils developed on various rocks (Kavirondian sediments, often mudstones)

- 188 U
h = well drained, moderately deep to very deep, dark red to strong brown, friable clay; in places shallow over petro-plinthite (orthic to rhodic FERRALSOLS, partly petro-ferric phase; with „murram cuirass" soils (10–40 %)

SOILS ON LACUSTRINE PLAINS

Soils developed on sediments from lacustrine mudstones

- 325 Pl
h = poorly drained, very deep, very dark grey to black, very firm, slightly sodic, cracking clay, with calcareous deeper subsoil (lower level of Kano plains) (pellic VERTISOLS, sodic phase)

SOILS ON BOTTOMLANDS

Soils developed on infill mainly from undifferentiated Basement System rocks

- 345 B
h, m = complex of imperfectly drained to poorly drained, very deep, very dark grey to brown, mottled, friable to firm, sandy clay to clay, often abruptly underlying a topsoil of friable sandy clay loam; in places saline and sodic (dystric PLANOSOLS; with pellic VERTISOLS, vertic and humic GLEYSOLS and plinthic ACRISOLS)

SOILS ON SWAMPS

- 370 S = very poorly drained, very deep, very dark grey to black, firm, cracking clay, with acid humic topsoil (seasonal swamps) (humic h GLEYSOLS)
- 371 S = very poorly drained, very deep, dark grey to black, firm clay, with acid humic topsoil; in many places peaty (permanent swamps) (humic h GLEYSOLS and dystic HISTOSOLS)

SOILS ON COASTAL OR LAKE-SIDE BEACH RIDGES

Soils developed on beach ridges along Lake Victoria

- 381 Z = imperfectly drained, very deep, dark brown to greyish brown, friable, sandy loam to sandy clay of varying salinity and sodi- m-h, l city; with inclusions of loose sand to loamy sand soils (SOLONCHAKS, undifferentiated; with ARENOSOLS undifferentiated)

1) Soil texture-classes

- h = heavy
- l = light
- m = medium
- x = stony or bouldery
- v = varying texture
- m-h = medium to heavy
- m, h = medium and heavy (e. g. abruptly underlying a topsoil of different texture)

Soil description from Kenya Soil Survey: Exploratory Soil Map and Agro-climatic Zones Map of Kenya, scale 1 : 1 000 000 Rep. E 1, Nairobi 1982, see this map also for colours, symbols simplified here.

POPULATION AND LAND

The population of the Busia District was nearly 300 000 people at the time of the Census in September 1979 (Table 4). About 8 % of this figure lived in the Busia Township. For the 275 000 rural people, there was a total area of 157 900 ha available of which 134 900 ha were agricultural land (Table 6). These figures indicate that an average household of 5.36 people had to live on 2.72 ha of agricultural land and 0.57 ha were available per person (Table 6).

In the AEZ LM 1 (Lower Midland Sugar Cane Zone) this is still adequate for a small farmer to make his living, as the figures of the fairly well developed Marachi Location with 2.18 ha show (Table 6). However it must not be forgotten that regarding the population growth it will be impossible in the future to improve the rural situation unless agricultural intensification progresses rapidly.

In LM 2-3 (Lower Midland Marginal Sugar Cane Zone and Lower Midland Cotton Zone) the lower quartile of the Small Farm Survey 1977 is 2.4 ha (Table 9b). In view of the fact that in the samples of LM 2-3 more than half of the agricultural land is used for livestock, any agricultural improvement possible becomes more and more necessary.

In Bunyala Location (mainly LM 4 = Marginal Cotton Zone, the worst zone of the district) there are less than 2 ha available per household. Therefore, melioration and cultivation of the large swamps there should start.

Despite the fact that intensification of land use in the Busia District is not very urgent because of the land/population ratio of the district, development of its potential is in the national interest.

BUSIA DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Northern Teso	15 809	16 628	32 437	6 285	200	162
Southern Teso	23 585	25 060	48 645	8 642	306	158
Northern Division	39 394	41 688	81 082	14 927	507	159
Bukhaya	27 799	30 932	58 731	10 694	407	144
Marachi	25 610	29 982	55 592	9 667	236	234
Central Division	53 409	60 914	114 323	20 361	644	177
Samia	21 879	25 635	47 514	8 390	248	191
Bunyala	13 593	16 472	30 065	5 756	182	164
Hakati/Southern Division	35 472	42 107	77 579	14 146	430	180
Busia Urban	2 510	2 756	5 266	1 138	1	4 246
South Teso	3 196	3 396	6 592	1 406	20	321
Bukhaya	6 161	6 838	12 999	3 127	22	568
Busia Township	11 867	12 990	24 857	5 671	44	557
Busia District	140 142	157 699	297 841	55 105	1 626	183

BUSIA DISTRICT

TABLE 5: COMPOSITION OF HOUSEHOLDS
PER
LOCATION AND DIVISION^{a)}

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Persons per Household total ^{b)}
		Adults > 15 years	Children < 15 years	Other Relatives		
Location:						
North Teso	6267	3.08	1.29	0.45	0.28	5.10
South Teso	8603	3.26	1.34	0.71	0.28	5.60
Division Northern	14870	3.19	1.32	0.60	0.28	5.39
Location:						
Bukhayo	10759	3.06	1.38	0.75	0.27	5.46
Marachi	9724	2.96	1.29	1.11	0.34	5.71
Division Central	20483	3.00	1.35	0.92	0.30	5.57
Location:						
Samia	8356	2.95	1.17	1.07	0.46	5.65
Bunyala	5752	2.63	0.72	1.33	0.55	5.22
Division Hakati/Southern	14108	2.82	0.98	1.17	0.55	5.48
Location:						
Busia Urban	1106	2.22	0.65	0.65	0.55	4.07
South Teso	1400	2.57	0.85	0.70	0.48	4.61
Bukhayo	3126	2.39	0.84	0.58	0.35	4.15
Division Busia Township	5632	2.39	0.81	0.62	0.42	4.25
DISTRICT: BUSIA	55093	2.99	1.14	0.87	0.36	5.36

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, includes one and two persons per household as well.

BUSIA DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION
AND PER
HOUSEHOLD AND PERSON

	in '00 ha = sqkm					in '00 ha = sqkm				in ha	
Location/Division without townships	Area total (Census) 79	Non-agricultural land			Agricultural land	Area in agro-ecological zones				Agric. land	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home- steads rivers...)		A E Z				per	
						LM 1	LM 2	LM 3	LM 4	household	person
North eso	200	2		20	178		81	97		2.83	0.55
South eso	306	2		31	273	85	180	8		3.15	0.56
North Division	506	4		51	451	85	261	105		2.99	0.55
Bukh o	407	2		41	364	221	118	25		3.40	0.62
Marat	236			24	212	196	16			2.18	0.38
Central Division	643	2		65	576	417	134	25		2.77	0.49
Samia	248	13		25	210		30	167	13	2.50	0.44
Buny	182	2	sw 50	18	112			30	82	1.85	0.37
Southern Division	430	15	50	43	322		30	197	95	2.25	0.42
Total rural area	1 579	21	50	159	1 349	502	425	327	95	2.72	0.57

For official land statistics see supplementary publication to
FM-Handbook, Vol. III A: Agriculture Land Statistics.

AGRICULTURAL STATISTICS

Roughly 27,000 ha of cotton are planted within the district annually. Seventy-five percent of the crop is interplanted into maize, yielding between 200 and 500 kg of seed cotton per ha. Other important cash crops are sugar cane and groundnuts and very localised tobacco.¹⁾

BUSIA DISTRICT

TABLE 7: COTTON
PRODUCTION^{a)}

Ginnery Zone	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Samia					
Seed Cotton in t	3850	2086	1876	2789	2516
Bales	6756	3661	3292	4893	4415
Nambale					
Seed Cotton in t	1936	1686	1907	2830	3005
Bales	3398	2958	3346	4965	5273

a) Source: C.L. & S.M.B., does not refer to district area only

¹⁾ Reliable agricultural statistics are not yet available for this district. For more up to date and detailed information see FMHB Vol. III A.

SMALL FARM SURVEY (SFS)¹⁾

The SFS gives information on the farm organizations in AEZ LM 1-2 and LM 2-3, but it does not cover the low potential region LM 4 along the lake shores. The farms included in the survey own 4.7 ha (LM 1-2) and 7.3 ha (LM 3-4) of land, half of it used for annual crops, the rest for grazing and/or left fallow. The stocking rate of 3.4 LU/ha (LM 1-2) and 0.9 LU/ha (LM 2-3) does not take into account the fallow land and commonly owned grazing area and is actually only half as high. The farmers plant approximately one crop per year (tables 8 and 9).

Maize, finger millet and cassava are the major food crops. The farms investigated planted sugar cane on 11 % (LM 1-2) and cotton on 14 % of their arable land area (LM 2-3). This proportion is above the district average; sugar cane is planted in a regionally confined area occupying roughly 3 % of the total land area of the district, and roughly 8 % of the land is planted with cotton (table 10). Besides seed for maize, no purchased inputs are used; the extremely low yields are also a result of the low soil fertility (table 12). Widespread livestock diseases have prevented the introduction of improved cattle; roughly 8-11 % of the grazing livestock units are goats and sheep - the rest are cattle of which 50-60 % are male (table 11). The staple food produced is consumed within the district. With the expansion of sugar cane, which occupies the better soils of the region, the district has become a 'net food importer' (table 13).

The different farm activities are spread over a relatively large period which is partly a result of the rainfall pattern but also reflect the fact that more or less all farms work at subsistence agriculture level (table 14). Yield increases will continue to be moderate in the future and will require comparatively high nutrient applications (table 15).²⁾

Mixed farm development with special emphasis on livestock and mechanisation using draught animals promises a lasting improvement in the living standards of the majority of small-holders.

1) November 1977, sample size 30. For more detailed and up to date informations see FMHB Vol. III B.
2) See also notes on farm management information, output and nutrient input, page 51

Annual Crop					Annual Crop
Maize	Finger Millet	Cassava	Sugar Cane	Cotton	
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500
2500	1500	1000	1000	1000	2500

34° E

34°30' E

BUSIA

SMALL FARM SURVEY AREAS (1977)

and

AGRO-ECOLOGICAL**ZONES**

+SOILS

Belt of A.E. Zones ——— Broken zonal boundaries
 A. E. Zones ——— are uncertain or
 Subzones ——— mean transitional strips
 Climatic data for AEZ formulas see table I and II

Unsuitable steep slopes



9 National Number of Survey Area

Survey Area sample size 30 per number

0 5 10 15 20 25 km
 AEZ R. Jatzold '81 Soils KSS

Min. of Agr., German Agr. Team

TABLE 8 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
		2.3	6.4	14.8			0.7	0.6	0.3
Farm Size Total	ha				Farming Intensity:				
Land Use: Annual Crops ¹⁾ First Season					Cropping Intensity	-			
Maize	ha	0.4	0.2	0.9	Portion of improved cattle kept	%	-	-	-
Sunflower	ha	0.2	0.5	0.4	Portion of Farmers owning a Plough	%	10%	70%	100%
Cassava	ha	0.2	0.7	0.4					
Cotton	ha	0.3	0.1	0.6					
Others	ha	0.1	1.8	0.8					
Total	ha	1.2	3.3	3.1					
Second Season ¹⁾					Labour on Farm:				
Cassava	ha	0.1	0.1	0.2	Family Adults	persons	2.1	3.3	3.0
Cotton	ha	0.1	-	-	Perm. Hired Labour	"	-	0.1	0.3
Maize & Beans	ha	-	0.1	0.1	Children > 14 years	"	1.2	1.8	1.3
Total	ha	0.2	0.2	0.3					
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
Sugarcane	ha	0.3	0.3	0.5	Adults > 14 years	persons	2.00	0.32	2.32
Bananas	ha	-	0.1	0.2	Children < 14 years	"	2.56	-	2.56
portion of total	%	13%	6%	5%	Subsistence Units	SU	3.53	0.32	3.85
Grazing & Forage	ha	0.4	1.9	9.5	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	17%	30%	64%	Maize		1226	1976	
Other Land Use	ha	0.4	0.8	1.5	Beans	kg	35	56	
Livestock on Farm:					Fingermillet	kg	105	164	
Cattle: local	LU	2.0	3.3	4.5	Cassava	kg	71	40	
improved	LU	-	-	-	Sorghum	kg	105	164	
Sheep & Goats	LU	0.1	0.5	0.5	Groundnuts	kg	5	8	
Total	LU	2.1	3.8	5.0					

Other Crops cultivated: Sorghum, Fingermillet, Groundnuts, Beans

1) Major crops only considered
2) Based on 1979 Census figures

BUSIA DISTRICT

AEZ: LM 2-3

TABLE 8 b: FARM ORGANIZATION: 1979 CENSUS DATA

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.7	3.9	8.1	Farming Intensity:				
Land Use:									
Annual Crops ¹⁾	ha	-	0.2	0.5	Cropping Intensity	-	0.8	0.7	0.5
First Season: Others	ha	0.4	0.5	0.7	Portion of improved cattle kept	%	-	-	12%
Maize	ha	0.2	0.3	0.6	Portion of Farmers owning a Plough	%	80%	70%	90%
Fingermillet	ha	0.1	0.3	0.5					
Sunflower	ha	0.1	0.3	0.4					
Cassava	ha	0.3	0.4	0.9					
Cotton	ha	1.1	2.0	3.6					
Total	ha								
Second Season¹⁾					Labour on Farm:				
Cotton	ha	0.1	0.1	-	Family Adults	persons	2.4	2.8	3.4
Cassava	ha	0.1	0.2	0.1	Perm. Hired Labour	"	0.5	0.4	0.5
Total	ha	0.2	0.3	0.1	Children > 14 years	"	3.0	1.3	2.6
Permanent Crops¹⁾					Persons living on Farm²⁾		Farmer's Family	Non-related Persons	Total
Sugarcane	ha	-	0.1	0.1	- average household size -	persons	2.05	0.17	2.22
Bananas	ha	0.1	0.2	0.2	Adults > 14 years	"	2.82	-	2.82
portion of total	%	6%	8%	4%	Children < 14 years	SU	3.74	0.17	3.91
Grazing & Forage	ha	0.4	1.1	2.5	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	6%	28%	31%	Maize	kg	959	1546	
Other Land Use	ha	0.1	0.5	1.7	Beans	kg	123	195	
Livestock on Farm:					Fingermillet	kg	242	379	
Cattle: local	LU	4.8	3.7	4.5	Sweet Potatoes	kg	670	212	
improved	LU	-	-	0.6		kg			
Sheep & Goats	LU	0.2	0.3	0.5		kg			
Total	LU	5.0	4.0	5.6		kg			

Other Crops cultivated: Maize & Fingermillet, Maize & Beans, Sorghum, Tobacco,

Beans

1) Major crops only considered

2) Based on 1979 Census figures

BUSIA DISTRICT

TABLE 9 a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: LM 1

Survey Area 09

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	7.3	9.6	0.8	2.8	0.1	1.5
Avg. 1	7.3	11.1	1.5	2.8	1.5	2.2
Up. Qu.	10.0	14.0	1.0	3.0	-	2.0
Lo. Qu.	3.0	2.0	-	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	2.5	35	0.5	7	3.4	48	-	-	0.5	7	0.3	4
Avg. 1	2.5	30	1.1	13	3.7	44	-	-	0.8	10	0.3	3
Up. Qu.	3.2	57	0.8	15	5.2	54	-	-	0.8	12	0.3	7
Lo. Qu.	1.2	28	-	-	0.6	13	-	-	-	-	0.1	2
Total	75.2		14.2		102.7		-		15.9		7.9	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.9	0.5	1.0	-
Avg. 1			0.9	-
Up. Qu.	1.0	1.0	4.2	-
Lo. Qu.	0.7	0.1	0.1	-

Inputs Applied

Inputs Applied													
Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P2O5		K2O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	46.9	0.2	0.5	2.8	-	-	-	0.1	-	1.8	-	-	-
Avg. 1	51.8	5.1	20.0	5.0	-	-	-	0.7	-	2.1	-	-	-
Up. Qu.	92.3	-	-	3.3	-	-	-	-	-	3.1	-	-	-
Lo. Qu.	28.6	-	-	-	-	-	-	-	-	0.2	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of farms, excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

E IA DISTRICT

TABLE 9 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

A LM 2-3

Survey Area 10

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	4.7	13.5	1.0	2.9	0.5	2.2
Avg. 1	4.7	14.0	1.3	3.0	2.0	3.0
Up. Qu.	6.4	17.0	1.0	3.0	-	3.0
Lo. Qu.	2.4	6.0	1.0	2.0	-	-

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	2.3	50	0.2	5	1.4	30	-	-	0.5	11	0.2	4
Avg. 1	2.3	40	0.5	8	1.4	25	0.4	7	0.9	16	0.2	4
Up. Qu.	2.9	70	0.4	10	1.8	37	-	-	0.8	13	0.3	6
Lo. Qu.	1.4	37	-	-	0.4	16	-	-	-	-	0.1	3
Total	69.0		6.9		41.1		0.4		15.0		6.1	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.9	1.0	3.5	4.0
Avg. 1			3.4	81.6
Up. Qu.	1.0	1.3	7.3	-
Lo. Qu.	0.8	0.6	1.6	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	64.1	1.0	-	4.3	-	-	-	-	-	1.9	-	-	-
Avg. 1	67.4	2.9	-	11.0	-	-	-	0.1	-	2.2	-	-	-
Up. Qu.	81.7	-	-	5.2	-	-	-	-	-	2.9	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	0.3	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of farms, excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

BUSIA DISTRICT

AEZ: LM 1

TABLE 10 a: CROPPING PATTERN

Survey Area 09

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.8	0.9	1.20	0.20	22.6	25.7
Sorghum	0.3	0.6	0.40	0.00	8.5	9.7
Fingermillet	0.2	0.5	0.40	0.00	7.2	8.2
Beans	0.1	0.4	0.00	0.00	2.2	2.5
Groundnuts	0.1	0.4	0.00	0.00	1.8	2.0
Sunflower	0.3	0.5	0.60	0.00	9.8	11.1
Cotton	0.4	0.6	0.60	0.00	12.4	14.1
Cassava	0.2	0.5	0.40	0.00	7.5	8.5
Sugarcane	0.3	1.1	0.80	0.00	10.3	11.7
Others	0.1	0.5	0.00	0.00	1.6	1.8
Maize & Beans	0.1	0.8	0.00	0.00	4.0	4.6
Total					87.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.0	0.4	0.00	0.00	0.4	1.6
Beans	0.0	0.4	0.00	0.00	0.8	3.2
Groundnuts	0.0	0.3	0.00	0.00	0.6	2.4
Sunflower	0.1	0.4	0.12	0.00	2.7	10.9
Cotton	0.0	0.7	0.00	0.00	1.4	5.6
Cassava	0.2	0.5	0.40	0.00	7.5	30.1
Sugarcane	0.3	1.1	0.80	0.00	10.3	41.3
Maize & Beans	0.0	0.6	0.00	0.00	1.2	4.8
Total					24.9	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sweet Bananas	0.0	0.4	0.00	0.00	0.4	100.0
Total					0.4	100.0

- Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points
% columns = % of total farm land

SIA DISTRICT

TABLE 10 b: CROPPING PATTERN

Z: LM 2-3

Survey Area 10

First rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.6	0.8	0.80	0.40	18.9	24.9
Sorghum	0.0	0.4	0.00	0.00	0.4	0.5
Fingermillet	0.4	0.5	0.60	0.00	11.8	15.6
Beans	0.0	0.2	0.00	0.00	0.4	0.5
Sunflower	0.3	0.7	0.80	0.00	10.4	13.7
Cotton	0.6	0.8	0.80	0.00	17.1	22.6
Tobacco	0.1	0.5	0.00	0.00	1.6	2.1
Cassava	0.3	0.5	0.40	0.00	8.4	11.1
Others	0.0	0.3	0.00	0.00	0.5	0.7
Maize & FMilt	0.0	0.2	0.00	0.00	0.2	0.3
Maize & Beans	0.2	1.0	0.00	0.00	6.0	7.9
Total					75.8	100.0

Second rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sunflower	0.0	0.4	0.00	0.00	1.3	11.3
Cotton	0.1	0.6	0.00	0.00	1.8	15.4
Cassava	0.3	0.5	0.40	0.00	8.4	71.7
Others	0.0	0.2	0.00	0.00	0.2	1.7
Total					11.7	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cookng Bananas	0.0	0.1	0.00	0.00	0.1	100.0
Total					0.1	100.0

Avg 0 = average of all sample farms

Avg 1 = average of all farms excluding zero entries

Up.Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points

% columns = % of total farm land

BUSIA DISTRICT

AEZ: LM 1

TABLE 11 a: HERD COMPOSITION (GRAZING LIVESTOCK)

- in Head and Livestock Units -

Nov. '77, Survey Area 09

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total		-	-	-	-	-	-	-	-	-	-	-
Average		-	-	-	-	-	-	-	-	-	-	-
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		0.0 % of total cattle, Calves + Heifers = 0.0 % of dairy cows										
Unimproved Livestock:												
Under 1 year, Average		0.17	-	-	0.70	-	0.57	0.77	0.31	-	-	0.31
Upper Qu.		-	-	-	1	-	1	1	0.4	-	-	0.4
1 - 2 years, Average		0.20	0.07	0.13	0.70	-	-	-	0.49	-	-	0.49
Upper Qu.		-	-	-	1	-	-	-	0.5	-	-	0.5
Over 2 years, Average		0.57	0.20	1.60	-	1.47	1.10	1.27	2.74	-	11.70	2.74
Upper Qu.		-	-	3	-	2	2	2	-	-	5	-
Subtotal (unimp.) Total		28	8	52	42	44	50	64	106.2	-	351	106.2
Average		0.93	0.27	1.73	1.40	1.47	1.67	2.13	3.54	-	11.70	3.54
Upper Qu.		1	-	4	2	2	3	3	5.0	-	15	5.0
Lower Qu.		-	-	-	-	-	-	-	0.4	-	5	0.4
LU Male Cattle =		55.4 % of total cattle, Calves + Heifers = 95.5 % of dairy cows										
LU Goats + Sheep =		10.7 % of total Grazing Livestock Units										
Improved + Unimproved												
Grazing L/Stock Total		28	8	52	42	44	50	64	106.2	-	351	106.2
Average		0.93	0.27	1.73	1.40	1.47	1.67	2.13	3.54	-	11.70	3.54
Upper Qu.		1	-	4	2	2	3	3	5.0	-	15	5.0
Lower Qu.		-	-	-	-	-	-	-	0.4	-	5	0.4
LU Male Cattle =		55.4 % of total cattle, Calves + Heifers = 95.5 % of dairy cows										
LU Goats + Sheep =		10.7 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

BUSIA DISTRICT

AEZ: LM 2-3

Nov. 77, Survey Area 10

TABLE 11 b: HERD COMPOSITION (AGRAZING LIVES-
- in Head and Livestock Units -

Improved Livestock	Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average	0.03	-	-	0.07	-	-	-	0.02	-	-	0.02
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average	0.03	-	-	0.03	-	-	-	0.03	-	-	0.03
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average	-	-	-	-	0.13	-	-	0.13	-	-	0.13
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total	2	-	-	3	4	-	-	5.3	-	-	5.3
Average	0.07	-	-	0.10	0.13	-	-	0.12	-	-	0.19
Upper Qu.	-	-	-	-	-	-	-	-	-	-	-
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle	12.0 % of total cattle.										
Unimproved Livestock:	Calves + Heifers = 75.0 % of dairy cows										
Under 1 year, Average	1.37	-	0.07	1.53	-	0.37	0.77	0.81	0.10	-	0.32
Upper Qu.	-	-	-	1	-	1	1	0.4	-	-	0.4
1 - 2 years, Average	0.20	-	0.50	1.23	-	-	-	0.37	-	-	0.87
Upper Qu.	-	-	-	2	-	-	-	0.9	-	-	0.9
Over 2 years, Average	0.43	-	1.57	-	2.03	0.90	1.50	2.23	0.03	15.63	2.93
Upper Qu.	1	-	3	-	3	2	1	-	-	6	-
Subtotal (unimp.) Total	75	-	67	33	61	38	68	138.1	4	469	138.7
Average	2.50	-	2.23	2.77	2.03	1.27	2.27	4.60	0.13	15.63	4.52
Upper Qu.	2	-	4	3	3	3	3	6.6	-	24	6.6
Lower Qu.	-	-	-	1	-	-	-	2.2	-	6	2.2
LU Male Cattle	48.6 % of total cattle.										
LU Goats + Sheep	7.7 % of total Grazing Livestock Units										
Improved + Unimproved	Calves + Heifers = 136.1 % of dairy cows										
Grazing L/Stock	77	-	67	86	65	33	63	143.9	4	469	144.5
Total	2.57	-	2.23	2.87	2.17	1.27	2.27	4.79	0.13	15.63	4.31
Average	2	-	4	3	3	3	3	7.1	-	24	6.6
Upper Qu.	-	-	-	1	-	-	-	2.2	-	6	2.2
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle	47.1 % of total cattle.										
LU Goats + Sheep	7.4 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

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TABLE 12 a: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LM 1

Survey Area 09

Crop		Imp- roved Seeds %	Inputs						Yield kg/ha
			Nutrients				Chemicals		
			N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	96	2	15	-	0.66	4	-	3,866
	UpQu	100	-	19	-	-	6	-	3,375
	LoQu	100	-	-	-	-	-	-	2,025
Sorghum	Avg.	-	-	-	-	-	-	-	1,120
	UpQu	-	-	-	-	-	-	-	1,200
	LoQu	-	-	-	-	-	-	-	500
Fingermillet	Avg.	-	-	-	-	-	-	-	1,103
	UpQu	-	-	-	-	-	-	-	1,250
	LoQu	-	-	-	-	-	-	-	638
Sunflower	Avg.	38	-	4	-	0.69	2	-	1,757
	UpQu	100	-	-	-	-	-	-	1,688
	LoQu	100	-	-	-	-	-	-	800
Cotton	Avg.	68	-	8	-	-	18	-	945
	UpQu	100	-	-	-	-	18	-	925
	LoQu	-	-	-	-	-	-	-	500
<u>Second Rains</u>									
Groundnuts	Avg.	-	-	-	-	-	-	-	1,075
	UpQu	100	-	6	-	-	-	-	1,725
	LoQu	100	-	-	-	-	-	-	1,000
Cotton	Avg.	75	-	10	-	-	21	21	908
	UpQu	100	-	-	-	-	25	25	925
	LoQu	-	-	-	-	-	4	4	700
<u>Perennial Crops</u>									
Cassava	Avg.	-	-	-	-	-	-	-	7,357
	UpQu	-	-	-	-	-	-	-	3,750
	LoQu	-	-	-	-	-	-	-	-
Sugarcane	Avg.	-	7	-	-	-	-	-	7,725
	UpQu	-	-	-	-	-	-	-	13,750
	LoQu	-	-	-	-	-	-	-	-

BUSIA DISTRICT

TABLE 12 b: INPUTS AND YIELDS OF MAJOR CROPS

EZ: LM 2-3

Survey Area 10

Crops		Imp- roved Seeds %	Inputs						Yield kg/ha
			N kg/ha	Nutrients		Chemicals			
				P ₂ O ₅ kg/ha	K ₂ O kg/ha	Fertilizers t/ha	Insect kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	88	2	8	-	0.01	2	-	2,495
	UpQu	100	-	-	-	-	-	-	3,150
	LoQu	100	-	-	-	-	-	-	1,923
Fingermillet	Avg.	-	-	-	-	-	-	-	916
	UpQu	-	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	625
Sunflower	Avg.	93	-	2	-	-	-	-	947
	UpQu	100	-	-	-	-	-	-	1,042
	LoQu	100	-	-	-	-	-	-	363
Cotton	Avg.	82	-	-	-	0.06	11	-	641
	UpQu	100	-	-	-	-	18	-	800
	LoQu	100	-	-	-	-	1	-	375
<u>Second Rains</u>									
Sunflower	Avg.	100	-	-	-	-	-	-	957
	UpQu	100	-	-	-	-	-	-	900
	LoQu	100	-	-	-	-	-	-	420
Cotton	Avg.	33	-	-	-	-	31	31	511
<u>Perennial Crops</u>									
Cassava	Avg.	-	-	-	-	-	-	-	4,642
	UpQu	-	-	-	-	-	-	-	8,125
	LoQu	-	-	-	-	-	-	-	-

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TABLE 13 a: DISPOSAL OF CROPS

AEZ: LM 1

Survey Area 09

Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	94,195	7,470	8	18,535	20	68,190	72
Maize & Beans	9,415	1,800	19	2,720	29	4,895	52
Beans	1,350	0	0	720	53	630	47
Fingermillet	7,875	0	0	1,575	20	6,300	80
Sorghum	7,480	0	0	1,150	15	6,330	85
Groundnuts	1,630	300	18	1,105	68	225	14
Sunflower	13,210	13,147	100	63	0	0	0
Cotton	11,156	8,556	77	0	0	2,600	23
<u>Second Rains</u>							
Maize	1,620	900	56	0	0	720	44
Maize & Beans	2,520	0	0	1,620	64	900	36
Beans	440	0	0	160	36	280	64
Groundnuts	580	250	43	285	49	45	8
Sunflower	5,242	5,242	100	0	0	0	0
Cotton	2,190	2,190	100	0	0	0	0
<u>Permanent Crops</u>							
Cassava	5,860	0	0	2,600	38	4,260	62

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TABLE 13 b: DISPOSAL OF CROPS

AEZ: LM 2-3

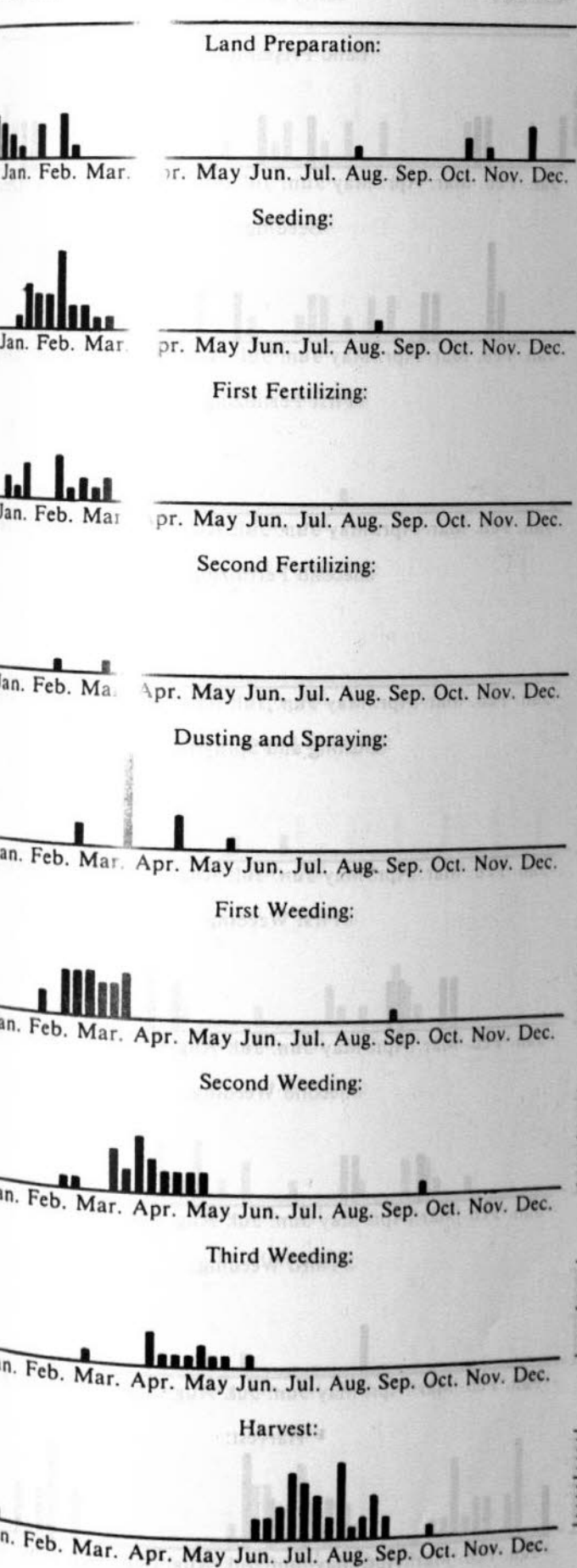
Survey Area 10

Survey Area

Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	41,200	7,180	17	13,935	34	20,085	49
Maize & Beans	28,200	4,200	15	11,699	41	12,301	44
Beans	255	0	0	170	67	85	33
Fingermillet	9,570	160	2	2,460	26	6,950	73
Sorghum	240	0	0	0	0	240	100
Sweet Potatoes	20,090	0	0	0	0	20,090	100
Sunflower	7,231	5,970	83	377	5	884	12
Cotton	9,927	9,027	91	0	0	900	9
Tobacco	1,030	1,030	100	0	0	0	0
<u>Second Rains</u>							
Fingermillet	720	0	0	400	56	320	44
Sunflower	4,154	3,550	85	436	10	168	4
Cotton	1,140	1,140	100	0	0	0	0
<u>Permanent Crops</u>							
Cassava	5,230	0	0	1,740	33	3,490	67

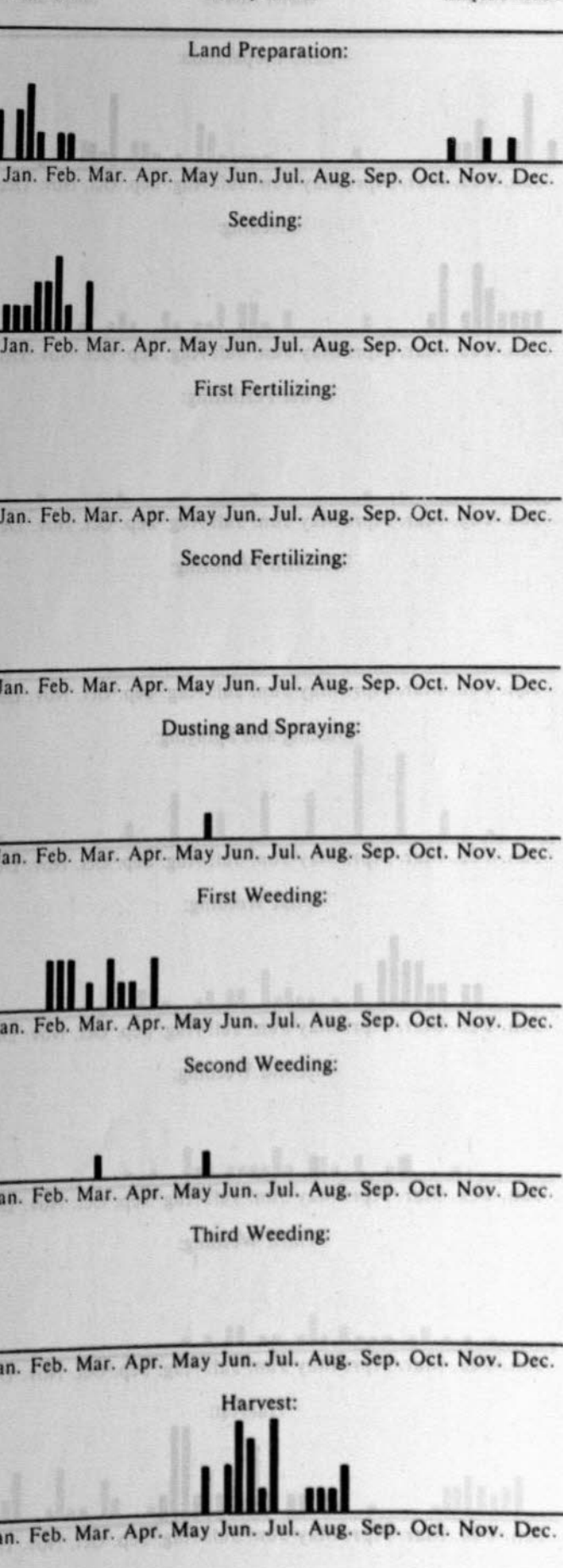
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TABLE 14 a: DISTRIBUTION OF FARMING ACTIVITIES
Crop: Maize
Cases: 25
AEZ: LM 1
Survey Area 09
Sample Size: 30



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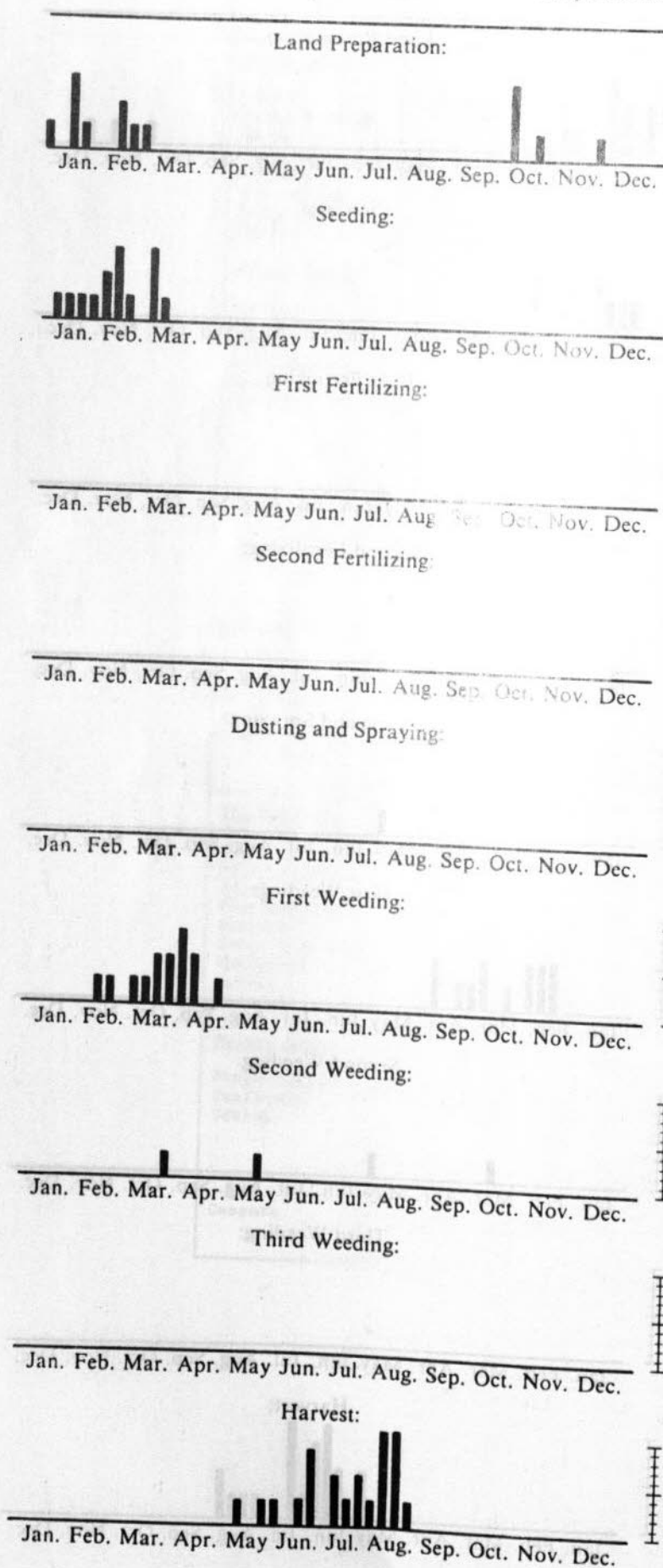
TABLE 14 b: DISTRIBUTION OF FARMING ACTIVITIES
Crop: 12
Cases: 13
AEZ: LM 1
Survey Area 09
Sample Size: 30



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TABLE 14 c: DISTRIBUTION OF FARMING ACTIVITIES

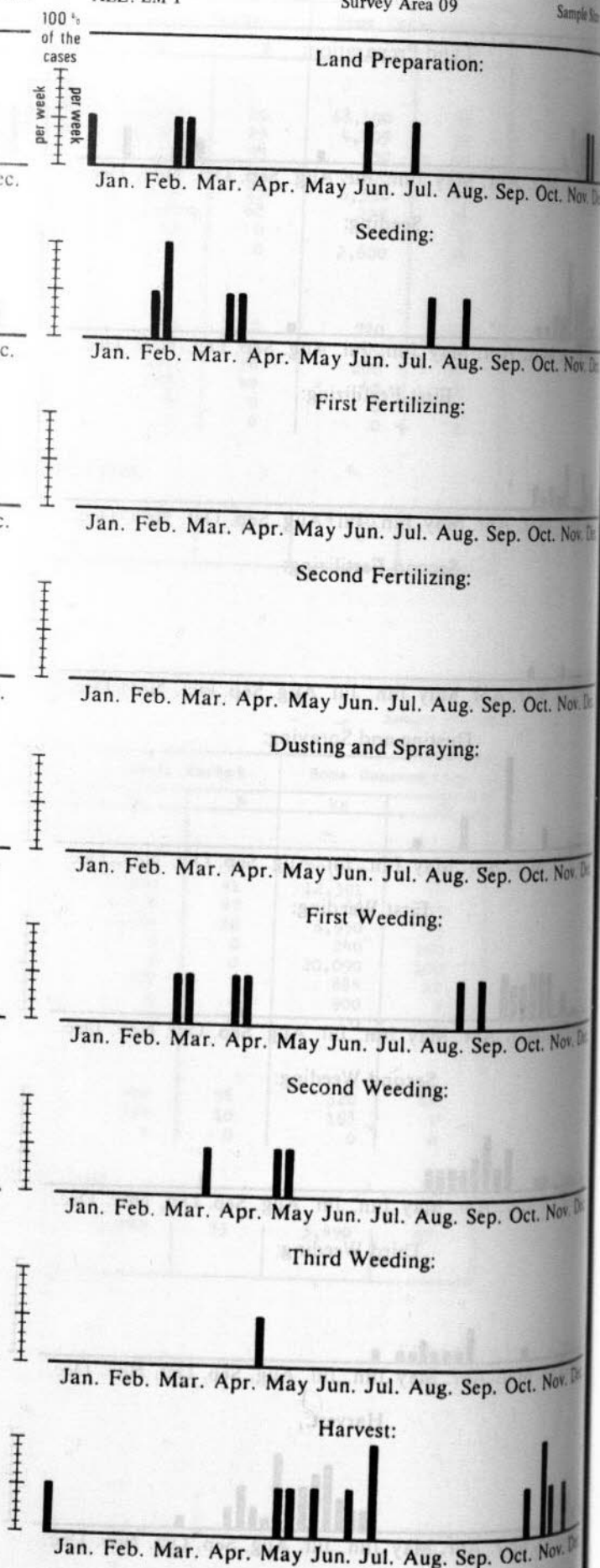
Crop 18 Sorghum Cases: 14
AEZ: LM 1 Survey Area 09 Sample Size: 30



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TABLE 14 d: DISTRIBUTION OF FARMING ACTIVITIES

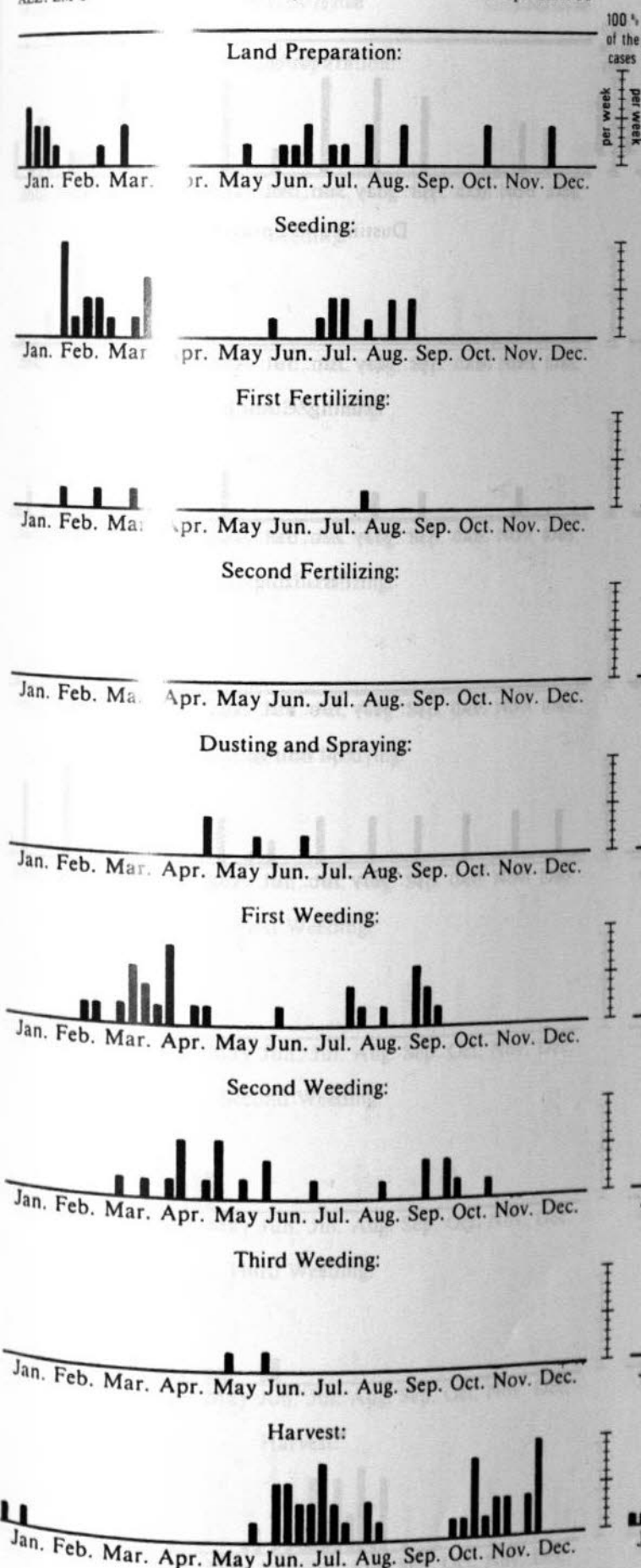
Crop 24 Groundnuts Cases: 7
AEZ: LM 1 Survey Area 09 Sample Size: 30



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TABLE 14 e: DISTRIBUTION OF FARMING ACTIVITIES

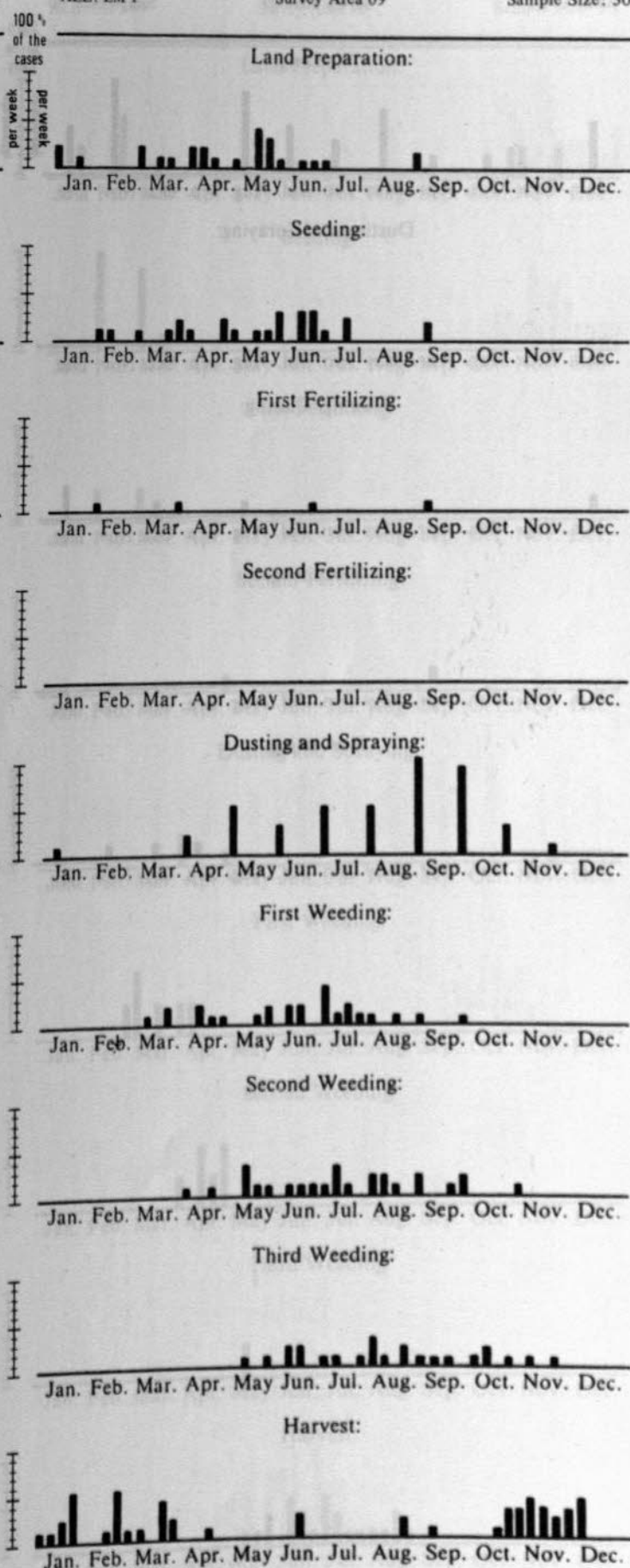
Crop: Sunflower Cases: 26
 AEZ: LM 1 Survey Area 09 Sample Size: 30



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TABLE 14 f: DISTRIBUTION OF FARMING ACTIVITIES

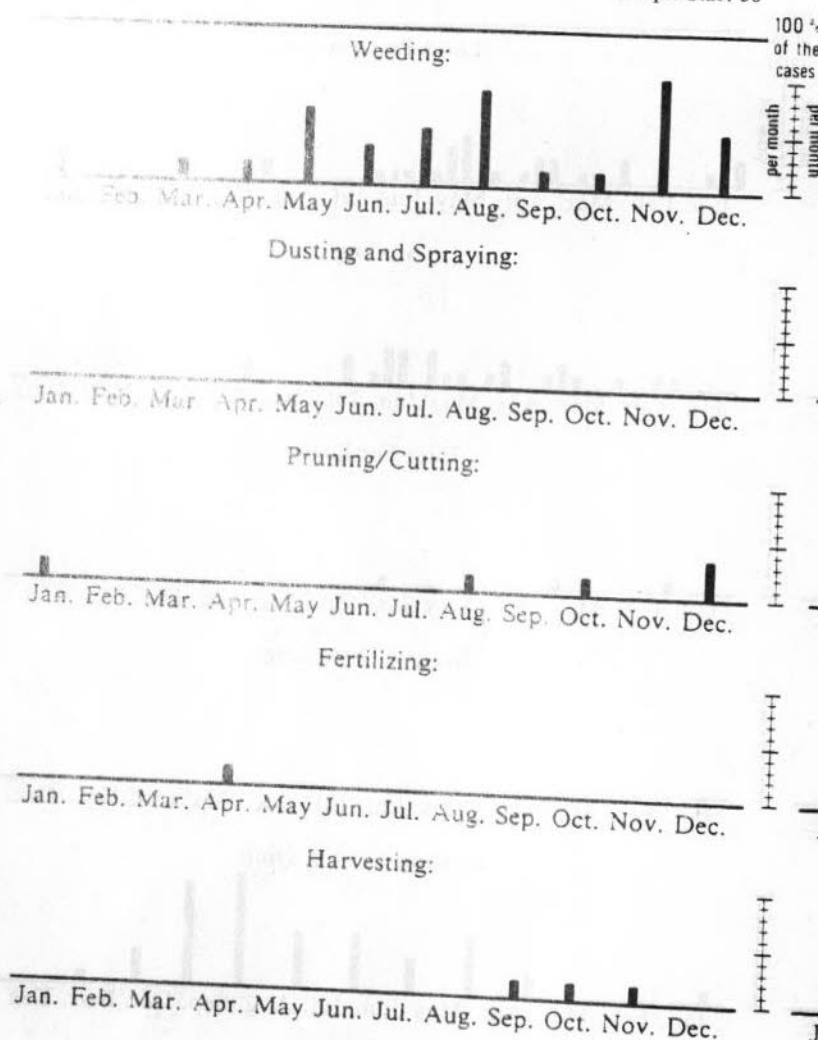
Crop: Cotton Cases: 26
 AEZ: LM 1 Survey Area 09 Sample Size: 30



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TABLE 14 g: DISTRIBUTION OF FARMING ACTIVITIES

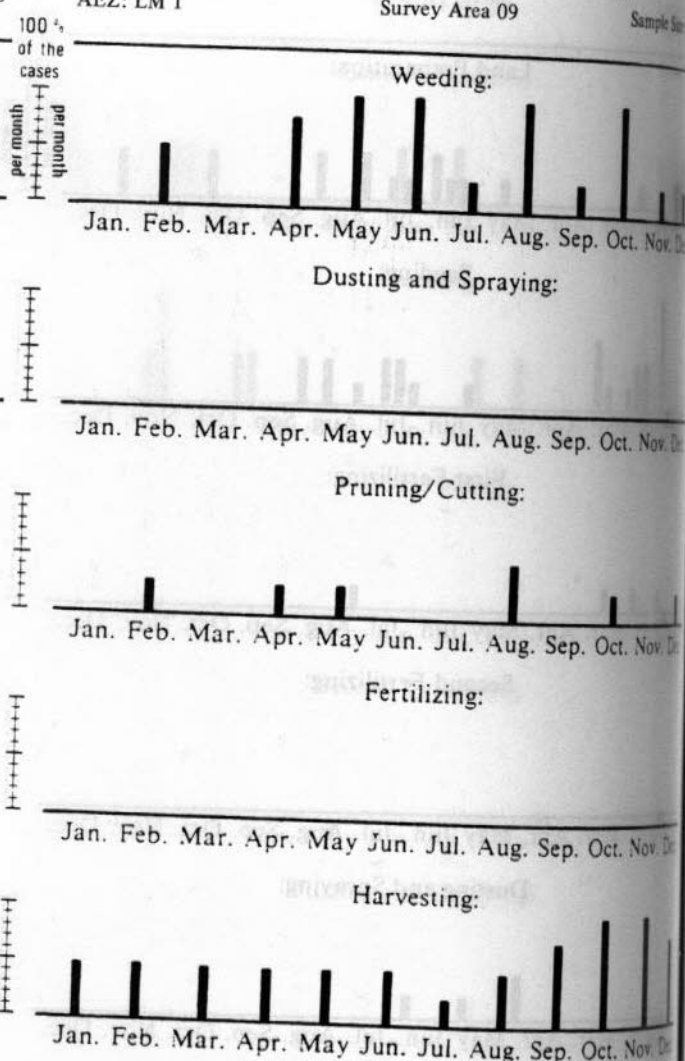
Crop 63 Sugarcane Cases: 10
AEZ: LM 1 Survey Area 09 Sample Size: 30



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TABLE 14 h: DISTRIBUTION OF FARMING ACTIVITIES

