FARM MANAGEMENT HANDBOOK OF KENYA

VOL. II

– Natural Conditions and Farm Management Information –

Part A

WEST KENYA

(Nyanza and Western Provinces)

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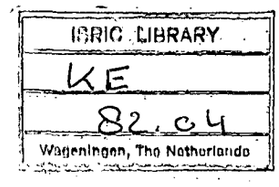

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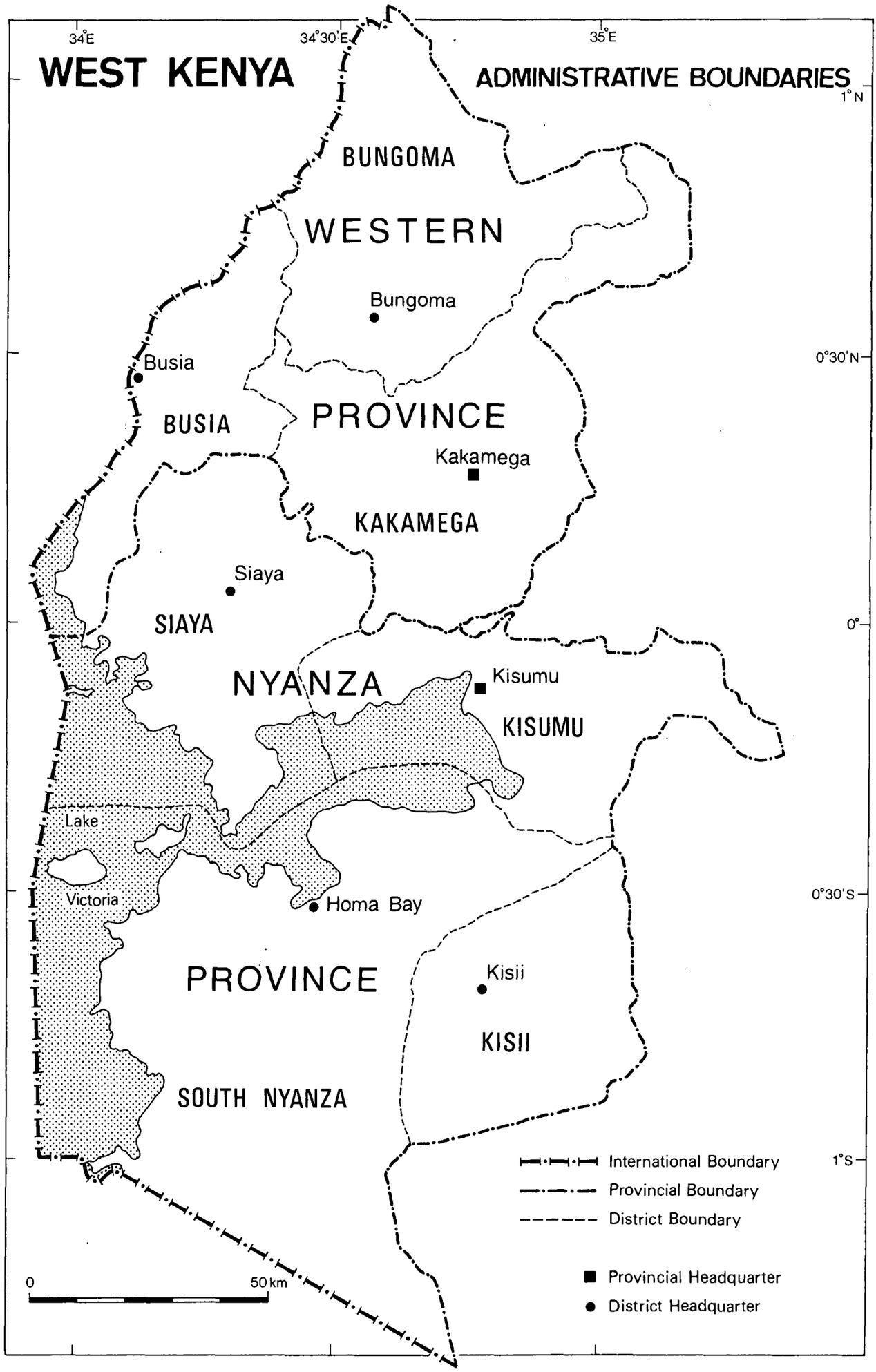
WEST KENYA
ADMINISTRATIVE BOUNDARIES
34°E
34°30'E
35°E
1°N
0°30'N
0°
0°30'S
1°S
BUNGOMA
WESTERN
Bungoma
Busia
BUSIA
PROVINCE
Kakamega
KAKAMEGA
Siaya
SIAYA
NYANZA
Kisumu
KISUMU
Lake
Victoria
Homa Bay
PROVINCE
Kisii
KISII
SOUTH NYANZA
International Boundary
Provincial Boundary
District Boundary
Provincial Headquarter
District Headquarter
0
50 km

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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Ministry of Agriculture

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. Zettelmeyer – computing farm data; H. Kutsch – computing crop water relations for yield probabilities, rainfall analysis, crop list; M. Buch – transcripting soil maps; M. Kronen – soil requirements and fertility groups; H. Ritz – district climate tables; F.N. Muchena, 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.

Helmut Schmidt
Farm Management Research Officer

Nairobi, May 1982

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

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
A = Alpine
add. = additional
a. o. = and others
av. = average
b. = beginning
bl. = black
br = bimodal rainfall
C. = Cooperative
CAZRI = Central Arid Zone Research Station (Jodhpur, India)
comp. = composite
D. = District
E_o = evaporation of a water surface
e. = end
f. i. = for instance
For. = Forest
F. = Farmer, Farmers
H = Highland; with crop name: hybrid
h. = heavy
ha = hectar
i = intermediate rains
kc = crop coefficient as potential evapotranspiration of a crop expressed in parts of E_o
L = Lowland, lower
l = long
LU = Livestock unit of **300** kg
M = Midland
m = medium
mat. = maturing
max. = maximum
min. = minimum
NARS = National Agricultural Research Station
norm. = normally
O. = Office
p = permanent
per. = period
pl. = planting
pr. = precipitation
r. = rains, rainy season
res. = resistant
R. = Reserve
s = short
sec. = secondary
St. = Station
T = Tropical
t = temperature; with yields: tons
U = Upper
ur = unimodal rainfall
v = very
var. = variety
y. = year
< = less than
> = 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 job[2]. 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.

1) Farm Management information which depends largely on financial facts had to be excluded, like Gross Margins, Cash Flows, Farm Models are published by the FMB annually and can be obtained from Kilimo House.

2) It was impossible to assess the large amount of statistical data in detail – the F.M.R.O. could only copy what was available in the respective departments.

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 definded as seasons with enough moisture in the soil to grow most crops, starting with a supply for plants to transpirate 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, 1977[3] and 1979[4], re-calculated by H. KUTSCH for 50 Kenyan varieties and adapted to the different agro-climates of R. JÄTZOLD[5]) 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".

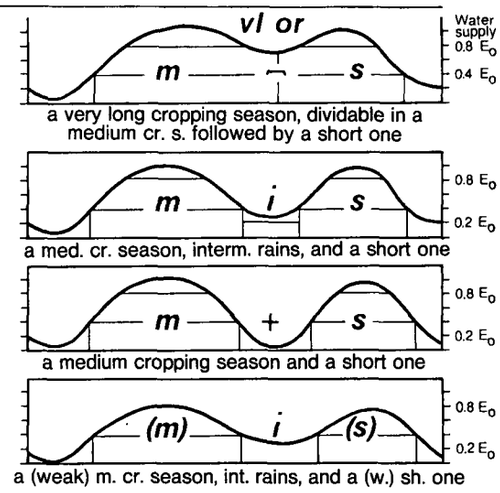
TABLE I: AGRO-ECOLOGICAL ZONES OF THE TROPICS [1]

Belts of Z. \ Main Zones	0 (perhumid)	1 (humid)	2 (subhumid)	3 (semi-humid)	4 (transitional)	5 (semi-arid)	6 (arid)	7 (perarid)
TA Tropical Alpine Zones Ann. mean 2-10° C	Glacier / Mountain swamps	I Cattle-Sheep Zone	II Sheep Zone				High altitude deserts	
UH Upper Highland Zones Ann. mean 10-15° Seasonal night frosts	s	Sheep-Dairy Zone	Pyrethrum-Wheat Zone	Wheat-Barley Zone	U. Highland Ranching Zone	* U. H. Nomadism Zone [4]		
LH Lower Highl. Zones Ann. mean 15-18° M. min. 8-11° norm. no frost	s e c o	Tea-Dairy Zone	Wheat/Maize [2] - Pyrethrum Zone	Wheat/(M) [2] - Barley Zone	Cattle-Sheep-Barley Zone	L. Highland Ranching Zone	* L. H. Nomadism Zone [4]	
UM Upper Midland Zones Ann. mean 18-21° M.min. 11-14°	N	Coffee-Tea Zone	Main Coffee Zone	Marginal Coffee Zone	Sunflower-Maize [3] Zone	Livestock-Sorghum Zone	U. Midland Ranching Zone	U. Midland Nom. Zone [4]
LM Lower Midland Zones Ann. mean 21-24° M. min. >14°	* s e r	L. Midl. Sugarcane Zone	Marginal Sugarcane Zone	L. Midland Cotton Zone	Marginal Cotton Zone [6]	L. Midland Livestock-Millet Zone	L. Midland Ranching Zone	L. Midland Nom. Zone [4]
L Lowland Zones **IL** Inner Lowland Z. Ann. mean >24° Mean max >31°	* o	* Rice-Taro Zone	* Lowland Sugarcane Zone	* Lowland Cotton Zone	* Groundnut Zone	Lowland Livestock-Millet Zone	Lowland Ranching Zone	Lowland Nom. Zone [4]
CL Coastal Lowl. Z. [5] Ann. mean >24° Mean max <31°	*	* 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 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°
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
p	Normally permanent	More than 364 days	
vl	Very long	285 - 364 days	
vl/l	Very long to long	235 - 284 "	
l/vl	Long to very long	215 - 234 "	
l	Long	195 - 214 "	
l/m	Long to medium	175 - 194 "	
m/l	Medium to long	155 - 174 "	
m	Medium	135 - 154 "	
m/s	Medium to short	115 - 134 "	
s/m	Short to medium	105 - 114 "	
s	Short	85 - 104 "	
s/vs	Short to very short	75 - 84 "	
vs/s	Very short to short	55 - 74[2] "	
vs	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_O)[4]

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

\+ = 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_O (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_O).

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 ist 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 irrigation[6] 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 datas 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 decadically 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 THORNTHWAITE/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 (> = 60 %) of sowing, defined by a water supply in the pre-phase of at least "1". In our example (Fig. 1) this probability ($PROB_1$) 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, $PROB_2$ = 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 ($PROB_3$ = 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 $PROB_4$ = 80–100 %.

– Probability for any deficiencies (water supply = "0") in a defined growing period. In our example the probability ($PROB_5$) 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	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	1	0	1
9.	1	0	1	1	2	0	3	3	3	3	2	2	2	2	0	1	0	0
10.	0	0	1	1	2	3	3	3	3	2	1	0	1	0	1	0	1	0
a. s. o.																		

P_4 = 80 - 100

$PROB_1$=60 P_1=80 P_5= 40 P_5= 20 P_5=40 P_5=40
$PROB_5$=40 P_5=20

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 (ky; 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 ky values using the following simple equation:

$$YR = 100 \cdot ky\,(1-SUP_{[peak]}) \qquad (1)$$

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:

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

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] Eo 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 phase[2](kc/i),
- water requirement coefficient for the peak water requirement period (kc/p),
- water requirement coefficient for the time of physical maturity (kc/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.

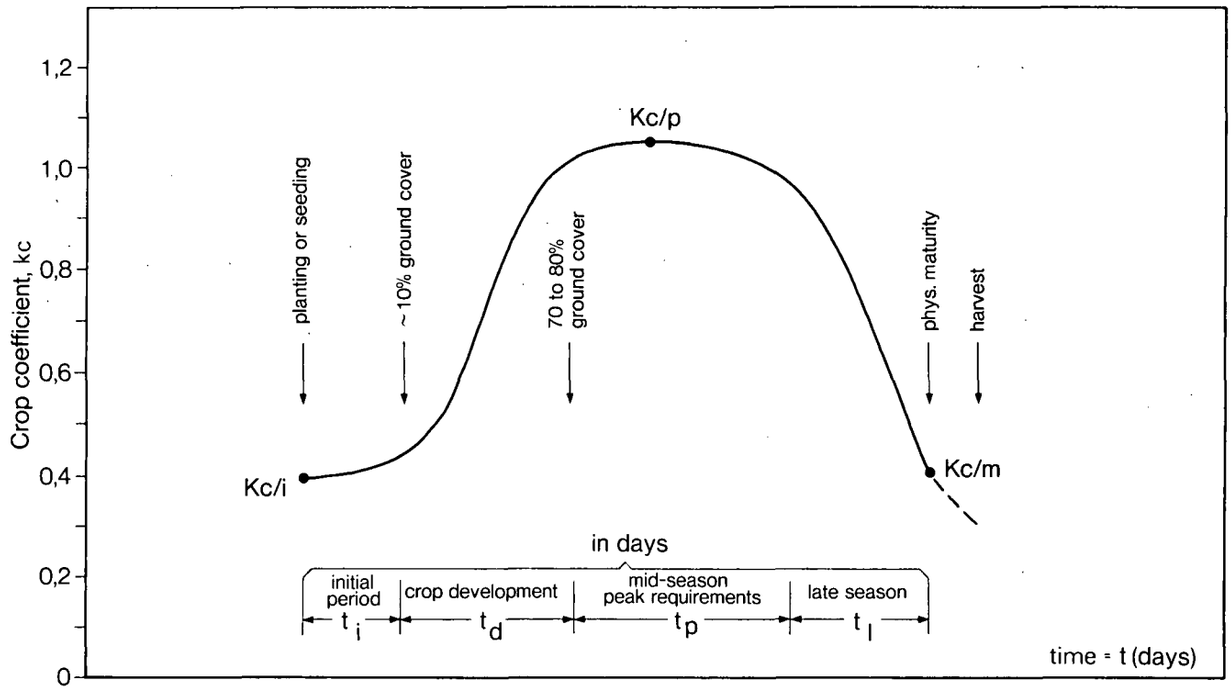


Fig. 2: General course of the curve for the water requirement coefficients, kc (from FAO, 1977, p. 39, modified).
kc: Crop coefficient as fraction of climatic evaporative demand (E_o); i = initial, p = peak, m = at physical maturity

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 kc value during the initial phase of an annual or perennial crop depends upon the climatic evaporation capacitiy (E_o) and the interval between significant rainfalls[3] (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.

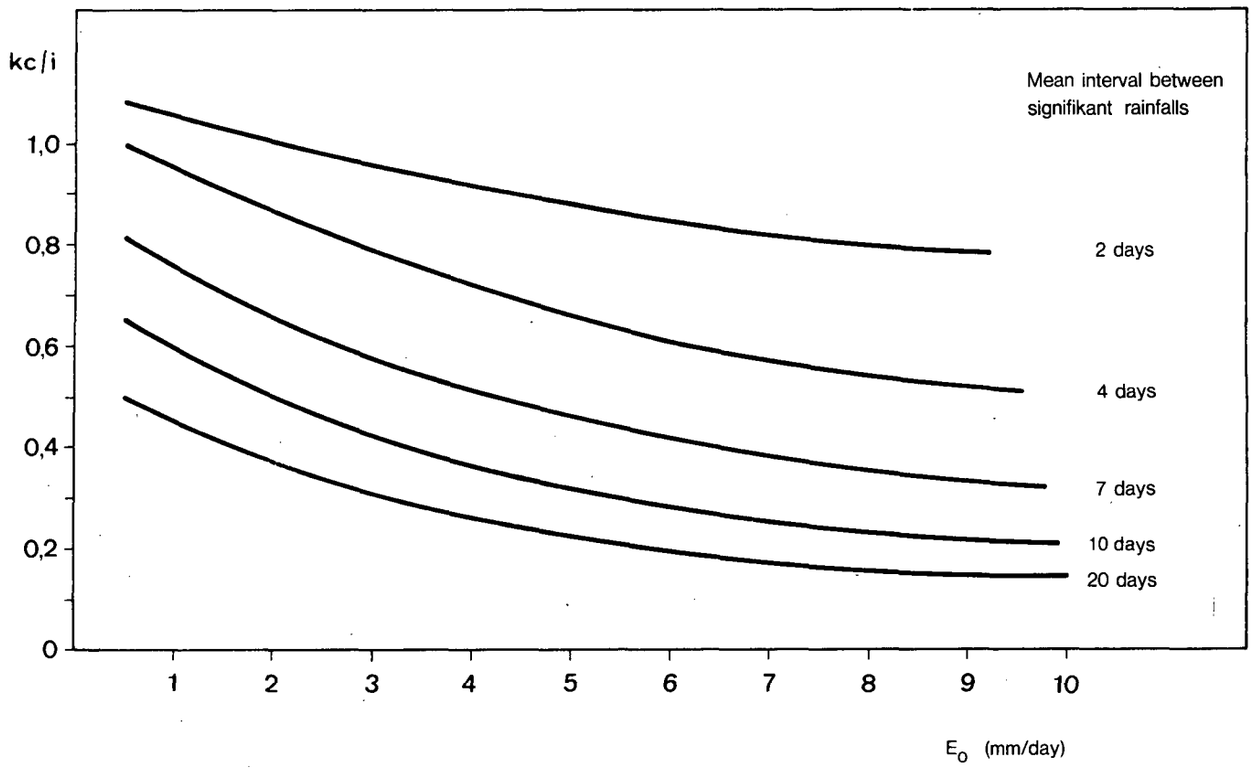


Fig. 3: General course of the curve for the water requirement coefficients in the initial phase kc/i (from FAO, 1977, p. 39)

The approximate mathematical expression is complex:

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

The first exponent contains as a variable element the mean daily evaporative demand of the climate during the initial phase (E_0/day):

$$exp\ 1 = -(0.2311 \cdot E_0 + 0.2)$$

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

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

The coefficients occuring 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:

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

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 $\sim$ 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)

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

where for t:

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

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.

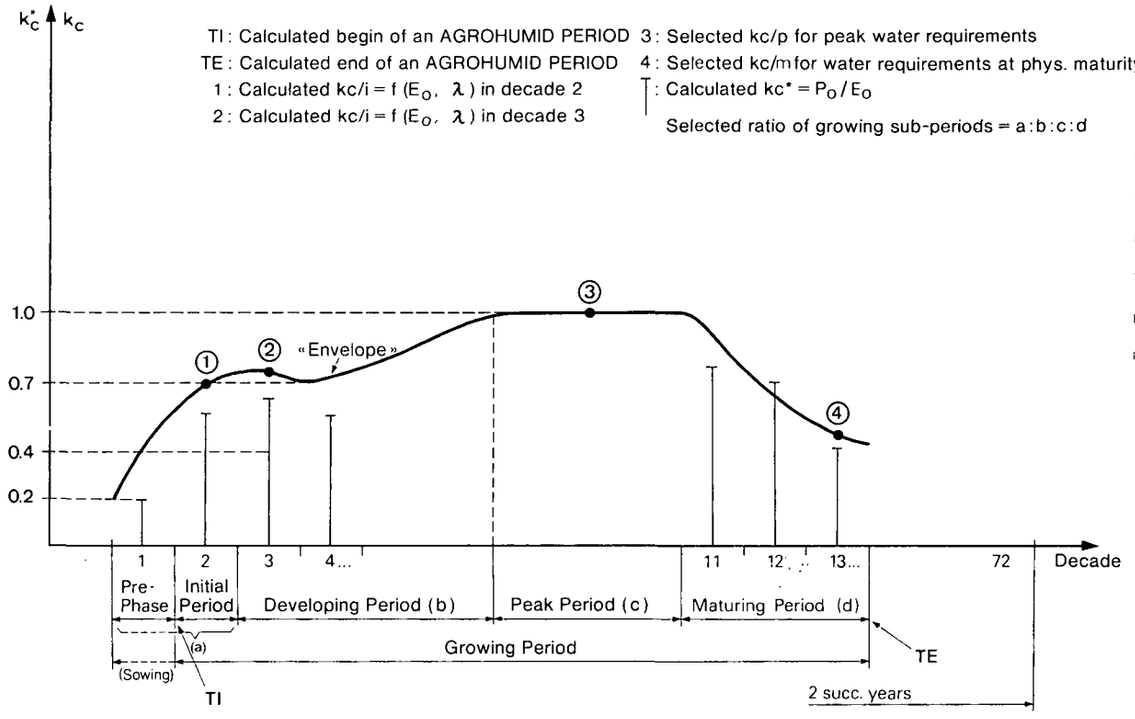


Fig. 4: Example of the automatic construction of the water requirement curve (kc curve) for a "normal" crop

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_e), **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_e) from the measured values (P_o) with the help of empirical reduction coefficients (r). For the current decade (i) we obtain:

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

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):

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

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).

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

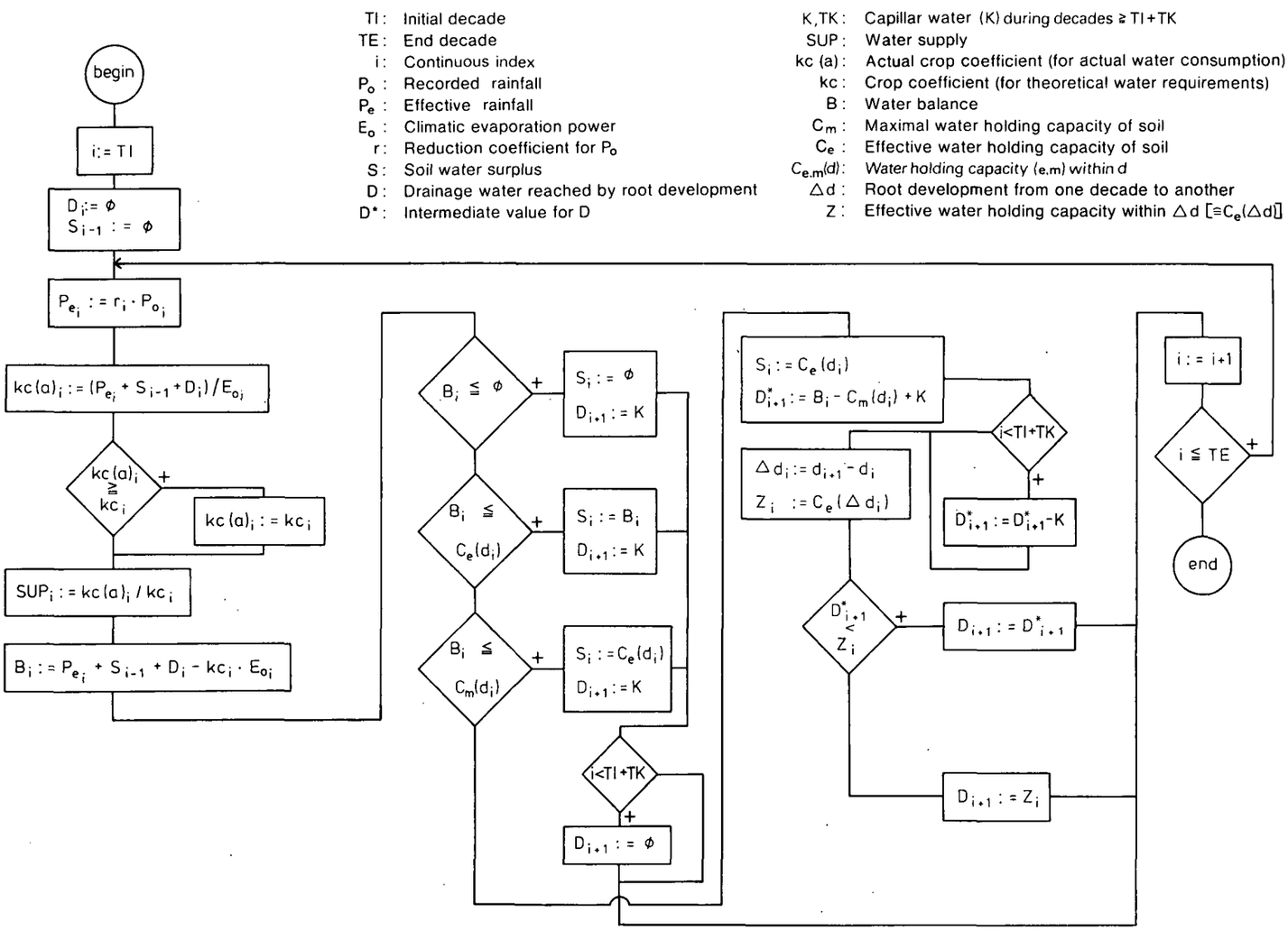


Fig. 5: Mathematical-logical model for the water balance of a defined crop stand

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:

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

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.

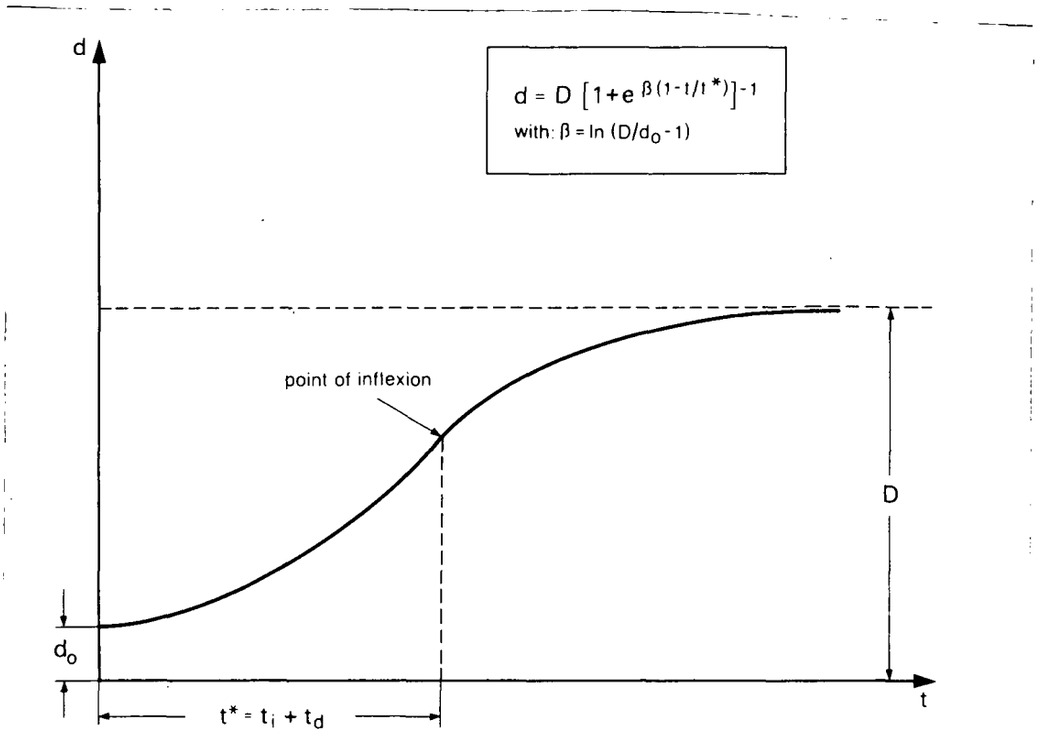


Fig. 6: Situation of the parameters D, d_0 and t* of an 80 % root complex

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):

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

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

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 straightforward 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.

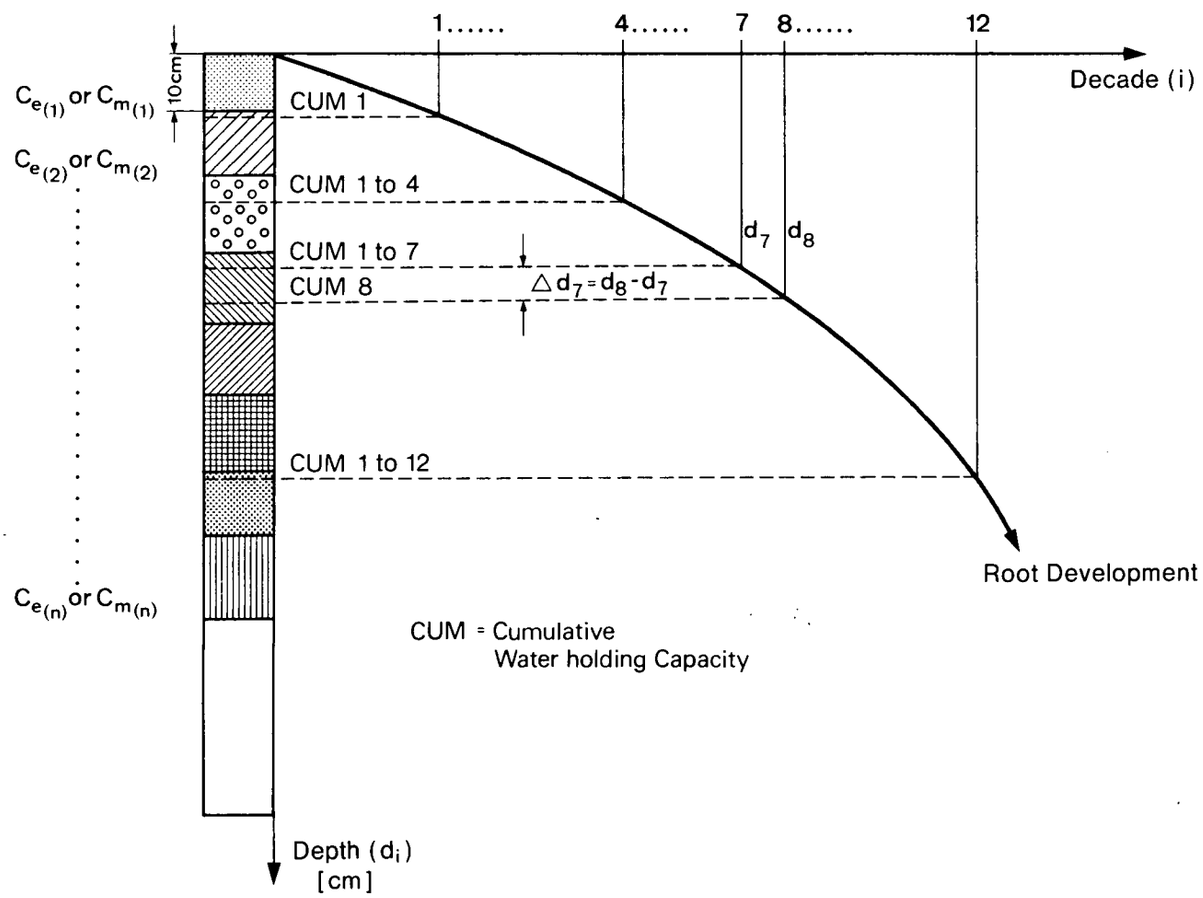


Fig. 7: Example of a multi-strata soil moisture model taking account of root growth and the different stored moisture in various strata

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

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

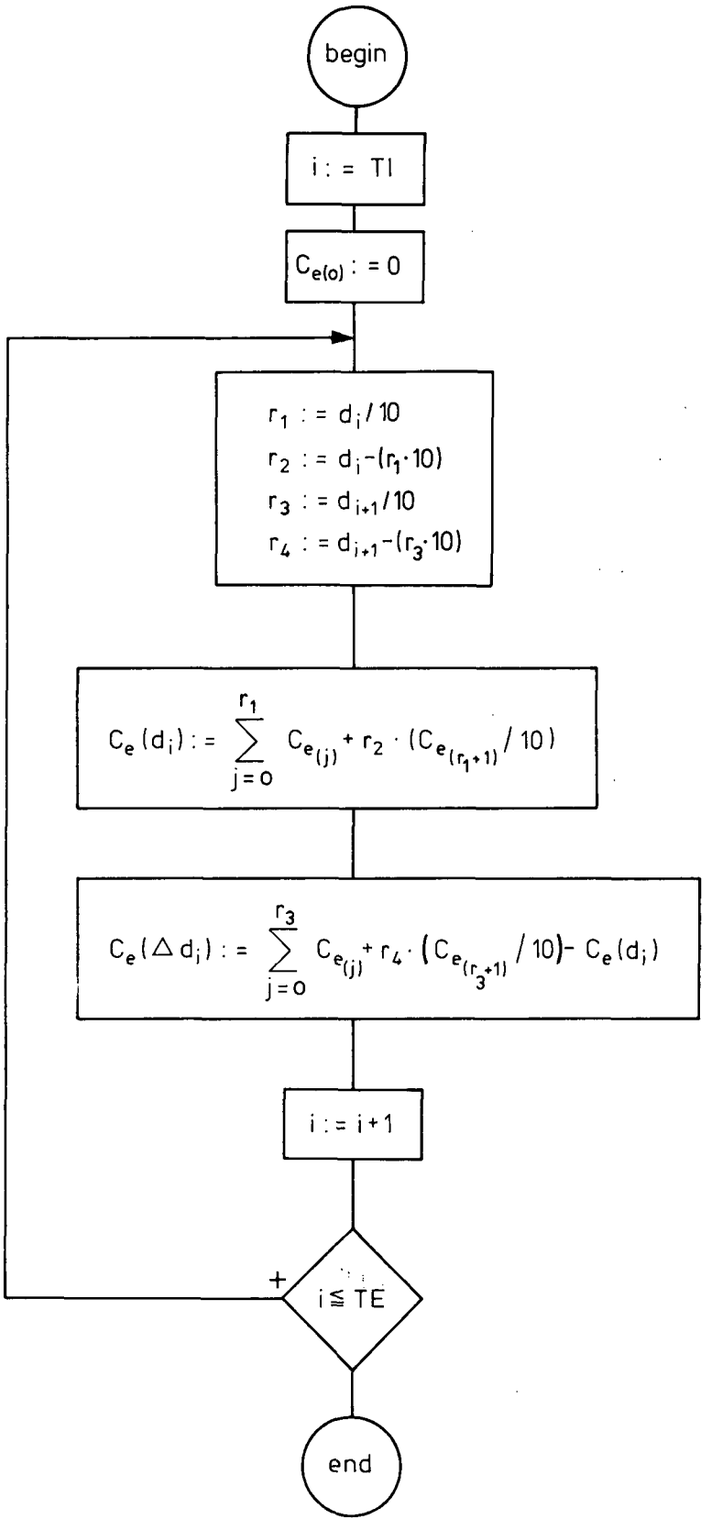


Fig. 8: Example for calculating the cumulative and differential effective water holding capacity using the multi-strata soil moisture model

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
$Ce(\ d_i)$: Differential effective water holding capacitiy

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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_o)
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 suitabel 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 nigthly min. below 8° C; night frosts occasionally in cold seasons
UH 1	**SHEEP AND DAIRY ZONE OR FOREST RESERVE** Climatic coniditions 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 ZONE[6]** 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 ZONE[6][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	Moderatley 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 ZONE[8]** 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-SORGHUM[9] ZONE OR UPPER MARGINAL SISAL ZONE[8]** 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 lowland 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 ZONE**[8]	
	Climatic conditions fair to poor for cotton an 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-MILLET**[12] **ZONE OR MARGINAL MIDDLE SISAL ZONE**[8]	
	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 ZONES**[13]	
	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 coniditons 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	**CASHEWNUT-CASSAVA ZONE OR LOWER SISAL ZONE**[8]	
	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-MILLET**[11] **ZONE OR MARG. LOWER SISAL ZONE**[8]	
	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 thoseof 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 loosing importance (see AC-LAND 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), Marama 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.!)	Lower limit of optimum yields[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	2 500 kg/ha
Short	MAIZE/e.mat.: Katumani, Composite B	85–105/100–120		260–450 mm	3 500 kg/ha
Short to medium	" "	105–135/120–150	1 500–1 900 m	280–480 mm	
Short	MAIZE/e.mat.: Taboran	90–110/105–125		380–600 mm	2 500 kg/ha
Short to medium	MAIZE/m.mat.:HX 105 A = Pioneer Hybrid	100–115/120–140	0–1 200 m	450–700 mm	3 000 kg/ha
"	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	160–180/190–230	1 500–2 100 m	600–950 mm	6 000 kg/ha
	H 614				6 600 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	1 800–2 100 m	350–530 mm	3 300 kg/ha (most Kenya varieties, African Mayo, Bounty)
Medium	" "	125–140	2 100–2 400 m		
"	WHEAT/e.mat.: K. Tembo, K. Fahari, K. Kifaru, K. Ngiri, K 6928–1	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	
Medium	" and Bounty	130–145	2 100–2 400 m	400–620 mm	4 000 kg/ha (new varieties R 199/200
"	"	145–165	2 400–2 800 m		
Medium	WHEAT/m.mat.: K. Leopard, Fanfare	125–140	1 800–2 100 m	450–650 mm	
"	" & K. Kudu	140–155	2 100–2 400 m		
Medium to long	"	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.!)	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		
"	TRITICALE/l.mat.: T 50	125–155	1 600–2 100 m	450–650 mm	4 500 kg/ha
"	" "	155–170	2 100–2 400 m		
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.: ISe 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		
"	HOG MILLET/v.e.mat. (Jodphur)	40– 50	0– 800 m	160–290 mm	1 500 kg/ha
"	" "	50– 70	800–1 300 m		
"	PROSO MILLET (Panicum miliac.)/ e.mat.: Serere I	45– 55	0– 800 m	200–280 mm	2 800 kg/ha
"	" "	55– 65	800–1 300 m		
Short	BULRUSH MILLET/e.mat. local	70– 90	0–1 250 m	220–400 mm	2 000 kg/ha
"	BULRUSH MILLET/e.mat.: Serere Comp. II	75– 90	0–1 250 m (short r.–1 500 m)	250–450 mm	4 000 kg/ha
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 (warmer seasons and places up to 1 800 m)	200–430 mm	3 800 kg/ha
Short	SORGHUM/e.mat.: Serena	85–110		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.!)	Lower limit of optimum yields[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	5 000 kg/ha
Medium to long	SORGHUM/l.mat.: E 1291, for stockfeed mainly	160–180		400–800 mm	9 000 kg/ha
Long	SORGHUM/v.l.mat.	180–240		620–1 000 mm	6 500 kg/ha
Bimodal	SORGHUM/ratoon from 2KX 17 or others	f.i. 90–115 + 90–110		f.i. 280–500 mm +230–450 mm	4 500 kg/ha + 3 500 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 (irr. water)	8 000 kg/ha (transpl.)
Medium	RICE/m.mat. = Faya S.L.	120–160	(in W–1 500 m)	800–1 200 mm (irr. water)	9 000 kg/ha (transpl.)
Short to long	GRAIN AMARANTH/ diff. species	90–180	0–2 900 m	190–800 mm	3 000 kg
Medium to long	QUINOA/var. Sajama (Bolivia)	150–180	2 300–3 200 m	300–800 mm	3 500 kg
	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	
Short	" "	90–100	1 200–1 500 m (W-Kenya)		1 500 kg/ha
Short	BLACK GRAMS	85–100	0–1 200 m		
"	" "	100–110	1 200–1 800 m (W-Kenya)	200–400 mm	
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		
Short to medium	" "	100–120	1 500–1 800 m		1 900 kg/ha
Medium	" "	120–150	1 800–2 400 m	250–450 mm	1 600 kg/ha
Short to medium	BEANS/m.mat.: Cuarentino a.o.	90–110	800–1 500 m		
Medium to short	" "	110–130	1 500–1 800 m		2 500 kg/ha
Medium	" "	130–160	1 800–2 400 m		1 800 kg/ha
Short to medium	BONAVIST BEANS = DOLICHOS LABLAB/ann. var.	100–140	0–1 200 m		
Medium to long	" "	140–180	1 200–2 100 m	200–700 mm	1 900 kg/ha
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		
Medium to short	" "	120–140	2 300–2 700 m	250–450 mm	3 000 kg/ha
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.!)	Lower limit of optimum yields [4]
Medium to short	SOYA BEANS/e.mat.: Black Hawk, Hill	110–130	1 200–1 800 m	350–680 mm	2 300 kg/ha
"	SOYA BEANS/m.mat.	110–130	0–1 200 m	400–750 mm	2 500 kg/ha
Medium	" "	130–150	1 200–1 800 m		
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 high oil cont.
Short	SUNFLOWER/e.mat.: 252	90–110	0–1 800 m	250–500 mm	1 600 kg/ha high oil cont.
"	SUNFLOWER/e.mat.: Hybrid S 345	85–110	0–1 500 m	280–550 mm	1 900 kg/ha very high oil c.
Short to medium	SUNFLOWER/m.mat.: Vympel, Mayok, 067, Luci, Sputnik	110–120	0–1 500 m		
"	" "	120–135	1 500–2 300 m		1 900 kg/ha
Medium	" "	135–150	2 300–2 600 m	300–600 mm	
Medium to short	SUNFLOWER/m.mat.: Comet	120–130	1 000–2 000 m		1 600 kg/ha fair oil cont.
" "	SUNFLOWER/m.mat.: Hybrid S 301 A	120–135	0–1 800 m	350–650 mm	2 800 kg/ha very high oil c.
Medium to long	SUNFLOWER/l.mat.: Kenya White	140–175	1 500–2 300 m	350–700 mm	2 200 kg/ha low oil cont.
Medium	LINSEED	120–150	1 800–2 700 m	300–600 mm	1 400 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	
Short to medium	RAPESEED/e.mat.: Turget	110–125	1 800–2 700 m	250–500 mm	1 350 kg/ha
Medium	RAPESEED/m.mat.: Midas, SV 69/1229, SV Gulle	125–140	1 800–2 700 m	300–600 mm	1 850 kg/ha
Medium	RAPESEED/l.mat.: Nilla, SV 71/1225	140–155	1 800–2 700 m	350–700 mm	2 100 kg/ha
Short to medium	SIMSIM/e.mat.	90–120	0–1 300 m (E)	300–500 mm	1 000 kg/ha
Medium	SIMSIM/m.mat.	120–140	0–1 500 m (W)	350–600 mm	1 300 kg/ha
Medium	SAFFLOR	120–150	1 200–1 800 m	250–400 mm	2 000 kg/ha
Medium	CASTOR/Dwarf	130–170	500–1 500 m	350–800 mm	1 200 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.)	3.0 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 culitvation 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 KENYA[1)]

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

Grasses:	
Kikuyu grass (Pennisetum clandestinum)	UH 1, (2)
Rye grass (Lolium perenne), except in wheat areas	UH 1, 2, 3, (4)
Cocksfoot (Dactylis glomerata)	UH 1, 2, 3, 4
Tall fescue (Festuca arundinacea)	UH 1, 2, 3, 4
Cereals:	
Oats (Avena sativa)	UH 1, (2)
Fodder barley (Hordeum vulgare)/var. B 106	UH 2
Fodder barley (Hordeum vulgare)/var. Amani	UH 3, (4)
Legumes:	
Lucerne (Medicago sativa), rust danger	UH 1, 2
Kenya white clover (Trifolium semipilosum)	UH 1, 2, 3
Tarwi (Lupinus mutabilis)	UH 1, 2, 3
Subterranen clover (Trifolium subterraneum)	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 (Pennisetum clandestinum)	LH 1, 2
Napier grass (Pennisetum purpureum) up to 2 000 m	LH 1, 2
Nandi setaria (Setaria sphacelata)	LH 1, 2, 3
Rhodes grass (Chloris gayana) 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 (Eragrostis tef)	LH 2, 3, (4)
Root crops:	
Fodder beets (Beta vulgaris)/var. alba DC.	LH 1, 2
Fodder radish (Raphanus sativus)	LH 1, 2
Yam bean[2)] (Pachyrhizus tuberosus), not above 2 000 m	LH 1, 2, 3, (4)
Legumes:	
Louisana white clover (Trifolium repens)	LH 1, 2
Green leaf desmodium (Desmodium intortum)	LH 1, 2
Silver leaf desmodium (Desmodium uncinatum)	LH 1, 2, (3)
Lotononis (Lotononis bainesii)	LH 2, 3, (4)
Subterranean clover (Trifolium subterraneum)	LH 3, 4

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

Grasses:	
Kikuyu grass (Pennisetum clandestinum)	LH 1, (2)
Rhodes grass (Chloris gayana), var. Elmba and Boma, in lower places (up to 2 000 m)	LH 1, 2, (3)
Nandi setaria (Setaria sphacelata)	LH 1, 2, 3
Napier grass (Pennisetum purpureum), lower places (up to 2 000 m)	LH 1, 2, (3)
Congo grass (Brachiara ruziziensis)	LH 2, 3
Root crops:	
Fodder beets (Beta vulgaris)/var. alba DC.	LH 1, 2
Fodder radish (Raphanus sativus)	LH 1, 2
Yam bean[2)] (Pachyrhizus tuberosus)	LH 1, 2
Yam bean/var. with short veg. cycle	LH 3, (4)

1) Based on informations supplied by P.K. Kusewa, 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 (Stylosanthes guyanensis)	LH 1, 2
Green leaf desmodium (Desmodium intortum)	LH 1, 2
Silver leaf desmodium (Desmodium uncinatum)	LH 1, 2, (3)
Louisana white clover (Trifolium repens)	LH 1, 2
Glycine (Glycine wightii)	LH 2, 3, (4)
Subterranean clover (Trifolium subterraneum)	LH 3, 4