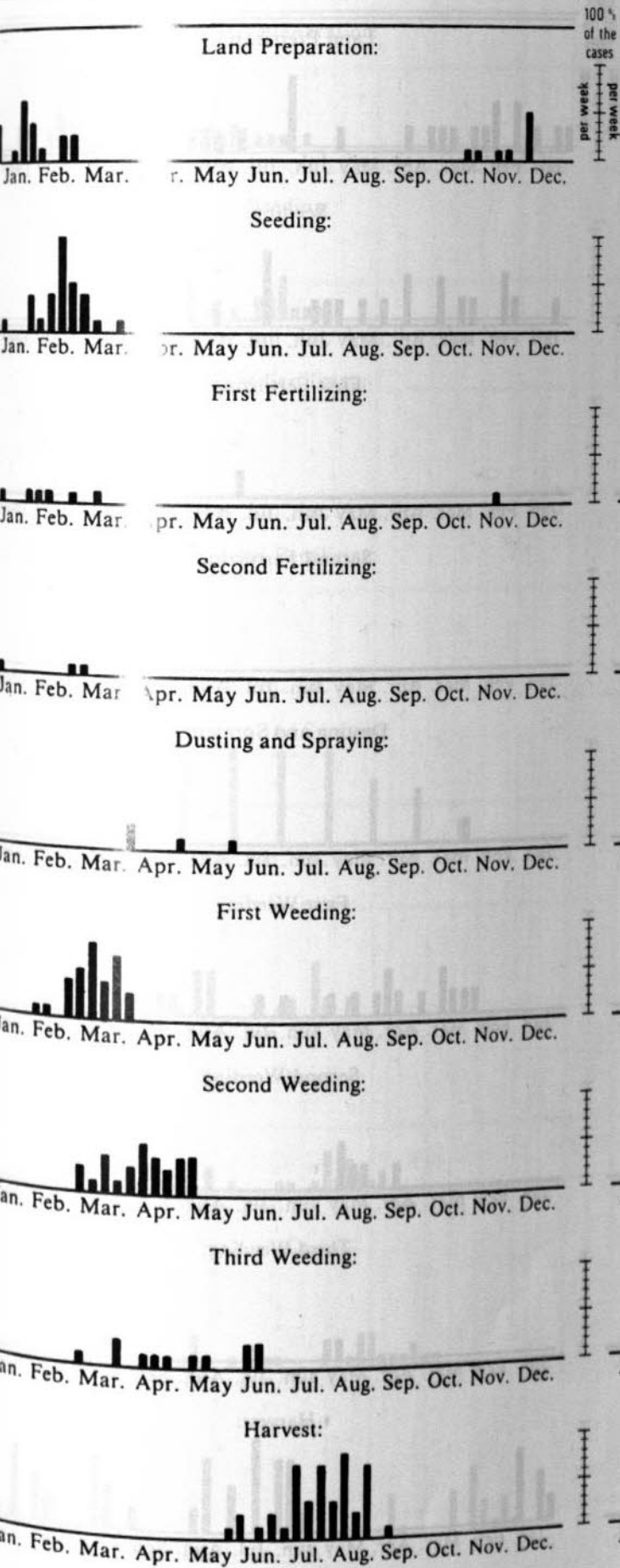
Crop 64 Cassava Cases: 7
AEZ: LM 1 Survey Area 09 Sample Size: 30



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TABLE 14 i: DISTRIBUTION OF FARMING ACTIVITIES

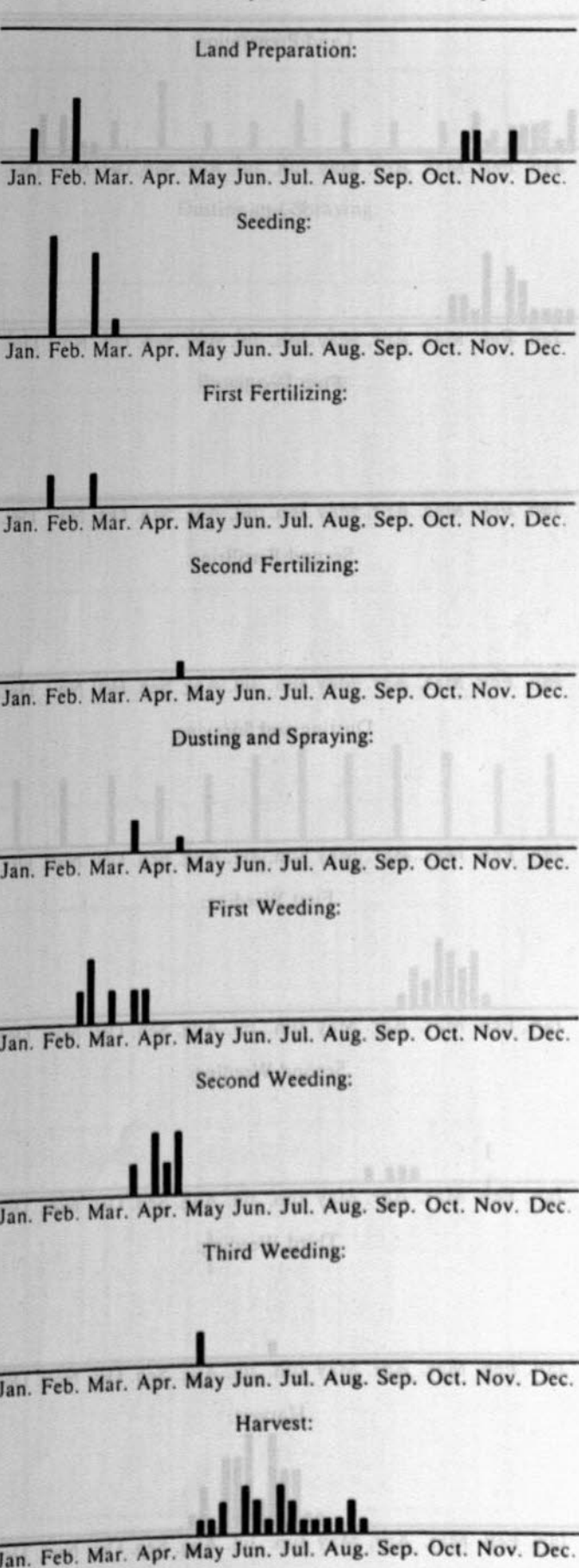
Crop: Maize Cases: 25
AEZ: LM 2-3 Survey Area 10 Sample Size: 30



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TABLE 14 j: DISTRIBUTION OF FARMING ACTIVITIES

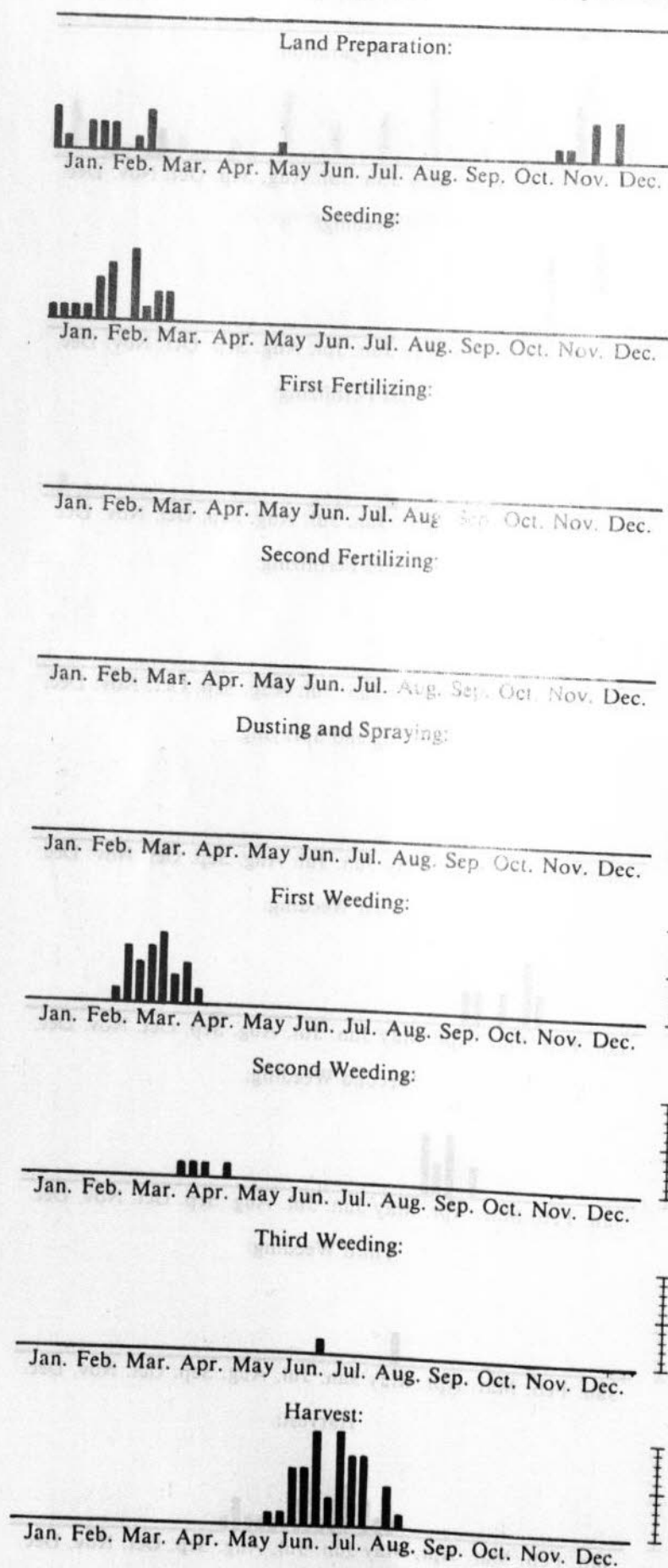
Crop 2 Maize & Beans Cases: 12
AEZ: LM 2-3 Survey Area 10 Sample Size: 30



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TABLE 14 k: DISTRIBUTION OF FARMING ACTIVITIES

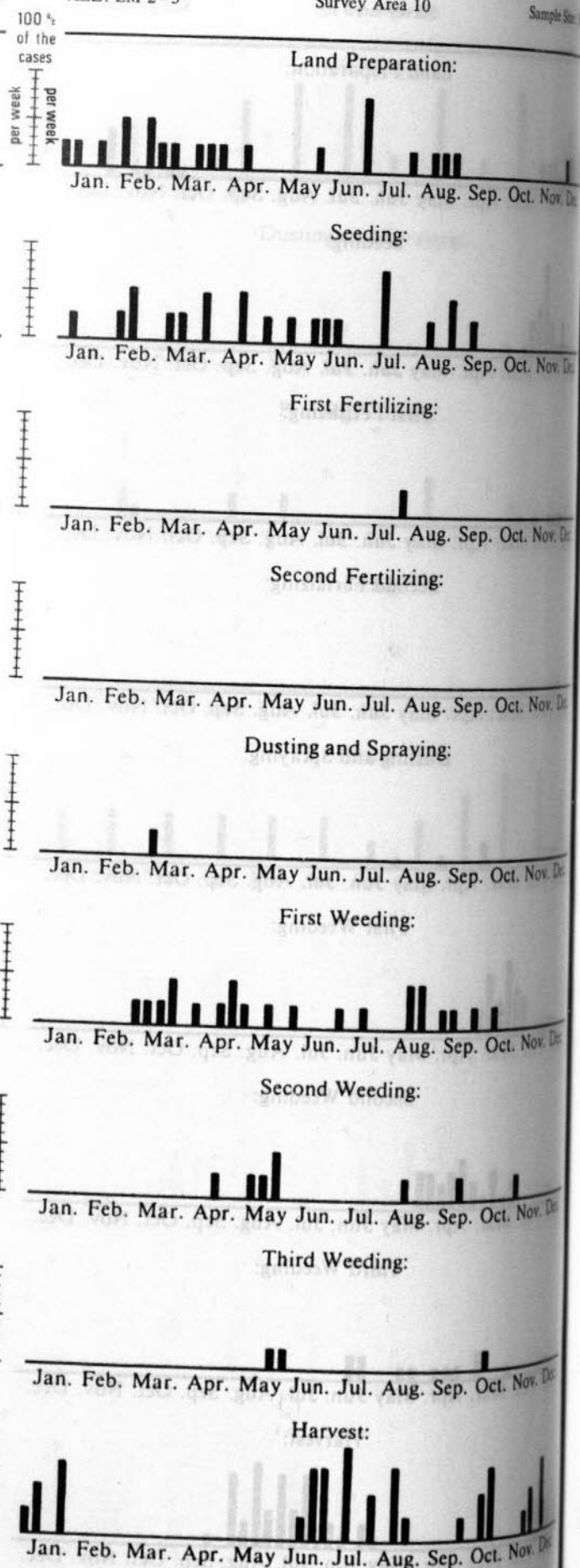
Crop 12 Fingermillet Cases: 23
 AEZ: LM 2-3 Survey Area 10 Sample Size: 30



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TABLE 14 l: DISTRIBUTION OF FARMING ACTIVITIES

Crop 18 Sunflower Cases: 22
 AEZ: LM 2-3 Survey Area 10 Sample Size: 30

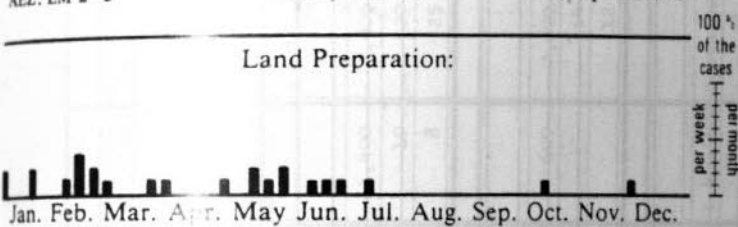


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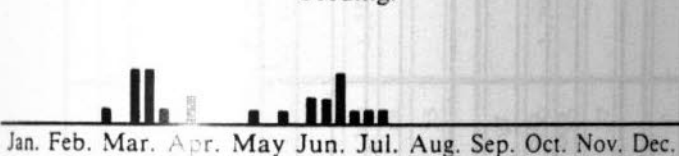
TABLE 14 m: DISTRIBUTION OF FARMING ACTIVITIES

Crop 28 Cotton Cases: 25
AEZ: LM 2-3 Survey Area 10 Sample Size: 30

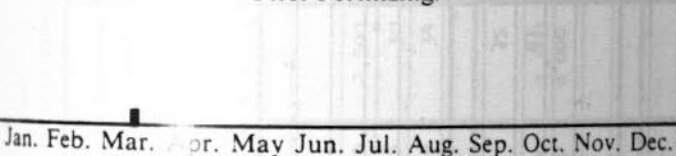
Land Preparation:



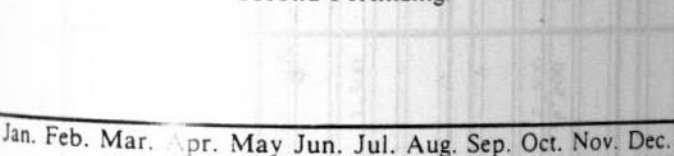
Seeding:



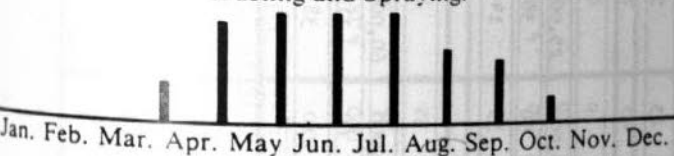
First Fertilizing:



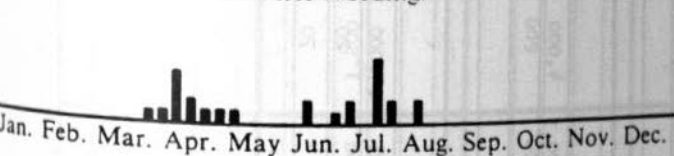
Second Fertilizing:



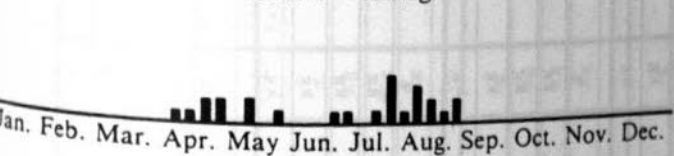
Dusting and Spraying:



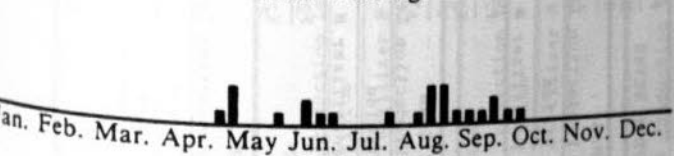
First Weeding:



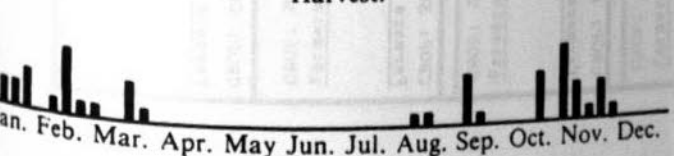
Second Weeding:



Third Weeding:



Harvest:

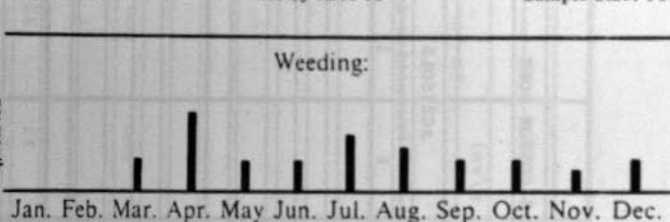


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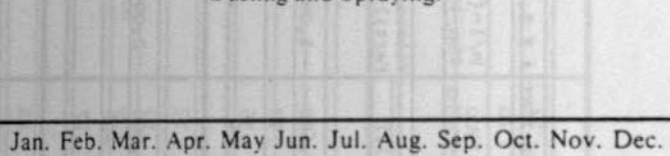
TABLE 14 n: DISTRIBUTION OF FARMING ACTIVITIES

Crop 64 Cassava Cases: 15
AEZ: LM 2-3 Survey Area 10 Sample Size: 30

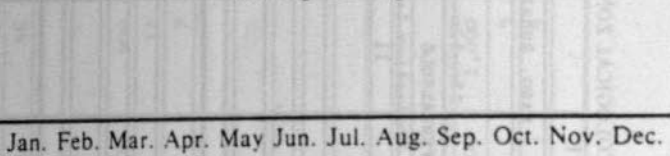
Weeding:



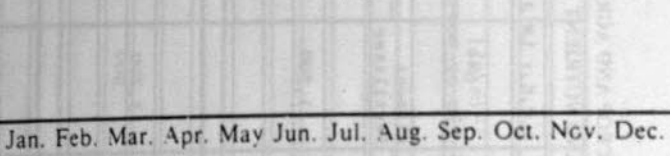
Dusting and Spraying:



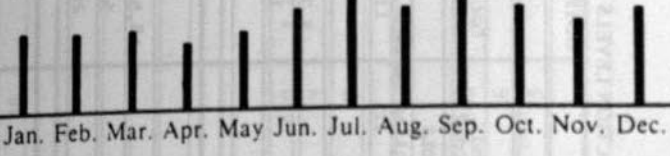
Pruning/Cutting:



Fertilizing:



Harvesting:



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TABLE 15 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

	A.E.Z.: LM 1 SUGAR CANE ZONE				A.E.Z.: LM 2				MARG. SUGAR CANE ZONE				A.E.Z.: LM 3 COTTON ZONE			
	Vegt. Period 1st + 2nd: 1st mi in Days, 1st: 195 or more		2nd: 120-130		1st (m/s) i 190 or more		Without Fertilizer		Production Level		Without Fertilizer		Production Level		Without Fertilizer	
	Soil:	Unit	I	II	III	Total: 315-325	I	II	III	I	II	III	I	II	III	IV
CROP: NATURAL PASTURE/LEYS																
Farmers in Production Level		%														
Yields		kg														
Fertilizer N		kg				3,700										
P2O5		kg				100										
K2O		kg														
CROP: NAPIER/BANA GRASS																
Farmers in Production Level		%														
Yields		kg														
Fertilizer N		kg				8,800										
P2O5		kg														
K2O		kg														
CROP: TEA																
Farmers in Production Level		%														
Yields		kg														
Fertilizer N		kg				1,500										
P2O5		kg														
K2O		kg														
CROP: BANANAS																
Farmers in Production Level		%														
Yields		kg														
Fertilizer N		kg				5,000										
P2O5		kg				116										
K2O		kg				23										
CROP: SUGAR CANE																
Farmers in Production Level		%														
Yields		kg														
Fertilizer N		kg				4,000										
P2O5		kg				5,000										
K2O		kg				10,000										
CROP: SUGAR CANE																
Farmers in Production Level		%														
Yields		kg														
Fertilizer N		kg				5,000										
P2O5		kg				15,000										
K2O		kg				20										
CROP: COTTON																
Farmers in Production Level		%														
Yields		kg														
Fertilizer N		kg														
P2O5		kg														
K2O		kg														

TABLE 15 b: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

BUSIA DISTRICT

	SUGAR CANE ZONE			MARG. SUGAR CANE ZONE			LM 3 COTTON ZONE		
	A.E.Z.: LM 1			A.E.Z.: LM 2			A.E.Z.: LM 3		
	Vegt. Period 1st + 2nd: in Days, 1st: 195 or more			2nd: 120-130			190 or more		
	Soil:			FERRALSOLS			FERRALSOLS		
CROP: MAIZE Farmers in Production Level	Unit	Production Level			Without Fertilizer	Production Level			Without Fertilizer
		I	II	III		I	II	III	
Yields	kg	1,200	2,000	4,000	1,300	1,500	2,500	3,200	1,100
Fertilizer N	kg		24	84		5	30	48	
P ₂ O ₅	kg		22	78		6	34	53	
K ₂ O	kg								
CROP: SORGHUM Farmers in Production Level	%								
Yields	kg		2,200	4,000	2,300	600	1,600	3,800	1,700
Fertilizer N	kg		10	90				60	
P ₂ O ₅	kg		8	65				37	
K ₂ O	kg								
CROP: MAIZE & BEANS Farmers in Production Level	%								
Yields	kg	1,200	2,000/400	4,000/500	1,300	1,500/350	2,000/400	3,200/400	1,100
Fertilizer N	kg		43	108		22	49	67	
P ₂ O ₅	kg		36	96		18	46	67	
K ₂ O	kg								
CROP: BEANS Farmers in Production Level	%								
Yields	kg				800	700	900	1,500	900
Fertilizer N	kg						12	42	
P ₂ O ₅	kg						7	25	
K ₂ O	kg								
CROP: SUNFLOWER Farmers in Production Level	%								
Yields	kg	700	600	1,200					
Fertilizer N	kg			5					
P ₂ O ₅	kg			7					
K ₂ O	kg								
CROP: SOYA BEANS Farmers in Production Level	%								
Yields	kg	800	700	1,200	900	700	1,000	1,500	
Fertilizer N	kg			16			5	30	
P ₂ O ₅	kg			15			4	23	
K ₂ O	kg								

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TABLE 15 c: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

OUTPUT AND NUTRIENT INPUT																	
A.E.Z.: LM 1 SUGAR CANE ZONE				A.E.Z.: LM 2 MARG. SUGAR CANE ZONE				A.E.Z.: LM 3 COTTON ZONE									
Veg. Period		1st + 2nd: 1-1 mi		2nd: 120-130		total: 315-325		1-1(m/s) i		110-120		300-310		m/1-(s or s/vs)		30-90	
in Days, 1st: 195 or more		Soil:		FERRALSOLS		FERRALSOLS		FERRALSOLS		FERRALSOLS		FERRALSOLS		ACRISOLS		ACRISOLS	
Unit		Without Fertilizer		Production Level		I		II		III		Without Fertilizer		Production Level		I	
FARMERS IN PRODUCTION LEVEL		%		kg		kg		kg		kg		kg		kg		kg	
Yields		900		500		1,000		1,500		800		700		1,100		1,400	
Fertilizer N						3		19						700		1,100	
P2O5						3		18								12	
K2O																23	
CROP: SIMSIN																	
FARMERS IN PRODUCTION LEVEL		% <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td>		kg <td colspan="2">kg<td colspan="2">kg</td></td>		kg <td colspan="2">kg</td>		kg	
Yields																	
Fertilizer N																	
P2O5																	
K2O																	
CROP: SWEET POTATOES																	
FARMERS IN PRODUCTION LEVEL		% <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td>		kg <td colspan="2">kg<td colspan="2">kg</td></td>		kg <td colspan="2">kg</td>		kg	
Yields		5,000		5,000		12,000		28,000		4,500		5,000		9,000		28,000	
Fertilizer N						70		210				5		45		235	
P2O5						49		147				4		32		164	
K2O																	
CROP: CASSAVA																	
FARMERS IN PRODUCTION LEVEL		% <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td>		kg <td colspan="2">kg<td colspan="2">kg</td></td>		kg <td colspan="2">kg</td>		kg	
Yields		5,000		5,000		8,000		14,000		6,000		5,000		7,000		12,000	
Fertilizer N						12		36				4		26		42	
P2O5						21		63				7		21		42	
K2O																	
CROP: CABBAGE																	
FARMERS IN PRODUCTION LEVEL		% <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td>		kg <td colspan="2">kg<td colspan="2">kg</td></td>		kg <td colspan="2">kg</td>		kg	
Yields		4,000		3,000		8,000		17,000									
Fertilizer N						28		91									
P2O5						28		91									
K2O																	
CROP:																	
FARMERS IN PRODUCTION LEVEL		% <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td></td>		kg <td colspan="2">kg<td colspan="2">kg<td colspan="2">kg</td></td></td>		kg <td colspan="2">kg<td colspan="2">kg</td></td>		kg <td colspan="2">kg</td>		kg	
Yields																	
Fertilizer N																	
P2O5																	
K2O																	

TABLE 15 d: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

BUSIA DISTRICT

A.E.Z.: LM 4 MARGINAL COTTON ZONE											
Vegt. Period		1st + 2nd:		2nd:							
in Days, 1st:		(m/s)+i		<45							
Soil:		GLEYSOLS									
	Unit	Without Fertilizer		Production Level			Without Fertilizer		Production Level		
				I	II	III			I	II	III
CROP: NATURAL PASTURE											
Farmers in Production Level	%										
Yields	kg		600			1,200					
Fertilizer N	kg					33					
P2O5	kg					16					
K2O	kg										
CROP: NAPIER/BANA GRASS											
Farmers in Production Level	%										
Yields	kg		1,100			2,500					
Fertilizer N	kg					77					
P2O5	kg					38					
K2O	kg										
CROP: MAIZE											
Farmers in Production Level	%										
Yields	kg										
Fertilizer N	kg										
P2O5	kg										
K2O	kg										
CROP: SORGHUM											
Farmers in Production Level	%										
Yields	kg		1,400	900	1,700	2,500					
Fertilizer N	kg				10	37					
P2O5	kg				8	34					
K2O	kg										
CROP: MILLET											
Farmers in Production Level	%										
Yields	kg										
Fertilizer N	kg										
P2O5	kg										
K2O	kg										
CROP: BEANS											
Farmers in Production Level	%										
Yields	kg										
Fertilizer N	kg										
P2O5	kg										
K2O	kg										

BUSIA DISTRICT
TABLE 15 e: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

A.E.2.: LM 4 MARGINAL COTTON ZONE									
Vegt. Period		2nd:		GLEYSOLS					
1st + 2nd: (m/s)+1				II		III		Without Fertilizer	
in Days, 1st: 130									
Soil:		Without Fertilizer		Production Level		Production Level		Production Level	
		Unit		I	II	I	II	I	II
CROP: SUNFLOWER									
Farmers in Production Level		%							
Yields		kg	800	500	700	800			
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
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CROP:									
Farmers in Production Level		%							
Yields		kg							
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Farmers in Production Level		%							
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Farmers in Production Level		%							
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Farmers in Production Level		%							
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CROP:									
Farmers in Production Level		%							
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CROP:									
Farmers in Production Level		%							
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CROP:									
Farmers in Production Level		%							
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CROP:									
Farmers in Production Level		%							
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CROP:									
Farmers in Production Level		%							
Yields		kg							
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CROP:									
Farmers in Production Level		%							
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P2O5		kg							
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CROP:									
Farmers in Production Level		%							
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Farmers in Production Level		%							
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CROP:									
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CROP:									
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K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
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CROP:									
Farmers in Production Level		%							
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Fertilizer N		kg							
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CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
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Fertilizer N		kg							
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Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									
Farmers in Production Level		%							
Yields		kg							
Fertilizer N		kg							
P2O5		kg							
K2O		kg							
CROP:									

BUNGOMA DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

The Bungoma district is mainly situated on the slopes and foothills of Mt. Elgon, and its natural potential is partly related to the natural potential of the districts in Central or East Kenya also situated on the slopes of a volcanic mountain: forest, tea and coffee zones, fertile volcanic soils, enough water. However, the climate shows differences. Here, the foot plains featuring well-distributed annual average rainfall of 1200–1800 mm are generally wetter than in East Kenya due to local rains caused by winds from Lake Victoria (p. 81). This allows sugar cane cultivation (except in western areas); for the same reason, differentiation in rainy seasons during the year is much less than in East Kenya.

It is very difficult to say what the second rains are because of more or less continuous rainfall. Therefore, the growing periods given in the subzones are only one possibility of dividing the normally very long period. The symbol for the second cropping season indicates here the remaining time for cultivation after the first maize crop is harvested. Of course the second period may be longer if planting starts earlier, but then the first one is shortened (Table 3).

The average annual rainfall in the district ranges from 1 000 to 1 800 mm; the seasonal distribution is 500–1 000 mm during 1st rains and 430–800 mm during 2nd rains in 6 out of 10 years (60 % reliability). The Agro-Ecological Zones stretch from Tropical Alpine Zones to Lower Midland Zones with tea, wheat/maize-pyrethrum, coffee, sunflower-maize, sugar cane and cotton zones. The potential for tea is not yet developed. Annual crops may be late maturing ones. The total amount for the 60 % reliability of growing periods ranges from more than 360 days (in LH 1) to about 230 days (in LM 3 or UM 3/UM 4).

In the southern part of the district (especially in LM 3) the annual mean temperature is about 21–22°C – in the northern part, however, because of the altitude, 5–10°C (in TA I and TA II). Evaporation is relatively low and increases from less than 1 000 mm (on Mt. Elgon) to 1 800 mm (in UM 1/UM 2). In the southern part of the district only, evaporation is about 1 800–2 000 mm per year.

BUNGOMA DISTRICT

TABLE 1: RAINFALL FIGURES FROM VARIOUS STATIONS
having at least 10 years of records up to 1976

No. and altitude	Name of Station	Years of rec.	Kind of rec.	Ann. rainf. mm	Monthly rainfall in mm											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
8934023 1 370 m	Bungoma, Vet. Station	43	Average	1 607	53	89	123	227	239	143	122	136	140	134	122	86
8934060 1 676 m	Kimilili, Agric. Department	30	Av. 60% prob ¹⁾	1 627 1 330	40	57	116	226	254	163	135	150	165	155	97	63
8934082 1 433 m	Bungoma, Agric. Department	23	Av.	1 619	61	73	141	240	237	134	108	131	125	165	128	78
8934098 2 073 m	Kimilili, Forest Station	16	Av.	1 556	58	59	100	222	233	114	128	155	153	163	116	55
8934113 1 829 m	Kapsakwany, Chief's Centre	14	Av.	2 054	66	114	153	277	246	201	152	197	208	243	116	81
8934118 1 615 m	Sirisia, Chief's Camp	14	Av. 60%	1 699 1 475	42	63	135	251	251	136	143	153	155	176	111	84
8934119 1 524 m	Webuye, Health Centre	13	Av.	1 734	52	82	135	248	283	159	163	148	165	165	78	56
8934120 1 615 m	Chwele, Health Centre	14	Av.	1 677	63	78	130	215	240	128	179	122	156	191	103	74

1) These figures of rainfall reliability should be exceeded normally in 6 out of 10 years

BUNGOMA DISTRICT

TABLE 2: TEMPERATURE DATA

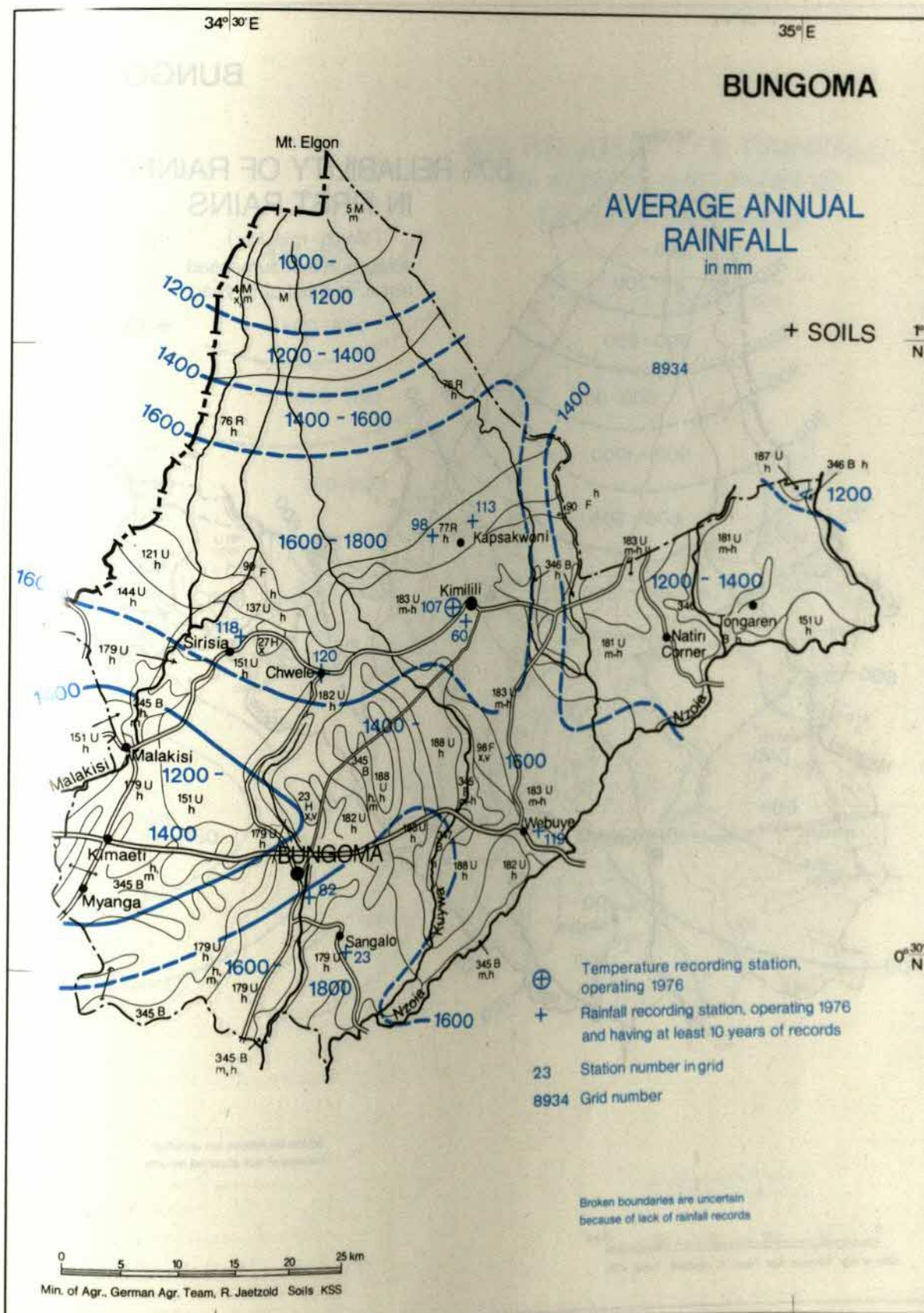
No. and altitude	Name of Station	AEZ ¹⁾	Kind of records	Temperature in °C												Y. of rec.	
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Year
8934107 1 705 m	Kamusinga School	LH 1 lp to UM 2 hp	Mean max.	26.8	27.8	27.6	26.2	24.9	24.8	23.5	(22.8)	25.2	25.6	25.0	(25.6)	25.5	8
			Mean temp.	19.9	20.6	20.7	20.4	19.4	18.8	18.3	18.1	18.7	19.6	19.4	19.5	19.4	
			Mean min.	12.9	13.4	13.7	14.6	13.8	12.7	13.1	(13.3)	12.1	13.5	13.7	13.3	13.3	
			Abs. min.	7.8	11.1	10.0	11.1	11.1	10.0	10.0	11.1	10.0	10.0	10.0	10.0	7.8	

1) AEZ = Agro-ecological zone; lp = lower places, hp = higher places within the zone

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall ¹⁾		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains ²⁾ in days	2nd rains in days	Total ³⁾ in days
TA I Tropical-Alpine Cattle and Sheep Zone		3 000–3 500	10.0–7.0	1 000–1 300	Unimportant, because crops only near UH				
TA II Tropical-Alpine Sheep Zone		Relatively small, unimportant							
UH 0–1 Forest Zone and Sheep and Dairy Zone		Here all Forest Reserve (steep slopes and valuable timber)							
LH 1 Tea-Dairy Zone	p or l/m m	1 950–2 400	18.0–15.2	1 650–1 800	750–950	650–800	190 or more ²⁾	170–175	>360
LH 2 Wheat/Maize-Pyrethrum Zone	vl i or two	1 800–2 200	18.8–16.4	1 300–1 700	630–800	630–690	185 or more	100–130	285–330
UM 1 Coffee-Tea Zone	vl i or m/l m/s i m/l m s/m	1 500–1 950	20.6–18.0	1 620–1 800	650–800	620–700	170 or more	110–130	280–300
				1 620–1 800	700–750	600–650	170 or more	105–115	275–285
UM 2 Main Coffee Zone	vl i or m/l m s i	1 500–1 800	20.6–18.8	1 350–1 700	650–720	550–630	160 or more	85–105	245–265
UM 3 Marginal Coffee Zone	l/vl i or m m s i	1 500–1 800	20.6–18.8	1 200–1 600	550–650	450–580	140 or more	85–105	215–245
UM 4 Sunflower-Maize Zone	l/vl or two	1 500–1 800	20.6–18.8	1 200–1 500	500–630	450–560	130 or more	80–100	210–230
LM 1 Lower Midland Sugar Cane Zone	l m	1 350–1 500	21.5–20.6	1 600–1 800	700–800	500–650	210 or more	130–140	340–350
LM 2 Marginal Sugar Cane Zone	l m (m/s)i l/m m (s/m) m/l m s/m	1 350–1 500	21.5–20.6	1 400–1 650	650–750	480–580	195 or more	115–130	310–325
				1 400–1 600	650–700	460–580	180 or more	105–115	285–295
				1 500–1 650	630–700	480–630	155–175	105–115	260–290
LM 3 Lower Midland Cotton Zone	m/l m (s)	1 200–1 400	22.4–21.2	1 200–1 500	500–650	430–500	150–170	85–105	230–270

- 1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants
 2) More if growing cycle of cultivated plants continues into the period of second rains
 3) Agrohumid conditions continue from 1st to 2nd rains in the whole district



34° 30' E

35° E

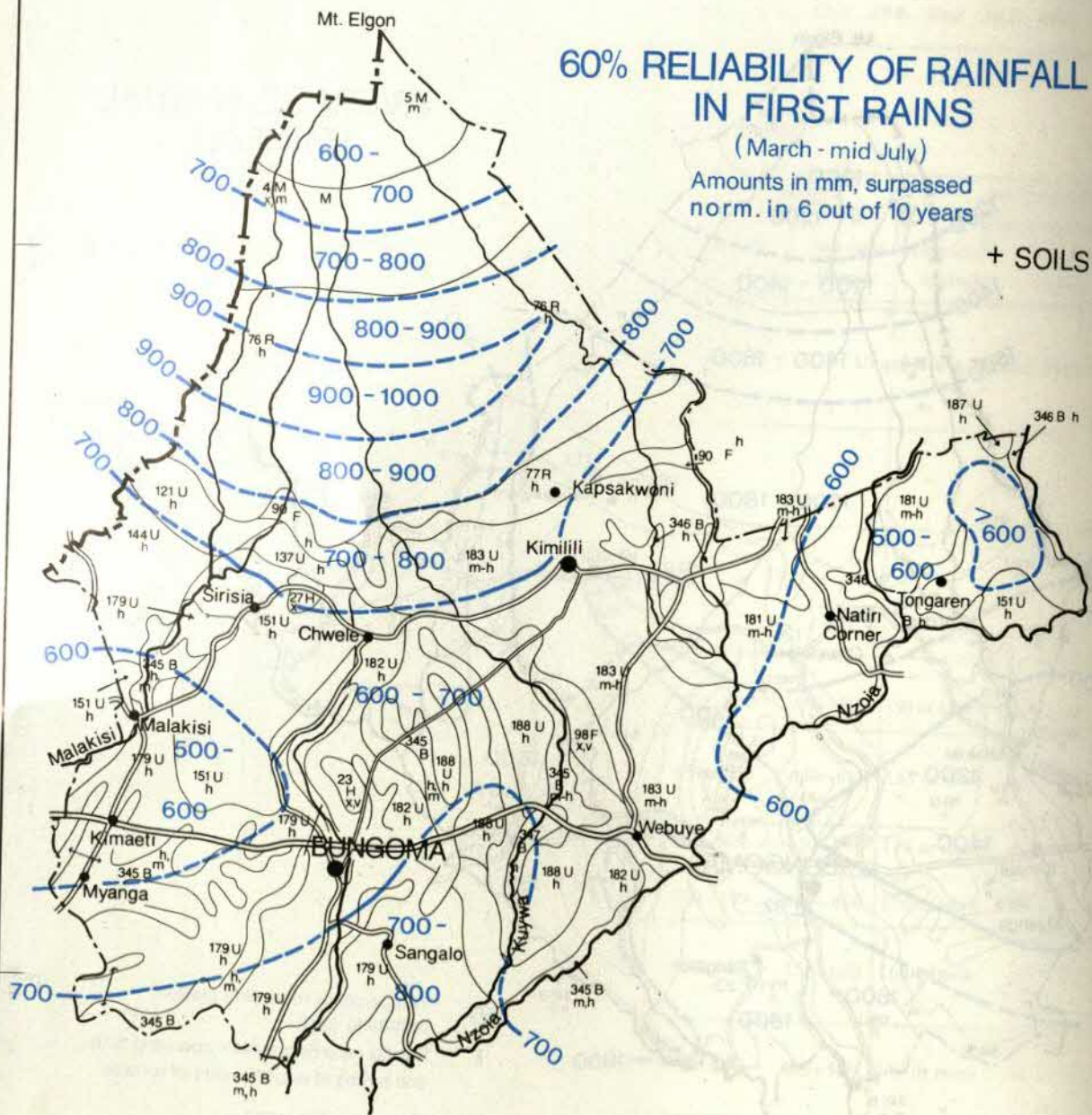
BUNGOMA

60% RELIABILITY OF RAINFALL IN FIRST RAINS

(March - mid July)

Amounts in mm, surpassed
norm. in 6 out of 10 years

+ SOILS



Broken boundaries are uncertain
because of lack of rainfall records



Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

34° 30' E

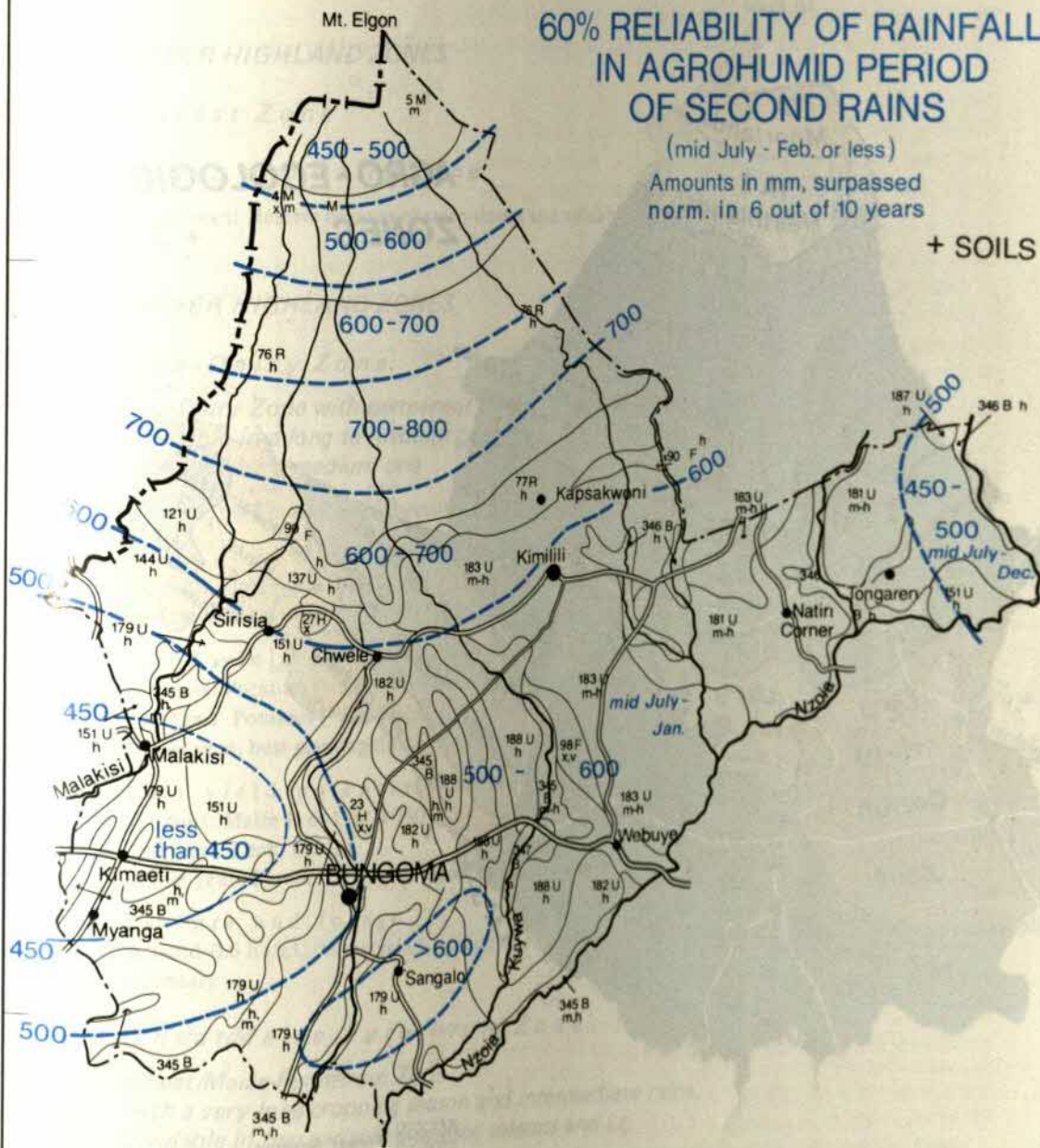
35° E

BUNGOMA**60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF SECOND RAINS**

(mid July - Feb. or less)

Amounts in mm, surpassed
norm. in 6 out of 10 years

+ SOILS

P
N

0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

AGRO-ECOLOGICAL ZONES

TA = TROPICAL-ALPINE ZONES

TA I = Tropical-Alpine Cattle and Sheep Zone

Grazing for sheep and cattle. Cabbages, potatoes and pyrethrum marginal (cultivable near forest only)

TA II = Tropical-Alpine Sheep Zone

Grazing for sheep

UH = UPPER HIGHLAND ZONES

UH 0 = Forest Zone

UH 1 = Sheep and Dairy Zone

Here Forest Reserve because of steep slopes and valuable timber production

LH = LOWER HIGHLAND ZONES

LH 1 = Tea-Dairy Zone

LH 1 = Tea-Dairy Zone with permanent cropping possibilities,
p or dividable in a long to medium cropping season
l/m — followed by a medium one

Most of it is Forest Reserve because of steep slopes, water retention and valuable timber production

Very good yield potential (av. more than 80 % of the optimum)

1st rains, start norm. mid to end F.: Peas; cabbages, lettuce

2nd rains, start norm. begin of August: Peas

Good yield potential (av. 60–80 % of the optimum)

1st rains: Potatoes (~ 60 %)¹; rape seed; carrots, leek, kales, endive

2nd rains: Potatoes (~ 60 %); carrots, kales, cabbages

Whole year, best planting time end F.: Tea (high quality on deeply weathered soils)

Fair yield potential (av. 40–60 % of the optimum)

1st rains: Maize H 611 or H 7801 (50–60 %)², finger millet; onions and sweet potatoes (lower places)

2nd rains: Leek, lettuce

Whole year: Pyrethrum (higher places), plums, passion fruit (lower places)

Pasture and forage

Around 0.6 ha/LU on secondary pasture of Kikuyu grass, well suitable for grade dairy cows; fodder planting not necessary

LH 2 = Wheat/Maize-Pyrethrum Zone

LH 2 = Wheat/Maize-Pyrethrum Zone

v i with a very long cropping season and intermediate rains,
or two dividable in two variable cropping seasons and i.r.

Good yield potential (av. 60–80 % of the optimum)

1st rains (to 2nd r.), start norm. March: Late mat. wheat like Kenya Bongo (Apr./May–O./N.), late mat. triticale, late mat. maize like H 611 (e.F./Apr.–S./N., ~ 80 % on deep volcanic soils in lower places); peas, horse beans, potatoes¹ (Apr.–Au.); late mat. sunflower like Kenya White (60–70 %, lower places ~ 70 %), linseed, rapeseed; cabbages, kales, cauliflower, carrots, beetroot, spinach, celery, lettuce

2nd rains, start undistinctly around end of June: M. mat. Barley like K. Research (June–O.), m. mat. wheat like K. Tembo (June–O.); linseed; kales, carrots, beetroot, spinach, tomatoes (lower places), celery

Whole year: Black Wattle, New Zealand Flax (higher places)

Fair yield potential (av. 40–60 % of the optimum)

1st rains: Finger millet, m. mat. beans like Cuarentino (50–60 %, lower places); tomatoes, onions

2nd rains: Peas, beans (below 2 100 m); potatoes (S.–D./J.); cabbages, cauliflower, onions, lettuce

Whole year: Pyrethrum (nearly 60 %); apples, pears, and plums above 2 200 m; strawberries, passion fruit (below 2 100 m)

¹ Spraying against fungus diseases important

² Needs 8 months to ripe (Feb.–Sept.)

Pasture and forage

Around 1 ha/LU on highland savanna of Kikuyu, Red oats and tufted grass³⁾ between Cedar forest remnants;
 ~0.6 ha/LU on art. pasture of Nandi Setaria > 2 000 m or Rhodes grass < 2 000 m; with add. feeding of Giant
 Setaria and lucerne or clover down to 0.3 ha/LU; suitable for grade dairy cows

UM = UPPER MIDLAND ZONES

UM 1 = Coffee-Tea Zone

UM 1 = Coffee-Tea Zone

with a very long cropping season and intermediate rains,
 dividable in a medium to long cropping season followed by a medium to short one and i. r.

Very good yield potential

1st rains, start norm. begin of March: Cabbages, kales

2nd rains, start undistinctly begin of August: M.mat. sunflower like Comet

Whole year: Tea (~80 %, less quality), passion fruit, guavas

Good yield potential

1st rains: Maize H 612-614, H 7801 (higher places), H 622 or 632 (lower places), finger millet; beans; potatoes
 (60-70 %, higher places), sweet potatoes (lower places); m.mat. sunflower like Hybrid S 301 A; spinach,
 onions, carrots (above 1 600 m), broccoli

2nd rains: Beans (~60 %), sweet potatoes; kales, onions, tomatoes

Whole year: Arabica coffee, bananas, yams, taro (in valleys), mountain pawpaws, avocados, loquats

Fair yield potential

1st rains: High alt. sorghum; tomatoes

2nd rains: Maize H 511 & 512, high alt. sorghum (Aug.-F.), finger millet; potatoes; cabbages

Whole year: Citrus, taro (on slopes)

Pasture and forage

Around 0.6 ha/LU on artificial or sec. pasture of star grass; down to about 0.12 ha/LU feeding Napier or Bana
 grass, banana leaves and stems, maize stalks and sweet potato vines.

UM 1 = Coffee-Tea Zone with a medium to long cropping season m/l - s/m followed by a short to medium one

The same like above, but sunflower Comet and tea only good instead of very good; stocking and feeding rates
 about 10 % less.

UM 2 = Main Coffee Zone

UM 2 = Main Coffee Zone

with a very long cropping season and intermediate rains,
 dividable in a medium to long cropping season followed by a short one and i. r.
 (See Diagram Kimilili)

Very good yield potential

1st rains, start norm. begin of March: Maize H 612-614 (~80 %, higher places, Mch.-O.); cabbages, kales
 Whole year, best planting time March: Castor

Good yield potential

1st rains: Maize H 622, 632 (70-80 %, lower places, Mch.-Au.), finger millet; m.mat. beans (lower places)⁴⁾;
 sweet potatoes; m.mat. sunflower like HS 301 A or Comet (May/June-O.), m.mat. soya beans; onions,
 spinach, tomatoes

2nd rains, start undistinctly b. of Aug.: E.mat. beans (~60 %), onions (on light soils)

Whole year: Arabica coffee (~60 %, on good deep volcanic soils), Macadamia nuts, bananas (in valleys), passion
 fruits, avocados, mountain pawpaws, guavas

Fair yield potential

1st rains: M.mat. wheat and barley (only in northeastern higher places, May-S.); potatoes, pigeon peas (lower
 places)

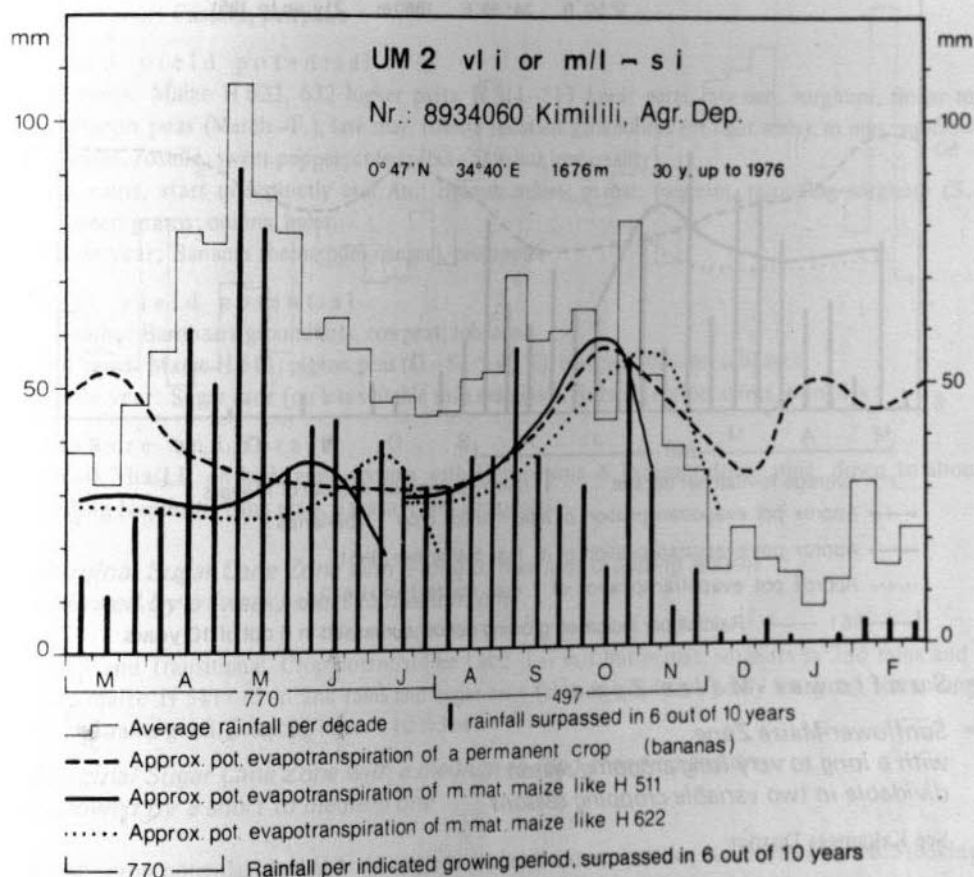
2nd rains: Maize H 511-513 (50-60 %), 622, 632 (~50 %); potatoes, sweet potatoes; tomatoes

Whole year: Arabica coffee (on less suitable soils), bananas (outside valleys), citrus, taro (in valleys), yams,
 pineapples (lower places)

3) The bad tufted grasses Eleusine jaegeri and Pennisetum schimperii are expanding if the areas are overgrazed. They may be controlled by fire.
 4) Sometimes rotting because of too wet conditions

Pasture and forage

0.6–1 ha/LU on sec. pasture, around 0.5 ha/LU on art. pasture of Rhodes grass; down to 0.15 ha/LU feeding Napier & Bana grass and others; Silver Leaf desmodium (*Desmodium uncinatum*) best fodder legume (for rotation and dairy cows)



UM 3 = Marginal Coffee Zone (here Coffee-Maize Zone)

UM 3 = Marginal Coffee Zone

l/vli
or m - s i
with a long to very long cropping season and intermediate rains,
dividable in a medium cropping season followed by a short one and i.r.
(See Diagram Ndubu)

Good yield potential

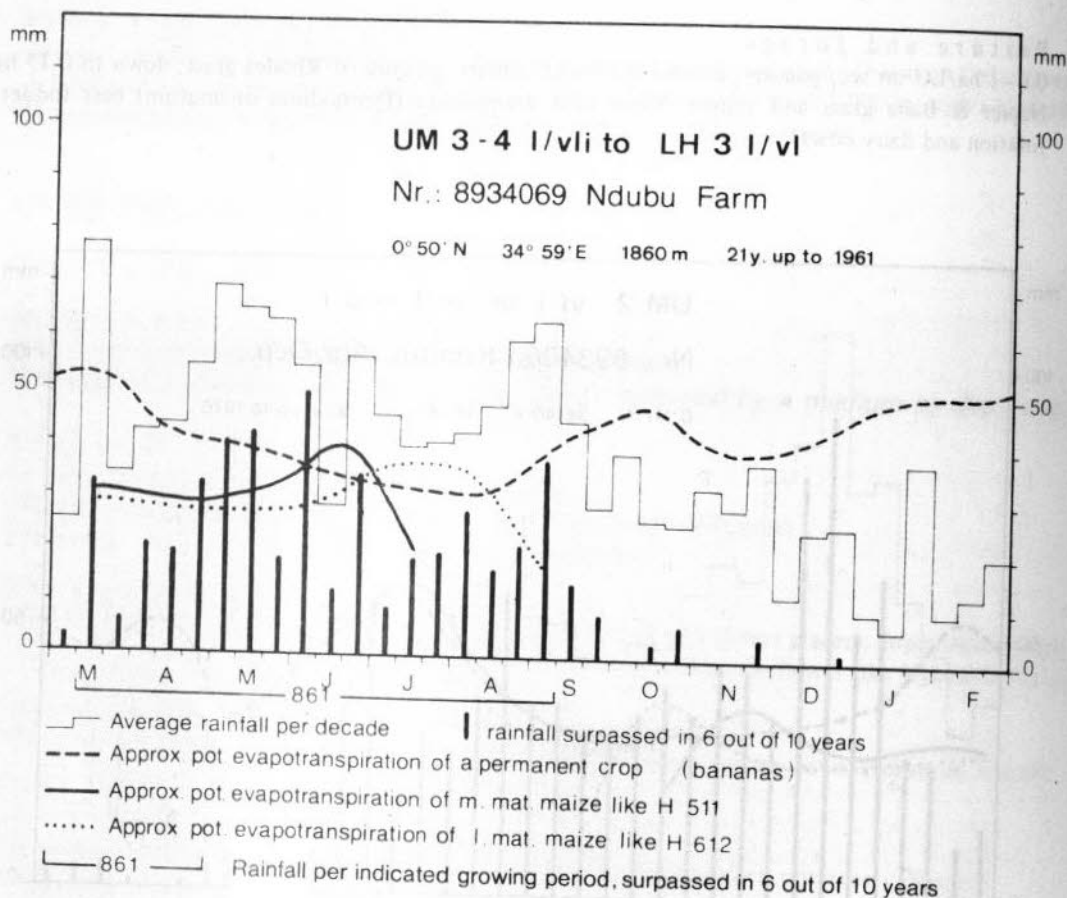
1st rains, start norm. begin March: Maize H 612–614 (nearly 80 %, higher northeastern places),
H 622, 632 (~ 70 %, lower places), finger millet (~ 60 %), high alt. sorghum; m.mat. beans (lower places)⁴,
sweet potatoes; m.mat. sunflower like Comet (June–O.), m.mat. like HS 301 A (~ 60 %), m.mat. soya beans
(lower places, ~ 60 %); cabbages, kales, onions (on light soils), tomatoes, spinach
2nd rains, start undistinctly b. of Aug.: V.e.mat. beans (~ 60 %); onions (~ 60 % on light soils)
Whole year: Mountain pawpaws, Macadamia nuts, castor

Fair yield potential

1st rains: M.mat. wheat and barley (only in northeastern higher places); potatoes (higher places)
2nd rains: Potatoes (higher pl.), sweet pot.; tomatoes
Whole year: Arabica coffee (with mulching on good deep soils ~ 40 %, otherwise poor resp. marginal), bananas
(like coffee), avocados, citrus⁵, pineapples

Pasture and forage

1–1.2 ha/LU on nat. sav. pasture, 0.6 ha/LU on art. pasture of Rhodes grass; down to 0.18 ha/LU feeding
Napier or Bana grass and others. *Desmodium uncinatum* best fodder legume



UM 4 = *Sunflower-Maize Zone*

UM 4 = *Sunflower-Maize Zone*
l/vl with a long to very long cropping season
or two dividable in two variable cropping seasons

See Kakamega District

LM = *LOWER MIDLAND ZONES*

LM 1 = *Lower Midland Sugar Cane Zone*

LM 1 = *Lower Midland Sugar Cane Zone with a long cropping season*
l-m followed by a medium one

Very good yield potential

1st rains, start norm. F.: M.mat. white sorghum; sweet potatoes; sunflower like 252 or HS 345, m.mat. soya beans like Black Hawk Hill; sweet pepper, kales, Chinese cabbage, spinach

Whole year, best pl. time b. of March: Sugar cane on deep alluvial soils, cassava, pawpaws, guavas

Good yield potential

1st rains: Maize H 622, 632; finger millet, late mat. sorghum; late mat. beans, pigeon peas (Mch.-F.); m.mat. sunflowers, cabbage, chillies, yellow yams (F.-O./N.)