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

a) Unimodal rainfall:

Grasses:

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

Root crops:

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

Legumes:

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

Trees and shrubs:

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

b) Bimodal rainfall:

Grasses:

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

3) Also edible. 7 months to mature. Seeds available at Nat. Bur. of Plant Gen. Resources, I.A.R.I., New Dehli (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)] (Pachyrhizus tuberosus)	UM 1, 2, 3, (4)
Psoralea patens/P. cinerea[4)]	UM 3, 4

Legumes:

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

Trees and shrubs:

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

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

a) Unimodal rainfall:

Grasses:

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

Root crops:

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

Trees and shrubs:

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

b) Bimodal rainfall:

Grasses:

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

Root crops:

Psoralea patens/P. cinerea[4)]	LM 3, 4
Vigna vexillata[5)]	LM 1, 2

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

Legumes:

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

Trees and shrubs:

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

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

Grasses:

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

Root crops:

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

Legumes:

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

Trees and shrubs:

Horse tamarind (Leucaena leucocephala)	L 3, 4
Gao tree, applering acacia (Acacia albida)	L 4, 5, (6)
Saltbush (Atriplex nummularia)	L 4, 5, 6
Mesquite (Prosopis juliflora)	L 5, 6
Algarrobo (Prosopis chilensis)	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 reseeding 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
Triticale (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
Bulrush millet (Pennisetum typhoides)	light to medium	5.0–8.0	well drained soils	drought resistant, tolerates salinity
Finger millet (Eleusine coracana)	medium	6.5–8.0	moderately drained soils	Turcana varieties drought resistant
Sorghum (Sorghum vulgare)	medium to heavy	4.5–8.5	moderately well to well drained soils	low to moderately fertile soils
LEGUMINOUS CROPS				
Tepary beans (Phaseolus acutifolius)	medium	6.0–7.5	well drained soils	drought resistant
Cowpeas (Vigna unguiculata)	light	5.0–7.5	free draining soils	drought resistant
Moth 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	drougth 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
Bambarra groundnuts (Voandzeia subterranea)	light	6.2–7.5	well drained soils	soil aeration must be adequate, not on heavy soils with pans; thrive better than 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
Marama 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 (Gossypium hirsutum)	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 (Linum usitatissimum)	medium	5.5–7.5	moderately drained soils	
New Zealand flax (Phormium tenax)	medium	5.5–7.0	moderately drained soils	
Sisal (Agave sisalana)	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 (Persea americana)	medium	6.0–7.5	well drained soils	not on saline soils
Bananas (Musa paradisiaca)	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 (Anacardium occidentale)	light	5.0–7.5	unimpeded drainage	on dry and steep slopes against soil erosion; thrive also on poor soils
Citrus (Citrus 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 (Cocos nucifera)	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 (Coffea arabica)	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 (Coffea canephora var. robusta)	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 (Macadamia spp.)	medium	5.0–6.0	free draining soils	
Pyrethrum (Chrysanthemum cinerariaefolium)	medium	5.6–7.5	well drained soils	
Sugarcane (Saccharum 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 (Camellia sinensis)	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 (Nicotiana tabacum)	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 (Aleurites fordii)	medium	4.5–6.5	well drained soils	
Ye-eb nuts (Cordeauxia edulis)	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
Ferralsols	clay	clay	variable	variable	variable	good	moderate to good	low	moderate	
Luvisols	clay	variable	variable	variable	above 5.5	moderate	moderate to good	low to moderate	moderate	
Acrisols	clay	variable	variable	variable	below 5.5	moderate to good	moderate to good	low	moderate	
Arenosols	sand	sand	variable	low	variable	good	good	low to very low	low to very low	
Nitosols	clay	clay	deep	moderate to high	variable	good	good	moderate to high	moderate to high	Kikuyu Red loam
Phaeozems	clay	variable	variable	high	above 5.5	good	good	high	high	Prairie soils
Andosols	clay	clay	deep	moderate to high	variable	good	good	high	high	Volcanic Ash Soils
Rendzinas	clay	clay	variable	high	above 5.5	good	good	high	high	
Cambisols	variable	variable	variable	variable	variable	moderate to good	moderate to good	moderate to high	variable	young soils
Fluvisols	variable	variable	variable	variable	variable	variable	variable	moderate to high	variable	Alluvial soil
Vertisols	clay	clay	variable	low to moderate	variable	poor	poor	moderate to high	high	Black Cotton soils cracking clay
Planosols	clay	variable	variable	low to moderate	variable	poor	moderate to poor	low to moderate	moderate to low	Vlei soils
Xerosols	clay	variable	variable	variable	above 5.5	variable	variable	variable	variable	non saline or sodic soils of dry regions
Solonchaks	clay	variable	variable	variable	above 7	variable	variable	variable	variable	saline soils
Solonetz	clay	variable	variable	variable	above 7	poor	poor	low	variable	sodic (alkali) soils
Regosols	clay	variable	variable	moderate to high	variable	variable	variable	variable	variable	
Rankers	clay	variable	variable	variable	below 5.5	variable	variable	variable	variable	
Lithosols	rock	variable	very shallow	variable	variable	variable	variable	variable	very low	very shallow soils
Gleysols	clay	clay	variable	moderate to high	variable	poor	poor	variable	moderate to high	poorly drained soils
Greyzems	clay	variable	variable	moderate to high	variable	moderate to poor	moderate	moderate	moderate to high	
Histosols	peat-clay	peat	variable	very high	below 5.5	moderate to poor	variable	moderate to high	moderate to high	peat soils

H.M.H. Braun, Kenya Soil Survey

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 conditions[1] 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 Area[1]

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 1,620 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 farmers*[1] *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. I[1] 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* approximately[2] 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) conditons 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 throroughly 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. **Grass 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 Grass[1]

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 scientifacally 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 K_2O 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.

a) The results of research work, demonstrations on the farm, results of book-keeping farms, etc. have been analysed to assess fertilizer response.

b) 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_2O_5	K_2O
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. Thus 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]	
	M&PB	AEZ[b]	1975 kg/ha	1976 kg/ha	1977 kg/ha	1978 kg/ha	1979 kg/ha	kg/ha	bags/ha
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
Katumani 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	Merrow 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 — per acre	15,487	15,455	13,552
Plants at harvest — per ha.	38,270	38,141	33,488
Fertilizer Kg/ha. — phosphate	67	65	95
Fertilizer Kg/ha. — nitrogen	119	109	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		CROPS											
		Maize			Sorghum			Groundnuts			Sunflower		
Nyanza													
Kisii	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	0-40-40			
	yield	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	0-40-40			
	yield	2,530	3,350	4,540	2,170	2,500	3,660	820	920	1,550			
	incremental	-	820	210	-	330	1,490	-	100	730			
	per kg nutrient	-	14	34(20)	-	8	37(29)	-	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	0-40-40			
	yield	2,250	3,120	3,920	2,680	2,690	3,100	500	680	1,100			
	incremental	-	870	1,670	-	10	420	-	180	600			
	per kg nutrient	-	15	29(14)	-	2	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	0-40-40			
	yield	3,160	3,910	4,930	1,340	2,100	2,800	820	1,150	1,400			
	incremental	-	750	1,770	-	760	1,460	-	330	580			
	per kg nutrient	-	13	30(17)	-	19	36(17)	-	8	15(7)			
Average Nyanza	yield	2,650	3,460	4,460	2,000	2,500	3,260	930	1,140	1,630			
	incremental	-	810	1,810	-	500	1,260	-	210	70			
	per kg nutrient	-	14	30(16)	-	13	32(19)	-	5	18(13)			
Western													
Busia	Crop					Soya Beans							
	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	0-40-40	0-0-0	0-40-0	0-40-40	0-0-0	0-40-0	40-40-0
	yield	3,400	4,300	5,620	530	700	950	650	900	1,160	1,250	1,400	1,760
	incremental	-			-	170	420	-	250	510	-	150	510
	per kg nutrient	-			-	4	10(6)	-	6	13(7)	-	4	13(9)
Bungoma	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	0-40-40	0-0-0	0-40-0	0-40-40	0-0-0	0-40-0	40-40-0
	yield	3,160	4,060	4,980	1,020	1,360	1,640	790	1,100	1,370	750	1,070	1,690
	incremental	-	900	1,820	-	340	620	-	310	580	-	320	940
	per kg nutrient	-	15	30(15)	-	9	16(7)	-	7	15(8)	-	8	24(16)
Kakamega	fertilizer treatment	0-0-0	0-60-0	60-60-0	0-0-0	0-40-0	0-40-40	0-0-0	0-40-0	0-40-40	0-0-0	0-40-0	40-40-0
	yield	3,800	5,000	6,100	760	1,100	1,400	860	1,200	1,430	840	1,200	1,620
	incremental	-	1,200	2,300	-	340	640	-	340	570	-	360	780
	per kg nutrient	-	20	38(18)	-	9	16(7)	-	9	14(5)	-	9	20(11)
Average Western	yield	3,450	4,450	5,570	770	1,050	1,330	770	1,070	1,320	950	1,220	1,690
	incremental	-	1,000	2,120	-	280	560	-	300	555	-	270	740
	per kg nutrient	-	17	35(18)	-	7	14(7)	-	8	14(6)	-	7	19(12)

RESULTS OF FERTILIZER TRIALS IN FARMERS FIELD
RIFT VALLEY PROVINCE

		CROPS											
		Maize			Beans			Sunflower			Potatoes		
District:	Fertilizer Treatment	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	870	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)

RESULTS OF FERTILIZER TRIALS IN FARMERS FIELD
CENTRAL, EASTERN AND COAST PROVINCES

		CROP																	
		Maize			Katumani Maize			Sorghum			Beans			Sunflower			Potatoes		
District:	Fertilizer Treatment	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	0-40-40	0-0-0	0-40-0	40-40-0	0-0-0	60-60-0	60-60-60
Nyahururu	yield																5,900	8,880	9,820
	incremental																	2,980	3,920
	per kg nutrient																	50	65(15)
Kiambu	yield	3,150	4,140	5,130	2,030	2,940	3,560				680	1,150	1,430				6,410	9,170	12,000
	incremental		990	1,980		910	1,530					470	750					2,760	5,590
	per kg nutrient		25	50(25)		23	38(15)					12	18(6)					46	93(47)
Nyeri	yield	2,670	3,400	4,700	900	1,800	3,600				540	950	1,320				9,300	14,400	19,000
	incremental		730	2,030		900	1,800					410	780					5,100	9,700
	per kg nutrient		18	50(32)		23	45(22)					10	20(10)					85	162(77)
Murang'a	yield	3,640	4,600	5,720	3,000	3,520	5,450				900	1,240	1,560				9,400	13,660	15,060
	incremental		960	2,080		520	2,450					340	660					4,260	5,660
	per kg nutrient		24	52(28)		13	61(48)					9	17(8)					71	94(23)
Kirinyaga	yield	4,000	4,670	5,490							1,370	1,630	1,900				9,300	12,500	15,400
	incremental		670	1,490								260	530					3,200	6,100
	per kg nutrient		17	37(20)								7	13(6)					53	102(49)
Average	yield	3,370	4,200	5,260	1,980	2,750	4,200				870	1,240	1,550				8,060	11,720	14,260
	incremental		830	1,890		770	2,220					370	680					3,660	6,200
	per kg nutrient		21	47(26)		19	56(37)					9	17(8)					61	103(42)
Embu	yield	2,590	3,400	4,300	970	1,410	2,000	2,040	2,520	3,140	570	850	920				7,850	10,700	13,600
	incremental		810	1,710		440	1,030		480	1,100		280	350					2,850	5,750
	per kg nutrient		20	43(23)		11	26(15)		12	28(16)		7	9(2)					48	96(48)
Meru	yield	2,870	3,610	4,400	1,060	1,440	2,140				560	800	1,000				7,100	12,550	11,700
	incremental		740	1,530		380	1,080					240	440					5,450	4,600
	per kg nutrient		19	38(19)		10	27(17)					6	11(5)					90	77
Machakos	yield				1,520	2,110	2,250	300	660	1,000	960	960	1,220						
	incremental					590	730		360	340		0	260						
	per kg nutrient					15	18(3)		9	8(-1)		-	7						
Average	yield	2,730	3,510	4,350	1,180	1,650	2,130	1,170	1,590	2,070	700	870	1,050				7,480	11,630	12,650
	incremental		780	1,620		470	950		420	900								4,150	5,170
	per kg nutrient		20	41(21)		12	24(12)		11	23(12)								69	86
Taita	Crop										Groundnuts								
	Fertilizer treatment										0-0-0	0-40-0	0-40-40						
	yield	3,480	4,450	5,500	1,100	1,500	2,040	500	1,050	1,410	980	1,400	1,370				9,980	11,810	15,200
	incremental		970	2,020		400	940		550	910		420	390					1,830	5,220
	per kg nutrient		24	51(27)		10	24(14)		14	22(8)		11	10					31	87(56)
Kwale	Crop																	Cassava	
	Fertilizer treatment																0-0-0	60-60-0	60-60-60
	yield							950	1,450	1,700	860	1,060	1,210	560	880	1,100	15,360	17,530	20,340
	incremental								500	750		200	350		320	540		2,170	4,980
	per kg nutrient								13	18(+5)		5	9(4)		8	14(6)		36	83(47)
Kilifi	yield							420	1,080	1,330	740	950	1,070	630	860	1,010	11,500	14,650	16,540
	incremental								660	910		210	330		230	380		3,150	5,040
	per kg nutrient								17	23(6)		5	8(3)		6	10(4)		52	840(788)
Average	yield	3,480	4,450	5,500	1,100	1,500	2,040	620	1,190	1,480	860	1,140	1,220	600	870	1,060	13,430	16,090	18,440
	incremental		970	2,020		400	940		570	860		280	360		270	460		2,660	5,010
	per kg nutrient		24	51(27)		10	24(14)		14	22(8)		7	9(+2)		7	12(5)		443	835(392)

THE PRODUCTIVITY OF GRASSLANDS IN MIXED FARMING AREAS
in t/ha[a)]

Kind of: Pasture Use Variety	Production[b)] 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	III	Total	I	II	III	Total	I	II	III	Total	I	II	III	Total
		J-M	A-S	O-D	per year	J-M	A-S	O-D	per year	J-M	A-A	S-D	per year	J-A	M-A	S-D	per year
Planted																	
Zero Grazing:																	
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
Natural Pasture																	
Grazing:																	
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
Planted Leys																	
Grazing:																	
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
Narsetaetaria	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
Nandi 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
Elmba 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
Maasaba 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
Pokot 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	b)	Eldoret LH 3 (l/vl)				Lanet LH 4 (l)				Naivasha UM 5 s/vs+i				Oljo-Orok UH 4 uri				Embu UM 3 m/s+s			
		I	II	III	Total	I	II	III	Total	I	II	III	Total	I	II	III	Total	I	II	III	Total
		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
Planted																					
Zero Grazing:																					
French Cameroon	DM	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
	TDN				6.2				4.7				5.0				3.7				8.9
Bana Grass	DM	2.9	5.0	2.5	10.4	3.2	6.9	2.8	12.9	2.3	8.0	2.7	13.0	2.1	3.3	2.6	8.0	5.8	7.1	3.6	16.5
	TDN				5.2				6.5				6.5				5.2				10.7
Giant Setaria	DM	0.8	2.5	1.3	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
	TDN				2.3				3.2				1.8				3.0				7.3
Guatemala	DM	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
	TDN				2.6				2.0				0.7				2.9				5.4
Natural Pasture																					
Grazing:																					
Stargrass	DM	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
	TDN				1.2				2.5				1.9				2.5				3.1
Kikuyu Grass	DM	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
	TDN				0.5				2.0				1.7				1.1				2.1
Planted Leys																					
Grazing:																					
Makueni Guinea	DM	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
	TDN				1.7				2.8				0.9				1.3				5.0
Coloured "	DM	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
	TDN				2.5				1.60				1.6				3.0				3.4
Narsetsetaria	DM	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
	TDN				1.5				2.5				0.7				2.9				3.5
Nandi Setaria	DM	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
	TDN				1.7				2.2				0.2				2.3				2.5
Boma Rhodes	DM	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
	TDN				2.4				3.6				4.6				3.9				5.3
Elmba Rhodes	DM	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
	TDN				1.8				4.0				2.6				3.5				4.3
Masaba Rhodes	DM	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
	TDN				2.0				3.1				3.8				4.0				5.4
Mbara Rhodes	DM	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
	TDN				2.0				3.0				4.0				3.3				3.8

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 form the trial yieds.

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 application and incremental			
Kisii, Research Station		(N)	0	40	80	120
		(P_2O_5)	0	30	60	90
(incremental of + 1 kg N 0.750 kg P_2O_5)	1973	H 613 C	3320	3770	5130	5510
	1974		6550	6860	6950	6510
	1974		3940	6960	6480	7440
	1974		5920	8260	8420	8340
	1976		7830	8070	9230	8610
average			5512	6784	7242	7282
incremental				1272	1730	1770
				32	22(12)	15(1)
Kisii, Keumbu I	1973	H 613 C	790	900	3120	3100
II	1973		990	2350	2320	2340
average			890	1625	2720	2720
incremental			-	735	1830	1830
				18	23(24)	8(-)
Kisii, Keroka I	1973	H 613 C	3500	3920	4400	4800
II	1973		1730	3350	3930	2540
III	1973		4370	5500	4330	5110
IV	1973		2390	2290	3190	3500
average			2998	3765	3963	3988
incremental				767	965	990
				19	12(5)	8(6)
South Nyanza, Oyani	1973	H 622	1570	4310	3960	4410
	1974		5920	8260	8420	8340
	1975		3520	2560	4250	4330
	1976		3520	4760	4620	4660
average			3633	4973	5313	5435
incremental				1340	1680	1802
				34	21(9)	15(3)
South Nyanza, Oyugis	1973	H 622	1360	850	1650	1290
			-	-	10	-
South Nyanza, Migori I	1973	H 622	1040	1030	1520	1020
II			2730	2690	2540	3380
III			5200	5930	7150	7140
average			2990	3217	3707	3847
incremental				227	717	857
				6	9(12)	7(4)
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)

Area	Year	Variety	Treatments/Yields at 0 application and incremental			
South Nyanza, Rongo I		(N)	0	40	80	120
		(P_2O_5)	0	30	60	90
	1973	H 622	2560	4010	4900	5160
Rongo II	1973		1350	3150	2420	4770
average			1955	3580	3660	4965
incremental				1625	1705	3010
				41	21(1)	25(32)
South Nyanza, Rongo	1975	H 512	1620	1700	2630	3370
	1976		4210	6140	6000	5610
average			2915	3920	4315	4490
incremental				1005	1400	1575
				25	18(5)	13(2)
South Nyanza, Homa Bay FTC	1974	H 512	7790	6920	7820	6860
			-	870	-	-
incremental				22	-	-
South Nyanza, Pe-Hill	1974	H 622	2860	5560	4860	6000
	1975		4500	5910	6720	6330
average			3680	5735	5790	6165
incremental				2055	2110	2485
				50	26(-)	21(3)
South Nyanza, Rakwaro	1974	H 622	2810	3900	4150	5530
" " Kuja	1974		2560	4900	6010	6600
" " Ranen	1975	H 512	2260	4070	3880	5630
average			2543	4290	4680	5920
incremental				1747	2137	3377
				44	27(5)	28(31)
Narok, Kilgoris I	1974	H 622	3370	4260	6090	5970
" Kilgoris II	1974		3420	4800	5520	5710
" Kilgoris II	1974	H 512	2450	3740	4070	5270
average			3080	4266	5227	5650
incremental				1186	2147	2570
				30	27(12)	21(4)
			Treatments			
(incremental of 1 kg N and 0.5 kg of P_2O_5)			0	40	90	140
			0	20	40	70
Kakamega, Luvambi	1972	H 613 C	5850	6080	6340	6640
" "	1973		5100	4900	5920	6640
average			5475	5490	6130	6640
incremental				15	655	1165
				-	7(7)	8

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
					0-0-0	26-0-0	26-69-0	26-138-0
Elgon down	1979	Sunflower	S 301 A	Response	2206	2568	2648	2950
				Increase in yield		362	442	744
				Increase per kg P_2O_5		-	6	5
"	1979	Sunflower	Hungarian White	Response	1918	2200	2337	2662
				Increase in yield		282	419	744
				Increase per kg P_2O_5		-	6	5
"	1979	Sunflower	Kenya White	Response	2563	2365	2154	2252
				Increase in yield		-	-	-
				Increase per kg P_2O_5		-	-	-
Japata	1979	Sunflower	S 301 A	Response	1061	603	844	599
				Increase in yield		-	-	-
				Increase per kg P_2O_5		-	-	-
"	1979	Sunflower	Hungarian White	Response	1357	1315	1390	1508
				Increase in yield		-	33	151
				Increase per kg P_2O_5		-	-	1
"	1979	Sunflower	Kenya White	Response	1734	2040	1555	2092
				Increase in yield		306	179	358
				Increase per kg P_2O_5		-	2	3

RESULTS OF FERTILIZER TRIALS IN MAIZE
AT APPLICATION OF
178 KG N + 104 KG OF P_2O_5 PER HA
WEST KENYA AND RIFT VALLEY
in kg/ha

Variety	Year	Siaya	Kakamega	Webuye	Kapsabet	Kericho	Kitale	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		2440					7690	5420	
	1979		6220						
H 612			10670		3070	3560	8760	4040	
H 614			9440		8310	8910	10150	5110	
H 613			12000		2390	3960	9470	4130	
H 7701			8800		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			
Machakos, Katumani Research	1974	Katumani	0	40	70	100
		Composite	0	30	30	30
		B		5920	5820	5140
incremental			not			
Machakos, Karigundo	1974		measured	3860	4550	5210
incremental						
Machakos, Kisau	1974			1060	1520	1610
incremental						
Kitui, Ithookwe	1974			3370	2960	2940
incremental						
Kitui, Kampi ya Mawe	1974			2680	2770	2720
incremental						
Kitui, Yatta	1974			3120	2340	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			
Machakos, Karigundo		B	measured	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	P_2O_5	
Kisii, Research Station	H 613	120	90	5510
		80	60	6950
		120	90	3440
		120	90	8610
Kitale, NAR Station		170	110 + 60 K_2O	7000
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_2O_5		2	11	4
Eldoret (old land)	1975	Wheat		Response	1300	1130	1220	1250
				Increase in yield		-	-	-
				Increase per kg P_2O_5		-	-	-
Endebess (old land)	1975	Wheat		Response	2070	2120	2390	2630
				Increase in yield		50	320	560
				Increase per kg P_2O_5		3	8	7
Kaptagat (old land)	1975	Wheat		Response	2310	2130	2460	2740
				Increase in yield		-	150	430
				Increase per kg P_2O_5		-	4	5
Londiani (old land)	1975	Wheat		Response	1260	1550	2210	2740
				Increase in yield		290	950	1480
				Increase per kg P_2O_5		14	23	18
Ngoro Ngore (old land)	1975	Wheat		Response	1950	1510	1810	1790
				Increase in yield		-	-	-
				Increase per kg P_2O_5		-	-	-
Mau Narok (new land)	1975	Wheat		Response	3750	3850	3620	3600
				Increase in yield		100	-	-
				Increase per kg P_2O_5		5	-	-
Limuru Ndeiya (old land)	1968	Wheat		Response	5730		6020	6240
				Increase in yield			290	510
				Increase per kg P_2O_5			7	6
Timau (old land)	1968	Wheat		Response	2770		4020	4000
				Increase in yield			1250	1230
				Increase per kg P_2O_5			31	15

RESULTS OF FERTILIZER TRIALS IN WHEAT BY NARS – NJORO (2)

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
					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_2O_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_2O_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_2O_5		-	37	8	11	6	4	7
Kaptagat (old land)	1975	Wheat		Response	2310	2210	2010	1970	2270	2690	2630	2790
				Increase in yield		-	-	-	-	380	320	480
				Increase per kg P_2O_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_2O_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_2O_5								
					40-0-0		40-10-0	40-20-0	40-40-0	40-60-0	40-80-0	40-100-0
Njoro (old land)	1975	Wheat		Response	2810		3060	3180	2930	2720	3230	2730
				Increase in yield			250	370	120	-	420	-
				Increase per kg P_2O_5			25	18	3	-	5	-
Eldoret (old land)	1975	Wheat		Response	1050		1050	1600	1710	1290	1400	1920
				Increase in yield			-	550	660	240	350	870
				Increase per kg P_2O_5				27	16	4	4	9
Endebess (old land)	1975	Wheat		Response	1950		2300	2750	2780	3300	3650	2460
				Increase in Yield			350	800	830	1350	1700	510
				Increase per kg P_2O_5			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
					0-0-0	0-20-0	0-40-0	0-60-0	0-80-0	0-100-0
Nairegia Nkare (new land)	1976	Wheat		Response	2130	2400	2700	1940	2590	2520
				Increase in yield		270	570	-	460	390
				Increase per kg P_2O_5		14	14	-	5	4
Eldoret (new land)	1976	Wheat		Response	720	1060	1150	1390	1100	1420
				Increase in yield		340	430	670	380	700
				Increase per kg P_2O_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_2O_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_2O_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_2O_5		16	10	1	8	2
NPBS Njoro (old land)	1976	Wheat		Response	1150	1500	1950	1570	1760	1920
				Increase in yield		350	800	420	610	770
				Increase per kg P_2O_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_2O_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_2O_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
					0-0-0	0-20-0	0-40-0	0-80-0
Njoro (new land)	1975	Triticale		Response	2490	3380	3860	3830
				Increase in yield		890	1370	1340
				Increase per kg P_2O_5		45	34	16
Eldoret (old land)	1975	Triticale		Response	2419	2630	1920	2290
				Increase in yield		211	-	-
				Increase per kg P_2O_5			-	-
Rongai (old land)	1975	Triticale		Response	3850	4560	3760	4370
				Increase in yield		710	-	520
				Increase per kg P_2O_5		36	-	7
					40-0-0	40-20-0	40-40-0	40-80-0
Njoro (new land)	1975	Triticale		Response	3520	3750	4450	3820
				Increase in yield		230	930	300
				Increase per kg P_2O_5		12	23	4
Eldoret (old land)	1975	Triticale		Response	2160	2460	2600	2310
				Increase in yield		300	440	150
				Increase per kg P_2O_5		15	11	2
Rongai (old land)	1975	Triticale		Response	4320	4530	5180	4790
				Increase in yield		210	860	470
				Increase per kg P_2O_5		11	21	6
					0-0-0	0-20-0	0-40-0	0-80-0
Njoro (new land)	1975	Barley		Response	1220	1360	1230	1510
				Increase in yield		140	10	290
				Increase per kg P_2O_5		7	-	4
Eldoret (old land)	1975	Barley		Response	1900	1650	1870	2050
				Increase in yield		-	-	150
				Increase per kg P_2O_5				2

RESULTS OF FERTILIZER TRIALS IN DIFFERENT CROPS

DURING 1977–1979, in kg/ha

Area	Crop	Variety	Treatment N	Treatment P_2O_5	Treatment K_2O	Yield
Kiambu, Thika Research Station	Potatoes	B53	0	0	0	16,250
" " " "	"		0	150	0	21,440
incremental						5,190
per 1 kg P_2O						35
incremental	Potatoes	B53	75	300	0	26,637
per 1 kg N 4 kg P_2O_5						10,387
						138(69)
	Potatoes	B53	150	300	0	34,162
incremental						17,912
per 1 kg N 2 kg P_2O_5						119(100)
	No response to K_2O applications					
Kiambu, Thika Research Station	Potatoes	Rosilin Emburu	72	184	0	18,593
Embu, Research Station	"	" "	72	184	0	18,445
Nairobi, Tigoni Station	"	" "	72	184	0	27,778
Nyambini RTC	"	" "	72	184	0	25,978
Kiambu, Thika Research Station	"	Kenya Baraka	72	184	0	18,667
Embu, Research Station	"	" "	72	184	0	25,407
Nairobi, Research Station	"	" "	72	184	0	29,481
Nyambini RTC	"	" "	72	184	0	33,822
Kiambu, Thika Research Station	"	Annet	72	184	0	19,778
Embu, Research Station	"	"	72	184	0	15,464
Nairobi, Tigoni Station	"	"	72	184	0	14,029
Nyambini RTC	"	"	72	184	0	39,844
Embu, Research Station	Sweet	Gikanda	60	0	0	23,000
" " "	Potatoes	Bisale	60	0	0	34,000
" " "	"	Muibai	60	0	0	22,000
" " "	"	Musinga	60	0	0	15,000
" " "	"	Muibai	150	30	50	8,000
" " "	"	Musinga	150	30	50	10,000
Kilifi, Mtwapa Research Station	Cassava	5543/156	-	-	-	35,625
" (yields in wet tubers)	"	50284/33	-	-	-	30,900
" "	"	37244/E	-	-	-	29,250
" "	"	F 279	-	-	-	28,875
" "	"	46106/27	-	-	-	26,400

Area	Crop	Variety	Treatment N	Treatment P_2O_5	Treatment K_2O	Yield
Sugarcane Belt	Sugar	CO 421	0	30	50	57,100
Serengititi	-cane	CO 421	100	30	50	69,500
	"	CO 421				
	"	CO 421				
	"	CO 421	200	30	50	69,800
	"	CO 421				
	"	CO 421	300	30	50	70,000
						12,900
						43
Nyanza Sugar Belt		CO 421	150	0	50	171,300
Region		CO 421	150	60	50	172,500
"		CO 421	150	120	50	173,800
"		CO 421	150	180	50	184,000
Nyanza Sugar Belt		CO 421	150	30	0	127,000
" " "		CO 421	150	30	65	145,300
" " "		CO 421	150	30	130	170,500
" " "		CO 421	150	30	195	175,500
incremental		CO 421				48,500
per 1 kg K_2O		CO 421				249
South Nyanza, Ranen		CO 421	0	-	-	367,500
(red clay loam)		CO 421	100	-	-	401,300
"		CO 421	150	-	-	389,200
"		CO 421	300	-	-	393,200
incremental		CO 421				25,700
per 1 kg of N						85
Other sources at Kibos linear yield increase						
planted crop			0	-	-	90,000
			60	-	-	96,000
incremental						6,000
per 1 kg of N						100
1st ratoon			0			83,000
			60			92,000
incremental						9,000
per 1 kg of N						150
2nd ratoon			0			63,000
incremental						9,000
per 1 kg of N						150
Kisumu, Kibos		planted crop	70	100	-	100,000
" "		1st ratoon	100	50	-	90,000
" "		2nd ratoon	100	-	-	80,000
Kwale, Ramisi		planted crop	200	100	-	70,000
" "		" "	200	100	-	27,000
" "		" "	200	100	-	45,000

RESULTS OF FERTILIZER TRIALS IN DIFFERENT CROPS

DURING 1977–1979 (2)

in kg/ha

Area	Crop	Variety	Treatment			Yield
			N	P_2O_5	K_2O	
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

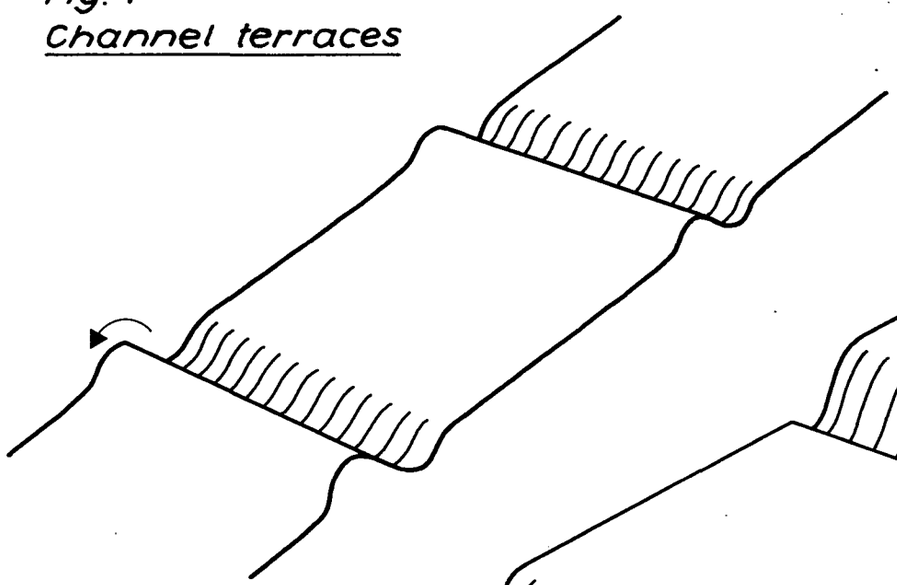
Terraces should not, if possible, be many hundreds of metres long. More than 400 m should be avoided.

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 %.

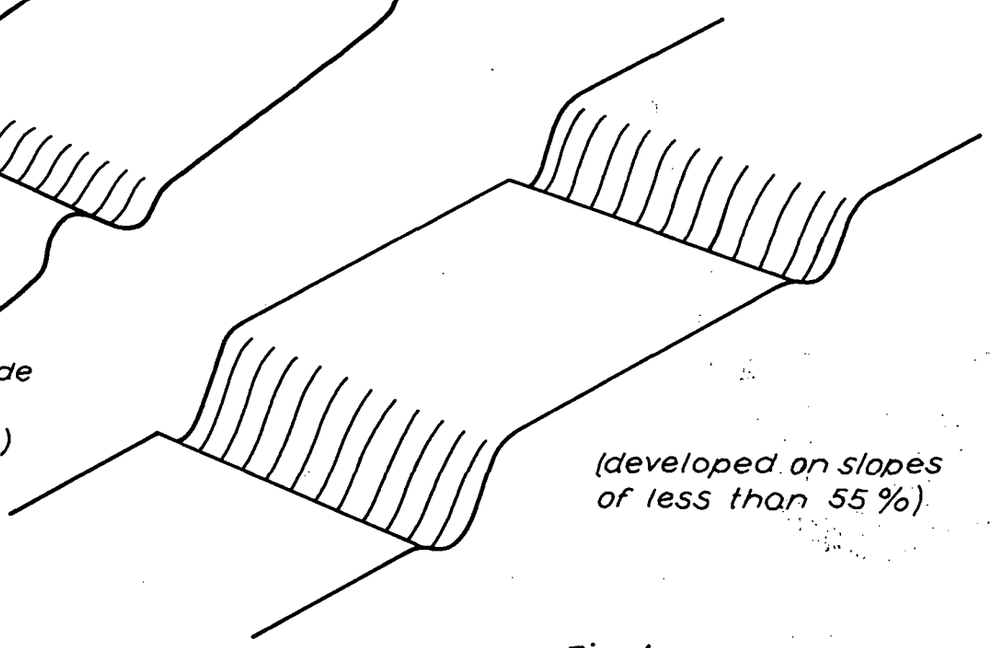
TYPES OF TERRACES

Fig. 1
Channel terraces



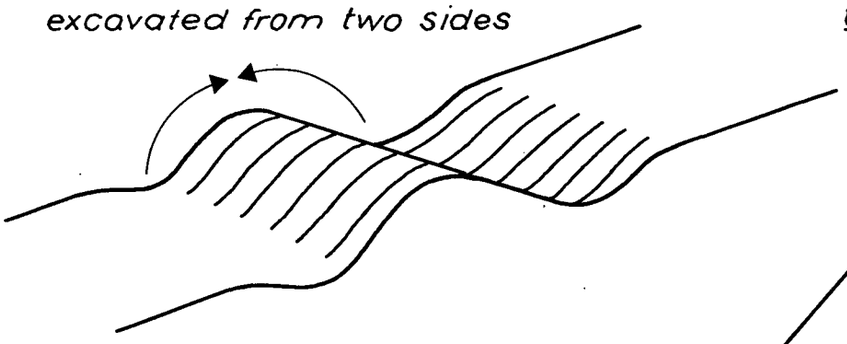
(machine-made on slopes of less than 12%)

Fig. 2
Bench terraces



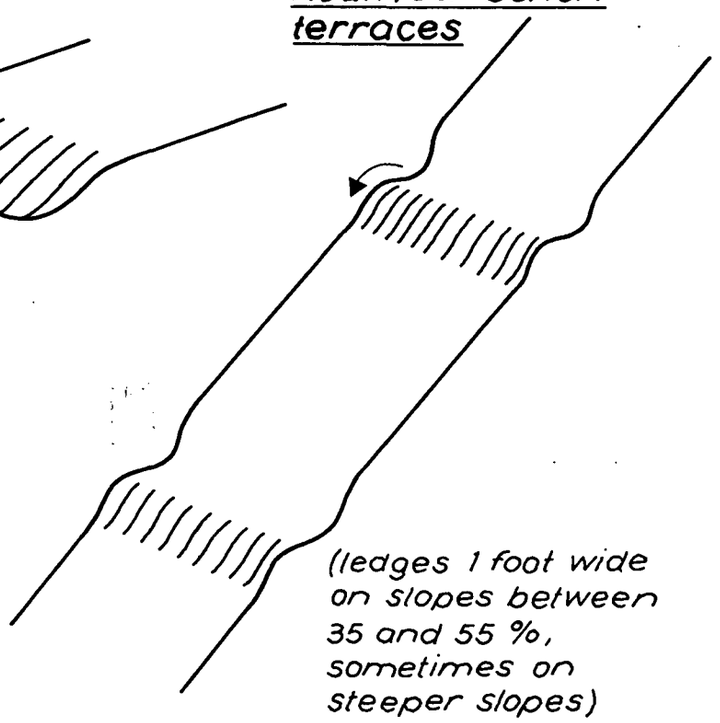
(developed on slopes of less than 55%)

Fig. 3
Ridge terrace
excavated from two sides



(machine-made on slopes of less than 5%)

Fig. 4
Modified bench terraces



(ledges 1 foot wide on slopes between 35 and 55%, sometimes on steeper slopes)

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. = $\frac{\text{V.I. x 100}}{\text{\% slope}}$

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.

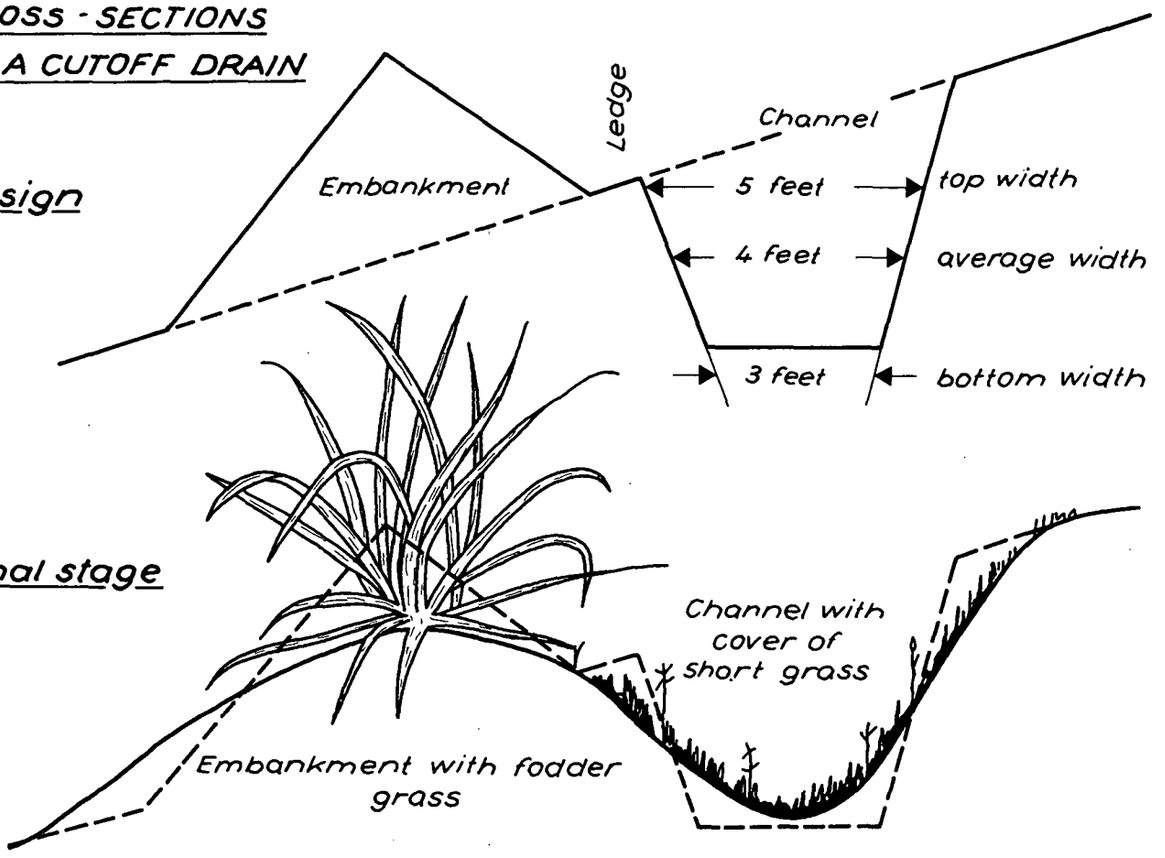
In the survey of a cutoff drain, you should start with the outlet point. If you cannot discharge the water in a safe way, do not dig any cutoff drain. Before measuring and setting out the pegs, you should walk along the proposed cutoff drain, checking that the drain is properly sited regarding houses,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

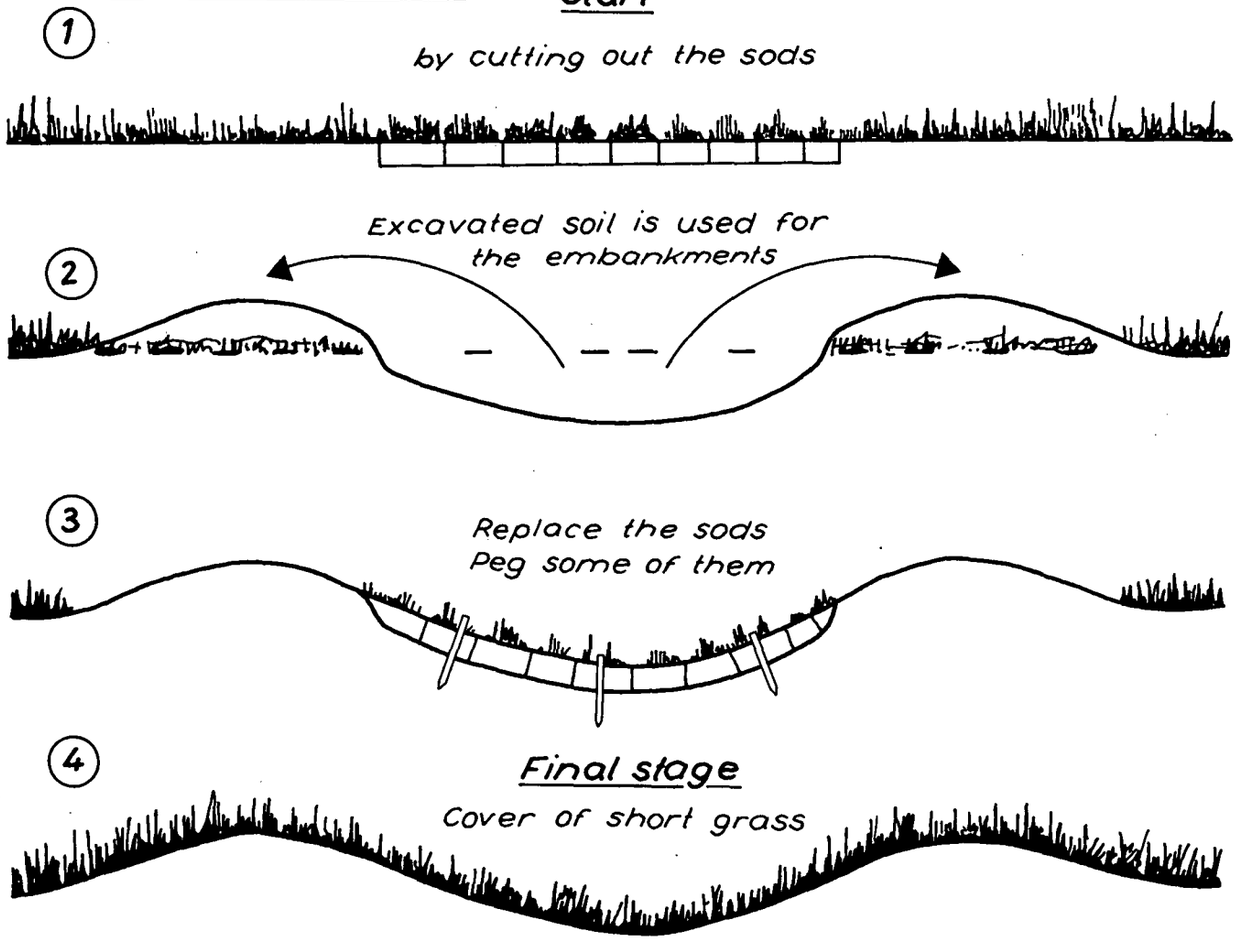
Lenght of cutoff drains

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



CROSS-SECTIONS OF AN ARTIFICIAL WATERWAY



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.