2nd rains, start undistinctly e. of Au.: Maize H 511, 512, (70-80 %), 622 (~ 60 %), m.mat. white sorghum, finger millet; beans, l.mat. cowpeas; m.mat. soya beans, sunflower 252; kales, Chinese cabbage, spinach, onions, sweet pepper, late mat. bambarra groundnuts (in light soils)

Whole year: Sugar cane on plateau soils, bananas (nematodes danger), tea in upper places (70-80 %, but medium to low quality), Robusta coffee, avocados, taro on alluvial soils

Fair yield potential

2nd rains: Late mat. groundnuts (rosette danger, 50-60 % in light soils)

Whole year: Mangoes, citrus, taro on plateau soils

Pasture and forage

Around 0.5 ha/LU on sec. pasture (orig. moist submontane forest); down to about 0.12 ha/LU feeding Napier or Bana grass and banana leaves

5) With add. irr. (D.-F.) well growing

LM 2 = *Marginal Sugar Cane Zone*

LM 2 = *Marginal Sugar Cane Zone with a long cropping season followed by a (weak) medium to short one and intermediate rains*
 l-m (m/s)

Very good yield potential

1st rains, start norm. mid F.: M.mat. sorghum; sweet potatoes; e.mat. sunflower like 252 or HS 345, m.mat. soya beans; onions

Whole year: Cassava, pawpaws

Good yield potential

1st rains: Maize H 622, 632 higher parts, H 511-513 lower parts, late mat. sorghum, finger millet; beans¹), pigeon peas (March-F.), late mat. rosette resistant groundnuts (in light soils); m.mat. sunflowers; cabbages, kales, roselle, sweet pepper; cotton (60-70 % but low quality)

2nd rains, start undistinctly end Au.: Bulrush millet, m.mat. sorghum, ratooning sorghum (S.-Au.); beans, green grams; onions, kales

Whole year: Bananas (nematodes danger), pineapples

Fair yield potential

1st rains: Bambarra groundnuts, cowpeas; tobacco

2nd rains: Maize H 511; pigeon peas (O.-S., ~ 60 %), cowpeas; simsim; cabbages

Whole year: Sugar cane (on less suitable soils marginal), Robusta coffee, citrus, mangoes

Pasture and forage

0.5-0.7 ha/LU on high grass savanna with Hyparrhenia & Panicum dominating; down to about 0.15 LU/ha feeding Napier or Bana grass, banana leaves and others

LM 2 = *Marginal Sugar Cane Zone with a long to medium cropping season followed by a (weak) short to medium one*
 l/m - (s/m)

Small and transitional. Crop potential like LM 2 l-m/s but m.mat. sorghum in 2nd rains and bananas only fair, maize H 511-13 in 2nd rains and sugar cane (also on good soils) only marginal. Ratooning sorghum 1st to 2nd rains good. Stocking rates ~ 10 % less

LM 2 = *Marginal Sugar Cane Zone with a medium to long cropping season followed by a short to medium one*
 m/l - (s/m)

Small, crop potential like LM 2 l-m (s) i but earlier mat. varieties. No Robusta coffee. Stocking rates ~ 15 % less

LM 3 = *Lower Midland Cotton Zone*

LM 3 = *Lower Midland Cotton Zone with a medium to long cropping season followed by a (weak) short one*
 m/l - (s)

Good yield potential

1st rains, start norm. beg. of March: M.mat. maize H 511-512 (~ 60 %), m.mat. sorghum (70-80 %), ratooning sorghum 1st to 2nd r., e.mat. millets (70-80 %); m.mat. beans, green grams, cowpeas; groundnuts and bambarra gr. (both in light soils), simsim²), sweet potatoes; cotton (lower places, ~ 60 %), m.mat. soya beans, tobacco (higher places), sunflower 252 or HS 345; tomatoes, muskmelons, onions; chick peas (esp. on heavy black soils)

2nd rains, start undistinctly end of Au.: Simsim, green grams

Whole year, best pl.time March: Cassava (~ 60 %), sisal. Near swamps with water regulation resp. add. irrigation: Rice, bananas (on dams), Chinese cabbage (on ridges) and other vegetables

Fair yield potential

1st rains: Maize H 622, finger millet (50-60 %); pigeon peas (March-F.)

2nd rains: E.mat. proso millet (O.-N.), dwarf sorghum, e.mat. bulrush millet (bird rejecting awned var. best); e.mat. beans, e.mat. bambarra groundnuts (in light soils); sweet potatoes in swampy places

Whole year: Pawpaws, mangoes, citrus

Pasture and forage

0.7-1.0 ha/LU on mixed savanna; to about 0.18 ha/LU feeding Bana or Napier grass and others; Stylosanthes for pasture improvement

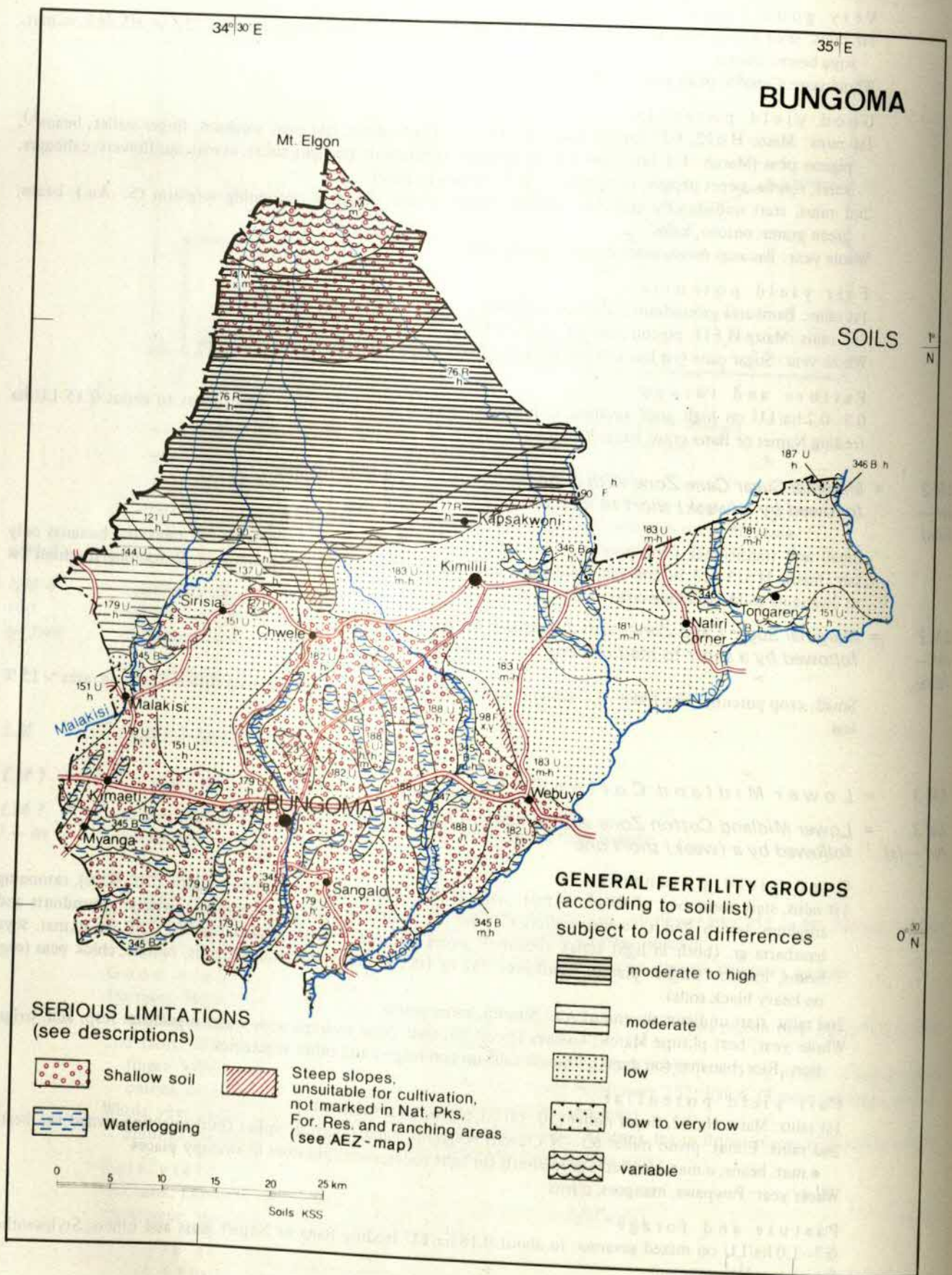
34° 30' E

35° E

BUNGOMA

SOILS

N



SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

The topography of the district ranges from the heights of the Mt. Elgon region to the low areas of the Nzoia river which drains the major part of the area. In the central part around Bungoma the landscape is characterized by a succession of valleys and higher areas. Apart from the Mt. Elgon region, the area is underlain by granites from the Basement system.

On the highest part of the extinct Mt. Elgon volcano, soils rich in organic matter are found (unit 5 M). Downhill, the depth of the horizon rich in organic matter becomes less thick (unit 4 M).

On the volcanic footridges, which make up the lower part of the mountain, fertile soils with a topsoil darkened by organic matter occur (units 76 R and 77 R). Soil units 90 F having a moderate to high fertility and 98 F with a low to very low fertility occupy the following footslope.

On the undulating plains upland soils of units 151 U and 188 U are dominant. Generally speaking, they have good physical properties, but their nutrient level is low. In the southeastern part of the district they are associated with soil unit 179 U which has developed on granites and includes an association of soils with a low fertility and „murram cuirass" soils.

Soils of the valley bottoms have poor workability and are often waterlogged (units 345 B, 346 B, 347 B). They occur around Bungoma and in the northeastern part of the district.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on olivine basalts and ashes of major older volcanoes

- 4 M = well drained, shallow to moderately deep, dark reddish brown, friable, humic, rocky and stony clay loam (nito-humic CAMBISOLS, rocky phase)
x, m¹⁾
- 5 M = imperfectly drained, shallow to moderately deep, dark greyish brown, very friable, acid humic to peaty, loam to clay loam, with rock outcrops and ice in the highest parts (dystric HISTOSOLS, lithic phase; with LITHOSOLS, rock outcrops and ice)
m

SOILS ON HILLS AND MINOR SCARPS

Soils developed on granites

- 23 H = complex of somewhat excessively drained, shallow, stony and rocky soils of varying colour, consistence and texture (dystric REGOSOLS; with ferralic CAMBISOLS, lithic phase and Rock Outcrops)
x, v

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

- 27 H = complex of excessively drained to well drained, shallow, dark red to brown, friable, sandy clay loam to clay; in many places rocky, bouldery and stony and in places with acid humic topsoil (dystric REGOSOLS; with LITHOSOLS, humic CAMBISOLS lithic phase and Rock Outcrops)
x

SOILS ON VOLCANIC FOOTRIDGES

Soils developed on Tertiary basic igneous rocks (basalts, nepheline phonolites; basic tuffs included)

- 76 R = well drained, extremely deep, dark reddish brown to dark brown, friable and slightly smeary clay, with acid humic topsoil (ando-humic NITHOSOLS; with humic ANDOSOLS)
h
- 77 R = well drained, extremely deep, dusky red to dark reddish brown, friable clay, with acid humic topsoil (humic NITOSOLS)
h

SOILS ON FOOTSLOPES

Soils developed on colluvium from basic igneous rocks (serpentinites, basalts, etc.)

- 90 F = well drained, very deep, dark reddish brown, firm, moderately calcareous clay (calcic CAMBISOLS)
h

Soils developed on colluvium from undifferentiated Basement System rocks

- 98 F = complex of well drained, deep to very deep, dark reddish brown to dark yellowish brown soils of varying consistence and texture, in places gravelly and stratified (ferralic ARENOSOLS; with ferralo-chromic, orthic LUVISOLS)
x, v

SOILS ON UPPER MIDDLE-LEVEL UPLANDS

Soils developed on Tertiary or older basic igneous rocks (basalts, nepheline phonolites, etc.; basic tuffs included)

- 121 U = well drained, extremely deep, dark reddish brown, friable clay, with humic topsoil (mollic NITOSOLS)
h

Soils developed on biotite gneisses

- 137 U = well drained, extremely deep, dark reddish brown, friable clay, with thick acid humic topsoil (humic NITOSOLS)
h

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

Soils developed on basic igneous rocks (basalts, etc.)

- 144 U = well drained, very deep, red to dark red, friable to firm, clay; in places moderately deep over petroplinthite (eutric NITOSOLS;
h with rhodic FERRALSOLS, partly petroferic phase)

Soils developed on granites

- 151 U = well drained, deep to very deep, brown to dark brown, friable, sandy clay to clay
h (ferralo-orthic ACRISOLS)

SOILS ON LOWER-LEVEL UPLANDS

Soils developed on granites

- 179 U = complex of: — well drained, moderately deep to very deep, reddish brown to yellowish brown, friable clay, over petroplinthite (orthic FERRALSOLS, partly petroferic phase; with orthic ACRISOLS)
h — moderately well drained, shallow, brown to dark brown soils over petroplinthite (about 30 %) („murram cuirass” soils)

Soils developed on granites and quartz-feldspar gneisses

- 181 U = well drained, deep, strong brown to reddish yellow, very friable, sandy clay loam to sandy clay (orthic FERRALSOLS; with
m-h ferralic CAMBISOLS)

Soils developed on biotite gneisses

- 182 U = association of: — well drained, moderately deep to very deep, red, very friable, sandy clay to clay, over petroplinthite (rhodic
h FERRALSOLS, partly petroferic phase)
— shallow soils over petroplinthite (about 50 %) („murram cuirass” soils)

- 183 U = well drained, very deep, dark red to dark reddish brown, very friable, sandy clay loam to clay
m-h (rhodic FERRALSOLS)

Soils developed on various rocks (Kavirondian sediments, often mudstones)

- 188 U = well drained, moderately deep to very deep, dark red to strong brown, friable clay; in places shallow over petroplinthite (orthic
h to rhodic FERRALSOLS, partly petroferic phase; with „murram cuirass” soils (10–40 %)

SOILS ON BOTTOMLANDS

Soils developed on infill mainly from undifferentiated Basement System rocks

- 345 B = complex of imperfectly drained to poorly drained, very deep, very dark grey to brown, mottled, friable to firm, sandy clay to
h, m clay, often abruptly underlying a topsoil of friable, sandy clay loam; in places saline and sodic (dystric PLANOSOLS; with pellic
VERTISOLS, vertic and humic GLEYSOLS and plinthic ACRISOLS)
- 346 B = complex of imperfectly drained to very poorly drained, very deep, very dark grey to dark greyish brown, mottled, firm clay; in
h places peaty or with acid humic topsoil (dystric GLEYSOLS; with eutric PLANOSOLS and some dystric HISTOSOLS)
- 347 B = poorly drained, very deep, dark greyish brown to black, very firm, slightly calcareous, cracking clay; in many places with a
h saline and sodic deeper subsoil (pellic VERTISOLS, partly saline-sodic phase; with eutric or vertic GLEYSOLS)

1) Soil texture-classes

- h = heavy
l = light
m = medium
x = stony or bouldery
v = varying texture
m-h = medium to heavy
m, h = medium and heavy (e.g. abruptly underlying a topsoil of different texture)

Soil description from Kenya Soil Survey: Exploratory Soil Map and Agro-climatic Zone Map of Kenya, Scale 1:1.000.000 Rep. E1, Nairobi 1982.
See this map also for colours; symbols simplified here.

POPULATION AND LAND

The results of the last Census indicate that 504 000 people lived in the Bungoma District in September 1979 (Table 4). Nearly 75 000 of the above mentioned figure were registered in the three townships of the district. An average rural family of 5.36 people owned approx. 2.86 ha, the total amount of agricultural land was 199 200 ha, i.e. 0.46 ha per person were available (Table 6).

There is less land than that in the better Agro-Ecological Zones of LH 1-2 (Lower Highland Tea-Dairy and Wheat/Maize-Pyrethrum Zone), UM 1-2 (Coffee-Tea and Main Coffee Zone), and LM 1-2 (Lower Midland Sugar Cane and Marginal Sugar Cane Zone). Taking into account that the population growth has been very high and that in all areas mentioned between 30-50 % of the agricultural land has been used as pasture, it becomes clear that agricultural intensification is a must for the future. This is also true for those areas of the district where the present-day situation does not yet seem to be quite so critical.

BUNGOMA DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
South Malakisi	15 198	15 942	31 140	4 542	160	194
North Malakisi	8 021	8 679	16 700	2 667	87	190
Siris Division	23 219	24 621	47 840	7 209	248	192
West Bukusu	29 575	32 298	61 873	10 364	350	176
East Bukusu	39 552	41 501	81 053	12 442	418	193
Bungoma Township	12 727	12 434	25 161	5 262	56	442
Kandayi Division	81 854	86 233	168 087	28 068	825	203
Kimilili	23 751	24 682	48 433	7 308	178	271
Ndirisi	20 249	21 492	41 741	6 311	205	203
Bokori	24 888	26 425	51 313	7 336	218	235
Webuye Township	9 104	8 859	17 963	3 960	56	315
Mt. Elgon Forest	505	422	927	269	610	1
Kimilili Division	78 497	81 880	160 377	25 184	1 268	126
Cheprais	14 010	14 243	28 253	4 129	101	277
Elgon	24 885	25 035	49 920	8 091	252	197
Elgon Division	38 895	39 278	78 173	12 220	354	220
Naitipi	13 682	13 970	27 652	3 288	194	142
Ndalu	10 694	11 112	21 806	3 002	184	118
Tongaren Division	24 376	25 082	49 458	6 290	378	130
Bungoma District	246 841	257 094	503 935	78 971	3 074	163

BUNGOMA DISTRICT

TABLE 5: COMPOSITION OF HOUSEHOLDS
PER
LOCATION AND DIVISION^{a)}

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Persons per Household total ^{b)}
		Adults >15 years	Children < 15 years	Other Relatives		
Location:						
South Malakisi	4524	3.71	1.89	0.93	0.31	6.84
North Malakisi	2662	3.51	1.58	0.98	0.19	6.27
Division Sinsia	7186	3.65	1.76	0.95	0.27	6.63
Location:						
West Bukusu	10406	3.45	1.64	0.66	0.19	5.94
East Bukusu	12411	3.59	1.85	0.71	0.35	6.50
Bungoma Township	5188	2.70	1.02	0.62	0.30	4.65
Division Kanduyi	28005	3.38	1.62	0.67	0.28	5.95
Location:						
Kimilili	7350	3.50	1.85	1.08	0.16	6.58
Ndirisi	6289	3.56	1.98	0.88	0.19	6.62
Bokoli	7308	3.70	2.01	1.10	0.17	6.98
Webuye Township	3966	2.74	1.02	0.51	0.25	4.53
Mt. Elgon Forest	268	2.35	0.78	0.19	0.08	3.46
Division Kimilili	25181	3.47	1.76	0.94	0.18	6.35
Location:						
Cheptais	4146	3.79	1.83	0.91	0.28	6.81
Elgon	8085	3.41	1.74	0.81	0.22	6.17
Division Elgon	12231	3.55	1.76	0.84	0.24	6.39
Location:						
Nawiri	3284	4.22	2.79	1.21	0.20	8.42
Ndalū	2994	3.98	2.16	0.90	0.24	7.28
Division Tangarar	6278	4.00	2.59	1.06	0.22	7.87
DISTRICT: BUNGOMA	78881	3.52	1.77	0.84	0.24	6.36

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, includes one and two persons per households as well

BUNGOMA DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION
AND PER
HOUSEHOLD AND PERSON

	in '00 ha = sqkm					in '00 ha = sqkm										in ha	
Location/Division without townships	Area total	Non-agricultural land			Agri- cultural land	Area in agro-ecological zones										Agric. land	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home- steads, rivers...)		A E Z										per	
						LH 1	LH 2	UM 1	UM 2	UM 3	UM 4	LM 1	LM 2	LM 3	household	person	
	Census 79																
South Malakisi	160	1		24	135			28	15				49	43	2.97	0.43	
North Malakisi	87	1		13	73			1					67	5	2.74	0.44	
Sirisia Division	247	2		37	208			29	15				116	48	2.85	0.44	
West Bukusu	350			53	297							43	66	188	2.86	0.48	
East Bukusu	418	3		66	349				7	53		111	136	42	2.81	0.43	
Kanduyi Division	768	3		119	646				7	53		154	202	230	2.84	0.45	
Kimilili	178			27	151			22	120	6			3		2.39	0.36	
Ndirisi	205	1		31	173				6	79	21	2	63	2	3.25	0.49	
Bokoli	218	10		33	175			36	49	9			81		2.39	0.34	
Kimilili Division	601	11		91	499			58	175	94	21	2	147	2	2.67	0.40	
Cheprais	101			12	89	24		64					1		2.16	0.32	
Elgon	252	5		38	209	111	52	29	17						2.58	0.42	
Elgon Division	353	5		50	298	135	52	93	17				1		2.37	0.37	
Nawiri	194			19	175				7	95	73				5.32	0.63	
Ndalu	184			18	166					36	130				5.52	0.76	
Tongaren Division	378			37	341				7	131	203				5.42	0.69	
Total rural area	2 347	21		334	1 992	135	52	180	221	278	224	156	466	280	2.86	0.46	

For official land statistics see supplementary publication to
FM-Handbook, Vol. III A: Agriculture Land Statistics.

AGRICULTURAL STATISTICS¹⁾

The district is one of the most fertile regions of Kenya. The combination of good soils and high, well distributed precipitation makes it particularly suitable for small-scale farming.

Coffee is planted on approximately 2,500 ha yielding approximately 200–400 kg of clean coffee per ha, but there is still considerable potential for yield increases. Pyrethrum production is limited by its high labour demand and therefore not very suitable for the relatively large farms of the area. It is estimated that roughly 7,000 ha of cotton is planted annually, yielding between 300 and 500 kg of seed cotton per ha. The ginnery at Malakisi gins 3,000 t of seed cotton p.a. of which two-thirds is probably produced within the district.

BUNGOMA DISTRICT

TABLE 7 a: COFFEE
AREA – PRODUCTION – YIELDS^{a)}

Co-operatives

Item	Unit	Year					
		74/75	75/76	76/77	77/78	78/79	79/80
Area	ha	2186	2186	2186	2186	3500	2543
Production	t	636	566	868	532	910	1031
Yield	kg/ha	291	259	397	243	260	405

TABLE 7 b: PYRETHRUM^{b)}
TRENDS IN PRODUCTION AND QUALITY

Item	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Production in t dried flowers	21	14	5	5	3.7
Pyrethrin content %	1.4	1.3	1.4	1.2	1.2

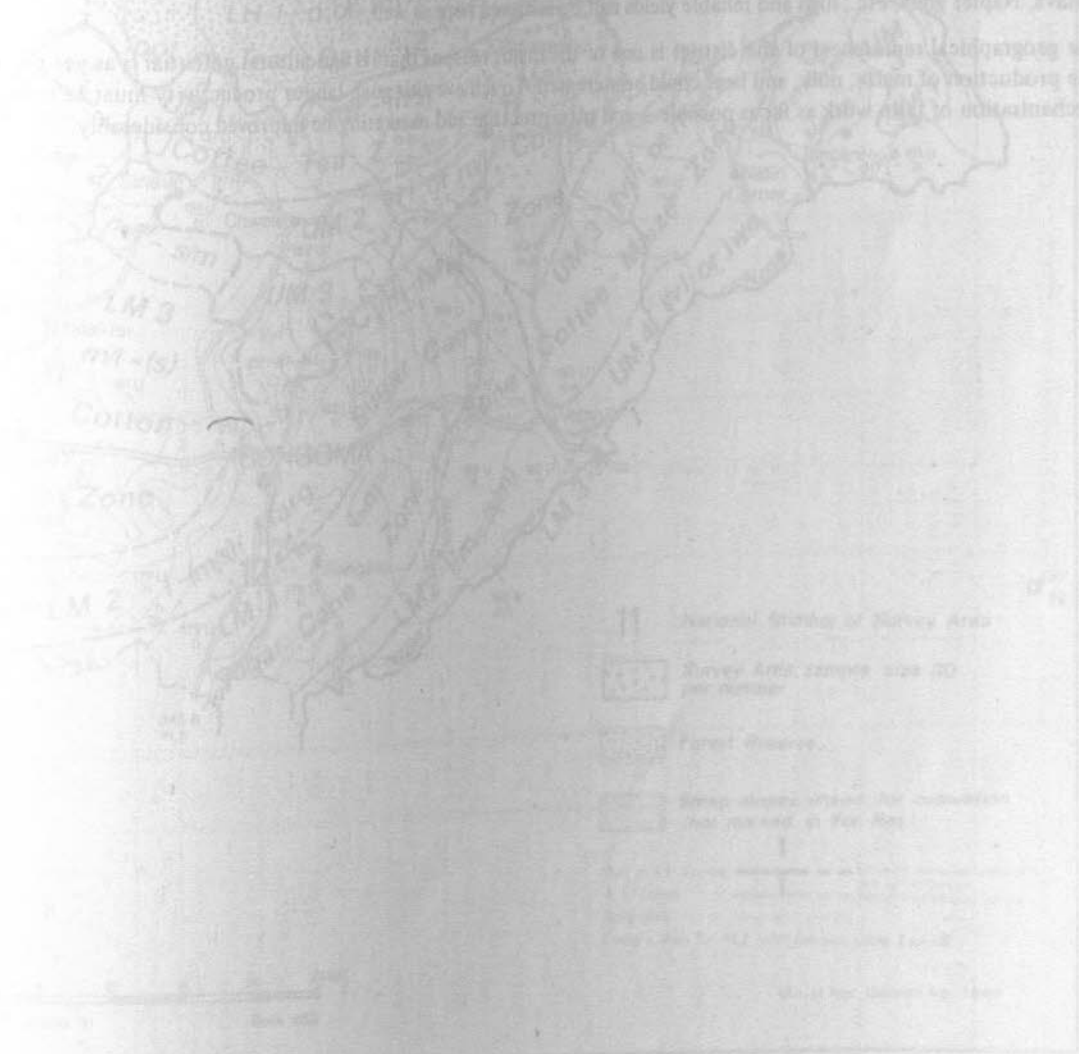
1) Fairly exact statistics exist for the industrial crops only; for more detailed and up to date information see FMHB Vol. III A

BUNGOM DISTRICT

TABLE 7 c: COTTON PRODUCTION^{c)}

Ginnery Zone	Year				
	1975/76	1976/77	1977/78	1978/79	1979/80
Malakisi					
Seed Cotton in t	2298	2771	3185	3042	3643
Bales	4032	4863	5589	5338	6392

Sources: a) C.B.K.
b) Pyrethrum Board
c) C.L. & S.M.B., does not refer to district area only



SMALL FARM SURVEY 1)

The SFS was carried out in only two areas of the district (LH 1-2 - UM 1-2 and LM 1-2). The size of the farms included in the survey is comparatively big (6-7 ha), particularly when comparing this with the overall farm size in the district of 2.86 ha. The high proportion of pasture and fallow land (60 %) indicates that there is still a labour shortage; the stocking rate of 1.5-2.0 LU/ha reflects the high potential of the region; 5-10 % of the cattle are improved dairy stock. The farmers grow approximately one crop p.a. and use comparatively large amounts of fertilizer (table 8, 9). Between 55 % and 80 % of the total annual crop area is planted with maize; the large sunflower and sugar cane area found in the investigated farms is higher than average (table 10). Between 7-9 % of the grazing livestock units are goats and sheep and 45 % of the total cattle population are male (table 11). The high maize yields show that the farmers are well informed on production techniques and also reflect the high natural fertility of the soils (table 12). About 25 % of the maize produced is exported from the district (table 13). The graph 14 indicates that most farmers plant and cultivate their maize crop at the recommended time of the year, but sunflower and beans receive less attention. The output and nutrient input table (15) reflects the enormous agricultural potential of AEZ LH and UM. The soils of the Lower Midlands (LM) are less fertile, but by selecting suitable crops like sweet potatoes, cassava, Napier grass, etc., high and reliable yields can be achieved here as well.²⁾

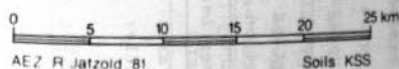
The geographical remoteness of the district is one of the major reasons that its agricultural potential is as yet not fully tapped. The production of maize, milk, and beef could be increased. To achieve this goal, labour productivity must be increased through mechanisation of farm work as far as possible - and infrastructure and marketing be improved considerably.

1) For more detailed and up to date information, see FMHB Vol. III/B

2) See also notes on farm management information, output and nutrient input, page 51

35° E

SMALL FARM SURVEY AREAS (1977) and AGRO-ECOLOGICAL ZONES + SOILS



BUNGOMA DISTRICT

AEZ: LH 1-2 - UM 1-2

TABLE 8 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	2.7	5.7	16.2	Farming Intensity:	-	0.6	0.6	0.3
Land Use:									
Annual Crops ¹⁾									
First Season									
Maize & Beans	ha	1.0	2.3	2.5	Cropping Intensity	-	0.6	0.6	0.3
Maize	ha	0.3	0.1	1.5	Portion of improved cattle kept	%	10%	4%	11%
Beans	ha	-	-	0.4	Portion of Farmers owning a Plough	%	80%	90%	100%
Sunflower	ha	-	0.2	0.1					
Others	ha	0.1	0.1	-					
Total	ha	1.4	2.7	4.5					
Second Season ¹⁾									
Beans	ha	-	0.1	-	Labour on Farm:	persons	2.8	3.2	3.6
Cassava	ha	-	0.1	-	Family Adults	"	0.1	0.3	1.4
Total	ha	-	0.1	-	Perm. Hired Labour	"	2.8	2.8	5.8
Permanent Crops ¹⁾					Children > 14 years				
Pyrethrum	ha	0.1	-	0.2	Persons living on Farm ²⁾	persons	2.60	0.23	2.83
Coffee	ha	0.2	0.2	0.2	- average household size -		3.41	-	3.41
Bananas	ha	-	0.2	0.2	Adults > 14 years	"	4.64	0.23	4.87
portion of total	%	11%	7%	4%	Children < 14 years	SU			
Grazing & Forage	ha	0.9	2.0	8.8	Subsistence Units				
Portion of total	%	33%	35%	54%					
Other Land Use	ha	0.3	0.4	2.3	Home Consumption of Major Food produced on Farm				
Livestock on Farm:									
Cattle: local	LU	3.6	4.7	9.5	Maize	kg	1106	1784	
improved	LU	0.4	0.2	1.2	Beans	kg	346	550	
Sheep & Goats	LU	0.3	0.3	0.9	Fingermillet	kg	14	22	
Total	LU	4.3	5.2	11.6	Cabbage	kg	28	3	
					Cooking Bananas	kg	16	6	

Other Crops cultivated: cabbage, fingermillet, passion fruit, cassava

1) Major crops only considered

2) Based on 1979 Census figures

BUNGOMA DISTRICT

TABLE 9 a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: LH 1-2 - UM 1-2

Survey Area 11

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	7.3	16.5	2.0	3.1	0.5	3.6
Avg. 1	7.3	16.5	2.2	3.1	1.9	4.7
Up. Qu.	10.0	20.0	2.0	4.0	1.0	5.0
Lo. Qu.	3.0	7.0	1.0	2.0	-	1.0

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	2.6	36	0.4	5	3.4	47	-	-	0.4	6	0.4	5
Avg. 1	2.6	33	0.4	5	3.4	42	0.2	2	1.0	13	0.4	5
Up. Qu.	3.6	55	0.6	11	3.4	51	-	-	0.8	10	0.2	5
Lo. Qu.	1.2	27	0.1	2	0.8	26	-	-	-	-	0.1	1
Total	78.6		11.8		100.8		0.2		13.4		11.8	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.9	0.9	2.0	8.5
Avg. 1			2.0	58.9
Up. Qu.	1.0	1.5	4.7	-
Lo. Qu.	0.8	0.7	2.1	-

Inputs Applied

Inputs Applied															
Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha								Manure Applied t/ha		Plant Protection			
		N		P2O5		K2O		Insecticide kg/ha				Fungicide kg/ha			
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC		
Avg. 0	61.0	7.4	0.8	11.6	-	0.7	-	-	-	0.2	0.1	-	0.3		
Avg. 1	65.1	12.9	3.2	17.7	0.1	2.2	0.3	1.0	-	1.0	0.2	-	0.6		
Up. Qu.	100.0	12.5	-	17.8	-	-	-	-	-	0.2	-	-	0.5		
Lo. Qu.	85.7	-	-	-	-	-	-	-	-	-	-	-	-		

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of farms, excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

BUTOMA DISTRICT

TABLE 9 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AELM 1-2

Survey Area 12

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	6.0	13.0	1.0	2.8	-	2.4
Avg. 1	6.0	15.0	1.6	2.9	1.0	3.2
Up. Qu.	8.4	21.0	1.0	4.0	-	3.0
Lo. Qu.	2.8	5.0	-	2.0	-	1.0

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	1.7	29	0.4	8	2.9	50	-	-	0.4	7	0.3	6
Avg. 1	1.7	25	0.8	11	3.0	44	0.2	3	0.8	12	0.3	5
Up. Qu.	2.4	50	0.8	13	4.2	62	-	-	0.8	12	0.4	8
Lo. Qu.	0.8	18	-	-	0.8	32	-	-	-	-	0.1	2
Total	51.1		13.3		88.1		0.5		12.2		10.1	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.0	0.8	1.6	5.3
Avg. 1			1.6	81.2
Up. Qu.	1.3	1.3	2.8	-
Lo. Qu.	0.8	0.5	0.7	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O		AC	PC	Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC			AC	PC	AC	PC
Avg. 0	74.8	0.3	-	2.3	-	-	-	0.1	-	-	-	-	-
Avg. 1	75.9	3.3	-	9.6	-	-	-	0.4	0.2	0.2	-	-	-
Up. Qu.	93.2	-	-	-	-	-	-	0.1	-	-	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of farms, excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

BUNGOMA DISTRICT

TABLE 10 a: CROPPING PATTERN

AEZ: LH 1-2 - UM 1-2

Survey Area 11

First Rains Annual & Semipermanent Crops						
Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	1.1	3.1	1.60	0.00	34.0	41.6
Maize IPC	0.0	0.4	0.00	0.00	0.4	0.5
Fingermillet	0.0	0.3	0.00	0.00	0.5	0.6
Beans	0.2	0.7	0.28	0.00	5.2	6.4
Beans IPC	0.0	0.2	0.00	0.00	0.2	0.3
Sunflower	0.1	0.8	0.00	0.00	1.6	2.0
Cabbage	0.0	0.1	0.00	0.00	0.2	0.3
Cassava	0.0	0.1	0.00	0.00	0.1	0.1
Pyrethrum	0.1	0.3	0.20	0.00	2.9	3.6
Passionfruit	0.0	0.1	0.00	0.00	0.1	0.1
Maize & Beans	1.2	1.9	2.00	0.00	36.4	44.5
Total					81.8	100.0

Second Rains Annual & Semipermanent Crops						
Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Beans	0.0	0.7	0.00	0.00	1.4	29.2
Beans IPC	0.0	0.2	0.00	0.00	0.2	5.0
Cassava	0.0	0.1	0.00	0.00	0.1	2.5
Pyrethrum	0.1	0.3	0.20	0.00	2.9	60.8
Passionfruit	0.0	0.1	0.00	0.00	0.1	2.5
Total					4.8	100.0

Permanent Crops						
Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sweet Bananas	0.1	0.6	0.00	0.00	1.9	22.2
Cookng Bananas	0.1	0.4	0.00	0.00	1.7	19.9
Coffee	0.2	0.2	0.28	0.00	5.0	57.9
Total					8.6	100.0

Avg 0 = average of all sample farms

Avg 1 = average of all farms excluding zero entries

Up.Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points

% columns = % of total farm land

BU GOMA DISTRICT

TABLE 10 b: CROPPING PATTERN

AL : LM 1-2

Survey Area 12

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.9	1.1	1.20	0.00	26.2	42.4
Sorghum	0.0	0.2	0.00	0.00	0.6	1.0
Ingemillet	0.1	0.3	0.20	0.00	2.7	4.4
Beans	0.1	0.3	0.12	0.00	2.2	3.5
Groundnuts	0.0	0.4	0.00	0.00	0.4	0.6
Sunflower	0.3	0.8	0.52	0.00	8.0	13.0
Engl. Potatoes	0.0	0.3	0.00	0.00	0.3	0.5
Cabbage	0.0	0.2	0.00	0.00	0.3	0.5
Cassava	0.2	0.5	0.20	0.00	5.9	9.6
Sweet Potatoes	0.0	0.2	0.00	0.00	1.2	1.9
Sugarcane	0.1	1.5	0.00	0.00	4.4	7.1
Pyrethrum	0.0	0.4	0.00	0.00	0.4	0.6
Maize & Beans	0.3	1.2	0.40	0.00	9.2	14.9
Total					61.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sorghum	0.0	0.1	0.00	0.00	0.1	0.6
Beans	0.0	0.2	0.00	0.00	0.5	2.4
Sunflower	0.3	0.9	0.40	0.00	9.5	43.7
Cassava	0.2	0.5	0.20	0.00	5.9	27.2
Sweet Potatoes	0.0	0.2	0.00	0.00	0.5	2.4
Sugarcane	0.1	1.5	0.00	0.00	4.4	20.2
Pyrethrum	0.0	0.4	0.00	0.00	0.4	1.8
Others	0.0	0.4	0.00	0.00	0.4	1.8
Total					21.8	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cooking Bananas	0.1	0.3	0.12	0.00	2.6	100.0
Total					2.6	100.0

Avg 0 = average of all sample farms

Avg 1 = average of all farms excluding zero entries

Up.Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points

% columns = % of total farm land

BUNGOMA DISTRICT

AEZ: LH 1-2 - UM 1-2
TABLE 11 a: HERD COMPOSITION (GRAZING LIVESTOCK)
- in Head and Livestock Units -

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		0.07	-	-	0.13	-	-	-	0.05	-	-	0.05
1 - 2 years, Average		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	-	-	0.03	-	-	-	0.02	-	-	0.02
Subtotal(improved) Total		0.03	-	0.17	-	0.33	-	-	0.42	-	-	0.42
Average		3	-	5	5	10	-	-	16.8	-	-	16.3
Upper Qu.		0.10	-	0.17	0.17	0.33	-	-	0.53	-	-	0.56
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 31.5 % of total cattle,		Calves + Heifers = 50.0 % of dairy cows										
Unimproved Livestock:												
Under 1 year, Average		0.47	-	0.20	1.03	-	0.30	0.30	0.50	-	-	0.50
1 - 2 years, Average		-	-	-	2	-	1	1	0.6	-	-	0.6
Over 2 years, Average		0.27	0.17	0.50	1.47	-	-	-	1.03	-	-	1.03
Subtotal (unimp.) Total		0.20	0.10	2.33	2	3.60	1.90	1.33	0.9	0.47	15.73	0.9
Average		31	8	91	75	103	81	64	130.6	14	472	132.7
Upper Qu.		1.03	0.27	3.03	2.50	3.60	2.70	2.13	6.02	0.47	15.73	6.09
Lower Qu.		1	-	4	3	4	3	3	7.0	-	19	7.0
LU Male Cattle = 42.1 % of total cattle,		Calves + Heifers = 69.4 % of dairy cows										
LU Goats + Sheep = 8.0 % of total Grazing Livestock Units												
Improved + Unimproved												
Grazing L/Stock		34	8	96	80	113	81	64	197.4	14	472	199.5
Average		1.13	0.27	3.20	2.67	3.93	2.70	2.13	6.53	0.47	15.73	6.55
Upper Qu.		1	-	4	3	4	3	3	7.0	-	19	7.0
Lower Qu.		-	-	1	1	2	-	-	2.1	-	7	2.6
LU Male Cattle = 41.1 % of total cattle,		Calves + Heifers = 67.3 % of dairy cows										
LU Goats + Sheep = 7.3 % of total Grazing Livestock Units												

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

Nov. '77, Survey Area 11

BUNGOMA DISTRICT

AEZ: LM 1-2

TABLE 11 b: HERD COMPOSITION (GRAZING LIVESTOCK)

- in Head and Livestock Units -

Nov. '77, Survey Area 12

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		0.10	-	-	0.07	-	-	-	0.04	-	-	0.04
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average		-	-	-	0.10	-	-	-	0.05	-	-	0.05
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	-	-	-	0.17	-	-	0.17	-	-	0.17
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total		3	-	-	5	5	-	-	7.8	-	-	7.8
Average		0.10	-	-	0.17	0.17	-	-	0.26	-	-	0.26
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 2.7 % of total cattle,		Calves + Heifers = 100.0 % of dairy cows										
Unimproved Livestock:												
Under 1 year, Average		0.23	-	-	0.23	-	0.37	1.20	0.53	-	-	0.53
Upper Qu.		-	-	-	1	-	-	1	0.3	-	-	0.3
1 - 2 years, Average		0.47	0.17	0.23	0.83	-	-	-	0.76	-	-	0.76
Upper Qu.		-	-	-	1	-	-	-	0.5	-	-	0.5
Over 2 years, Average		0.13	0.17	1.90	-	2.43	0.83	1.97	3.29	-	14.13	3.29
Upper Qu.		-	-	4	-	3	1	2	0.7	-	4	0.7
Subtotal (unimp.) Total		46	10	64	53	73	36	95	137.6	-	424	137.6
Average		1.53	0.23	2.13	1.77	2.43	1.20	3.17	4.59	-	14.13	4.59
Upper Qu.		1	-	4	3	3	1	3	6.9	-	18	6.9
Lower Qu.		-	-	-	-	1	-	-	1.8	-	4	1.8
LU Male Cattle = 43.4 % of total cattle,		Calves + Heifers = 72.6 % of dairy cows										
LU Goats + Sheep = 9.5 % of total Grazing Livestock Units												
Improved + Unimproved												
Grazing L/Stock Total		49	10	64	58	78	36	95	145.4	-	424	145.4
Average		1.63	0.23	2.13	1.93	2.60	1.20	3.17	4.84	-	14.13	4.84
Upper Qu.		1	-	4	3	5	1	3	6.9	-	18	6.9
Lower Qu.		-	-	-	-	1	-	-	1.3	-	4	1.3
LU Male Cattle = 46.1 % of total cattle,		Calves + Heifers = 74.4 % of dairy cows										
LU Goats + Sheep = 9.0 % of total Grazing Livestock Units												

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

BUNGOMA DISTRICT

TABLE 12 a: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LH 1-2

Survey Area 11

Crop		Imp- roved Seeds %	Inputs						Yield kg/ha
			N kg/ha	Nutrients			Chemicals		
				P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	100	8	34	-	-	1	-	4,111
	UpQu	100	11	46	-	-	-	-	3,750
	LoQu	100	-	-	-	-	-	-	2,813
Maize & Beans									
Maize	Avg.	95	34	23	5	0.04	1	-	3,268
Beans	Avg.	-	4	3	1	0.04	-	-	525
Maize	UpQu	100	31	58	4	-	2	-	4,500
Beans	UpQu	-	-	-	-	-	-	-	563
Maize	LoQu	100	-	-	-	-	-	-	2,500
Beans	LoQu	-	-	-	-	-	-	-	150
<u>Second Rains</u>									
Beans	Avg.	-	-	17	-	-	-	-	304
	UpQu	-	-	25	-	-	-	-	450
	LoQu	-	-	-	-	-	-	-	13
Cabbage	Avg.	100	-	23	-	-	67	67	2,000
<u>Perennial Crops</u>									
Pyrethrum	Avg.	-	-	-	-	-	3	-	584
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	120
Cookng Bananas	Avg.	-	-	-	-	-	-	-	3,600
	UpQu	-	-	-	-	-	-	-	4,000
	LoQu	-	-	-	-	-	-	-	750
Coffee	Avg.	-	56	-	1	0.25	3	15	3,586
	UpQu	-	46	-	-	-	3	25	5,000
	LoQu	-	-	-	-	-	-	-	1,786

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TABLE 12 b: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LM 1-2

Survey Area 12

Crop			Inputs						Yield	
			Imp- roved Seeds %	Nutrients				Chemicals		
				N kg/ha	K ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha		Fung- icide kg/ha
<u>First Rains</u>										
Maize	Avg.	95	3	12	-	0.46	-	-	2,307	
	UpQu	100	-	-	-	-	-	-	3,375	
	LoQu	100	-	-	-	-	-	-	1,575	
Beans	Avg.	-	-	-	-	-	-	-	706	
	UpQu	-	-	-	-	-	-	-	800	
	LoQu	-	-	-	-	-	-	-	200	
Sunflower	Avg.	100	-	-	-	-	-	-	876	
	UpQu	100	-	-	-	-	-	-	865	
	LoQu	100	-	-	-	-	-	-	500	
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	5,490	
	UpQu	-	-	-	-	-	-	-	6,000	
	LoQu	-	-	-	-	-	-	-	1,500	
Maize & Beans										
	Maize Avg.	88	-	14	-	0.14	-	-	2,527	
	Beans Avg.	13	-	2	-	0.65	-	-	264	
	Maize UpQu	100	-	-	-	0.19	-	-	2,700	
	Beans UpQu	-	-	-	-	-	-	-	400	
	Maize LoQu	100	-	-	-	-	-	-	1,800	
	Beans LoQu	-	-	-	-	-	-	-	120	
<u>Second Rains</u>										
Sunflower	Avg.	100	-	-	-	0.11	-	-	744	
	UpQu	100	-	-	-	-	-	-	1,000	
	LoQu	100	-	-	-	-	-	-	350	
<u>Perennial Crops</u>										
Cassava	Avg.	-	-	-	-	-	-	-	8,405	
	UpQu	-	-	-	-	-	-	-	4,875	
	LoQu	-	-	-	-	-	-	-	2,400	
Cookng Bananas	Avg.	-	-	-	-	0.20	-	-	9,605	
	UpQu	-	-	-	-	-	-	-	5,625	
	LoQu	-	-	-	-	-	-	-	2,000	

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TABLE 13 a: DISPOSAL OF CROPS

AEZ: LH 1-2 - UM 1-2

Survey Area 11

Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	154,590	58,400	38	23,370	15	72,820	47
Maize & Beans	125,160	28,350	23	52,580	42	44,230	35
Maize IPC	720	0	0	720	100	0	0
Beans	3,450	400	12	1,940	56	1,110	32
Beans IPC	240	0	0	16	7	224	93
Fingermillet	420	0	0	0	0	420	100
Sunflower	600	0	0	0	0	600	100
Cabbage	1,225	0	0	440	36	785	64
<u>Second Rains</u>							
Beans	602	400	66	40	7	162	27
Beans IPC	80	0	0	48	60	32	40
Cabbage	240	0	0	175	73	65	27
Permanent Crops							
Coffee	600	600	100	0	0	0	0
Pyrethrum	48	48	100	0	0	0	0
Cooking Bananas	480	0	0	0	0	480	100

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TABLE 13 b: DISPOSAL OF CROPS

AEZ: LM 1-2

Survey Area 12

Survey Area

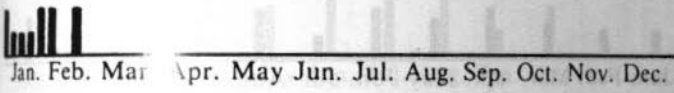
Crop	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	62,710	22,230	35	18,810	30	21,670	35
Maize & Beans	26,710	4,630	17	6,160	23	15,920	60
Beans	1,326	160	12	370	28	796	60
Fingermillet	2,080	0	0	240	12	1,840	88
Sorghum	870	0	0	320	37	550	63
Groundnuts	140	140	100	0	0	0	0
Engl. Potatoes	180	0	0	148	82	32	18
Sweet Potatoes	5,940	0	0	360	6	5,580	94
Sunflower	4,000	4,000	100	0	0	0	0
Cabbage	9,300	0	0	6,700	72	2,600	28
<u>Second Rains</u>							
Beans	225	0	0	0	0	225	100
Sorghum	430	0	0	0	0	430	100
Sweet Potatoes	3,500	0	0	360	10	3,140	90
Sunflower	9,880	9,628	97	0	0	252	3
Permanent Crops							
Nil							

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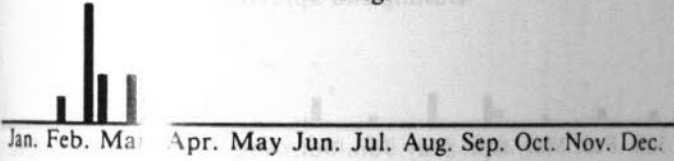
TABLE 14 a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 11
AEZ: LH 1-2 - UM -2 Survey Area 11 Sample Size: 30

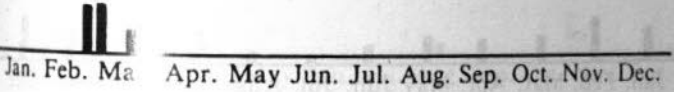
Land Preparation:



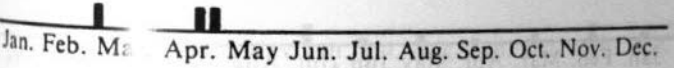
Seeding:



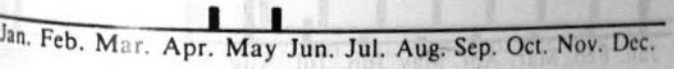
First Fertilizing:



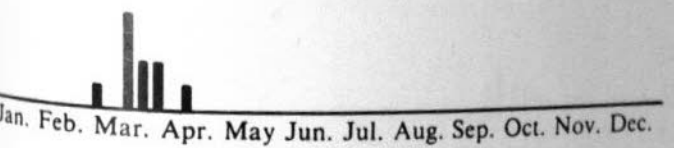
Second Fertilizing:



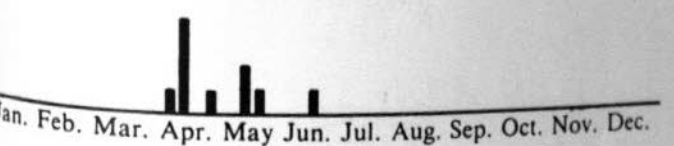
Dusting and Spraying:



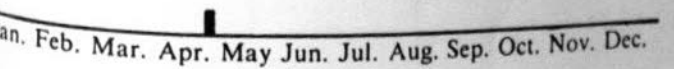
First Weeding:



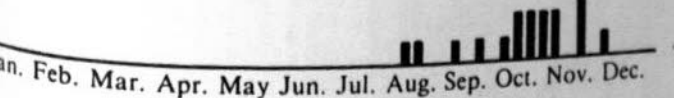
Second Weeding:



Third Weeding:



Harvest:

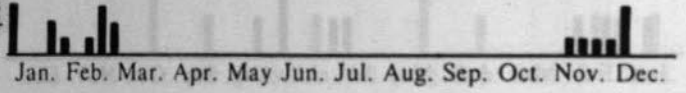


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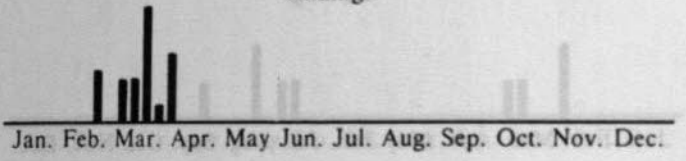
TABLE 14 b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 40¹⁾
AEZ: LH 1-2 - UM 1-2 Survey Area 11 Sample Size: 30