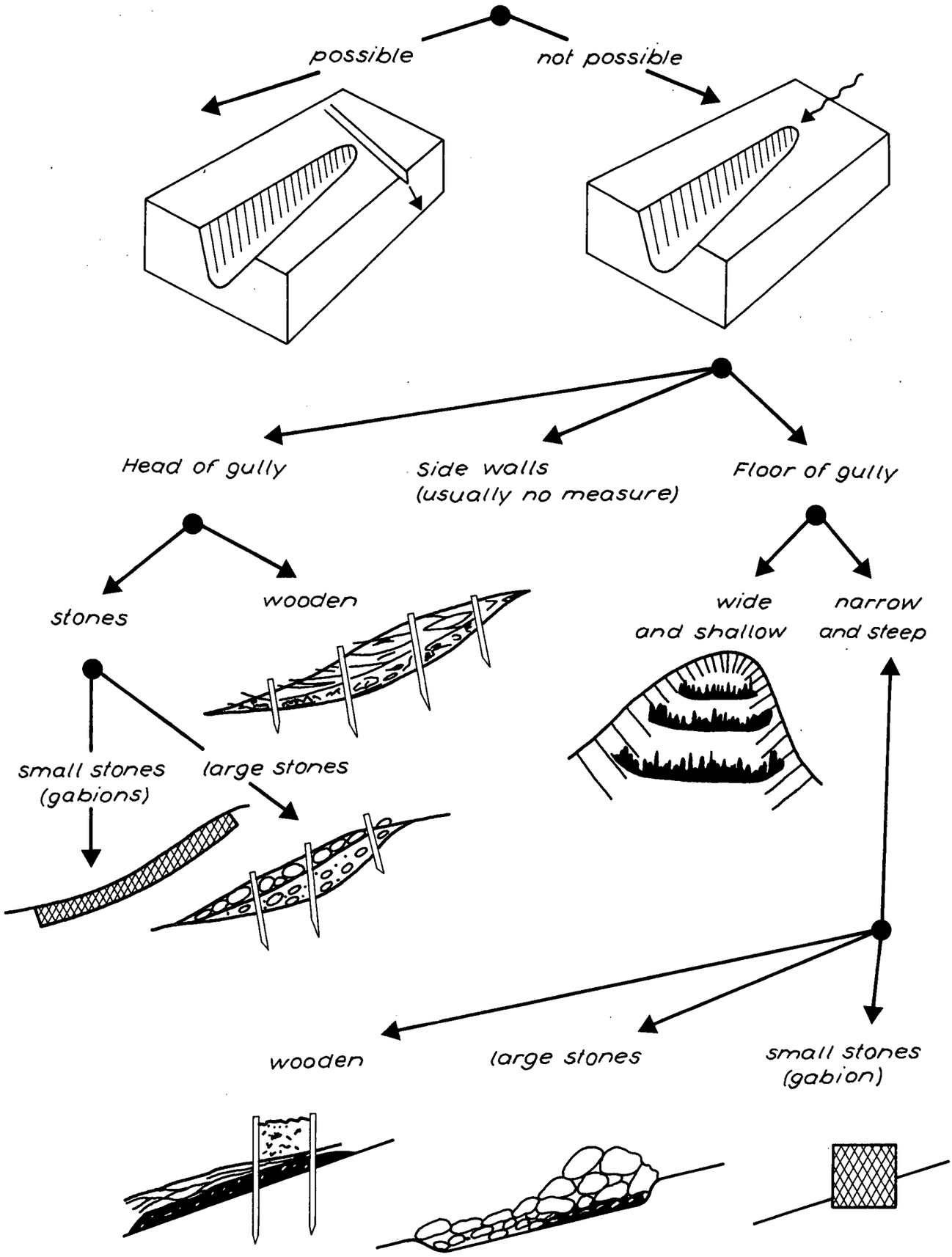
Experience has shown that farmers hesitate to accept even half of the widths recommended. An alternative then is to construct check dams as recommended for the floor in gully control (see the figure on the next page).

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):

	Cross-sections		Costs in shs/m	
Depth	Average width	Area	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 POLICIY 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

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 vegetables[2)]. 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 may 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 altidude	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	Kisii, District	64	Average	1 784	70	89	176	265	220	146	111	151	171	138	141	107
1 740 m	Office		60 % prob.[1]	1 602	45	70	126	238	198	126	83	134	131	107	104	78
9034005	Kamagambo Training	36	Average	1 600	57	101	148	236	206	123	82	113	128	126	165	115
1 500 m	School		60 %	1 435	46	64	131	197	124	85	56	75	148	109	115	109
9034024	Singoiwet Farm	36	Average	1 429	87	95	156	190	157	132	78	132	101	81	104	161
1 920 m			60 %	1 281	64	61	129	159	103	100	63	103	81	62	65	61
9034031	Nyanturago F. Coop.	27	Average	2 089	94	108	146	333	260	198	127	179	185	171	151	137
1 680 m	Society		60 %	1 397	47	58	110	196	133	98	67	100	120	138	80	73
903432	Moromba F. Coop.	34	Average	2 056	83	96	169	307	255	180	127	190	191	161	167	132
1 890 m	Society		60 %	1 716	51	71	150	231	196	116	76	103	139	126	136	90
9034042	Nyathegogi F. Coop.	29	Average	1 826	71	80	187	287	221	161	90	134	146	143	170	130
1 620 m	Society		60 %	1 647	17	50	129	197	180	107	51	90	104	107	138	69
9034046	N.Mugirango Nyabo-	26	Average	1 902	44	85	181	321	223	150	117	143	183	175	175	107
1 710 m	mite F.C. Society		60 %	1 719	26	38	155	243	192	108	72	109	154	139	116	73
9034056	Nyakoe, Kisii F.C.	21	Average	1 741	79	87	162	256	222	124	96	141	161	130	165	118
1 500 m	Society															
9034072	Kiamokama Agric.	15	Average	1 622	68	93	173	220	182	87	65	132	109	155	211	127
1 500 m	Holding															
9034080	Kisii, Coffee Sub-	33	Average	1 952	72	103	194	290	238	155	104	169	193	148	165	122
1 680 m	Station															
9034088	Kisii, Exp. Station	11	Average	2 677	110	125	234	474	338	227	178	184	143	217	240	208
1 680 m																

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 Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Y. of rec.
9034080	Kisii, Coffee	UM	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	
1 766 m	Sub-Station	1	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	18
		hp	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	Kisii, Experi-	UM	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	
1 765 m	mental	1	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	5
	Station	hp	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**

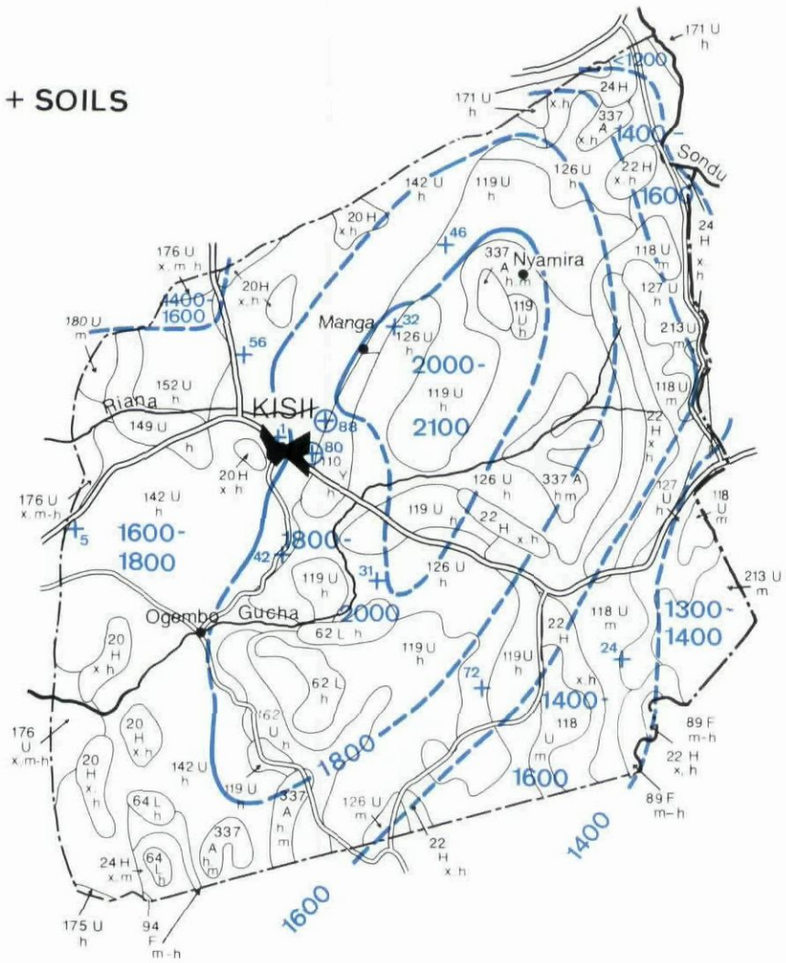
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall [1] 1st rains in mm	2nd rains in mm	60 % reliability of growing period 1st rains[2] in days	2nd rains in days	Total[3] in days
LH 1 Tea-Dairy Zone	p or l ⌐ m	∿1 900–2 211	18.0°–16.2°	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)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 ($< 0.2\ E_o$) 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

KISII



⊕ 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

35° E

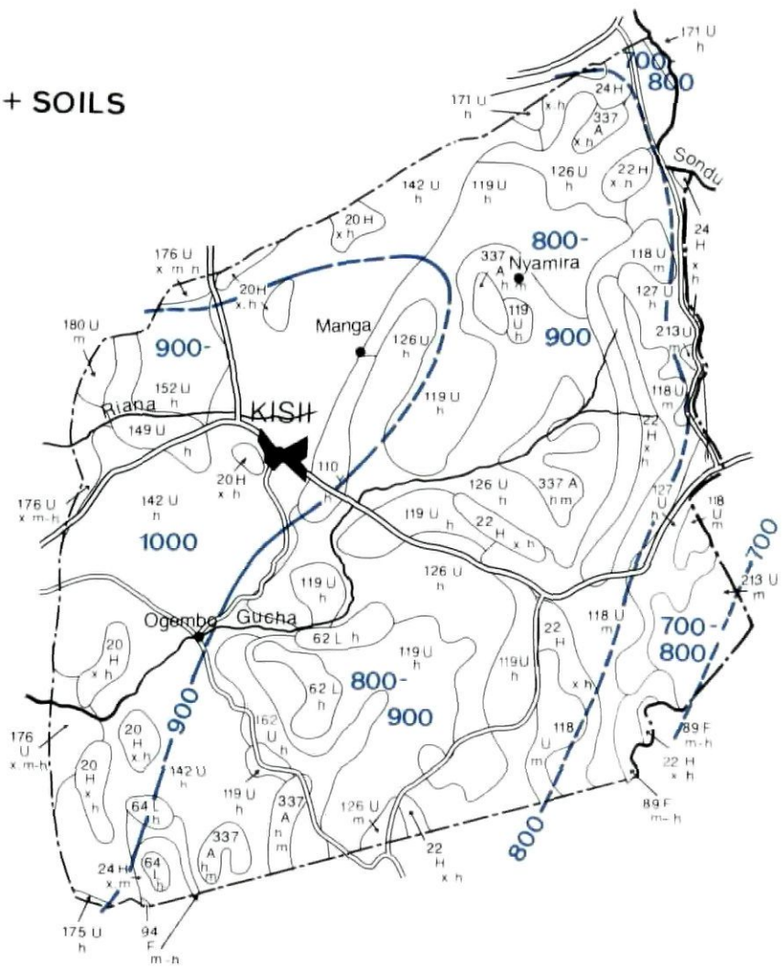
60% RELIABILITY OF RAINFALL IN FIRST RAINS

(mid Febr. - beg. Aug.)

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

KISII

+ SOILS



0°30' S

1° S

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

35°E

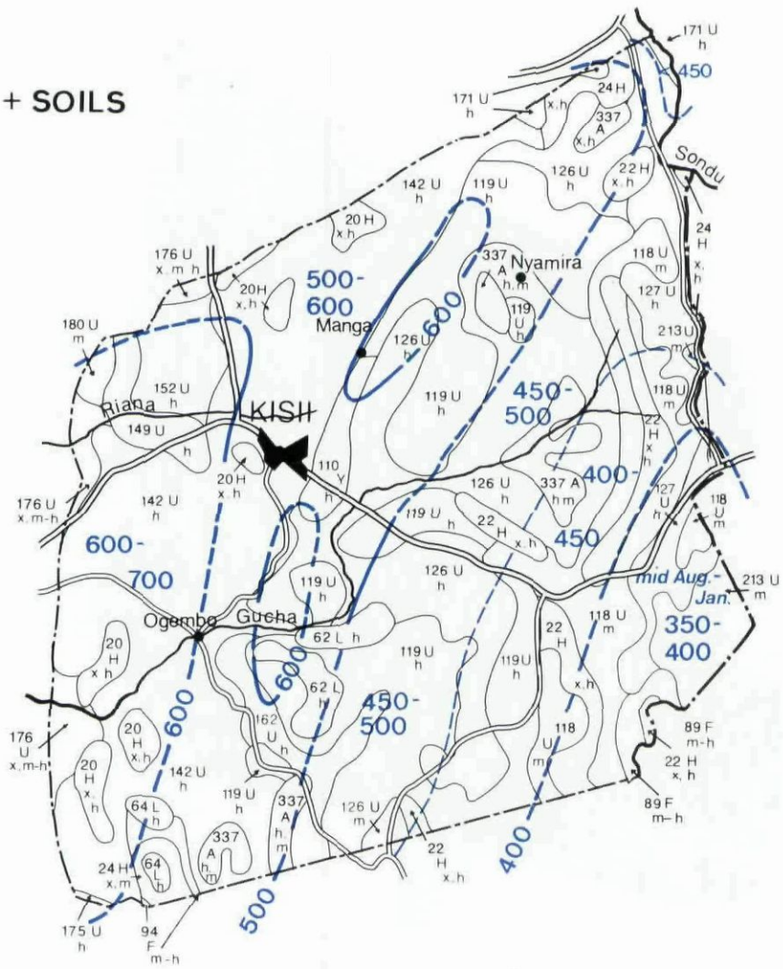
60% RELIABILITY OF RAINFALL IN SECOND RAINS

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

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

KISII

+ SOILS



Broken boundaries are uncertain because of lack of rainfall records

0 5 10 15 20 25 km

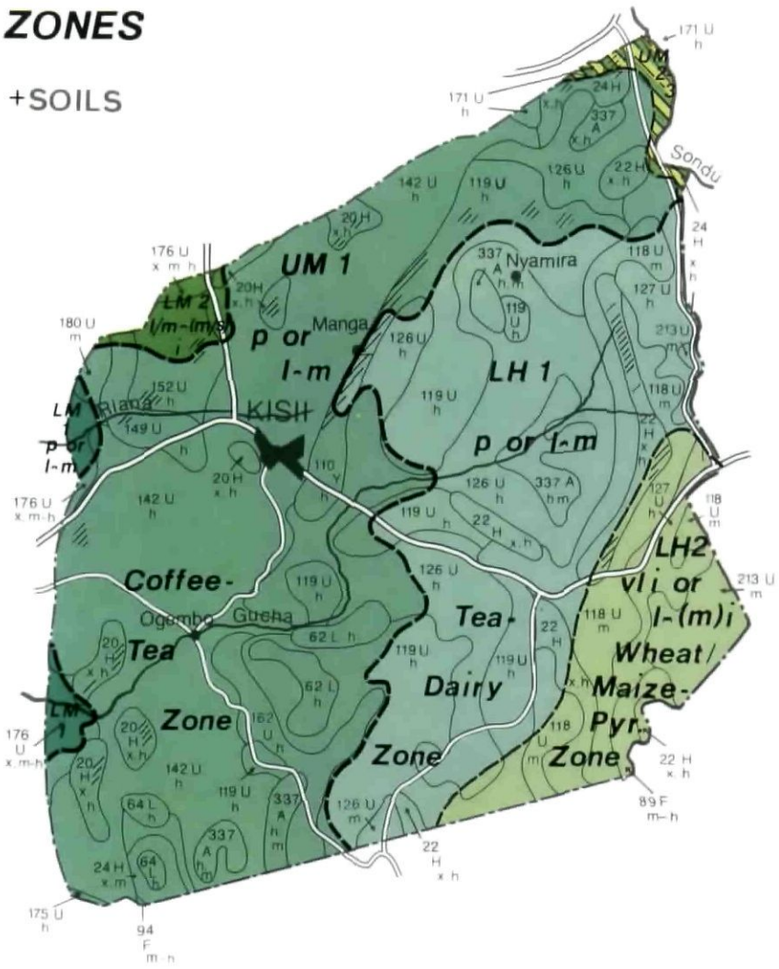
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS

35°E

KISII

AGRO - ECOLOGICAL ZONES

+SOILS



0°30' S

1° S

Unsuitable steep slopes

Belt of A. E. Zones ——— - - -

A. E. Zones ——— - - -

Subzones .....

Broken zonal boundaries are uncertain or mean transitional strips

Climatic data for AEZ formulas see table I and II

0 5 10 15 20 25 km

Min. of Agr., German Agr. Team

AEZ R Jatzold '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; onions[2]
2nd rains: Beans (below 2 000 m); onions[2]
Whole year: Pyrethrum (too wet), avocadoes

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

LH2 = *Maize/Wheat-Pyrethrum Zone*[3]

LH 2 vl i or l⌐(m) i = *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./0.); peas (∿ 60 %), horse beans; potatoes[1]; 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, avocadoes

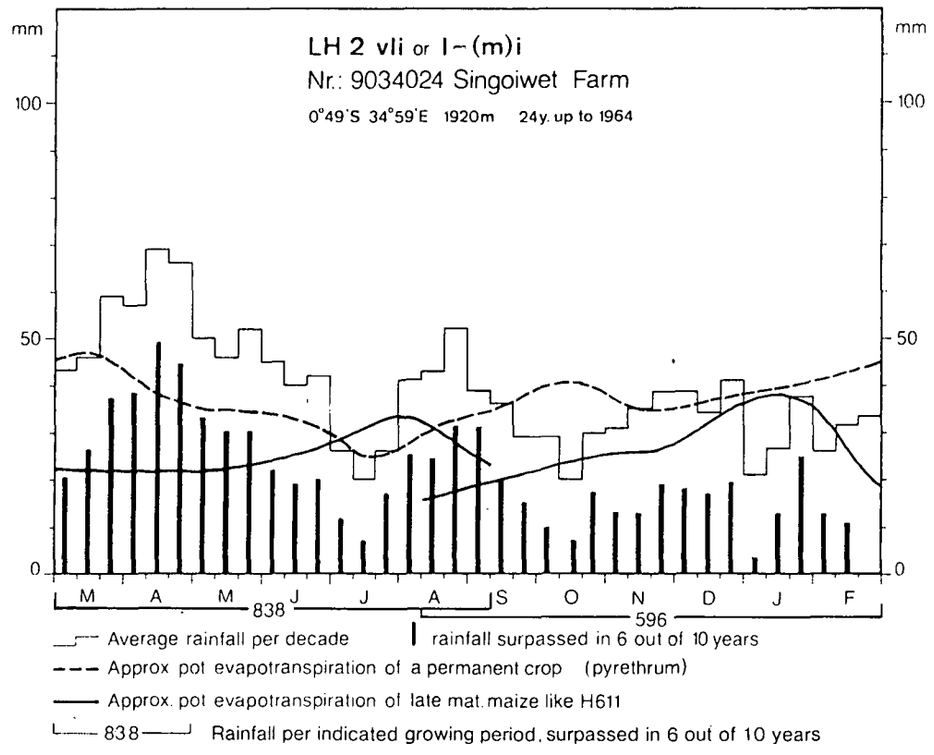
Pasture and forage
0.8–1 ha/LU on Kikuyu and tufted grass pasture; down to 0.6 ha/LU on art. pasture of Nandi Setaria or Rhodes grass; suitable for grade dairy cows; Louisiana white clover as add. forage

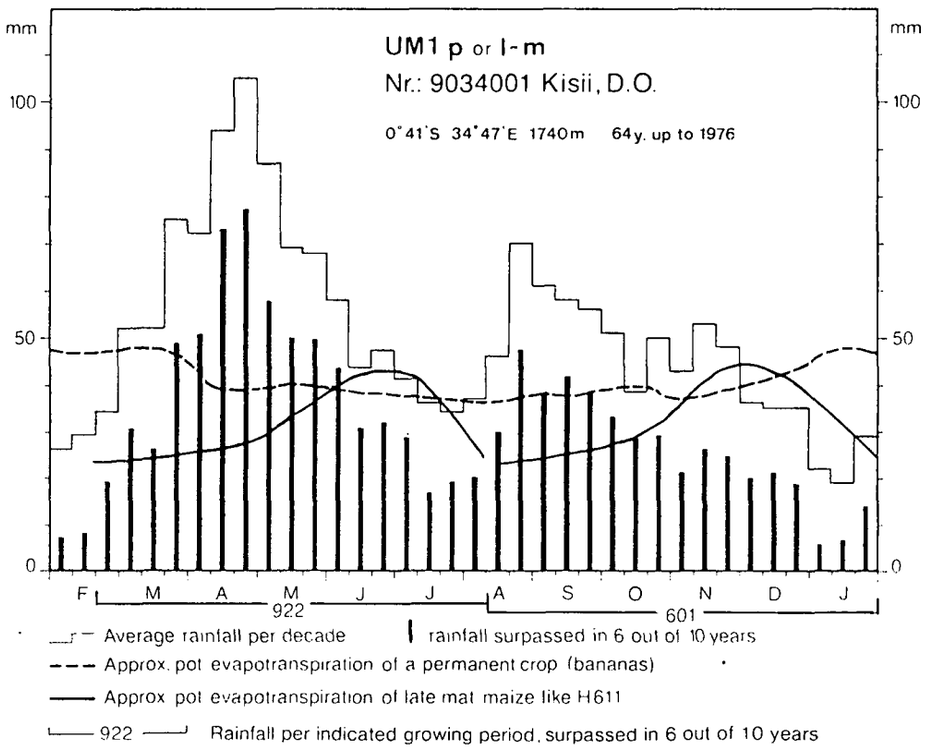
UM = *UPPER MIDLAND ZONES*

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, rinogu[4]
2nd rains, start around Aug.: M. mat. sunflower like Hybrid S 301 A (∿ 80 %)
Whole year: Pawpaws, guavas


LH 2 vli or l-(m)i
Nr.: 9034024 Singoiwet Farm
0°49'S 34°59'E 1920m 24y. up to 1964
mm
100
50
0
M A M J J A S O N D J F
838
596
Average rainfall per decade
rainfall surpassed in 6 out of 10 years
Approx pot evapotranspiration of a permanent crop (pyrethrum)
Approx. pot evapotranspiration of late mat. maize like H611
838
Rainfall per indicated growing period, surpassed in 6 out of 10 years


UM1 p or l-m
Nr.: 9034001 Kisii, D.O.
0°41'S 34°47'E 1740m 64y. up to 1976
mm
100
50
0
F M A M J J A S O N D J
922
601
Average rainfall per decade
rainfall surpassed in 6 out of 10 years
Approx. pot evapotranspiration of a permanent crop (bananas)
Approx pot evapotranspiration of late mat maize like H611
922
Rainfall per indicated growing period, surpassed in 6 out of 10 years

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, rinogu[4], 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, avocadoes, 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

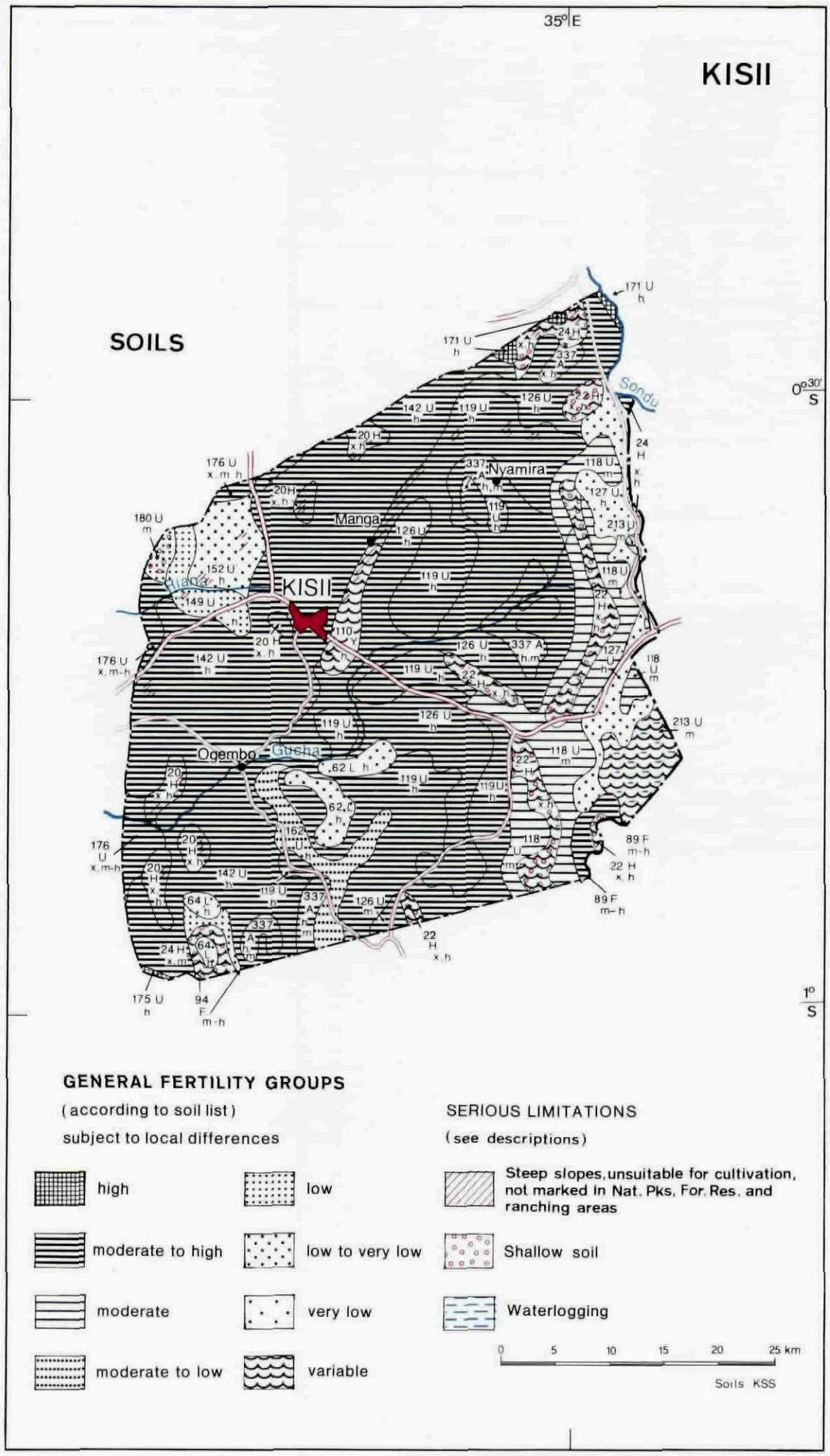
LM 1 = Lower Midland Sugar Cane Zone

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) Fresh onions mainly (shallots)
3) Wheat or maize mainly depending on farm scale, here more maize
4) Local spinach (Solanum nigrum)


35°E
KISII
SOILS
0°30' S
1° S
Sondu
Nyamira
Manga
KISII
Ogembo
Gucha
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
moderate to low
low
low to very low
very low
variable
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

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 occassionally 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 extremly 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 x, h[1)] = somewhat excessively drained, shallow to moderately deep, dark reddish brown, friable, gravely clay, with acid humic topsoil (humic CAMBISOLS, partly paralithic phase)

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

22 H x, h = somewhat excessively drained, shallow, dark reddish brown. friable, gravely clay; in places with humic topsoil, partly acid (RANKERS; with ando-haplic PHAEOZEMS, lithic phase and LITHOSOLS)

Soils developed on quartzites

24 H x, h = somewhat excessivly 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 ON PLATEAUS AND HIGH LEVEL STRUCTURAL PLAINS

Soils developed on intermediate igneous rocks (syenites, trachytes, phonolites, etc.)

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

Soils developed on quartzites

64 L h = well drained, deep to very deep, reddish brown, friable clay, with acid humic topsoil (jumic FERRALSOLS)

SOILS ON FOOTSLOPES

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

89 F x-h = moderately well drained to imperfectly drained, deep, dark reddish brown, mottled, friable clay loam, with humic topsoil and deeper subsoil of compact clay (gleyic PHAEOZEMS)

Soils developed on colluvium from quartzites

94 F m-h = well drained, deep to very deep, reddish brown to yellowish red, friable, sandy loam to clay, often with acid humic topsoil (humic ACRISOLS; with luvic ARENOSOLS)

SOILS ON PIEDMONT PLAINS

Soils developed on alluvium from undifferentiated Basement System rocks

110 Y h = moderately well drained, very deep, dark yellowish brown to strong brown, friable, lightly to moderately calcareous and slightly 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 m = well drained, deep to very deep, dark reddish brown, friable and slightly smeary silty clay loam, with thick humic topsoil (andoluvic PHAEOZEMS)

Soils developed on intermediate igneous rocks (syenites, trachytes, andesites), with volcanic ash admixture

119 U h = well drained, deep to extremly deep, reddish brown, friable clay, with thick humic topsoil ((dystro-) mollic NITOSOLS and chromo-luvic PHAEOZEMS)

Soils developed on intermediate igneous rocks (syenites, andesites, etc.), with volcanic ash admixture

126 U h = well drained, extremely deep, reddish brown, friable clay, with thick humic topsoil ((dystro-) mollic NITOSOLS)

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

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

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

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

Soils developed on granites

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

Soils developed on biotite/hornblende granites

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

Soils developed on acid igneous rocks

176 U x, m-h = complex of predominantly well drained, moderately deep to deep, reddish brown to brown, friable, gravely 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)

Soils developed on granites

180 U m = 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)

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

213 U m = association of:
- 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 PHAEOZEMS)

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 underlaying 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**

KISII DISTRICT

CENSUS 1979

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/Chache	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 Chache	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 Chache	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 Chache	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**

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 AEZ						Agric. land per	
	Census 79	Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads, rivers...)		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/Chache	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 Chache	114	1		22	91			87		4		1.61	0.28
South Mugirango Borabu	86	1		18	67			64		3		1.49	0.23
Bosongo Division	323	3		64	256			242		13		1.42	0.24
Majoge Chache	105			22	83			83				1.21	0.21
Majoge Borabu	112			22	90	2		88				1.29	0.21
Bassi Chache	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 STATISTICS[1)]

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 Kisii 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
Keumbu Kenimbu	Area	ha	2,861	3,513	3,739	4,000	4,395
	Production	t	4,709	6,117	9,079	9,239	
	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	2,310	
	Value per ha	Shs	2,568	5,328	4,856	4,620	
	Area per Grower	ha	0.29		0.61	0.31	
	Returns per Grower	Shs	751	1,581	4,856	1,457	
Kitutu	Area	ha	2,056	2,259	2,464	2,605	2,781
	Production	t	5,693	7,163	9,075	9,514	7,295
	Value	'000 Shs	9,393	25,499	19,745	20,836	17,800
	Growers	No	6,818	7,503	8,001	8,186	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 SURVEY[1)]

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 limitattions of the survey when making use of the data. More detailed information is included in FMHB Vol. III A and III B.

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 = 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

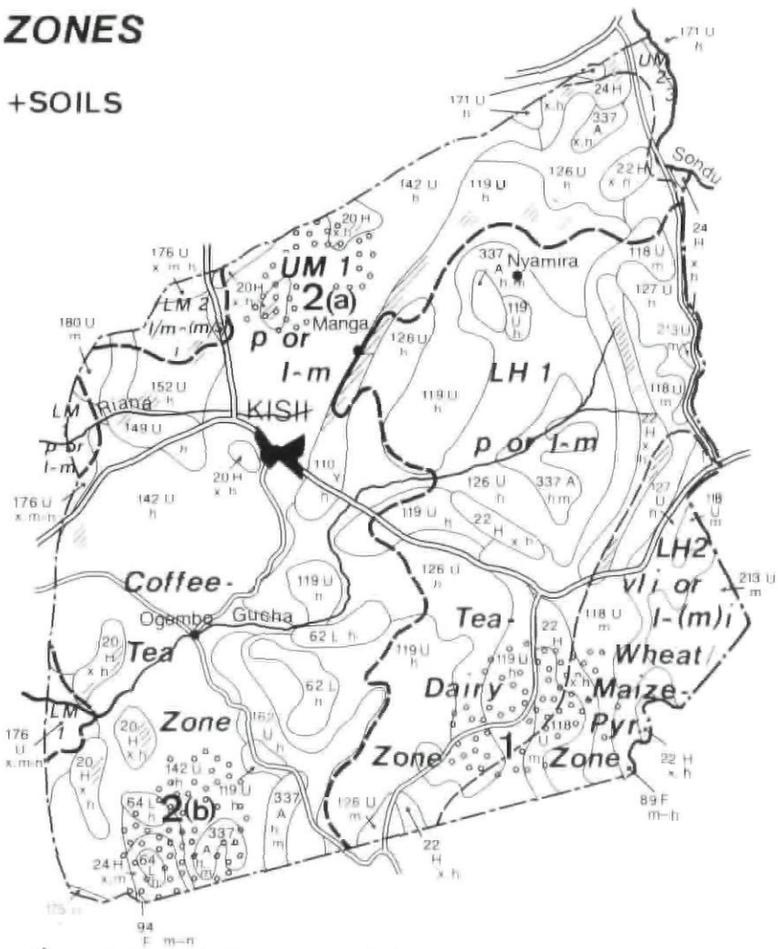
2) See also notes on farm management information, output/nutrient input page 51

35° E

KISII

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

+SOILS



0°30' S

1° S

1 National Number of Survey Area

Survey Area, sample size 30 per number

Unsuitable steep slopes

Belt of A. E. Zones

A. E. Zones

Subzones

Broken zonal boundaries are uncertain or mean transitional strips

Climatic data for AEZ formulas see table I and II

0 5 10 15 20 25 km

Min of Agr. German Agr Team

AEZ R Jatzold 81

Soils KSS

KISII DISTRICT

TABLE 8 a: **FARM ORGANISATION ACCORDING TO FARM SIZE GROUP**

AEZ: LH 1–2

Survey Area 01

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.1	5.9	10.2
Land Use: Annual Crops[1]				
First Season				
Maize	ha	0.1	0.4	0.4
Maize & Beans	ha	0.3	0.4	1.3
Beans	ha	-	0.1	-
Finger Millet	ha	-	0.1	0.1
	ha			
Total	ha	0.4	1.0	1.8
Second Season[1]				
Beans	ha	0.1	0.1	0.3
	ha			
	ha			
Total	ha	0.1	0.1	0.3
Permanent Crops[1]				
Pyrethrum	ha	0.3	0.6	1.2
Tea	ha	0.1	0.3	0.6
Coffee	ha	-	0.1	-
	ha			
portion of total	%	39%	33%	23%
Grazing & Forage	ha	0.1	0.8	3.5
portion of total	%	9 %	29%	10%
Other Land Use	ha	0.2	0.2	0.8
Livestock on Farm:				
Cattle: local	LU	2.2	2.1	3.6
improved	LU	6.6	0.9	1.4
Sheep & Goats	LU	1.2	0.3	0.3
Total	LU	4.0	3.3	4.3

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.8	0.7	0.5
Portion of improved cattle kept	%	21%	30%	29%
Portion of Farmers owning a Plough	%	40%	50%	90%
Labour on Farm:				
Family Adults	persons	2.1	3.1	2.4
Perm. Hired Labour	"	-	0.3	0.4
Children > 14 years	"	2.3	2.9	6.4
Persons living on Farm[2] - average household size -		**Farmer's Family**	**Non-related Persons**	**Total**
Adults > 14 years	persons	1.98	0.32	2.30
Children < 14 years	"	3.58	-	3.58
Subsistence Units	SU	4.13	0.32	4.45
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1295	2087	
Beans	kg	268	426	
Finger Millet	kg	39	61	
English Potatoes	kg	27	9	
Sweet Potatoes	kg	3	2	
Cabbage	kg	12	1	
	kg			
	kg			

Other Crops cultivated: English Potatoes, Sweet Potatoes, Cabbage
Sugarcane

1) Major crops only considered

2) Based on 1979 Census figures

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		
		small	medium	large
Farm Size Total	ha	1.4	2.9	6.1
Land Use: Annual Crops[1]				
First Season				
Maize & Beans	ha	0.5	0.7	1.1
Maize	ha	-	0.3	-
Finger Millet	ha	-	0.1	-
Beans	ha	-	-	0.3
	ha			
Total	ha	0.5	1.1	1.4
Second Season[1]				
Maize & Beans	ha	0.3	0.5	0.1
Maize	ha	0.1	0.1	-
Beans	ha	-	0.2	0.9
Total	ha	0.4	0.8	1.0
Permanent Crops[1]				
Coffee	ha	0.2	0.3	0.2
Bananas	ha	0.1	0.2	0.3
Sugarcane	ha	-	0.1	0.5
	ha			
portion of total	%	29%	21%	16%
Grazing & Forage	ha	0.4	0.9	3.2
portion of total	%	29%	31%	52%
Other Land Use	ha	0.2	0.3	0.5
Livestock on Farm:				
Cattle: local	LU	1.4	1.7	4.3
improved	LU	0.2	0.5	0.7
Sheep & Goats	LU	0.1	0.3	0.3
Total	LU	1.7	2.5	5.3

Item	Unit	Intensity, Labour/Persons on Farm / Home Consumption / Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.9	0.9	0.6
Portion of improved cattle kept	%	13%	23%	14%
Portion of Farmers owning a Plough	%	30%	50%	100%
Labour on Farm:				
Family Adults	persons	2.6	1.9	3.3
Perm. Hired Labour	"	-	-	-
Children > 14 years	"	0.9	2.6	2.1
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	1.98	0.15	2.13
Children < 14 years	"	3.69	-	3.69
Subsistence Units	SU	4.20	0.15	4.35
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1264	2037	
Beans	kg	204	324	
Finger Millet	kg	23	36	
English Potatoes	kg	96	32	
Sweet Potatoes	kg	32	18	
Cabbage	kg	13	1	
Cooking Bananas	kg	50	20	
	kg			

Other Crops cultivated: Sweet Potatoes, Pyrethrum, Tea, Rice Uplands
Cabbage, Tomatoes, Pineapples

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

KISII DISTRICT

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

AEZ: LH 1–2

Survey Area 01

	Assets			People on Farm		
Range	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
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	4.7
Up. Qu.	3.6	11.0	1.0	3.0	0.0	5.0
Lo. Qu.	1.8	4.0	0.0	2.0	0.0	1.0

Land Use

Range	Annual Crops ha	%	Perm. Crops ha	%	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	1.0	28	1.0	28	1.3	35	-	-	0.1	4	0.2	5
Avg. 1	1.0	25	1.0	24	1.4	35	0.1	3	0.4	9	0.2	5
Up. Qu.	1.2	37	1.2	38	1.2	33	-	-	0.4	8	0.2	10
Lo. Qu.	0.6	25	0.5	24	0.2	14	-	-	-	-	0.1	2
Total	30.5		30.4		37.7		0.1		3.9		5.1	

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	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	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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	-	-	0.5	0.1	-	-
Up. Qu.	100.0	-	4.2	16.4	-	-	-	-	-	-	-	-	-
Lo. Qu.	33.3	-	-	-	-	-	-	-	-	-	-	-	-

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, PC = AC - annual crops; PC - perennial crops

KISII DISTRICT

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

AEZ: UM 1

Survey Area 02

	Assets			People on Farm		
Range	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 Crops ha	%	Perm. Crops ha	%	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_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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**

AEZ: LH 1-2

Survey Area 01

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

KISII DISTRICT

TABLE 10 b: **CROPPING PATTERN**

AEZ: UM 1

Survey Area 02

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	0.7	0.8	1.20	0.40	22.5	65.1
Maize & Others	0.0	0.0	0.00	0.00	0.0	0.1
Total					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	0.1	0.5	0.08	0.00	3.8	14.2
Pyrethrum	0.1	0.2	0.04	0.00	1.6	6.1
Pineapples	0.0	0.1	0.00	0.00	0.1	0.3
Maize & Beans	0.4	0.9	0.80	0.00	11.9	44.5
Maize & Others	0.0	0.0	0.00	0.00	0.0	0.1
Total					26.7	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	0.2	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 O = 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

KISII DISTRICT

TABLE 11 a: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: LH 1–2 — in Head and Livestock Units — Oct. '77, Survey Area 01

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 Units										
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	3.9
	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										

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 11 b: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: UM 1 — in Head and Livestock Units — Oct. '77, Survey Area 02

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			0.01
	Upper Qu.	-	-	-	-				-			-
1 - 2 years,	Average	0.03	0.03	-	-				0.03			0.03
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	-	-	0.10		0.13			0.21			0.21
	Upper Qu.	-	-	-		-			-			-
Subtotal(improved)	Total	1	1	3	1	4			7.7			7.7
	Average	0.03	0.03	0.10	0.03	0.13			0.25			0.25
	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		0.30	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	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	1.33	0.73	2.37	-	13.43	2.37
	Upper Qu.	1	-	2	1	2	2	1	3.2	-	18	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 =		8.7 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	24	5	28	25	51	40	22	78.8	-	403	78.8
	Average	0.80	0.17	0.93	0.83	1.70	1.33	0.73	2.62	-	13.43	2.62
	Upper Qu.	1	-	2	1	2	2	1	3.4	-	18	3.2
	Lower Qu.	-	-	-	-	1	-	-	0.9	-	5	0.9
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										

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

KISII DISTRICT

TABLE 12 a: **INPUTS AND YIELDS OF MAJOR CROPS**

AEZ: LH 1–2 Survey Area 01

Crop		Inputs							Yield
		Improved Seeds %	Nutrients N kg/ha	P_2O_5 kg/ha	K_2O kg/ha	Manure t/ha	Chemicals Insec. kg/ha	Fungicide kg/ha	kg/ha
First Rains									
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
Maize & Beans									
Maize	Avg.	92	-	26	-	0.01	-	-	2,448
Beans	Avg.	-	-	32	-	0.01	-	-	521
Maize	UpQu	100	-	46	-	-	-	-	2,250
Beans	UpQu	-	-	-	-	-	-	-	400
Maize	LoQu	100	-	-	-	-	-	-	1,350
Beans	LoQu	-	-	-	-	-	-	-	113
Second Rains									
Maize	Avg.	100	-	18	-	-	-	-	2,250
Beans	Avg.	-	3	2	1	-	-	-	640
	UpQu	-	-	-	-	-	-	-	700
	LoQu	-	-	-	-	-	-	-	250
Maize & Beans									
Maize	Avg.	100	-	14	-	0.25	-	-	2,250
Beans	Avg.	-	-	-	-	-	-	-	300
Perennial Crops									
Sugarcane	Avg.	-	-	-	-	-	-	-	4,000
Pyrethrum	Avg.	-	-	-	-	-	-	-	1,614
	UpQu	-	-	-	-	-	-	-	1,500
	LoQu	-	-	-	-	-	-	-	500
Tea	Avg.	-	43	18	6	-	-	-	5,140
	UpQu	-	54	-	6	-	-	-	6,905
	LoQu	-	-	-	-	-	-	-	1,410

KISII DISTRICT

TABLE 12 b: **INPUTS AND YIELDS OF MAJOR CROPS**

AEZ: UM 1

Survey Area 01

Crop		Inputs							Yield
		Improved Seeds	Nutrients				Chemicals		
			N	P_2O_5	K_2O	Manure	Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
Maize	Avg.	80	-	17	-	0.08	-	-	2,603
	UpQu	100	-	-	-	-	-	-	4,163
	LoQu	-	-	-	-	-	-	-	750
Fingermillet	Avg.	-	-	-	-	-	-	-	1,450
Maize & Beans									
Maize	Avg.	92	4	10	-	0.19	-	-	2,445
Beans	Avg.	4	-	6	-	0.08	-	-	759
Maize	UpQu	100	-	29	-	0.25	-	-	3,150
Beans	UpQu	-	-	12	-	-	-	-	1,000
Maize	LoQu	100	-	-	-	-	-	-	1,688
Beans	LoQu	-	-	-	-	-	-	-	400
Second Rains									
Maize	Avg.	75	-	22	-	-	-	-	3,231
	UpQu	100	-	-	-	-	-	-	4,050
	LoQu	-	-	-	-	-	-	-	1,000
Beans	Avg.	-	-	-	-	-	-	-	875
	UpQu	-	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	450
Maize & Beans									
Maize	Avg.	93	5	17	-	0.04	-	-	2,181
Beans	Avg.	7	-	6	-	-	1	1	525
Maize	UpQu	100	-	39	-	-	-	-	3,308
Beans	UpQu	-	-	-	-	-	-	-	800
Maize	LoQu	100	-	-	-	-	-	-	1,125
Beans	LoQu	-	-	-	-	-	-	-	300
Perennial Crops									
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

TABLE 13 a: **DISPOSAL OF CROPS**

AEZ: LH 1–2

Survey Area 01

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	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	400	36	700	64
			Permanent Crops				
Tea	2,000	2,000	100	0	0	0	0

KISII DISTRICT

TABLE 13 b: **DISPOSAL OF CROPS**

AEZ: UM 1

Survey Area 02

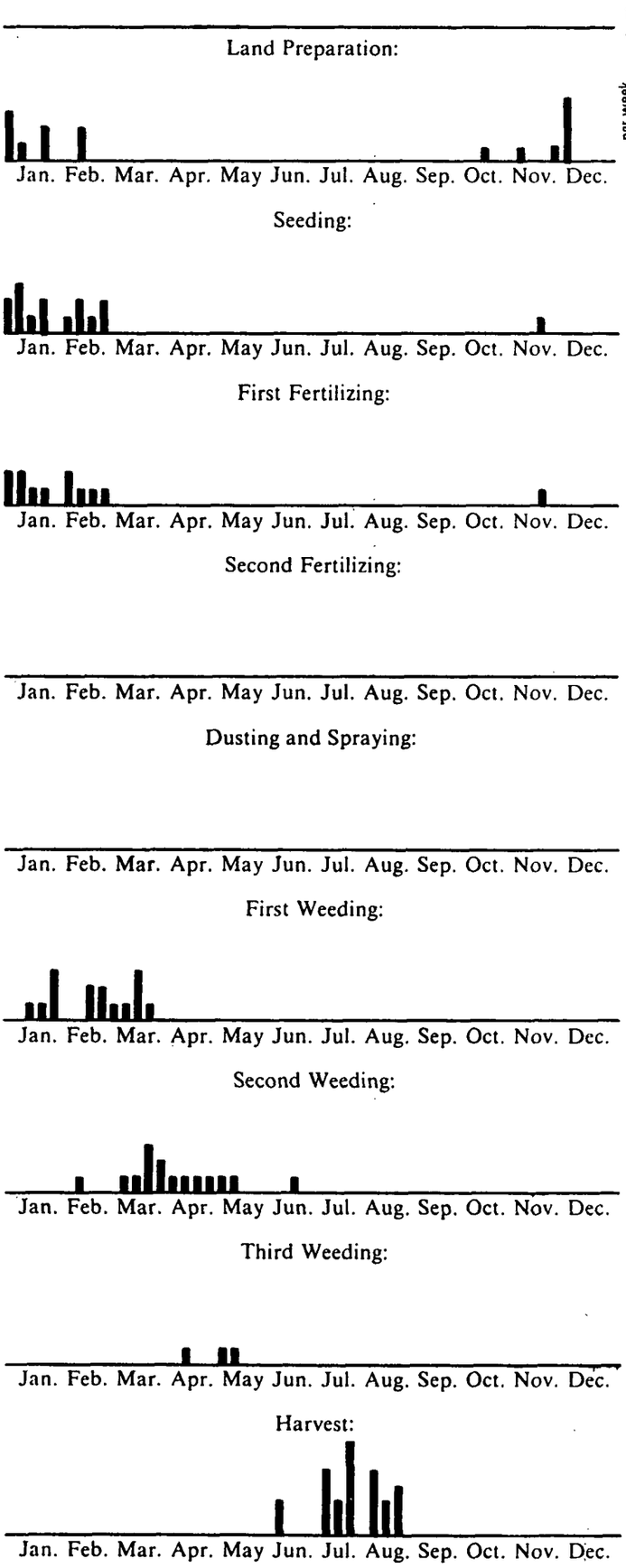
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	8,730	2,700	31	14,400	165	-8,370	-96
Maize & Beans	71,503	9,680	14	24,055	34	37,768	53
Maize & Others	193	0	0	0	0	193	100
Beans	160	0	0	0	0	160	100
Fingermillet	630	90	14	75	12	465	74
Sweet Potatoes	1,080	0	0	120	11	960	89
Second Rains							
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
Fingermillet	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
Permanent Crops							
Tea	400	400	100	0	0	0	0
Cookng 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

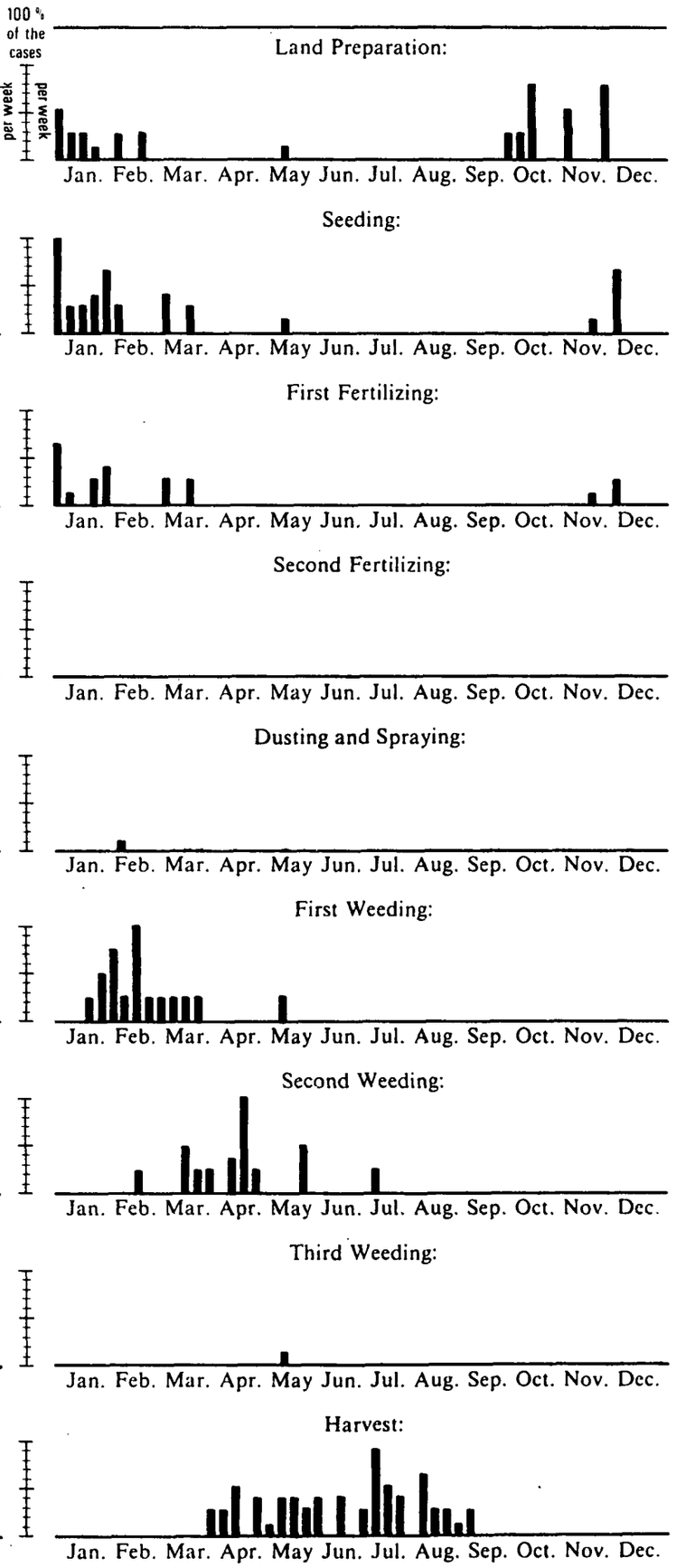


KISII DISTRICT

TABLE 14 b: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 34

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

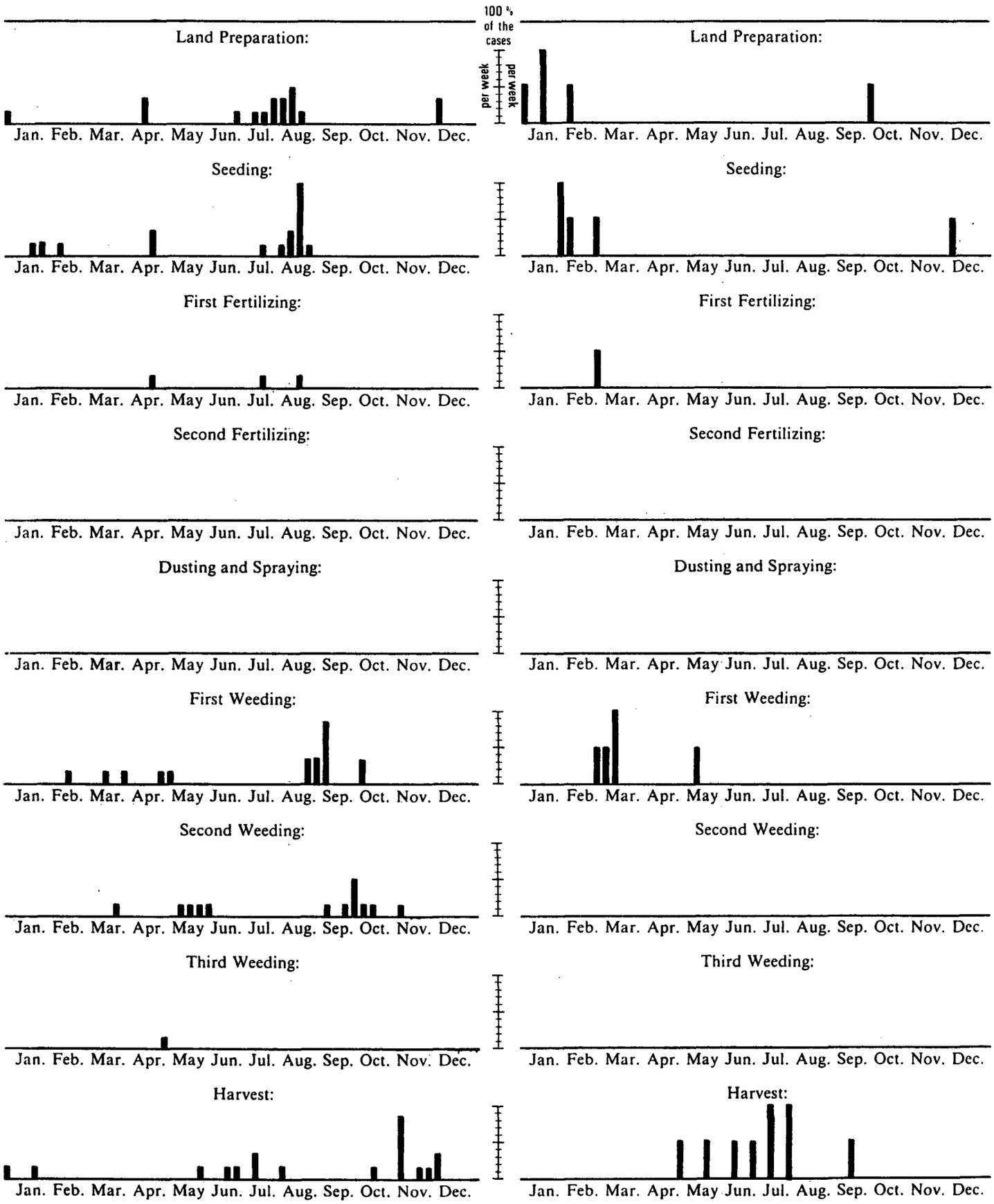


KISII DISTRICT

TABLE 14 c: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 10 **Beans** Cases: 16

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



KISII DISTRICT

TABLE 14 d: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 12 **Fingermillet** Cases: 5

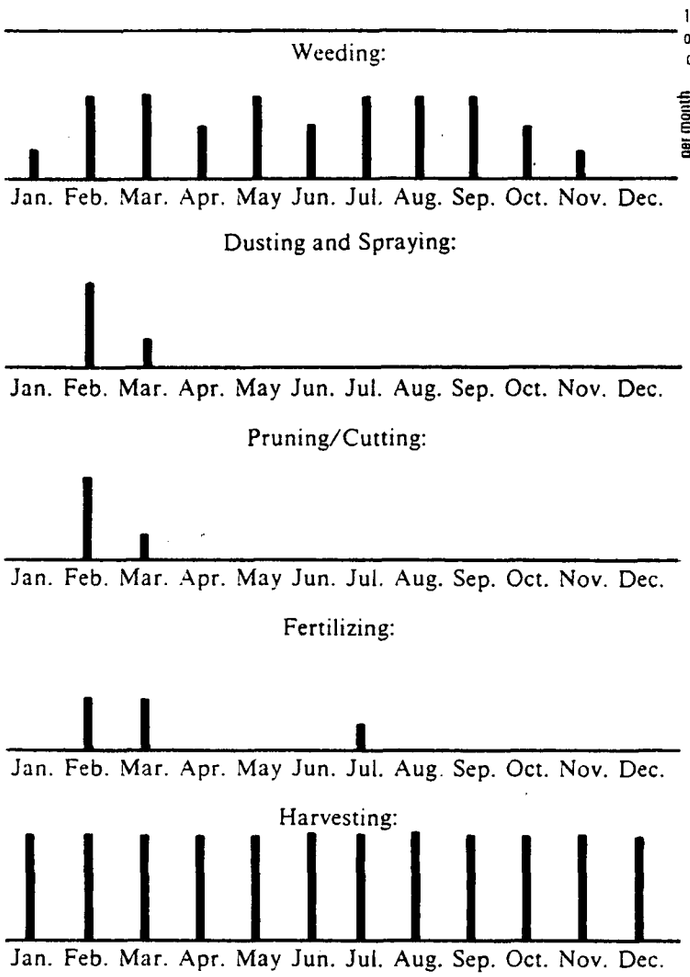
AEZ: LH 1–2 Survey Area 01 Sample Size: 30

KISII DISTRICT

TABLE 14 e: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 50 **Tea** Cases: 4

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



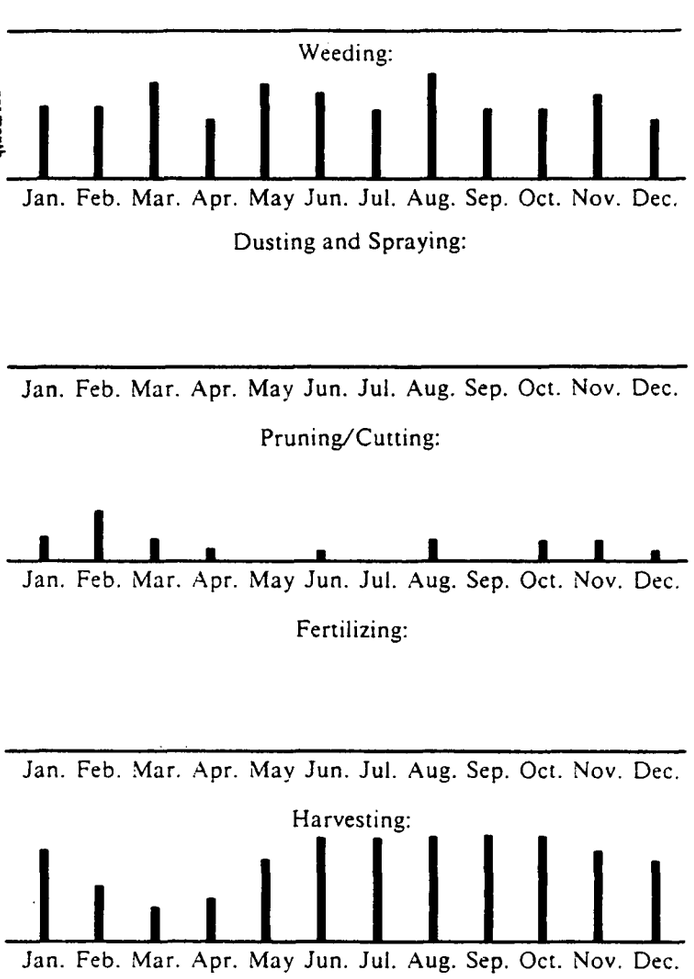
100 % of the cases per month per month

KISII DISTRICT

TABLE 14 f: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 52 **Pyrethrum** Cases: 10

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

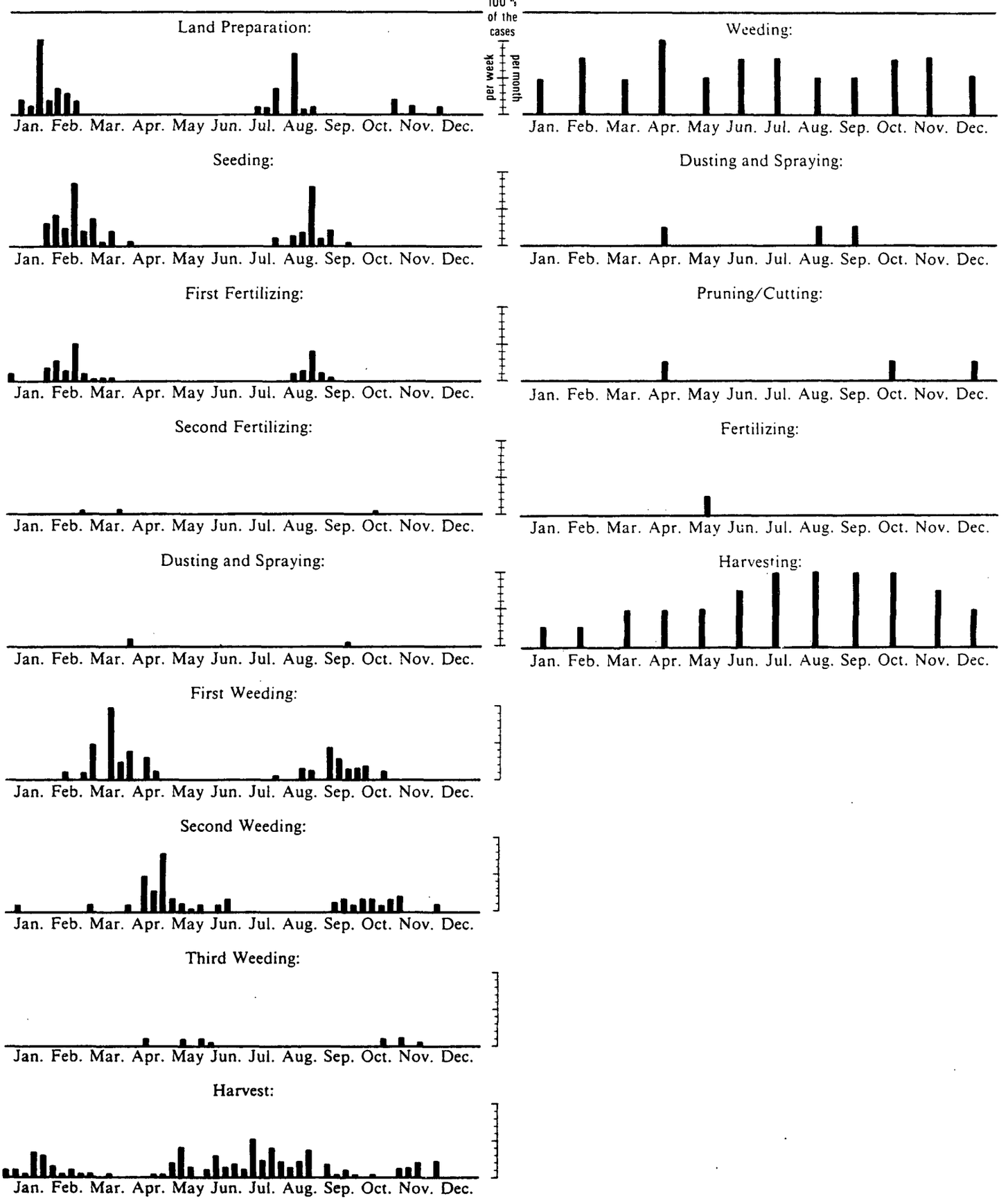


KISII DISTRICT

TABLE 14 g: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 60 [1]

AEZ: UM 1 Survey Area 02 Sample Size: 30



[1] Maximum 30 per crop and season

KISII DISTRICT

TABLE 14 h: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 50 **Tea** Cases: 4

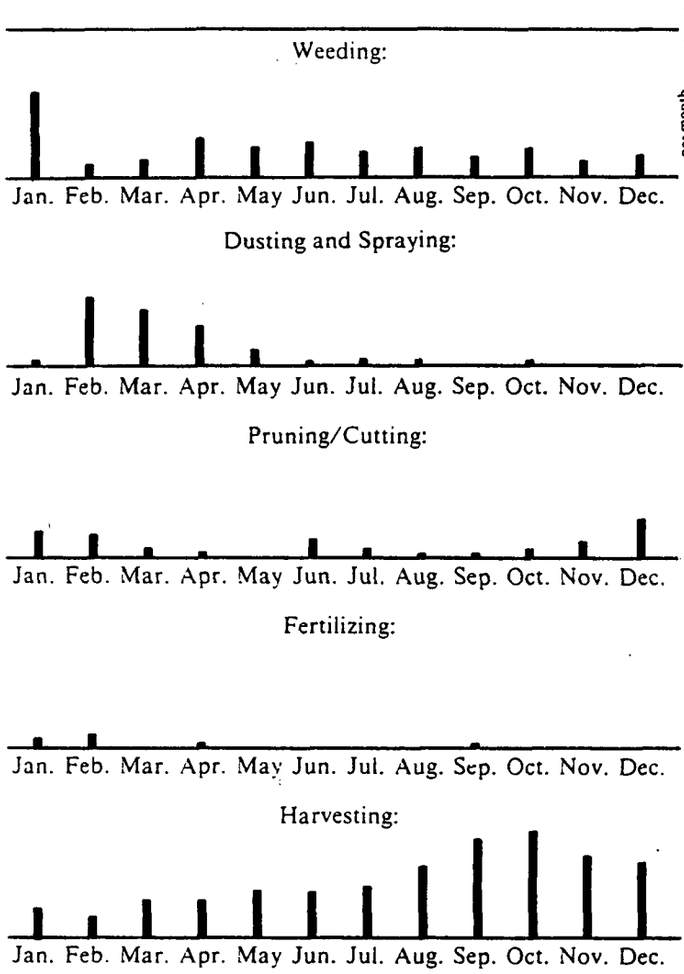
AEZ: UM 1 Survey Area 02 Sample Size: 30

KISII DISTRICT

TABLE 14 i: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 51 **Coffee** Cases: 26

AEZ: UM 1 Survey Area 02 Sample Size: 30

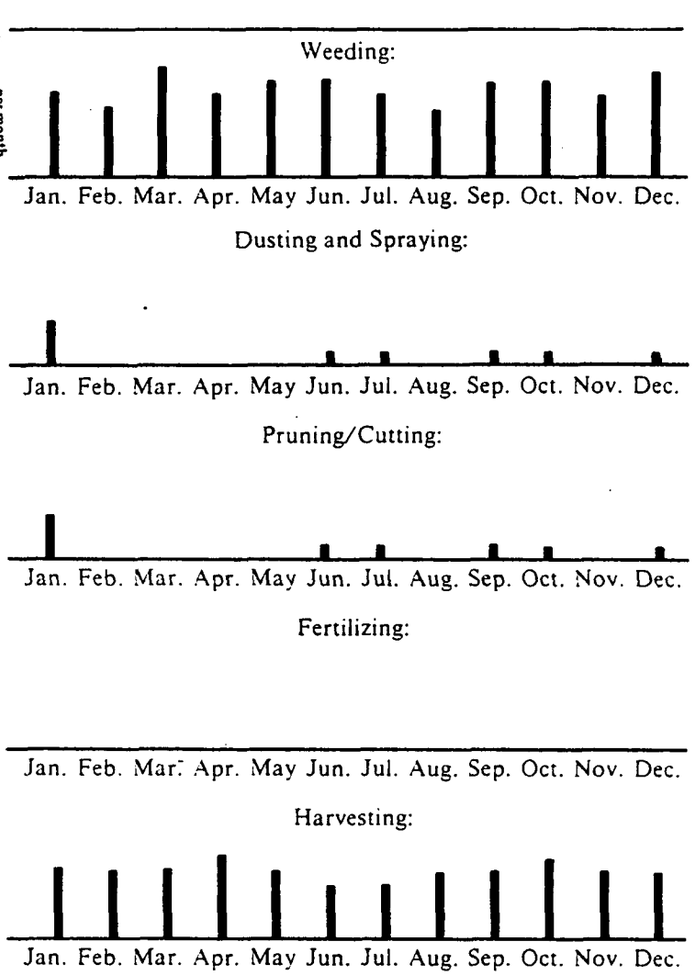


KISII DISTRICT

TABLE 14 j: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 52 **Pyrethrum** Cases: 8

AEZ: UM 1 Survey Area 02 Sample Size: 30



KISII DISTRICT

TABLE 14 k: **DISTRIBUTION OF FARMING ACTIVITIES**
Crop 56 **Cooking Bananas** Cases: 16

AEZ: UM 1 Survey Area 02 Sample Size: 30

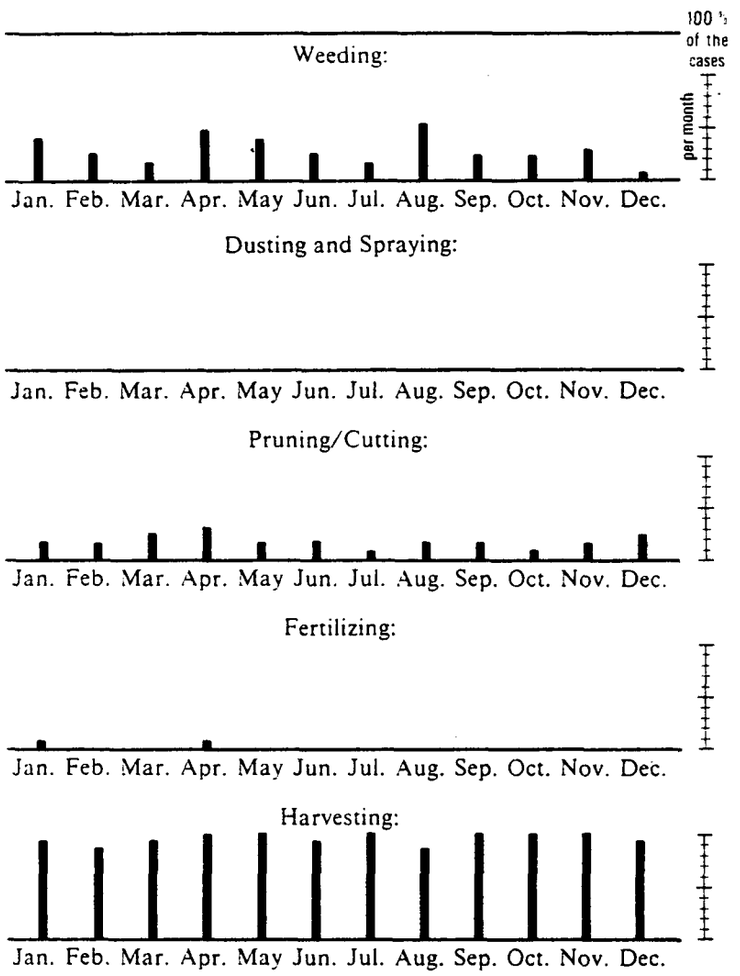


TABLE 15 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES

OUTPUT AND NUTRIENT INPUT

		A.E.Z.: LH 1 TEA-DAIRY ZONE				A.E.Z.: LH 2 WHEAT/MAIZE-PYRETHRUM ZONE						
		Vegt. Period 1st + 2nd: p or l–m		2nd:	total:	vl i or l–(m)i		13o-14o	33o-34o			
		in Days 1st: 215 or more		150	(365)	200 or more						
		Soil: NITOSOLS				NITOSOLS						
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: N. PASTURE/LEYS													
Farmers in Production Level	%												
Yields TDN	kg	3,300			8,000	2,700			5,400				
Fertilizer N	kg				261				150				
P_2O_5	kg				130				75				
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	4,500			10,000	4,100			8,700				
Fertilizer N	kg				305				255				
P_2O_5	kg				152				127				
K_2O													
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	2,500	3,500	5,000	10,000	2,500	1,400	5,000	7,000				
Fertilizer N	kg		33	83	300			83	180				
P_2O_5	kg		6	17	60			17	36				
K_2O	kg		6	17	60			17	36				
CROP: PYRETHRUM													
Farmers in Production Level	%												
Yields	kg					600	500	800	1,300				
Fertilizer N	kg							5	18				
P_2O_5	kg							7	27				
K_2O	kg												
CROP: PASSION FRUIT													
Farmers in Production Level	%												
Yields	kg	3,600	-	10,000	16,000								
Fertilizer N	kg			102	198								
P_2O_5	kg			134	260								
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	2,500	1,700	4,000	5,500	2,200	2,000	4,000	6,000				
Fertilizer N	kg			38	75			45	95				
P_2O_5	kg			36	72			43	91				
K_2O	kg												

TABLE 15 b: **PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES**

OUTPUT AND NUTRIENT INPUT

	A.E.Z.: LH 1 TEA-DAIRY ZONE					A.E.Z.: LH 2 WHEAT/MAIZE-PYRETHRUM ZONE						
	Vegt. Period 1st + 2nd: p or l¬m in Days, 1st: 215 or more.		2nd: 150	total: (365)		vl i or l¬(m)i 200 or more		13o-14o	33o-34o			
	Soil:		NITOSOLS			NITOSOLS						
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level 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	-				
P_2O_5	kg			45				50	-				
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg					1,200	400	1,000	1,100				
Fertilizer N	kg								-				
P_2O_5	kg								-				
K_2O									-				
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg					1,000	400	1,000	2,000				
Fertilizer N	kg								34				
P_2O_5	kg								28				
K_2O	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				
P_2O_5	kg		7	70	208		23	86	302				
K_2O	kg												
CROP: SUKUMAWIKI													
Farmers in Production Level	%												
Yields	kg					4,000	5,000	10,000	35,000				
Fertilizer N	kg						7	42	217				
P_2O_5	kg						6	36	186				
K_2O	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				
P_2O_5	kg		9	63	237		6	84	216				
K_2O	kg												

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

OUTPUT AND NUTRIENT INPUT

	A.E.Z.: UM 1 COFFEE-TEA ZONE					A.E.Z.: UM 2-3 COFFEE ZONE						
	Vegt. Period 1st + 2nd: p or l-m in Days, 1st: 215 or more			2nd: 150	total: (365)	vl i or l/m-mi 180 or more		110-130	290-310			
	Soil: NITOSOLS					NITOSOLS						
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NAT. PASTURE/LEYS													
Farmers in Production Level	%												
Yields	kg	3,000			6,000								
Fertilizer N	kg				166								
P_2O_5	kg				83								
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	6,000			14,000								
Fertilizer N	kg				444								
P_2O_5	kg				222								
K_2O													
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	2,500	3,000	5,000	8,500								
Fertilizer N	kg		16	83	240								
P_2O_5	kg		3	16	48								
K_2O	kg		3	16	48								
CROP: COFFEE ARABICA													
Farmers in Production Level	%												
Yields	kg		600	800	1,100		600	1,000	1,400				
Fertilizer N	kg		60	80	110		60	100	140				
P_2O_5	kg		90	90	100		90	90	100				
K_2O	kg												
CROP: PASSION FRUIT													
Farmers in Production Level	%												
Yields	kg	3,600		14,000	21,000								
Fertilizer N	kg			146	244								
P_2O_5	kg			218	365								
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	9,000	9,500	21,500	32,500								
Fertilizer N	kg		8	188	353								
P_2O_5	kg		3	75	141								
K_2O	kg												

TABLE 15 d: **PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES**

OUTPUT AND NUTRIENT INPUT

	A.E.Z.: UM 1 COFFEE-TEA ZONE											
	Vegt. Period 1st + 2nd: p or l-m in Days 1st: 215 or more		2nd: 150	total: (365)								
	Soil:	NITOSOLS										
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	2,500	2,000	3,500	6,000								
Fertilizer N	kg			25	88								
P_2O_5	kg			24	84								
K_2O	kg												
CROP: FINGER MILLET													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O													
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg	2,500	2,500/400	2,800/400	4,000/400								
Fertilizer N	kg			31	94								
P_2O_5	kg			28	88								
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	1,100	400	800	1,800								
Fertilizer N	kg				24								
P_2O_5	kg				29								
K_2O	kg												
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	1,500	875	1,400	2,250								
Fertilizer N	kg				30								
P_2O_5	kg				25								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

KISII DISTRICT

TABLE 15 e: **PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES**

OUTPUT AND NUTRIENT INPUT

	A.E.Z.: UM 1 COFFEE-TEA ZONE												
	Vegt. Period 1st + 2nd: p or l⌐m in Days 1st: 215 or more			2nd: 15o	total: (365)								
	Soil: NITOSOLS												
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: POTATOES													
Farmers in Production Level	%												
Yields	kg	7,200	8,000	12,000	25,000								
Fertilizer N	kg		6	38	143								
P_2O_5	kg		7	43	160								
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	9,000	8,000	16,000	35,000								
Fertilizer N	kg			56	208								
P_2O_5	kg			42	156								
K_2O													
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	4,500	3,000	10,000	35,000								
Fertilizer N	kg			39	214								
P_2O_5	kg			33	183								
K_2O	kg												
CROP: SUKUMAWIKI													
Farmers in Production Level	%												
Yields	kg	4,500	5,000	10,000	30,000								
Fertilizer N	kg		4	39	179								
P_2O_5	kg		3	33	153								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	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 page81) are tremendous: Annual averages between 700 and 1 800 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 altidude	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	Kamagambo	36	Average	1 600	57	101	148	236	206	123	82	113	128	126	165	115
1 523 m			60% prob.[1]	1 350	46	64	131	197	124	85	56	75	105	109	135	90
9034006	Asumbi	37	Average	1 629	58	106	161	217	214	96	74	118	147	141	183	114
1 422 m			60%	1 460	50	55	145	198	186	80	50	100	102	126	138	89
9034041	Marinde	30	Average	1 776	59	56	149	288	266	117	77	124	140	191	172	137
1 370 m			60%	1 481	24	31	100	235	229	82	52	64	139	130	94	67
9034045	Kosele	29	Average	1 133	43	68	112	192	181	81	58	88	94	71	62	84
1 370 m			60%	1 020	14	74	99	160	121	42	53	65	62	70	50	39
9034047	Uriri	24	Average	1 367	66	73	192	217	179	90	52	81	97	127	141	111
1 493 m			60%	1 228	40	62	131	214	111	71	25	56	77	99	120	74
9034049	Mbeta Agr. Holding	23	Average	931	28	57	113	167	123	53	39	43	35	68	112	94
1 309 m			60%	841	10	50	69	142	102	32	24	42	22	41	56	33
9034059	Macalder-Nyanza	14	Average	1 116	39	92	122	201	142	64	37	42	56	89	148	84
1 218 m	Mines		60%	1 000	21	51	98	165	123	50	31	35	43	63	109	67
9034063	Lambwe Valley	23	Average	1 327	59	65	141	238	185	69	67	61	101	129	143	71
1 218 m			60%	1 201	34	50	116	179	140	50	51	38	62	108	102	50
9034073	Chief's Camp	17	Average	1 653	37	89	163	277	187	85	43	80	152	197	243	100
1 309 m			60%	1 223	5	19	79	187	126	54	23	57	76	98	169	61
9134009	Hydromet. Station	22	Average	813	48	59	104	142	121	47	20	28	22	56	92	74
1 218 m			60%	709	24	33	90	128	92	39	13	17	15	47	61	53
9134010	Migori, Agr. Office	28	Average	1 371	55	87	122	245	195	89	35	59	93	125	148	119
1 370 m			60%	1 228	40	64	85	169	132	60	17	61	93	91	109	89
9134012	Tarananya School	12	Average	1 414	78	92	188	187	181	88	43	64	97	116	143	138
1 523 m																

[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 Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Y. of rec.
9034059	Macalder Nyanza	LM	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	
1 218 m	Mines	3	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	15
			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	Homa Bay, D.C.	LM	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	
1 218 m		3	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	4
			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**

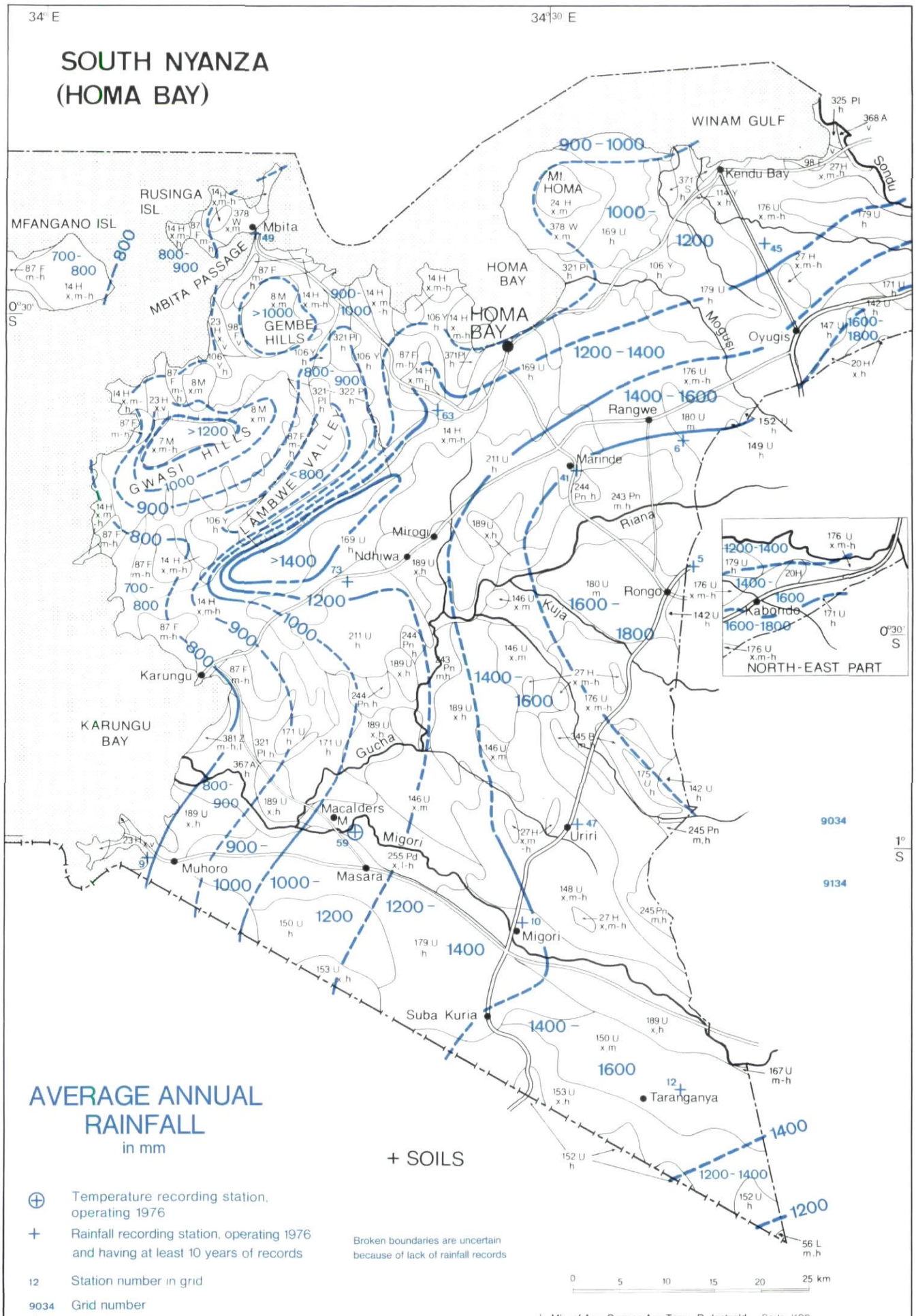
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1]		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains[2] in days	2nd rains in days	Total[3] in days
UM 1 Coffee-Tea Zone	p or l ⌐ m	1 500–1 600[4]	20.5°–19.9°	1 600–1 800	850–1 000	500–700	215 or more	about 150	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	120–140	310–330
							180 or more	115–130	295–310
UM 3 (Marginal Coffee Zone)	Steep	slopes,	unsuitable for cultivation						
UM 3–4 Coffee to Sun-flower-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	110–120	280–290
				> 1 400	600–700	300–400	135–155	85–105	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 165	365
							190 or more	140–165	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	

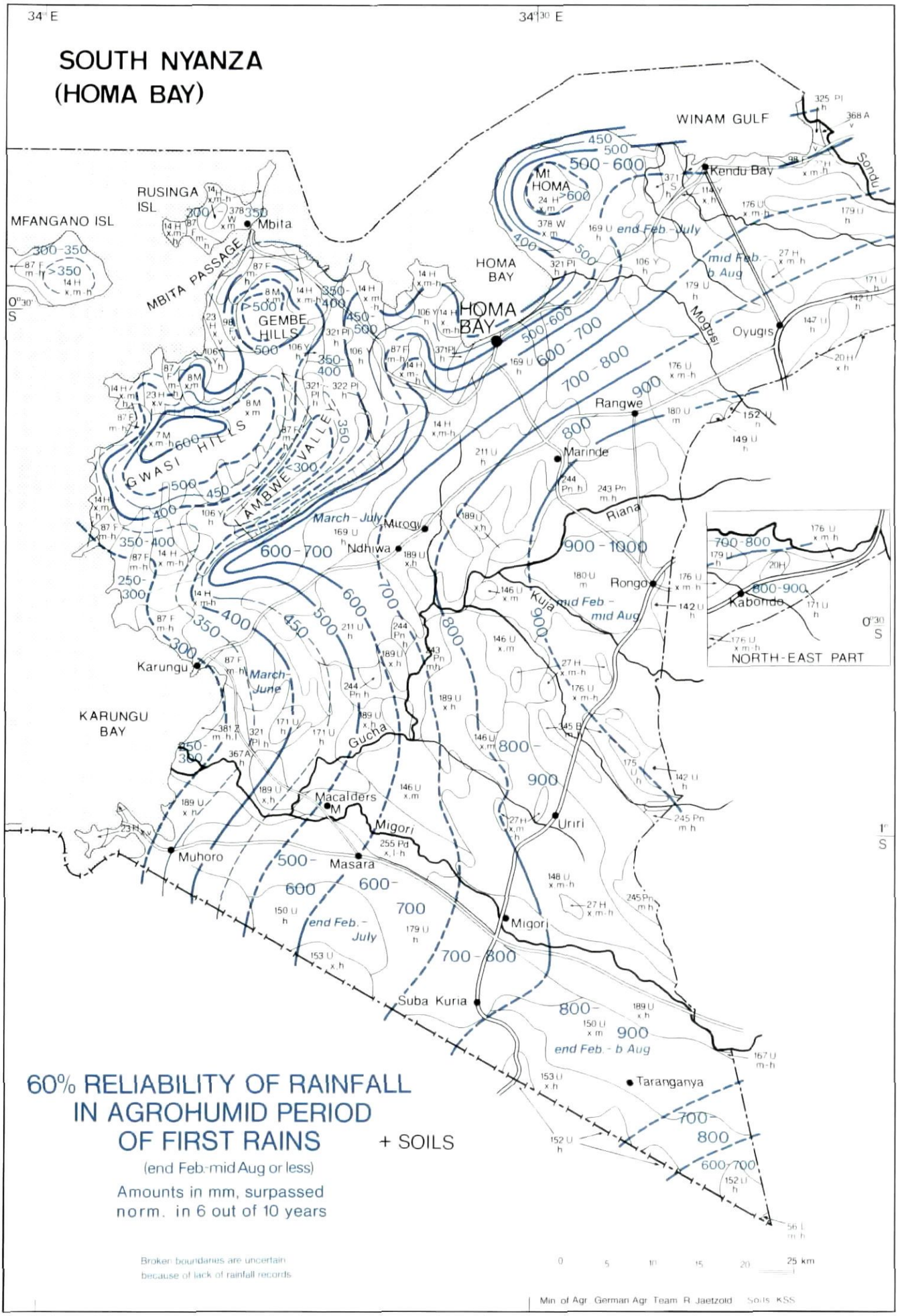
1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants.