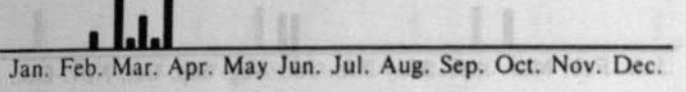
Land Preparation:



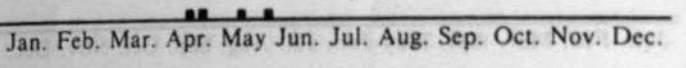
Seeding:



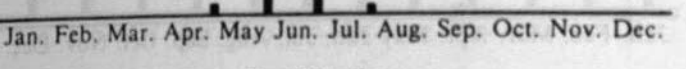
First Fertilizing:



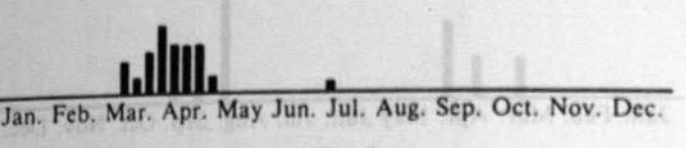
Second Fertilizing:



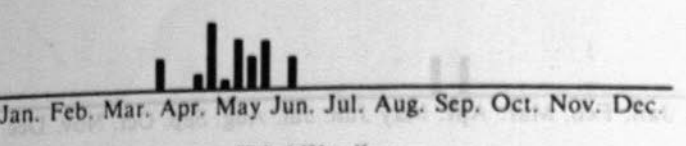
Dusting and Spraying:



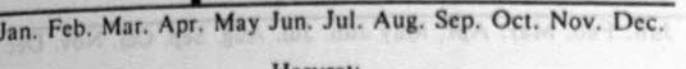
First Weeding:



Second Weeding:



Third Weeding:



Harvest:

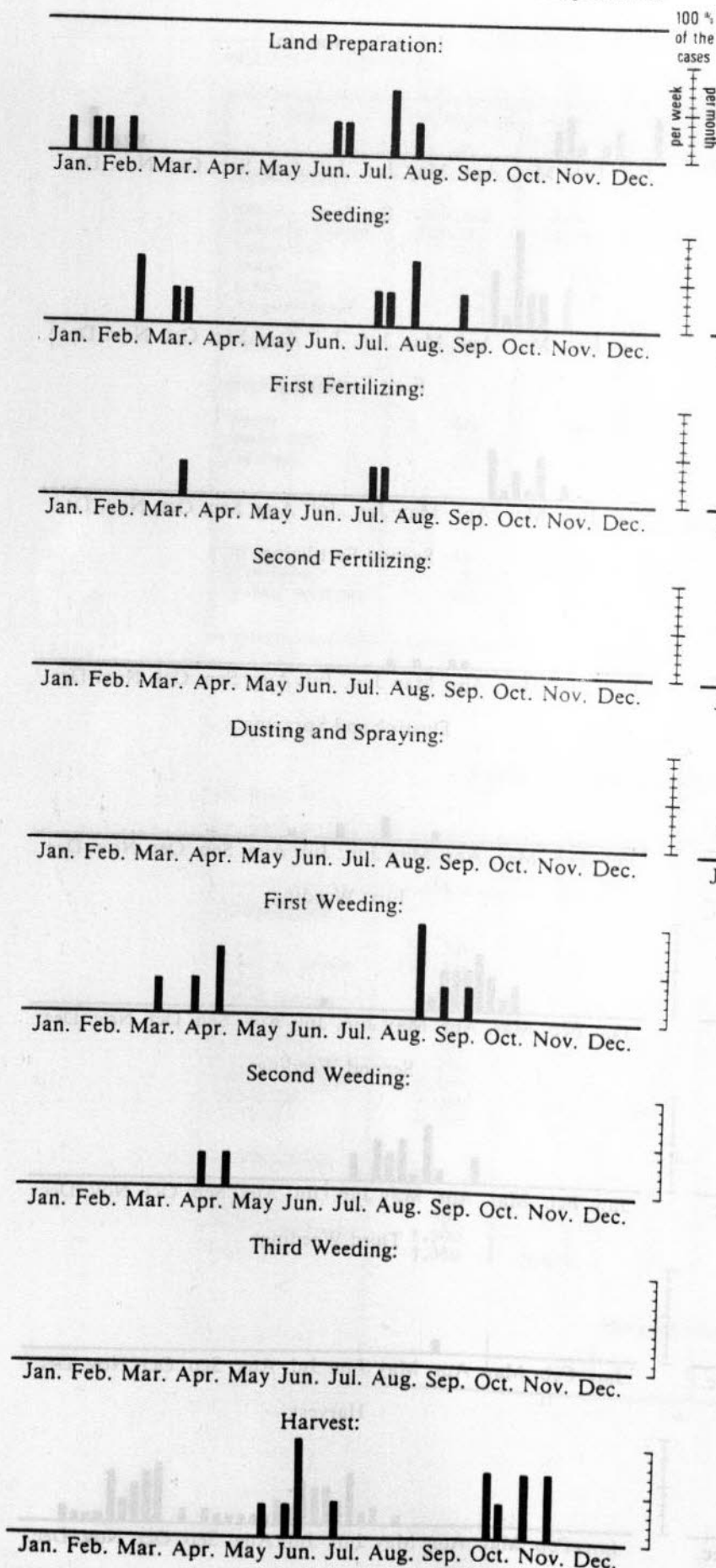


1) Maximum 30 per crop and season

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TABLE 14 c: DISTRIBUTION OF FARMING ACTIVITIES

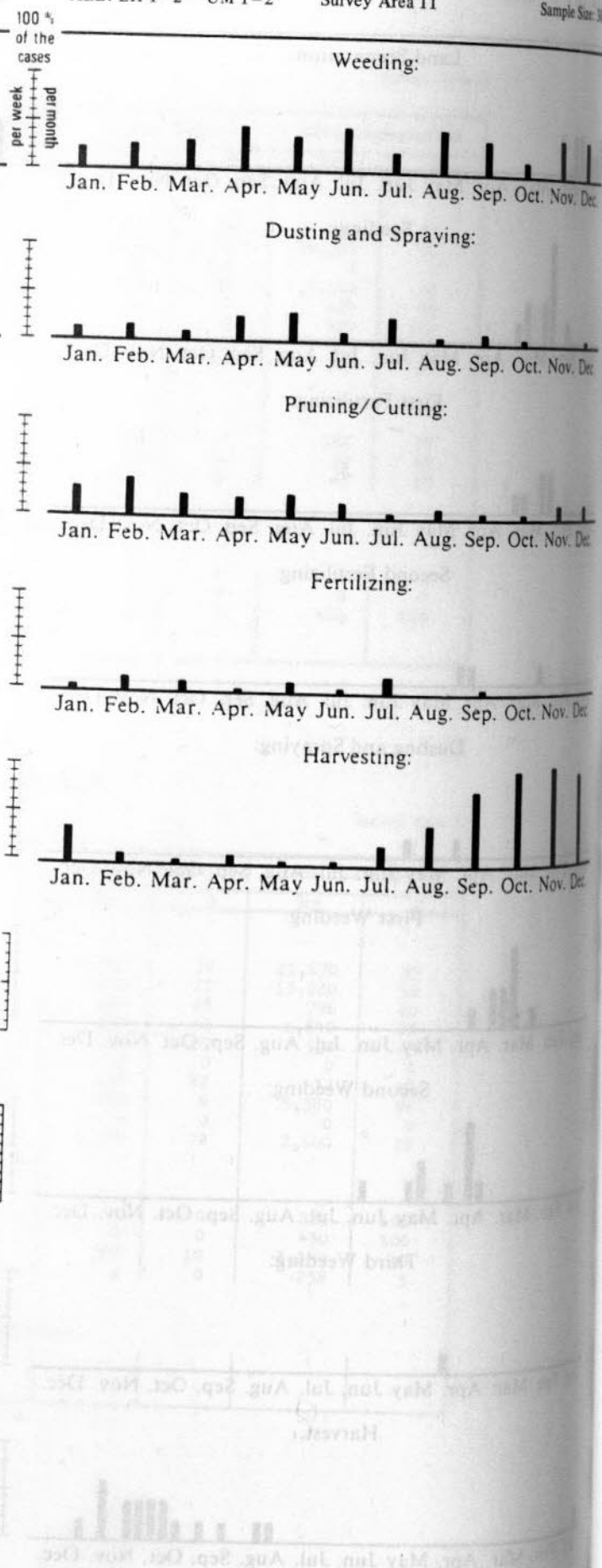
Crop 10 Beans Cases: 9
AEZ: LH 1-2 - UM 1-2 Survey Area 11 Sample Size: 30



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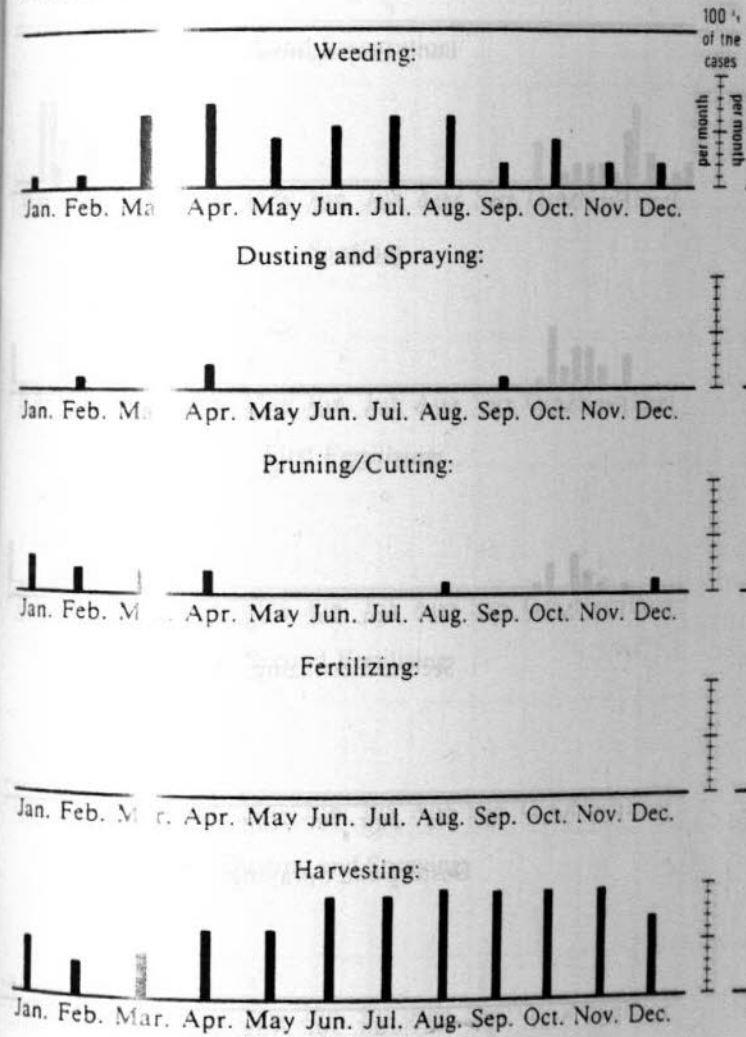
TABLE 14 d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 21
AEZ: LH 1-2 - UM 1-2 Survey Area 11 Sample Size: 30



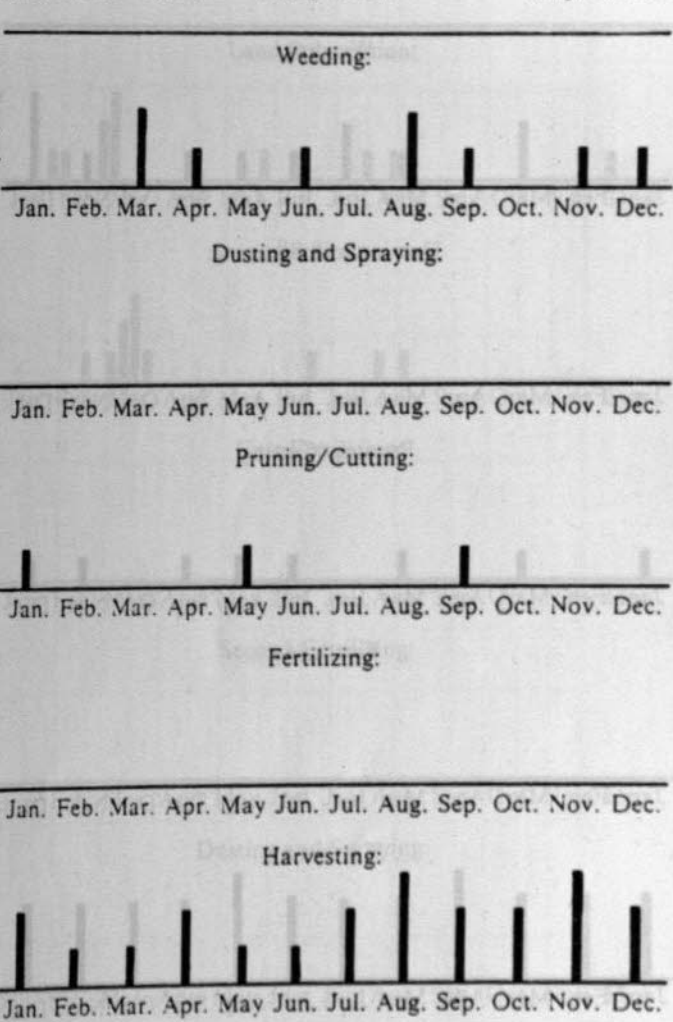
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TABLE 14 e: DISTRIBUTION OF FARMING ACTIVITIES
Crop 52 Pyrethrum Cases: 11
AEZ: LH 1-2 - Survey Area 11 Sample Size: 30



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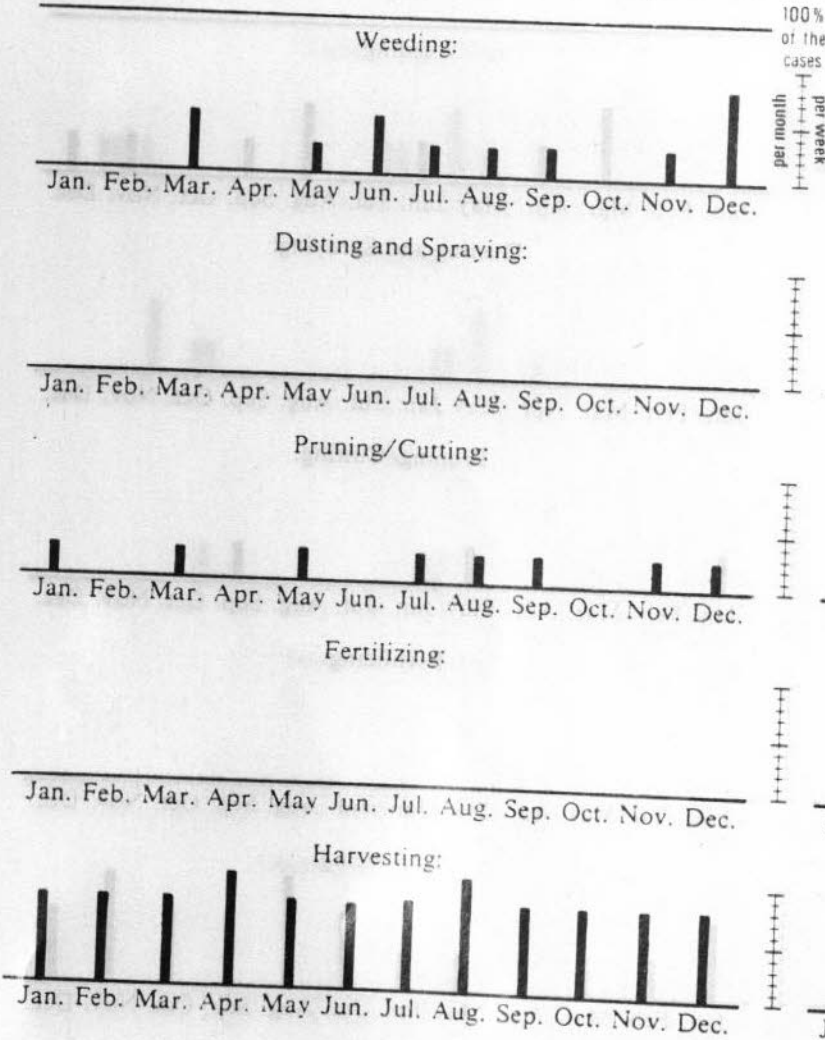
TABLE 14 f: DISTRIBUTION OF FARMING ACTIVITIES
Crop 55 Sweet Bananas Cases: 3
AEZ: LH 1-2 - UM 1-2 Survey Area 11 Sample Size: 30



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TABLE 14 g: DISTRIBUTION OF FARMING ACTIVITIES

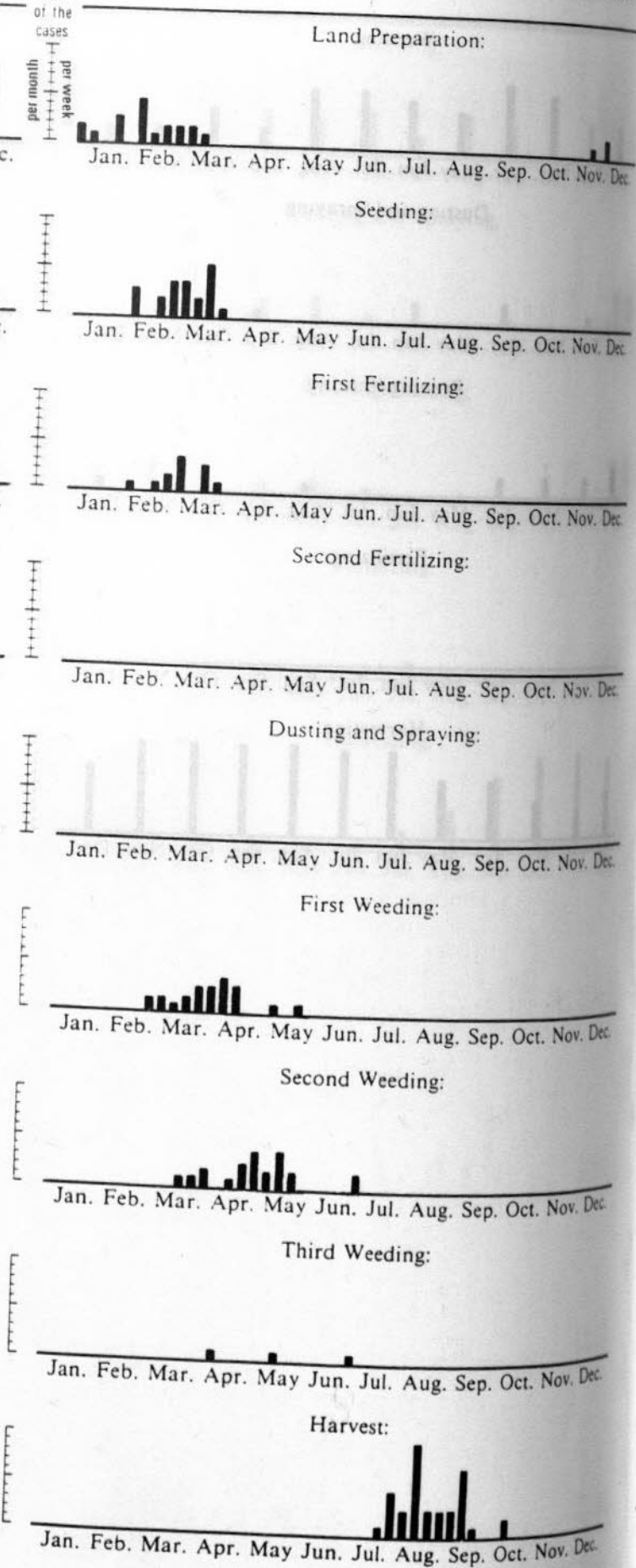
Crop 56 Cooking Bananas Cases: 4
AEZ: LH 1-2 - UM 1-2 Survey Area: 11 Sample Size: 30



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TABLE 14 h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 22
AEZ: LM 1-2 Survey Area 12 Sample Size: 30



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TABLE 14 i: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2

Maize & Beans

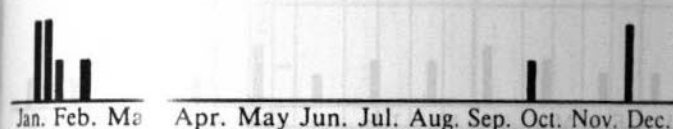
Cases: 18

AEZ: LM 1-2

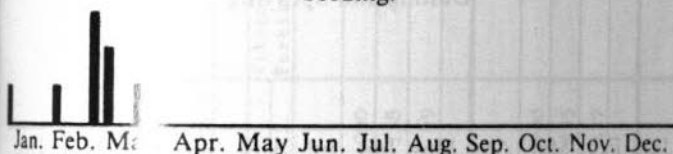
Survey Area 12

Sample Size: 30

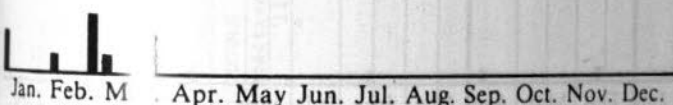
Land Preparation:



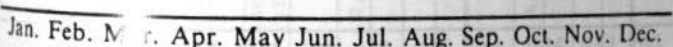
Seeding:



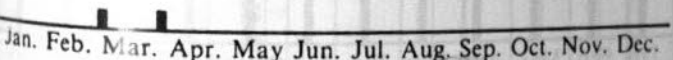
First Fertilizing:



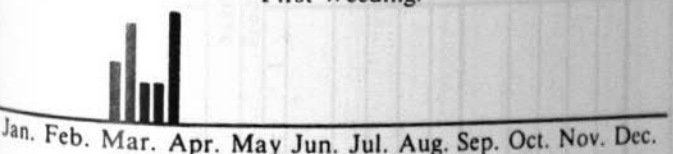
Second Fertilizing:



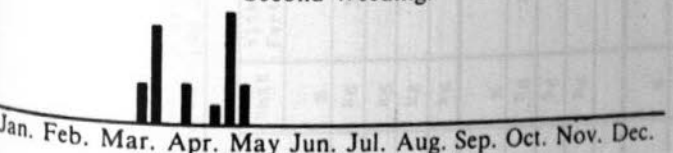
Dusting and Spraying:



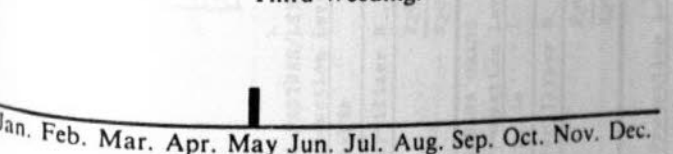
First Weeding:



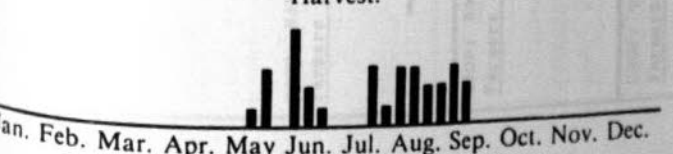
Second Weeding:



Third Weeding:



Harvest:



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TABLE 14 j: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10

Beans

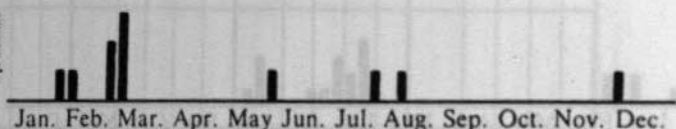
Cases: 11

AEZ: LM 1-2

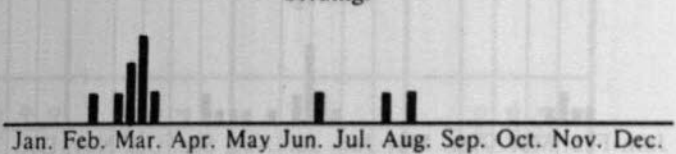
Survey Area 12

Sample Size: 30

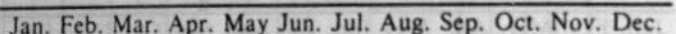
Land Preparation:



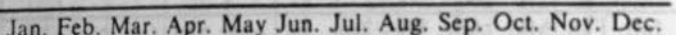
Seeding:



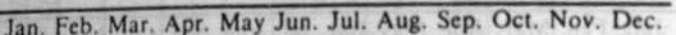
First Fertilizing:



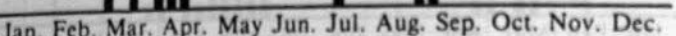
Second Fertilizing:



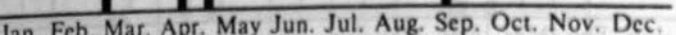
Dusting and Spraying:



First Weeding:



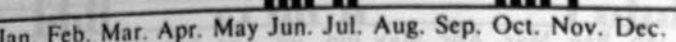
Second Weeding:



Third Weeding:



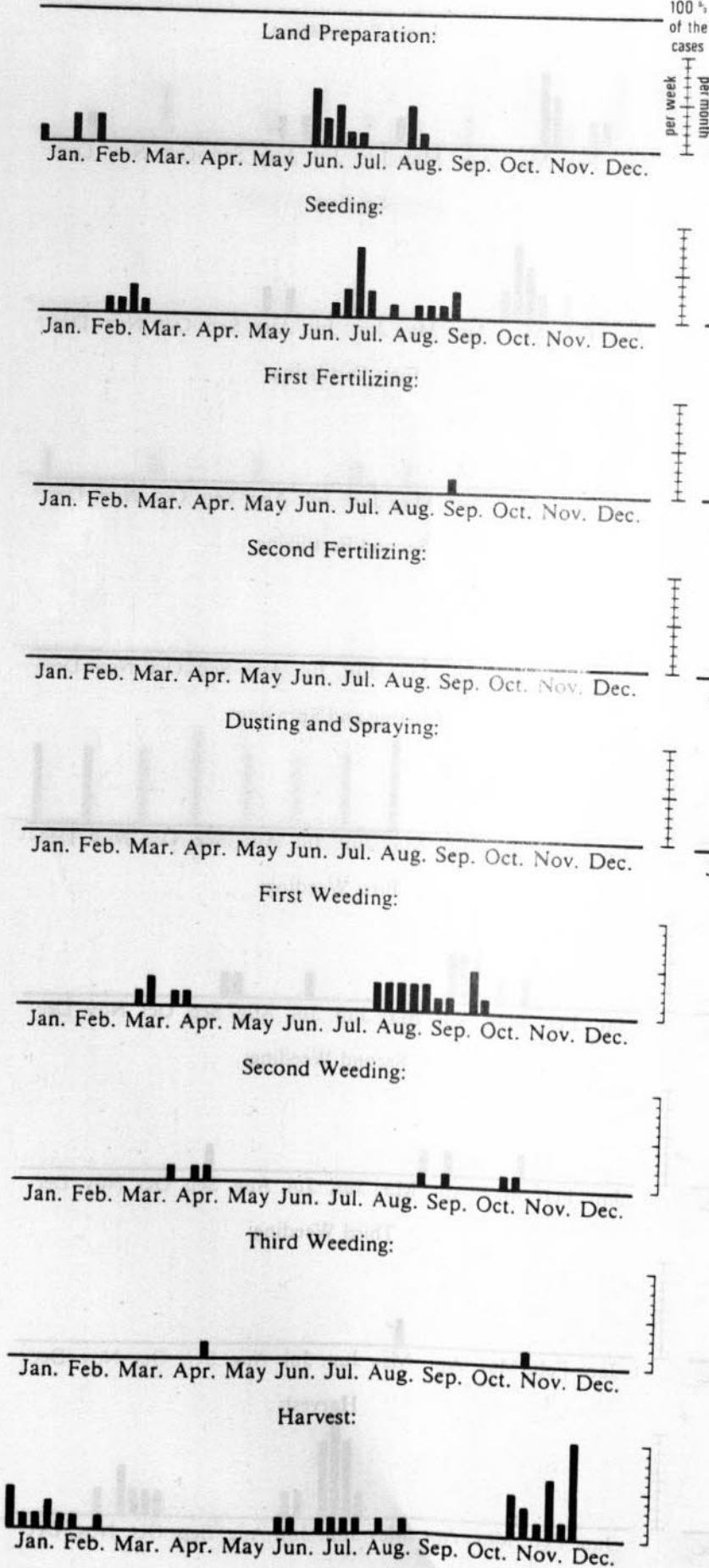
Harvest:



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TABLE 14 k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 34 Sunflower Cases: 21
AEZ: LM 1-2 Survey Area 12 Sample Size: 30



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TABLE 14 l: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 9
AEZ: LM 1-2 Survey Area 12 Sample Size: 30

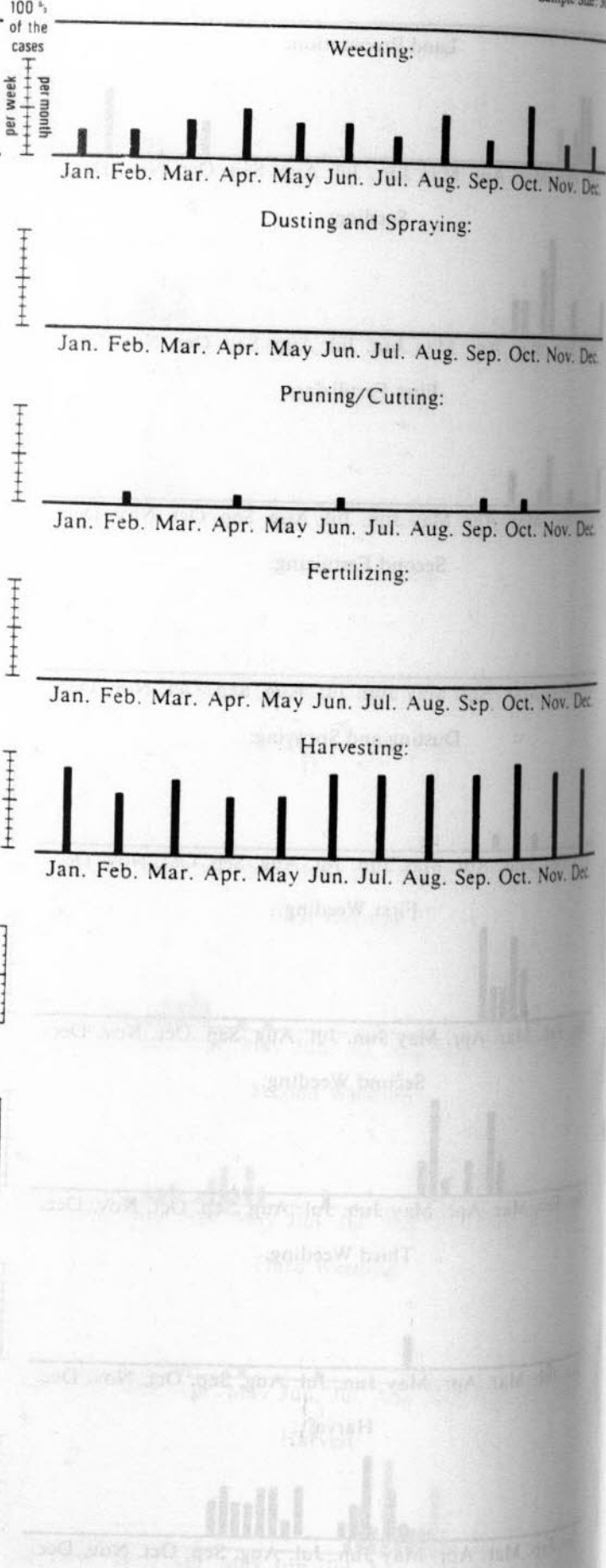


TABLE 15 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

A.E.Z.: I II TEA/DAIRY ZONE		A.E.Z.: III 2000/MAIZE-PYRETHRUM ZONE	
Veg. Period 1st + 2nd: p or 1/m-m in Days, 1st: 190 or more		2nd: 170-175	
Soil:		total: >360	
		vli or two 185 or more	
		100-130	
		285-330	
		NITOSOLS	
		Production Level	
		Without Fertilizer	
		I II III	
		Production Level	
		Without Fertilizer	
		I II III	
		Production Level	
		Without Fertilizer	
		I II III	
		Production Level	
		Without Fertilizer	
		I II III	
		Production Level	
		Without Fertilizer	
		I II III	
		Production Level	
		Without Fertilizer	
		I II III	
		Production Level	
		Without Fertilizer	
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		I II III	
		Production Level	
		Without Fertilizer	
		I II III	
		Production Level	
		Without Fertilizer	

TABLE 15 b: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

BUNGOMA DISTRICT

A.E.Z.: LH 1 TEA/DAIRY ZONE										A.E.Z.: LH 2 WHEAT/MAIZE-PYRETHRUM ZONE																								
Veg. Period					2nd:					vii or two					100-130					285-330														
1st + 2nd:					170-175					total:					>360																			
in Days, 1st:					190 or more																													
Soil:					NITOSOLS					NITOSOLS					Without Fertilizer					Production Level					Without Fertilizer					Production Level				
					I					II					III					I					II					III				
					II					III					I					II					III									
					III																													

TABLE 15 c: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

BUNGOMA DISTRICT

A.E.Z.: UM 1 COFFEE/TEA ZONE									
Vegt. Period 1st + 2nd: in Days, 1st: 170 or more		m/l-s/m		2nd: 105-115		total: 275-285		vli or m/l-si 160 or more	
Soil:		NITOSOLS		FERRALSOLS		FERRALSOLS		FERRALSOLS	
		Without Fertilizer	Production Level I	Production Level II	Production Level III	Without Fertilizer	Production Level I	Production Level II	Production Level III
CROP: NATURAL PASTURE/LEYS									
Farmers in Production Level									
Yields	%								
Fertilizer N	kg	2,000			4,800	2,000			4,000
P2O5	kg				155				111
K2O	kg				77				55
CROP: NAPIER/BANA GRASS									
Farmers in Production Level									
Yields	%								
Fertilizer N	kg	4,900			10,400	3,900			8,400
P2O5	kg				305				250
K2O	kg				152				125
CROP: TEA									
Farmers in Production Level									
Yields	%								
Fertilizer N	kg	2,100		5,000	12,000				
P2O5	kg			97	495				
K2O	kg			19	99				
CROP: COFFEE									
Farmers in Production Level									
Yields	%								
Fertilizer N	kg		300	550	900		300	400	1,400
P2O5	kg		30	55	90		30	40	140
K2O	kg		90	90	100		90	90	90
CROP: PASSION FRUIT									
Farmers in Production Level									
Yields	%								
Fertilizer N	kg	3,000		12,000	18,000	3,200		14,000	16,000
P2O5	kg			126	210			151	179
K2O	kg			189	315			259	307
CROP: BANANAS									
Farmers in Production Level									
Yields	%								
Fertilizer N	kg	7,500	2,000	15,000	28,000	6,000	2,000	14,000	20,000
P2O5	kg			113	308			120	210
K2O	kg			45	123			56	98

TABLE 15 d: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

A.E.Z.: UM 1 COFFEE/TEA ZONE										A.E.Z.: UM 2 MAIN COFFEE ZONE					A.E.Z.: UM 3 MARGINAL COFFEE ZONE														
Vegt. Period 1st + 2nd: in Days, 1st: m/lcs/m Soil:			2nd: 105-115			total: 275-285			vli or m/lcs 160 or more		85-105		245-265		1/vli or m-lcs 130 or more		85-100		215-230										
NITOSOLS										FERRALSOLS					FERRALSOLS														
Production Level										Production Level					Production Level														
Without Fertilizer										Without Fertilizer					Without Fertilizer														
I										I					I														
II										II					II														
III										III					III														
CROP: MAIZE																													
Farmers in Production Level																													
Yields																													
Fertilizer N																													
P2O5																													
K2O																													
CROP: MAIZE & BEANS																													
Farmers in Production Level																													
Yields																													
Fertilizer N																													
P2O5																													
K2O																													
CROP: BEANS																													
Farmers in Production Level																													
Yields																													
Fertilizer N																													
P2O5																													
K2O																													
CROP: SUNFLOWER																													
Farmers in Production Level																													
Yields																													
Fertilizer N																													
P2O5																													
K2O																													
CROP: SOYA BEANS																													
Farmers in Production Level																													
Yields																													
Fertilizer N																													
P2O5																													
K2O																													
CROP:																													
Farmers in Production Level																													
Yields																													
Fertilizer N																													
P2O5																													
K2O																													

TABLE 15c: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

BUNGOMA DISTRICT

A.E.Z.: UM 1 COFFEE/TEA ZONE																			
Veg. Period 1st + 2nd: in Days		m/lrs/m 170 or more		2nd: 105-115		total: 275-285		vli or m/lrs 160 or more		85-105		245-265		l/vli or m-si 130 or more		85-100		215-230	
Soil:		NITOSOLS				FERRALSOLS				FERRALSOLS				FERRALSOLS					
Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III			
CROP: POTATOES																			
Farmers in Production Level	%																		
Yields	kg	6,000	3,000	8,000	18,000														
Fertilizer N	kg			13	80														
P2O5	kg			15	90														
K2O	kg																		
CROP: SWEET POTATOES																			
Farmers in Production Level	%																		
Yields	kg	7,500	6,000	8,000	20,000														
Fertilizer N	kg			4	100														
P2O5	kg			3	75														
K2O	kg																		
CROP: CABBAGE																			
Farmers in Production Level	%																		
Yields	kg	3,000	2,500	8,000	20,000														
Fertilizer N	kg			35	119														
P2O5	kg			30	102														
K2O	kg																		
CROP: SUKUMAWIKI																			
Farmers in Production Level	%																		
Yields	kg	3,000	5,000	10,000	25,000														
Fertilizer N	kg		14	49	154														
P2O5	kg		12	42	132														
K2O	kg																		
CROP:																			
Farmers in Production Level	%																		
Yields	kg																		
Fertilizer N	kg																		
P2O5	kg																		
K2O	kg																		
CROP:																			
Farmers in Production Level	%																		
Yields	kg																		
Fertilizer N	kg																		
P2O5	kg																		
K2O	kg																		

TABLE 15f: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

BUNGOMA DISTRICT

A.E.Z.: LM 1 SUGAR CANE ZONE				A.E.Z.: LM 2 MARG. SUGAR CANE ZONE				A.E.Z.: LM 3 COTTON ZONE			
Veg. Period 1st + 2nd: in Days, 1st: 210 or more		2nd: 130-140		total: 340-350		1st (m/s) 1 195 or more		115-130 310-325		m/1 ~ (s) 150-170 80-100 230-270	
Soil:											
FERRALSOLS											
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TABLE 15 h: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

A.E.Z.: LM 1 SUGAR CANE ZONE										A.E.Z.: LM 2 MARG. SUGAR CANE ZONE				A.E.Z.: LM 3 COTTON ZONE			
Vegt. Period 1st + 2nd: 1st m in Days, 1st: 210 or more Soil:										1st m (m/s) 1 195 or more				m/l (s) 150-170			
FERRALSOLS										FERRALSOLS				FERRALSOLS			
Production Level										Production Level				Production Level			
Without Fertilizer										Without Fertilizer				Without Fertilizer			
I										I				I			
II										II				II			
III										III				III			
%										%				%			
kg										kg				kg			
kg										kg				kg			
kg										kg				kg			
kg										kg				kg			
Yields										Yields				Yields			
Fertilizer N										Fertilizer N				Fertilizer N			
P2O5										P2O5				P2O5			
K2O										K2O				K2O			
CROP: GROUNDNUTS										CROP: GROUNDNUTS				CROP: GROUNDNUTS			
Farmers in Production Level										Farmers in Production Level				Farmers in Production Level			
Yields										Yields				Yields			
Fertilizer N										Fertilizer N				Fertilizer N			
P2O5										P2O5				P2O5			
K2O										K2O				K2O			
CROP: SIMSIN										CROP: SIMSIN				CROP: SIMSIN			
Farmers in Production Level										Farmers in Production Level				Farmers in Production Level			
Yields										Yields				Yields			
Fertilizer N										Fertilizer N				Fertilizer N			
P2O5										P2O5				P2O5			
K2O										K2O				K2O			
CROP: SWEET POTATOES										CROP: SWEET POTATOES				CROP: SWEET POTATOES			
Farmers in Production Level										Farmers in Production Level				Farmers in Production Level			
Yields										Yields				Yields			
Fertilizer N										Fertilizer N				Fertilizer N			
P2O5										P2O5				P2O5			
K2O										K2O				K2O			
CROP: CASSAVA										CROP: CASSAVA				CROP: CASSAVA			
Farmers in Production Level										Farmers in Production Level				Farmers in Production Level			
Yields										Yields				Yields			
Fertilizer N										Fertilizer N				Fertilizer N			
P2O5										P2O5				P2O5			
K2O										K2O				K2O			
CROP: CABBAGE										CROP: CABBAGE				CROP: CABBAGE			
Farmers in Production Level										Farmers in Production Level				Farmers in Production Level			
Yields										Yields				Yields			
Fertilizer N										Fertilizer N				Fertilizer N			
P2O5										P2O5				P2O5			
K2O										K2O				K2O			
CROP: SUKUMAWIKI										CROP: SUKUMAWIKI				CROP: SUKUMAWIKI			
Farmers in Production Level										Farmers in Production Level				Farmers in Production Level			
Yields										Yields				Yields			
Fertilizer N										Fertilizer N				Fertilizer N			
P2O5										P2O5				P2O5			
K2O										K2O				K2O			

KAKAMEGA DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

This district has one of the highest population densities of Kenya. In several locations, more than 700 people must live on the agricultural output of a sqkm. This figure, as well as a high annual rainfall averaging between 1 200 and 2 100 mm, suggests a high potential area, there are, however some limitations: in the center of the district rainfall is too high, leaching the soils and spoiling the crops (mainly by favoring fungus diseases). Therefore, this area is classified as UM 0 and is thus taken out of agricultural planning as a forest zone (of course some cropping is possible together with planting young trees). In large parts of the district the soils are the main problem. They are leached because of their age, poor, and in many places worn out. In the northeastern areas the generally humid climate is interrupted by droughts restricting cultivation of important perennial plants like bananas.

In view of the increasing population, the development of the full land use potential of a mixed farming ecosystem is very necessary, especially considering legumes, other vegetables, fruits and forage. In the main area, cultivation is possible throughout the year, although the time from December to February is drier (see Diagram Kakamega). Nevertheless, three harvests of vegetables and other quickly maturing crops are possible per year in many places. The growing periods shown in the subzones can be validated because there is no real dry gap between the rainfall peaks during the year. Only towards the end of the year and during the first weeks of the next one it becomes drier, although normally it is not an arid time except for the North-East.

The rainfall expectation is high, at least 500–1 100 mm during 1st rains and 450–850 mm during 2nd rains in 6 out of 10 years. The 60 % reliability of the length of the growing periods ranges from 365 days in UM 1 to about 230 days in UM 4 (see Table 3). In the eastern part of the district (in UM 0 and UM 1) the annual mean temperature is about 18°–20.5°; in the rest of the district it is higher than 20.5°.

Due to the wet climate evaporation is not high, 1 600–1 800 mm per year for nearly the whole district. Only in the very lowest parts, the annual average evaporation is higher than 1 800 mm.

KAKAMEGA DISTRICT

TABLE 1: RAINFALL FIGURES FROM VARIOUS STATIONS
having at least 10 years of records up to 1976

No. and altitude	Name of Station	Years of rec.	Kind of rec.	Ann. rainf. mm	Monthly rainfall in mm											
					Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
8934001 1 554 m	Kakamega District Office	55	Average 60% prob. ¹⁾	1 930 1 729	60	95	151	254	260	190	164	230	186	134	118	87
8934002 1 463 m	Bukura Farm Institute	52	Av.	1 788	52	91	161	257	247	157	131	187	161	127	123	94
8934009 1 615 m	Kaimosi Mission	34	Av. 60%	1 815 1 543	74	100	154	259	251	165	157	198	161	120	108	78
8934013 1 340 m	Mumias, Girl's School	41	Av. 60%	1 756 1 579	58	80	155	258	258	168	136	155	164	139	115	71
8934028 1 676 m	Kakamega Forest Station	38	Av. 60%	2 025 1 866	88	108	148	279	289	195	171	220	173	140	122	93
8934031 1 463 m	Yala, St. Mary's School	34	Av. 60%	1 832 1 613	73	89	145	277	264	150	118	165	154	136	145	116
8934040 1 433 m	Butere Health Centre	34	Av. 60%	1 840 1 649	55	94	162	298	260	152	117	171	177	144	118	92
8934061 1 595 m	Malava Dispensary	29	Av. 60%	2 085 1 871	55	78	164	244	294	204	212	257	205	173	115	83
8934071 1 905 m	Turbo, Stanley Estate	28	Av.	1 332	39	42	78	157	166	142	155	225	134	82	59	52
8934078 1 707 m	Esirwa, Kaimosi F.T.C.	36	Av.	2 119	78	88	160	282	301	197	190	235	202	162	122	103
8934096 1 585 m	Kakamega, Exp. Station	18	Av.	1 918	55	111	178	240	239	150	133	224	172	169	152	98
8934103 1 585 m	Vihiga, Maragoli	23	Av.	1 875	91	106	169	290	242	125	102	158	144	144	161	140
8935015 1 829 m	Turbo, Forest Lands Estate	59	Av.	1 258	36	43	75	151	153	141	184	229	112	60	53	21
8935042 1 844 m	Lahre Farm	38	Av.	1 194	30	32	67	154	174	132	168	191	100	58	51	36
8935076 1 890 m	Turbo, Selborne Estate	29	Av.	1 169	35	40	72	142	148	124	147	202	108	67	43	40

¹⁾ These figures of rainfall reliability should be exceeded normally in 6 out of 10 years

KAKAMEGA DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ ¹⁾	Kind of records	Temperature in °C												Y. of rec.	
				Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.		Year
8934028 1 676 m	Kakamega Forest Station	UM 0 lp	Mean max.	27.1	27.2	27.7	26.0	25.8	25.2	24.4	23.8	25.0	25.3	25.7	25.9	25.8	8
			Mean temp.	19.0	18.8	19.7	19.3	19.0	18.3	18.0	17.5	17.8	18.4	18.9	18.7	18.6	
			Mean min.	10.8	10.4	11.7	12.6	12.2	11.3	11.6	11.1	10.6	11.5	12.0	11.4	11.4	
			Abs. min.	5.0	4.4	5.0	9.0	8.0	8.0	8.0	5.0	5.0	8.0	7.8	6.0	4.4	
8934009 1 615 m	Kaimosi Mission (operating to 1949)	UM 1 lp	Mean max.	26.8	27.4	27.1	26.5	26.0	25.3	23.8	24.9	25.9	25.7	25.4	26.2	25.9	8
			Mean temp.	21.1	21.6	21.4	21.1	20.5	20.1	19.3	19.8	20.4	20.4	20.6	20.8	20.6	
			Mean min.	15.3	15.7	15.7	15.6	14.9	14.8	14.8	14.7	14.9	15.0	15.8	15.4	15.2	
			Abs. min.	10.0	9.4	10.0	10.0	8.3	8.9	8.9	8.9	10.6	10.6	11.1	8.9	8.3	
8935012 1 885 m	Soy, Kazi Moto Estate (operating to 1936)	UM 4 hp	Mean max.	28.9	27.9	27.4	25.8	25.3	23.9	24.3	25.2	26.6	27.3	27.3	27.3	26.4	11
			Mean temp.	20.2	19.9	20.4	20.3	19.4	18.2	17.5	17.5	17.6	19.1	19.9	18.9	19.1	
			Mean min.	11.4	12.0	13.3	13.2	12.9	11.0	11.1	10.6	10.0	11.6	12.4	10.4	11.7	
			Abs. min.	3.9	5.6	7.8	8.9	8.3	4.4	5.6	5.6	6.7	7.8	8.3	3.3	3.3	

1) AEZ = Agro-ecological zone; lp = lower places, hp = higher places within the zone

KAKAMEGA DISTRICT

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

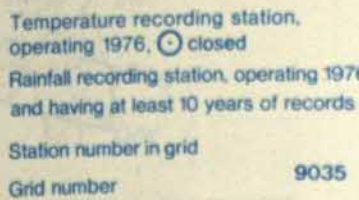
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall ¹⁾		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains ²⁾ in days	2nd rains in days	Total ³⁾ in days
UM 0									
Forest Zone		1 500-1 700	19.6-18.6	2 000-2 200	900-1 100	700-850	whole year	very wet	
UM 1	p or two/	1 500-1 800	20.4-18.1	1 800->2 000	800-1 000	700-800	150 or more	210-215	365
	three			1 600->2 000	700-1 000	650-800	150 or more	210-215	365
UM 2									
Coffee Zone	Very small, see Bungoma								
UM 3									
Marginal Coffee Zone	Very small, see Bungoma								
UM 4	l/vl or two	1 500-1 900	20.9-18.9	1 000-1 600	500-700	450-600	115 or more	115 or less	~230
LM 1	p or two	1 300-1 500	22.0-20.8	1 800-2 000	800-900	580-750	170 or more	180-190	350-360
Lower Midland Sugar Cane Zone	vl i or 1-m i			1 650-1 850	750-850	550-730	195 or more	135-145	330-340
LM 2	1-m (m/s)i	1 300-1 500	22.0-20.9	1 550-1 950	700-900	550-700	195 or more	115-135	310-330
Marginal Sugar Cane Zone	l/m - (s/m)			1 500-1 800	650-750	500-600	175 or more	105-115	280-290
LM 3									
Lower Midland Cotton Zone	Very small, see Bungoma								
LM 4									
Marginal Cotton Zone	Very small, see Busia								

- 1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants
2) More if growing cycle of cultivated plants continues into the period of second rains
3) Agrohumid conditions continue from 1st to 2nd rains in the whole district

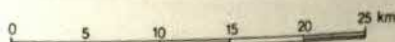
35 E

+ SOILS

8935

$$O^{\frac{30}{N}}$$


Broken boundaries are uncertain because of lack of rainfall records



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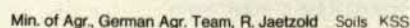
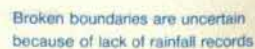
35° E

March -

151 U $\rightarrow$

500- 25 H

A topographic map segment showing contour lines. A blue contour line is labeled '600'. Above it, a point is marked with 'x' and labeled 'm-h'.