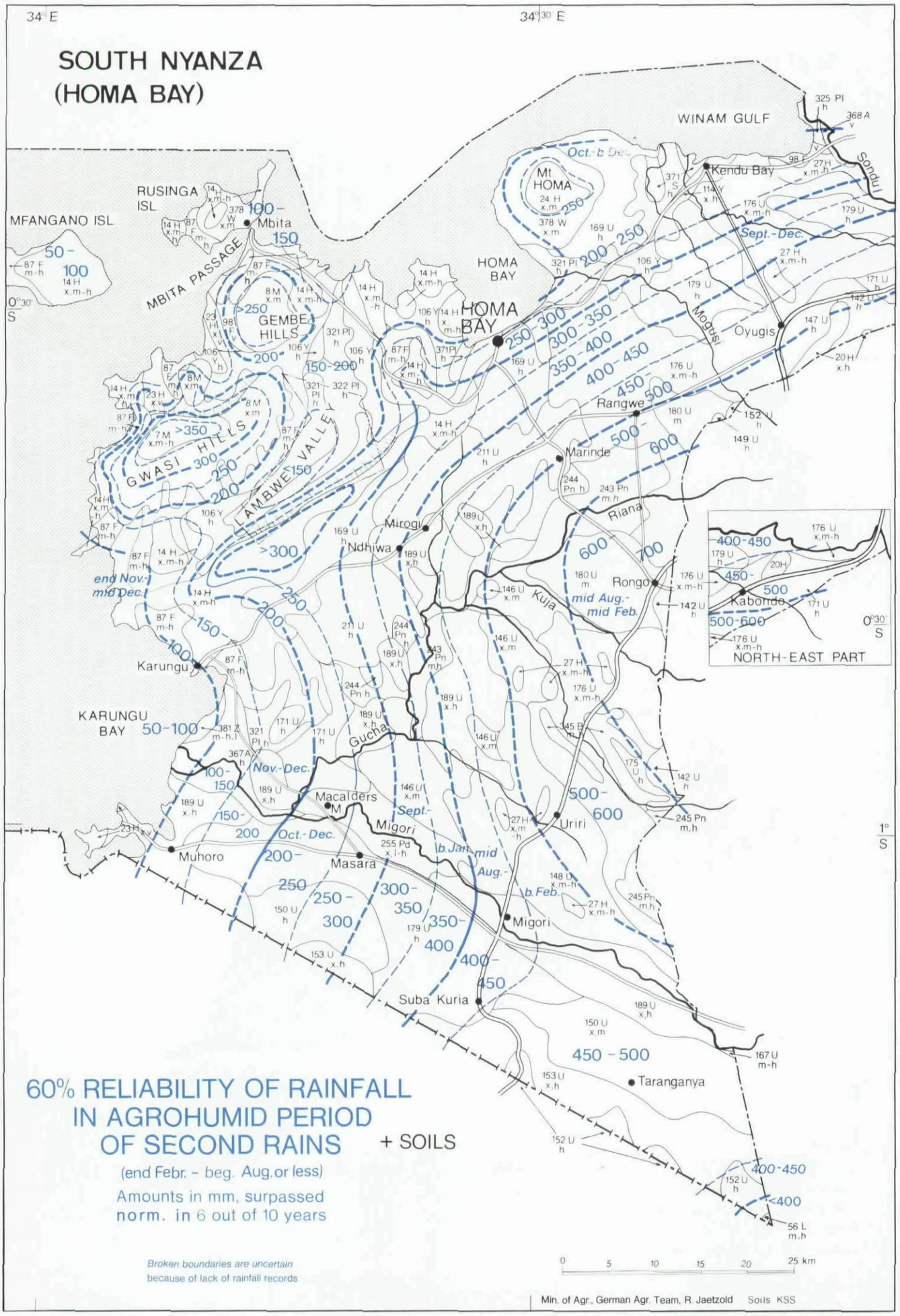
2) More if growing cycle of cultivated plants continues into the period of second rains

3) Only added if rainfall continues at least for survival (> 0.2 E_o) 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.


SOUTH NYANZA
(HOMA BAY)
34° E
34°30' E
WINAM GULF
Kendu Bay
Sondu
Mt. HOMA
RUSINGA ISL.
MFANGANO ISL
Mbita
MBITA PASSAGE
GEMBE HILLS
HOMA BAY
Oyugis
Mogusi
Rangwe
Marinde
GWASI HILLS
LAMBWE VALLEY
Mirogi
Ndhiwa
Riana
Rongo
Kabondo
Kuja
Karungu
KARUNGU BAY
Gucha
Macalders
Migori
Uriri
Muhoro
Masara
Suba Kuria
Taranganya
NORTH-EAST PART
0°30' S
1° S
9034
9134
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


34° E
34°30 E
SOUTH NYANZA
(HOMA BAY)
WINAM GULF
Kendu Bay
Sondu
Mt HOMA
RUSINGA ISL
MFANGANO ISL
Mbita
MBITA PASSAGE
HOMA BAY
HOMA BAY
GEMBE HILLS
Oyugis
Modusi
Rangwe
Marinde
GWASI HILLS
LAMBWE VALLEY
Riana
Mirogi
Ndhiwa
Rongo
Kuja
Kaborode
NORTH-EAST PART
Karungu
KARUNGU BAY
Gucha
Macalders M
Migori
Uriri
Muhoro
Masara
Migori
Suba Kuria
Taranganya
0°30' S
1° S
March - July
mid Feb - mid Aug
March - June
end Feb. - July
end Feb. - b Aug
mid Feb. - b Aug
60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF FIRST RAINS
+ SOILS
(end Feb.-mid Aug or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
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

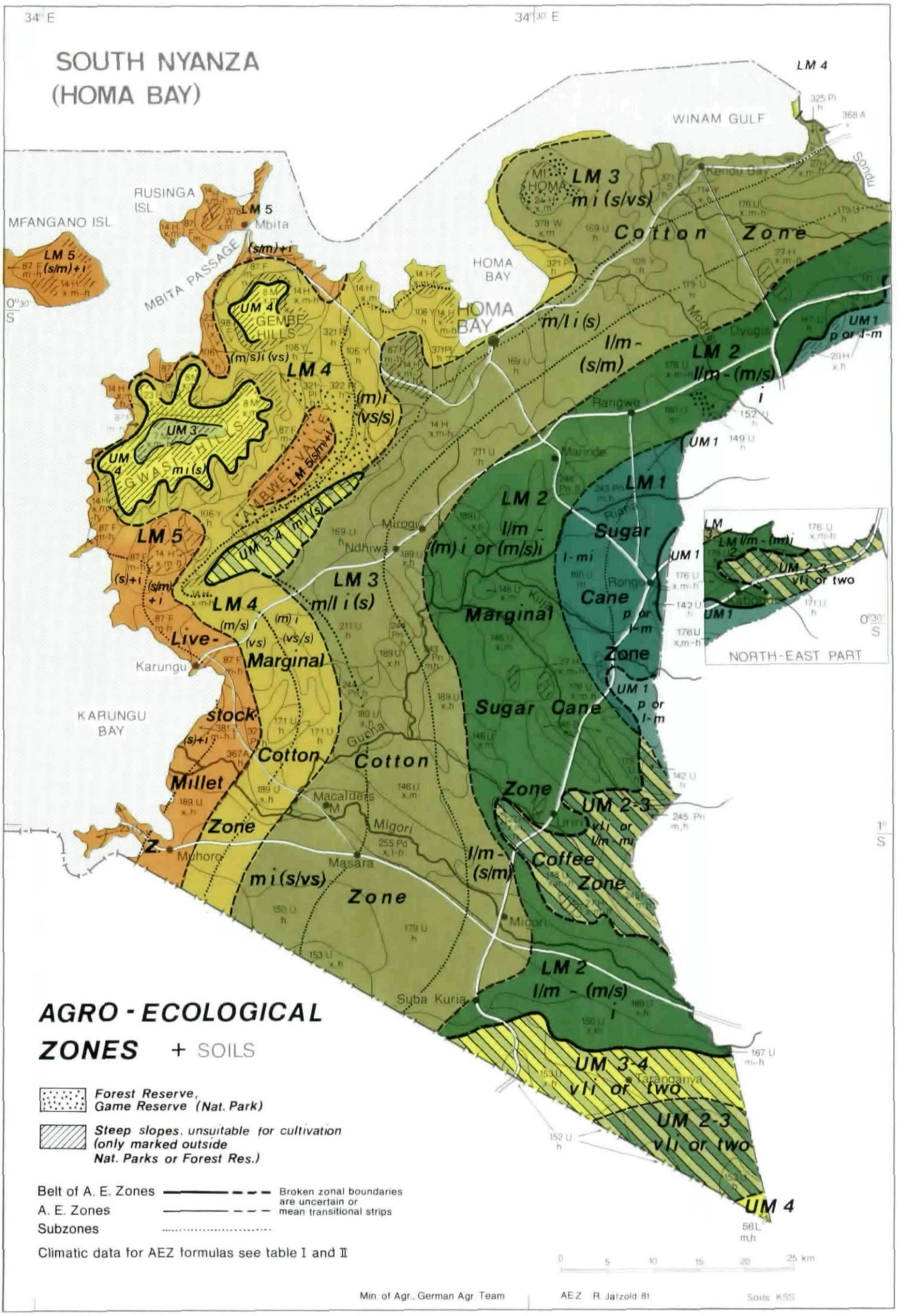


60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF SECOND RAINS + SOILS

(end Febr. - beg. Aug. or less)

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

Broken boundaries are uncertain because of lack of rainfall records


SOUTH NYANZA
(HOMA BAY)
34° E
34°30' E
0°30' S
1° S
WINAM GULF
RUSINGA ISL
MFANGANO ISL
MBITA PASSAGE
Mbita
HOMA BAY
GEMBE HILLS
GWASI HILLS
LAMBWE VALLEY
KARUNGU BAY
Karungu
Mirogi
Ndhiwa
Rangwe
Marinde
Kendu Bay
Sondu
Dyugis
Rongo
Kabondo
Uriri
Macalders
Migori
Masara
Muhoro
Suba Kuria
Taranganya
Cotton Zone
Sugar Cane Zone
Marginal Sugar Cane Zone
Coffee Zone
Live-stock Millet Zone
Marginal Cotton Zone
Cotton Zone
LM 1
LM 2
LM 3
LM 4
LM 5
UM 1
UM 2-3
UM 3-4
UM 4
NORTH-EAST PART
AGRO - ECOLOGICAL ZONES + SOILS
Forest Reserve, Game Reserve (Nat. Park)
Steep slopes, unsuitable for cultivation (only marked outside Nat. Parks or Forest Res.)
Belt of A. E. Zones
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team
AEZ R. Jatzold 81
Soils: KSS

AGRO-ECOLOGICAL ZONES

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

Very small, potential see Kisii District

UM 2 = Coffee Zone[1)]

UM 2 vl i or l/m⌐m i = Coffee Zone with a very long cropping season and intermediate rains, dividable in a long to medium cropping season 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 , avocadoes, 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 Coffee[1)], 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 Zone[1)]

UM 3 vl i or two = Marginal Coffee Zone with a very long cropping season and intermediate rains, 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. beans[2)], 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), avocadoes, citrus[3)], 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 mi(s) = Sunflower-Maize Zone with a medium cropping season, 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 vlei 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 p or l⌒m/l = Lower Midland Sugar Cane Zone with permanent cropping possibilities, dividable in a long cropping season 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. beans[2]; 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; beans[2]; 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, avocadoes, 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, mangoes[4], citrus[4]

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*
l⌒m i *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], avocadoes

Fair yield potential

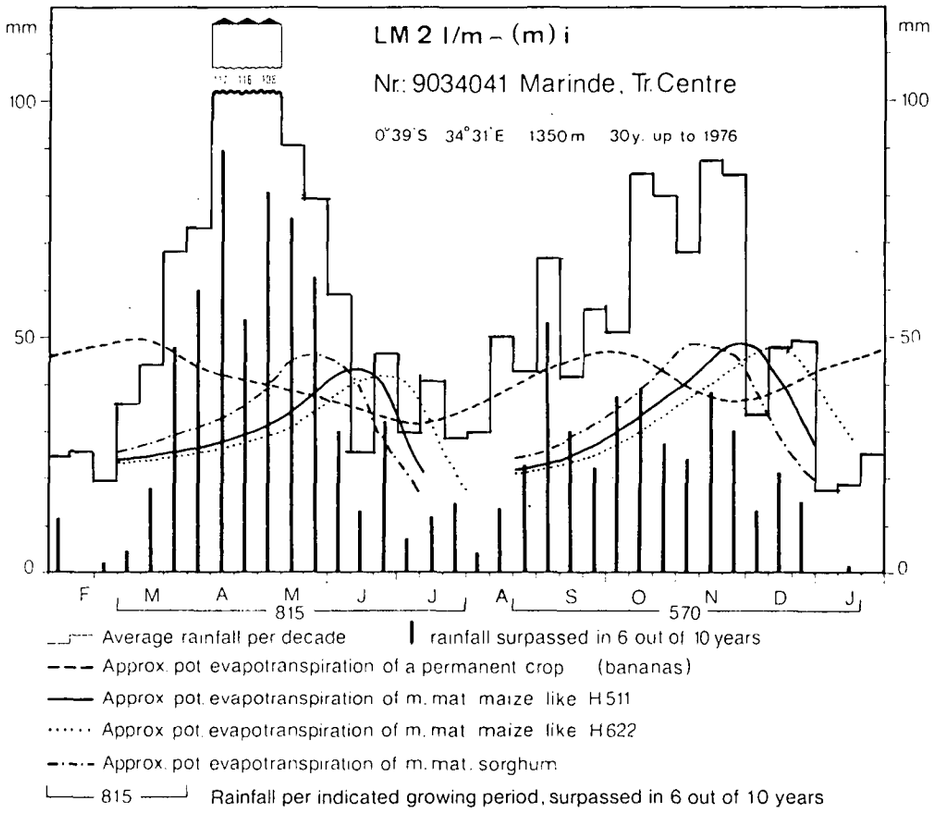
2nd rains: Maize H 622, 632, finger millet; late mat. groundnuts and late mat. bambarra groundnuts (both in light soils); cabbage

Whole year: Mangoes[4], taro, citrus[4]

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 l/m ⌐ (m) i or (m/s) i = Marginal Sugar Cane Zone with a long cropping season followed by a (weak) medium or medium to short one 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 var.); sweet potatoes; m. mat. 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 millet; beans, pigeon peas; late mat. groundnuts (rosette resistant); late mat. soya beans, m. mat. sunflower like H S 301 A; 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, yam beans, 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, danger of rain in open bolls); cabbages, kales, egg plants (to 2nd r.)
2nd rains: M. mat. sorghum, m. mat. maize (40–50 %), bulrush millet (awned var.); beans (higher places), cowpeas (lower places), bambarra groundnuts (in light soils); sweet potatoes (∿ 40 %); cotton (Jy.–F., relay planted in maize of first rains)
Whole year: Sugar cane, pineapples, sisal, citrus (low quality), mangoes[4]

Pasture and forage
0.6–1.0 ha/LU on sec. high grass savanna with Zebra grass (Hyparrhenia rufa) and Guinea grass (Panicum max.) 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 l/m ⌐ (s/m) = Lower Midland Cotton Zone 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, finger millet; late mat. groundnuts, m. mat. beans like Cuarentino, m. mat. cowpeas; sweet potatoes; cotton, m. 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 mwezi moja (∿ 40 %); sweet potatoes; m. mat. soya beans, e. mat. bambarra groundnuts (in light soils); dwarf sunflower
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 legumes like Townsville lucerne (Stylosanthes humilis) and Centro (Centrosema pubescens)

LM 3 m/l i (s) = Lower Midland Cotton Zone with a medium to long cropping season, 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. sorghum (70–80 %), e. mat. millets (70–80 %); m. mat. beans, green grams[5], cowpeas; groundnuts and bambarra gr. (both in light soils), simsim[5]; sweet pot.; cotton (∿ 60 %), m. mat. soya beans, m. mat. sunflower like Vympel or H S 301 A; tomatoes, onion; chick peas (on heavy black soils); dwarf castor[6]
2nd rains, start norm. Sept.: Ratoon of sorghum; simsim, 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. additional irrigation: Rice, bananas (on dams), Chinese cabbage (on ridges) 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

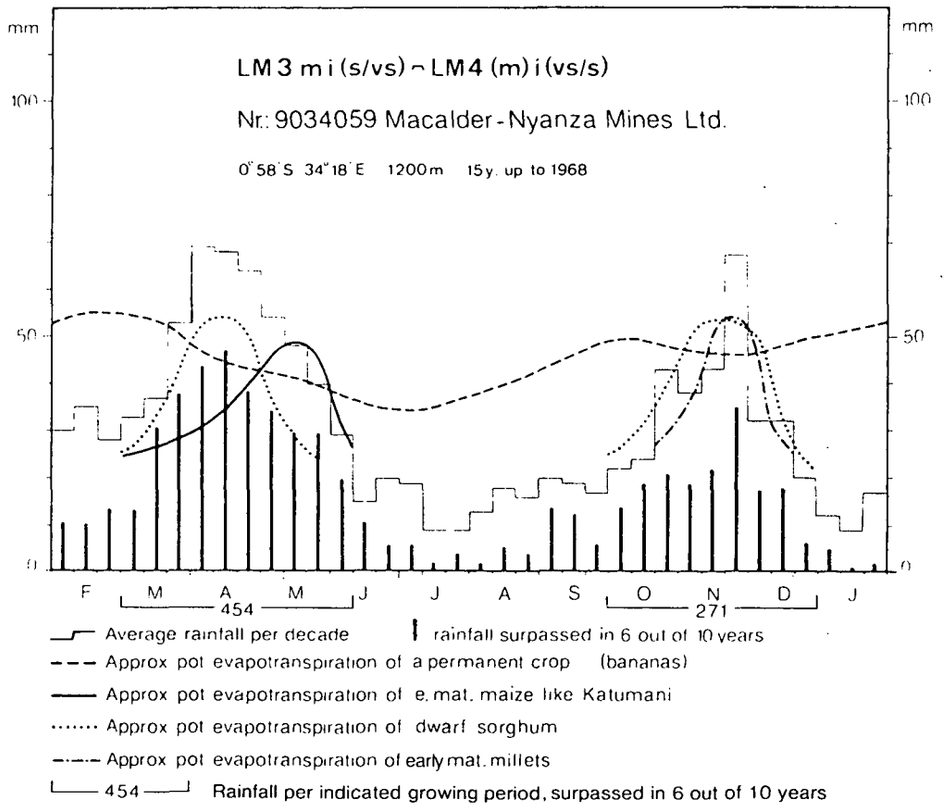
LM 3 m i (s/vs) = *Lower Midland Cotton Zone with a medium cropping season, intermediate rains, and a (weak) short to very short one* (see Diagram Macalder Ny. M.)

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, simsim; 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 againstStriga
7) Yield in kg/ha is higher than that of Katumani



LM 4 = *Marginal Cotton Zone*

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

(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 (70–80 %) 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 irrigable 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 tamarind (Leucaena leucocephala)

LM 4 (m/s) i (vs) = *Marginal Cotton Zone with a (weak) medium to short cropping season, 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 (s/m) + i = *Lower Midland Livestock-Millet Zone 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

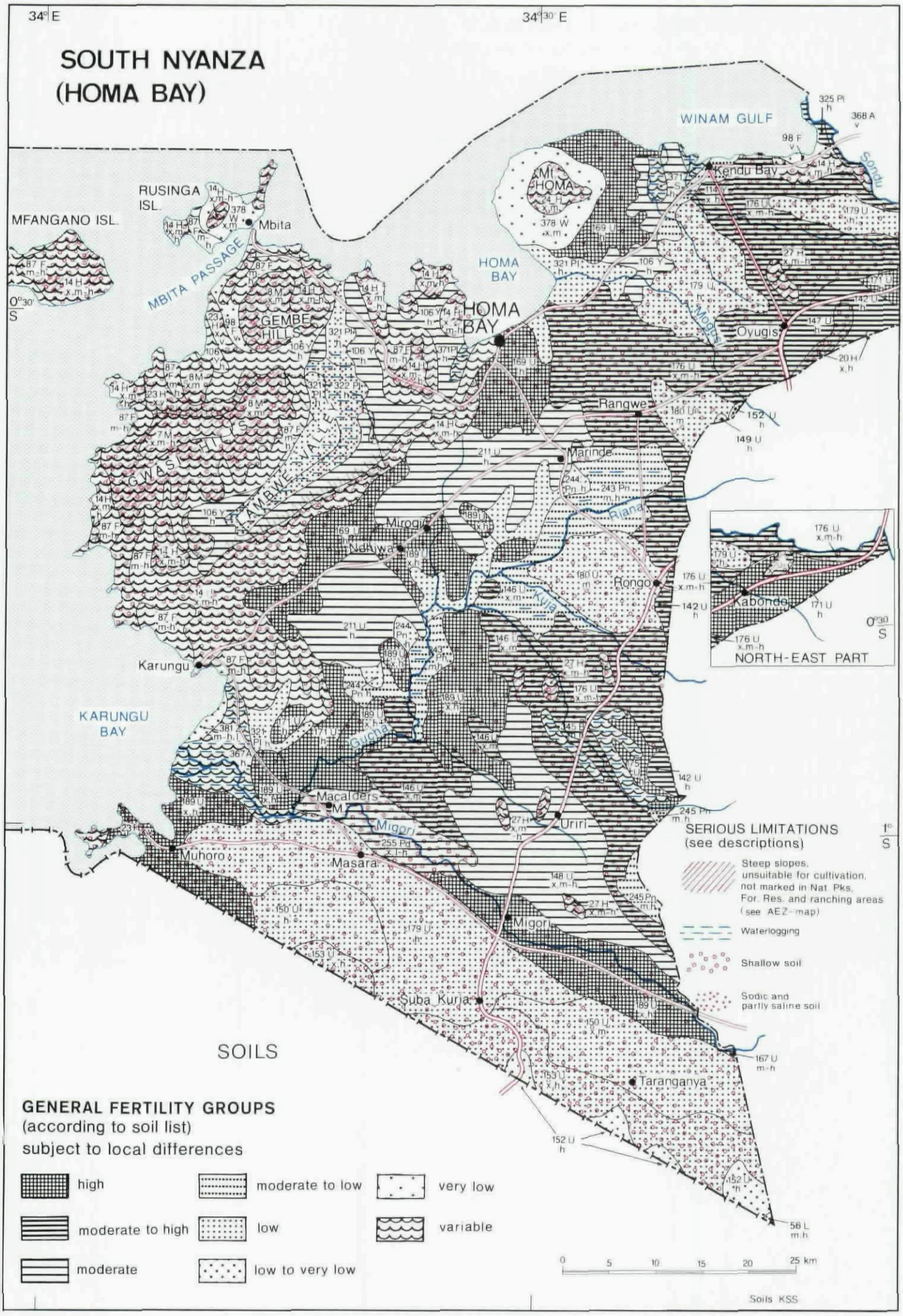
TABLE 4: **RISK OF TOTAL CROP FAILURE IN THE LIVESTOCK-MILLET ZONE LM 5 (s)+i**

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.


SOUTH NYANZA
(HOMA BAY)
34° E
34°30' E
WINAM GULF
Kendu Bay
Sondu
Mt. HOMA
HOMA BAY
RUSINGA ISL.
MFANGANO ISL.
Mbita
MBITA PASSAGE
GEMBE HILLS
Oyugis
Rangwe
Marinde
Mirogi
Ndiwa
Riana
Rongo
Kuja
Karungu
KARUNGU BAY
Gucha
Macalders
Migori
Uriri
Muhoro
Masara
Migori
Suba Kuria
Taranganya
Kabondo
NORTH-EAST PART
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (see AEZ-map)
Waterlogging
Shallow soil
Sodic and partly saline soil
SOILS
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
moderate to low
low
low to very low
very low
variable
0 5 10 15 20 25 km
Soils KSS

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 x, m-h[1)] = well drained, shallow to moderately deep, dark reddish brown to dark brown, rocky and bouldery, clay loam to clay; in places with humic topsoil (nito-chromic CAMBISOLS; with haplic PHAEOZEMS, lithic phase, LITHOSOLS, eutric REGOSOLS and Rock Outcrops)

8 M x,m = well drained, shallow, dark brown, firm, rocky and stony, clay loam (eutric REGOSOLS; with Rock Outcrops)

SOILS ON HILLS AND MINOR SCARPS

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

14 H x, m-h = complex of well drained to moderately well drained, shallow to moderately deep, dark brown, firm, stony, clay loam to clay; 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 x, h = somewhat excessively drained, shallow to moderately deep, dark reddish brown, friable, gravelly clay, with acid humic topsoil (humic CAMBISOLS, partly paralithic phase)

Soils developed on granites

23 H x, v = 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 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-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)

SOILS ON FOOTSLOPES

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

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

Soils developed on colluvium from undifferentiated Basement System rocks

98 F 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 PIEDMONT PLAINS

Soils developed on alluvium from Tertiary/Quaternary volcanic rocks (mainly basalts)

106 Y h = 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)

Soils developed on alluvium from volcanic ashes and other pyroclastic rocks of recent volcanoes

114 Y x, h = imperfectly drained, very deep, very dark grey to black, very firm, cracking, gravely clay to clay, with calcareous deeper subsoil; in places gravelly (verto-eutric PLANOSOLS)

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

Soils developed on intermediate igneous rocks (andesites, etc.)

146 U x, m = well drained, shallow to moderately deep, reddish brown to yellowish red, friable, gravelly sandy clay loam to clay loam, over soft rock (ferralic CAMBISOLS, paralithic phase)

Soils developed on acid igneous rocks (rhyolites, etc.)

147 U h = well drained, deep to extremely deep, reddish brown, friable clay, with humic topsoil (chromo-luvic PHAEOZEMS; with mollic NITOSOLS)

148 U x, m-h = 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)

Soils developed on granites

150 U x, m = imperfectly drained, moderately deep, brown to dark yellowish brown, mottled, friable, gravelly sandy clay loam, in places rocky and shallow (gleyic ACRISOLS, partly paralithic and rocky phase)

Soils developed on biotite/hornblende granites

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

153 U x, h = 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)

SOILS ON LOWER-LEVEL UPLANDS

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

169 U h = moderately well drained, shallow to moderately deep, dark brown, firm clay (verto-luvic PHAEOZEMS, lithic phase)

171 U h = 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)

Soils developed on acid igneous rocks

175 U h = well drained to moderately well drained, moderately deep to deep, reddish brown to dark grey, friable clay, with humic topsoil (gleyic and haplic PHAEOZEMS)

176 U x, m-h = 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)

Soils developed on granites

179 U h = 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)

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

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

189 U x, h = 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 %)).

SOILS ON UPLAND-PLAIN TRANSITIONAL LANDS

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

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

SOILS ON NON-DISSECTED EROSIONAL PLAINS

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

243 Pn m, h = imperfectly drained to poorly drained, deep, dark grey, firm clay, abruptly underlying a topsoil of friable silt loam; in many places with a sodic deeper subsoil (eutric and solodic PLANOSOLS)

244 Pn h = imperfectly drained, very deep, very dark brown to black, firm, moderately sodic clay (luvo-orthic SOLONETZ)

245 Pn m, h = complex of:
- 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 x, l-h = well drained, shallow, dark red to yellowish red, stony loamy sand to clay (chromic CAMBISOLS, paralithic and stony phase; with ferralic ARENOSOLS, lithic phase)

SOILS ON LACUSTRINE PLAINS

Soils developed on sediments from volcanic ashes and other sources

321 Pl h = imperfectly drained to poorly drained, very deep, dark grey to dark greyish brown, very firm, slightly calcareous, non to slightly saline but moderately sodic, cracking clay (upper level of Lambwe valley) (chromic VERTISOLS, sodic phase)

322 Pl h = very poorly drained, very deep, very dark grey, very firm, slightly to moderately calcareous, gypsiferous, slightly saline but strongly sodic clay, with humic topsoil (lower level of Lambwe valley) (mollic SOLONETZ)

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 m, h = 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 FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

367 A h = poorly drained, deep, dark greyish brown, mottled, firm clay, with acid humic topsoil (humic GLEYSOLS)

368 A v = 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

371 S h = 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 BADLANDS

Badlands developed on various older lacustrine and volcanic rocks

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

SOILS ON COASTAL OR LAKE-SIDE BEACH RIDGES

Soils developed on beach ridges along Lake Victoria

381 Z m-h, l = 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 underlaying a topsoil of different texture)

Soil description from Kenya Soil Survey: Exploraty 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	11 498	21 878	4 606	125	174
North Sakwa	14 150	15 325	29 475	4 366	158	185
South Sakwa	7 662	8 013	15 675	2 670	100	156
Kamagambo	19 560	21 403	40 963	7 036	211	193
Central Division	86 124	92 314	178 438	31 749	921	193
Kaksingri	5 917	6 424	12 341	1 876	183	67
Rusinga	4 805	5 100	9 905	1 303	43	229
Mgangano	3 246	3 630	6 876	1 350	66	103
Gembe	8 755	8 950	17 705	2 569	158	111
Gwassi	11 008	12 394	23 402	3 225	253	92
Lambwe	7 049	7 410	14 459	2 405	334	43
Mbita Division	40 780	43 908	84 688	12 728	1 039	81
Kabuoch	14 217	15 393	29 610	5 406	225	131
Kanymwa	12 364	13 521	25 885	4 667	234	110
Karungu	6 927	7 702	14 629	2 315	156	93
West Nyokal	12 299	13 344	25 643	4 680	231	110
Ndhiwa Division	45 807	49 960	95767	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	Persons per Household total [b)]
		Adults >15 years	Children < 15 years	Other Relatives		
Location:						
Kanyanda	7131	3.24	1.16	0.68	0.37	5.45
North Nyokal	5908	3.30	1.34	0.26	0.28	5.19
Gem	4687	2.96	1.06	0.33	0.30	4.65
North Sakwa	4344	3.53	1.35	1.14	0.72	6.74
South Sakwa	2670	3.38	1.30	0.63	0.56	5.87
Kamagambo	7030	3.36	1.43	0.63	0.37	5.79
Division Central	31770	3.29	1.28	0.60	0.41	5.57
Location:						
Kaksingri	1872	3.51	1.54	0.69	0.85	6.59
Rusinga	1296	3.89	1.78	1.01	0.96	5.29
Mjangano	1343	3.17	1.06	0.79	0.40	5.05
Gembe	2564	3.77	1.41	0.64	1.08	6.90
Gwassi	3210	4.04	1.86	0.76	0.61	7.27
Lambwe	2400	3.46	1.52	0.41	0.59	5.99
Division Mbita	12685	3.65	1.57	0.69	0.75	6.65
Location:						
Kabuoch	5400	3.26	1.19	0.62	0.40	5.48
Kanyamwa	4660	3.33	1.26	0.58	0.38	5.54
Karungu	2314	3.60	1.56	0.58	0.59	6.32
West Nyokal	4681	3.41	1.38	0.37	0.31	5.47
Division Ndhiwa	17055	3.37	1.31	0.53	0.39	5.61
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	0.64	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 Census 79	Non-agricultural land			Agricultural land	Area in agro-ecological zones AEZ									Agric. land per household	Agric. land per person
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, homesteads, rivers...)		UM 1	UM 2	UM 3	UM 4	LM 1	LM 2	LM 3	LM 4	LM 5		
Kanyarida	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	32	5.70	0.87
Rusinga	43	12		7	24									24	1.84	0.24
Mfangano	66	18		10	38									38	2.81	0.55
Gembe	158	16	20	19	103								81	22	4.00	0.58
Gwassi	253	12	83	30	128								61	67	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	183	4.16	0.63
Kabuoch	225			30	195					24	171				3.53	0.65
Kanyamwa	234	4		26	204			12			59	133			4.43	0.80
Karungu	156	8		16	132								73	59	5.70	0.90
West Nyokal	231			25	206			34			12	143	17		4.34	0.79
Ndhiwa Division	846	12		97	737			46		24	242	276	90	59	4.50	0.79
Kanyamkago	373			37	336		86				136	114			4.79	0.73
Suna East	199			32	167		51				56	60			2.47	0.43
Migori Division	572			69	503		137				192	174			3.65	0.59
Suna West	256			26	230							230			4.79	0.84
South Kadem	360			36	324							169	69	86	5.35	0.98
North Kadem	205			21	184							29	108	47	6.76	1.25
Macalder Division	822			83	738							428	177	133	5.63	1.02
Nyabassi	134			13	121		52	45			24				4.84	0.54
Bukira	201			20	181		11	85			85				6.19	0.73
Bwiregi	53			8	45		37	1	7						2.59	0.36
Bugumbe	185			19	166			29			103	34			4.80	0.65
Kihancha Division	573			60	513		100	160			212	34			4.61	0.57
Kabondo	140			24	116	1	47				46	22			1.99	0.37
West Kasipul	123		5	21	97						71	26			2.00	0.40
Central Kasipul	133			23	110	11						44	55		2.33	0.41
East Kasipul	106			21	85	35					39	11			2.15	0.34
Oyugis Division	502		5	89	408	47	47				156	103	55		2.12	0.38
Central Karachuonyo	96			16	80							80			2.07	0.34
Kanyaluo	60			8	52						52				3.56	0.37
Wang-Chieng	92	9		16	67						66	1			2.04	0.34
West Karachuonyo	180	3	12	31	134						107	27			2.00	0.40
Kendu Division	429	12	12	71	333						305	28			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.

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	included 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

SMALL FARM SURVEY (SFS)[1)]

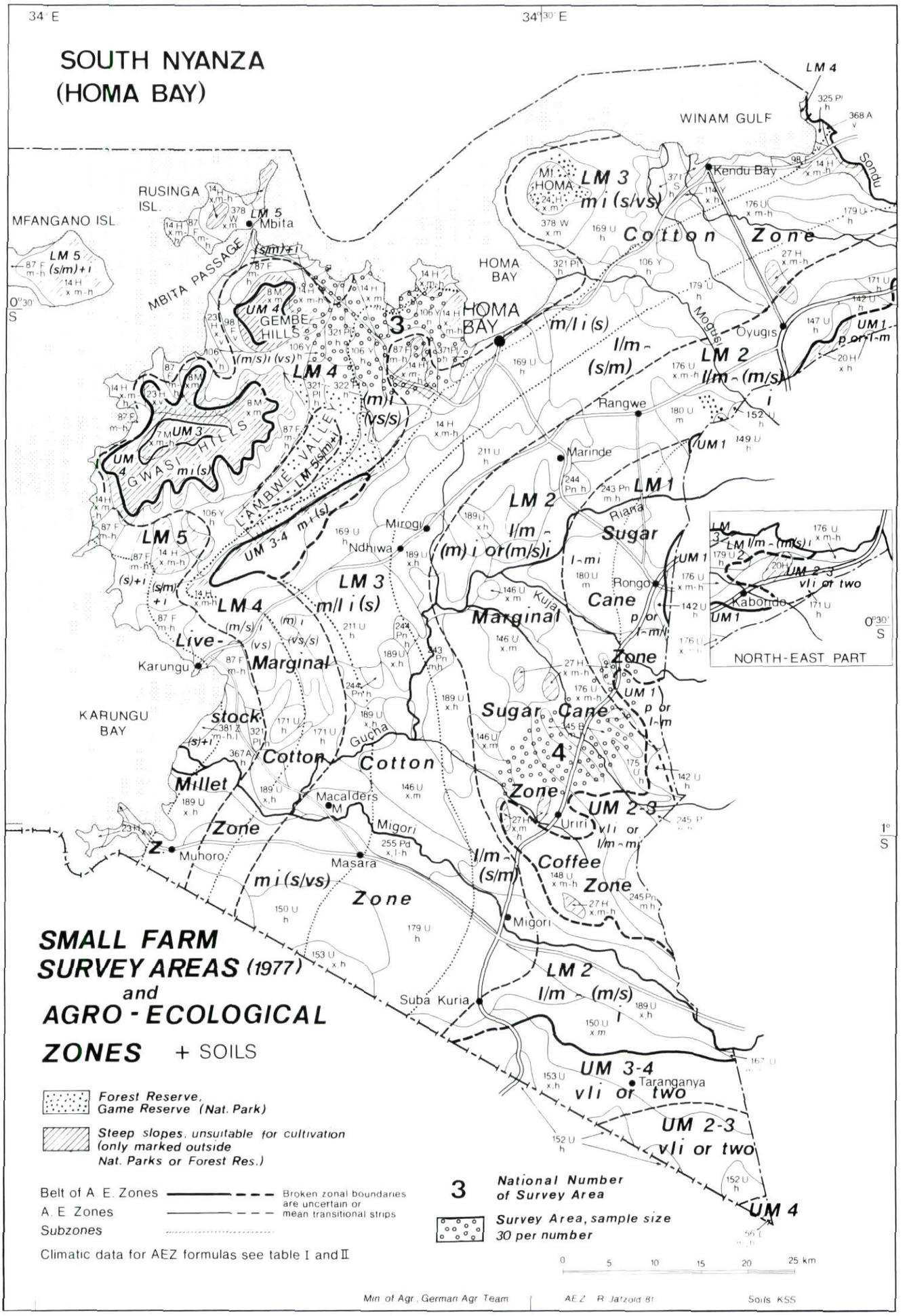
The natural conditions within the district are much less favourable than within neighbouring Kisii. The SFS was carried out mainly in the somewhat more productive regions of AEZ LM 2 and LM 3 and thus reflects above average conditions, especially as regards the investigations carried out in AEZ LM 2. A productivity level similar to the results shown for AEZ LM 3 farms and lower is typical for the less productive areas of the district (LM 3, 4, 5).

The farms are quite large – half of their area is planted with annual crops and the other half used for grazing. The high stocking rate of 2.4 LU/ha is also a result of the availability of off-farm grazing. A number of cattle diseases have so far prevented the introduction of improved breeds, the use of fertilizer is practically unknown and plant protection is applied to early planted cotton only (table 9 and 10). Maize, sorghum and cotton are the major crops. Most farmer grow one crop p.a. only, but in AEZ LM 1, 2 planting for the second rains is common (table 11).

Table 13 – Inputs & Yields – give some information on the farmer's opinion of his crop husbandry.[2)] Apart from improved seeds for maize and plant protection in cotton, no purchased inputs are used. About 10 % of the grazing livestock are sheep or goats, the rest are cattle, half of which are male. There were no improved cattle on the farms investigated (table 12). Practically all food crops produced are consumed in the district itself. Most farmers still practise a kind of subsistence agriculture (Table 14). Intensifying livestock production and introduction a suitable animal-draught mechanisation will help to improve the standard of living of the farmers. The largely unfavourable natural conditions will continue to limit agricultural output and slow rural development.

1) October 1977, sample size 30. For more detailed and up to date information see FMBH Vol. III B

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


SOUTH NYANZA
(HOMA BAY)
34° E
34°30' E
0°30' S
1° S
WINAM GULF
Kendu Bay
Sondu
RUSINGA ISL.
MFANGANO ISL.
Mbita
MBITA PASSAGE
HOMA BAY
GEMBE HILLS
GWASI HILLS
LAMBWE VALLEY
Oyugis
Rangwe
Marinde
Mirogi
Ndhiwa
Rongo
Kabondo
Karungu
KARUNGU BAY
Macalders
Uriri
Muhoro
Masara
Migori
Suba Kuria
Taranganya
Cotton Zone
Sugar Cane Zone
Marginal Sugar Cane Zone
Coffee Zone
Live-stock Cotton Zone
Millet Zone
Cotton Zone
Zone
LM 1
LM 2
LM 3
LM 4
LM 5
UM 1
UM 2-3
UM 3-4
UM 4
NORTH-EAST PART
SMALL FARM SURVEY AREAS (1977) and AGRO-ECOLOGICAL ZONES + SOILS
Forest Reserve, Game Reserve (Nat. Park)
Steep slopes, unsuitable for cultivation (only marked outside Nat. Parks or Forest Res.)
Belt of A. E. Zones
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
3 National Number of Survey Area
Survey Area, sample size 30 per number
0 5 10 15 20 25 km
Min of Agr. German Agr Team
AEZ R. Jatzold 81
Soils KSS

SOUTH NYANZA DISTRICT

TABLE 9 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: LM 3–4

Survey Area 03

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	2.5	5.9	10.2
Land Use: Annual Crops[1] First Season				
Maize	ha	0.4	1.9	1.3
Sorghum	ha	0.3	1.0	1.2
Maize & Sorghum	ha	0.3	-	0.2
Cotton	ha	0.2	-	0.8
Others	ha	-	-	0.6
Total	ha	1.2	2.9	4.1
Second Season[1]				
Maize	ha			0.5
Maize & Beans	ha			0.1
	ha			
Total	ha			0.6
Permanent Crops[1]				
Sisal	ha			0.1
	ha			
	ha			
	ha			
portion of total	%			6%
Grazing & Forage	ha	0.9	2.4	4.3
portion of total	%			42%
Other Land Use	ha	0.4	0.6	1.5
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

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.5	0.5	0.5
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	30%	50%	120%
Labour on Farm:				
Family Adults	persons	3.0	2.6	3.3
Perm. Hired Labour	"	0.1	0.2	0.6
Children > 14 years	"	1.8	2.7	3.4
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.67	0.67	3.34
Children < 14 years	"	3.17	-	3.17
Subsistence Units	SU	4.57	0.67	5.24
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1225	1974	
Beans	kg	235	333	
Finger Millet	kg	60	94	
Sorghum	kg	229	359	
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: **Groundnuts, Bulrush Millet, Finger Millet, Sunflower, Sugarcane**

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

SOUTH NYANZA DISTRICT

TABLE 9 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: UM 1 – LM 1–2

Survey Area 04

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	2.6	6.3	19.4
Land Use: Annual Crops[1] First Season				
Maize	ha	0.2	0.1	0.6
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 Season[1]				
Maize	ha	0.2	0.1	1.0
Maize & Beans	ha	0.3	1.0	1.7
Cassava	ha	0.1	-	0.1
Others	ha	-	-	0.2
Total	ha	0.6	1.1	3.0
Permanent Crops[1]				
Sugarcane	ha	0.2	0.6	2.0
Bananas	ha	0.1	0.1	0.4
Coffee	ha	0.1	0.1	0.2
	ha			
portion of total	%	23%	17%	13%
Grazing & Forage	ha	0.7	3.0	8.0
portion of total	%	27%	48%	41%
Other Land Use	ha	0.4	0.9	4.1
Livestock on Farm:				
Cattle: local	LU	0.2	3.3	21.3
improved	LU	-	0.2	0.1
Sheep & Goats	LU	0.1	0.5	1.9
Total	LU	0.3	4.0	23.3

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.7	0.6	0.5
Portion of improved cattle kept	%	-	6%	-
Portion of Farmers owning a Plough	%	-	70%	200%
Labour on Farm:				
Family Adults	persons	3.3	2.8	3.6
Perm. Hired Labour	"	0.3	0.4	3.0
Children > 14 years	"	1.7	5.1	4.1
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.37	0.78	3.15
Children < 14 years	"	3.28	-	-
Subsistence Units	SU	4.33	0.78	5.11
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1070	1725	
Beans	kg	206	327	
English Potatoes	kg	8	3	
Sweet Potatoes	kg	122	69	
Cabbage	kg	40	4	
Cassava	kg	50	28	
Sorghum	kg	227	356	
Millet	kg	60	94	

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

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

SOUTH NYANZA DISTRICT

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

AEZ: LM 3–4 Survey Area 03

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 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

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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	-	-	-	0.1	-	2.2	-	-	-
Up. Qu.	42.9	-	-	-	-	-	-	-	-	1.6	-	-	-
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 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 Crops ha	%	Perm. Crops ha	%	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		115.5		-		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_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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	17.4
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 & Sorgm	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 & Sorgm	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

TABLE 12 a: HERD COMPOSITION (GRAZING LIVESTOCK)

AEZ: LM 3–4 — 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	–			0.3			0.3
	Average	–	–	–	0.03	–			0.01			0.01
	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	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										

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 12 b: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: UM 1 – LM 1–2 — – in Head and Livestock Units – — 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	Total	102	26	71	107	144	148	97	252.1	41	783	258.3
	Average	3.40	0.87	2.37	3.57	4.80	4.93	3.23	8.40	1.37	26.10	8.61
	Upper Qu.	2	–	4	4	4	7	4	10.4	–	39	10.4
	Lower Qu.	–	–	–	–	–	–	–	0.6	–	9	0.6
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		Inputs							Yield
			Nutrients				Chemicals		
		Improved Seeds %	N kg/ha	P_2O_5 kg/ha	K_2O kg/ha	Manure t/ha	Insec. kg/ha	Fungicide kg/ha	kg/ha
First Rains									
Maize	Avg.	45	-	1	-	0.02	1	-	2,269
	UpQu	100	-	-	-	-	-	-	2,025
	LoQu	-	-	-	-	-	-	-	1,183
Sorghum	Avg.	-	-	-	-	-	-	-	1,336
	UpQu	-	-	-	-	-	-	-	1,350
	LoQu	-	-	-	-	-	-	-	630
Fingermillet	Avg.	-	-	-	-	-	-	-	525
Groundnuts	Avg.	-	-	-	-	-	-	-	1,129
Sunflower	Avg.	100	-	-	-	-	-	-	547
	UpQu	100	-	-	-	-	-	-	733
	LoQu	100	-	-	-	-	-	-	205
Cotton	Avg.	58	-	-	-	-	15	-	589
	UpQu	100	-	-	-	-	17	-	750
	LoQu	-	-	-	-	-	-	-	306
Maize & Sorgm									
Maize	Avg.	-	-	-	-	-	-	-	900
Sorgm	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
Second Rains									
Maize	Avg.	50	-	-	-	-	-	-	1,240
	UpQu	100	-	-	-	-	-	-	833
	LoQu	-	-	-	-	-	-	-	450
Perennial Crops									
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		Inputs							Yield
		Improved Seeds	Nutrients			Manure	Chemicals		
			N	P_2O_5	K_2O		Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
Maize	Avg.	100	14	28	-	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
Maize & Beans									
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
Second Rains									
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
Maize & Beans									
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
Perennial Crops									
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	%
First Rains							
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 & Sorgm	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
FMlt & 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
Second Rains							
Maize	4,150	1,170	28	900	22	2,080	50
Maize & Beans	3,260	0	0	0	0	3,260	100
Permanent Crops							
Nil							

SOUTH NYANZA DISTRICT

TABLE 14 b: **DISPOSAL OF CROPS**

AEZ: UM 1 – LM 1–2 Survey Area 04

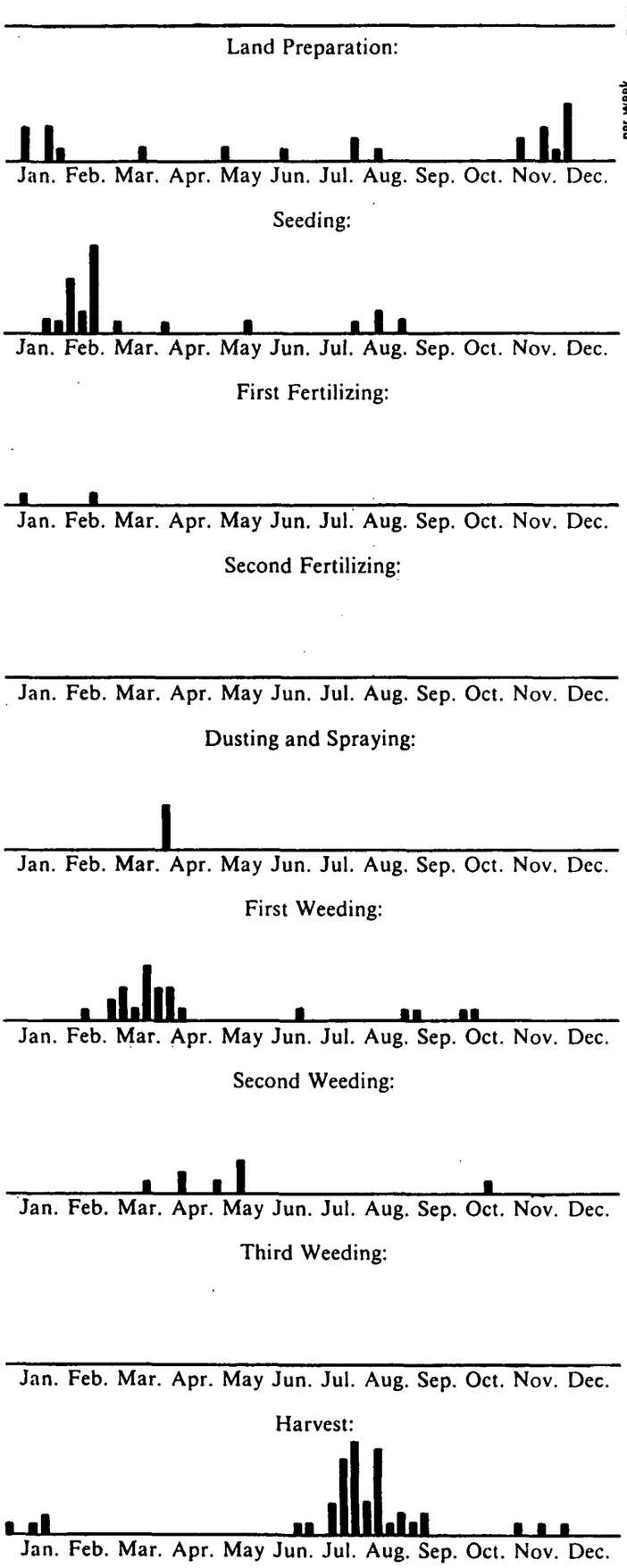
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	59,531	97,010	163	7,290	12	-44,769	-75
Maize & Beans	86,770	36,405	42	25,460	29	24,905	29
Maize & Sorgm	2,760	0	0	0	0	2,760	100
Beans	3,910	540	14	2,340	60	1,030	26
Bulrushmillet	1,800	0	0	0	0	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
Second Rains							
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
Permanent Crops							
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



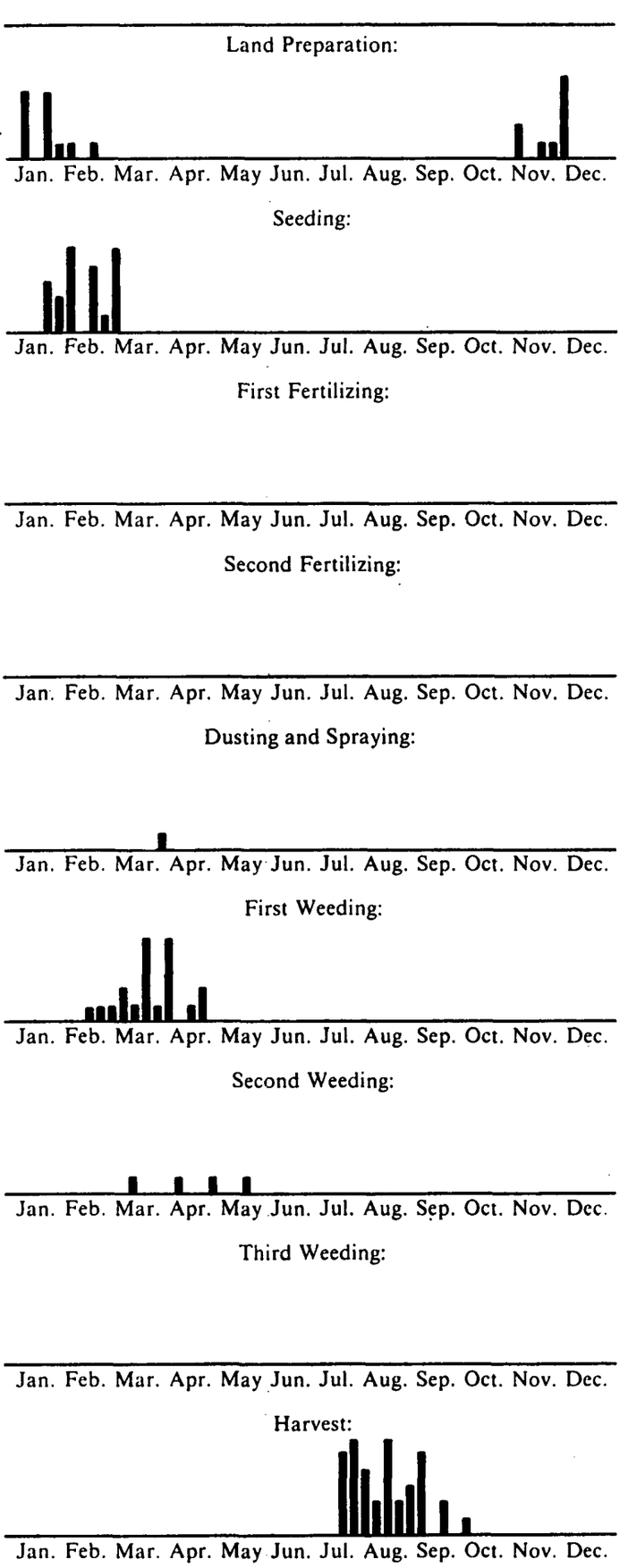
100 % of the cases per week

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

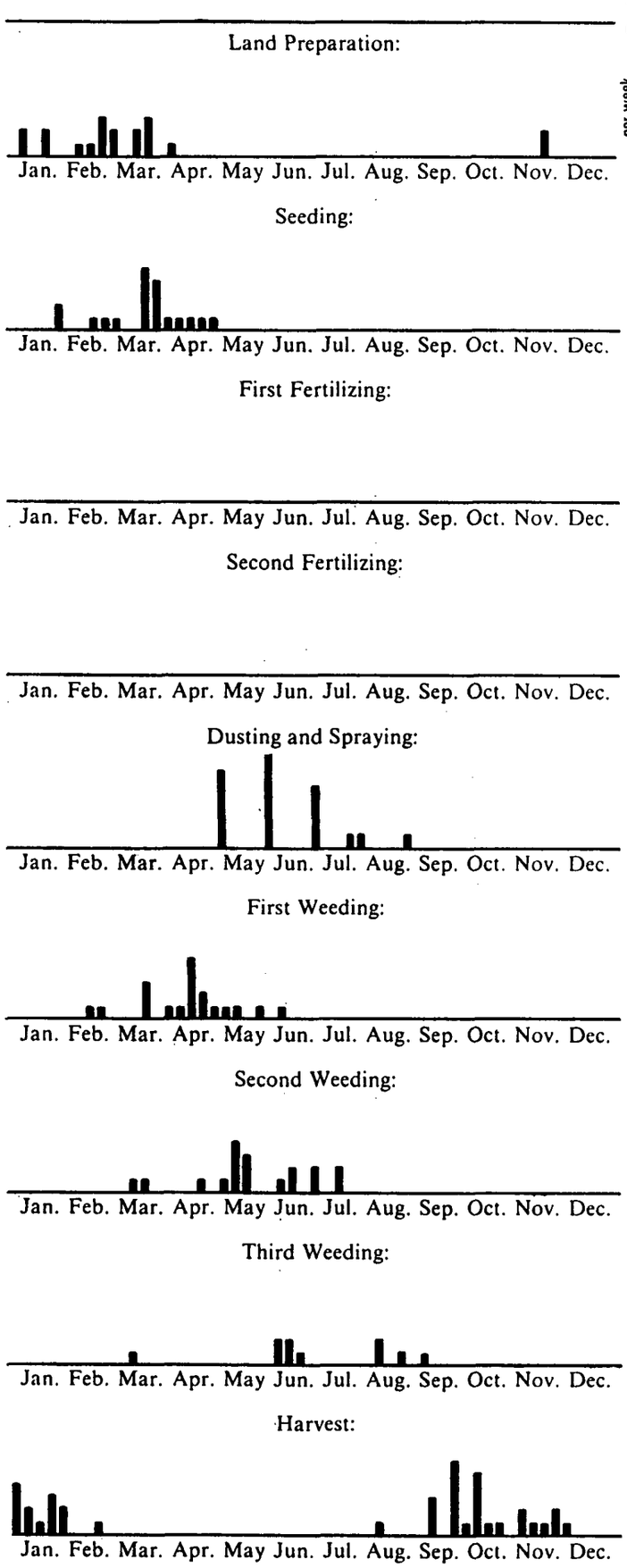


SOUTH NYANZA DISTRICT

TABLE 15 c: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 35 **Cotton** Cases: 19

AEZ: LM 3–4 Survey Area 03 Sample Size: 30

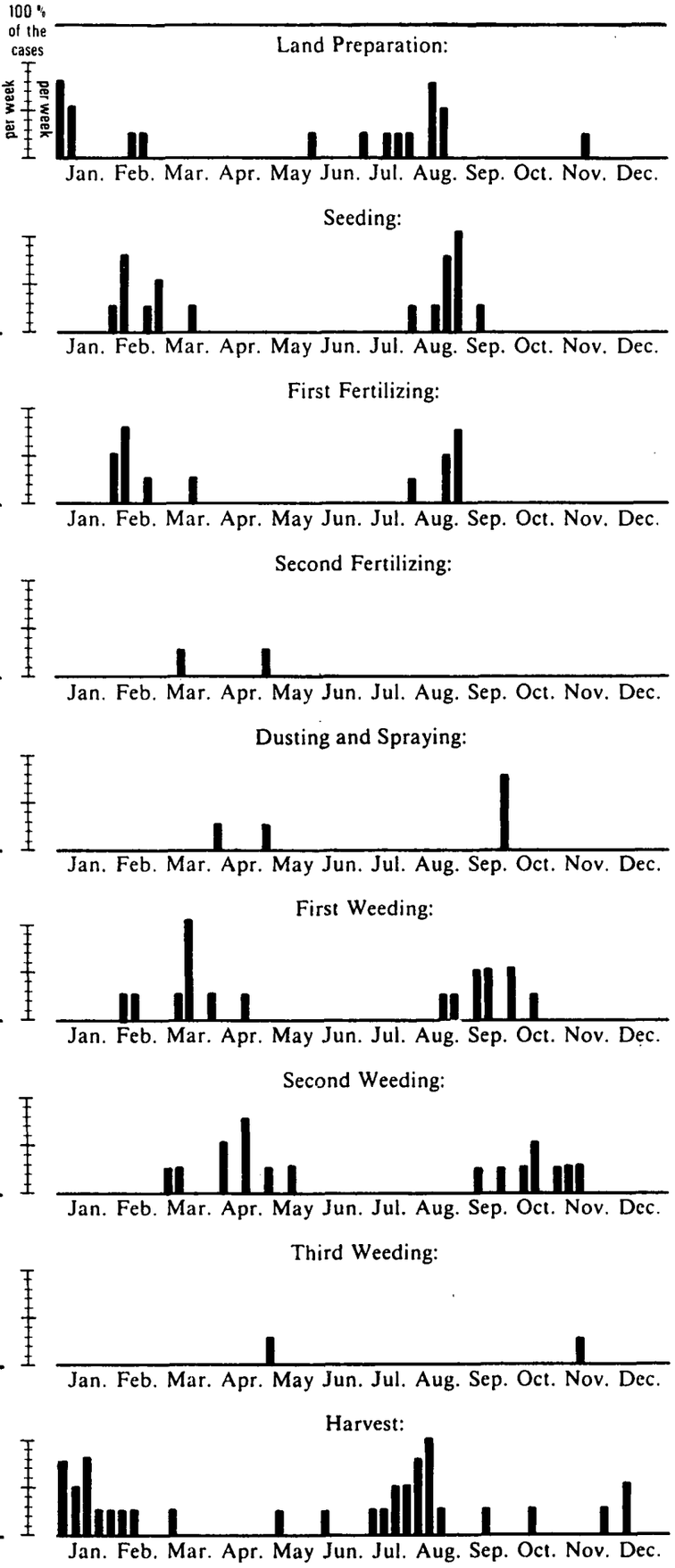


SOUTH NYANZA DISTRICT

TABLE 15 d: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 **Maize** Cases: 18

AEZ: UM 1 – LM 1–2 Survey Area 04 Sample Size: 30

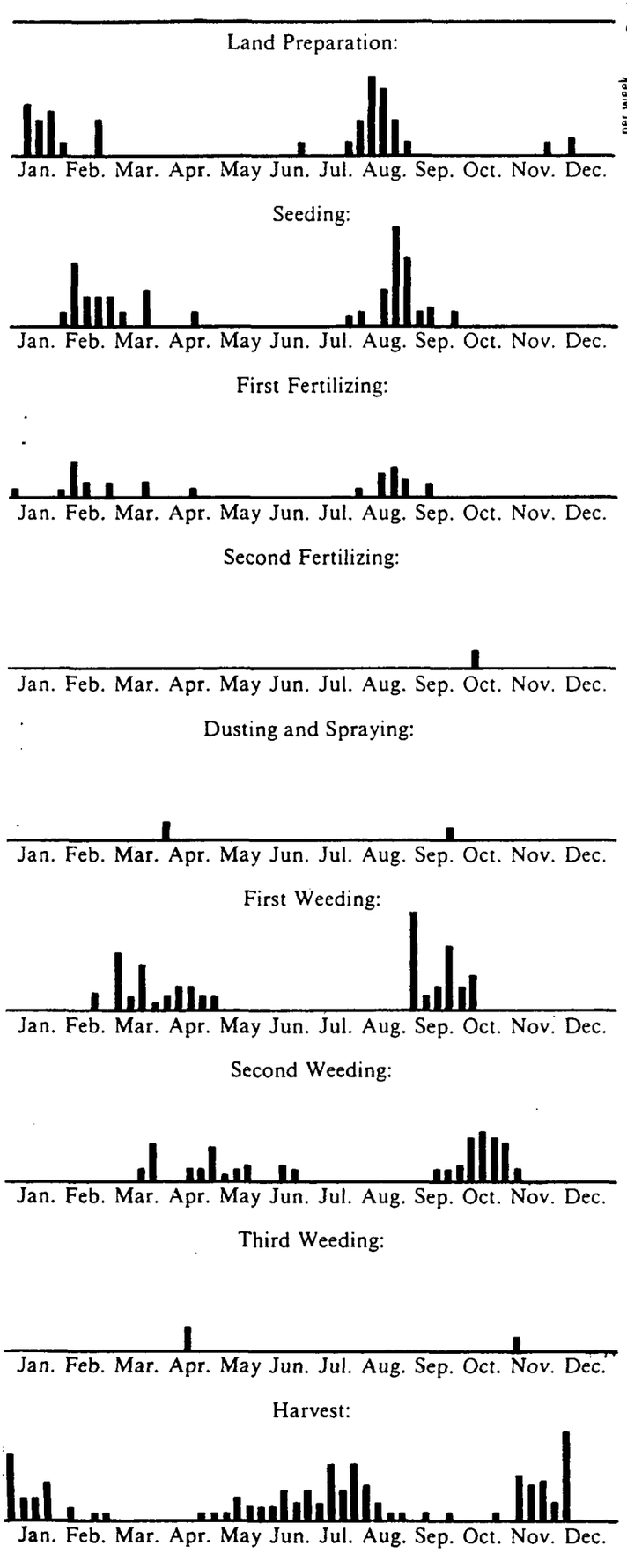


SOUTH NYANZA DISTRICT

TABLE 15 e: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 60[1)]

AEZ: UM 1 – LM 1–2 Suvey Area 04 Sample Size: 30

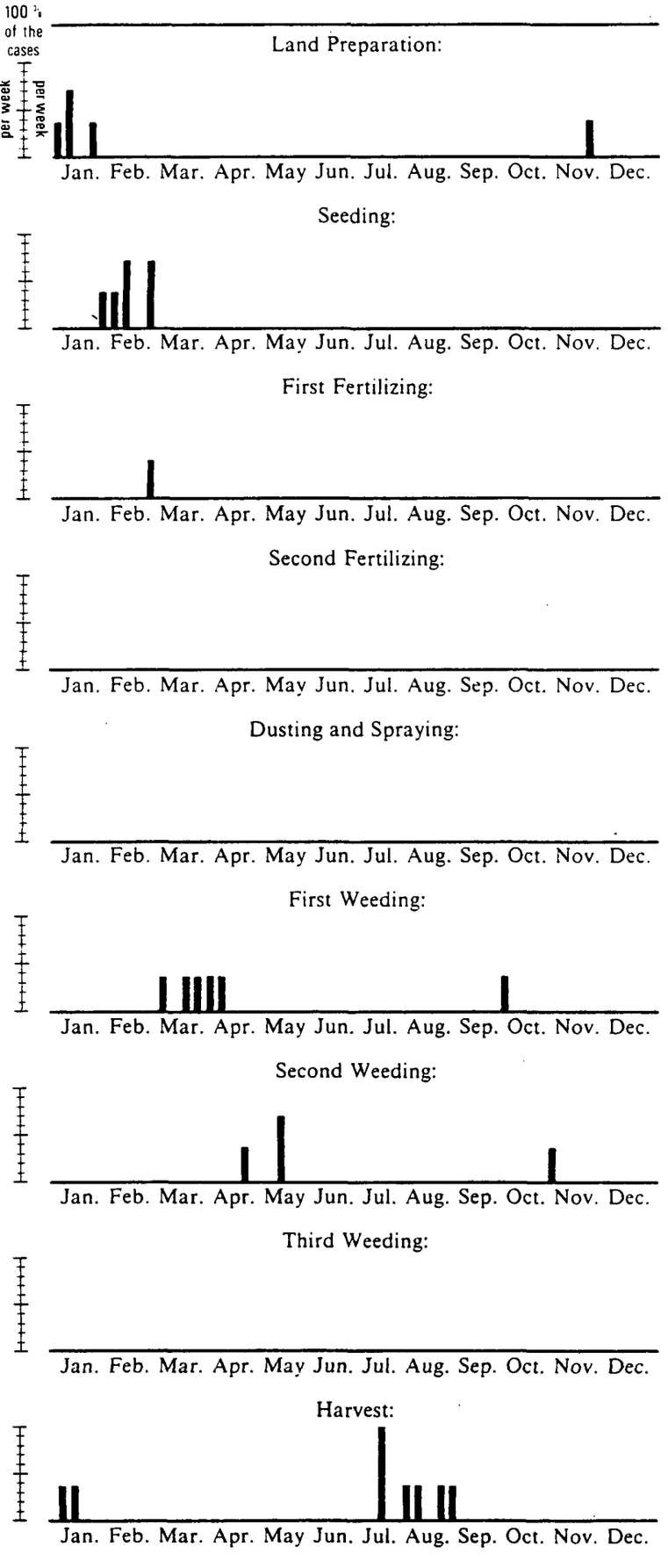


SOUTH NYANZA DISTRICT

TABLE 15 f: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 18 **Sorghum** Cases: 6

AEZ: UM 1 – LM 1–2 Survey Area 04 Sample Size: 30



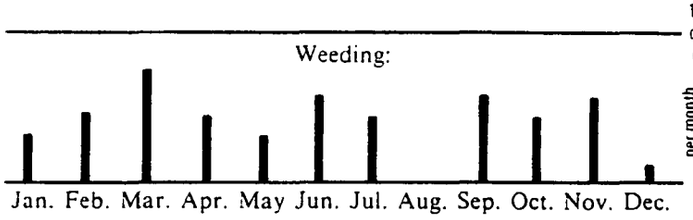
1) Maximum 30 per crop and season

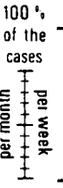
SOUTH NYANZA DISTRICT

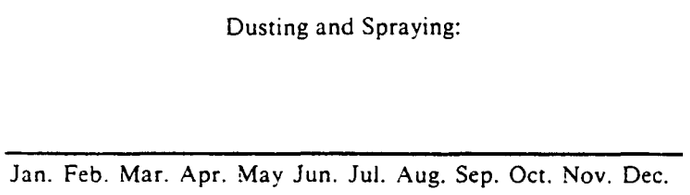
TABLE 15 g: **DISTRIBUTION OF FARMING ACTIVITIES**

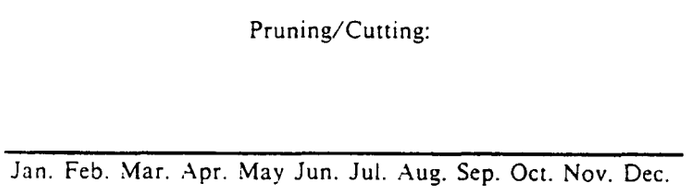
Crop 63 **Sugarcane** Cases: 18

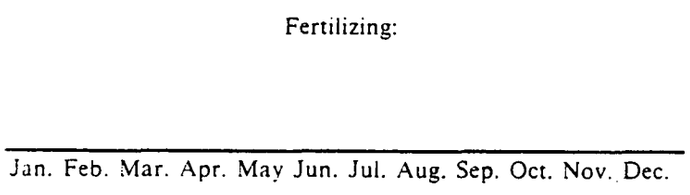
AEZ: UM 1 – LM 1–2 Survey Area 04 Sample Size: 30

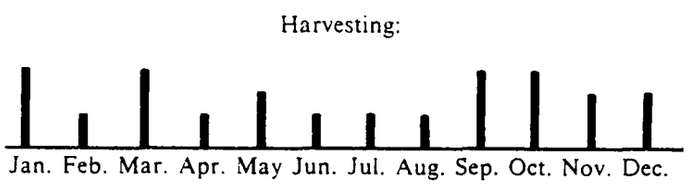










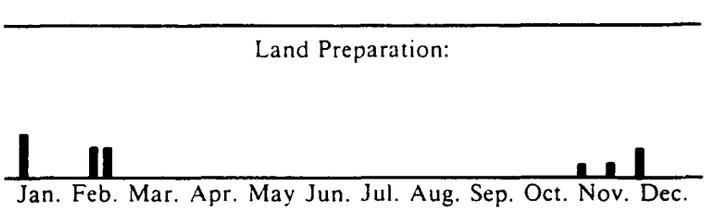


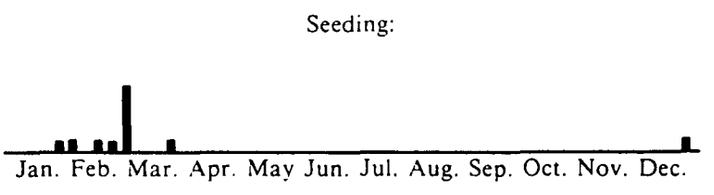
SOUTH NYANZA DISTRICT

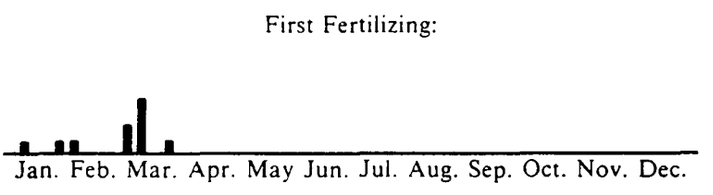
TABLE 15 h: **DISTRIBUTION OF FARMING ACTIVITIES**

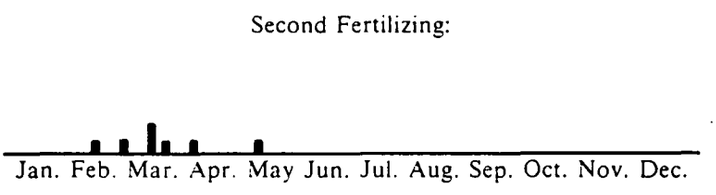
Crop 39 **Tobacco** Cases: 11

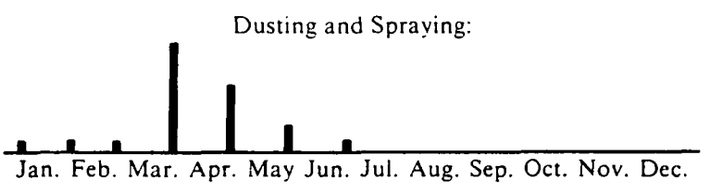
AEZ: UM 1 – LM 1–2 Survey Area 04 Sample Size: 30

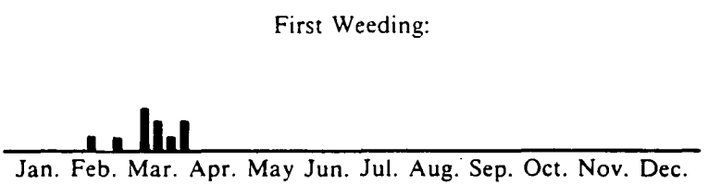


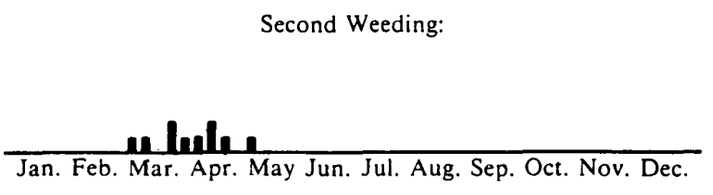


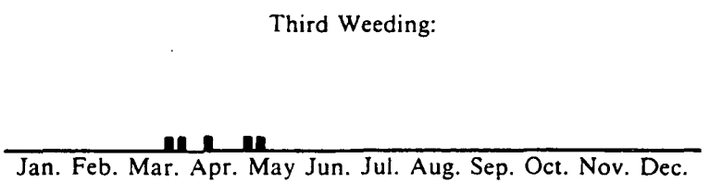


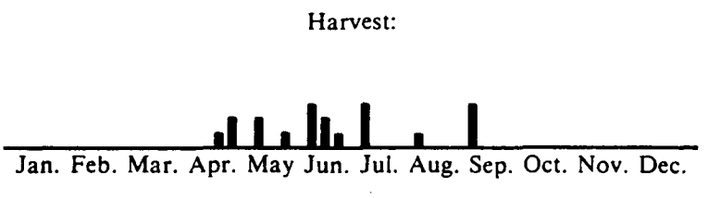










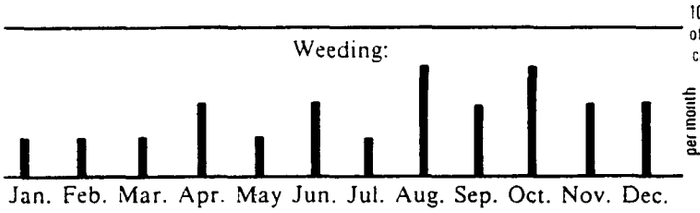


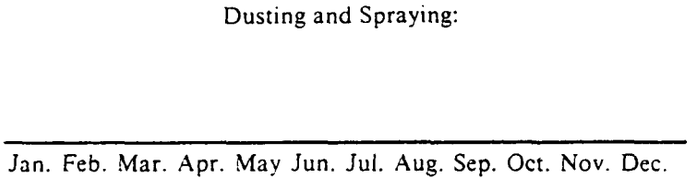
SOUTH NYANZA DISTRICT

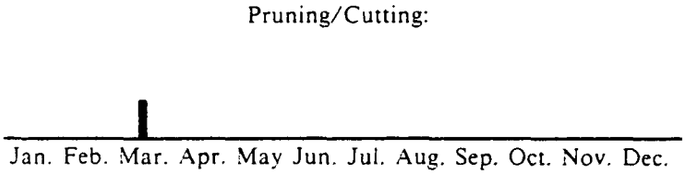
TABLE 15 i: **DISTRIBUTION OF FARMING ACTIVITIES**

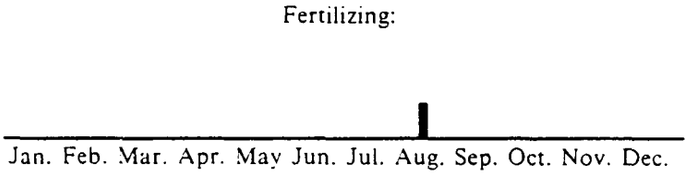
Crop 57 **Pineapples** Cases: 3

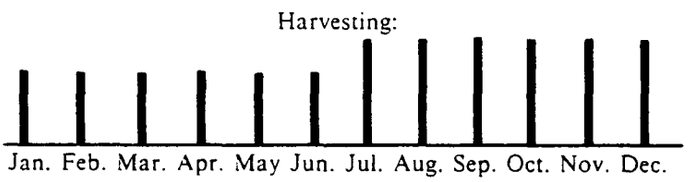
AEZ: UM 1 – LM 1–2 Survey Area 04 Sample Size: 30











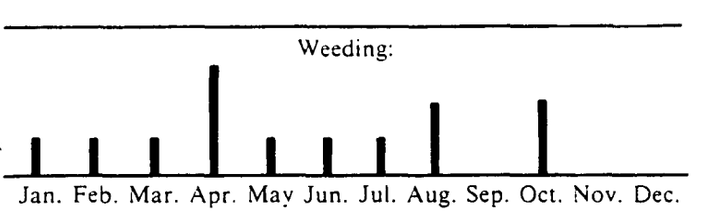


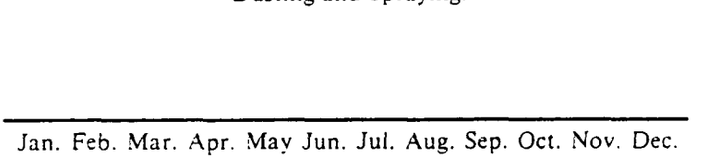
SOUTH NYANZA DISTRICT

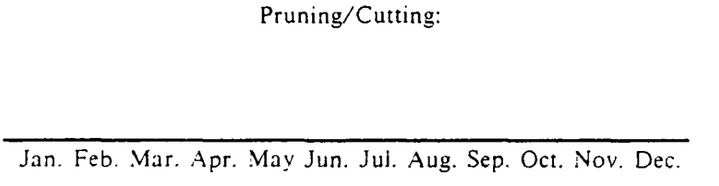
TABLE 15 k: **DISTRIBUTION OF FARMING ACTIVITIES**

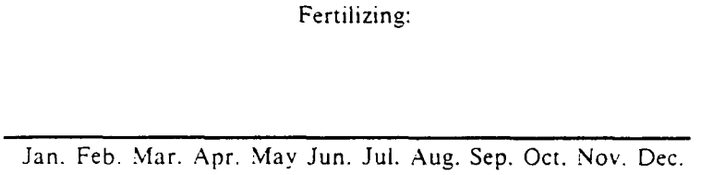
Crop 64 **Cassava** Cases: 4

AEZ: UM 1 – LM 1–2 Survey Area 04 Sample Size: 30









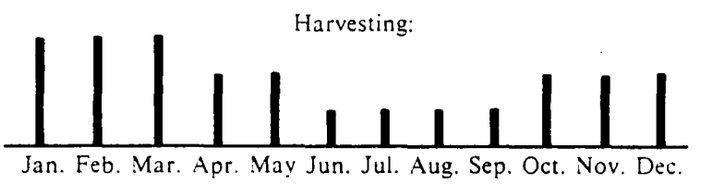


TABLE 16 a: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

	A.E.Z.: UM 2-3 COFFEE ZONE													
	Vegt. Period 1st + 2nd: vl i or l/m¬(m)i in Days, 1st: 180 or more			2nd: 115-130 total: 295-310										
	Soil: PHAEOZEMS													
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NAT. PASTURE/LEYS														
Farmers in Production Level	%													
Yields	kg	2,400			4,800									
Fertilizer N	kg				133									
P_2O_5	kg				66									
K_2O	kg													
CROP: NAPIER GRASS														
Farmers in Production Level	%													
Yields	kg	4,800			10,400									
Fertilizer N	kg				311									
P_2O_5	kg				155									
K_2O														
CROP:														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O	kg													
CROP: COFFEE														
Farmers in Production Level	%													
Yields	kg		300	400	600									
Fertilizer N	kg		30	40	60									
P_2O_5	kg		90	90	90									
K_2O	kg													
CROP: BANANAS														
Farmers in Production Level	%													
Yields	kg	8,500	6,000	18,000	28,000									
Fertilizer N	kg			143	293									
P_2O_5	kg			38	78									
K_2O	kg													
CROP: PASSION FRUIT														
Farmers in Production Level	%													
Yields	kg	3,400		12,000	20,000									
Fertilizer N	kg			120	232									
P_2O_5	kg			120	232									
K_2O	kg													

TABLE 16 b: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

	A.E.Z.: UM 2-3 COFFEE ZONE													
	Vegt. Period 1st + 2nd: vl i or l/m¬(m)i in Days, 1st: 18o or more			2nd: 115-13o	total: 295-31o									
	Soil:			PHAEOZEMS										
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	2,600	2,500	3,500	6,000								
Fertilizer N	kg			23	85								
P_2O_5	kg			14	54								
K_2O	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								
P_2O_5	kg				60								
K_2O													
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg	1,500	400	800	1,800								
Fertilizer N	kg				15								
P_2O_5	kg				12								
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	1,100	400	800	1,800								
Fertilizer N	kg				24								
P_2O_5	kg				19								
K_2O	kg												
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	1,500	900	1,500	2,300								
Fertilizer N	kg				27								
P_2O_5	kg				18								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

TABLE 16 c: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

	A.E.Z.: UM 2-3 COFFEE ZONE													
	Vegt. Period 1st + 2nd: vl i or l/m~(m)i in Days, 1st: 18o or more			2nd: 115-13o total: 295-31o										
	Soil: PHAEOZEMS													
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	8,500	4,000	8,000	22,000								
Fertilizer N	kg				108								
P_2O_5	kg				54								
K_2O	kg												
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	4,200	3,000	5,000	22,000								
Fertilizer N	kg			6	125								
P_2O_5	kg			3	71								
K_2O													
CROP: SUKUMAWIKI													
Farmers in Production Level	%												
Yields	kg	4,200	3,500	7,500	20,000								
Fertilizer N	kg			23	111								
P_2O_5	kg			13	63								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

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: p or l-m/l in Days, 1st: 200 or more		2nd: 160	total: (360)	l/m-(m/s) or (m)i 180 or more		115-140	295-320	m/li (s) 155-175		85-105	240-280
			Soil: FERRALSOLS				GREYZEMS				PLANOSOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NAT. PASTURE/LEYS														
Farmers in Production Level		%												
	Yields	kg	1,800			3,600	1,600			3,200	1,200			2,400
	Fertilizer N	kg				100				88				66
	P_2O_5	kg				50				44				33
	K_2O	kg												
CROP: NAPIER GRASS														
Farmers in Production Level		%												
	Yields	kg	3,600			8,000	3,400			8,000	2,400			5,500
	Fertilizer N	kg				244				255				172
	P_2O_5	kg				122				127				86
	K_2O													
CROP: TEA														
Farmers in Production Level		%												
	Yields	kg	1,400	3,000	5,000	9,000								
	Fertilizer N	kg		53	120	380								
	P_2O_5	kg		10	24	76								
	K_2O	kg		10	24	76								
CROP: BANANAS														
Farmers in Production Level		%												
	Yields	kg	5,000	6,000	10,000	20,000	6,000	4,000	10,000	18,000				
	Fertilizer N	kg		18	90	270			72	216				
	P_2O_5	kg		7	35	105			28	84				
	K_2O	kg												
CROP: SUGAR CANE														
Farmers in Production Level		%												
	Yields - year	kg	8,000	17,000	40,000	60,000								
	Fertilizer N	kg		18	64	104								
	P_2O_5	kg		63	224	364								
	K_2O	kg												
CROP: COTTON														
Farmers in Production Level		%												
	Yields	kg									450	160		1,700
	Fertilizer N	kg												134
	P_2O_5	kg												100
	K_2O	kg												

TABLE 16 e: 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: p or l-m/l		2nd:	total:	l/m-(m/s)i or (m)i		115-140	295-320	m/li (s)		85-105	240-280
			in Days, 1st: 200 or more		160	(360)	180 or more				155-175			
			Soil: FERRALSOLS				GREYZEMS				PLANOSOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE														
Farmers in Production Level		%												
	Yields	kg	1,200	1,100	2,000	4,000	1,600	1,200	2,800	4,000	1,600	1,300	2,000	2,600
	Fertilizer N	kg			24	84			30	60			12	30
	P_2O_5	kg			22	78			34	67			11	28
	K_2O	kg												
CROP: SORGHUM														
Farmers in Production Level		%												
	Yields	kg	2,000	1,200	2,500	3,800	2,400	1,300	2,000	4,000	2,400	1,300	2,200	3,800
	Fertilizer N	kg			22	70				50				45
	P_2O_5	kg			16	57				48				43
	K_2O													
CROP: MAIZE & BEANS														
Farmers in Production Level		%												
	Yields	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	2,600/500
	Fertilizer N	kg			40	105			42	72			12	45
	P_2O_5	kg			33	93			40	73			17	38
	K_2O	kg												
CROP: BEANS														
Farmers in Production Level		%												
	Yields	kg					950	600	1,000	1,600	1,000	400	800	1,300
	Fertilizer N	kg							3	39				18
	P_2O_5	kg							2	23				11
	K_2O	kg												
CROP: SUNFLOWER														
Farmers in Production Level		%												
	Yields	kg	700		600	1,200								
	Fertilizer N	kg				17								
	P_2O_5	kg				25								
	K_2O	kg												
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_2O_5	kg			4	23				19				
	K_2O	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			
		Vegt. Period 1st + 2nd: p or l-m/l in Days, 1st: 200 or more		2nd: 160	total: (360)	l/m-(m/s)i or (m)i 180 or more		115-140	295-320	m/li (s) 155-175		85-105	240-280
		Soil: FERRALSOLS				GREYZEMS				PLANOSOLS			
	Unit	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	900	600	1,000	1,500	1,000	600	800	1,600	1,100	600	800	1,600
Fertilizer N	kg			3	18				19				16
P_2O_5	kg			3	18				18				10
K_2O	kg												
CROP: BAMBARA GROUNDNUTS													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O													
CROP: SIMSIM													
Farmers in Production Level	%												
Yields	kg									850			1,200
Fertilizer N	kg												10
P_2O_5	kg												12
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	5,000	6,000	10,000	26,000	6,000	6,000	10,000	30,000	5,000	5,000	8,000	16,000
Fertilizer N	kg		10	50	210			40	240			30	110
P_2O_5	kg		7	35	147			28	168			18	66
K_2O	kg												
CROP: CASSAVA													
Farmers in Production Level	%												
Yields - year	kg	6,500	3,000	4,000	12,000	7,000	4,000	7,000	12,000	6,000	4,000	8,000	12,000
Fertilizer N	kg				22				20			8	24
P_2O_5	kg				29				35			14	42
K_2O	kg												
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	4,000	2,000	6,000	18,000								
Fertilizer N	kg			14	98								
P_2O_5	kg			14	98								
K_2O	kg												

TABLE 16 g: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

	A.E.Z.: LM 4 MARGINAL COTTON ZONE													
	Vegt. Period 1st + 2nd: (m)i (v s/s) in Days, 1st: 135-145			2nd: 65-75	total: 200-220									
	Soil: REGOSOLS													
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE														
Farmers in Production Level		%												
Yields		kg	750			1,500								
Fertilizer N		kg				41								
	P_2O_5	kg				20								
	K_2O	kg												
CROP: NAPIER/BANA GRASS														
Farmers in Production Level		%												
Yields		kg	1,500			3,200								
Fertilizer N		kg				94								
	P_2O_5	kg				47								
	K_2O													
CROP: SORGHUM														
Farmers in Production Level		%												
Yields		kg	1,200	800	1,600	2,500								
Fertilizer N		kg			15	42								
	P_2O_5	kg			10	36								
	K_2O	kg												
CROP: MILLET														
Farmers in Production Level		%												
Yields		kg												
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O	kg												
CROP: COTTON														
Farmers in Production Level		%												
Yields		kg	300	150		850								
Fertilizer N		kg				67								
	P_2O_5	kg				50								
	K_2O	kg												

TABLE 16 h: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

A.E.Z.: LM 4 MARGINAL COTTON ZONE														
Vegt. Period 1st + 2nd: (m)i (v s/s) in Days, 1st: 135-145			2nd: 65-75		total: 200-220									
Soil: REGOSOLS														
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: BEANS														
Farmers in Production Level	%													
Yields	kg	500	400	500	650									
Fertilizer N	kg				9									
P_2O_5	kg				5									
K_2O	kg													
CROP: GROUNDNUTS														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O														
CROP: SUNFLOWER														
Farmers in Production Level	%													
Yields	kg	400	350	600	800									
Fertilizer N	kg			7	14									
P_2O_5	kg			10	20									
K_2O	kg													
CROP:														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O	kg													
CROP:														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O	kg													
CROP:														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O	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 Tropics[1]. Here, we can start slightly lower (about 1 350 m) 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). Neverless, 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 Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Y. of rec.
9034025	Kisumu Met.	LM	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	
1 145 m	Station	3	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	64
			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	Kibos Cotton	LM	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	
1 171 m	Research Stat.	2–3	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	9
			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	Kano Irrigation	LM	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	
1 218 m	Station	3	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	7
			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	Koru Coffee	UM	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	
1 559 m	Research	3	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	6
	Station	lp	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; 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 altidude	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	Kisumu, P.C's Office	72	Average	1 041	43	71	127	184	140	72	53	70	59	55	86	82
1 135 m			60% prob.[1]	931	18	44	115	156	111	50	43	45	44	38	31	56
9034008	Miwani, The Mill	52	Av.	1 341	63	85	137	216	164	100	83	104	86	90	116	98
1 206 m			60%	1 202	39	62	119	195	128	80	64	92	74	77	62	69
9034011	Maseno, Vet. Farm	42	Av.	1 678	64	81	142	262	211	98	87	131	159	173	160	110
1 463 m			60%	1 510	40	42	132	240	186	84	67	116	128	146	120	76
9034012	Miwani, Sugar Section I	40	Av.	1 381	57	88	141	228	166	103	77	111	92	97	126	103
1 219 m			60%	1 242	46	57	120	185	141	88	68	97	74	80	85	60
9034025	Kisumu, Met. Station	37	Av.	1 353	56	99	148	236	174	73	64	88	87	88	143	98
1 148 m			60%	1 212	32	67	133	200	148	46	52	72	76	72	104	73
9034060	Kisumu, New Prison	23	Av.	1 343	41	86	140	247	192	63	62	82	96	91	146	97
1 219 m			60%	1 161	26	45	108	217	108	34	40	60	70	83	118	44
9034078	Maseno, Gov. Training	16	Av.	1 853	71	105	157	298	216	111	80	134	161	191	180	151
1 515 m	Institute															
9034081	Kibos Cotton Exp.St.	24	Av.	1 320	46	91	156	223	164	67	66	102	91	84	137	94
1 172 m			60%	1 181	20	62	139	200	123	52	43	71	86	67	100	52
9034085	Kisumu Town Hall	14	Av.	1 588	78	116	160	243	168	92	43	68	81	89	121	93
1 180 m																
9034086	Ahero, Kano Irr. Stat.	14	Av.	1 219	82	98	152	204	124	82	72	57	60	81	111	94
1 219 m																
9035046	Chemelil Plantations	44	Av.	1 396	76	98	124	192	155	106	82	97	97	105	173	92
1 229 m			60%	1 253	64	65	109	161	134	91	72	83	78	92	87	45
9035148	Koru Mission	13	Av.	1 650	115	99	183	208	159	146	134	126	62	105	176	116
1 706 m																
9035220	Koru Homa Lime Co.	15	Av.	1 059[2]	63	72	129	151	123	94	82	92	71	58	84	71
1 493 m																
9035230	Koru, Coffee Board	16	Av.	1 742[3]	111	91	199	270	150	143	133	134	96	103	137	125
1 574 m	Substat.															