34°30' E

35° E

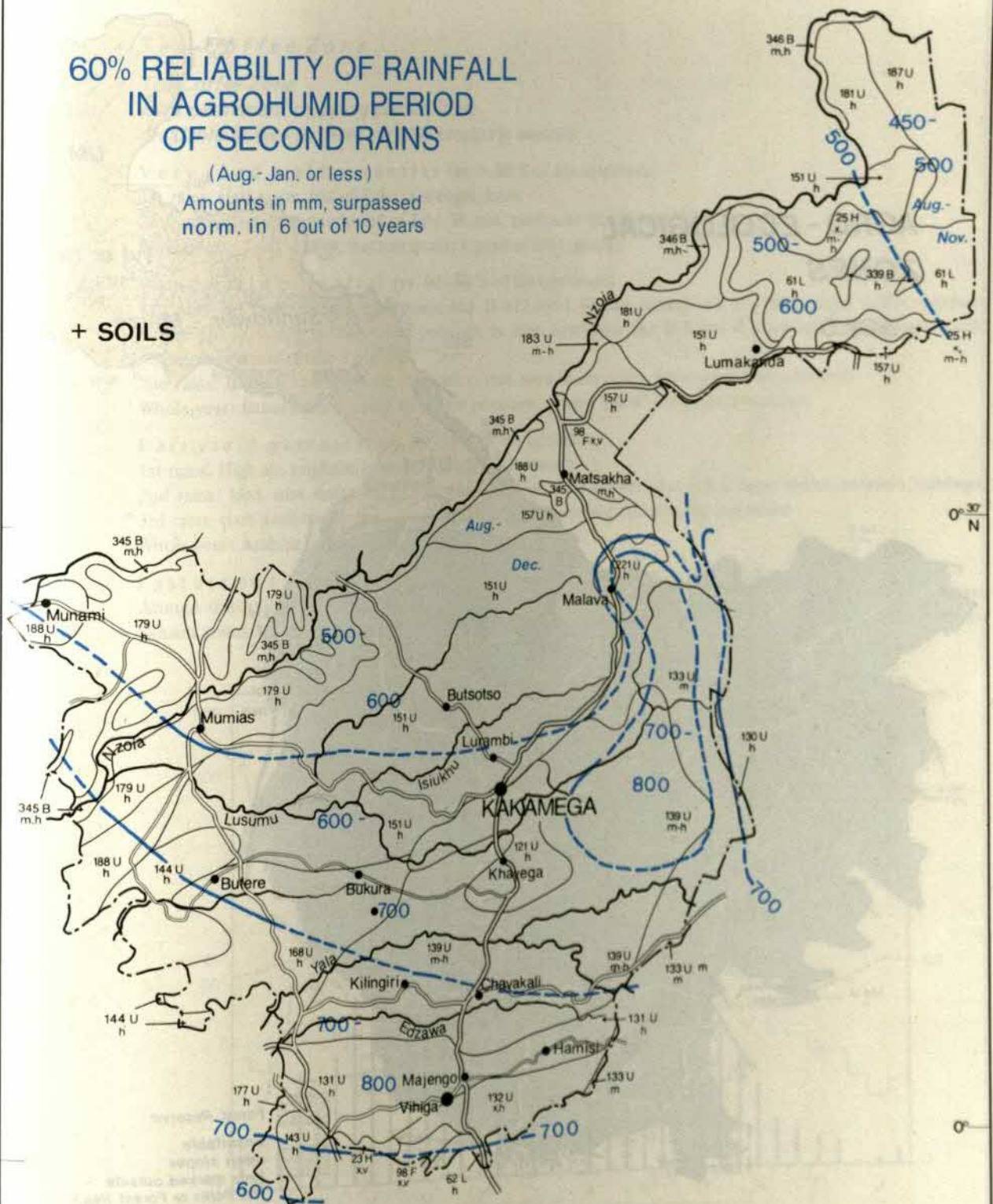
KAKAMEGA

60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF SECOND RAINS

(Aug.- Jan. or less)

Amounts in mm, surpassed
norm. in 6 out of 10 years

+ SOILS



Broken boundaries are uncertain
because of lack of rainfall records

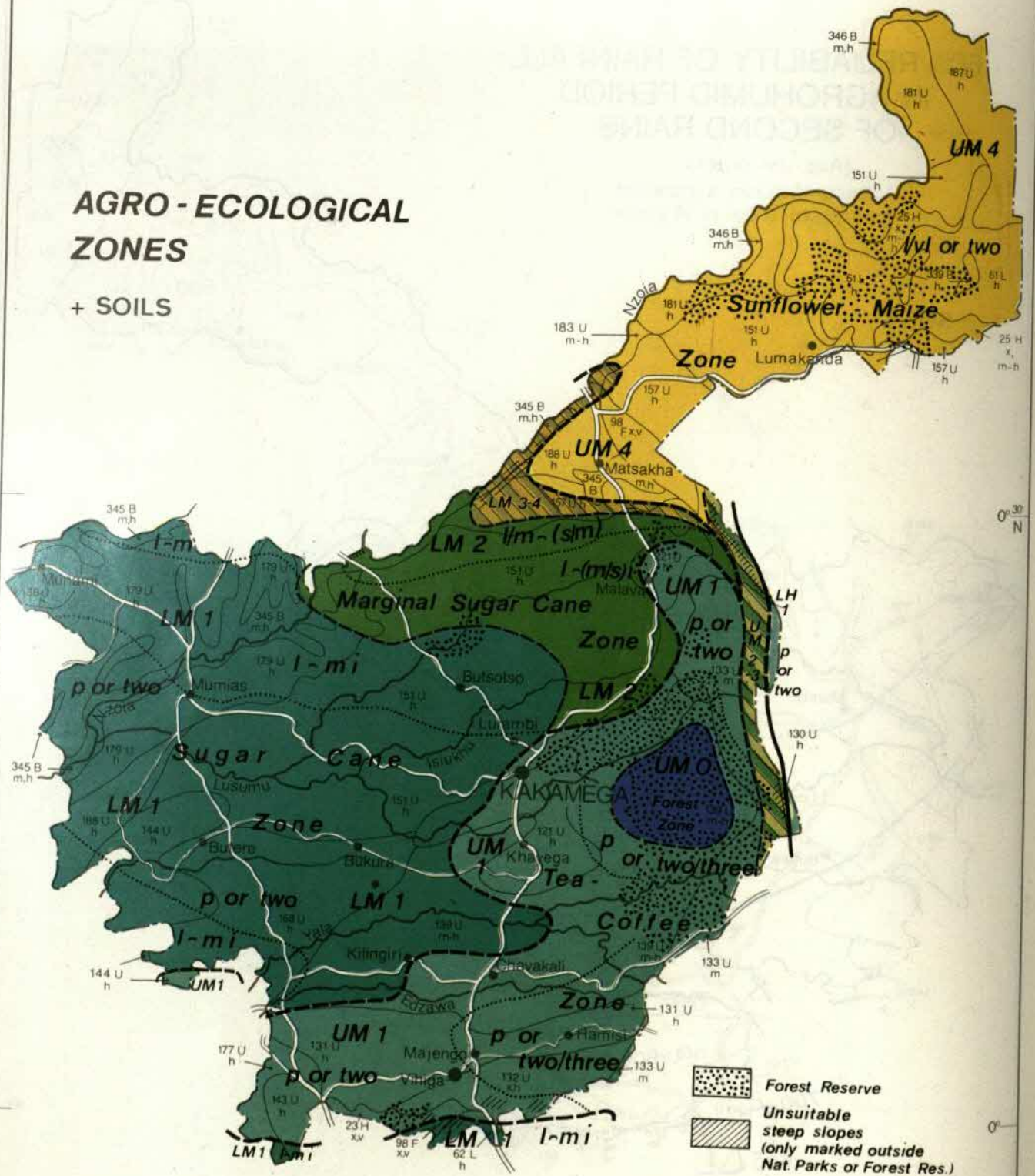
0 5 10 15 20 25 km

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KAKAMEGA

AGRO - ECOLOGICAL ZONES

+ SOILS



0 5 10 15 20 25 km

AEZ R. Jätzold '81

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AGRO-ECOLOGICAL ZONES

U 1 = UPPER MIDLAND ZONES

U 10 = Forest Zone

Too wet for good yields of most crops. Forest best land use

U 11 = Tea-Coffee Zone

U 11 = Tea-Coffee Zone

per two/
three with permanent cropping possibilities,
dividable in two to three variable cropping seasons

Very good yield potential (av. > 80 % of the optimum)

1st rains, start norm. end of Febr.: Cabbages, kales

2nd rains, start undistinctly end of July: M. mat. sunflower like Hybrid S 301 A

Whole year: Tea (~ 80 %, medium quality), passion fruit, guavas

Good yield potential (av. 60–80 % of the optimum)

1st rains (to 2nd r.): Late mat. maize like H 612–614 (higher places) and H 7 801, finger millet; potatoes (60–70 %, higher places), sweet potatoes; m. mat. sunflower like H S 301 A, soya beans; spinach, broccoli, onions, carrots (above 1 600 m)

2nd rains: Beans (~ 60 %), sweet potatoes; e. mat. soya beans; kales, onions, broccoli, tomatoes

Whole year: Bananas, taro, yams, mountain pawpaws, winged beans¹), loquats, avocados

Fair yield potential (av. 40–60 % of the optimum)

1st rains: High alt. sorghum; beans (50–60 %)²); tomatoes

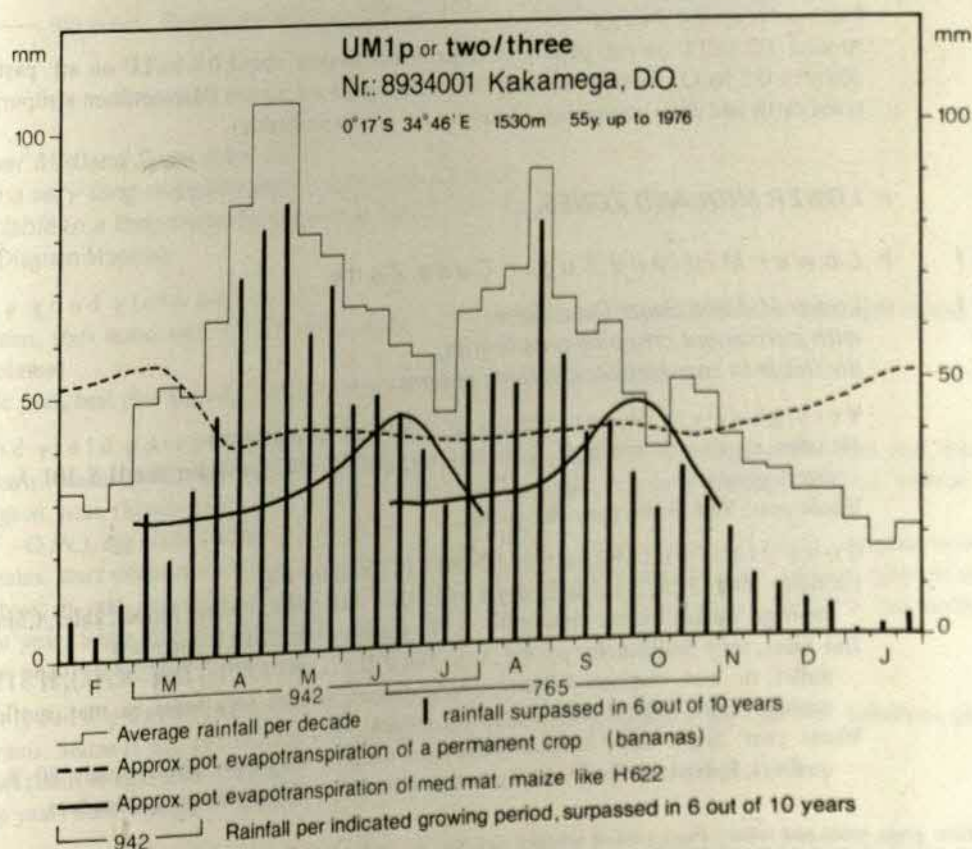
2nd rains: Med. mat. maize like H 511 and 512, high alt. sorghum (Aug.–F.), finger millet; potatoes; cabbages

3rd rains, start undistinctly around end O.: V. e. mat. beans and fast growing vegetables

Whole year: Arabica coffee, citrus

Pasture and forage

Around 0.6 ha/LU on art. or sec. pasture of star grass; down to 0.12 ha/LU feeding Napier or Bana grass, banana stems and leaves, maize stalks, and fodder legumes (*Desmodium uncinatum*, *Stylosanthes guyanensis*)



UM 1 = *Tea-Coffee Zone*
 p or two with permanent cropping possibilities,
 dividable in two variable cropping seasons
 (see Diagram Kakamega)

Like UM 1 p or two/three, but no reliable third crop in N.-F. Stocking rates about 10 % less

UM 2 = *Coffee Zone*

Very small and transitional, potential see Bungoma District, but much lower yields because of less suitable soils and sometimes excessive rains

UM 3 = *Marginal Coffee Zone*

Very small and transitional, potential see Bungoma District, but lower yields because of less suitable soils

UM 4 = *Sunflower-Maize Zone*

UM 4 = *Sunflower-Maize Zone*
 l/vl or two with a long to very long cropping season,
 dividable in two variable cropping seasons

Good yield potential

1st rains, start norm. around end of F./March (most crops continue to 2nd rains): Late mat. maize like H 612-614; m. mat. or late planted e. mat. beans ($\sim 60\%$)², soya beans; sweet potatoes ($\sim 60\%$); m. mat. sunflower like H S 301, late mat. sunflower like Kenya White in higher places; cabbages, kales, spinach

2nd rains, start undistinctly mid July: M. mat. sunflower like H S 301 A

Whole year: Sisal, castor

Fair yield potential

1st rains: Finger millet, high alt. sorghum (50–60 %); tomatoes, e. mat. onions (on light soils)

2nd rains: M. or late mat. beans (50–60 %); sweet potatoes, potatoes (higher places); late mat. onions (50–60 % on light soils)

Whole year: Avocadoes³, citrus³, pineapples

Pasture and forage

Around 1.2 ha/LU on nat. pasture of Hyparrhenia savanna, about 0.6 ha/LU on art. pasture of Rhodes grass, down to 0.2 ha/LU feeding Napier or better Bana grass and Siratro (*Macroptilium atropurpureum*); suitable for grade cattle and dairy cows (silage or hay for dry season profitable)

LM = *LOWER MIDLAND ZONES*

LM 1 = *Lower Midland Sugar Cane Zone*

LM 1 = *Lower Midland Sugar Cane Zone*
 p or two with permanent cropping possibilities,
 dividable in two variable cropping seasons

Very good yield potential (av. > 80 % of the optimum)

1st rains, start norm. end of F.: Late mat. sorghum; m. mat. sunflower like H S 301 A, late mat. soya beans; sweet potatoes

Whole year: Yam beans, pawpaws, guavas

Good yield potential (av. 60–80 % of the optimum)

1st rains: Maize H 622 and 632, finger millet; late mat. beans²; sweet pepper, kales, Chinese cabbage, spinach, cabbage, chillies, yellow yams (e. F.–b. N.), egg plants (to 2nd r.), pumpkins

2nd rains, start undistinctly around Aug.: Maize H 622 and 632 (e. June–N./D.), H 511 (e. July–D.), finger millet, m. mat. sorghum; beans²; sweet potatoes; m. mat. soya beans, m. mat. sunflower like H S 301 A; cabbage, kales, Chinese cabbage, spinach, onions

Whole year: Sugar cane, bananas (nematodes danger), tea (upper places, nearly 80 %, but medium to low quality), Robusta coffee ($\sim 60\%$), cassava (on sandy soils), pigeon peas, avocadoes

1) Edible pods, vines and tubers. Fixes a lot of nitrogen (see Nat. Ac. of Science: The Winged Bean: A High Protein Crop for the Tropics. Washington 1975). Needs very high rainfall.

2) Sometimes rotting because of too wet conditions

3) With add. irrigation (D.–F.) well growing

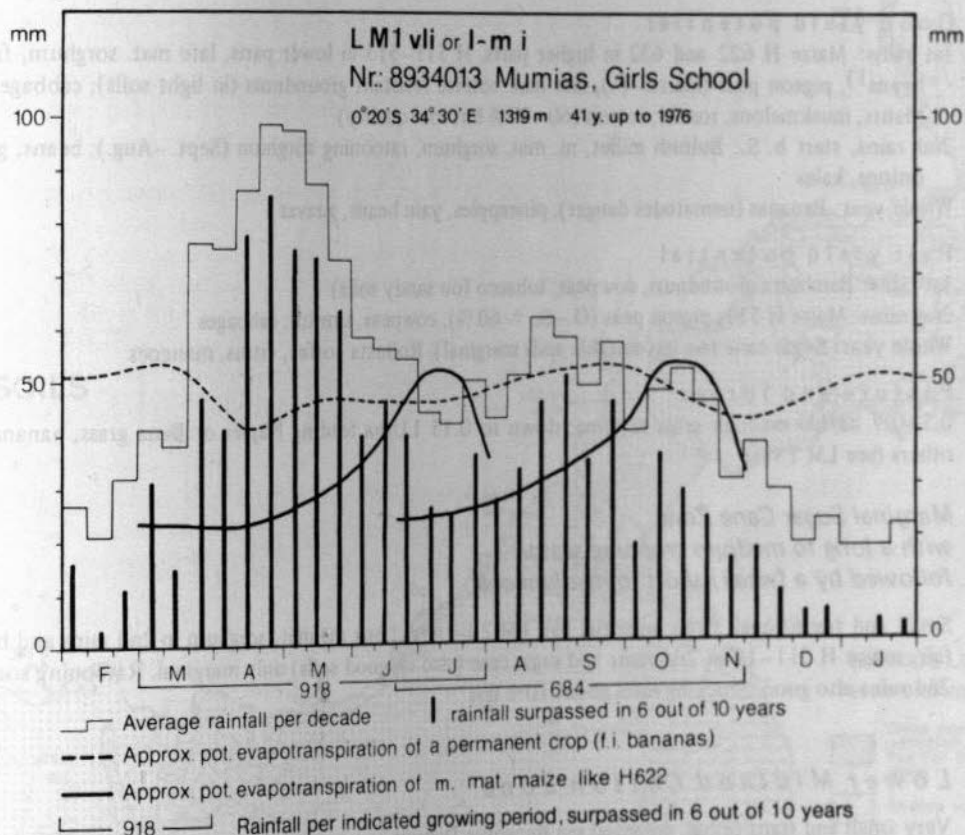
Fair yield potential (av. 40–60 % of the optimum)

2nd rains: Late mat. groundnuts and late mat. bambarra groundnuts (both in light soils), cowpeas

Whole year: Taro, mangoes⁵), citrus⁵)

Pasture and forage

Around 0.5 ha/LU on sec. pasture where orig. there has been a moist submontane forest; down to 0.12 ha/LU feeding Napier of Bana grass, banana leaves and others (see LM 1 vi i)



LM 1 = Lower Midland Sugar Cane Zone
vli or l-m i = with a very long cropping season and intermediate rains, dividable in a long cropping season followed by a medium one and i. r. (see Diagram Mumias)

Very good yield potential

1st rains, start norm. end of F.: M. mat. sorghum; m. mat. sunflower like H S 301 A, m. mat. soya beans; sweet potatoes

Whole year, best planting time beginning March: Yam beans, pawpaws, guavas

Good yield potential (av. 60–80 % of the optimum)

1st rains: Maize H 622 and 632 (60–70 %), late mat. sorghum (70–80 %), finger millet; late mat. beans²), pigeon peas (March–F.); sweet pepper, kales, Chinese cabbage, spinach, cabbage, chillies, yellow yams (F.–O./N.), egg plants (to 2nd r.), pumpkins

2nd rains, start undistinctly end of Aug.: Maize H 511, m. mat. sorghum; beans (~ 60 %), cowpeas; sweet potatoes; m. mat. soya beans, e. mat. sunflower like 252 or H S 345; kales, Chinese cabbage, spinach, onions

Whole year: Sugar cane, bananas (nematodes danger⁴), cassava, tea in upper places (70–80 %, but medium to low quality), Robusta coffee (~ 60 %⁴), avocados

Fair yield potential (av. 40–60 % of the optimum)

2nd rains: Maize H 622 and 632 (Jy.–N.), finger millet; late mat. groundnuts and late mat. bambarra groundnuts (both in light soils); cabbage

Whole year: Taro, mangoes⁵), citrus⁵)

Pasture and forage

Around 0.6 ha/LU on sec. pasture where originally there has been a moist submontane forest; down to 0.13 ha/LU feeding Napier or Bana grass, banana leaves and stems, maize stalks, sweet potato vines and fodder legumes

⁴) Remarks see Busia

⁵) Danger of fungus diseases

LM 2 = Marginal Sugar Cane Zone

LM 2 = Marginal Sugar Cane Zone with a long cropping season

l-(m/s) i followed by a (weak) medium to short one and intermediate rains

Very good yield potential

1st rains, start norm. mid F.: M. mat. sorghum; m. mat. sunflower like Vympel or H S 301 A, m. mat. soya beans; sweet potatoes; chillies, onions, sweet pepper

Whole year: Cassava (on light to medium soils), pawpaws

Good yield potential

1st rains: Maize H 622 and 632 in higher parts, H 511-513 in lower parts, late mat. sorghum, finger millet; beans¹), pigeon peas (March-F.), late mat. rosette resistant groundnuts (in light soils); cabbages, kales, egg plants, muskmelons, roselle; cotton (60-70 % but low quality)

2nd rains, start b. S.: Bulrush millet, m. mat. sorghum, ratooning sorghum (Sept.-Aug.); beans, green grams; onions, kales

Whole year: Bananas (nematodes danger), pineapples, yam beans, guavas

Fair yield potential

1st rains: Bambarra groundnuts, cowpeas; tobacco (on sandy soils)

2nd rains: Maize H 511; pigeon peas (O.-S., ~ 60 %), cowpeas; simsim; cabbages

Whole year: Sugar cane (on less suitable soils marginal), Robusta coffee, citrus, mangoes

Pasture and forage

0.5-0.7 ha/LU on high grass savanna; down to 0.15 LU/ha feeding Napier or Bana grass, banana leaves and others (see LM 1 vi i)

LM 2 = Marginal Sugar Cane Zone

l/m -(s/m) with a long to medium cropping season followed by a (weak) short to medium one

Small and transitional. Crop potential like LM 2 l-(m/s) i but m. mat. sorghum in 2nd rains and bananas only fair, maize H 511-13 in 2nd rains and sugar cane (also on good soils) only marginal. Ratooning sorghum 1st to 2nd rains also good. Stocking rates about 10 % less

LM 3 = Lower Midland Cotton Zone

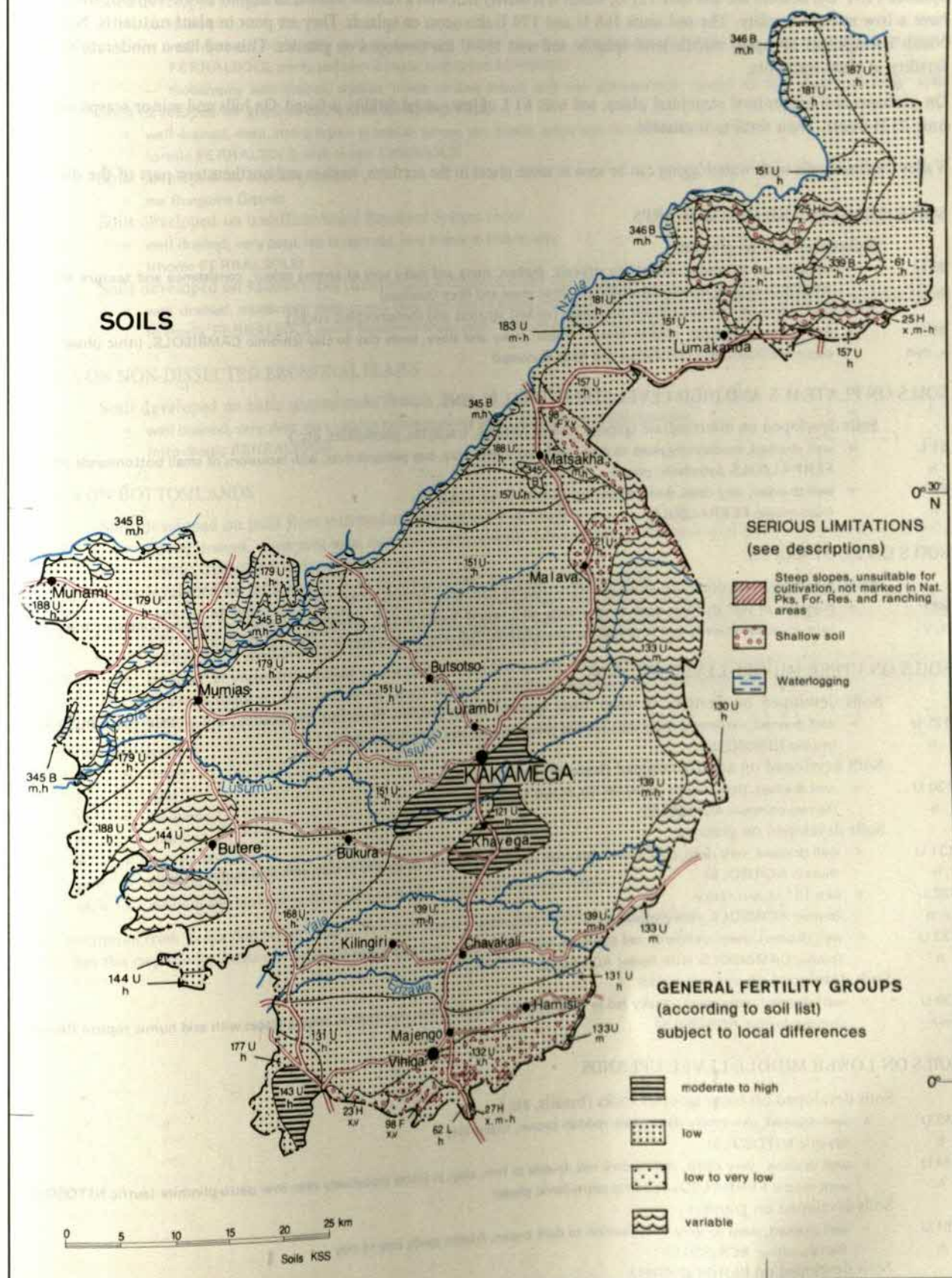
Very small and transitional, potential see Bungoma District

LM 4 = Marginal Cotton Zone

Very small and transitional. Marginal mainly because of cool temperature during night. Potential see Busia District

35° E

SOILS



SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

The major part of the district shows a rather uniform undulating topography, but its eastern boundary is formed by the Nandi Escarpment, a prominent topographical feature. West of Soy, in the northeastern area of the district, there is a plateau with moderately deep soils (unit 61 L).

The dominant soils of the district are found on upper middle-level uplands (units 121 U and 139 U) and on lower middle-level uplands (151 U). Besides the soil unit 121 U, which is relatively rich with a variable content of humus in the topsoil, these soils have a low natural fertility. The soil units 168 U and 179 U also occur on uplands. They are poor in plant nutrients. Near the Nandi Escarpment on upper middle-level uplands, soil unit 133 U has developed on granites. This soil has a moderate to high fertility in plant nutrients.

On plateaus and higher-level structural plains, soil unit 61 L of low natural fertility is found. On hills and minor scarps soils of unit 23 H occur. Their fertility is variable.

Valley bottom soils with waterlogging can be seen in some places in the northern, western and northeastern part of the district.

SOILS ON HILLS AND MINOR SCARPS

Soils developed on granites

- 23 H
x, v¹) = complex of somewhat excessively drained, shallow, stony and rocky soils of varying colour, consistence and texture (dystric REGOSOLS; with ferralic CAMBISOLS, lithic phase and Rock Outcrops)

Soils developed on various parent materials (mixed igneous and metamorphic rocks)

- 25 H
x, m-h = well drained, shallow, reddish brown, friable, rocky and stony, sandy clay to clay (chromic CAMBISOLS, lithic phase; with eutric REGOSOLS, LITHOSOLS and Rock Outcrops)

SOILS ON PLATEAUS AND HIGH-LEVEL STRUCTURAL PLAINS

Soils developed on intermediate igneous rocks (syenites, trachytes, phonolites, etc.)

- 61 L
h = well drained, moderately deep to deep, dark red, friable clay, over petroplinthite; with inclusions of small bottomlands (rhodic FERRALSOLS, petroferic phase)

- 62 L
h = well drained, very deep, dark reddish brown to dark red, friable clay (nito-rhodic FERRALSOLS)

SOILS ON FOOTSLOPES

Soils developed on colluvium from undifferentiated Basement System rocks

- 98 F
x, v = complex of well drained, deep to very deep, dark reddish brown to dark yellowish brown soils of varying consistence and texture, in places gravelly and stratified (ferralic ARENOSOLS; with ferralo-chromic, orthic LUVISOLS)

SOILS ON UPPER MIDDLE-LEVEL UPLANDS

Soils developed on Tertiary or older basic igneous rocks (basalts, nepheline phonolites, etc.; basic tuffs included)

- 121 U
h = well drained, extremely deep, dark reddish brown, friable clay, with humic topsoil (mollic NITOSOLS)

Soils developed on undifferentiated Basement System rocks

- 130 U
h = well drained, deep, red to yellowish red, friable sandy clay (ferralo-chromic ACRISOLS)

Soils developed on granites

- 131 U
h = well drained, very deep, dark red to yellowish red, friable to firm, sandy clay to clay, with acid humic topsoil (humic ACRISOLS)

- 132 U
x, h = like 131 U, but rocky (humic ACRISOLS, rocky phase)

- 133 U
h = well drained, deep, yellowish red to brown, friable clay loam, with acid humic topsoil (humic CAMBISOLS; with humic ACRISOLS)

Soils developed on various rocks

- 139 U
m-h = well drained, very deep, dusky red to yellowish red, friable to firm, clay loam to clay; in places with acid humic topsoil (ferralo-chromic/orthic ACRISOLS)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

Soils developed on basic igneous rocks (basalts, etc.)

- 143 U
h = well drained, extremely deep, dark reddish brown, friable clay (dystric NITOSOLS)

- 144 U
h = well drained, very deep, red to dark red, friable to firm, clay; in places moderately deep over petro-plinthite (eutric NITOSOLS; with rhodic FERRALSOLS, partly petro-ferric phase)

Soils developed on granites

- 151 U
h = well drained, deep to very deep, brown to dark brown, friable, sandy clay to clay (ferralo-orthic ACRISOLS)

Soils developed on biotite gneisses

- 157 U
h = well drained, deep, red, friable clay (rhodic FERRALSOLS; with ferralo-chromic ACRISOLS)

Soils developed on various rocks (Kavirondian sediments, often mudstones)

- 168 U = well drained, deep to very deep, dark reddish brown to strong brown, friable clay
h (rhodic to orthic FERRALSOLS)

SOILS ON LOWER-LEVEL UPLANDS

Soils developed on acid igneous rocks

- 177 U = see Siaya District

Soils developed on granites

- 179 U = complex of:
h — well drained, moderately deep to very deep, reddish brown to yellowish brown, friable clay, over petro-plinthite (orthic FERRALSOLS, partly petroferric phase; with orthic ACRISOLS)
— moderately well drained, shallow, brown to dark brown soils over petroplinthite (about 30 %) ("murrum cuirass" soils)

Soils developed on granites and quartz-feldspar gneisses

- 181 U = well drained, deep, strong brown to reddish yellow, very friable, sandy clay loam to sandy clay
h (orthic FERRALSOLS; with ferralic CAMBISOLS)

Soils developed on biotite gneisses

- 182 U = see Bungoma District

Soils developed on undifferentiated Basement System rocks

- 187 U = well drained, very deep, red to dark red, very friable to friable, clay
h (rhodic FERRALSOLS)

Soils developed on various rocks (Kavirondian sediments, often mudstones)

- 188 U = well drained, moderately deep to very deep, dark red to strong brown, friable clay; in places shallow over petro-plinthite (orthic
h to rhodic FERRALSOLS, partly petroferric phase; with "murrum cuirass" soils (10–40 %)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

Soils developed on basic igneous rocks (basalts, etc.)

- 221 U = well drained, very deep, dark reddish brown to dusky red, friable clay; in places bouldery
h (nito-rhodic FERRALSOLS)

SOILS ON BOTTOMLANDS

Soils developed on infill from intermediate igneous rocks (phonolites)

- 339 B = poorly drained, moderately deep, dark grey to grey, mottled, firm clay, with humic topsoil; in many places over petro-plinthite
h (mollic GLEYSOLS, partly petro-ferric phase)

Soils developed on infill mainly from undifferentiated Basement System rocks

- 345 B = complex of imperfectly drained to poorly drained, very deep, very dark grey to brown, mottled, friable to firm, sandy clay to
m, h clay, often abruptly underlying a topsoil of friable sandy clay loam; in places saline and sodic (dystric PLANOSOLS; with pellic VERTISOLS, vertic and humic GLEYSOLS and plinthic ACRISOLS)

- 346 B = complex of imperfectly drained to very poorly drained, very deep, very dark grey to dark greyish brown, mottled, firm clay;
m, h in places peaty or with acid humic topsoil (dystric GLEYSOLS; with eutric PLANOSOLS and some dystric HISTOSOLS)

1) Soil texture-classes

- h = heavy
l = light
m = medium
x = stony
v = varying texture
m-h = medium to heavy
m, h = medium and heavy (e. g. abruptly underlying a topsoil of different texture)

Soil description from Kenya Soil Survey: Exploratory Soil Map and Agro-climatic Zones Map of Kenya, scale 1:1 000 000, Rep. E 1, Nairobi 1982. See this map also for colours; symbols simplified here.

POPULATION AND LAND

The population of the Kakamega District consisted of 1 031 000 people in 1979 according to the Census of September of that year (Table 4). A few more than 32 000 people were inhabitants of the Kakamega Municipality, so that nearly one million rural people shared the 254 800 ha of agricultural land available. In the Kakamega District an average household consisting of 5.18 people had on average only 1.33 ha of agricultural land and one person not more than 0.26 ha (Table 5 and 6). In the zone UM 1 (Coffee-Tea Zone) the figures are 0.70 and 0.13 ha respectively. In the sugar cane zones LM 1 and 2 it is about the district average. Here, in many locations, the shortage of agricultural land is already extreme (Table 6).

In the zones UM 4 and LM 3-4 (Sunflower-Maize Zone and Cotton to Marginal Cotton Zone) the agricultural situation seems to be more positive with 4 and 0.6 ha respectively, but in these drier areas comparatively more pasture is needed to support the average small farm (Table 10 a).

Summing up, it can be stated that nearly in all areas of this densely populated district (300 persons per sqkm) all possible means of improvement have to be used to overcome the critical situation and to help the rural population at least to keep their present standard.

KAKAMEGA DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
North Maragoli	37 659	44 681	82 340	14 694	110	748
South Maragoli	27 805	32 064	59 869	10 752	88	674
East Bunyore	23 996	27 783	51 779	10 032	72	715
West Bunyore	28 233	32 719	60 952	12 262	97	627
Vihiga Division	117 693	137 247	254 940	47 740	368	692
Tiriki	31 937	35 585	67 522	12 037	106	633
Nyang'ori	12 678	14 547	27 225	5 036	48	566
Hamisi Division	44 615	50 132	94 747	17 073	154	612
Butsoiso	21 262	23 109	44 371	8 125	191	231
Bunyala	15 195	16 354	31 549	5 364	160	196
Kakamega Municipality	16 123	15 902	32 025	6 661	47	676
Lurambi Division	52 580	55 365	107 945	20 150	399	270
Isukha	38 431	42 463	80 894	15 177	209	386
Idakho	28 095	31 659	59 754	11 760	139	427
Ikolomani Division	66 526	74 122	140 648	26 937	349	402
South Kabras	25 719	27 164	52 883	8 543	264	199
North Kabras	23 835	25 398	49 233	8 139	186	263
Kabras Division	49 554	52 562	102 116	16 682	451	226
Nzoia	8 367	8 788	17 155	2 643	96	177
Lumakanda	15 790	16 077	31 867	4 801	253	125
Soy	10 178	9 465	19 643	3 234	185	105
Lugari Division	34 335	34 330	68 665	10 678	535	128
Kisa	27 541	32 046	59 587	12 128	143	416
Marama	31 295	34 244	65 539	13 806	201	324
Butere Division	58 836	66 290	125 126	25 934	344	362
North Wanga	23 853	26 575	50 428	12 780	268	188
South Wanga	23 971	25 536	49 507	12 104	148	333
East Wanga	15 399	17 441	32 840	7 184	152	215
Mumias Division	63 223	69 552	132 775	32 068	568	233
Kakamega Forest	2 576	1 349	3 925	808	322	12
Kakamega District	489 938	540 949	1 030 887	198 070	3 495	294

KAKAMEGA DISTRICT

TABLE 5: COMPOSITION OF HOUSEHOLDS
PER
LOCATION AND DIVISION^{a)}

LOCATION/DIVISION	No. of Households total	Farmers Family ^{b)}			Non-Relatives	Persons per Households total ^{b)}
		Adults >15 years	Children < 15 years	Other Relatives		
Location:						
North Maragoli	14695	2.78	1.60	1.03	0.19	5.60
South Maragoli	10756	2.81	1.50	1.04	0.18	5.53
East Bunyore	10013	2.79	1.47	0.78	0.13	5.17
West Bunyore	12275	2.78	1.38	0.69	0.12	4.96
Division Vihiga	47739	2.80	1.48	0.89	0.16	5.33
Location:						
Tiriki	12012	2.89	1.58	0.99	0.16	5.16
Nyang'ori	5020	2.89	1.58	0.81	0.12	5.41
Division Hamisi	17032	2.30	1.58	0.93	0.15	5.55
Location:						
Butsotso	8088	3.05	1.49	0.72	0.18	5.44
Bunyala	5358	3.37	1.74	0.57	0.21	5.89
Kakamega Municipality	6634	2.65	0.96	0.69	0.32	4.62
Division Lurambi	20080	3.00	1.39	0.67	0.23	5.29
Location:						
Isukha	15137	2.98	1.51	0.68	0.14	5.31
Idakho	11787	2.84	1.43	0.70	0.10	5.07
Division Ikolomani	26924	2.92	1.48	0.69	0.12	5.21
Location:						
South Kabras	8506	3.45	1.83	0.68	0.25	6.21
North Kabras	8132	3.35	1.72	0.75	0.19	6.02
Division Kabras	16638	3.39	1.80	0.71	0.22	6.12
Location:						
Nzoia	2644	3.23	1.96	1.02	0.27	6.49
Lumakanda	4793	3.45	2.04	0.92	0.22	6.63
Soy	3223	3.20	1.72	0.77	0.30	5.99
Division Lugari	10660	3.32	1.93	0.90	0.26	6.40
Location:						
Kisa	12169	2.81	1.42	0.54	0.11	4.87
Marama	13793	2.83	1.27	0.55	0.11	4.75
Division Butere	25962	2.82	1.34	0.54	0.11	4.81
Location:						
North Wanga	12772	2.47	0.93	0.42	0.11	3.95
South Wanga	12084	2.57	0.89	0.48	0.13	4.08
East Wanga	7220	2.75	1.17	0.48	0.15	4.55
Division Mumias	32076	2.57	0.97	0.46	0.13	4.13
Location:						
Kakamega Forest	771	2.72	0.62	0.33	0.25	3.92
Division Kakamega Forest	771	2.72	0.62	0.33	0.25	3.92
DISTRICT: KAKAMEGA	197882	2.89	1.42	0.71	0.16	5.18

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, includes one and two persons per household as well.

KAKAMEGA DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION
AND PER
HOUSEHOLD AND PERSON

	in '00 ha = sqkm					in '00 ha = sqkm								in ha	
Location/Division without townships	Area total	Non-agricultural land			Agri- cultu- ral land	Area in agro-ecological zones								Agric. land	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home- steads, rivers...)		A E Z								per	
	Census 79					LH 1	UM 1	UM 2-3	UM 4	LM 1	LM 2	LM 3-4	UM 0	house- hold	person
North Maragoli	110			23	87				85		2			0.59	0.11
South Maragoli	88		F 4	18	66				59		7			0.61	0.11
East Bunyore	72			16	56				44		12			0.56	0.11
West Bunyore	97			20	77				61		16			0.63	0.13
Vihiga Division	367		F 4	77	286				249		37			0.60	0.12
Tiriki	106			22	84				83		1			0.70	0.12
Nyang'ori	48			10	38				36		2			0.75	0.14
Hamisi Division	154			32	122				119		3			0.73	0.13
Butso	191			32	159				2		155	2		1.96	0.36
Bunyala	160		F 7	26	127						43	84		2.37	0.40
Lurambi Division	351		F 7	58	286				2		198	86		2.17	0.38
Isukha	204	1		42	161	1	115	21		6	9	(9)		1.00	0.20
Idakho	139			28	111				13		98			0.94	0.19
Ikolomani Division	343	1		70	272	1	128	21		104	9	(9)		0.97	0.20
South Kabras	264	5		42	217	4	47	14			152			2.54	0.41
North Kabras	186	4		32	150			2	109		20	19		1.84	0.31
Kabras Division	450	9		74	367	4	47	16	109		172	19		2.19	0.36
Nzoia	96			13	83										
Lumakanda	253			28	225			83						3.13	0.48
Soy	185			19	166			225						4.69	0.71
Lugari Division	534			60	474			166						5.13	0.85
								474						4.32	0.68
Kisa	143			29	114					114				0.94	0.19
Marama	201			38	163					163				1.18	0.25
Butere Division	344			67	277					277				1.06	0.22
North Wanga	268			48	220					218	2			1.72	0.44
South Wanga	148			30	118					118				0.98	0.24
East Wanga	152			26	126					126				1.75	0.38
Mumias Division	568			104	464					462	2			1.48	0.35
Total rural area	3 111	10	11	542	2 548	5	545	37	583	1 081	269	19	(9)	1.33	0.26

TABLE 7: LAND SITES IN FORMER SCHEDULED AREAS¹⁾

Cadastral Sheet No	Land Reference No	Area in ha
	11855/R	55.73
	11856	10.72
	11855/1	3.34
	1087	334.68
	1088	60.30
TOTAL DISTRICT		464.77

¹⁾ Compiled for Agricultural Extension and Planning work only; not
to be used in any legal affairs.

Source: Survey of Kenya, December 1980

AGRICULTURAL STATISTICS¹⁾

About 85 % of the district area is covered with infertile Agrisols, but the agricultural research station is situated in the small fertile Nitosols area; thus much of the research information gives a far too optimistic picture of the agricultural potential of the region. The high and well spaced rainfall and the subsequent generally lush vegetation support the erroneous general opinion that the whole district is of high agricultural potential.

Roughly 1,000 ha of coffee is planted yielding 150 kg of clean coffee per ha per year, while the tea area is approximately 2,000 ha in size and produces 1,400 kg of green leaves per ha/year. The productivity of both crops is among the lowest in the country. In addition some sugar cane is grown within the district, but as cane growing can be done only by larger farmers with surplus land, little or no positive effect for the average small-holder is achieved by promoting this crop.

KAKAMEGA DISTRICT

TABLE 8 a: TEA
AREA - PRODUCTION - GROWERS - YIELDS - RETURNS^{a)}

Small Farmers

Division	Item	Unit	Year				
			1975/76	1976/77	1977/78	1978/79	1979/80
Central	Area	ha	440	450	450	460	475
	Production	t	361	431	548	575	632
	Value	'000 Shs	473	1,326	1,135	1,598	1,560
	Growers	No	1,797	1,842	1,847	1,852	1,898
	Yield per ha	kg	820	958	1,218	1,250	1,331
	Value per ha	Shs	1,075	2,950	2,535	3,474	3,234
	Area per Grower	ha	0.24	0.24	0.24	0.25	0.25
	Returns per Grower	Shs	263	720	614	863	822
Vihiga	Area	ha	1,043	1,181	1,226	1,388	1,437
	Production	t	1,010	1,464	1,633	2,003	2,087
	Value	'000 Shs	1,324	4,454	3,382	5,569	5,155
	Growers	No	3,264	3,522	3,747	3,976	4,075
	Yield per ha	kg	968	1,225	1,333	1,443	1,452
	Value per ha	Shs	1,270	3,770	2,758	4,012	3,587
	Area per Grower	ha	0.32	0.34	0.33	0.35	0.35
	Returns per Grower	Shs	406	1,265	902	1,401	1,265

a) Source: K.T.D.A.

¹⁾ Fairly exact statistics exist for industrial crops only; for more detailed and up to date information see FMHB Vol. III A

KAKAMEGA DISTRICT

TABLE 8 b: COFFEE
AREA – PRODUCTION – YIELDS^{a)}

Co-operatives

Item	Unit	Year				
		74/75	75/76	76/77	77/78	79/80
Area	ha	930	930	930	930	1028
Production	t	280	143	163	171	146
Yield	kg/ha	312	154	175	183	142

a) Source: C.B.K.

SMALL FARM SURVEY (SFS)¹⁾

The SFS was mainly carried out in the AEZs UM 1 and LM 1 which cover nearly two-thirds of the district area. The average land area of the farms included is 1.9 ha (UM 1) and 4.5 ha (LM 1 – UM 4), which is somewhat above average.²⁾ Roughly half of the land area is used to produce food crops and one third is under pasture. The cropping intensity is high (1.9) in UM 1, while the above average size farms in LM 1 – UM 4 produce 1 crop p.a. The stocking rate in these farms is also influenced by the existence of grazing possibilities on commonly owned land and is actually lower. The high amount of fertilizer applied to annual crops reflects the low natural fertility of the soils in general (table 9 – 10). Practically all arable land is planted with food crops (table 11). The high maize yields recorded are achieved only on the small Nitosols soil area (table 13). Roughly 10 % of the cattle kept are of improved stock; sheep and goats account for 6 % of the grazing livestock units, the rest are cattle (table 12). The sale of 35 % of the harvested maize to the Marketing Board does not indicate that the district is a food exporter, but rather the high degree of urbanisation i.e. outside employment and purchases of processed staple food by part-time farmers (table 14).

The distribution of farming activities for annual crops is a result of the high and well distributed rainfall, but also indicates the subsistence agriculture farming level practised (Graphs in table 15). The input/output table (16) shows that good yields require heavy dosages of nutrients, but large amounts of organic manure must be added if a lasting overall improvement in soil fertility is to be achieved.³⁾

Due to the number of circumstances, agricultural production and rural development show accelerating negative tendencies which will eventually result in a totally impoverished rural population. Only major efforts centering around soil fertility improvement, expansion of labour-intensive horticultural crops, introduction of semi-zero or zero grazing methods, etc. will help to arrest this undesirable development.

1) For more detailed and up to date information see FMHB Vol. III B

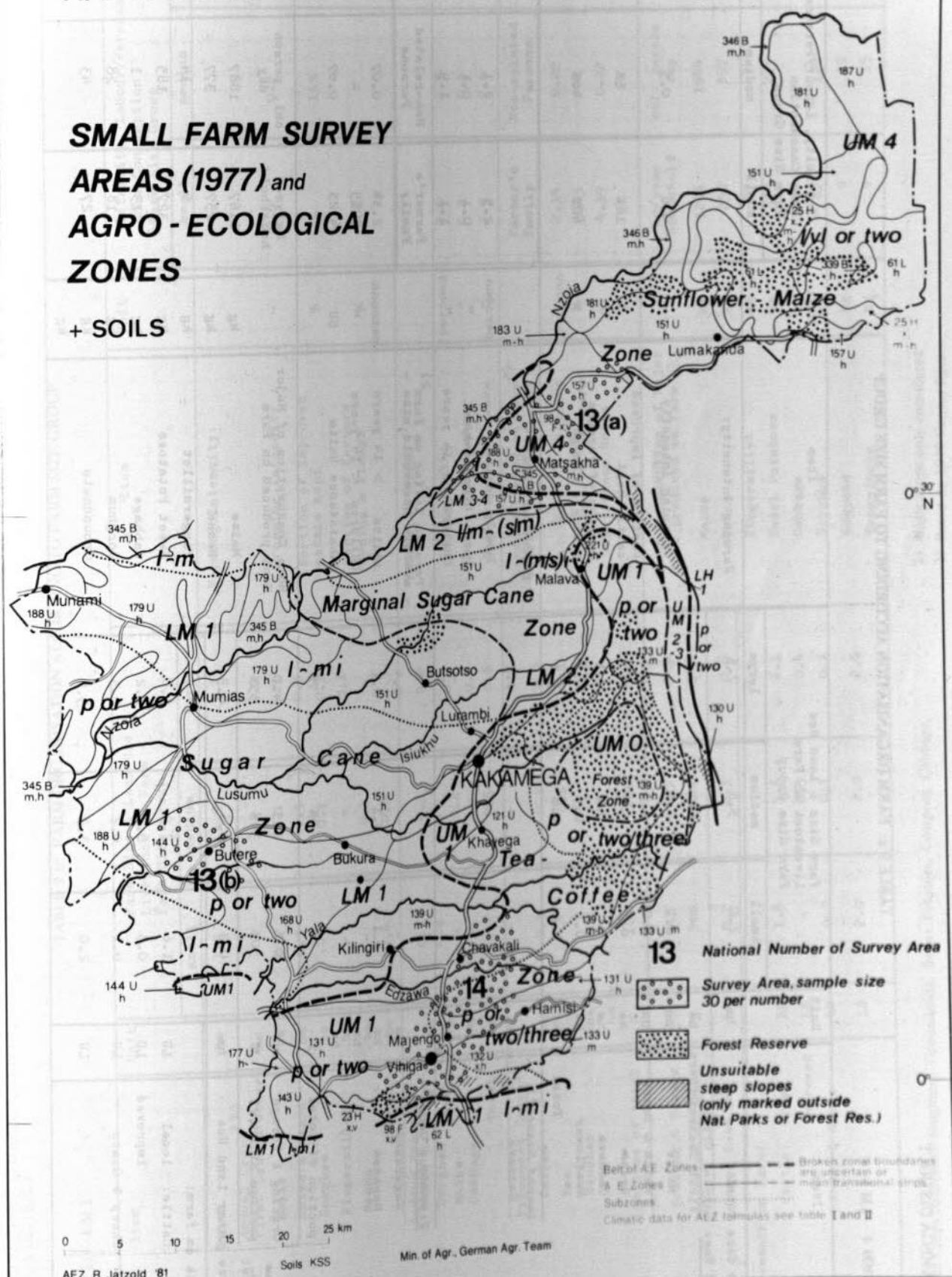
2) See also table 6: AEZ – Land Area

3) See also notes on farm management information, output and nutrient input, page 51

35° E

SMALL FARM SURVEY AREAS (1977) and AGRO-ECOLOGICAL ZONES

+ SOILS



KAKAMEGA DISTRICT

AEZ: UM 4 - LM 1-4

TABLE 9 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 13

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	2.0	3.8	7.3	Farming Intensity:				
Land Use: Annual Crops ¹⁾									
First Season Others	ha	-							
Maize	ha	0.1	0.1	0.1	Cropping Intensity	-	0.6	0.5	0.4
Maize & Beans	ha	0.7	0.8	0.7	Portion of improved cattle kept	%	16%	6%	23%
Beans	ha	0.1	-	0.1	Portion of Farmers owning a Plough	%	40%	40%	80%
Cassava	ha	-	0.1	0.1					
Sunflower	ha	0.1	0.3	0.1					
Total	ha	1.0	1.8	2.3					
Second Season ¹⁾									
Cassava	ha	-	-	0.2	Labour on Farm:	persons	2.5	2.1	2.3
	ha				Family Adults	"	0.1	0.1	0.8
	ha				Perm. Hired Labour	"	1.1	1.9	3.8
Total	ha			0.2					
Permanent Crops ¹⁾									
Sugarcane	ha	-	-	0.4	Persons living on Farm ²⁾	Farmer's Family	2.34	0.07	2.41
Bananas	ha	0.1	0.1	0.1	- average household size -	Non-related Persons	3.15	-	3.15
	ha				Adults > 14 years		4.23	0.07	4.30
portion of total	%	5%	3%	7%					
Grazing & Forage	ha	0.6	1.3	4.0	Home Consumption of Major Food produced on Farm	kg/year household	1167	1887	
portion of total	%	30%	34%	55%			237	377	
Other Land Use	ha	0.3	0.6	0.5	Maize	kg	9	14	
					Beans	kg	327	185	
Livestock on Farm:					Finger millet	kg	13	1	
Cattle: local	LU	1.6	2.9	4.0	Sweet Potatoes	kg	18	28	
improved	LU	0.3	0.2	1.2	Cabbage	kg	27	43	
Sheep & Goats	LU	0.1	0.2	0.3	Sorghum	kg			
					Groundnuts	kg			
Total	LU	2.0	3.3	5.5					

Other Crops cultivated: Pyrethrum, Cowpeas, Groundnuts, Cassava, Sugarcane, Sweet Potatoes

1) Major crops only considered

2) Based on 1979 Census figures

TABLE 9 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: (LM 1) - UM 1

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.0	1.9	3.7	Farming Intensity:	-	0.9	0.8	0.6
Land Use:									
Annual Crops ¹⁾	ha				Cropping Intensity	%	-	16%	16%
First Season: Others	ha	0.1	0.1	0.2	Portion of improved cattle kept	%	30%	-	-
Maize	ha	0.3	0.5	0.8	Portion of Farmers owning a Plough	%	-	-	-
Maize & Beans	ha	-	-	0.1					
Sorghum	ha	-	0.1	0.1					
Finger millet	ha	-	-	-					
Beans	ha	0.4	0.8	1.3					
Total	ha	0.3	0.3	0.2	Labour on Farm:	persons	2.6	2.5	2.1
Second Season ¹⁾	ha	0.1	0.2	0.4	Family Adults	"	0.2	0.5	0.7
Maize & Beans	ha	-	-	-	Farm. Hired Labour	"	2.5	2.6	2.4
Sorghum	ha	-	-	-	Children > 14 years				
Maize	ha	0.4	0.5	0.6	Persons living on Farm ²⁾				
Cabbage	ha				- average household size -				
Total	ha	0.1	0.2	0.2	Adults > 14 years	persons	2.34	0.22	2.55
Permanent Crops¹⁾					Children < 14 years	"	3.43	-	3.43
Coffee	ha	-	-	-	Subsistence Units	SU	4.39	0.22	4.61
Tea	ha	-	-	-					
Bananas	ha	10%	16%	11%					
portion of total	%	0.3	0.5	0.6					
Grazing & Forage	ha	0.3	0.5	1.4	Home Consumption of Major Food produced on Farm				
portion of total	%	30%	26%	38%	Maize	kg	1206	1944	
Other Land Use	ha	0.2	0.3	0.6	Beans	kg	250	397	
Livestock on Farm:					Finger millet	kg	45	70	
Cattle: local	LU	1.8	1.6	2.1	Sweet Potatoes	kg	379	215	
improved	LU	-	0.3	0.4	Cabbage	kg	4		
Sheep & Goats	LU	0.2	0.1	0.1	Sorghum	kg	82	128	
Total	LU	2.0	2.0	2.6	Cowpeas	kg	9	15	
					Groundnuts	kg	9	15	

1) Major crops only considered

2) Based on 1979 Census figures

Other Crops cultivated: Sorghum, Groundnuts, Sweet Potatoes, Cowpeas, Cabbage,

Arrowroots

KAKAMEGA DISTRICT

TABLE 10 a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS
AEZ: UM 4 - LM 1-4

Survey Area 13

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children >14 No.
Avg. 0	4.5	9.1	0.9	2.4	0.4	2.4
Avg. 1	4.5	10.1	1.4	2.4	1.7	3.4
Up. Qu.	6.0	12.0	1.0	3.0	-	4.0
Lo. Qu.	2.4	4.0	-	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	1.7	38	0.3	6	2.1	45	-	1	0.3	6	0.2	4
Avg. 1	1.7	31	0.5	9	2.1	39	0.5	8	0.5	10	0.2	4
Up. Qu.	2.4	53	0.3	11	2.7	50	-	-	0.4	13	0.2	8
Lo. Qu.	0.9	31	-	-	0.6	19	-	-	-	-	0.1	2
Total	51.0		8.0		61.6		0.9		8.2		6.0	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.9	0.8	1.8	17.3
Avg. 1			1.8	65.3
Up. Qu.	1.0	1.4	5.9	-
Lo. Qu.	0.8	0.5	0.9	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	57.3	2.5	-	8.5	-	0.1	-	-	-	0.1	-	-	-
Avg. 1	58.0	12.3	-	13.8	-	2.7	-	0.1	0.1	1.8	-	-	-
Up. Qu.	100.0	-	-	21.1	-	-	-	-	-	-	-	-	-
Lo. Qu.	69.0	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of farms, excluding zero entries
Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points
AC = Annual Crops
PC = Perennial Crops

KAKAMEGA DISTRICT

TABLE 10 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: (LM 1) -UM 1

Survey Area 14

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children >14 No.
Avg. 0	1.9	5.2	0.5	2.4	0.4	2.5
Avg. 1	1.9	5.4	1.3	2.4	1.3	3.0
Up. Qu.	2.4	7.0	1.0	2.0	1.0	4.0
Lo. Qu.	1.1	3.0	-	2.0	-	1.0

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	0.8	43	0.3	15	0.6	31	-	1	-	3	0.1	7
Avg. 1	0.8	35	0.3	14	0.6	28	0.2	9	0.2	8	0.1	6
Up. Qu.	1.2	52	0.3	20	0.7	40	-	-	0.1	4	0.2	9
Lo. Qu.	0.4	32	0.1	6	0.1	11	-	-	-	-	0.1	4
Total	23.2		8.3		16.7		0.8		1.4		3.8	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.9	1.1	3.7	10.1
Avg. 1			3.4	57.0
Up. Qu.	2.0	1.9	6.6	-
Lo. Qu.	1.5	0.7	1.3	-

Inputs Applied

Inputs Applied													
Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
	AC												
Avg. 0	37.1	6.7	3.6	20.2	1.8	0.4	0.1	-	-	1.2	0.4	-	-
Avg. 1	39.5	16.4	9.5	23.2	6.0	12.5	3.8	0.2	0.2	3.3	1.1	0.5	1.1
Up. Qu.	37.0	9.1	6.3	30.8	-	-	-	-	-	1.9	0.2	-	0.7
Lo. Qu.	-	-	-	3.2	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of farms, excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50 % of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

KAKAMEGA DISTRICT

TABLE 11 a: CROPPING PATTERN

AEZ: UM 4 – LM 1-4

Survey Area 13

First Rains Annual & Semipermanent Crops						
Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.5	1.8	0.80	0.00	14.6	25.4
Sorghum	0.0	0.2	0.00	0.00	0.6	1.0
Fingermillet	0.0	0.3	0.00	0.00	0.6	1.0
Beans	0.0	0.5	0.00	0.00	1.0	1.7
Cowpeas IPC	0.0	0.2	0.00	0.00	0.2	0.4
Groundnuts	0.0	0.2	0.00	0.00	0.8	1.4
Bambara GNuts	0.0	0.2	0.00	0.00	0.2	0.3
Sunflower	0.1	1.0	0.00	0.00	3.8	6.6
Cabbage	0.0	0.2	0.00	0.00	0.4	0.7
Arrow Roots	0.0	0.1	0.00	0.00	0.1	0.2
Cassava	0.1	0.3	0.20	0.00	2.8	4.9
Sweet Potatoes	0.0	0.2	0.12	0.00	1.2	2.2
Sugarcane	0.1	0.6	0.12	0.00	4.0	6.9
Maize & Beans	0.9	1.3	1.40	0.00	27.2	47.3
Total					57.6	100.0

Second Rains Annual & Semipermanent Crops						
Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sorghum	0.0	0.3	0.00	0.00	0.3	3.2
Cowpeas IPC	0.0	0.2	0.00	0.00	0.2	2.8
Groundnuts	0.0	0.3	0.00	0.00	0.5	6.0
Bambara GNuts	0.0	0.0	0.00	0.00	0.0	0.5
Sunflower	0.0	0.4	0.00	0.00	0.8	9.3
Cassava	0.1	0.3	0.20	0.00	2.8	32.4
Sugarcane	0.1	0.6	0.12	0.00	4.0	45.8
Total					8.6	100.0

Permanent Crops						
Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sweet Bananas	0.0	0.1	0.00	0.00	0.1	8.1
Cookng Bananas	0.0	0.2	0.12	0.00	1.4	91.9
Total					1.5	100.0

- Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points
% columns = % of total farm land

KAKAMEGA DISTRICT

TABLE 11 b: CROPPING PATTERN

AEZ: (LM 1) - UM 1

Survey Area 14

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.1	0.5	0.00	0.00	1.6	6.7
Sorghum	0.1	0.2	0.12	0.00	1.8	7.4
Fingermillet	0.0	0.1	0.00	0.00	0.7	3.0
Beans	0.0	0.8	0.00	0.00	0.8	3.4
Beans IPC	0.0	0.3	0.00	0.00	0.3	1.2
Cowpeas	0.0	0.2	0.00	0.00	0.4	1.7
Groundnuts	0.0	0.1	0.00	0.00	0.2	1.0
Cabbage	0.0	0.1	0.00	0.00	0.4	1.8
Cassava	0.0	0.1	0.00	0.00	0.1	0.5
Sweet Potatoes	0.0	0.1	0.00	0.00	0.4	1.5
Sugarcane	0.0	0.1	0.00	0.00	0.3	1.2
Pyrethrum	0.0	0.1	0.00	0.00	0.1	0.5
Maize & Beans	0.5	0.6	0.80	0.20	15.7	65.9
Maize & Others	0.0	0.8	0.00	0.00	0.8	3.4
FMLt & Sorghum	0.0	0.2	0.00	0.00	0.2	0.8
Total					23.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.1	0.6	0.00	0.00	2.4	11.2
Sorghum	0.0	0.2	0.00	0.00	1.1	5.0
Beans IPC	0.0	0.3	0.00	0.00	0.3	1.3
Cowpeas	0.0	0.2	0.00	0.00	0.4	1.9
Cabbage	0.0	0.2	0.00	0.00	7.2	33.5
Cassava	0.2	7.2	0.00	0.00	0.1	0.6
Sweet Potatoes	0.0	0.1	0.00	0.00	0.1	0.6
Sugarcane	0.0	0.1	0.00	0.00	0.1	0.6
Pyrethrum	0.0	0.1	0.00	0.00	0.3	1.3
Maize & Beans	0.0	0.1	0.00	0.00	0.1	0.6
Maize & Beans	0.3	0.5	0.40	0.00	9.5	44.2
Total					21.5	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Sweet Bananas	0.0	0.0	0.00	0.00	0.0	0.5
Cookng Bananas	0.0	0.2	0.08	0.00	1.2	16.1
Coffee	0.0	0.2	0.20	0.08	5.0	65.6
Tea	0.2	0.2	0.00	0.00	1.4	17.7
Total	0.0	0.3			7.7	100.0