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

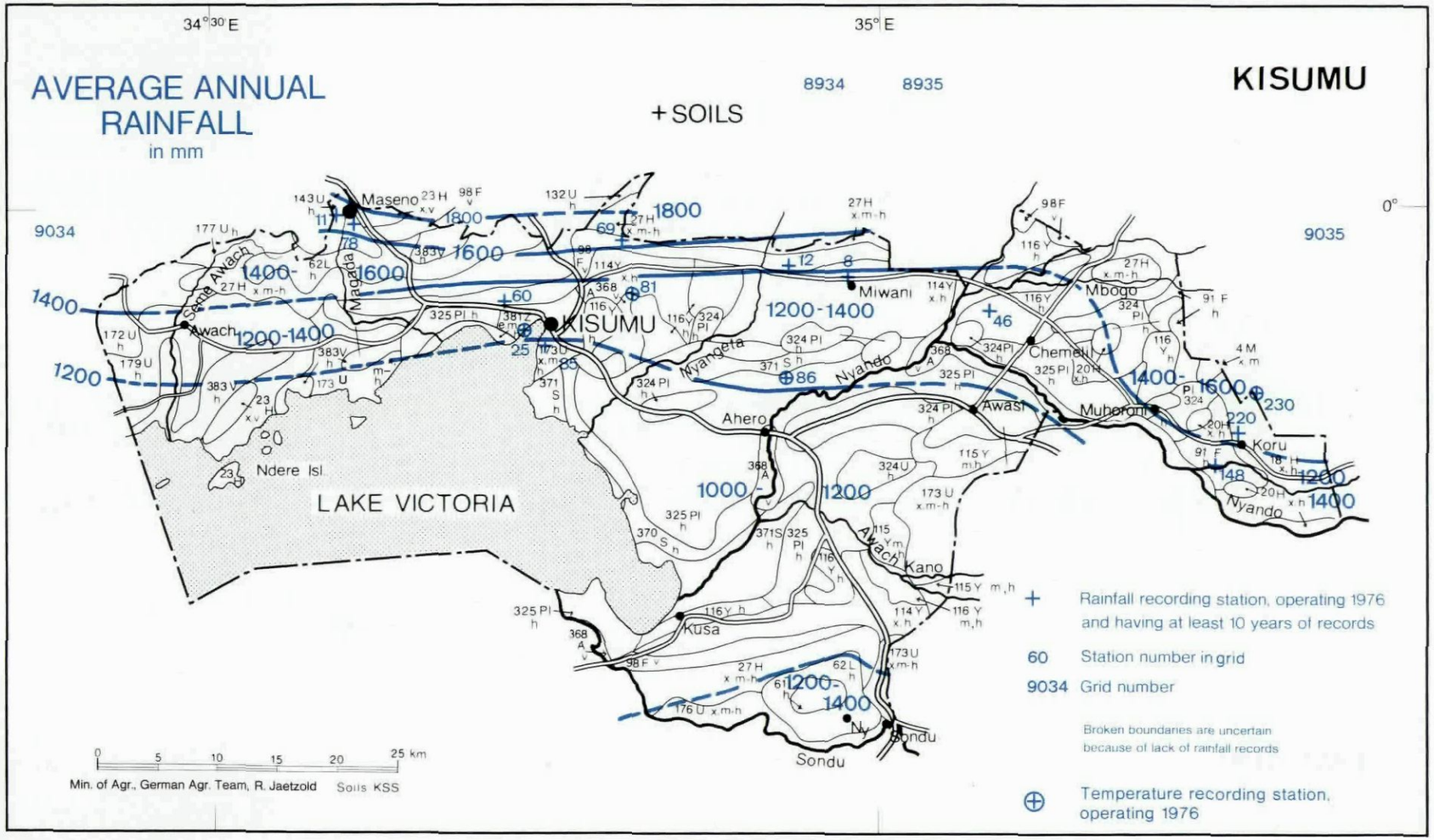
TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

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	vli or two	1 500–1 600	20.8°–20.2°	1 400–1 600	> 700	450–550	180 or more	120–130	300–310
	l i s			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 ⌐ (m/s)i	1 200–1 500	22.3°–20.9°	1 400–1 600	600–700	450–600	180 or more	110–120	290–300
	l/m ⌐ (m/s or s/m)			1 200–1 580	550–700	450–600	170 or more	105–120	275–290
	l/m ⌐ (s/m)i			1 200–1 400	600–700	450–500	170 or more	100–110	270–280
LM 3 L. Midland Cotton Zone	m/li(s or s/vs)	1 140–1 450	22.7°–21.0°	1 000–1 400	450–650	330–500	155–175	75–105	230–280
	m/l ⌐ (s or s/vs)			1 100–1 350	500–650	330–450	155–165	75–100	230–265
	m+f(vs)			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	

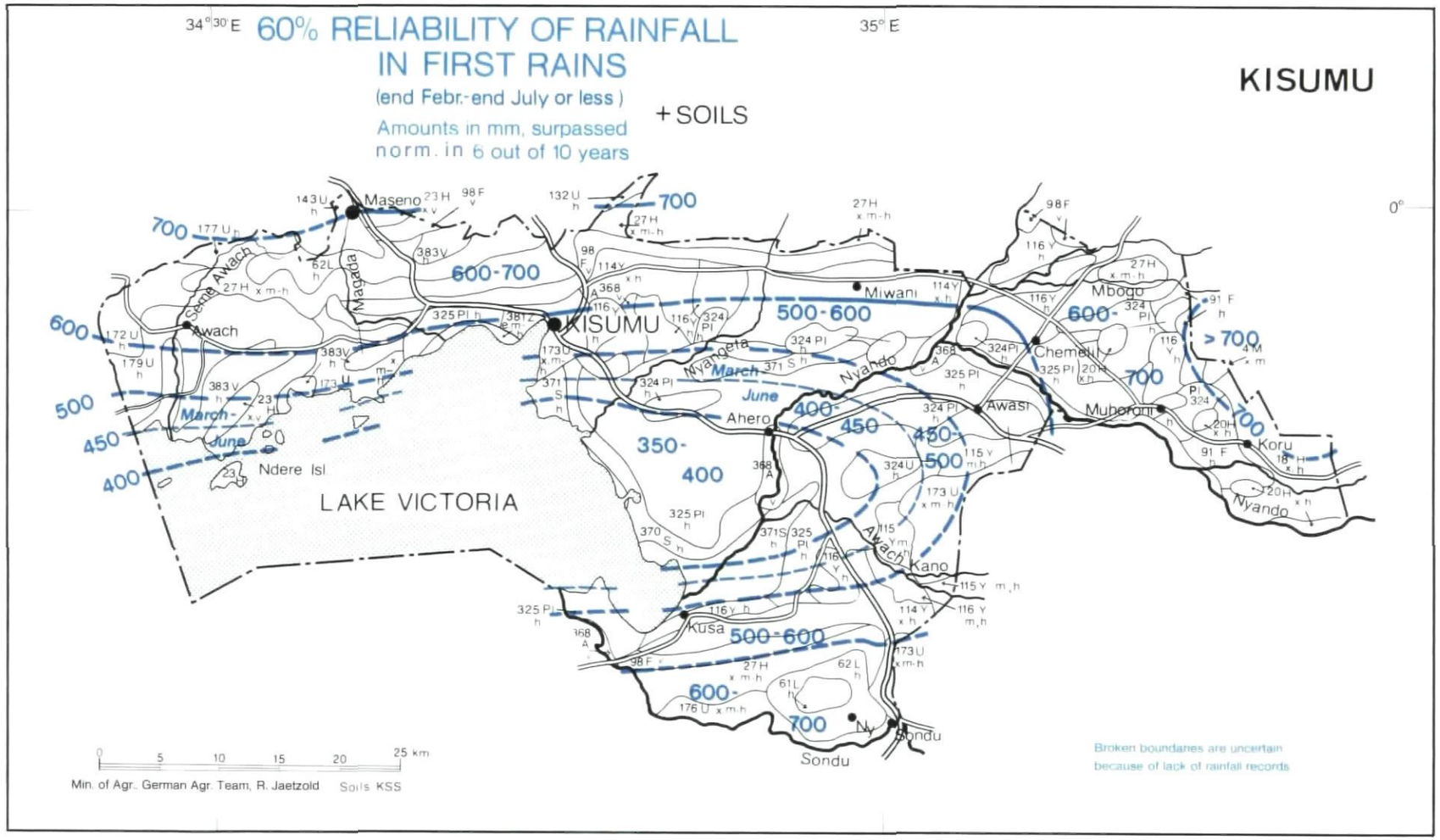
1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants

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

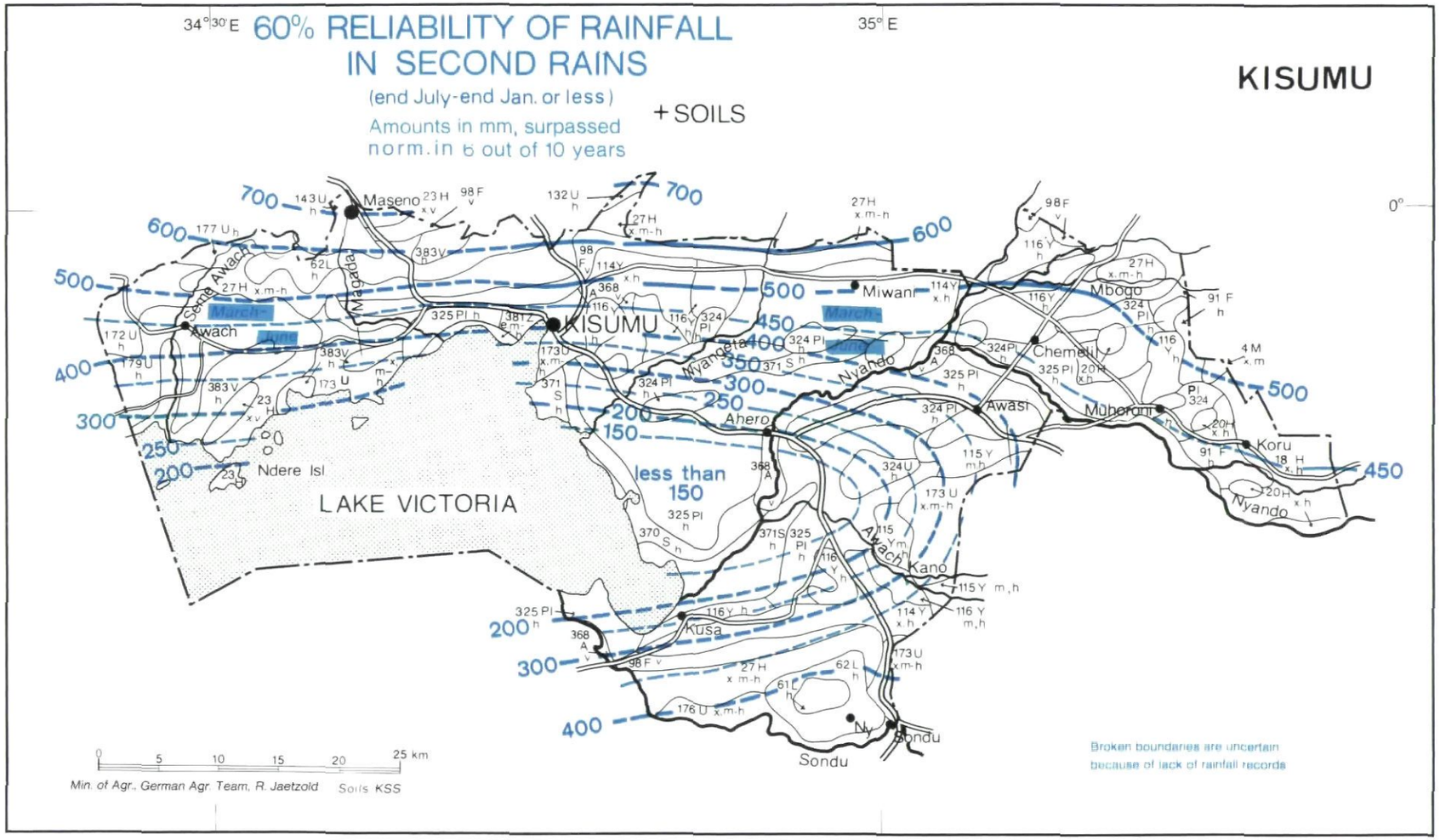
3) Only added if rainfall continues at least for survival (> 0.2 E_o) of most long term crops



AVERAGE ANNUAL RAINFALL
in mm
KISUMU
+ SOILS
34°30' E
35° E
8934
8935
9034
9035
0°
LAKE VICTORIA
Maseno
KISUMU
Awach
Ndere Isl.
Miwani
Mbogo
Chemelil
Muhoroni
Koru
Awasi
Ahero
Kano
Kusa
Ny
Sondu
Nyangeta
Nyando
Magada
Seme Awach
1800
1600
1400
1200-1400
1200
1000
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
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS



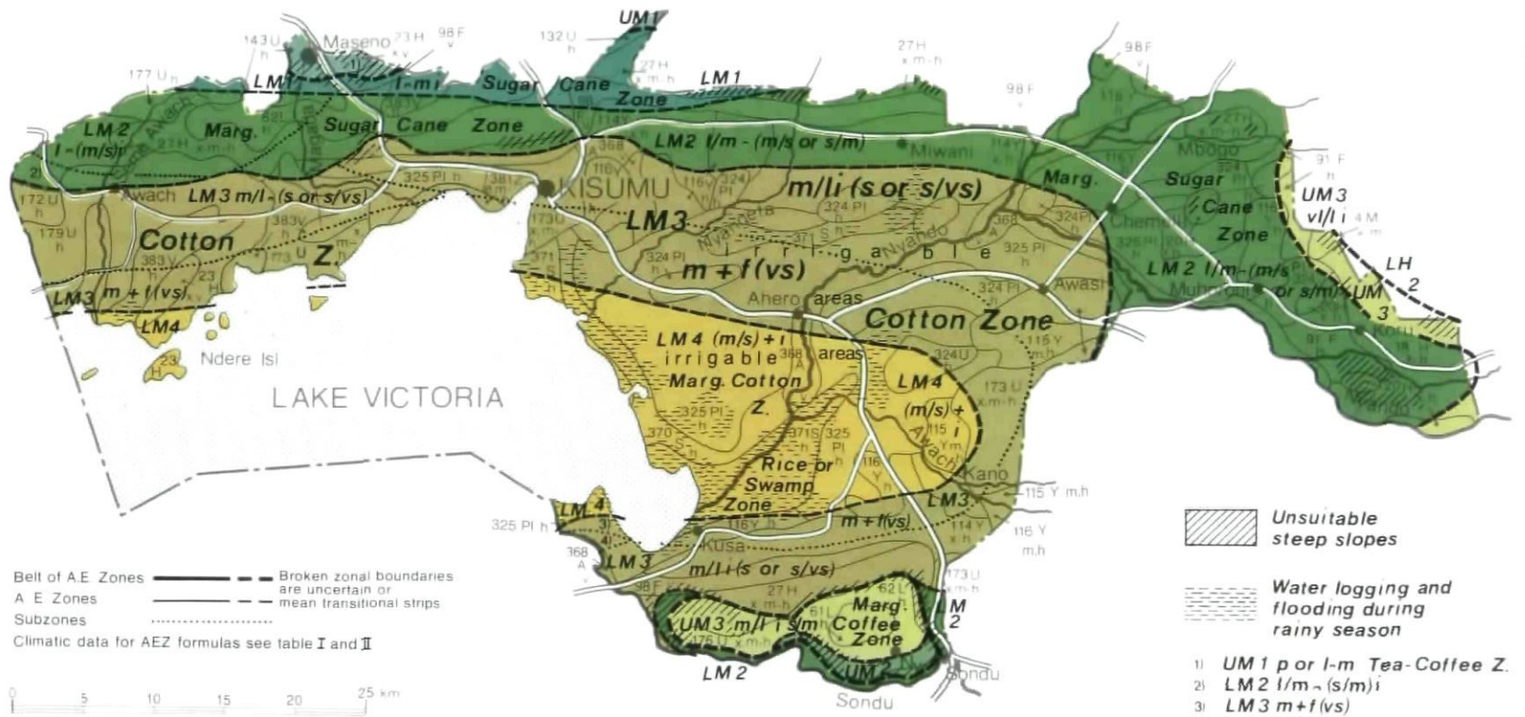
60% RELIABILITY OF RAINFALL
IN FIRST RAINS
(end Febr.-end July or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+ SOILS
KISUMU
34°30' E
35° E
0°
LAKE VICTORIA
Maseno
KISUMU
Awach
Ndere Isl
Miwani
Mbogo
Chemelil
Muhoroni
Koru
Awasi
Ahero
Kano
Kusa
Ny
Sondu
Nyando
Nyangeta
Seme Awach
Magada
March-June
700
600
500
450
400
600-700
500-600
350-400
400-450
450-500
600-700
> 700
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS
Broken boundaries are uncertain
because of lack of rainfall records



34°30'E
60% RELIABILITY OF RAINFALL
IN SECOND RAINS
(end July-end Jan. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
35° E
KISUMU
0°
Maseno
KISUMU
Miwani
Mbogo
Chemelil
Awasi
Muhoroni
Koru
Ahero
Kano
Kusa
Ny
Sondu
Awach
Ndere Isl
LAKE VICTORIA
Seme Awach
Magada
Nyangeta
Nyando
March-June
less than 150
700
600
500
450
400
350
300
250
200
150
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS
Broken boundaries are uncertain
because of lack of rainfall records

AGRO-ECOLOGICAL ZONES + SOILS

KISUMU



AGRO-ECOLOGICAL ZONES

UM = *UPPER MIDLAND ZONES*

UM 1 = *C o f f e e - T e a Z o n e*

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

Very small area near Maseno. Land use potential see Kakamega District

UM 2 = *C o f f e e Z o n e*

Small and transitional because soils and unimodal distribution of rainfall do not promote high yields, see South Nyanza District

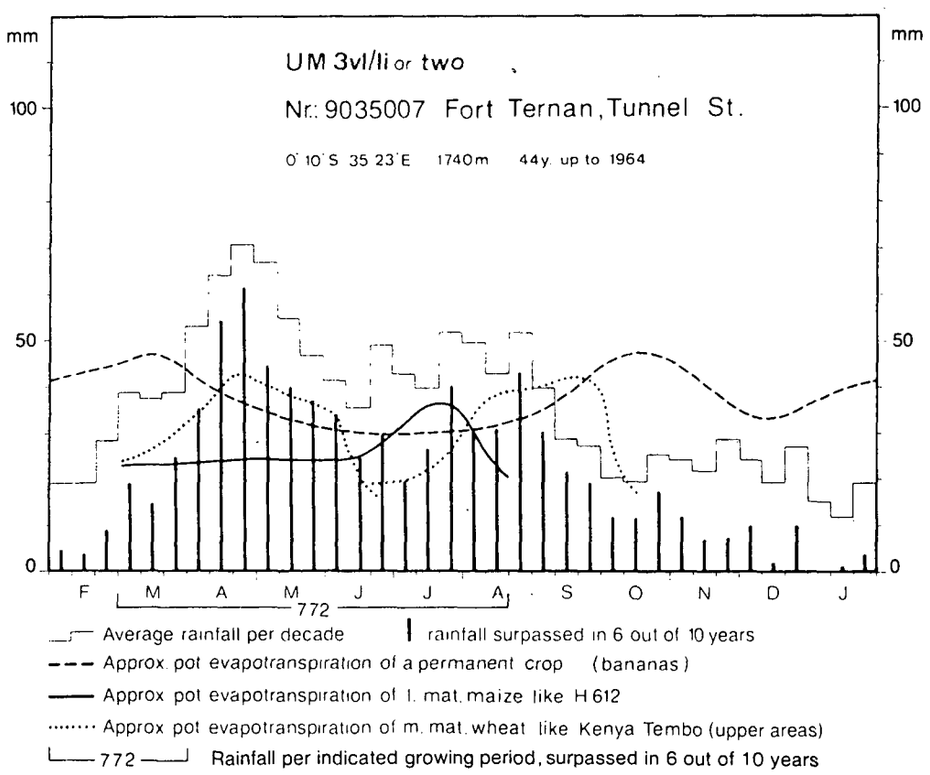
UM 3 = *M a r g i n a l C o f f e e Z o n e*

UM 3 m/l i s/m = *Marginal Coffee Zone with a medium to long cropping season, intermediate rains, and a short to medium one*

G o o d y i e l d p o t e n t i a l (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, avocadoes, passion fruits (higher places)

F a i r y i e l d p o t e n t i a l (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

P a s t u r e a n d f o r a g e
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 vl/l i or two = *Marginal Coffee Zone with a very long to long cropping season and intermediate rains, dividable in two variable cropping seasons and i.r.*
(see Diagram Ft. Ternan)

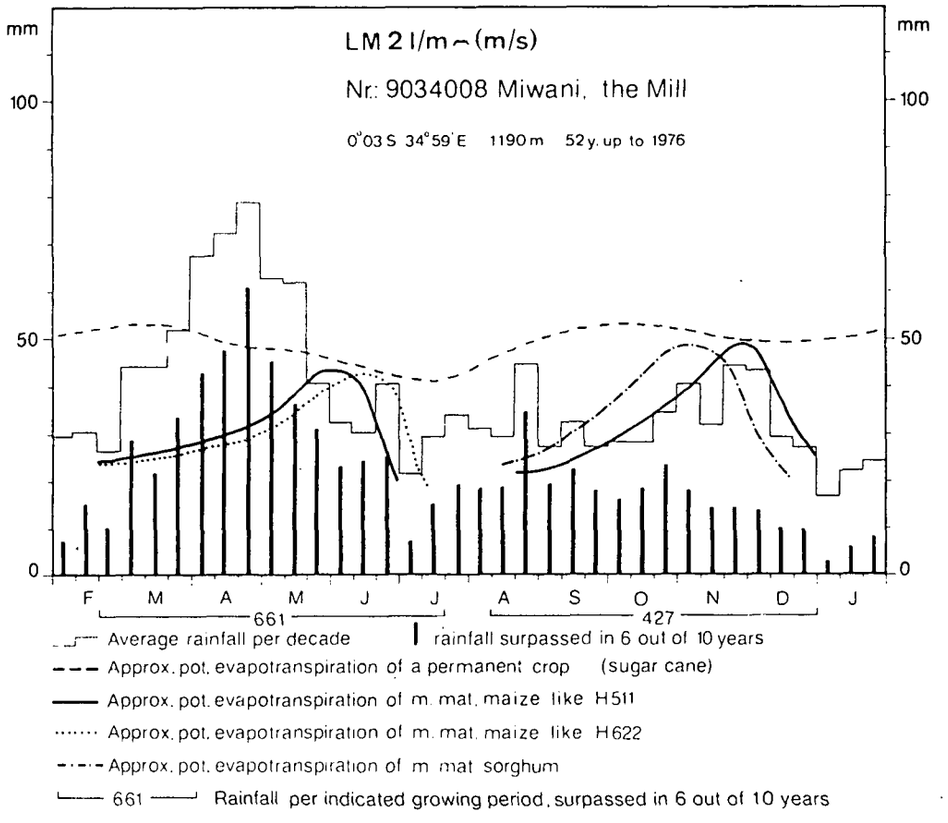
Small, potential 1st rains nearly like above except prefering maize H 612, but second rains start undistinctly around July with fair chances for m. mat. maize like H 511–12. Marginal for coffee also on good soils

LM = *LOWER MIDLAND ZONES*

LM 1 = *Lower Midland Sugar Cane Zone*

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

Very small, land use potential see Siaya District



LM 2 = *Marginal Sugar Cane Zone*

LM 2 l/m⌐ (m/s or s/m) = *Marginal Sugar Cane Zone 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)

F a i r y i e l d p o t e n t i a l (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)

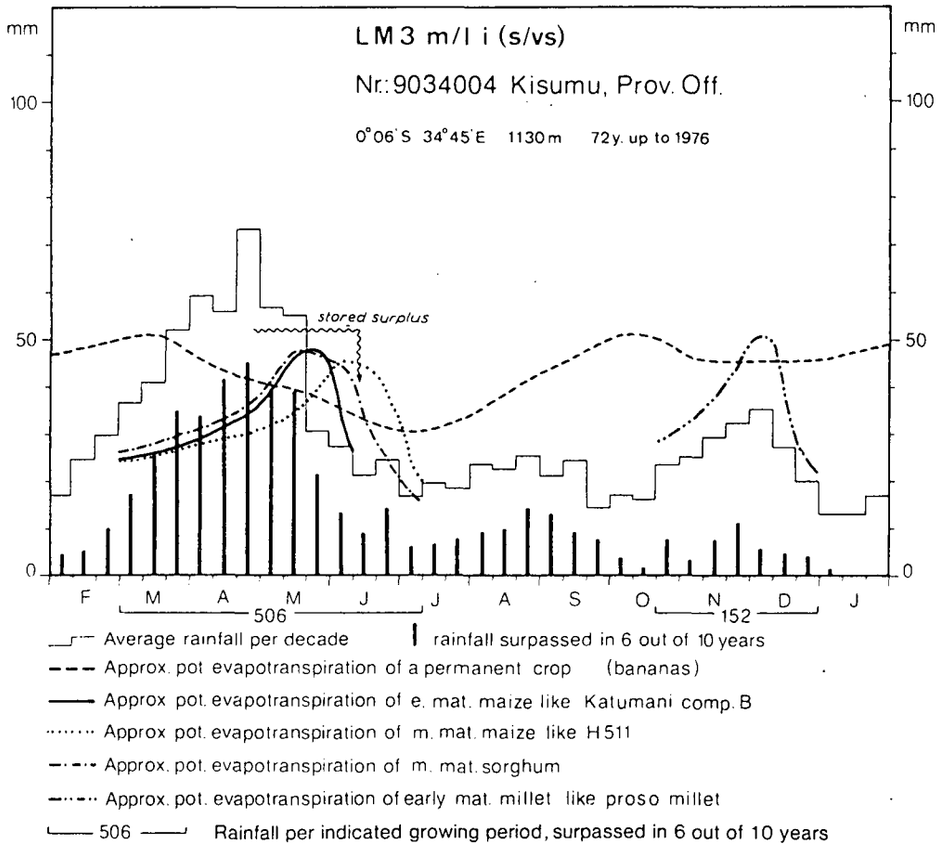
P a s t u r e a n d f o r a g e
0.6–1.2 ha/LU on sec. high grass savanna with Hyparrhenia and Panicum dominating; down to 0.15 ha/LU feeding Napier or Bana grass, maize stalks, and Banana leaves, and planting fodder legumes

LM 2 l⌐ (m/s) i = *Marginal Sugar Cane Zone with a long cropping season followed by a (weak) medium to short one and intermediate rains*

Small, potential see Siaya District

LM 2 l/m ⌐ (s/m) i = *Marginal Sugar Cane Zone with a long to medium cropping season followed by a (weak) short to medium one and intermediate rains*

Very small, potential see Siaya District



LM 3 = *L o w e r M i d l a n d C o t t o n Z o n e*

LM 3 m/l i (s or s/vs) = *Lower Midland Cotton Zone with a medium to long cropping season, 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], m. mat. sorghum (70–80 %), e. mat. bulrush millet (70–80 %); m. mat. beans, green grams, cowpeas; groundnuts and bambarra gr. (both in light soils), simsim[3]; sweet potatoes; cotton (∿ 60 %), m. mat. soya beans, e. mat. sunflower like 52; tomatoes, onions; chick peas (on heavy bl. soils), dwarf castor[4], kales, muskmelons
2nd rains, start undistinctly after middle rains of Jy.–S. in Oct.: Ratoon of sorghum; simsim (plant 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. bambarra 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 m/l ⌐ (s or s/vs) = Lower Midland Cotton Zone with a medium to long cropping season, 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 m i (s/vs) = Lower Midland Cotton Zone with a medium cropping season, intermediate rains, and a (weak) short to very short one

Very small, land use potential see South Nyanza District

LM 3 m + f (vs) = 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 % (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 (m/s) + i = Marginal Cotton Zone with a (weak) medium to short cropping season and intermediate rains

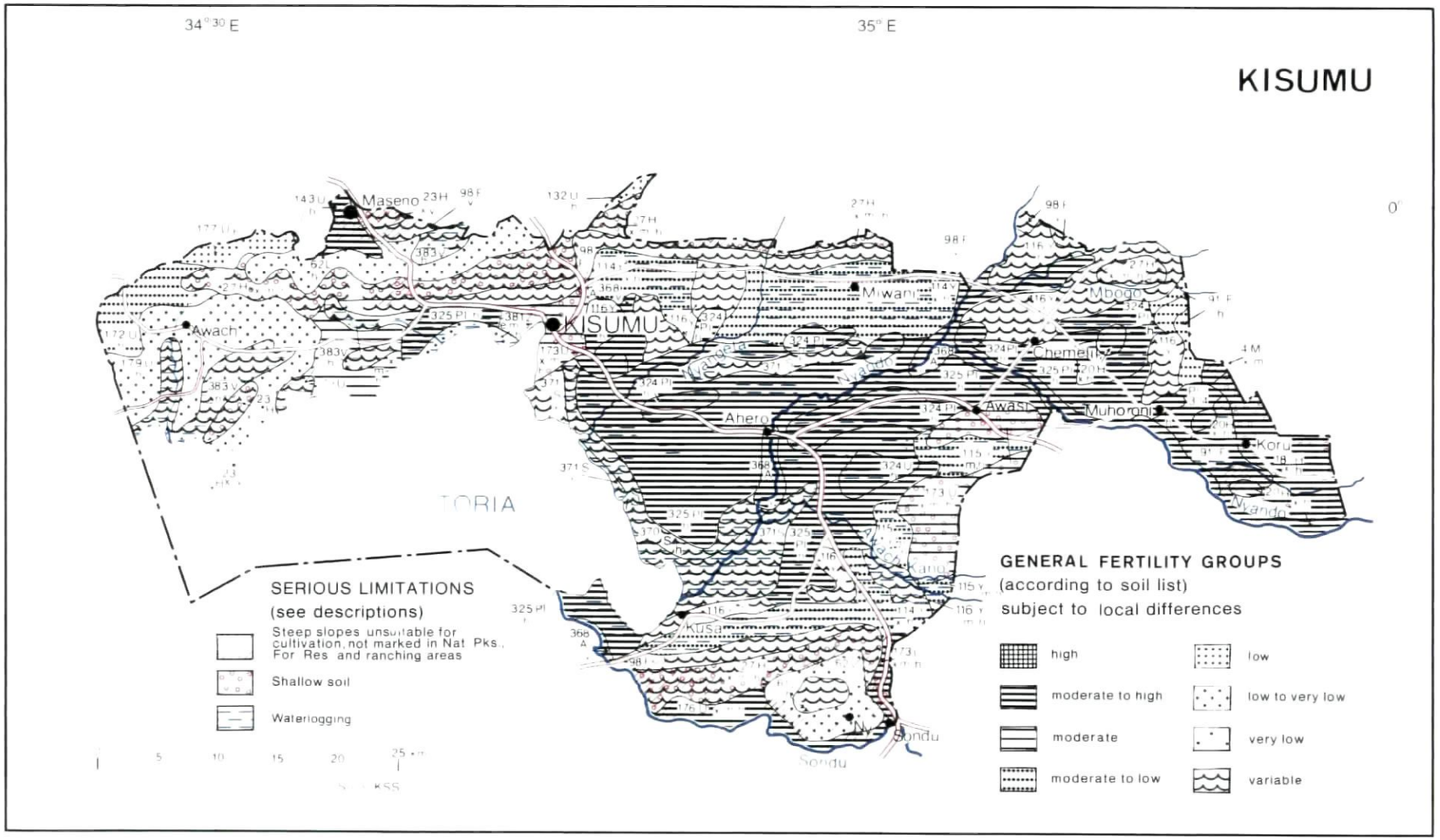
Good yield potential
1st rains, start norm. mid March: E. mat. sorghum (∿ 60 %), e. mat. foxtail or proso millet (60–70 %); e. mat. beans (∿ 60 %), tepary beans (70–80 %), green grams, cowpeas, chick peas (on h. black soils); e. mat. sunflower like Issanka (∿ 60 %), simsim
Whole year: Sisal
Near swamps: 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


34°30 E
35° E
KISUMU
0°
Maseno
Awach
KISUMU
Miwani
Ahero
Awasi
Chemelil
Muhoroni
Mbogo
Koru
Kondu
TORIA
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes unsuitable for cultivation, not marked in Nat. Pks., For. Res. and ranching areas
Shallow soil
Waterlogging
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
moderate to low
low
low to very low
very low
variable

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 northwestern area are the soils of the rocky Southern Kakamega Uplands (unit 179 U) which are soils of low fertility underlain by murram 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 waterlogging.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on olivine basalts and ashes of major older volcanoes

4 M x, m[1] = well drained, shallow to moderately deep, dark reddish brown, friable, humic, rocky and stony clay loam (nito-humic CAMBISOLS, rocky phase)

SOILS ON HILLS AND MINOR SCARPS

Soils developed on intermediate igneous rocks (syenites, trachytes, etc.)

18 H x, 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 PHAEOZEMS, lithic and bouldery phase)

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

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

Soils developed on granites

23 H x, v = 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 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-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)

Soils developed on Jurassic sandstones, grits and conglomerates

30 H m = well drained, shallow, brown, fraible, rocky and stony, sandy clay loam (on hills and plateau rests) (eutric REGOSOLS)

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 of mollic GLEYSOLS, partly petro-ferric phase (rhodic FERRALSOLS, petroferric phase)

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

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 h = well drained, deep to very deep, dusky red to dark reddish brown, friable clay, often with humic topsoil (nito-rhodic FERRALSOLS, with verti-mollic NITOSOLS)

Soils developed on colluvium from undifferentiated Basement System rocks

98 F 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 PIEDMONT PLAINS

Soils developed on alluvium from undifferentiated Basement System rocks

114 Y x, h = 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 m, h = 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 h = 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 h = well drained, deep to extremely deep, dark red, friable clay, with thick humic topsoil (mollic NITOSOLS; with nito-luvic PHAEOZEMS)

143 U h = 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 h = 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)

Soils developed on intermediate igneous rocks (andesites, etc.)

172 U h = 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 x, m-h = well drained, shallow, dark reddish brown to brown, sandy clay loam to gravelly clay, partly over petroplinthite („murram cuirass" soils soils (50—75%) and eutric CAMBISOLS, lithic or petroferric phase; with orthic LUVISOLS)

Soils developed on acid igneous rocks

176 U x, m-h = 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)

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 petroferric phase; with orthic ACRISOLS)
- — 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 Pl h = 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 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 FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

368 A v = 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

370 S h = very poorly drained, very deep, very dark grey to black, firm, cracking clay, with acid humic topsoil (seasonal swamps) (humic GLEYSOLS)

371 S h = 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

381 Z l, m-h = 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

383 V h = 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 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 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 si still adequte, 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	118	284
Seme East	14 841	17 239	32 080	6 072	139	229
Seme West	12 603	14 884	27 487	5 546	122	224
Maseno Division	43 341	49 847	93 188	18 241	380	245
North East Kano	20 042	21 651	41 693	8 421	202	205
South East Kano	17 645	19 208	36 853	6 646	296	124
North Nyakach	15 959	18 170	34 129	6 489	183	186
South Nyakach	11 092	12 847	23 939	4 233	79	301
West Nyakach	8 995	10 062	19 057	4 025	97	195
Nyando Div.	73 733	81938	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

Location/Division without townships	in '00 ha = sqkm					in '00 ha = sqkm							in ha	
	Area total	Non-agricultural land			Agricultural land	Area in agro-ecological zones AEZ							Agric. land per	
	Census 79	Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, homesteads, rivers...)		UM 1	UM 2	UM 3	LM 1	LM 2	LM 3	LM 4	household	person
Kisumu East Kisumu West	226	7		22	197	13			24	63	97		2.97	0.59
Seme East	139			13	126				2	67	57		2.08	0.39
Seme West	122		sw. 2	12	108					19	82	7	1.95	0.39
Maseno Division	487	7	sw. 2	47	431	13			26	149	236	7	2.02	0.39
North East Kano	202		sw. 15	20	167					17	150		2.27	0.46
South East Kano	296		sw. 29	30	237					6	143	88	3.81	0.68
North Nyakach	183		sw. 37	18	128						88	40	1.97	0.38
South Nyakach	79	10		8	61		8	31		20	2		1.44	0.25
West Nyakach	97	10	F. 2 sw. 3	.10	72			16		7	48	1	1.79	0.38
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			10		56			1.99	0.54
Koru	78	9		8	61			11		50			3.62	0.80
Miwani	102	10		10	82				6	76			3.65	1.01
Chemelil	182	6		18	164			3		155			3.30	0.73
Muhoroni Division	438	27		44	356			24	6	33			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 percent of the maize harvested in AEZ LM 1–3 is sold to the Marketing Board, while in LM 3–4 all food produced in 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)]

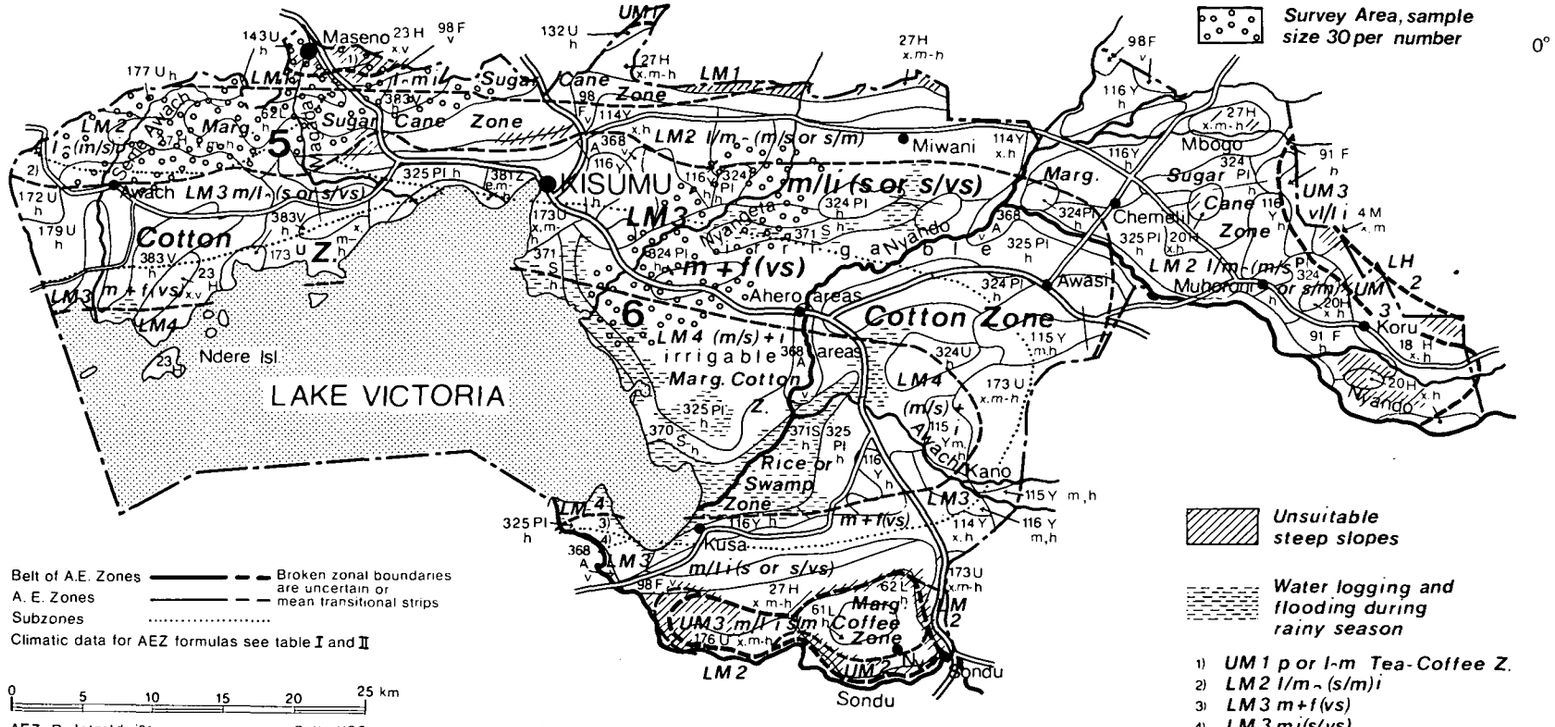
Lasting improvement of the socio-economic situation of most small-scale farmers of the district can only be achieved through large investment in drainage and irrigation by the Government. The sugar belt yields returns mostly to larger farms only.

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

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

KISUMU



KISUMU DISTRICT

AEZ: UM 1 – LM 1–3

TABLE 8 a: **FARM ORGANISATION ACCORDING TO FARM SIZE GROUP**

Survey Area 05

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.9	4.0	7.6
Land Use: Annual Crops[1]				
First Season		0.1	0.2	0.1
Maize	ha	0.3	0.7	1.8
Sorghum	ha	0.2	0.3	0.4
Maize & Sorghum	ha	0.1	0.2	-
Cotton	ha	0.3	0.5	0.6
Cassava	ha	0.1	0.1	0.2
Others		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
Maize & Beans	ha	-	-	0.2
Cassava	ha	0.1	0.1	0.2
Others		-	0.2	0.8
Total	ha	0.4	0.9	2.2
Permanent Crops[1]				
Sugarcane	ha	0.1	0.3	0.5
	ha			
	ha			
	ha			
portion of total	%	5%	8%	7%
Grazing & Forage	ha	0.3	1.4	2.2
portion of total	%	16%	35%	29%
Other Land Use	ha	0.3	0.1	1.1
Livestock on Farm:				
Cattle: local	LU	1.9	3.8	5.1
improved	LU	-	-	-
Sheep & Goats	LU	0.3	0.8	1.4
Total	LU	2.2	4.6	6.5

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.9	0.8	0.8
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	30%	30%	110%
Labour on Farm:				
Family Adults	persons	2.7	3.3	3.2
Perm. Hired Labour	"	0.1	0.7	0.7
Children > 14 years	"	2.4	3.3	2.2
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.56	0.16	2.72
Children < 14 years	"	2.54	-	2.54
Subsistence Units	SU	4.08	0.16	4.24
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1241	2000	
Beans	kg	71	113	
Cabbage	kg	4		
Sorghum	kg	252	395	
Cowpeas	kg	14	23	
Groundnuts	kg	22	35	
	kg			
	kg			

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

AEZ: LM 3–4

Survey Area 06

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.4	2.5	4.2
Land Use: Annual Crops[1]				
First Season				
Maize	ha	0.2	0.3	0.2
Sorghum	ha	0.1	0.2	0.1
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 Season[1]				
Cotton	ha	0.2	0.1	0.6
Maize & Beans	ha	-	-	0.7
	ha			
Total	ha	0.2	0.1	1.3
Permanent Crops[1]				
	ha			
	ha			
	ha			
	ha			
portion of total	%			
Grazing & Forage	ha	0.4	0.8	1.5
portion of total	%	29%	32%	36%
Other Land Use	ha	0.2	0.3	0.5
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

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.7	0.6	0.8
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	10%	20%	80%
Labour on Farm:				
Family Adults	persons	2.7	2.5	2.5
Perm. Hired Labour	"	-	0.2	0.5
Children > 14 years	"	1.3	2.8	1.8
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.18	0.33	2.51
Children < 14 years	"	3.06	-	3.06
Subsistence Units	SU	4.01	0.33	4.34
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1304	2102	
Beans	kg	112	178	
Sorghum	kg	156	244	
	kg			
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Sunflower, Cassava

1) Major crops only considered

2) Based on 1979 Census figures

KISUMU DISTRICT

TABLE 9 a: 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 ha	%	Perm. Crops ha	%	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	2.3	54	0.3	7	1.2	27	-	-	0.3	7	0.2	6
Avg. 1	2.3	46	0.7	13	1.2	24	-	-	0.6	12	0.3	5
Up. Qu.	2.8	67	0.5	11	1.8	35	-	-	0.4	13	0.3	7
Lo. Qu.	1.2	40	-	-	0.4	17	-	-	-	-	0.1	2
Total	69.8		8.5		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

Range	Improved Seeds Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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 = 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 Crops ha	%	Perm. Crops ha	%	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_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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 & Sorgm	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

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

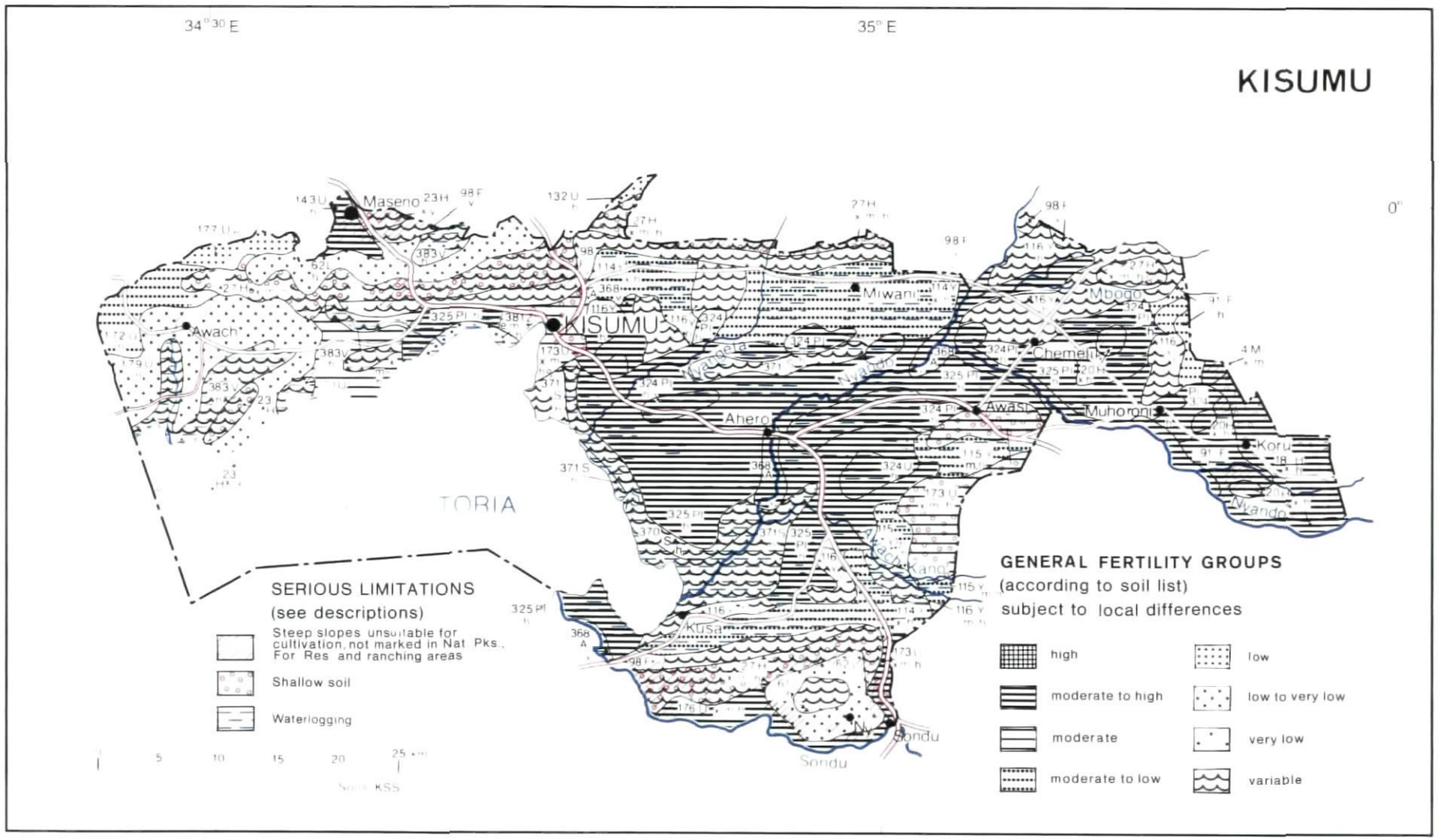
Poor yield potential

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


34°30 E
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KISUMU
Maseno
Awach
KISUMU
Miwani
Ahero
Chemelil
Muhoroni
Awasi
Koru
Mbogo
Kano
Kusa
Sondu
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes unsuitable for cultivation, not marked in Nat. Pks., For. Res. and ranching areas
Shallow soil
Waterlogging
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
moderate to low
low
low to very low
very low
variable

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 northwestern area are the soils of the rocky Southern Kakamega Uplands (unit 179 U) which are soils of low fertility underlain by murram 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 waterlogging.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on olivine basalts and ashes of major older volcanoes

4 M x, m[1] = well drained, shallow to moderately deep, dark reddish brown, friable, humic, rocky and stony clay loam (nito-humic CAMBISOLS, rocky phase)

SOILS ON HILLS AND MINOR SCARPS

Soils developed on intermediate igneous rocks (syenites, trachytes, etc.)