Avg 0 = average of all sample farms
 Avg 1 = average of all farms excluding zero entries
 Up.Qu./Lo. Qu. = Upper/Lower Quartile, 50 % of all sample cases are in between these points
 % columns = % of total farm land

KAKAMEGA DISTRICT

AEZ: UM 4 - LM 1-4
Livestock Unit (LU)

TABLE 12 a: HERD COMPOSITION (GRAZING LIVESTOCK)
- in Head and Livestock Units -

Nov. '77, Survey Area 13

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average Upper Qu.		0.13	-	-	0.13	-	-	-	0.07	-	-	0.07
1 - 2 years, Average Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average Upper Qu.		-	-	-	0.23	-	-	-	0.12	-	-	0.12
Subtotal(improved) Total		-	-	0.03	-	0.43	-	-	-	-	-	-
Average		4	-	1	11	13	-	-	19.3	-	-	19.3
Upper Qu.		0.13	-	0.03	0.37	0.43	-	-	0.64	-	-	0.64
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle = 9.3 % of total cattle,		Calves + Heifers = 84.6 % of dairy cows										
Unimproved Livestock:												
Under 1 year, Average Upper Qu.		1.10	-	0.03	0.63	-	0.47	0.33	0.43	-	-	0.43
1 - 2 years, Average Upper Qu.		1	-	-	1	-	1	-	0.5	-	-	0.5
Over 2 years, Average Upper Qu.		0.20	-	0.17	0.47	-	-	-	0.37	-	-	0.37
Subtotal (unimp.) Total		-	-	-	1	-	-	-	0.5	-	-	0.5
Average		0.23	0.07	1.30	-	1.67	0.90	0.53	2.27	-	15.27	2.27
Upper Qu.		-	-	2	-	3	2	1	-	-	5	-
Lower Qu.		46	2	45	33	50	41	26	92.3	-	458	92.3
LU Male Cattle = 50.2 % of total cattle,		Calves + Heifers = 66.0 % of dairy cows										
LU Goats + Sheep = 7.3 % of total Grazing Livestock Units												
Improved + Unimproved Grazing L/Stock		50	2	46	44	63	41	26	111.6	-	458	111.6
Average		1.67	0.07	1.53	1.47	2.10	1.37	0.87	3.72	-	15.27	3.72
Upper Qu.		2	-	4	3	3	2	1	5.5	-	20	5.0
Lower Qu.		-	-	-	-	1	-	-	1.6	-	5	1.3
LU Male Cattle = 42.7 % of total cattle,		Calves + Heifers = 69.3 % of dairy cows										
LU Goats + Sheep = 6.0 % of total Grazing Livestock Units												

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

KAKAMEGA DISTRICT

TABLE 12 b: HERD COMPOSITION (GRAZING LIVESTOCK)

Nov. '77, Survey Area 14
 - in Head and Livestock Units -

AEZ: (LM 1) - UM 1

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average		-	-	-	0.07	-	-	-	0.02	-	-	0.02
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
1 - 2 years, Average		0.03	-	-	0.03	-	-	-	0.03	-	-	0.03
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Over 2 years, Average		-	-	-	-	0.17	-	-	0.17	-	-	0.17
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Subtotal(improved) Total		1	-	-	3	5	-	-	6.5	-	-	6.5
Average		0.03	-	-	0.10	0.17	-	-	0.22	-	-	0.22
Upper Qu.		-	-	-	-	-	-	-	-	-	-	-
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		7.7 % of total cattle, Calves + Heifers = 60.0 % of dairy cows										
Unimproved Livestock:												
Under 1 year, Average		0.27	-	-	0.53	-	-	0.67	0.23	-	-	0.23
Upper Qu.		1	-	-	1	-	-	1	0.5	-	-	0.5
1 - 2 years, Average		0.07	-	-	0.63	-	-	-	0.31	-	-	0.31
Upper Qu.		-	-	-	1	-	-	-	0.5	-	-	0.5
Over 2 years, Average		-	-	-	-	2.03	0.17	0.27	1.39	-	17.77	1.39
Upper Qu.		-	-	-	-	2	-	1	0.7	-	6	0.7
Subtotal (unimp.) Total		10	-	-	35	61	5	37	58.1	-	533	58.1
Average		0.33	-	-	1.17	2.03	0.17	1.23	1.94	-	17.77	1.94
Upper Qu.		1	-	-	2	2	-	2	2.4	-	25	2.4
Lower Qu.		-	-	-	-	1	-	-	1.3	-	6	1.3
LU Male Cattle =		4.6 % of total cattle, Calves + Heifers = 57.4 % of dairy cows										
LU Goats + Sheep =		7.2 % of total Grazing Livestock Units										
Improved + Unimproved		11	-	-	38	66	5	37	64.6	-	533	64.6
Grazing L/Stock Total		0.37	-	-	1.27	2.20	0.17	1.23	2.15	-	17.77	2.15
Average		1	-	-	2	2	-	2	2.5	-	25	2.5
Upper Qu.		-	-	-	-	1	-	-	1.3	-	6	1.3
Lower Qu.		-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =		5.0 % of total cattle, Calves + Heifers = 57.6 % of dairy cows										
LU Goats + Sheep =		6.5 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1-2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU
 Unimproved Stock = Under 1 year 0.20 LU, 1-2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU
 Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

KAKAMEGA DISTRICT

TABLE 13 a: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: UM 4 - LM 1-4

Survey Area 13

Crop		Imp- roved Seeds %	Inputs						Yield kg/ha
			N kg/ha	Nutrients			Chemicals		
				P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	89	26	31	1	0.03	-	-	5,721
	UpQu	100	34	77	-	-	-	-	3,000
	LoQu	100	-	-	-	-	-	-	1,800
Groundnuts	Avg.	-	-	-	-	-	-	-	1,327
	UpQu	-	-	-	-	-	-	-	1,400
	LoQu	-	-	-	-	-	-	-	600
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	5,312
	UpQu	-	-	-	-	-	-	-	4,167
	LoQu	-	-	-	-	-	-	-	2,667
<u>Maize & Beans</u>									
Maize	Avg.	100	9	33	-	0.05	1	-	2,779
Beans	Avg.	5	-	4	-	0.04	-	-	245
Maize	UpQu	100	-	60	-	-	-	-	3,150
Beans	UpQu	-	-	-	-	-	-	-	450
Maize	LoQu	100	-	-	-	-	-	-	1,841
Beans	LoQu	-	-	-	-	-	-	-	100
<u>Second Rains</u>									
Sunflower	Avg.	100	4	12	1	-	-	-	575
	UpQu	100	-	-	-	-	-	-	1,000
	LoQu	100	-	-	-	-	-	-	-
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	47,567
<u>Perennial Crops</u>									
Cassava	Avg.	-	-	-	-	-	-	-	3,545
	UpQu	-	-	-	-	-	-	-	5,000
	LoQu	-	-	-	-	-	-	-	2,200
Sugarcane	Avg.	-	-	-	-	-	-	-	2,963
	UpQu	-	-	-	-	-	-	-	-
	LoQu	-	-	-	-	-	-	-	-
Cookng Bananas	Avg.	-	-	-	-	0.60	-	-	8,255
	UpQu	-	-	-	-	-	-	-	4,550
	LoQu	-	-	-	-	-	-	-	-

KAKAMEGA DISTRICT

TABLE 13 b: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: (LM 1) - UM 1

Survey Area 14

Crop		Inputs							Yield kg/ha
		Imp- roved Seeds t	Nutrients				Chemicals		
			N kg/ha	P ₂ O ₅ kg/ha	K ₂ O kg/ha	Manure t/ha	Insec. kg/ha	Fung- icide kg/ha	
<u>First Rains</u>									
Maize	Avg.	83	8	32	-	-	3	-	3,071
	UpQu	100	-	58	-	-	-	-	3,150
	LoQu	-	-	-	-	-	-	-	2,025
Sorghum	Avg.	-	-	-	-	-	-	-	761
	UpQu	-	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	450
Maize & Beans									
Maize	Avg.	87	13	48	-	0.03	2	-	2,511
Beans	Avg.	-	1	3	-	0.03	-	-	493
Maize	UpQu	100	24	60	-	-	4	-	3,150
Beans	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	100	-	9	-	-	-	-	1,950
Beans	LoQu	-	-	-	-	-	-	-	200
<u>Second Rains</u>									
Sorghum	Avg.	-	-	-	-	-	-	-	863
	UpQu	-	-	-	-	-	-	-	950
	LoQu	-	-	-	-	-	-	-	450
Maize & Beans									
Maize	Avg.	52	6	38	-	-	4	4	2,016
Beans	Avg.	-	-	-	-	-	-	-	411
Maize	UpQu	100	-	60	-	-	-	-	2,500
Beans	UpQu	-	-	-	-	-	-	-	500
Maize	LoQu	-	-	-	-	-	-	-	1,050
Beans	LoQu	-	-	-	-	-	-	-	175
<u>Perennial Crops</u>									
Cooking Bananas	Avg.	-	-	-	-	0.34	-	-	20,958
	UpQu	-	-	-	-	-	-	-	18,000
	LoQu	-	-	-	-	-	-	-	6,750
Coffee	Avg.	-	40	29	1	0.53	5	7	3,820
	UpQu	-	94	-	-	-	3	13	5,000
	LoQu	-	-	-	-	-	-	-	1,214

KAKAMEGA DISTRICT

TABLE 14 a: DISPOSAL OF CROPS

AEZ: UM 4 – LM 1-4

Survey Area 13

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	38,340	12,150	32	9,710	25	16,480	43
Maize & Beans	82,473	17,320	21	15,725	19	49,428	60
Beans	1,304	530	41	0	0	774	59
Fingermillet	675	0	0	415	61	260	39
Sorghum	600	0	0	135	23	465	78
Cowpeas	180	0	0	180	100	0	0
Cowpeas IPC	22	0	0	0	0	22	100
Groundnuts	972	0	0	710	73	262	27
Bambara GNuts	280	0	0	210	75	70	25
Sweet Potatoes	2,870	0	0	1,500	52	1,370	48
Sunflower	450	450	100	0	0	0	0
Cabbage	2,400	0	0	2,000	83	400	17
Arrow Roots	2,250	0	0	900	40	1,350	60
<u>Second Rains</u>							
Sorghum	90	0	0	0	0	90	100
Cowpeas IPC	22	0	0	0	0	22	100
Groundnuts	1,360	800	59	0	0	560	41
Bambara GNuts	50	0	0	0	0	50	100
Sweet Potatoes	28,540	0	0	450	2	28,090	98
Sunflower	1,400	1,400	100	0	0	0	0
<u>Permanent Crops</u>							
Nil							

KAKAMEGA DISTRICT

TABLE 14 b: DISPOSAL OF CROPS

AEZ: (LM 1) – UM 1

Survey Area 14

Crops	Production kg	Marketing Board		Local Market		Home Consumption	
		kg	%	kg	%	kg	%
<u>First Rains</u>							
Maize	11,470	4,270	37	1,000	9	6,200	54
Maize & Beans	41,871	0	0	16,855	40	25,016	60
Maize & Others	2,870	0	0	980	34	1,890	66
Beans IPC	640	270	42	160	25	210	33
Fingermillet	700	0	0	135	19	565	81
FMI & Sorghum	990	0	0	0	0	990	100
Sorghum	1,475	0	0	40	3	1,435	97
Cowpeas	350	0	0	190	54	160	46
Groundnuts	80	0	0	0	0	80	100
Sweet Potatoes	6,760	0	0	380	6	6,380	94
Cabbage	1,350	0	0	1,230	91	120	9
<u>Second Rains</u>							
Maize	2,750	0	0	0	0	2,750	100
Maize & Beans	24,862	0	0	6,485	26	18,377	74
Beans IPC	640	360	56	160	25	120	19
Sorghum	820	0	0	0	0	820	100
Cowpeas	120	0	0	0	0	120	100
Groundnuts	200	0	0	0	0	200	100
Sweet Potatoes	5,000	0	0	0	0	5,000	100
<u>Permanent Crops</u>							
Nil							

KAKAMEGA DISTRICT

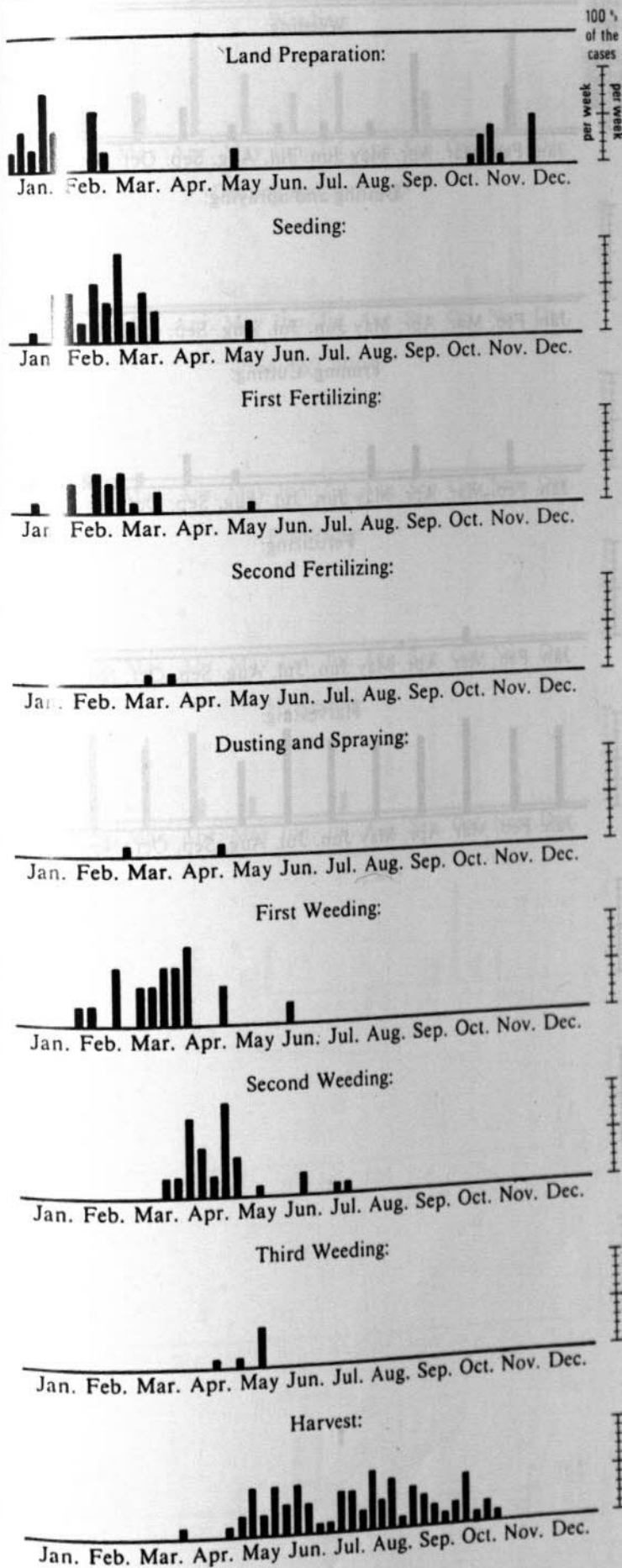
TABLE 15 a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 44¹⁾

AEZ: UM 4 - LM 1-4

Survey Area 13

Sample Size: 30



KAKAMEGA DISTRICT

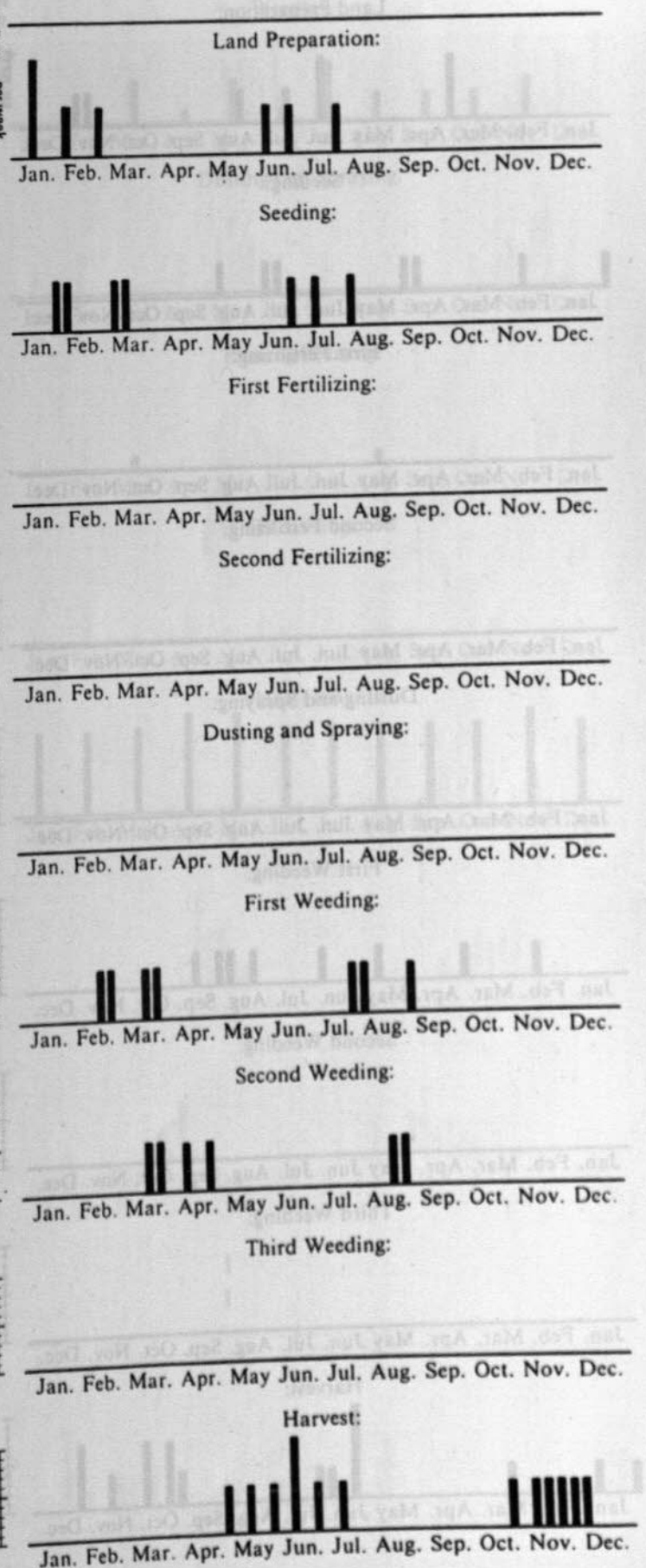
TABLE 15 b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 24 Groundnuts Cases: 7

AEZ: UM 4 - LM 1-4

Survey Area 13

Sample Size: 30

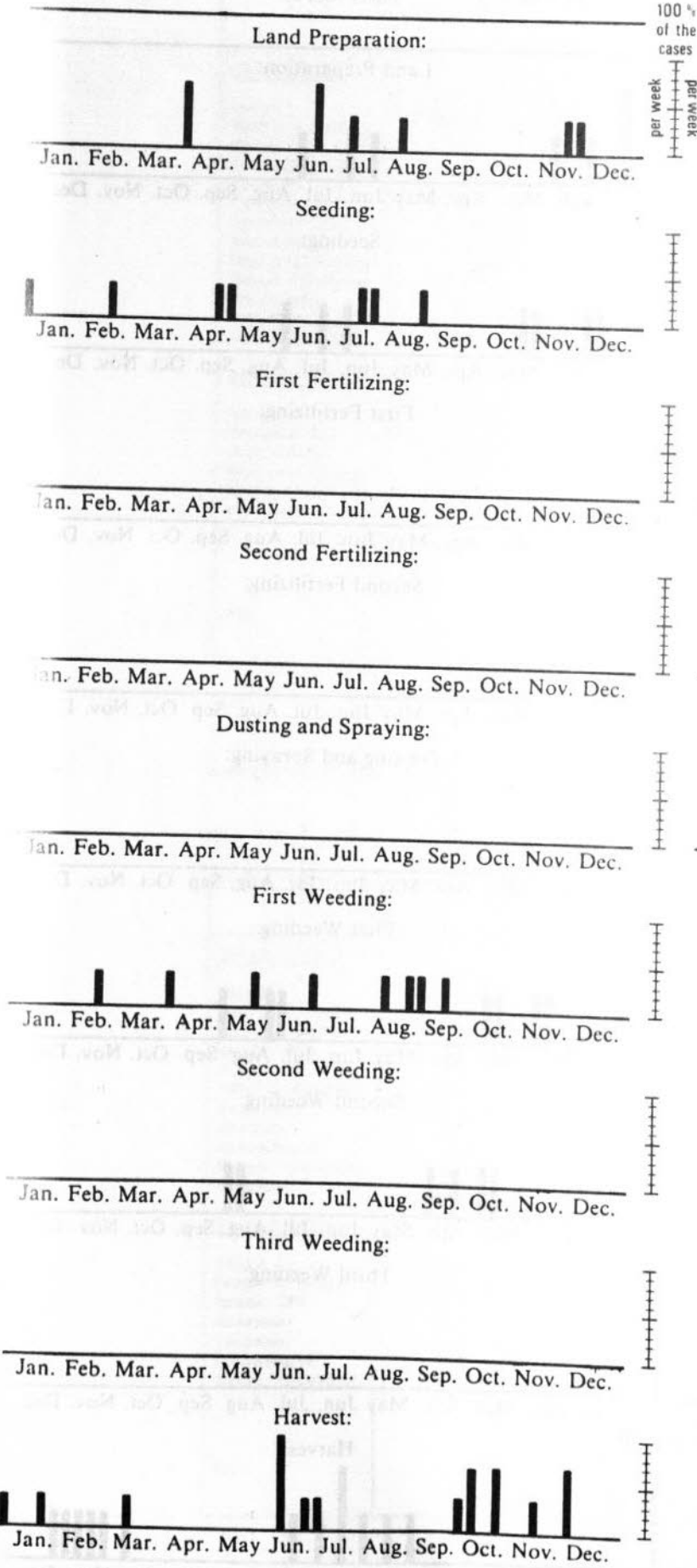


1) Maximum 30 per crop and season

KAKAMEGA DISTRICT

TABLE 15 c: DISTRIBUTION OF FARMING ACTIVITIES

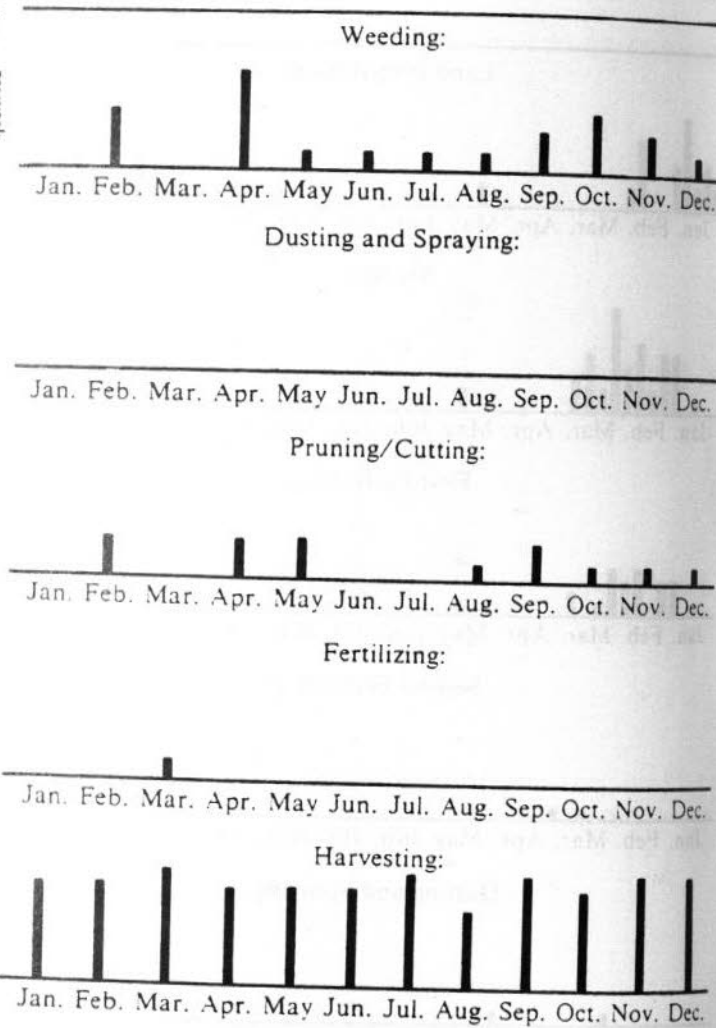
Crop 30 Sweet Potatoes Cases: 8
AEZ: UM 4 – LM 1–4 Survey Area 13 Sample Size: 30



KAKAMEGA DISTRICT

TABLE 15 d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 7
AEZ: UM 4 – LM 3–4 Survey Area 13 Sample Size: 30



KAKAMEGA DISTRICT

TABLE 15 e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 63

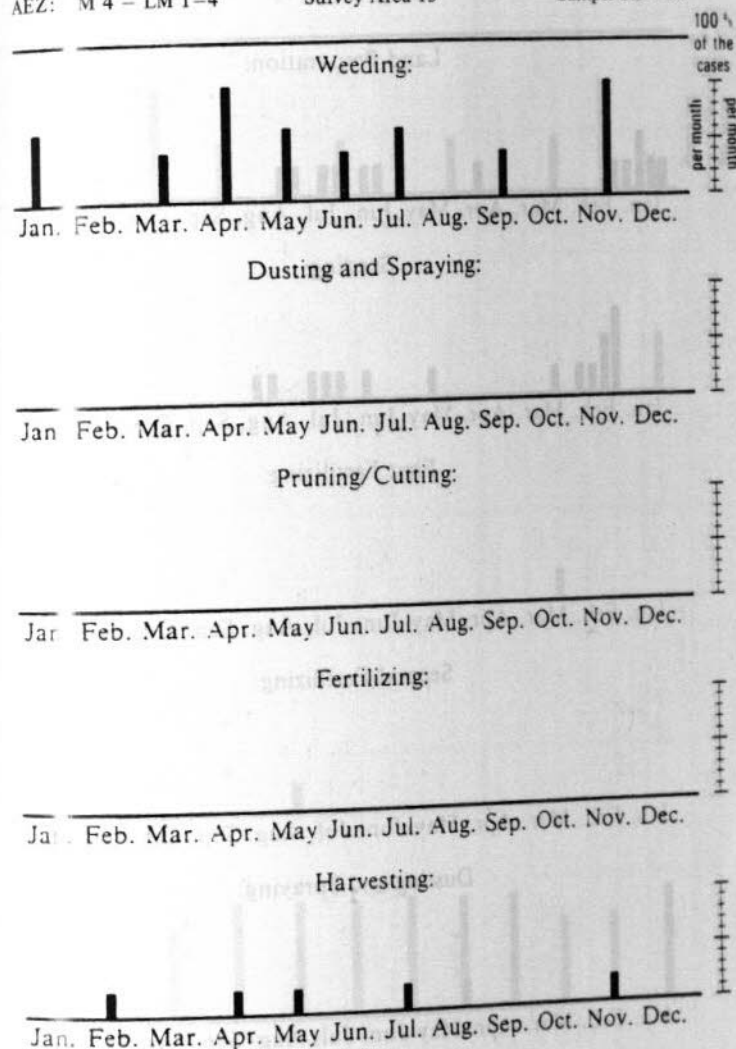
Sugarcane

Cases: 9

AEZ: M 4 - LM 1-4

Survey Area 13

Sample Size: 30



KAKAMEGA DISTRICT

TABLE 15 f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 64

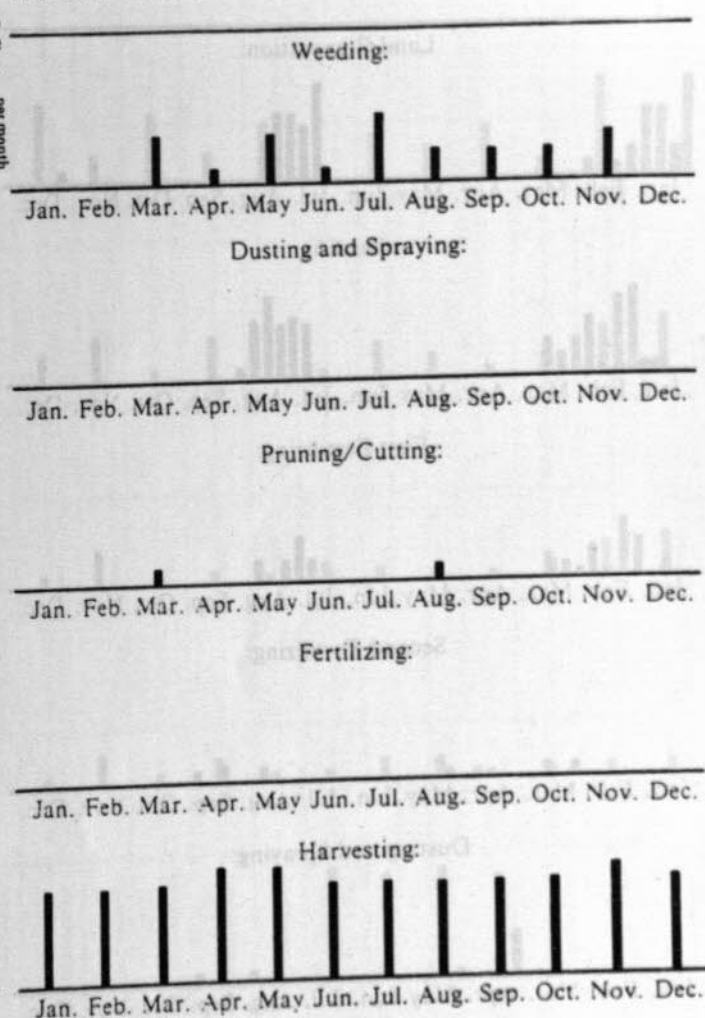
Cassava

Cases: 10

AEZ: UM 4 - LM 1-4

Survey Area 13

Sample Size: 30

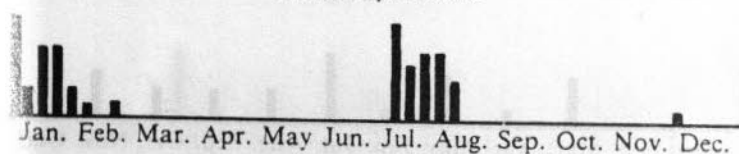


KAKAMEGA DISTRICT

TABLE 15 g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 60¹⁾
AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30

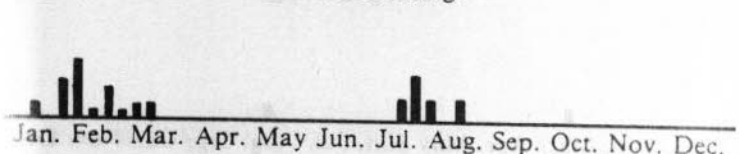
Land Preparation:



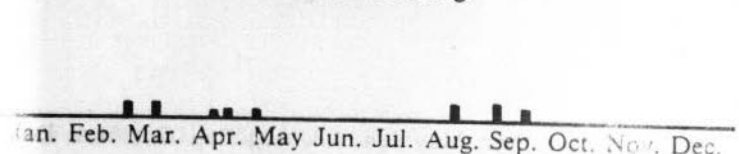
Seeding:



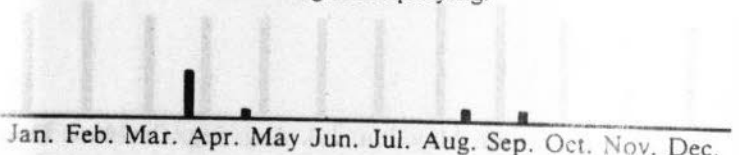
First Fertilizing:



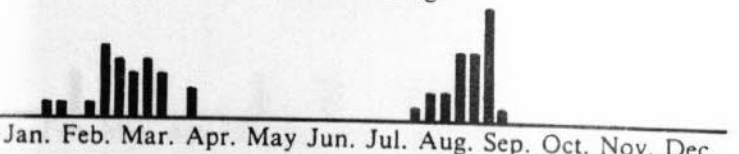
Second Fertilizing:



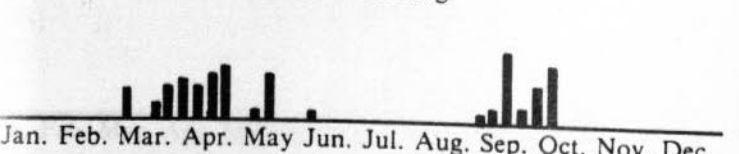
Dusting and Spraying:



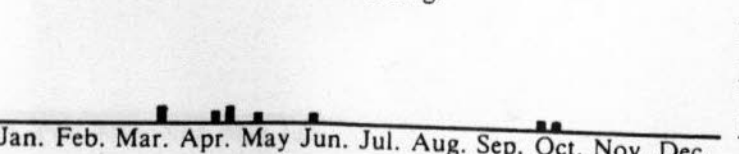
First Weeding:



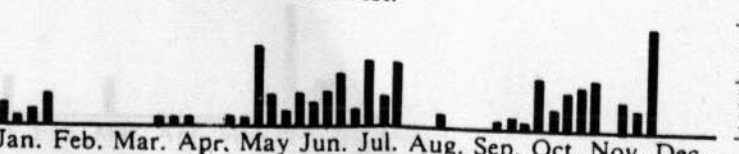
Second Weeding:



Third Weeding:



Harvest:



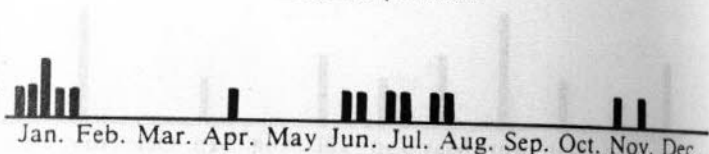
1) Maximum 30 per crop and season

KAKAMEGA DISTRICT

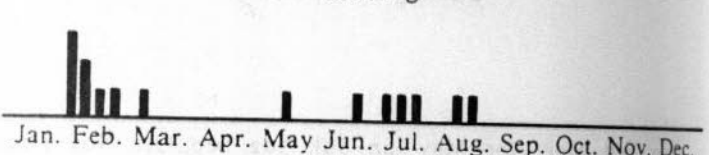
TABLE 15 h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 18 Sorghum Cases: 16
AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30

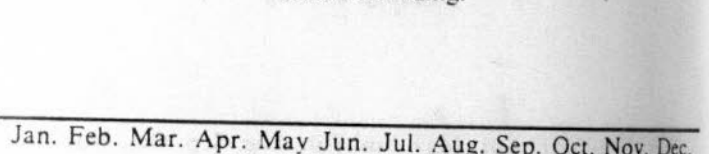
Land Preparation:



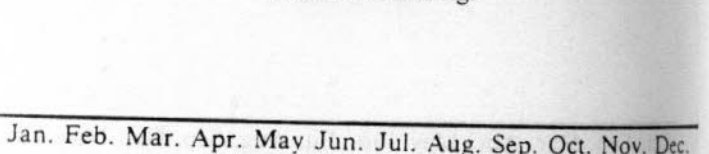
Seeding:



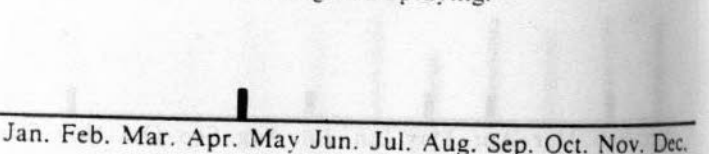
First Fertilizing:



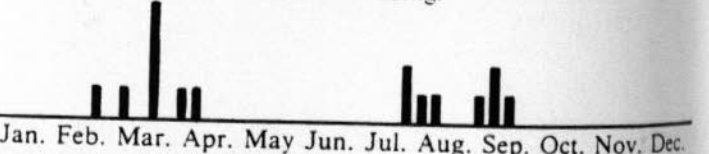
Second Fertilizing:



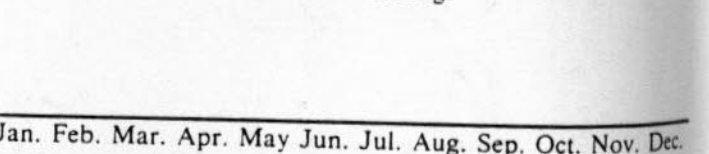
Dusting and Spraying:



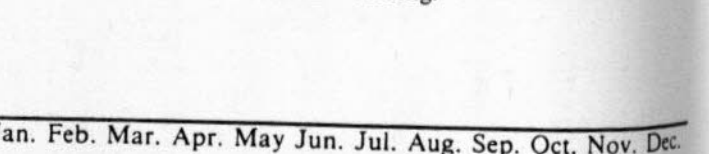
First Weeding:



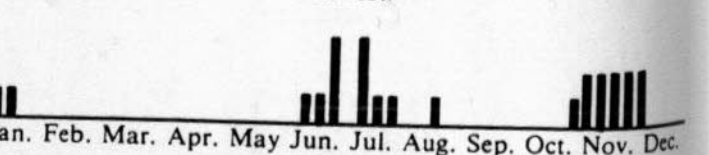
Second Weeding:



Third Weeding:



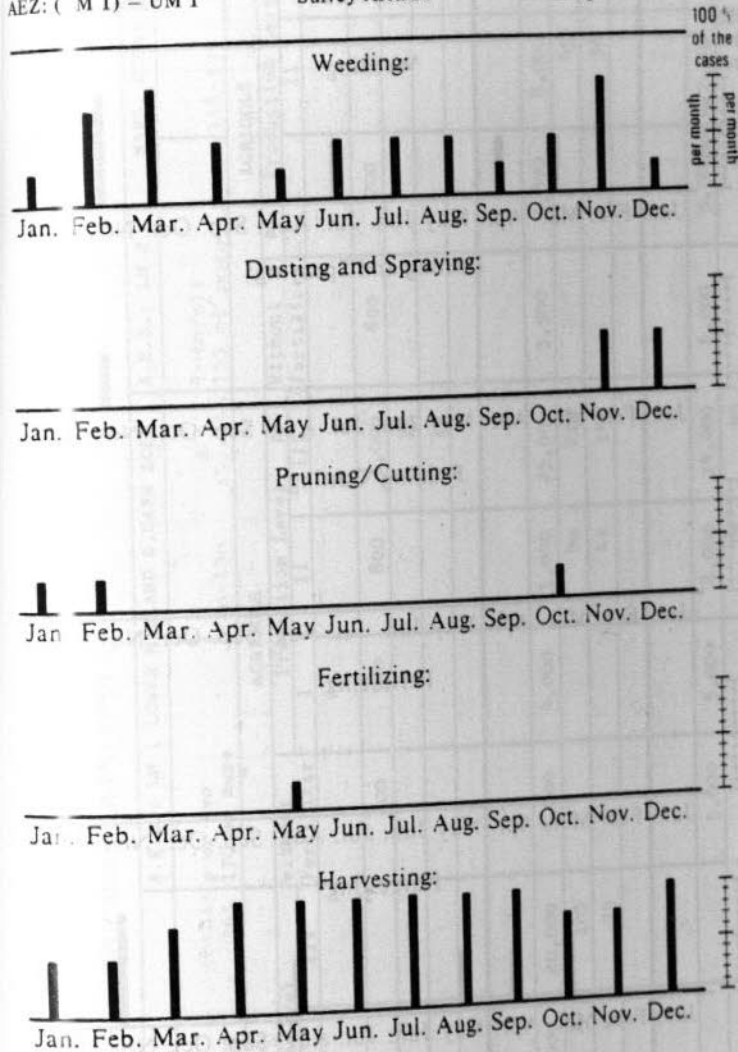
Harvest:



KAKAMEGA DISTRICT

TABLE 15 i: DISTRIBUTION OF FARMING ACTIVITIES

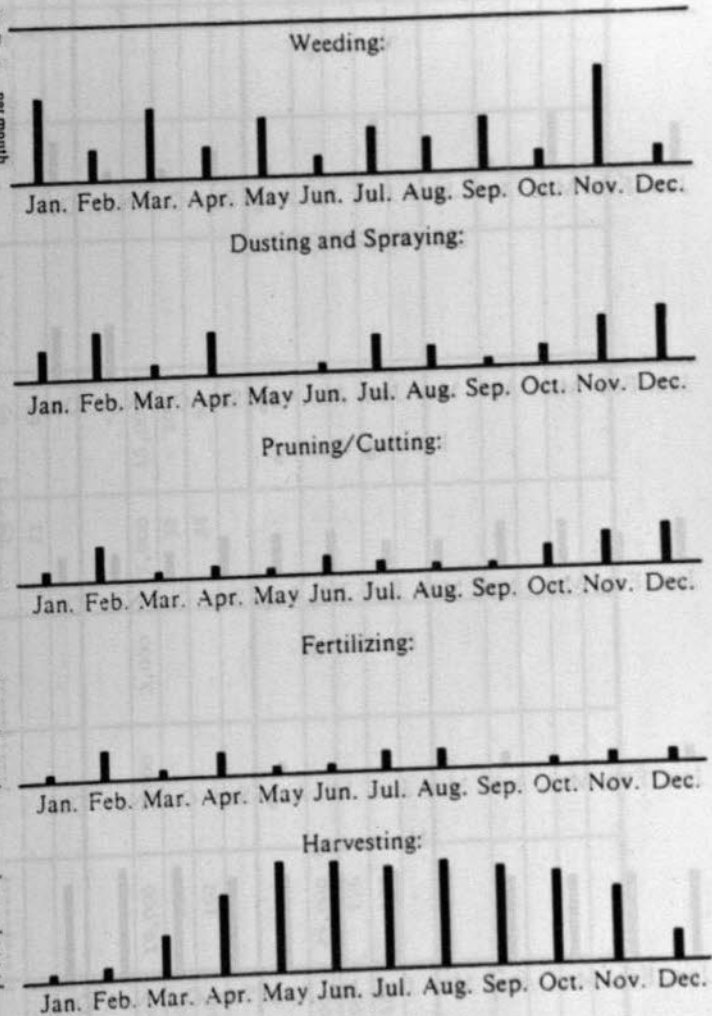
Crop 50 Tea Cases: 4
AEZ: (M 1) - UM 1 Survey Area 14 Sample Size: 30



KAKAMEGA DISTRICT

TABLE 15 j: DISTRIBUTION OF FARMING ACTIVITIES

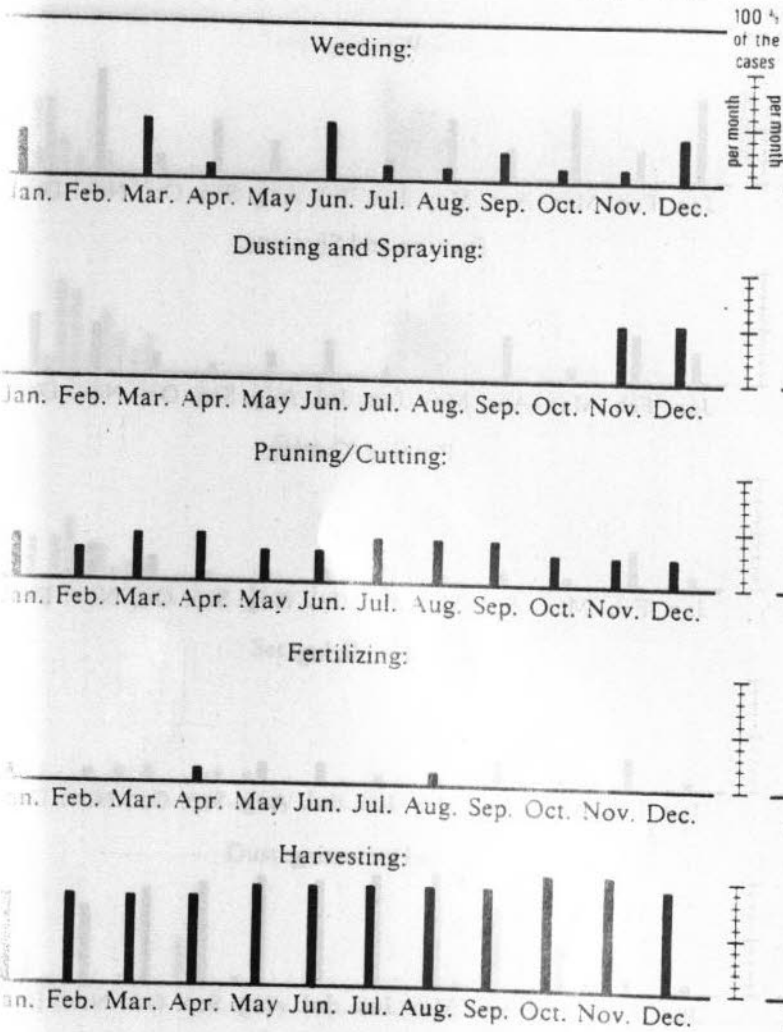
Crop 51 Coffee Cases: 25
AEZ: (LM 1) - UM 1 Survey Area 14 Sample Size: 30



KAKAMEGA DISTRICT

TABLE 15 k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 8
AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30



KAKAMEGA DISTRICT

TABLE 15 l: DISTRIBUTION OF FARMING ACTIVITIES

Crop 63 Sugarcane Cases: 3
AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30

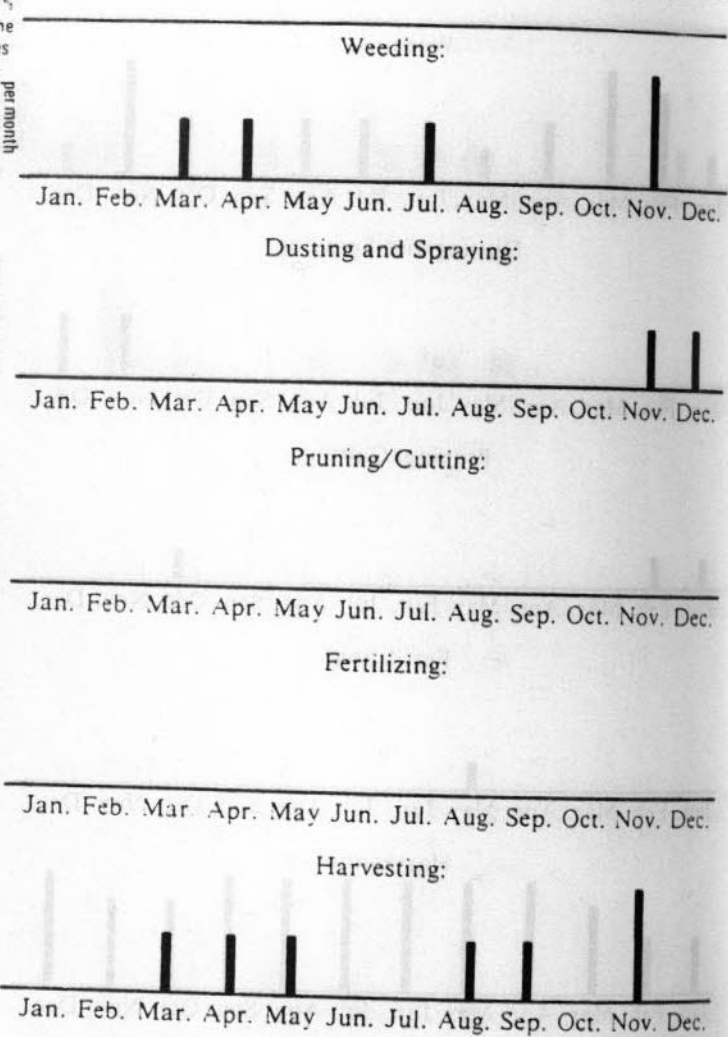


TABLE 16 a: PRODUCTION LEVELS PER CROP AND AGRICULTURAL ZONE
OUTPUT AND NUTRIENT INPUT

A.E.Z.: UM 1 COFFEE-TTA ZONE				A.E.Z.: LM 1 LOWER MIDLAND S.CANE ZONE				A.E.Z.: LM 2				MARG. SUGAR CANE ZONE			
Vegt. Period 1st + 2nd: in Days, 1st: 150 or more	p or two/three 1st: 150 or more	2nd: 210-215	total: 365	ACRISOLS			ACRISOLS			ACRISOLS			ACRISOLS		
				Without Fertilizer	Production Level I II III	Without Fertilizer	Production Level I II III	Without Fertilizer	Production Level I II III	Without Fertilizer	Production Level I II III				
CROP: GROUNDNUTS															
Farmers in Production Level	%														
Yields	kg														
Fertilizer N	kg														
P2O5	kg														
K2O	kg														
CROP: SWEET POTATOES															
Farmers in Production Level	%														
Yields	kg														
Fertilizer N	kg														
P2O5	kg														
K2O	kg														
CROP: CASSAVA															
Farmers in Production Level	%														
Yields	kg														
Fertilizer N	kg														
P2O5	kg														
K2O	kg														
CROP: CABBAGE															
Farmers in Production Level	%														
Yields	kg														
Fertilizer N	kg														
P2O5	kg														
K2O	kg														
CROP: SUKUMAWIKI															
Farmers in Production Level	%														
Yields	kg														
Fertilizer N	kg														
P2O5	kg														
K2O	kg														
CROP:															
Farmers in Production Level	%														
Yields	kg														
Fertilizer N	kg														
P2O5	kg														
K2O	kg														

TABLE 16 b: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

A.E.Z.: UM 1 COFFEE-TEA ZONE										A.E.Z.: LM 1 LOWER MIDLAND S.CANE ZONE				A.E.Z.: LM 2				MARG. SUGAR CANE ZONE			
Vegt. Period										p or two				1-(m/s) i				115-135			
1st + 2nd:										170 or more				195 or more				310-330			
in Days, 1st: 150 or more										180-190				350-360							
Soil:										ACRISOLS				ACRISOLS				ACRISOLS			
										Production Level				Production Level				Production Level			
										Without Fertilizer				Without Fertilizer				Without Fertilizer			
										I				I				I			
										II				II				II			
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OUTPUT AND NUTRIENT INPUT

A.E.Z.: UM 1 COFFEE-TEA ZONE														A.E.Z.: LM 1 LOWER MIDLAND S.CANE ZONE														A.E.Z.: LM 2 MARG. SUGAR CANE ZONE																																																																																																																																											
Vegt. Period 1st + 2nd: p or two/three in Days, 1st: 150 or more														total: 210-215 365														p or two 170 or more														180-190 350-360														195 or more 115-135														310-330																																																																																																	
Soil:														ACRISOLS														ACRISOLS														ACRISOLS														ACRISOLS																																																																																																															
Unit														Without Fertilizer														Production Level														Without Fertilizer														Production Level														Without Fertilizer														Production Level																																																																																			
I														II														III														I														II														III														I														II														III																																																							
CROP: NATURAL PASTURE/LEYS														CROP: NAPIER/BANA GRASS														CROP: TEA														CROP: PASSION FRUIT														CROP: BANANAS														CROP: SUGAR CANE																																																																																																	
Farmers in Production Level														Farmers in Production Level														Farmers in Production Level														Farmers in Production Level														Farmers in Production Level														Farmers in Production Level														Farmers in Production Level														Farmers in Production Level														Farmers in Production Level																																																							
Yields														Yields														Yields														Yields														Yields														Yields														Yields														Yields														Yields														Yields																																									
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4,800														10,000														5,000														12,000														14,000																																																																																																															
155														305														97														126														150																																																																																																															
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SUBLOCATION - LOCATION - DISTRICT

Agricultural Land

152,797.63 ha

of it: Small Family Farms 2)

152,526.00 ha

Settlement Farms

ha

Medium Size to Large Farms 3)

271.63 ha

Forests

69,795.12 ha

Water Area

16,300.00 ha

Urban Centres

800.00 ha

Land Adjudication (1/1/81)
 Adjudication 50%
 completed.
 1% to be set aside

Location	Sub-Location	Area in ha	Remarks
Lembus	Masaba-Arama	508	
	Kilombe	5,035	
	Simonin	1,210	
	Torongo	4,405	
	Tinet	738	
	Poror	1,003	
	Metipso	399	
	Sore	2,675	
	Kaptum	5,778	
	Kisokon	5,997	
	Chemogoch	3,506	
	Ngubereti	1,751	
	Kabimoi	3,445	
	Saos	2,106	
	Kibias	1,592	
	Kiptuno	1,135	
	Kabonyoni		
	Muringwo	745	
	Sigoro	5,997	
	Total	48,025	
Chap Chap	Kaptorokwa	6,934	
	Kabasis	319	
	Kituro	569	
	Kimakata	4,006	
	Total	11,828	
Pokor-Keben	Koiteren	1,262	
	Mugurin	8,837	
	Molo-Sirwet	5,051	
	Kiromui	3,002	
	Gobat	7,713	
	Kisanana	1,348	
	Kisanana	1,953	
	Ngendalel	3,551	
	Kares	3,062	
	Kamalanget	1,448	
	Cheberen	7,893	
	Kimose	5,533	
	Tenges	1,424	
	Total	52,077	

Location	Sub-Location	Area in ha	Remarks
Saimo	Kasisit	413	
	Kapchepkor	1,449	
	Pemwal	599	
	Tirimionin	1,199	
	Bartolimo	1,042	
	Issas	989	
	Total	5,691	
Sacho	Kabarak	1,381	
	Kibei	3,287	
	Koibarak	1,599	
	Kaplelelwa	6,324	
	Total	12,591	
Kabarnet	Kapropita		
	Kosoiyo	1,025	
	Kabarnet/)		
	Kewamoi 'B')	6,295	
	Kewamoi 'A')		
	Kapchomuswa	3,477	
	Total	10,797	
Kakamor	Cheplambus	3,775	
	Kiprota	2,395	
	Rosoga	1,235	
	Koitebes	917	
	Sirwo	1,966	
	Kimngurum	1,229	
	Total	11,517	
<u>Forests</u>	Chebartigon	103.2	Trust
	Chemoigok	1,346.8	Trust
	Chepkuchumo	319.7	Trust
	Cherial	42.5	Trust
	Kabarak	1,392.1	Trust
	Kabiok	14.2	Trust
	Kaptimom	89.0	Trust

/continued

- 1) Source: Survey of Kenya: Statistic to be used for agricultural extension and planning work only.
- 2) Farms in former Trust lands, usually cultivated exclusively by owner's family
- 3) Former scheduled area, usually large mechanised operation depending on hired labour

AGRO - CLIMATIC ZONES OF KENYA

by H.M.H.Braun

V3 Agro-climatic zone symbol
 temperature zone symbol
 moisture availability zone symbol

MOISTURE AVAILABILITY		TEMPERATURE		
ZONE	r/Eo	ZONE	mean annual temperature	altitude (feet)
I	> 80%	9	<10°C	> 10,000
II	65-80	8	10-12	9,000-10,000
III	50-65	7	12-14	8,000-9,000
IV	40-50	6	14-16	7,000-8,000
V	25-40	5	16-18	6,000-7,000
VI	15-25	4	18-20	5,000-6,000
VII	< 15	3	20-22	4,000-5,000
		2	22-24	3,000-4,000
		1	24-30	< 3000

— moisture availability zone boundary
 — temperature zone boundary (only if different from the moisture availability zone boundary)
 - - - - - availability zone boundary

Projection Universal Transverse Mercator

REFERENCE
 Boundaries: Inter-Territorial
 Provincial
 District
 Railways
 Roads
 Rivers

Scale 1:3,000,000
 Kilometres 0 20 40 60 80 100 120 140
 Miles 0 20 40 60 80 100

Topographical information derived from Survey of Kenya Atlas base map No. 2 scale 1:3m

AGRO - CLIMATIC ZONES OF KENYA

by H.M.H.Braun

V3 Agro-climatic zone symbol
 temperature zone symbol
 moisture availability zone symbol

MOISTURE AVAILABILITY		TEMPERATURE		
ZONE	r/Eo	ZONE	mean annual temperature	altitude (feet)
I	> 80%	9	<10°C	> 10,000
II	65-80	8	10-12	9,000-10,000
III	50-65	7	12-14	8,000-9,000
IV	40-50	6	14-16	7,000-8,000
V	25-40	5	16-18	6,000-7,000
VI	15-25	4	18-20	5,000-6,000
VII	<15	3	20-22	4,000-5,000
		2	22-24	3,000-4,000
		1	24-30	<3000

— moisture availability zone boundary
 --- temperature zone boundary (only if different from the moisture availability zone boundary)

Projection Universal Transverse Mercator

REFERENCE
 Boundaries: Inter-Territorial
 Provincial
 District
 Railways
 Roads
 Rivers

Scale 1:3,000,000
 Kilometres 20 0 20 40 60 80 100 120 140 Kilometres
 Miles 20 0 20 40 60 80 100 Miles

Topographical information derived from Survey of Kenya Atlas base map No. 2 scale 1:3m

POPULATION BY SEX AND SUB-LOCATION
TABLE I

BARINGO		POPULATION BY SEX AND SUB-LOCATION					BARINGO	
ADMINISTRATIVE AREA		MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY	
MAJI NOEGE		412	402	814	199	107	7	
SANDAI		435	422	857	191	87	9	
CHEBINYINY		609	642	1251	224	154	8	
LOBOI		1456	1466	2922	614	349	8	
MARIGAT SPECIAL AREA		821	654	1475	325	16	91	
MARIGAT SPECIAL AREA		821	654	1475	325	16	91	
SABOR		640	668	1308	405	55	23	
MARIGAT		444	425	869	234	88	9	
SUI		173	176	349	85	39	8	
KAMUNGEI		229	207	436	129	20	21	
KORIEMA		310	278	588	169	27	21	
TIRIONY		610	734	1344	365	23	56	
KAPTARAKWA		504	497	1001	287	18	53	
KITUKO		841	877	1718	487	17	97	
MARIGAT T.C.		551	436	987	203	6	160	
CHAPCHAP		4302	4298	8600	2364	297	28	
ELDUME		404	404	808	172	42	19	
NGAMBO		1454	1663	3117	543	47	66	
SALABANI		923	870	1793	360	35	50	
LOJMINANG		729	794	1523	267	181	8	
MAKUTANI		685	856	1541	238	192	8	
NJEMPS		4195	4587	8782	1580	497	17	
MARIGAT		10774	11005	21779	4883	1160	18	
KOKORE		454	581	1035	174	107	9	
PAKA		576	519	1095	158	270	4	
KAPEDO EAST ORUS		493	233	726	103	30	23	
NGINYANG EAST/NAKOKO		623	460	1083	166	357	3	
LOYAMOROK		2146	1793	3939	601	765	5	
TANGULBEI		1403	1497	2900	477	785	3	
KECHII		1188	1191	2379	527	191	12	
ORUS		504	488	992	167	225	4	
CHURO		1038	1299	2337	422	107	21	
KOKOSI		4113	4475	8588	1593	1309	6	
CHEPKERERAT		927	1088	2015	225	317	6	
CHEPANDA		613	760	1373	178	93	14	
KAPEDO		577	482	1059	160	252	4	
MONGORTEN		620	585	1205	158	206	5	
KORINYAN/HIRGIS		324	448	772	91	-	-	
NGINYANG WEST		1101	1396	2497	476	166	15	
NAKOKO		581	363	944	105	59	15	
KORUMEN		512	616	1128	142	49	23	
LOIWA		638	725	1363	171	285	4	
TILINGWO		488	504	992	145	138	7	
RIBKWO		6381	6967	13348	1851	1569	8	
TIRIOKO		498	544	1042	166	796	1	
TIRIOKO		498	544	1042	166	796	1	
NGINYANG		13138	13779	26917	4211	4441	6	
BARINGO		101606	102186	203792	42724	9885	20	

ADMINISTRATIVE AREA

ATTIAR
BARKETIEN
KAPKOMON
KABOSKEI
TULUK
KAPTURO
NAPINITY
POROR
NGORORA

KABARNET

KIPTOIM
MOGOTIO
POROR
SAOS
TORONGO
TUGUMOI
SIGORO
SORE
MOGOTIO T.C.
LEMBUS
NATO
EPINING
KISANANA
TENGEN
NGENDALEL
CHEBEREN
MOLO-SIRWE
MUGURIN
TEBEI
KIMOSE
TENGEN T.C.
POKOR/KEBEN
DEKIBON
RADAD
OLKOKWE
MAJI MOTO
KCIITUIMET
ENDOROIS
SOROK
SIRWA
KIMING'OROM
ROSOGA
CHEPLAMBUS
KAKAMOR
ELDAMA RAVINE TOWNSHIP
MAJI MAZURI
SABATIA SCHEME
MAKUTANO
SABATIA ESAGERI
MAJI MAZURI T.C.
RAVINE

ELDAMA RAVINE

MAJI MAZURI

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MAJI MAZURI

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
ATTIAR	1599	1707	3306	555	87	37
BARKETIEN	485	522	1007	184	57	17
KAPKOMON	434	443	877	196	43	20
KABOSKEI	4425	4568	8993	1808	378	23
TULUK	368	406	774	168	132	5
KAPTURO	307	332	639	150	92	6
NAPINITY	1175	1353	2528	506	167	15
POROR	245	270	515	124	94	5
NGORORA	2095	2361	4456	948	488	9
KABARNET	36791	37843	74634	17047	2353	31
KIPTOIM	2971	2862	5833	976	99	58
MOGOTIO	1718	1555	3273	598	114	28
POROR	2706	2607	5313	892	79	67
SAOS	1171	1650	3395	626	75	44
TORONGO	1071	1229	2400	456	36	65
TUGUMOI	1366	1139	2210	458	24	90
SIGORO	602	1311	2677	563	18	143
SORE	1279	622	1224	288	33	36
MOGOTIO T.C.	14629	13912	28541	5401	483	1978
LEMBUS	406	405	811	164	46	17
NATO	1201	1193	2394	501	74	32
EPINING	378	335	713	139	34	20
KISANANA	467	475	946	202	15	62
TENGEN	507	521	1028	230	51	19
NGENDALEL	960	974	1934	423	41	46
CHEBEREN	685	701	1386	300	67	20
MOLO-SIRWE	893	915	1808	401	103	17
MUGURIN	443	421	864	222	48	18
TEBEI	526	505	1031	233	85	12
KIMOSE	233	219	452	107	0	470
TENGEN T.C.	6699	6668	13367	2922	570	23
POKOR/KEBEN	499	557	1056	276	71	14
DEKIBON	759	745	1504	364	110	13
RADAD	1354	1450	2804	615	123	22
OLKOKWE	520	538	1058	231	92	11
MAJI MOTO	221	217	438	114	58	7
KCIITUIMET	3353	3507	6860	1600	454	15
ENDOROIS	490	480	970	260	24	38
SOROK	336	301	637	151	6	99
SIRWA	339	337	676	158	27	24
KIMING'OROM	687	697	1384	299	38	35
ROSOGA	741	783	1524	343	26	58
CHEPLAMBUS	2593	2598	5191	1211	123	41
KAKAMOR	1997	1944	3941	871	7	535
ELDAMA RAVINE TOWNSHIP	1721	1763	3484	789	43	79
MAJI MAZURI	4367	4007	8374	1269	126	66
SABATIA SCHEME	1571	1536	3109	707	34	90
MAKUTANO	1918	1812	3730	749	79	47
SABATIA ESAGERI	2055	1810	3865	1064	6	623
MAJI MAZURI T.C.	13629	12874	26503	5449	296	89
RAVINE	40903	39559	80462	16583	1929	41

TABLE 1

POPULATION BY SEX AND SUB-LOCATION

BARINGO

ADMINISTRATIVE AREA

	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
SALAMA	1246	1320	2566	758	89	28
KAPCHOMUSO	1293	1315	2608	573	33	77
KEMAOI	810	874	1684	425	54	30
KIBOINO	1357	1453	2810	688	80	34
KABARNET T.C.	-1879	-1742	3621	1017	2	1534
KABARNET	6585	6708	13293	3461	261	50
KIPKURJANY	473	478	951	226	38	24
KABASIS	755	872	1627	381	31	51
KCIBARAK	192	232	425	85	15	27
KIBEI	378	350	728	183	24	30
KAPTIRIONY	294	285	579	163	11	49
KABARAK	660	698	1358	320	58	50
SACHO	2752	2917	5669	1358	144	39
MCIGUTWO	494	508	1002	215	12	78
SCGON	439	421	860	136	19	44
SERETUNIN	870	959	1829	396	18	99
KABUSA	326	331	657	181	55	11
KINONDIS	451	476	927	265	47	19
RIMO	978	973	1951	466	24	79
ENDAU	259	272	531	144	44	11
EMALEL	3817	3940	7757	1803	223	34
KAPLUK	1731	1744	3475	859	110	31
KETURWO	1071	1021	2092	371	47	44
BARWESSA	2144	2115	4259	946	102	41
KAPTUM	2120	2141	4261	874	56	76
KAPKIAMO	962	981	1943	444	49	39
KABARTCNJO	239	247	486	92	0	1350
KAMNAROK	8267	8253	16520	3586	365	45
BARTOLIMO	957	921	1878	426	9	202
ISSAS	674	719	1393	288	7	193
KAPKOMB	431	507	938	192	1	732
TIRIMIONIN	651	673	1324	257	4	280
KASISIT	621	683	1304	297	6	208
KURESHUN	202	204	406	94	2	178
KAPTARE	359	391	750	143	4	160
LELIAN	648	685	1333	285	17	75
KAPCHEPKOR	679	620	1299	252	8	162
RONDININ	323	262	585	150	15	36
KAIMUGUL	191	201	392	100	36	10
SIBILO	178	176	354	96	51	6
LORUK	541	563	1104	222	72	15
KOIBAMARE	281	312	593	142	42	13
KABARAINA	209	254	463	120	22	20
TAIMON	339	364	703	203	35	19
KIPCHERERE	279	299	578	163	38	15
KOROTO	269	291	560	150	24	22
CHEBARSIAT	223	231	454	121	43	10
AKOROVAN	795	740	1535	382	45	33
SAIMO	8850	9096	17946	4083	491	36
KAPKOIWO	284	266	550	127	25	21
KABARKEBO	593	658	1251	276	28	44
TERIK	578	570	1148	251	82	13
KARERER	452	402	854	209	54	15

Veget. Period		(s/vs) (va/s)	(vs) (vs-s)	80	(130)
1st + 2nd:		(m/l) or two	95 (50+45)	175	50 or more
in Days:		80 or more			

CROP: NATURAL PASTURE

Farmers in Production Level

Yields

Fertilizer N

P₂O₅K₂O

GAMBISOLS

Production Level

I

II

III

LITHOSOLS

Production Level

I

II

III

without
Fertilizer

Production Level

I

II

III

Unit

Without
Fertilizer

%

kg

kg

kg

kg

%

kg

kg

kg

kg

%

kg

kg

kg

kg

%

kg

kg

kg

kg

%

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kg

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kg

%

kg

kg

kg

kg

CROP: COTTON

Farmers in Production Level

Yields

Fertilizer N

P₂O₅K₂O

CROP: MAIZE

Farmers in Production Level

Yields

Fertilizer N

P₂O₅K₂O

CROP: MILLET

Farmers in Production Level

Yields

Fertilizer N

P₂O₅K₂O

CROP: BEANS

Farmers in Production Level

Yields

Fertilizer N

P₂O₅K₂O

1,000

450

700

3,500

2,000

600

1,000

11

55

8

40

1,000

1,300

1,800

1,800

3

20

20

2

19

19

1,800

500

1,200

1,600

800

800

1,200

24

12

PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

[illegible]

District: KIAMBU 30
AEZ III : UM 2-3

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.4	0.6	0.40	0.00	11.5	46.1
Maize IPC	0.0	0.5	0.00	0.00	1.1	4.3
Beans	0.1	0.2	0.12	0.00	2.4	9.6
Groundnuts IPC	0.0	0.2	0.00	0.00	0.2	0.8
Engl. Potatoes	0.1	0.3	0.04	0.00	2.3	9.2
Cabbage	0.0	0.2	0.00	0.00	0.6	2.3
Tomatoes	0.0	0.6	0.00	0.00	0.6	2.6
Sweet Potatoes	0.0	0.1	0.00	0.00	0.2	1.0
Sugarcane	0.0	0.1	0.00	0.00	0.1	0.5
Passionfruit	0.0	0.6	0.00	0.00	0.6	2.4
Others	0.0	0.8	0.00	0.00	0.8	3.2
Maize & Beans	0.1	0.3	0.00	0.00	2.4	9.5
Maize & Others	0.1	0.4	0.00	0.00	2.1	8.5
Total					24.9	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.1	0.3	0.20	0.00	4.0	24.2
Maize IPC	0.0	0.3	0.00	0.00	0.7	4.1
Beans	0.1	0.2	0.00	0.00	1.7	10.4
Beans IPC	0.0	0.8	0.00	0.00	0.8	4.8
Engl. Potatoes	0.2	0.3	0.20	0.00	4.4	26.3
Cabbage	0.0	0.3	0.00	0.00	0.6	3.4
Sugarcane	0.0	0.1	0.00	0.00	0.1	0.7
Passionfruit	0.0	0.6	0.00	0.00	0.6	3.6
Maize & Beans	0.1	0.5	0.00	0.00	3.7	22.5
Total					16.6	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cooking Bananas	0.0	0.3	0.00	0.00	0.8	4.3
Coffee	0.6	0.7	0.80	0.00	15.9	86.3
Macademia Nuts	0.0	0.1	0.00	0.00	0.1	0.7
Tea	0.1	0.5	0.00	0.00	1.6	8.7
Total					18.4	100.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo.Qu. = Upper/Lower quartile, 50% of all sample cases are in between these points
% columns = % of total farm land

District: KIAMBU 31
AEZ IV : UM 4-5 - LM 4

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.4	0.6	0.68	0.00	11.5	35.3
Beans	0.1	0.7	0.00	0.00	2.1	6.5
Pigeonpeas	0.0	0.1	0.00	0.00	0.1	0.2
Engl. Potatoes	0.0	0.3	0.00	0.00	1.0	3.1
Cabbage	0.0	0.1	0.00	0.00	0.1	0.4
Cotton	0.0	0.3	0.00	0.00	0.8	2.5
Tobacco	0.1	0.4	0.00	0.00	2.6	8.0
Sweet Potatoes	0.0	0.1	0.00	0.00	0.1	0.4
Others	0.0	0.3	0.00	0.00	0.3	0.9
Maize & Beans	0.4	1.0	0.80	0.00	12.3	37.9
Maize & Others	0.0	1.2	0.00	0.00	1.2	3.7
Maize int.oth.	0.0	0.4	0.00	0.00	0.4	1.2
Total					32.5	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.3	0.6	0.60	0.00	8.8	39.9
Beans	0.0	0.6	0.00	0.00	1.1	5.1
Engl. Potatoes	0.0	0.4	0.00	0.00	1.1	4.9
Tomatoes	0.0	0.1	0.00	0.00	0.1	0.5
Cotton	0.0	0.1	0.00	0.00	0.1	0.5
Others	0.0	0.5	0.00	0.00	0.5	2.4
Maize & Beans	0.3	0.9	0.80	0.00	10.3	46.7
Total					22.1	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cooking Bananas	0.0	0.4	0.00	0.00	0.4	100.0
Total					0.4	100.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50% of all sample cases are in between these points
% columns = % of total farm land

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
WANJOHI	3977	4342	8319	1401	108	76
WANJOHI	5750	6210	12000	1939	203	58
MIHAFATI	5416	6051	11467	2047	89	127
GITHIRO	2257	2370	4627	715	81	56
KIRIKO	2106	2312	4418	749	73	60
KIPIPIRI	9779	10733	20512	3511	244	83
GETA	3105	3327	6432	1268	28	223
KIAMBOGO	2631	2824	5455	1090	32	168
GETA	5736	6151	11887	2358	61	194
MAINA WARD	2062	1701	3763	1251	1	2294
HOSPITAL WARD	224	356	580	91	0	1208
STATION WARD	554	328	922	363	0	1355
KEGANDA	558	382	940	316	1	546
ADURURUMU	607	462	1069	339	0	1373
SURROUNDING AREA	59	91	190	54	11	16
NDLYU	2044	1736	3783	1053	0	7275
NYAHURUL TOWNSHIP	6188	5089	11277	3467	17	642
KIPIPIRI	27453	28183	55676	11275	526	105
NYANDARUA	114856	118446	233302	43197	3528	66

NYANDARUA

POPULATION BY SEX AND SUB-LOCATION

NYANDARUA

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
SABUGO	3278	3413	6691	1155	58	113
PATINDIRI	850	859	1709	284	26	65
UPPER GILGIL	628	641	1269	236	19	65
NGORIKA	2954	3051	6005	1055	70	85
MELANGINI	2834	3013	5847	1046	36	160
DINDORI	10544	10977	21521	3816	210	102
RURIT	4061	4219	8280	1463	91	90
PASSENGA	1104	1109	2213	352	36	60
RIFIT	5165	5328	10493	1855	128	81
MURINDATI	1854	1734	3628	569	65	55
MAWINGO	4610	4455	9065	1679	201	45
OL KALOU T.C.	977	934	1911	624	2	955
OL KALOU	7481	7123	14604	2872	268	54
OL KALOU	23190	23428	46618	8543	607	76
NDARAGWA	4082	4155	8237	1632	157	52
SHAMATA	2702	2847	5549	940	40	137
PE SI	2555	2396	4951	935	125	39
KANYAGIA	2238	2307	4545	789	63	71
NDARAGWA	11577	11705	23282	4296	387	60
OL JORO OROK WEST	4523	4765	9288	1636	143	64
ORAIMUTIA	754	808	1602	278	37	43
SILIRWET	2855	2921	5816	1090	65	89
LESIRKO	3969	4169	8138	1459	116	69
NYAIRKO	524	533	1057	171	18	56
OL JORO OROK	12715	13196	25911	4634	381	67
KARAGINI	6700	7351	14051	2530	137	102
LESHAU	3152	3413	6565	1285	47	136
LESHAU	9852	10764	20616	3815	185	111
NORTHERN	34144	35665	69809	12745	954	73
TULAGA	2415	2402	4817	867	28	166
MURUAKI	2724	2720	5444	883	71	76
NJABINI	4189	4328	8527	1654	55	153
SOUTH KINANGOP	9328	9460	18788	3404	155	120
MURINGAPI	2214	2306	4520	757	47	95
KAHUPU MURUAKI	1815	2049	3864	554	58	65
MUKUNGI	1206	1399	2605	457	41	63
MIKAPU	1579	1747	3326	643	29	111
NANDARASI KITIRI	3959	3929	7888	1384	83	94
NORTH KINANGOP	10773	11430	22203	3795	260	85
KARATI	2026	2172	4198	713	78	53
BAMROO	2578	2682	5260	876	57	92
MUKEO	4372	4518	8890	1437	43	202
GITWE	652	908	1560	409	10	179
MAGUMU	9928	10280	20208	3435	190	106
KINANGOP	33029	31170	64199	10634	606	100
MALEWA	1813	1868	3681	528	94	38

FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha		10.5	17.9	Farming Intensity:				
Land Use: Annual Crops ¹⁾									
First Season									
Maize	ha		0.8	1.4	Cropping Intensity	-		0.2	0.2
English Potatoes	ha		0.3	0.3	Portion of improved cattle kept	%		86%	92%
Wheat/Barley	ha		0.1	0.3	Portion of Farmers owning a Plough	%		40%	10%
Vegetables	ha		0.4	0.1					
Total	ha		1.6	2.1					
Second Season ¹⁾					Labour on Farm:				
English Potatoes	ha		0.2	0.1	Family Adults	persons		2.6	2.5
Cabbage & other Vegetables	ha			0.2	Perm. Hired Labour	"		0.8	0.7
Total	ha		0.2	0.3	Children > 14 years	"		2.4	3.8
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
Pyrethrum	ha		0.6	0.9	Adults > 14 years	persons	2.32	0.27	2.47
	ha				Children < 14 years	"	3.14	-	3.14
	ha				Subsistence Units	SU	4.20	0.27	4.47
portion of total	%		6%	5%					
Grazing & Forage	ha		7.2	12.5	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%		69%	70%	Maize	kg	1538	2479	
Other Land Use	ha		1.1	2.4	English Potatoes	kg	255	83	
Livestock on Farm:					Cabbage	kg	30	3	
Cattle: local	LU		1.1	0.7	Groundnuts	kg	9	14	
improved	LU		6.8	7.7		kg			
Sheep & Goats	LU		1.0	0.9		kg			
Total	LU		8.9	9.3		kg			

Other Crops cultivated: Groundnuts

- 1) Major crops only considered
 2) Based on 1979 Census figures

District: 27 NYANDARUA NORTH II
 AEZ: UH 2-3 - LH 3

December, 1977
 Sample Size 30

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children >14 No.
Avg. 0	14.0	22.0	1.0	2.5	0.8	3.1
Avg. 1	14.0	22.8	1.9	2.5	1.4	4.0
Up. Qu.	17.2	26.0	1.0	3.0	1.0	5.0
Lo. Qu.	9.6	15.0	-	2.0	-	1.0

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	2.0	15	0.8	6	9.1	69	0.6	4	0.5	4	0.3	3
Avg. 1	2.0	14	0.9	7	9.1	65	0.7	5	1.0	7	0.3	2
Up. Qu.	2.4	20	1.0	6	11.4	78	0.8	7	0.8	5	0.4	3
Lo. Qu.	1.0	9	0.1	1	6.4	53	0.2	1	-	-	0.1	1
Total	58.6		20.2		273.6		17.6		14.3		10.3	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.9	0.7	0.9	79.3
Avg. 1			0.9	89.7
Up. Qu.	1.2	1.0	1.3	94.1
Lo. Qu.	0.7	0.5	0.6	84.3

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	50.6	1.8	0.4	7.4	0.3	-	-	-	-	0.2	-	-	-
Avg. 1	60.0	3.6	2.5	8.4	2.2	0.3	-	-	-	0.4	0.4	-	-
Up. Qu.	85.7	2.2	-	9.8	-	-	-	-	-	0.3	-	-	-
Lo. Qu.	42.9	-	-	2.7	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children >14 No.
Avg. 0	9.0	19.6	0.2	2.5	0.1	2.6
Avg. 1	9.0	20.3	1.4	2.6	1.0	3.0
Up. Qu.	9.9	28.0	-	3.0	-	4.0
Lo. Qu.	6.0	11.0	-	2.0	-	1.0

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	1.7	19	0.3	4	5.5	63	0.5	6	0.6	7	0.2	2
Avg. 1	1.7	18	0.5	5	5.5	59	0.7	7	0.9	9	0.2	2
Up. Qu.	2.2	23	0.4	6	6.0	69	0.8	9	0.8	8	0.2	3
Lo. Qu.	0.6	9	-	-	2.8	47	-	-	-	-	0.1	1
Total	50.1		9.6		165.9		14.8		18.3		5.3	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.1	0.9	1.3	79.0
Avg. 1			1.3	88.8
Up. Qu.	1.5	1.3	2.2	100.0
Lo. Qu.	0.8	0.6	1.1	64.1

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	19.4	0.6	0.1	12.0	-	-	-	0.1	-	0.1	-	0.1	-
Avg. 1	36.1	10.1	2.8	16.6	-	-	-	0.7	-	0.3	1.8	1.2	-
Up. Qu.	28.6	-	-	17.2	-	-	-	-	-	0.1	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

District: NYANDARUA SOUTH 28
AEZ II : UH 2

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.2	0.6	0.60	0.00	6.6	11.1
Wheat	0.5	2.4	0.00	0.00	14.4	24.1
Engl. Potatoes	0.4	0.6	0.80	0.00	12.8	21.4
Cabbage	0.2	0.5	0.40	0.00	5.6	9.4
Others	0.1	0.5	0.00	0.00	2.8	4.6
Pyrethrum	0.3	0.5	0.40	0.00	9.4	15.8
Others	0.2	0.4	0.40	0.00	7.3	12.2
Maize & Others	0.0	0.8	0.00	0.00	0.8	1.3
Total					59.7	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Engl. Potatoes	0.4	0.6	0.80	0.00	11.5	36.7
Cabbage	0.2	0.7	0.16	0.00	4.6	14.5
Others	0.0	0.5	0.00	0.00	1.0	3.2
Pyrethrum	0.3	0.5	0.40	0.00	9.4	30.1
Others	0.2	0.4	0.20	0.00	4.8	15.4
Total					31.4	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Total					0.0	0.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.qu./Lo.qu. = Upper/Lower quartile, -50% of all sample cases
are in between these points
% columns = % of total farm land

FARM ORGANISATION: ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.0	3.7	10.2	Farming Intensity:				
Land Use: Annual Crops ¹⁾					Cropping Intensity	-	0.5	0.3	0.2
Maize	ha	0.2	0.5	0.8	Portion of improved cattle kept	%	34%	79%	87%
Maize & Beans	ha	0.3	0.5	0.5	Portion of Farmers owning a Plough	%			
Finger millet	ha	-	-	0.2					
Total	ha	0.5	0.5	1.5					
Second Season ¹⁾	ha				Labour on Farm:				
	ha				Family adults	persons	2.0	2.6	3.1
	ha				Term. Hired Labour	"	-	0.3	1.0
	ha				Children > 14 years	"	1.6	1.6	4.4
Permanent Crops ¹⁾					Persons living on Farm ²⁾				
Pyrethrum	ha	-	0.7	0.2	- average household size -	persons	Farmer's Family	Non-related Persons	Total
Coffee	ha	-	0.3	0.6	adults > 14 years	"	2.00	0.39	2.39
	ha				Children < 14 years	"	2.40	-	2.40
	ha				Subsistence Units	SU	3.44	0.39	3.83
Portion of total	%	-	14%	8%					
Grazing & Forage Portion of total	ha	0.4	1.7	6.9	Home Consumption of Major Food produced on Farm	kg/year household		cal. person day	
Other Land Use	ha	0.1	0.5	1.0	Maize	kg	424	2295	
Livestock on Farm:					Beans	kg	174	277	
Cattle: local	LU	2.9	0.8	0.8	Finger millet	kg	89	139	
Improved	LU	1.5	3.0	5.5	Cabbage	kg	43	4	
Sheep & Goats	LU	0.4	1.8	0.5		kg			
Total	LU	4.8	5.6	6.8		kg			

1) Major crops only considered
2) Based on 1979 Census figures

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		Small	Medium	Large			Small	Medium	Large
Farm Size Total	ha	5.2	9.7	20.5	Farming Intensity:				
Land Use: Annual Crops ¹⁾ First Season									
Maize	ha	0.6	0.7	1.7	Cropping Intensity	-	0.4	0.1	0.2
Maize & Beans	ha	1.3	0.5	0.9	Portion of improved cattle kept	%	98%	90%	96%
Finger millet	ha	0.1	-	0.2	Portion of Farmers owning a Plough	%	80%	10%	40%
Cowpeas	ha	-	-	0.3					
Total	ha	2.0	1.2	3.1					
Second Season¹⁾	ha				Labour on Farm:				
	ha				Family adults	persons	2.4	2.1	2.4
	ha				Perm. hired Labour	"	1.4	0.5	1.6
	ha				Children > 14 years	"	3.8	1.5	2.8
Permanent Crops¹⁾	ha								
Pyrethrum	ha	0.1	0.1	0.1	Persons living on Farm ²⁾ - average household size -	persons			
	ha				adults > 14 years	"	1.98	0.15	2.13
	ha				Children < 14 years	"	2.26	-	2.26
Portion of total	%	2%	1%	-	Subsistence Units	SU	3.33	0.15	3.48
Grazing & Forage Portion of total	ha	2.1	7.6	14.6	Home Consumption of Major Food produced on Farm	kg/year household			
Other Land Use	ha	1.0	1.2	2.7	Maize	kg	1288	2076	
					Beans	kg	150	238	
					Finger millet	kg	47	74	
					English Potatoes	kg	125	41	
					Cabbage	kg	3		
Livestock on Farm:									
Cattle: local	LU	0.3	0.9	0.6					
Improved	LU	13.1	8.4	14.2					
Sheep & Goats	LU	2.7	0.3	1.4					
Total	LU	16.1	9.6	16.2					

Other Crops cultivated: English Potatoes, Coffee, Cabbage

1) Major crops only considered
2) Based on 1979 Census figures

TABLE 1
POPULATION BY SEX AND SUB-LOCATION

KILIFI	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
ADMINISTRATIVE AREA						
KALOLENI	3026	3573	6599	859	25	254
CHALANI/MIHINGONI	1988	2445	4433	441	26	164
MIKINIANI	1646	2050	3696	457	24	150
DIRINI/MWAMULEKA	463	557	1020	145	15	65
KALOLENI T.C.	529	642	1171	156	1	887
MAKOMBOANI/KINANI	1350	1652	3002	326	17	174
KALOLENI	9002	10919	19921	2384	111	178
KIMBABWANI	1121	1426	2547	290	25	101
KINAGONI/MIGWALENI	1043	1342	2385	233	17	135
VIRAGONI/MTULU/MIZAHENI	1920	2354	4314	468	62	69
IKANGA/MIYANI	1042	1332	2374	270	40	59
MBALAMWENI	1885	2440	4325	401	54	79
PONGWE/MURIMANI	901	1167	2158	235	7	304
MAZIACHENCA/KITHENGWANI	1999	2460	4459	452	70	63
KAYAFUNGO	10001	12561	22562	2409	277	81
TSANGATSINI	1250	1411	2661	452	24	107
MARIKANI/MITANGONI	2577	2576	5153	919	91	61
MACZIMBANI/MNYENZENI	2338	2789	5127	720	75	68
KAWALA/TENOLO	1107	1286	2393	371	10	237
MARIKANI URBAN	1444	1322	2766	754	2	127
MARIKANI	8816	9784	18600	3216	203	91
MWARAKAYA	2029	2495	4524	696	33	134
KIZINGO	3492	4116	7658	1266	20	366
PINGILIKANI	1458	1827	3285	580	42	78
CHONYI SOUTH	6979	8488	15467	2542	56	159
CHASIMBA	2117	2546	4665	635	24	136
KITSOENI	1788	2202	3991	635	36	109
ZIANI	3061	3599	6660	841	35	185
CHONYI NORTH	6966	8350	15316	2111	106	143
KALIANGOMBE/JIMBA	2365	2675	5040	799	25	195
NGUMDPATSA/HAZERAS	2154	2351	4505	692	8	546
BUNI/KISIMANI	2185	2438	4623	806	19	233
SIKENI/MWELE/KISURUTINI	2726	3136	5864	911	15	375
HAZERAS T.C.	494	461	955	274	3	314
PABAI	9924	11062	20987	3432	72	290
MWAMUTSUNGA/CHANGOMBE	1820	2115	3941	541	16	237
CHONYI/MWAWESA	1730	1992	3722	466	10	353
MIYUNI MLEJI	1985	2203	4188	549	21	192
JIMBA/KALIANGOMBE	3224	4009	7233	914	35	204
RURUMA	8765	10219	19084	2470	84	226
MAEFENI/PANGANI	1474	1565	3039	408	20	148
MAKOMBENI/FJROZANI	1525	1659	3184	507	36	88
MWAKA/KIKOMANI	1865	2096	3961	587	12	311
KAMBE/RIBE	4864	5320	10184	1592	69	146
KWALE/NYALANI	2085	2257	4342	704	10	222
CHILILI/TSANGWA	2425	2616	5041	848	16	312
JTBANA	4510	4912	9423	1552	35	262
	69827	81717	151544	21708	1057	143
SOUTHERN						
MIRITINI	799	1002	1801	399	22	78
KIDEMU	1103	1348	2451	598	38	63
MUNAGONI	1875	2281	4156	960	1066	3

SUBLOCATION - LOCATION - DISTRICT

DISTRICT: KILIFI

Agricultural Land

350,021 ha

of it: Small Family Farms 2)

326,221 ha

Settlement Farms

..... ha

Medium Size to Large Farms 3)

23,800.27 ha

Forests

81,831.6 ha

Water Area

10,900 ha

Urban Centres

27,200 40

Land Adjudication (1/1/81)

Adjudication 50%
completed.
0.5% to be set
aside

Location	Sub-Location	Area in ha	Remarks

Location	Sub-Location	Area in ha	Remarks

1) Source: Survey of Kenya: Statistic to be used for agricultural extension and planning work only.

2) Farms in former Trust lands, usually cultivated exclusively by owner's family

District: 25 BARINGO II/III
AEZ: LH 2 - UM 3

September, 1977
Sample Size 30

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	4.7	18.6	0.9	2.6	0.4	2.3
Avg. 1	4.7	20.0	1.6	2.6	2.0	3.5
Up. Qu.	5.6	20.0	2.0	3.0	-	4.0
Lo. Qu.	2.0	7.0	-	2.0	-	-

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	1.0	22	0.5	10	2.7	58	0.1	3	0.1	3	0.2	4
Avg. 1	1.1	19	0.7	12	2.9	49	0.4	6	0.6	9	0.2	4
Up. Qu.	1.6	41	0.5	11	3.0	61	0.4	5	-	2	0.3	7
Lo. Qu.	0.4	18	-	-	0.8	27	-	-	-	-	-	3
Total	31.3		13.8		80.8		3.7		4.4		5.8	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rat.		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.9	1.2	2.0	57.1
Avg. 1			1.9	72.7
Up. Qu.	1.0	1.8	4.4	96.8
Lo. Qu.	0.9	0.7	1.1	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	60.6	0.2	1.3	2.1	0.4	-	-	-	-	1.4	0.4	-	1.0
Avg. 1	61.4	6.8	5.4	4.5	7.4	-	-	0.2	0.1	1.7	0.7	0.3	1.8
Up. Qu.	100.0	-	-	1.9	-	-	-	-	-	2.2	0.3	-	0.5
Lo. Qu.	50.0	-	-	-	-	-	-	-	-	0.2	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

District: 26 BARINGO II/III
AEZ: UM 2-3

September, 1977
Sample Size 30

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	13.3	30.5	1.6	2.3	1.1	2.4
Avg. 1	13.3	30.5	2.4	2.3	1.6	3.4
Up. Qu.	20.0	43.0	2.0	2.0	2.0	3.0
Lo. Qu.	7.4	16.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Crops %	Perennial Crops ha	Crops %	pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	2.2	17	0.1	1	9.3	73	0.2	1	0.4	3	0.5	4
Avg. 1	2.2	14	0.3	2	9.6	64	1.2	8	1.1	8	0.6	4
Up. Qu.	2.8	21	-	1	12.8	83	-	-	0.6	4	0.4	4
Lo. Qu.	1.2	11	-	-	5.9	57	-	-	-	-	0.1	1
Total	65.0		2.6		278.6		4.7		12.6		16.2	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	0.8	1.0	1.4	86.1
Avg. 1			1.4	86.1
Up. Qu.	1.0	1.5	2.0	100.0
Lo. Qu.	0.8	0.7	1.0	84.2

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	65.0	1.3	0.1	3.9	0.1	-	-	-	-	0.4	-	-	-
Avg. 1	65.9	3.5	0.9	5.2	4.3	0.7	-	-	-	0.8	-	-	0.2
Up. Qu.	100.0	1.9	-	6.0	-	-	-	-	-	0.6	-	-	-
Lo. Qu.	90.9	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of all farms excluding zero entries
Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
AC = Annual Crops
PC = Perennial Crops

District: BARINGO 25
AEZ II/III: LH 2 - UM 3

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.5	0.9	0.80	0.00	14.1	40.4
Maize IPC	0.0	0.6	0.00	0.00	0.6	1.7
Fingermillet	0.1	0.3	0.04	0.00	2.4	6.9
Beans IPC	0.0	0.2	0.00	0.00	0.2	0.6
Cabbage	0.0	0.2	0.00	0.00	0.2	0.6
Onions	0.0	0.1	0.00	0.00	0.1	0.3
Pyrethrum	0.1	0.3	0.40	0.00	4.2	12.2
Maize & FMilt	0.0	0.4	0.00	0.00	0.4	1.1
Maize & Beans	0.4	0.8	0.80	0.00	12.6	36.2
Total					34.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cabbage	0.0	0.1	0.00	0.00	1.1	2.8
Pyrethrum	0.1	0.3	0.40	0.00	4.2	97.2
Total					4.4	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Coffee	0.3	0.6	0.28	0.00	7.7	98.5
Citrus	0.0	0.1	0.00	0.00	0.1	1.5
Total					7.8	100.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50% of all sample cases
are in between these points
% columns = % of total farm land

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	1.1	1.7	1.60	0.00	33.2	49.8
Fingermillet	0.1	0.4	0.12	0.00	2.9	4.4
Cowpeas	0.1	3.6	0.00	0.00	3.6	5.4
Engl. Potatoes	0.0	0.5	0.00	0.00	1.0	1.5
Cabbage	0.0	0.2	0.00	0.00	0.2	0.3
Pyrethrum	0.1	0.3	0.00	0.00	1.8	2.8
Maize & Beans	0.8	1.6	2.00	0.00	23.6	35.3
FMLt & Sorghum	0.0	0.4	0.00	0.00	0.4	0.6
Total					66.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Engl. Potatoes	0.0	0.4	0.00	0.00	0.4	17.9
Pyrethrum	0.1	0.3	0.00	0.00	1.8	82.1
Total					2.2	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Coffee	0.0	0.4	0.00	0.00	0.8	100.0
Total					0.8	100.0

Avg 0 = average of all sample farms
 Avg 1 = average of all farms excluding zero entries
 Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50% of all sample cases
 are in between these points
 % columns = % of total farm land

Nairobi, 17/4/80

A SUMMARY OF THE 'PROJECT' FARM MANAGEMENT
HANDBOOK OF KENYA

1.0 Contents

The project is an attempt to summarise the present knowledge about agriculture in Kenya in such a way that it can be directly used by the agricultural Extension and Planning officers. The work includes the natural conditions of all farming areas, and special attempts are made to illustrate the socio-economic conditions of Kenya's small farms. The handbook gives the present stage of development and will show the most likely and possible development path for the coming 20 years.

1.1 The reason for the project

There is almost a complete breakdown in the flow of information between agricultural research on the one hand and the agriculture Planning and Extension officers on the other. The result is that:

- a) Approximately KShs. 2 million spent year after year on agricultural research does not result in any significant productivity increase in agriculture.
- b) The work output of an approximately 10,000 person strong technical staff in the Ministry is low, and its effectiveness is declining more or less continuously. Advice given in the more recently cultivated areas is usually wrong.
- c) The work of the agriculture planning staff is often incorrect - the productivity of the officers involved is low, thus planning is slow and is only suitable for macro-economic assessments.

Approximately 50% of the agricultural projects fail or do not take off the ground at all. Other projects have to be brought in line with reality by a rather laborious work plan system, etc. It is a safe assumption that approximately 25% of the failures in agriculture are as a direct result of lack of knowledge. By closing this gap, enormous amounts of money could be saved and development could be speeded up.

The GAT has been asked to assist in the Farm Management part of agricultural planning and with Extension work, because we are probably the most experienced advisors in the Ministry. However, with the expansion of agriculture in the semi-arid areas, our knowledge is no longer sufficient to supply advice of an acceptable quality. This does not mean to say that there is anybody else in the Ministry who could give better advice than we are at present supplying.

2.0 The approach

There are two possible approaches - macro- and micro-economic. The macro-economic approach is quicker but lends itself only to policy measurements at national level. For example, 40% of flour for bread should be cassava flour, etc. This approach is generally unsuitable for the purpose of speeding up farm development.

The micro-economic approach starts with the individual farm, zone or region and assesses the situation there. By putting the different pieces together, one finally arrives at a summary which reflects fairly correctly the situation of the country.

For Kenya - a country of great diversity in every respect - the micro-economic approach seems to be the right one. This approach supplies the tools to carry out policy in the field, while the macro-economic assessment usually remains a plan only, as it does not supply the tools for implementation.

3.0 Critique

It was planned to compile the above Handbook, in addition to the other work expected from the FMRO, and to limit it to 17 districts only. The aim was to give a static present day picture and some information about water availability for agriculture in different soils of the country. The work was to be the result of a joint effort of the approximately 30 DFM officers.

Experience has shown that:

- no officer is willing to take an active part in such a joint effort;
- the Handbook must cover the whole country and must include all natural and socio-economic conditions. A work such as this cannot be produced as a sideline, but must be properly planned.

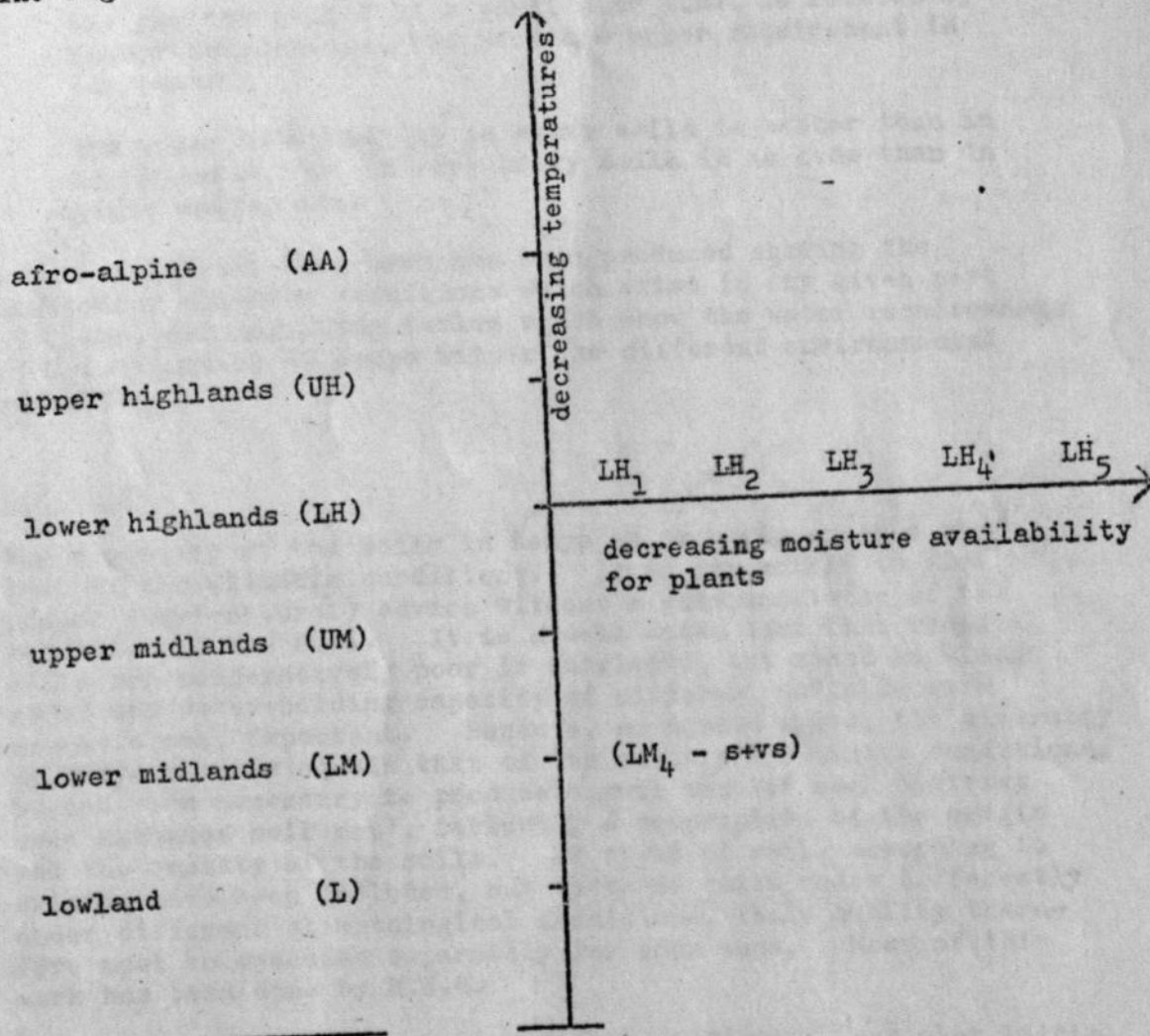
1 First, the natural conditions, climate and soil, should be assessed. If this knowledge is available, a socio-economic survey should be undertaken, after which the farming systems should be planned.

Originally, 1.5 man years and approximately DM 150,000 were estimated for this project - in actual fact however, approximately 3 man years and DM 650,000 will be needed. In any event, compared with the possible savings, this project is most economic.

4.0 Work done

4.1 Assessment of Agro Ecological Zones, AEZ

This work has been done largely by Prof. Jaetzold. He grouped the different natural conditions (e.g. temperature, water availability, length of growing season, etc.) together in such a way as to meet the requirements of a representative group of plants. The figure below illustrates this approach:



: for details, see list attached

In each of the five (temperature) zones approximately five moisture zones are found. In addition, twelve growing periods for annual crops had to be assessed. Altogether, approximately 350 AEZ have been established (see zones of the Kiambu district, for example).

This work is rather complicated. For example:

- the growing period of a particular plant is reduced by higher temperature, but here the water requirement is increased;
- the water availability in heavy soils is better than in light soils, but in very heavy soils it is less than in light soils, etc.

A meteorological data bank has been produced showing the particular climatic conditions which exist in any given part of Kenya, and including tables which show the water requirements of approximately 40 crops within the different environmental conditions.

4.2 The soils

The diversity of the soils in Kenya is probably greater than that of the climatic conditions. It is impossible to give proper (agricultural) advice without a good knowledge of the condition of the soil. It is a well known fact that tropical soils are comparatively poor in nutrients, but sound knowledge about the water-holding capacity of different soils in warm areas is most important. Because, as stated above, the diversity of Kenya's soils equals that of the country's climatic conditions, it has been necessary to produce a soil map for each district (see Machakos soil map), including a description of the origin and the quality of the soils. 22 types of soil, according to origin, have been included, but as these soils react differently under different climatological conditions, their quality therefore must be assessed separately for each zone. Most of this work has been done by K.S.S.

As a whole Kenya's soils are extremely infertile, and what little soil fertility exists is declining at an alarming rate. The danger resulting from this trend is obvious.

5.0 Farm Management assessments

Small scale farming is a way of life and therefore any recommendations must take into account not only the natural conditions but also the socio-economic conditions. For this reason, it was necessary to establish the present situation with the help of a survey (carried out by Mr. Swobeda), the results of which have been analysed by Dr. Zettelmeyer.

However, whereas the natural conditions remain fairly stable over long periods of time, the same cannot be said for socio-economic conditions which, over time, show considerable movement and change.

It is desirable, both from the farmers' and the national point of view, that the highest value product per area unit, capital and labour input is produced. Farm models, projected approximately 15 years into the future, should guide the extension and planning staff in arriving at an (possible) optimal land use in Kenya.

5.1 Optimisation calculations are a widely used approach in order to find out the most economic use of the resources of a farmer's family. This approach, however, must fail for the period (20 years) in question, and therefore the optimisation must be based on other (non-monetary) criteria. Thus, it is planned to value the different agricultural enterprises according to the objectives given below.

These objectives have been approved by the Ministry of Agriculture. This was necessary because, once released, the Handbook will set in motion a trend which will only be stopped with difficulty. The objectives, therefore, must be in line with the long term agricultural policy of Kenya.

OBJECTIVES FOR THE WEIGHING OF SUITABILITY OF ENTERPRISES

order of importance	II	III	IV
	High Altitude Region Dairy/Tea/Pyrethrum Area	Medium Altitude Region Coffee/Maize/Bananas Area	Low Altitude Region Cotton/Sorghum/Beans Area
1	Employment	Employment	Securing of food supply on farm
2	Food Production	Securing of food supply on farm	Employment
3	Soil fertility	Soil fertility	Soil fertility
4	Secure marketing	Secure marketing	Secure marketing
5	Foreign Exchange earnings	Foreign Exchange earnings	-

- 5.2 It is clear, to anybody familiar with soils in Kenya, that only the massive use of fertilizer and plant protective agents will help to avoid famine in future. The nutrient supply of the soils and the nutrient recovery of the plants differ widely (e.g. 14% - 42% for P). Unfortunately, the nutrient recovery on poor soils (e.g. Machakos) is very low. Any economic production increase is only possible in the Highlands. Farming in arid areas and irrigation projects can therefore only be justified from a political point of view, for food production.

A guide will be given of the present yields and inputs, and the possible yields and nutrient inputs required (see table Input/Output level) for each crop and for each zone.

Based on the information acquired so far, matrixes for about 1000 models will be drawn up and the models calculated with the help of a computer. An estimated 25-30 million calculations are needed to establish the farm models or farming systems.

- 6.0 All the above calculations are per farm, AEZ or district. For national planning the figures have to be aggregated. This will be done by measuring the areas per AEZ and multiplying this figure by the yields/output per ha, farm, labourers, etc. In this way we should arrive at a realistic picture for macro-economic planning purposes.

AGRO-ECOLOGICAL ZONES AEZ
(in 100 ha)

DISTRICT	LM 1	LM 2	LM 3	LM 3-4	LM 4	LM 4-5	LM 5	LM 5-6	LM 6	L 1	L 2	L 2-3	L 3	L 3-4	L 4	L 5	L 6
Kisii	16	24															
South Nyanza	244	1058	1548		652	375											
Kisumu	32	552	729		192												
Siaya	547	408	695		359	20											
Busia	502	425	327		95												
Bungoma	156	466	280														
Kakamega	1081	289		19													
Nandi	12	152															
Kericho		97	42														
Trans-Nzoia ²⁾																	
Uasin Gishu																	898
West Pokot ³⁾					21	120	1439	133	261								
Elgeyo Marakwet ⁴⁾					224		350										1474
Baringo					639		2935		295								
Laikipia									132								
Nakuru							9										
Narok	41	81															
South East Kajiado																	
Nyandarua																	
Kilimo																	
Meru			51		113												
Nyeri																	
Kirinyaga			158		338	9										115	
Elgeyo			198		247	105	1046										
Narok									124								418
Machakos			196		1478		5723									786	6996
Kitui			25		2533		9380									1029	1943
Taita-Taveta					442		762		1405								
Rwala												235	953		897	2342	2886
Kilifi													443	53	2043	2658	1914
Southern Tana River													280	138	138	970	7162
Lamu													511		3376	1606	24
TOTAL	2631	3532	4249	19	7333	629	21644	133	2217	-	-	235	2187	191	6456	9506	23709

4231,700

4231,400

Foot note: 3) in addition there are 14300 ha in LH₄-UM₃; 4500 ha in LH₂-UM₃, 136 ha in LH₃-UM₃
 4) in addition there are 1200 ha in TAI-UH₂; 1100 ha in LH₂-UM₃
 5) in addition there are 6100 ha in TAI UH₂₋₃, 1400 ha in TAI-UH₂₋₃
 6) in addition there are 1500 ha in UM₄-IM₄
 7) no data available 27100
 7086

MAIN AGRO-ECOLOGICAL ZONES OF THE TROPICS¹⁾

Belts of Zone	0 (perhumid)	1 (humid)	2 (subhumid)	3 (semi-humid)	4 (transitional)	5 (semi-arid)	6 (arid)	7 (per-arid)
TA Tropical Alpine Zones Ann. Temp. 2-10° C (10-15° C)	Glacier Mountain swamps	II. Sheep Zone						High altitude deserts
UM Upper Highland Zones Ann. Temp. 10-15° C Annual night frosts		I. Cattle-Sheep Zone	Sheep-Dairy Zone	Pyrethrum-Wheat Zone	Wheat-Barley Zone Kichuwa	U. Highland Ranching Zone	U.H. Nomadism Zone ⁴⁾	
LM Lower Highland Zones Ann. Temp. 15-18° C Monthly 10-11° C Normally no frost		Tea-Dairy Zone	Wheat/Maize-Pyrethrum Zone	Wheat/(Maize)-Barley Zone	Cattle-Sheep-Barley Zone	L. Highland Ranching Zone	L.H. Nomadism Zone ⁴⁾	
UN Upper Midland Zones Ann. mean 18-21° C Ann. Temp. 11-14° C		Coffee-Tea Zone	Main Coffee Zone	Marginal Coffee Zone	Sunflower-Maize Zone	Livestock-Sorghum Zone	U. Midland Ranching Zone	U. Midland Nom. Zone ⁴⁾
LN Lower Midland Zones Ann. mean 21-24° C Ann. Temp. > 14° C		L. Midland Sugarcane Zone	Marginal Sugarcane Zone	L. Midland Cotton Zone	Marginal Cotton Zone	L. Midland Livestock-Millet Zone	L. Midland Ranching Zone	L. Midland Nom. Zone ⁴⁾
L Lowland Zones								
LL Inner Lowland Zones Ann. Temp. > 24° C Mean max. > 31° C		Rice-Taro Zone	Lowland Sugarcane Zone	Lowland Cotton Zone	Groundnut Zone	Lowland Livestock-Millet Zone	Lowland Ranching Zone	Lowland Nom. Zone ⁴⁾
LL Coastal Lowland Zones Ann. Temp. > 24° C Mean max. > 31° C		Cocoa Oil Palm Zone	Lowland Sugarcane Zone	Coconut-Cassava Zone	Cashewnut-Cassava Zone	Lowland Livestock-Millet Zone	Lowland Ranching Zone	Lowland Nom. Zone ⁴⁾

- 1) In the Tropics, different zonation towards the margins. The T for Tropical is left out in the thermal belts of zones (except at TA), because it is only necessary if other climates occur in the same country. The names of potentially leading crops were used to indicate the zones. Of course these crops can also be grown in some other zones, but they are then normally less profitable.
- 2) Wheat or maize depending on farm scale, topography, etc. Maize is a good cash crop here, but maize also in LM 1, UM 1-3, LN and L 1-4.
- 3) Nomadism, semi-nomadism and other forms of shifting grazing.
- 4) An exception because of the vicinity of cold currents are the tropical cold Coastal Lowlands cCL in Peru and Namibia. Annual mean temperature there between 16° and 24° C.
- 5) In unimodal rainfall areas growing periods may be already too short for cotton. Then the zone could be called Lower Midland Sunflower-Maize Zone.

* Not in Kenya

Source: FAO, MOA.

100
90
80
70
60
50
40
30
20
10
0

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
NTHAWA	7723	8799	16522	3707	364	45
KATHERA	1717	2039	3756	917	59	54
NGUTHI	2845	3328	6173	1303	55	111
EVURORI	1937	2094	4031	775	53	74
THAMBU	1216	1384	2600	544	65	39
KAMARANDI	1215	1437	2652	529	74	35
IRIA ITUNE	1210	1286	2496	562	96	25
EVURORI	10140	11568	21708	4630	415	52
SINAKAGO	17863	20367	38230	8337	779	49
KIAMURINGA	889	966	1855	372	51	35
GACHOKA	1564	1678	3242	603	57	56
GACHURIRI	824	803	1627	316	70	23
KANGAKU	2256	2393	4649	792	12	367
ITABUA	1179	1191	2370	420	28	83
MBETI	6712	7031	13743	2503	220	62
KIPIMA	2403	2523	4926	1037	83	59
KITHUNTHIRE	1576	1862	3438	702	36	93
GICHICHE	1233	1474	2707	541	86	31
KIAMREPE	1712	1940	3652	733	166	21
MAVURIA	1870	2012	3882	802	88	43
MBITA	2239	2601	4840	969	55	87
RIACINA	482	514	996	249	105	9
MAVURIA	11515	12926	24441	5033	622	39
RIAKANAU	2270	2270	4540	962	125	36
KAPABA	2262	2390	4652	893	51	90
GATEGI	1503	1525	3028	560	89	33
WACHORO	1862	1930	3792	833	39	96
MAKIMA	1929	2001	3930	752	65	60
MBONDONI	1415	1285	2700	718	56	48
MWEA	11241	11401	22642	4718	427	53
MAJENGO	637	481	1118	388	0	3992
CENTRAL EAST	1076	791	1867	743	0	2745
BLUE VALLEY	1333	1262	2595	554	1	1351
CENTRAL WEST	951	695	1646	413	2	748
MATAKARI	1837	1643	3480	1113	2	1553
KAMIU	1343	1088	2431	597	6	366
THAMBO	828	872	1700	342	3	482
NJUKTIRI	562	587	1149	209	7	160
EMBU MUNICIPALITY	8567	7419	15986	4359	24	648
GACHOKA	38035	38777	76812	16613	1294	59
EMBU	127867	135306	263173	50241	2714	96

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
KAIRURI	983	970	1953	342	4	410
MBURORI	2683	2663	5346	872	11	478
MAHYATTA	1797	1840	3637	593	6	554
NGOVIO	2695	2729	5414	903	13	406
KIRUGU	3126	3353	6479	987	11	575
KIFIGI	1548	1647	3195	482	8	399
KATHANGARI	1560	1669	3229	511	5	545
MUKANGU	1126	1227	2353	391	7	314
KAMHENJA	1143	1267	2410	437	7	310
KIRIARI	2271	2335	4606	790	13	333
NGANDORI	18922	19700	38622	6308	90	428
NEMBURE	1590	1711	3301	518	7	425
KA VUTIRI	2308	2435	4743	812	11	420
MAKENG	1906	2049	3955	655	7	531
KA VOTE	2251	2419	4670	764	11	418
KITHIMU	2315	2616	4931	891	16	300
KITHEGI	1885	1897	3782	715	22	166
GA TUNDURI	2433	2595	5028	810	13	382
ENA	1408	1638	3046	549	10	281
KIANJUKI	1687	1842	3529	551	6	541
GATURI	17783	19202	36985	6305	107	344
KATHANJURI	2334	2499	4833	799	8	569
KATHUNGURI	1772	1964	3736	681	16	220
KIGUMO	1455	1573	3028	488	11	261
KIANGUNGI	1856	2030	3886	661	7	533
MUFU	1329	1571	2900	445	8	357
KARURUMO	1610	1631	3241	579	17	182
KA SAFIRI	260	298	558	107	8	66
RUKURIRI	1693	1754	3447	570	8	424
KATHARI	2587	2729	5316	743	12	439
KYENI	14896	16049	30945	5073	98	313
KIANJOKCHA	1261	1297	2558	470	7	351
KANJA	2000	2045	4045	719	11	367
MBUINJERU	2071	2045	4116	704	13	298
GITARE	1059	1206	2265	373	5	442
MUKUURI	1884	1964	3848	702	11	331
KICAA	1795	1938	3733	672	11	339
GICHICHE	1830	2004	3834	649	8	453
GIKUURI	2507	2711	5218	848	6	820
KAWANJARA	1163	1235	2398	485	10	222
NTHAGAIYA	1962	1971	3933	776	23	166
GICHEHA	2055	2310	4065	753	39	103
RUNYENJES T.C.	781	785	1566	454	1	932
KAGAARI	20368	21211	41579	7605	149	277
RUNYENJES	71969	76162	148131	25291	446	332
SIKAGO	1583	1749	3332	768	17	189
SIKAGO T.C.	85	122	207	48	1	136
RIANDU	1703	1824	3527	812	64	54
GITIPORE	1505	1692	3197	661	43	73
KIRIE	1102	1299	2401	617	128	18
GANGARA	1745	2113	3858	801	108	35

Agricultural Land
of it: Small Family Farms 2)
Settlement Farms
Medium Size to Large Farms 3)
Forests
Water Area
Urban Centres

270,159.02 ha
270,159.02 ha
ha
ha
4,787 ha
ha
2,400 ha

Location	Sub-Location	Area in ha	Remarks
Mbeti	Kiamuringa	4,074	
	Gachoka	5,815	
	Gachuriri	6,902	
	Kangaru	15.78	
	Itabua	4,756.28	
	Total	21,563.06	
Mavuria	Kithunthiri	3,973	
	Mbita	5,200	
	Kirima	7,000	
	Mavuria	9,200	
	Gichiche	9,700	
	Kiambere	14,900	
	Kasavari	5,900	
	Riacina	13,300	
	Total	69,173	
Nthawa	Siakago	2,857	
	Riandu	6,199	
	Gitibore	4,900	
	Gangara	9,200	
	Kerie) Mutitu)	14,600	
	Total	37,756	
Evurore	Nguthi	4,356	
	Kathera	4,922	
	Evurore	5,400	
	Kasarandi	7,600	
	Ntambu	6,800	
	Iriatune	8,500	
	Total	37,578	
Ngandori	Ngovio	5,390.42	There are now 6 more Sub-locations in Ngandori Location.
	Kiriari	4,486.55	
	Kirigi	9,464.80	
	Total	19,341.77	

Location	Sub-Location	Area in ha	Remarks
Gaturi	Nemburi	6,977.23	There are now 7 more Sub-locations in Gaturi Location.
	Githimu	4,433.72	
	Total	11,410.95	
Kagari	Kanja	5,208.32	There are now ten more Sub-locations in Kagari Location.
	Central)	3,722.71	
	Itura)	6,210.72	
	Weru		
	Total	15,141.75	
Mwea	Karaba	5,300	
	Riakana	19,900	
	Gategi	22,900	
	Total	48,100	
Kyen	Mufu	4,429.29	There are now more Sub- locations in Keni Location.
	Kigumo	5,665.20	
	Total	10,094.49	
<u>Forests</u>	Bondoni		
	Keraini	24	Trust
	Kiambere	643	Trust
	Kionjiru	1,004	Trust
	Kiria		
	Kirimiri	101	Trust
	Kiangombe	2,104	Trust
	Muthini		
	Muranga	219	Trust
	Molinduko	194	Trust
	Ndune		
	Njukini East	498	Trust
	Twanyoni		
	Total	4,787	

- 1) Source: Survey of Kenya: Statistic to be used for agricultural extension and planning work only.
- 2) Farms in former Trust lands, usually cultivated exclusively by owner's family
- 3) Former scheduled area, usually large mechanised operation depending on hired labour

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.7	3.6	10.6	Farming Intensity:				
Land Use: Annual Crops ¹⁾					Cropping Intensity	-	0.9	0.8	0.5
First Season					Portion of improved cattle kept	%	-	-	-
Maize	ha	0.3	0.5	0.6	Portion of Farmers owning a Plough	%	30%	10%	40%
Beans	ha	0.3	0.4	0.8					
Maize & Beans	ha	0.1	0.4	0.4					
Cotton	ha	0.3	0.3	0.6					
Others	ha	-	0.2	0.7					
Total	ha	1.0	1.8	3.1					
Second Season ¹⁾					Labour on Farm:				
Maize	ha	0.2	0.3	0.6	Family Adults	persons	2.0	2.5	2.0
Beans	ha	0.2	0.4	0.8	Perm. Hired Labour	"	0.3	0.1	0.2
Bulrush	ha	0.1	0.2	0.2	Children > 14 years	"	1.0	1.7	1.4
Others	ha	0.1	0.2	0.4					
Total	ha	0.6	1.1	2.0					
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
	ha				Adults > 14 years	persons	3.88	0.37	4.25
	ha				Children < 14 years	"	1.98	-	1.98
	ha				Subsistence Units	SU	5.06	0.37	5.43
portion of total	%								
Grazing & Forage	ha	0.4	1.4	6.9	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	24%	39%	65%	Maize	kg	1015	1963	
Other Land Use	ha	0.3	0.4	0.6	Beans	kg	247	471	
Livestock on Farm:					Sorghum	kg	29	55	
Cattle: local	LU	2.2	1.5	7.1	Millet	kg	108	203	
improved	LU	-	-	-	Cowpeas	kg	35	69	
Sheep & Goats	LU	0.4	0.8	1.3		kg			
Total	LU	2.6	2.3	8.4		kg			

Other Crops cultivated: Maize & Cowpeas, Cowpeas, Maize & Bulrush Millet, Sorghum

1) Major crops only considered

2) Based on 1979 Census figures

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	4.1	13.1	0.7	2.2	0.2	1.4
Avg. 1	4.1	15.1	2.1	2.2	1.0	2.5
Up. Qu.	4.0	21.0	1.0	2.0	-	2.0
Lo. Qu.	2.2	3.0	-	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	1.8	44	-	-	2.0	49	-	-	0.1	3	0.2	4
Avg. 1	1.8	40	0.1	3	2.0	46	-	-	0.4	8	0.2	3
Up. Qu.	2.2	74	-	-	1.6	54	-	-	0.1	2	0.2	7
Lo. Qu.	1.0	31	-	-	0.4	18	-	-	-	-	0.1	2
Total	53.3		0.1		58.9		-		3.0		4.5	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.5	0.8	1.7	0.5
Avg. 1			1.7	13.0
Up. Qu.	1.8	1.0	3.5	-
Lo. Qu.	1.3	0.1	0.3	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	45.7	2.2	-	4.9	-	-	-	0.2	-	2.4	-	-	-
Avg. 1	57.6	10.1	-	12.5	-	-	-	0.8	-	2.6	-	-	-
Up. Qu.	40.0	-	-	2.3	-	-	-	-	-	5.0	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	1.1	-	-	-

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

District: EMBU 43
AEZ IV : LM 3

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.4	0.8	0.80	0.00	12.8	24.0
Sorghum	0.1	0.8	0.00	0.00	1.6	3.0
Bulrushmillet	0.0	0.2	0.00	0.00	0.9	1.7
Beans	0.4	0.7	0.80	0.00	13.1	24.5
Cowpeas	0.1	0.3	0.00	0.00	1.5	2.9
Sunflower	0.0	0.4	0.00	0.00	0.4	0.8
Cotton	0.3	0.5	0.60	0.00	10.0	18.7
Tobacco	0.1	0.9	0.00	0.00	3.4	6.4
Others	0.0	0.6	0.00	0.00	0.6	1.1
Maize & Beans	0.3	0.7	0.40	0.00	8.0	15.0
Maize & Cowps	0.0	0.2	0.00	0.00	0.2	0.4
Maize & Others	0.0	0.8	0.70	0.00	0.8	1.5
Total					53.3	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.3	0.7	0.60	0.00	9.3	27.5
Sorghum	0.0	0.2	0.00	0.00	0.2	0.6
Bulrushmillet	0.2	0.5	0.40	0.00	4.6	13.6
Beans	0.4	0.7	0.80	0.00	11.6	34.3
Cowpeas	0.0	0.2	0.00	0.00	0.7	2.1
Sunflower	0.0	0.4	0.00	0.00	0.4	1.2
Others	0.0	0.4	0.00	0.00	0.4	1.2
Maize & BulMlt	0.0	0.4	0.00	0.00	0.4	1.2
Maize & Beans	0.1	0.5	0.20	0.00	3.8	11.2
Maize & Cowps	0.0	0.2	0.00	0.00	0.2	0.6
Maize & Others	0.1	0.7	0.00	0.00	2.2	6.5
Total					33.8	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cooking Bananas	0.0	0.1	0.00	0.00	0.1	100.0
Total					0.1	100.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.qu./Lo.qu. = Upper/Lower Quartile, 50% of all sample cases are in between these points
% columns = % of total farm land

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
KIIRUA	1800	1880	3680	560	16	230
NAARI	4388	4538	8926	1540	27	325
RUIRI	3185	3263	6448	991	38	166
THEGE	380	374	754	123	5	142
RWARERA	1656	1427	3083	547	88	34
NKANDO	991	929	1920	359	53	36
KIIRUA	12400	12411	24811	4120	229	108
GIARI	5348	5188	10536	1740	99	106
GIARI	5348	5188	10536	1740	99	106
IGOKI WEST	4456	4344	8800	2019	11	756
IGOKI EAST	4779	4120	8899	1994	5	1544
NTAKIRA WEST	2852	2904	5756	1083	5	1024
NTAKIRA EAST	3495	3692	7187	1218	5	1278
NTHIMBIRI	3192	3219	6411	1083	7	813
MILIMANI	177	132	309	81	0	965
CENTRAL	552	379	931	274	0	1939
HOSPITAL WARD	1158	997	2155	645	0	8979
MWENDANTU	227	177	404	147	0	2525
CATHEDRAL	141	84	225	95	0	703
COMMERCIAL	483	243	726	208	0	2268
MULATHANKARI NORTH	1050	1054	2104	402	3	565
MULATHANKARI SOUTH/NKABUNE	2868	2844	5712	1076	15	373
THUURA	3233	3273	6506	1224	32	201
MUNITHU	2967	3183	6150	1045	33	183
CHUGU-KITHOKA	4007	4157	8164	1318	5	1607
PERU MUNICIPALITY	1054	556	1610	393	-	-
PERU MUNICIPALITY	36651	35358	72009	14305	128	561
GAITU	2994	2884	5878	968	33	174
KAONGO	2539	2658	5197	970	35	145
IGANE	2341	2544	4885	882	21	223
GITIE	2336	2549	4885	859	21	223
MAKANDUNE	1250	1290	2540	503	34	74
KIAMURI	2114	2118	4232	783	62	68
MWANGATHIA	13574	14043	27617	4965	209	131
KIPBO/MUCHENE	3203	2929	6132	1233	57	107
NEW-KIBIPICHA	2628	2603	5231	660	19	274
KIIRUA IRII	1014	1107	2121	403	17	119
NTUMBURI	1591	1658	3249	534	38	83
KIRIRICHIA	8436	8297	16733	2830	132	125
KATHERI	5515	5993	11508	1821	28	404
GITHONGO	2832	2995	5827	1060	14	413
KITHIRUNE	3564	3756	7320	1217	19	381
MARIENE	2423	2500	4923	887	9	502
PUIGA	3632	3580	7212	1236	26	269
KARIENE	4941	4957	9898	1671	19	503
UPPER ABOTHUGUCHI	22907	23781	46688	7892	117	396
TIMAU	3844	3386	7230	1689	176	41
NGARE NDARE	4548	3497	8045	1806	429	18
ONTULILI	4270	3844	8114	1972	185	43
TIMAU	12662	10727	23389	5467	790	29
NORTH IMENTI	112018	109805	221823	41319	1708	129
UPPER KIONGONE	3273	3350	6623	1178	28	236

Agricultural Land	469,569	ha
of it: Small Family Farms 2)	417,109	ha
Settlement Farms	9,468	ha
Medium Size to Large Farms 3)	42,991.92	ha
Forests	42,930	ha
Wetland National Parks	87,000	ha
Urban Centres	20,200	ha

Location	Sub-Location	Area in ha	Remarks
Mutuati	Nasithu	5,000	
	Awathi Mutuati	12,500	
	Awathi	7,700	
	Antubetwe Kiongo	16,800	
	Total	42,000	
12) Maua	Athiru Runjine	2,100	
	Antubetwe Njouno	4,600	
	Kiengu	4,506.3	
	Kiengo	6,724.5	
	Awathi Maua	6,800	
	Total	24,730.8	
North Tharaka	Nikondi		
	Marimanti	18,854.7	
	Gatunga	12,100	
	Mujiwa		
	Makande	5,594.9	
	Kanjoro	20,100.0	
	Total	56,649.6	
13) South Tharaka	Tunyai	8,200	
	Chiokarige	10,300	
	Kanyuru	10,400	
	Total	28,900	
14) Mikinduri	Antuamburi	5,900	
	Athwana	700	
	Akaiga	5,000	
	Igarie	9,500	
	Githu	2,700	
	Ankamia	1,600	
	Kiguchwa	8,600	
	Total	34,000	

Location	Sub-Location	Area in ha	Remarks
Akithi	Akithi I)	1,900	
	Akithi II)	2,100	
	Akithi III	2,100	
	Kathee	2,100	
	Athwana Akithi	2,700	
	Total	8,800	
Forests			
Maatha	North Tharaka	639.4	
Kikingo	" "	1,234.3	
Kijegge	South Tharaka	3,296.2	
Kerera	" "	793.2	
Kiega	Kianjai	546.3	
Kiagu	L. Abothuguchi	1,366.2	
Lower Imenti	Kiirua	10,388.3	
Munguni	Mwimbe	194.2	
Mutharanga	South Tharaka	299.5	
Ngaiya	Mutuati	4,139.9	
Ntugi	South Tharaka	1,378.8	
Nyambeni	Mikinduri	4,689.9	
"	Muthara	701.3	
Timau		295.4	
Thuuri	Mikinduri	734.5	
Thunguru Hill		631.3	
Ajuguni		2,003.2	
Ajare		5,554.3	
Mutejwa		1,375.9	
Upper Imenti		2,462.1	
Kibithewa		206.4	
	Total	44,930.7	
Settlement Farms			
	Timau	2,436	
	Maran'a	3,178	
	Lewa	3,854	
	Total	9,468	

- Source: Survey of Kenya: Statistic to be used for agricultural extension and planning work only.
- Farms in former Trust lands, usually cultivated exclusively by owner's family
- Former scheduled area, usually large mechanised operation depending on hired labour

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.1	1.9	4.0	Farming Intensity:				
Land Use: Annual Crops ¹⁾									
First Season									
Maize	ha	-	0.1	0.1	Cropping Intensity	-	0.8	0.7	0.5
English Potatoes	ha	-	-	0.2	Portion of improved cattle kept	%	86%	70%	74%
Maize & Beans	ha	0.2	0.3	0.4	Portion of Farmers owning a Plough	%	-	-	-
Beans	ha	0.1	-	0.1					
Others	ha	-	-	-					
Total	ha	0.3	0.4	0.8					
Second Season ¹⁾					Labour on Farm:				
Maize	ha	-	-	0.1	Family Adults	persons	2.2	2.9	1.8
Beans	ha	-	0.1	0.1	Perm. Hired Labour	"	0.3	0.3	1.2
Maize & Beans	ha	0.3	0.1	0.4	Children > 14 years	"	1.5	1.7	1.0
Total	ha	0.3	0.2	0.6					
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
Coffee	ha	0.3	0.6	0.6	Adults > 14 years	persons	2.36	0.17	2.53
Bananas	ha	-	0.1	0.1	Children < 14 years	"	3.28	-	3.28
	ha				Subsistence Units	SU	4.32	0.17	4.49
portion of total	%	27%	37%	18%					
Grazing & Forage	ha	0.3	0.7	1.8	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	27%	37%	45%					
Other Land Use	ha	0.2	0.1	0.7	Maize	kg	917	1774	
					Beans	kg	268	511	
Livestock on Farm:					Fingermillet	kg	4	8	
Cattle: local	LU	0.3	0.7	0.7	English Potatoes	kg	201	78	
improved	LU	1.9	1.6	2.0	Sweet Potatoes	kg	7	5	
Sheep & Goats	LU	0.4	0.3	1.1		kg			
Total	LU	2.6	2.6	3.9		kg			

Other Crops cultivated: Fingermillet, Sweet Potatoes, Sugarcane

- 1) Major crops only considered
2) Based on 1979 Census figures

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	2.7	5.8	17.2	Farming Intensity:				
Land Use: Annual Crops ¹⁾									
First Season									
Maize	ha	0.3	1.4	1.6	Cropping Intensity	-	1.2	1.0	0.6
Beans	ha	0.2	0.7	0.8	Portion of improved cattle kept	%	35%	32%	51%
Sunflower	ha	0.3	0.2	0.7	Portion of Farmers owning a Plough	%	-	10%	20%
Cotton	ha	0.8	0.9	2.0					
Maize & Beans	ha	0.5	0.3	0.4					
Total	ha	2.1	3.5	5.5					
Second Season ¹⁾					Labour on Farm:				
Maize	ha	0.2	1.2	1.6	Family Adults	persons	1.4	2.3	2.4
Beans	ha	0.2	0.6	0.8	Perm. Hired Labour	"	-	0.6	2.0
Sunflower	ha	0.2	0.2	0.7	Children > 14 years	"	1.4	3.1	1.8
Maize & Beans	ha	0.4	0.2	0.4					
Total	ha	1.0	2.2	3.5					
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
Bananas	ha	-	0.1	0.6	Adults > 14 years	persons	2.37	0.22	2.59
Citrus	ha	-	0.1	0.4	Children < 14 years	"	3.02	-	3.02
	ha				Subsistence Units	SU	4.18	0.22	4.40
portion of total	%	-	3%	6%					
Grazing & Forage	ha	0.5	1.5	8.4	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	25%	26%	49%	Maize	kg	1074	2077	
Other Land Use	ha	0.1	0.6	2.3	Beans	kg	243	463	
					Millet	kg	69	129	
Livestock on Farm:						kg			
Cattle: local	LU	1.1	2.5	3.3		kg			
improved	LU	0.6	1.2	4.0		kg			
Sheep & Goats	LU	0.3	1.3	2.4		kg			
Total	LU	2.0	5.0	10.2		kg			

Other Crops cultivated: Bulrush Millet

1) Major crops only considered

2) Based on 1979 Census figures

District: 46 KERU ABOTHUGUCHI IV
AEZ: UM 2

January, 1978
Sample Size 30

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	1.9	8.4	0.8	2.4	0.4	1.5
Avg. 1	1.9	8.7	1.2	2.4	1.3	2.8
Up. Qu.	2.2	11.0	1.0	3.0	1.0	2.0
Lo. Qu.	1.2	4.0	-	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	0.5	27	0.6	30	0.6	32	0.1	3	-	2	0.1	6
Avg. 1	0.5	22	0.6	25	0.7	29	0.2	6	0.3	13	0.1	5
Up. Qu.	0.6	33	0.9	47	0.7	38	0.1	8	-	-	0.1	8
Lo. Qu.	0.2	17	0.2	13	0.1	8	-	-	-	-	0.1	4
Total	15.0		16.7		17.8		1.8		1.3		3.3	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.4	1.5	4.3	63.7
Avg. 1			4.0	82.2
Up. Qu.	2.0	2.5	9.8	90.4
Lo. Qu.	1.0	0.9	2.1	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	42.5	4.3	13.2	14.5	5.2	-	-	-	0.1	0.8	0.3	0.3	6.4
Avg. 1	52.5	23.3	18.6	38.5	42.4	-	2.1	0.6	0.4	2.1	0.7	2.3	6.4
Up. Qu.	57.1	-	27.9	25.2	-	-	-	-	0.3	1.3	-	-	10.7
Lo. Qu.	-	-	3.3	-	-	-	-	-	-	-	-	-	3.0

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of all farms excluding zero entries
Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
AC = Annual Crops
PC = Perennial Crops

District: 45 MERU LOWER ABO. IV
AEZ: LM 3

January, 1978
Sample Size 30

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Fern.Hrd. Labourers	Children > 14 No.
Avg. 0	7.2	21.3	1.5	2.2	0.7	2.6
Avg. 1	7.2	22.1	1.8	2.2	2.2	3.2
Up. Qu.	8.0	21.0	2.0	2.0	1.0	4.0
Lo. Qu.	4.0	9.0	1.0	2.0	-	1.0

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	3.6	51	0.3	4	2.3	33	0.1	2	0.5	7	0.2	3
Avg. 1	3.6	39	0.9	9	2.5	27	0.5	5	1.6	17	0.2	2
Up. Qu.	4.4	80	0.4	7	3.0	40	0.2	4	0.4	10	0.2	5
Lo. Qu.	2.4	40	-	-	0.5	11	-	-	-	-	0.1	2
Total	108.2		8.8		70.0		4.5		15.8		6.2	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.4	0.7	2.2	28.4
Avg. 1			2.1	55.7
Up. Qu.	1.6	0.9	5.5	44.6
Lo. Qu.	1.3	0.4	1.2	-

Inputs Applied

Inputs Applied													
Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
	AC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	64.1	0.2	-	1.5	-	-	-	-	-	5.1	0.1	-	-
Avg. 1	64.1	6.3	-	22.6	-	-	-	0.3	0.1	5.1	3.0	-	1.0
Up. Qu.	61.5	-	-	-	-	-	-	-	-	8.3	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	2.1	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of all farms excluding zero entries
Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
AC = Annual Crops
PC = Perennial Crops

District: MERU 44
AEZ II/III: LH 1 - UM 1

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper quartile ha	Lower quartile ha	Total Sample Area	
					ha	%
Maize	0.2	0.5	0.40	0.00	4.5	23.5
Wheat	0.0	0.1	0.00	0.00	0.1	0.4
Beans	0.1	0.3	0.00	0.00	1.9	10.0
Engl. Potatoes	0.1	0.3	0.20	0.00	3.2	16.8
Cabbage	0.1	0.2	0.12	0.00	1.7	8.7
Pyrethrum	0.0	0.2	0.00	0.00	1.1	5.6
Others	0.0	0.1	0.00	0.00	0.3	1.7
Maize & Sorghm	0.0	0.1	0.00	0.00	0.1	0.6
Maize & Beans	0.2	0.4	0.40	0.00	6.1	31.6
Maize & Others	0.0	0.2	0.00	0.00	0.2	1.0
Total					19.2	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper quartile ha	Lower quartile ha	Total Sample Area	
					ha	%
Beans	0.1	0.4	0.20	0.00	3.0	34.1
Engl. Potatoes	0.1	0.3	0.20	0.00	2.3	26.4
Cabbage	0.0	0.2	0.00	0.00	1.2	13.2
Sweet Potatoes	0.0	0.2	0.00	0.00	0.2	2.3
Pyrethrum	0.0	0.2	0.00	0.00	1.1	12.3
Others	0.0	0.1	0.00	0.00	0.2	2.3
Maize & Beans	0.0	0.3	0.00	0.00	0.8	9.5
Total					8.8	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower quartile ha	Total Sample Area	
					ha	%
Cookng Bananas	0.0	0.1	0.00	0.00	0.1	0.9
Coffee	0.2	0.3	0.32	0.00	5.0	37.6
Tea	0.3	1.2	0.12	0.00	8.1	61.5
Total					13.2	100.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo.Qu. = Upper/Lower quartile, 50% of all sample cases
are in between these points
% columns = % of total farm land

District: MERU ABOTHUGUCHI 46
 AEZ IV : UM 2

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.0	0.5	0.00	0.00	1.0	6.7
Fingermillet	0.0	0.1	0.00	0.00	0.1	0.8
Beans	0.0	0.3	0.00	0.00	1.0	7.0
Engl. Potatoes	0.0	0.2	0.00	0.00	1.4	9.2
Sweet Potatoes	0.0	0.1	0.00	0.00	0.1	0.8
Sugarcane	0.0	0.2	0.00	0.00	0.2	1.3
Others	0.0	0.8	0.00	0.00	0.8	5.4
Maize & Beans	0.3	0.4	0.40	0.12	10.2	63.7
Total					14.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.0	0.6	0.00	0.00	0.6	6.2
Beans	0.0	0.3	0.00	0.00	1.4	14.9
Engl. Potatoes	0.0	0.2	0.00	0.00	0.5	5.0
Sugarcane	0.0	0.2	0.00	0.00	0.2	2.1
Maize & Beans	0.2	0.5	0.40	0.00	6.9	71.8
Total					9.6	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cookng Bananas	0.0	0.2	0.00	0.00	0.8	4.7
Coffee	0.5	0.5	0.72	0.24	15.0	92.8
Tea	0.0	0.2	0.00	0.00	0.4	2.5
Total					16.2	100.0

Avg 0 = average of all sample farms
 Avg 1 = average of all farms excluding zero entries
 Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50% of all sample cases
 are in between these points
 % columns = % of total farm land

District: MERU LOWER AB.O. 45
AEZ IV : LM 3

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	1.1	1.5	1.60	0.00	32.0	29.0
Bulrushmillet	0.1	0.7	0.00	0.00	2.6	2.4
Beans	0.6	0.9	0.80	0.00	18.2	16.5
Sunflower	0.4	0.7	0.80	0.00	13.0	11.8
Cotton	1.1	1.3	1.60	0.40	33.4	30.3
Tobacco	0.0	0.4	0.00	0.00	0.4	0.4
Cassava	0.1	0.8	0.00	0.00	1.8	1.6
Sugarcane	0.0	0.6	0.00	0.00	0.6	0.5
Maize & Beans	0.3	1.0	0.40	0.00	8.2	7.4
Total					110.2	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.9	1.3	1.20	0.00	28.0	40.8
Bulrushmillet	0.0	0.4	0.00	0.00	0.4	0.6
Beans	0.6	0.9	0.80	0.00	13.4	28.3
Sunflower	0.3	0.6	0.80	0.00	10.2	14.9
Cassava	0.1	1.8	0.00	0.00	1.8	2.6
Sugarcane	0.0	0.6	0.00	0.00	0.6	0.9
Maize & Beans	0.3	1.0	0.40	0.00	8.2	12.0
Total					68.6	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Cookng Bananas	0.2	0.5	0.40	0.00	5.2	76.5
Citrus	0.1	0.8	0.00	0.00	1.6	23.5
Total					6.8	100.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50% of all sample cases
are in between these points
% columns = % of total farm land

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
THIGIO	2654	2927	5581	1066	27	205
NDLIYA	7065	7821	14886	2855	96	153
LIMURU	55352	54861	110213	23988	464	237
RUIRU TOWNSHIP	986	732	1718	516	3	490
RUIRU RURAL	3592	2526	6218	1748	62	98
GITHUNGURI RANCHING	6151	5156	11347	2850	42	268
KITAMAIYU	1821	1355	3176	986	25	123
RUIRU	12550	9909	22459	6100	134	167
NGOLIBA	2681	1990	4671	1597	68	68
GATUANYAGA	1546	1515	3061	638	23	132
THIKA	4227	2505	7732	2235	91	84
MUMYU	1922	1685	3607	677	22	162
JUJA RUKAL	8964	6867	15831	4794	235	67
JUJA	10686	8552	19438	5471	257	75
KOMU	5009	3540	8549	2305	32	260
HOSPITAL WARD 2	3552	2710	6702	2001	6	1003
NDURUKUMU WARD 3	537	360	897	258	3	299
MUGUMU WARD 4	1159	1063	2222	526	1	1501
KIGANDA WARD 5	936	591	1527	466	21	70
BIASHAKA WARD 6	761	702	1463	481	0	3657
MARKET WARD 7	4551	3127	7718	2134	1	4487
CHANIA WARD 8	755	698	1493	441	10	137
KAPIMINU WARD 9	233	158	391	127	7	54
KARIBARIKI WARD 10	309	254	563	147	6	91
MAJENGO WARD 11	2569	2023	4612	1404	0	11530
KIANDA WARD 12	2853	2294	5187	1592	-	-
-THIKA MUNICIPALITY	23804	17520	41324	11882	92	447
THIKA	51467	39486	90953	25688	575	157
KIRIA	3535	3768	7303	1232	12	567
GITHUNGURI	2685	2465	5550	914	10	547
GITHUNGURI T C	1270	1247	2517	742	1	2420
NYAGA	3153	3359	6512	1267	9	668
GIATHIEKO	1628	1621	3249	617	5	570
RIUKI	2646	2881	5527	995	7	744
GITHIHA	1835	1934	3765	683	10	371
KANJAI	2504	2595	5099	1016	9	560
GITHUNGARI	1842	1875	3717	732	11	332
GITHIGA	5056	5423	10519	1964	11	951
IKINU	5399	5758	11157	2093	11	969
KIMATHI	2613	2728	5341	952	9	546
GITHUNGURI	34206	36054	70260	13207	109	640
G/CHOIRE	1854	1874	3728	632	15	233
KAGAA	1527	1532	3069	549	13	226
KYANDUMA	2198	2425	4623	823	15	299
KAMUCHEGE	1726	1926	3652	629	11	318
KAGWE	1757	1950	3716	692	17	212
KAMBURU	2201	2464	4665	757	17	273
GATAMAIYU	11273	12180	23453	4122	90	257

KIAMBUR

POPULATION BY SEX AND SUB-LOCATION

KIAMBUR

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
NGURUNGO	2092	2115	4207	746	10	384
KANYONI	1427	1436	2863	551	8	321
KAIRI	3259	3453	6712	1182	10	654
GITUAMBA	1373	1433	2806	519	8	325
KIKIKO	1307	1364	2671	460	8	331
KAMWANGI	2002	2112	4114	734	9	429
CHANIA	15887	16643	32530	5768	82	396
GATHAITI	1415	1634	3049	492	6	320
GAKJE	1660	1717	3377	609	13	257
KIENI	608	595	1203	218	17	69
KARATU	1659	1842	3501	592	17	201
GACHARAGE	1304	1454	2758	525	15	178
GATEI	1965	2049	4014	679	8	488
KARINGA	1285	1262	2547	420	7	354
NJAMI	604	724	1228	257	8	160
GITWE	1241	1296	2537	519	8	322
KAMUNYAKA	1205	1290	2495	459	13	180
NDARUGU	12946	14063	27009	4770	118	227
	73012	79359	152371	27562	386	393
GATUNDU						
KEMIFITHU	4703	4864	9567	2057	24	392
RIBIFIONI	5800	6110	11910	2044	18	650
GITHIA	2136	2295	4431	850	14	297
LIMURU TOWNSHIP	1061	667	1728	653	0	1963
LIMURU	13700	13936	27636	5604	58	472
KAMBAA	1548	1567	3115	542	6	448
KAMBAA TC	479	521	1000	204	0	2272
LARI SETTLEMENT SCHEME	685	684	1369	230	7	186
MAGINA	1293	1396	2689	550	3	759
KIRENGA	1657	1855	3552	719	7	445
BATHI	1750	1846	3596	716	5	609
MBAUINI	818	937	1755	360	4	404
KIJABE	1862	1932	3794	808	32	116
GITHIAIONI	1244	1298	2542	459	16	155
KINALE	1565	1609	3174	722	46	68
ESCAPMENT	1231	1401	2632	505	9	265
KAMAF/PAGIA	1318	1280	2598	408	27	95
GITHOITO	442	420	862	177	6	125
UPLANDS	364	347	711	158	13	51
UPLANDS TC	707	549	1256	357	0	1427
LARI	17003	17642	34645	6955	190	181
KAFAMBAINI	8074	6371	14445	4277	61	235
ITHANJI	3078	2176	5254	1661	38	135
TIGONI	11152	8547	19699	5938	99	197
NGECHA	3309	3564	6873	1306	10	630
RIRONI	2137	2263	4400	857	5	761
KABUKU	966	1089	2074	433	1	1091
NGECHA	6432	6915	13347	2596	18	718
NDIUNI	876	1026	1902	368	7	270
TIFKUNU	1040	1053	2093	372	18	115
NDERU	2455	2815	5310	1049	44	119

ADMINISTRATIVE AREA	MALE	FEMALE	TOTAL	NUMBER OF HOUSEHOLDS	SQUARE KILOMETRES	DENSITY
KARURI	5352	5328	11380	2404	9	1168
MUCHATHA	3654	3952	7546	1418	7	1022
KAKURA	2168	2261	4429	813	5	817
KIMAPA	4036	4154	8190	1530	8	954
GRTHANGA	2325	2432	4757	925	4	1066
KIAMBA	2445	2495	4940	1074	4	1216
KANUNGA	3289	3548	6837	1271	8	827
RWAKA	3486	3472	6958	1456	7	871
KIAMBAA	26955	28042	55037	10891	55	984
ANMER	3250	2652	5902	1586	39	148
CIANDA	3307	2475	5782	1485	33	175
THINDIGUA LOWER SET AREA	2825	2226	5051	1442	32	154
KIMARA AND IRCNIA	295	179	474	173	-	-
KIAMBA SETTLED AREA	9677	7532	17209	4686	105	163
FIABFI	4446	4785	9231	1831	10	869
TINGANGA	4053	4528	8581	1474	9	859
NDUMBEPI	5075	5257	10332	1936	8	1227
NDUMBEPI	13574	14570	28144	5241	29	969
KIAMBU CENTRAL KANGOYA	756	560	1216	407	0	3290
BIASHARA WARD 2	244	322	666	165	0	1665
HOSPITAL WARD 3	509	518	1027	237	0	1351
MARKET WARD 4	373	287	660	231	0	5500
KIAMBU TOWNSHIP	1982	1687	2669	1040	1	2183
KIAMBA	52228	51831	104059	21958	191	542
GITHUNGUCU	3578	4055	7633	1648	11	680
NYAMANGAPA	1457	1552	3049	527	5	542
KEMUGUINI	2353	2770	5163	973	9	572
ITUURU	1718	1932	3650	641	7	511
KAMWANGI	2165	2330	4495	747	6	643
KAKURI	2453	2718	5211	846	7	709
MANGU	1972	2323	4295	749	6	629
GRTHAGE	2124	2483	4607	823	7	624
KIMUNYU	2587	3269	5856	1140	11	544
GAUKLYU	2148	2328	4476	853	5	819
MUKUWE	1323	1501	2824	505	5	498
MITEFO	1204	1299	2503	435	4	622
NG'ENDA	25562	28600	54162	9897	88	615
GACHIKA	1062	1099	2161	393	10	197
KIGANJO	1854	2039	3893	768	8	451
MUNDORO	2110	2160	4290	801	18	229
NEMBU	4426	4922	9348	1745	13	690
KA NEEGE	1943	2135	4078	798	11	340
KIAMWANGI	2082	2233	4315	786	4	880
GATITU	1292	1384	2676	487	10	261
KIAMKUPIA	1551	2074	4065	653	9	446
FITHO	1857	1987	3844	706	9	386
KIGANJO	18617	20053	38670	7137	97	394
MATARA	1456	1522	2978	527	17	170
MAKWE	2571	3238	6179	1049	8	755

FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	0.9	2.0	6.5	Farming Intensity:				
Land Use: Annual Crops ¹⁾									
First Season				0.1					
Maize	ha	0.2	0.3	1.1	Cropping Intensity	-	1.2	1.1	0.8
Beans	ha	0.1	0.1	0.2	Portion of improved cattle kept	%	93%	-	-
Maize & Beans	ha	0.1	0.2	-	Portion of Farmers owning a Plough	%	-	-	-
English Potatoes	ha	-	0.1	0.2					
Others	ha	-	-	0.3					
Total	ha	0.4	0.7	1.9					
Second Season ¹⁾					Labour on Farm:				
Maize	ha	0.1	0.2	0.4	Family Adults	persons	2.0	3.1	1.9
English Potatoes	ha	0.1	0.2	0.4	Perm. Hired Labour	"	-	0.1	0.7
Maize & Beans	ha	0.1	0.1	0.5	Children > 14 years	"	1.5	2.9	3.6
Others	ha	-	0.1	0.4					
Total	ha	0.3	0.6	1.7					
Permanent Crops ¹⁾					Persons living on Farm ²⁾		Farmer's Family	Non-related Persons	Total
Coffee	ha	0.3	0.7	1.1	- average household size -				
Tea	ha	0.1	-	0.1	Adults > 14 years	persons	2.03	0.33	2.36
Bananas	ha	-	0.1	-	Children < 14 years	"	2.94	-	2.94
Passion Fruit	ha	-	-	0.1	Subsistence Units	SU	3.79	0.33	4.12
portion of total	%	44%	40%	20%					
Grazing & Forage	ha	0.1	0.3	1.5	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	11%	15%	13%	Maize	kg	1115	2157	
Other Land Use	ha	-	0.2	1.8	Beans	kg	126	240	
Livestock on Farm:					English Potatoes	kg	485	189	
Cattle: local	LU	0.1	-	-	Cabbage	kg	12	1	
improved	LU	1.3	1.7	2.6					
Sheep & Goats	LU	0.4	0.4	0.7					
Total	LU	1.8	2.1	3.3					

Other Crops cultivated: Cabbage, Sweet Potatoes, Groundnuts, Sugarcane, Macadamia

- 1) Major crops only considered
2) Based on 1979 Census figures

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	1.9	3.7	6.0	Farming Intensity:				
Land Use: Annual Crops ¹⁾									
First Season			0.1		Cropping Intensity	-	0.7	0.5	0.8
Maize	ha	0.5	0.3	-	Portion of improved cattle kept	%	60%	8%	75%
Maize & Beans	ha	0.1	0.5	0.6	Portion of Farmers owning a Plough	%	-	10%	-
Tobacco	ha	0.2	-	1.3					
Beans	ha	-	0.2	-					
Others	ha	-	0.1	0.5					
Total	ha	0.8	1.2	2.4					
Second Season ¹⁾					Labour on Farm:				
Maize	ha	0.4	0.1	0.7	Family Adults	persons	1.9	2.1	1.3
Maize & Beans	ha	0.1	0.3	1.6	Perm. Hired Labour	"	0.1	-	-
English Potatoes	ha	0.1	-	0.1	Children > 14 years	"	0.8	1.1	4.3
Others	ha	-	0.1	-					
Total	ha	0.6	0.5	2.4					
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
	ha				Adults > 14 years	persons	2.27	0.34	2.61
	ha				Children < 14 years	"	2.70	-	2.70
	ha				Subsistence Units	SU	3.89	0.34	4.23
portion of total	%								
Grazing & Forage	ha	0.7	2.0	2.1	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	37%	54%	35%	Maize	kg	993	1921	
Other Land Use	ha	0.4	0.5	0.5	Beans	kg	195	372	
					English Potatoes	kg	268	105	
Livestock on Farm:					Cabbage	kg	18	2	
Cattle: local	LU	0.4	1.1	0.4					
improved	LU	0.6	0.1	1.2					
Sheep & Goats	LU	0.5	0.9	1.0					
Total	LU	1.5	2.1	2.6					

Other Crops cultivated: Sweet Potatoes, Pigeon Peas, Cabbage, Tomatoes, Bananas, Cotton

1) Major crops only considered
2) Based on 1979 Census figures

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	2.6	6.6	0.6	2.2	0.2	2.1
Avg. 1	2.6	7.2	1.2	2.4	1.7	3.2
Up. Qu.	2.4	10.0	1.0	3.0	-	4.0
Lo. Qu.	0.8	3.0	-	2.0	-	-

Land Use

Range	Annual Crops		Perm. Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	0.8	41	0.6	31	0.2	12	0.1	5	0.1	3	0.2	9
Avg. 1	0.8	30	0.7	24	0.6	22	0.3	9	0.2	7	0.2	8
Up. Qu.	1.0	50	0.8	48	0.2	9	0.2	6	0.1	3	0.2	11
Lo. Qu.	0.3	24	0.3	22	-	-	-	-	-	-	-	4
Total	23.7		17.7		6.8		2.8		1.5		5.3	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking R:te		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.7	0.9	6.6	76.5
Avg. 1			3.9	79.3
Up. Qu.	2.0	2.4	2.6	93.8
Lo. Qu.	1.4	0.5	-	62.5

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	42.0	18.1	15.2	45.0	4.2	-	-	-	-	1.8	1.1	0.9	4.2
Avg. 1	55.3	18.3	15.7	48.2	14.5	-	-	-	0.1	2.7	10.7	2.0	5.9
Up. Qu.	25.0	27.6	39.0	70.5	8.7	-	-	-	-	4.1	-	2.2	9.2
Lo. Qu.	-	7.0	6.5	14.0	-	-	-	-	-	0.1	-	-	0.8

Notes: Avg. 0 = average of all sample farms
 Avg. 1 = average of all farms excluding zero entries
 Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
 AC = Annual Crops
 PC = Perennial Crops

District: 31 KIAMBUI IV
AEZ: UM 4-5 - LM 4

August, 1977
Sample Size 30

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	3.2	9.2	0.1	1.9	-	1.3
Avg. 1	3.2	10.6	1.5	1.9	1.0	2.6
Up. Qu.	4.0	14.0	-	2.0	-	3.0
Lo. Qu.	2.0	2.0	-	1.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	1.2	38	-	-	1.4	45	-	1	0.2	7	0.3	9
Avg. 1	1.2	25	0.4	8	1.8	37	0.3	7	0.7	15	0.3	7
Up. Qu.	1.7	60	-	-	2.3	62	-	-	0.2	9	0.3	15
Lo. Qu.	0.7	20	-	-	0.2	14	-	-	-	-	0.1	2
Total	35.7		0.4		42.8		1.0		6.4		8.6	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Re'e		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.4	0.6	1.2	17.2
Avg. 1			1.1	76.1
Up. Qu.	2.0	0.8	1.8	-
Lo. Qu.	1.0	0.1	0.2	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	46.1	3.0	-	2.3	-	0.4	-	-	-	0.7	-	-	-
Avg. 1	50.2	13.7	-	6.8	-	10.6	-	-	-	1.7	-	0.3	-
Up. Qu.	76.2	0.9	-	2.3	-	-	-	-	-	0.7	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of all farms excluding zero entries
Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
AC = Annual Crops
PC = Perennial Crops

FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group			Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large			small	medium	large
Farm Size Total	ha	2.6	5.6	28.1	Farming Intensity:				
Land Use: Annual Crops ¹⁾ First Season					Cropping Intensity	-	1.0	0.8	0.2
Maize	ha	0.4	0.9	0.7	Portion of improved cattle kept	%	-	-	18%
Maize & Cowpeas	ha	0.3	0.3	0.2	Portion of Farmers owning a Plough	%	-	30%	-
Cotton	ha	0.1	0.1	0.1					
Cassava	ha	-	0.3	0.2					
Others	ha	0.6	0.3	0.7					
Total	ha	1.4	1.9	1.9					
Second Season ¹⁾					Labour on Farm:				
Maize	ha	0.2	-	0.4	Family Adults	persons	2.8	3.8	5.0
Cowpeas	ha	0.6	0.2	0.3	Perm. Hired Labour	"	-	0.1	-
Cassava	ha	-	0.3	0.4	Children > 14 years	"	1.5	2.3	-
Others	ha	0.2	0.3	0.5					
Total	ha	1.0	0.8	1.6					
Permanent Crops ¹⁾					Persons living on Farm ²⁾ - average household size -		Farmer's Family	Non-related Persons	Total
Cashewnuts	ha	0.3	1.8	1.3	Adults > 14 years	persons	4.82	0.52	5.34
Coconuts	ha	-	0.1	0.7	Children < 14 years	"	2.95	-	2.95
	ha				Subsistence Units	SU	6.59	0.52	7.11
portion of total	%	12%	34%	7%					
Grazing & Forage	ha	0.6	1.1	17.8	Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
portion of total	%	23%	20%	63%	Maize	kg	1155	1885	
Other Land Use	ha	0.3	0.7	6.4	Beans	kg	13	18	
					Cassava	kg	69	34	
					Cowpeas	kg	189	265	
Livestock on Farm:									
Cattle: local	LU	2.8	2.5	4.5					
improved	LU	-	-	0.4					
Sheep & Goats	LU	1.2	1.9	2.6					
Total	LU	4.0	4.4	7.5					

Other Crops cultivated: Tomatoes, Tobacco

1) Major crops only considered
 2) Based on 1979 Census figures

District: 54 KILIFI IV A/B/C
AEZ: L 3-4

October, 1977
Sample Size 29

TABLE : ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children >14 No.
Avg. 0	6.5	21.8	0.3	3.6	0.1	2.0
Avg. 1	6.5	28.7	2.5	3.7	1.0	3.4
Up. Qu.	6.2	45.0	-	4.0	-	3.0
Lo. Qu.	4.0	2.0	-	2.0	-	-

Land Use

Range	Annual Crops		Perennial Crops		Pasture		Forage		Fallow		Other Use	
	ha	%	ha	%	ha	%	ha	%	ha	%	ha	%
Avg. 0	1.8	34	1.7	32	1.5	27	-	-	0.3	5	0.1	2
Avg. 1	1.8	27	2.0	30	1.9	29	0.1	2	0.7	11	0.1	2
Up. Qu.	2.4	46	2.2	35	1.5	39	-	-	0.4	12	0.1	2
Lo. Qu.	0.6	13	0.5	12	0.1	-	-	-	-	-	-	-
Total	52.6		42.8		42.6		0.1		7.4		2.7	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.3	0.7	3.0	0.6
Avg. 1			2.7	6.7
Up. Qu.	1.9	1.0	2.8	-
Lo. Qu.	1.0	-	-	-

Inputs Applied

Range	Improved Seed Us.d % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P ₂ O ₅		K ₂ O				Insecticide kg/ha		Fungicide kg/ha	
		AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
Avg. 0	31.0	0.1	-	0.1	-	-	-	-	-	0.5	-	-	-
Avg. 1	53.7	0.5	-	0.5	-	-	-	0.1	-	3.4	-	-	-
Up. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of all farms excluding zero entries
Up. Qu./Lo. Qu. = Upper/Lower Quartile, refers to individual farm, 50% of all sample cases lie between these points
AC = Annual Crops
PC = Perennial Crops

District: KILIFI 54
AEZ IV : L 3-4

TABLE 7
CROPPING PATTERN

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.7	1.4	1.00	0.00	21.1	32.3
Maize IPC	0.1	1.1	0.00	0.00	2.1	3.2
Cowpeas	0.1	0.7	0.00	0.00	2.0	3.1
Cotton	0.1	0.7	0.00	0.00	4.2	6.4
Tobacco	0.0	0.0	0.00	0.00	0.0	0.1
Cassava	0.2	0.7	0.40	0.00	7.2	11.0
Others	0.4	0.9	0.40	0.00	10.4	15.8
Maize & Cowps	0.2	1.3	0.00	0.00	6.3	9.6
Maize & Others	0.4	1.5	0.52	0.00	12.1	18.5
Total					65.4	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Maize	0.3	1.2	0.20	0.00	9.3	27.2
Cowpeas	0.2	1.4	0.00	0.00	5.4	15.8
Tomatoes	0.0	0.4	0.00	0.00	0.8	2.5
Cassava	0.2	0.7	0.40	0.00	7.2	21.1
Others	0.3	0.9	0.12	0.00	8.2	23.9
Maize & Beans	0.1	2.0	0.00	0.00	2.0	5.9
Maize & Others	0.0	1.2	0.00	0.00	1.2	3.5
Total					34.1	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area	
					ha	%
Citrus	0.0	0.2	0.00	0.00	0.2	0.5
Cashew Nuts	0.6	1.1	1.20	0.00	18.3	49.6
Coconuts	0.6	1.7	0.40	0.00	18.4	49.8
Total					36.9	100.0

Avg 0 = average of all sample farms
Avg 1 = average of all farms excluding zero entries
Up.Qu./Lo.Qu. = Upper/Lower Quartile, 50% of all sample cases
are in between these points
% columns = % of total farm land

SUBLOCATION - LOCATION - DISTRICT

Agricultural Land

152,797.63 ha

of it: Small Family Farms 2)

152,526.00 ha

Settlement Farms

..... ha

Medium Size to Large Farms 3)

271.63 ha

Forests

69,795.12 ha

Water Area

16,300.00 ha

Urban Centres

800.00 ha

Land Adjudication (1/1/81)

Adjudication 50% completed.

1% to be set aside

Location	Sub-Location	Area in ha	Remarks
Lembus	Macaba-Arama	508	
	Kilombe	5,035	
	Simonin	1,210	
	Torongo	4,405	
	Tinet	738	
	Poror	1,003	
	Metipso	399	
	Sore	2,675	
	Kaptum	5,778	
	Kinokon	5,997	
	Chemogoch	3,506	
	Ngubereti	1,751	
	Kabimoi	3,445	
	Saos	2,106	
	Kibias	1,592	
	Kiptuno	1,135	
	Kabonyoni		
	Muringwo	745	
	Sigoro	5,997	
	Total	48,025	
Chap Chap	Kaptorokwa	6,934	
	Kabasis	319	
	Kituro	569	
	Kimakata	4,006	
	Total	11,828	
Pokor-Keben	Koiteren	1,262	
	Mugurin	8,837	
	Molo-Sirwet	5,051	
	Kiromui	3,002	
	Gobat	7,713	
	Kisanana	1,348	
	Kisanana	1,953	
	Ngendalel	3,551	
	Kares	3,062	
	Kamalanget	1,448	
	Cheberen	7,893	
	Kimose	5,533	
	Tenges	1,424	
	Total	52,077	

Location	Sub-Location	Area in ha	Remarks
Saimo	Kasisit	413	
	Kapchepkor	1,449	
	Pemwal	599	
	Tirimionin	1,199	
	Bartolimo	1,042	
	Iexas	989	
	Total	5,691	
Sacho	Kabarak	1,381	
	Kibei	3,287	
	Koibarak	1,599	
	Kaplelelwa	6,324	
	Total	12,591	
Kabarnet	Kapropita		
	Kosoiyo	1,025	
	Kabarnet/)		
	Kewamoi 'B')	6,295	
	Kewamoi 'A')		
	Kapchomuswa	3,477	
	Total	10,797	
Kakamor	Cheplambus	3,775	
	Kiprota	2,395	
	Rosoga	1,235	
	Koitebes	917	
	Sirwo	1,966	
	Kimngorom	1,229	
	Total	11,517	
<u>Forests</u>	Chebartigon	103.2	Trust
	Chemoigok	1,346.8	Trust
	Chepkuchumo	319.7	Trust
	Cherial	42.5	Trust
	Kabarak	1,392.1	Trust
	Kabiok	14.2	Trust
	Kaptimom	89.0	Trust

/continued

1) Source: Survey of Kenya: Statistic to be used for agricultural extension and planning work only.

2) Farms in former Trust lands, usually cultivated exclusively by owner's family

3) Former scheduled area, usually large mechanised operation depending on hired labour

SUBLOCATION - LOCATION - DISTRICT

BARINGO (continued)

Agricultural Land

of it: Small Family Farms 2)

Settlement Farms

Medium Size to Large Farms 3)

Forests

Water Area

Urban Centres

152,797.63 ha
152,526.00 ha
271.63 ha
69,795.12 ha
16,300.00 ha
800.00 ha

Land Adjudication (1/1/81)

Adjudication 50% completed.

1% to be set aside

Location	Sub-Location	Area in ha	Remarks
Forests (continued)	Katimok	2,080.1	Trust
	Kemeto	210.4	Trust
	Ketnwan	46.5	Trust
	Kilombe Hill	1,554.3	Government
	Kimojoch	758.8	Trust
	Lembus	16,211.3	Trust
	Maji Mazuri	7,609.3	Government
	Marop	216.5	Trust
	Mosegem	204.4	Trust
	Momit Londiani	29,682.4	Government
	Mtarakwa	112.1	Trust
	Mukobe	784.7	Trust
	Tutwon	12.1	Trust
	Tarambas Hill	422.9	Trust
	Sokta Hill	163.5	Trust
	Sanao	299.5	Trust
	Sekenwo	862.0	Trust
	Saimo	750.7	Trust
	Pekerra Catchment	4,358.5	Trust
	Pemwai	147.7	Trust
	Total	69,795.12	

Location	Sub-Location	Area in ha	Remarks

- Source: Survey of Kenya: Statistic to be used for agricultural extension and planning work only.
- Farms in former Trust lands, usually cultivated exclusively by owner's family
- Former scheduled areas, usually large mechanised operation depending on hired labour

SUBLOCATION - LOCATION - DISTRICT

Agricultural Land	152,797.63	ha
of it: Small Family Farms 2)	152,526.00	ha
Settlement Farms		ha
Medium Size to Large Farms 3)	271.63	ha
Forests	69,795.12	ha
Water Area	16,300.00	ha
Urban Centres	800.00	ha

Land Adjudication (1/1/81)
 Adjudication 50%
 completed.
 1% to be set aside

Location	Sub-Location	Area in ha	Remarks
Forests (continued)	Katimok	2,080.1	Trust
	Kemeto	210.4	Trust
	Ketnwan	46.5	Trust
	Kilombe Hill	1,554.3	Government
	Kimojoch	758.8	Trust
	Lenbus	16,211.3	Trust
	Maji Mazuri	7,609.3	Government
	Marop	216.5	Trust
	Mosegem	204.4	Trust
	Momit Londiani	29,682.4	Government
	Mtarakwa	112.1	Trust
	Mukobe	784.7	Trust
	Tutwon	12.1	Trust
	Tarambas Hill	422.9	Trust
	Sokta Hill	163.5	Trust
	Sanao	299.5	Trust
	Sekenwo	862.0	Trust
	Saimo	750.7	Trust
	Pekerra Catchment	4,358.5	Trust
	Ponvui	147.7	Trust
	Total	69,795.12	

Location	Sub-Location	Area in ha	Remarks

- 1) Source: Survey of Kenya: Statistic to be used for agricultural extension and planning work only.
- 2) Farms in former Trust lands, usually cultivated exclusively by owner's family
- 3) Former scheduled area, usually large mechanised operation depending on hired labour