18 H x, 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 PHAEOZEMS, lithic and bouldery phase)

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

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

Soils developed on granites

23 H x, v = 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 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-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)

Soils developed on Jurassic sandstones, grits and conglomerates

30 H m = well drained, shallow, brown, fraible, rocky and stony, sandy clay loam (on hills and plateau rests) (*eutric* REGOSOLS)

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 of mollic GLEYSOLS, partly petro-ferric phase (rhodic FERRALSOLS, petroferric phase)

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

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 h = well drained, deep to very deep, dusky red to dark reddish brown, friable clay, often with humic topsoil (nito-rhodic FERRALSOLS, with verti-mollic NITOSOLS)

Soils developed on colluvium from undifferentiated Basement System rocks

98 F 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 PIEDMONT PLAINS

Soils developed on alluvium from undifferentiated Basement System rocks

114 Y x, h = 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 m, h = 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 h = 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 h = well drained, deep to extremely deep, dark red, friable clay, with thick humic topsoil (mollic NITOSOLS; with nito-luvic PHAEOZEMS)

143 U h = 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 h = 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)

Soils developed on intermediate igneous rocks (andesites, etc.)

172 U h = 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 x, m-h = well drained, shallow, dark reddish brown to brown, sandy clay loam to gravelly clay, partly over petroplinthite („murram cuirass" soils soils (50–75%) and eutric CAMBISOLS, lithic or petroferric phase; with orthic LUVISOLS)

Soils developed on acid igneous rocks

176 U x, m-h = 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)

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 petroferric phase; with orthic ACRISOLS)
- 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 Pl h = 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 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 FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

368 A v = 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

370 S h = very poorly drained, very deep, very dark grey to black, firm, cracking clay, with acid humic topsoil (seasonal swamps) (humic GLEYSOLS)

371 S h = 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

381 Z l, m-h = 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

383 V h = 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 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 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 si still adequte, 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	118	284
Seme East	14 841	17 239	32 080	6 072	139	229
Seme West	12 603	14 884	27 487	5 546	122	224
Maseno Division	43 341	49 847	93 188	18 241	380	245
North East Kano	20 042	21 651	41 693	8 421	202	205
South East Kano	17 645	19 208	36 853	6 646	296	124
North Nyakach	15 959	18 170	34 129	6 489	183	186
South Nyakach	11 092	12 847	23 939	4 233	79	301
West Nyakach	8 995	10 062	19 057	4 025	97	195
Nyando Div.	73 733	81938	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**

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							Agric. land per	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads, rivers...)		AEZ							household	person
	Census 79					UM 1	UM 2	UM 3	LM 1	LM 2	LM 3	LM 4		
Kisumu East Kisumu West	226	7		22	197	13			24	63	97		2.97	0.59
Seme East	139			13	126				2	67	57		2.08	0.39
Seme West	122		sw. 2	12	108					19	82	7	1.95	0.39
Maseno Division	487	7	sw. 2	47	431	13			26	149	236	7	2.02	0.39
North East Kano	202		sw. 15	20	167					17	150		2.27	0.46
South East Kano	296		sw. 29	30	237					6	143	88	3.81	0.68
North Nyakach	183		sw. 37	18	128						88	40	1.97	0.38
South Nyakach	79	10		8	61		8	31		20	2		1.44	0.25
West Nyakach	97	10	F. 2 sw. 3	10	72			16		7	48	1	1.79	0.38
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			10		56			1.99	0.54
Koru	78	9		8	61			11		50			3.62	0.80
Miwani	102	10		10	82				6	76			3.65	1.01
Chemelil	182	6		18	164			3		155			3.30	0.73
Muhoroni Division	438	27		44	356			24	6	33			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.

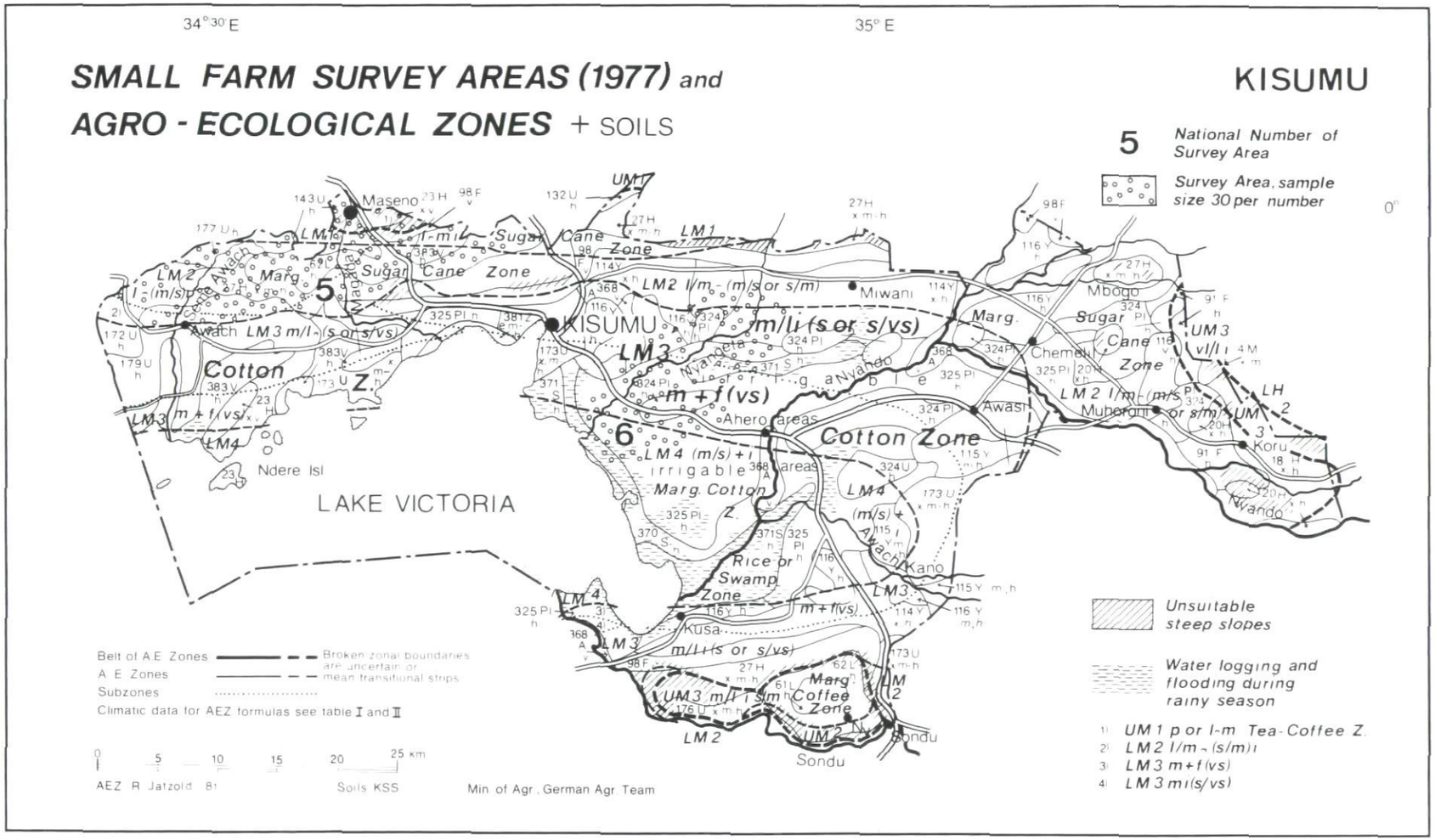
The farms investigated are relatively small in size: 2.2 to 4.4 ha; half of the land is used for crops and half for grazing. There are however still comparatively large areas of commonly owned grazing grounds available. Therefore the stocking rates given of 3.8–5.4 LU/ha do not reflect the carrying capacity 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 percent of the maize harvested in AEZ LM 1–3 is sold to the Marketing Board, while in LM 3–4 all food produced in 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


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°
KISUMU
Miwani
Maseno
Mbogo
Chemelil
Awasi
Muhoroni
Koru
Kwando
Ahero areas
Kano
Kusa
Sondu
Ndere Isl
LAKE VICTORIA
Cotton Zone
Sugar Cane Zone
Marg. Cotton Z.
Rice or Swamp Zone
Marg Coffee Zone
Irrigable areas
Unsuitable steep slopes
Water logging and flooding during rainy season
1) UM1 p or l-m Tea-Coffee Z.
2) LM2 l/m-(s/m)1
3) LM3 m+f(vs)
4) LM3 m1(s/vs)
Belt of A E Zones
A E Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
0 5 10 15 20 25 km
AEZ R Jatzold 81
Soils KSS
Min of Agr , German Agr Team

KISUMU DISTRICT

TABLE 8 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: UM 1 - LM 1-3

Survey Area 05

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.9	4.0	7.6
Land Use: Annual Crops[1] First Season		0.1	0.2	0.1
Maize	ha	0.3	0.7	1.8
Sorghum	ha	0.2	0.3	0.4
Maize & Sorghum	ha	0.1	0.2	-
Cotton	ha	0.3	0.5	0.6
Cassava	ha	0.1	0.1	0.2
Others		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
Maize & Beans	ha	-	-	0.2
Cassava	ha	0.1	0.1	0.2
Others		-	0.2	0.8
Total	ha	0.4	0.9	2.2
Permanent Crops[1]				
Sugarcane	ha	0.1	0.3	0.5
	ha			
	ha			
	ha			
portion of total	%	5%	8%	7%
Grazing & Forage	ha	0.3	1.4	2.2
portion of total	%	16%	35%	29%
Other Land Use	ha	0.3	0.1	1.1
Livestock on Farm:				
Cattle: local	LU	1.9	3.8	5.1
improved	LU	-	-	-
Sheep & Goats	LU	0.3	0.8	1.4
Total	LU	2.2	4.6	6.5

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.9	0.8	0.8
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	30%	30%	110%
Labour on Farm:				
Family Adults	persons	2.7	3.3	3.2
Perm. Hired Labour	"	0.1	0.7	0.7
Children > 14 years	"	2.4	3.3	2.2
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.56	0.16	2.72
Children < 14 years	"	2.54	-	2.54
Subsistence Units	SU	4.08	0.16	4.24
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1241	2000	
Beans	kg	71	113	
Cabbage	kg	4		
Sorghum	kg	252	395	
Cowpeas	kg	14	23	
Groundnuts	kg	22	35	
	kg			
	kg			

Other crops cultivated: Beans, Sweet Potatoes, Groundnuts, Cowpeas, Onions, Tomatoes

1) Major crops only considered

2) Based on 1979 Census figures

KISUMU DISTRICT

TABLE 8 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: LM 3–4

Survey Area 06

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.4	2.5	4.2
Land Use: Annual Crops[1]				
First Season				
Maize	ha	0.2	0.3	0.2
Sorghum	ha	0.1	0.2	0.1
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 Season[1]				
Cotton	ha	0.2	0.1	0.6
Maize & Beans	ha	-	-	0.7
	ha			
Total	ha	0.2	0.1	1.3
Permanent Crops[1]				
	ha			
	ha			
	ha			
	ha			
portion of total	%			
Grazing & Forage	ha	0.4	0.8	1.5
portion of total	%	29%	32%	36%
Other Land Use	ha	0.2	0.3	0.5
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

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.7	0.6	0.8
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	10%	20%	80%
				-
Labour on Farm:				
Family Adults	persons	2.7	2.5	2.5
Perm. Hired Labour	"	-	0.2	0.5
Children > 14 years	"	1.3	2.8	1.8
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.18	0.33	2.51
Children < 14 years	"	3.06	-	3.06
Subsistence Units	SU	4.01	0.33	4.34
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1304	2102	
Beans	kg	112	178	
Sorghum	kg	156	244	
	kg			
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Sunflower, Cassava

1) Major crops only considered

2) Based on 1979 Census figures

KISUMU DISTRICT

TABLE 9 a: 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 ha	%	Perm. Crops ha	%	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	2.3	54	0.3	7	1.2	27	-	-	0.3	7	0.2	6
Avg. 1	2.3	46	0.7	13	1.2	24	-	-	0.6	12	0.3	5
Up. Qu.	2.8	67	0.5	11	1.8	35	-	-	0.4	13	0.3	7
Lo. Qu.	1.2	40	-	-	0.4	17	-	-	-	-	0.1	2
Total	69.8		8.5		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	3.8	-
Avg. 1			3.8	-
Up. Qu.	1.4	1.3	6.5	-
Lo. Qu.	1.1	0.6	1.6	-

Inputs Applied

Range	Improved Seeds Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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 = 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 Crops ha	%	Perm. Crops ha	%	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_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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 & Sorgm	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 & Sorgm	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 11 a: **HERD COMPOSITION** (GRAZING LIVESTOCK)

– in Head and Livestock Units –

Survey Area 05

AEZ: UM 1 – LM 1–3

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	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	-	-	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 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

KISUMU DISTRICT

TABLE 11 b: **HERD COMPOSITION** (GRAZING LIVESTOCK)

– in Head and Livestock Units –

Survey Area 06

AEZ: LM 3–4

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 =		18.4 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total		118	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 =		18.4 % 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

KISUMU DISTRICT

TABLE 12 a: **INPUTS AND YIELDS OF MAJOR CROPS**

AEZ: UM 1 – LM 1–3

Survey Area 05

Crop		Inputs							Yield
		Improved Seeds	Nutrients				Chemicals		
			N	P_2O_5	K_2O	Manure	Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
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
Second Rains									
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
Perennial Crops									
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		Inputs							Yield
		Improved Seeds %	Nutrients N kg/ha	P_2O_5 kg/ha	K_2O kg/ha	Manure t/ha	Chemicals Insec. kg/ha	Fungicide kg/ha	kg/ha
First Rains									
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 & Sorgm									
Maize	Avg.	50	-	-	-	-	-	-	998
Sorgm	Avg.	-	-	-	-	-	-	-	1,030
Maize	UpQu	100	-	-	-	-	-	-	1,350
Sorgm	UpQu	-	-	-	-	-	-	-	1,250
Maize	LoQu	-	-	-	-	-	-	-	675
Sorgm	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
Second Rains									
Nil									
Perennial Crops									
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 Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	72,180	38,070	53	5,900	8	28,210	39
Maize & Beans	2,620	0	0	0	0	2,620	100
Maize & Sorgm	3,864	90	2	560	14	3,214	83
Maize & Others	777	0	0	0	0	777	100
Beans	640	0	0	75	12	565	88
Sorghum	6,960	0	0	500	7	6,460	93
Cowpeas	180	0	0	0	0	180	100
Groundnuts	4,505	2,950	65	900	20	655	15
Sweet Potatoes	3,900	0	0	2,100	54	1,800	46
Sunflower	6,135	6,135	100	0	0	0	0
Cotton	9,437	9,037	96	0	0	400	4
Cabbage	120	0	0	0	0	120	100
Onions	2,400	0	0	2,400	100	0	0
Tomatoes	800	0	0	800	100	0	0
Second Rains							
Maize	42,020	21,330	51	1,560	4	19,130	46
Maize & Beans	5,355	0	0	2,080	39	3,275	61
Maize & Others	835	0	0	90	11	745	89
Beans	8,000	6,800	85	800	10	400	5
Sorghum	450	0	0	0	0	450	100
Cowpeas	240	0	0	0	0	240	100
Sunflower	4,250	4,250	100	6	0	-6	-0
Cotton	375	375	100	0	0	0	0
	Permanent Crops						
Nil							

KISUMU DISTRICT

TABLE 13 b: **DISPOSAL OF CROPS**

AEZ: LM 3–4 Survey Area 06

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	10,180	750	7	1,600	16	7,830	77
Maize & Beans	20,180	800	4	2,746	14	16,634	82
Maize & Sorgm	17,865	0	0	4,365	24	13,500	76
Maize & Others	7,567	1,895	25	217	3	5,455	72
Maize IPC	60	0	0	0	0	60	100
Beans	200	0	0	160	80	40	20
Sorghum	2,235	0	0	244	11	1,991	89
Sunflower	1,200	1,200	100	0	0	0	0
Cotton	13,796	12,156	88	370	3	1,270	9
Second Rains							
Maize & Beans	3,445	0	0	0	0	3,445	100
	Permanent Crops						
Nil							

KISUMU DISTRICT

TABLE 14 a: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 **Maize** Cases: 43[1)]

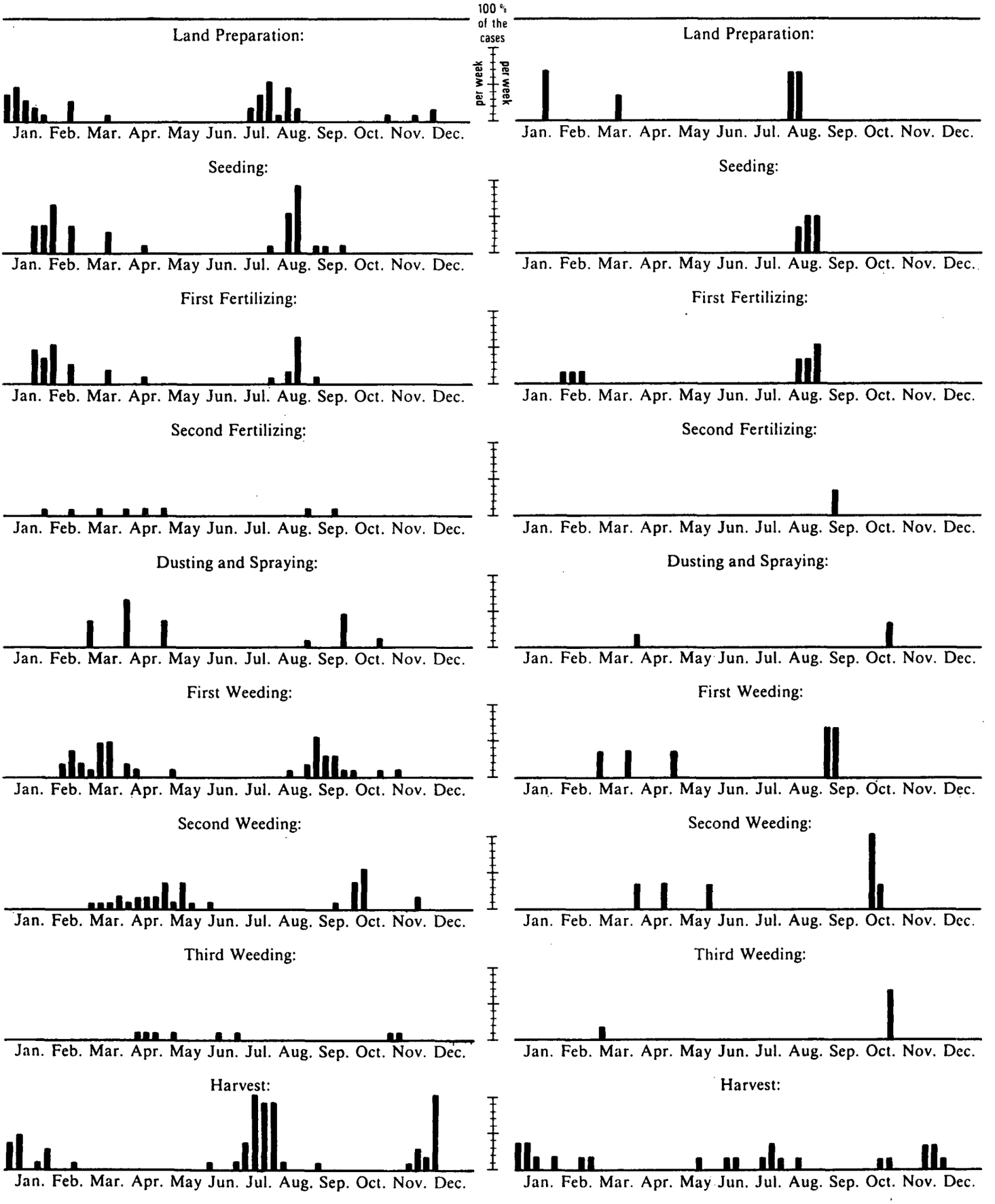
AEZ: UM 1 – LM 1–3 Survey Area 05 Sample Size: 30

KISUMU DISTRICT

TABLE 14 b: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 14

AEZ: UM 1 – LM 1–3 Survey Area 05 Sample Size: 30



[1)] Maximum 30 per crop and season

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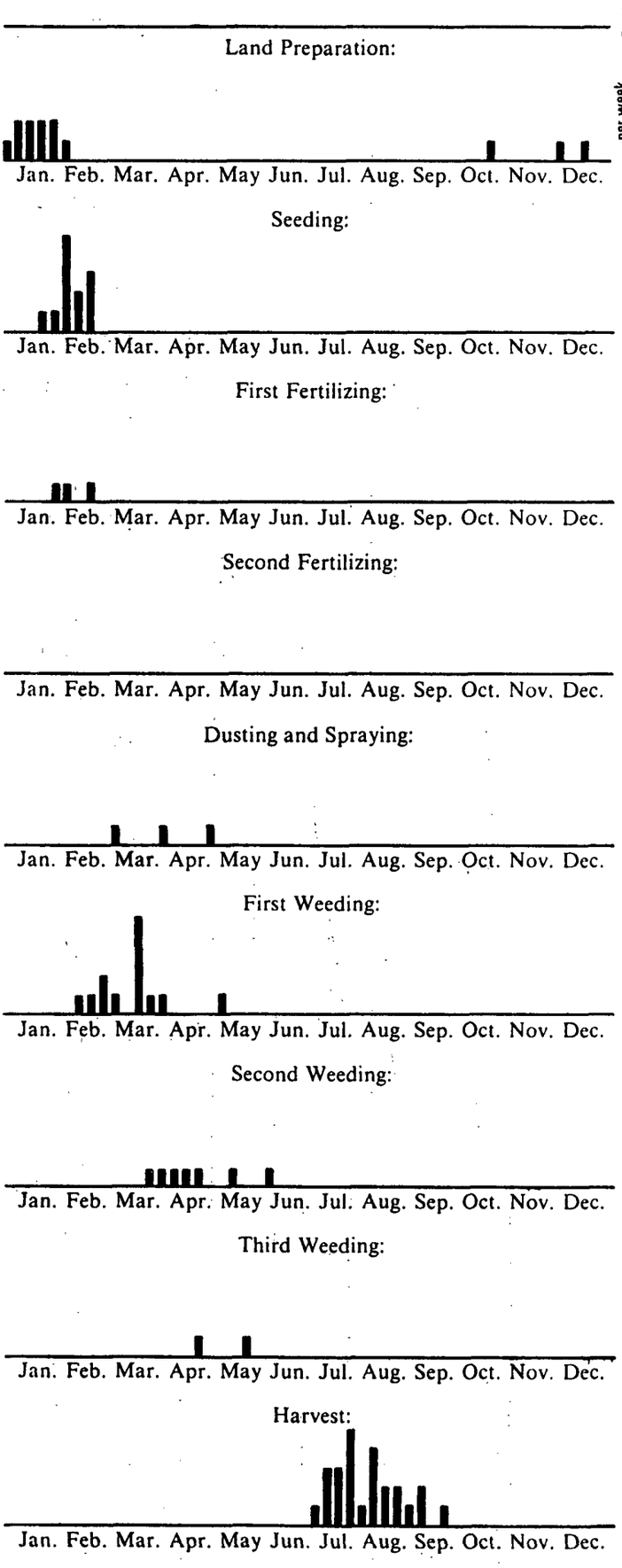
TABLE 14 c: **DISTRIBUTION OF FARMING ACTIVITIES**

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 **Groundnuts** Cases: 10

AEZ: UM 1 – LM 1–3 Survey Area 05 Sample Size: 30

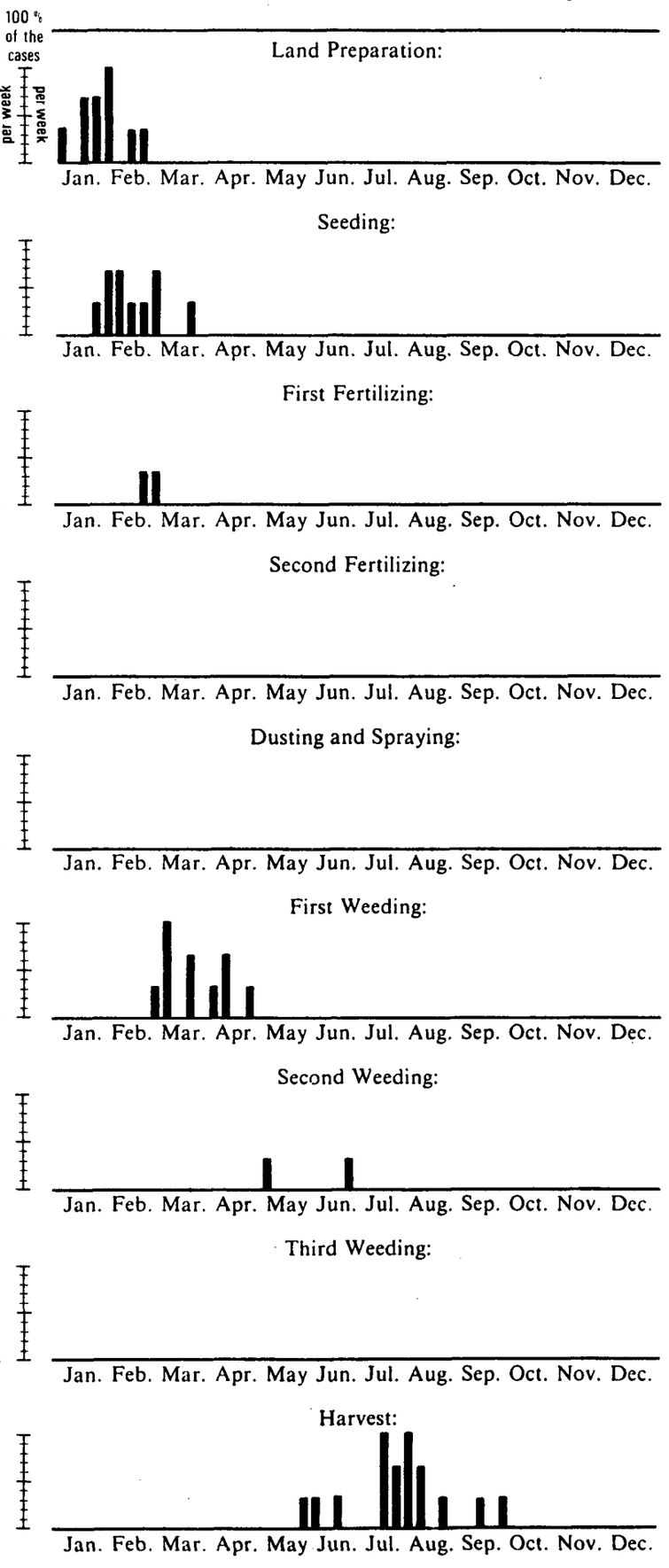


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TABLE 14 e: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 34 **Sunflower** Cases: 13

AEZ: UM 1 – LM 1–3 Survey Area 05 Sample Size: 30

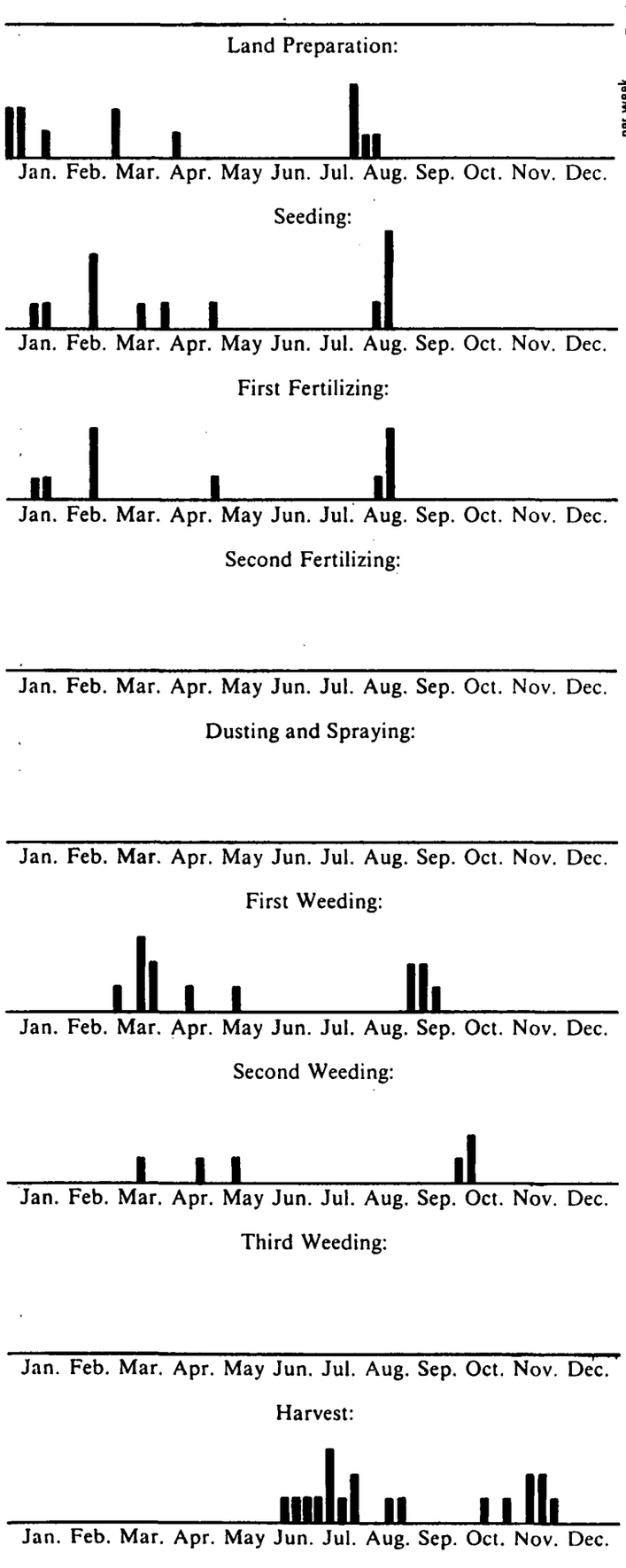

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TABLE 14 f: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 35 **Cotton** Cases: 24

AEZ: UM 1 – LM 1–3 Survey Area 05 Sample Size: 30

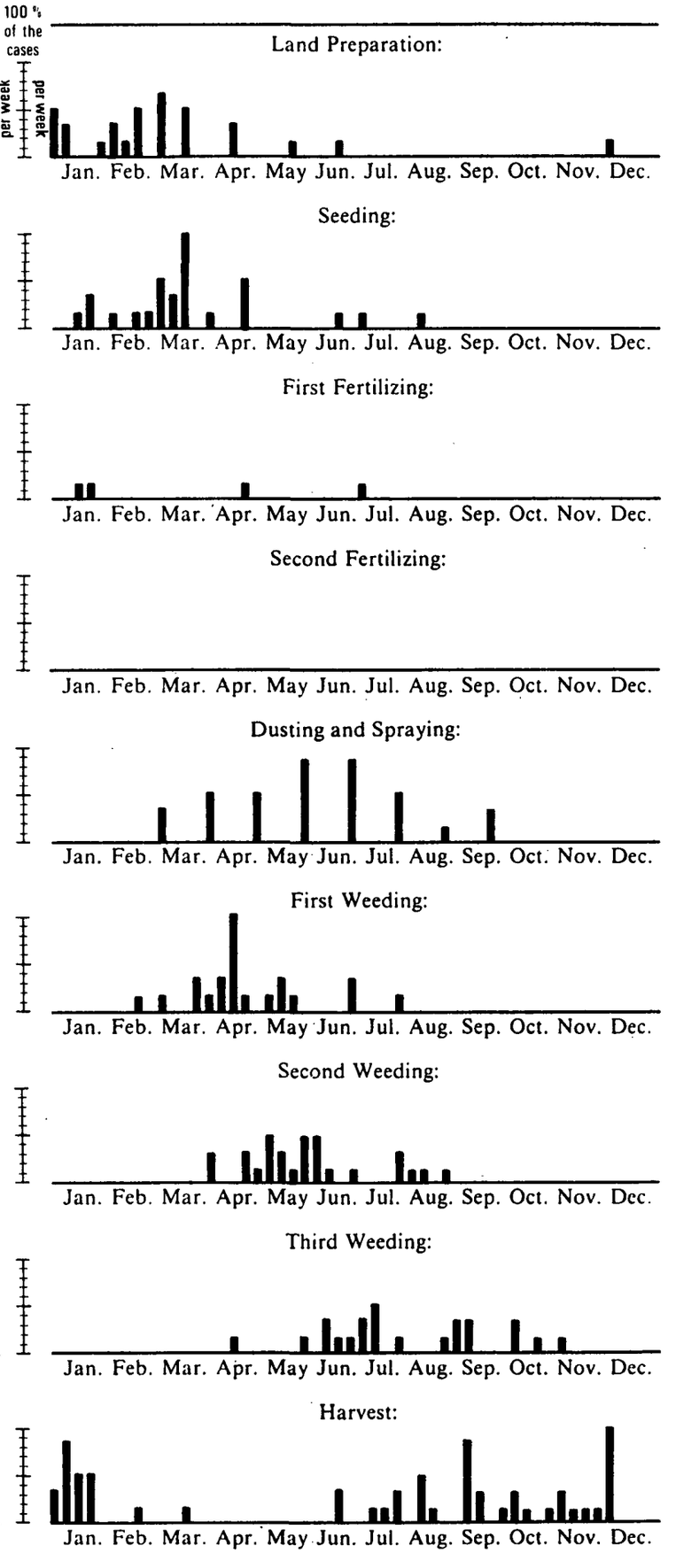

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TABLE 14 g: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 63 **Sugarcane** Cases: 5

AEZ: UM 1 – LM 1–3 Survey Area 05 Sample Size: 30

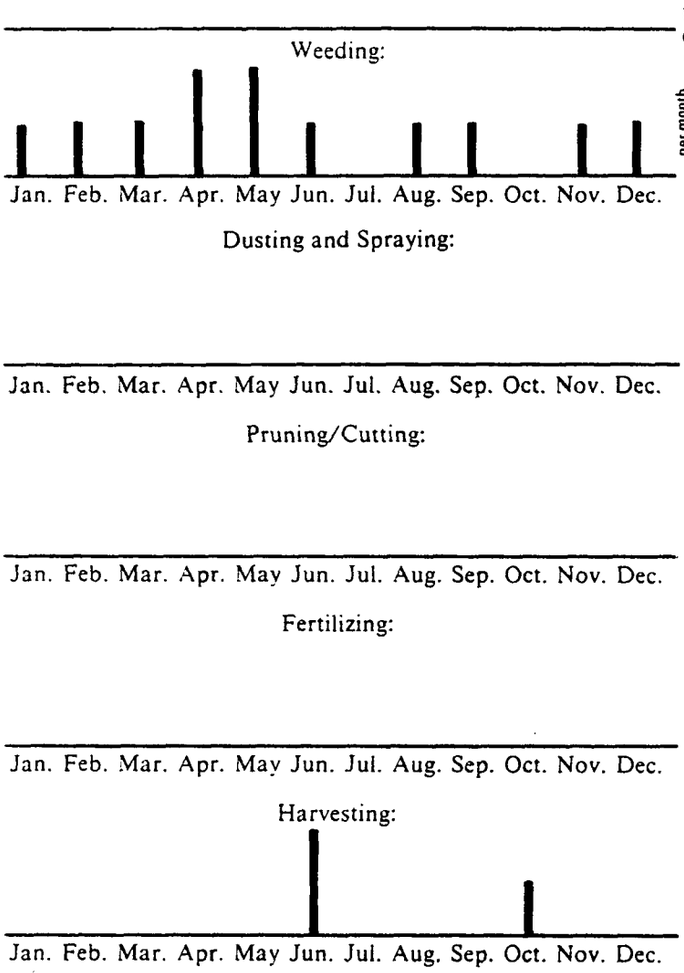



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TABLE 14 h: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 64 **Cassava** Cases: 10

AEZ: UM 1 – LM 1–3 Survey Area 05 Sample Size: 30

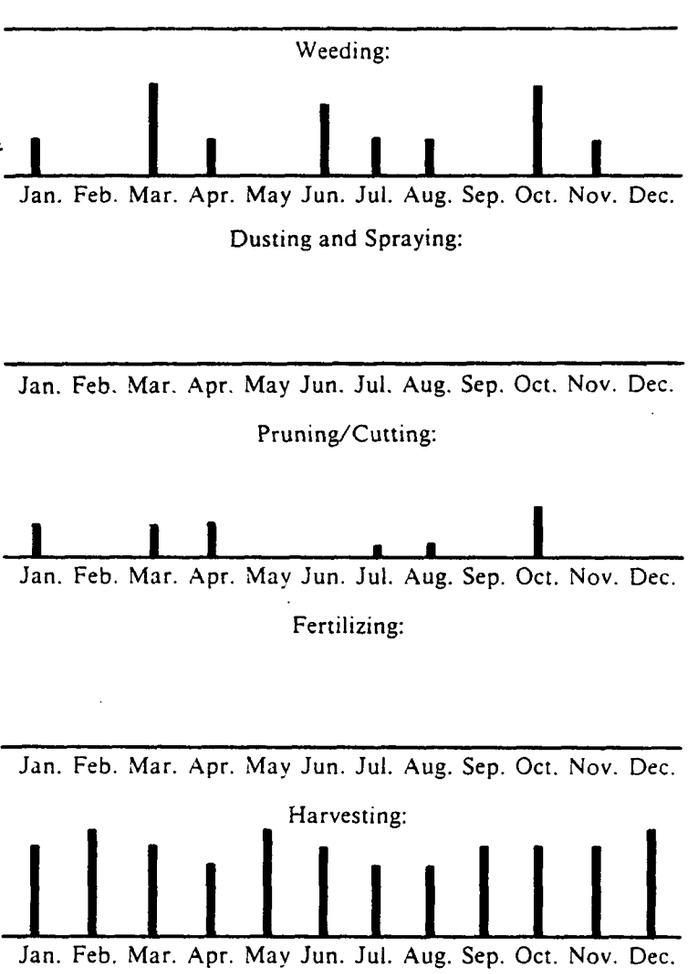

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TABLE 14 i: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 18

AEZ: LM 3–4 Survey Area 06 Sample Size: 30

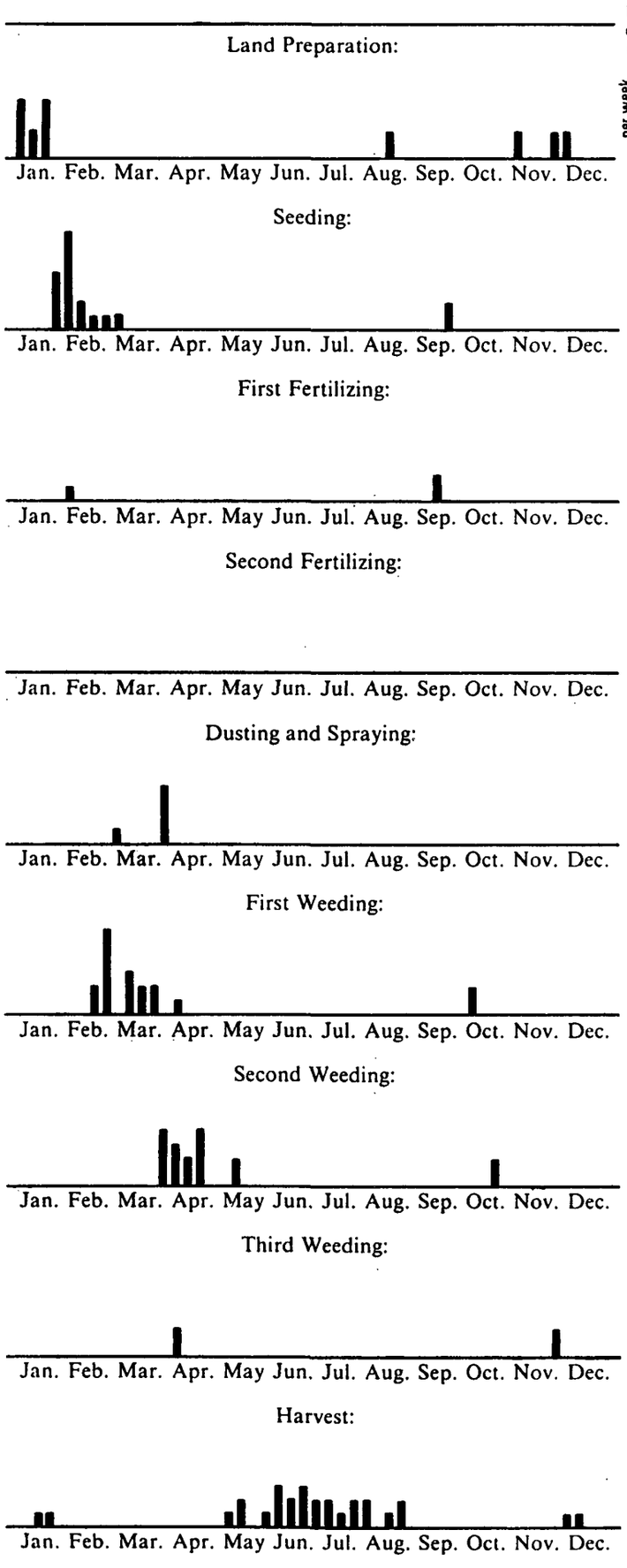

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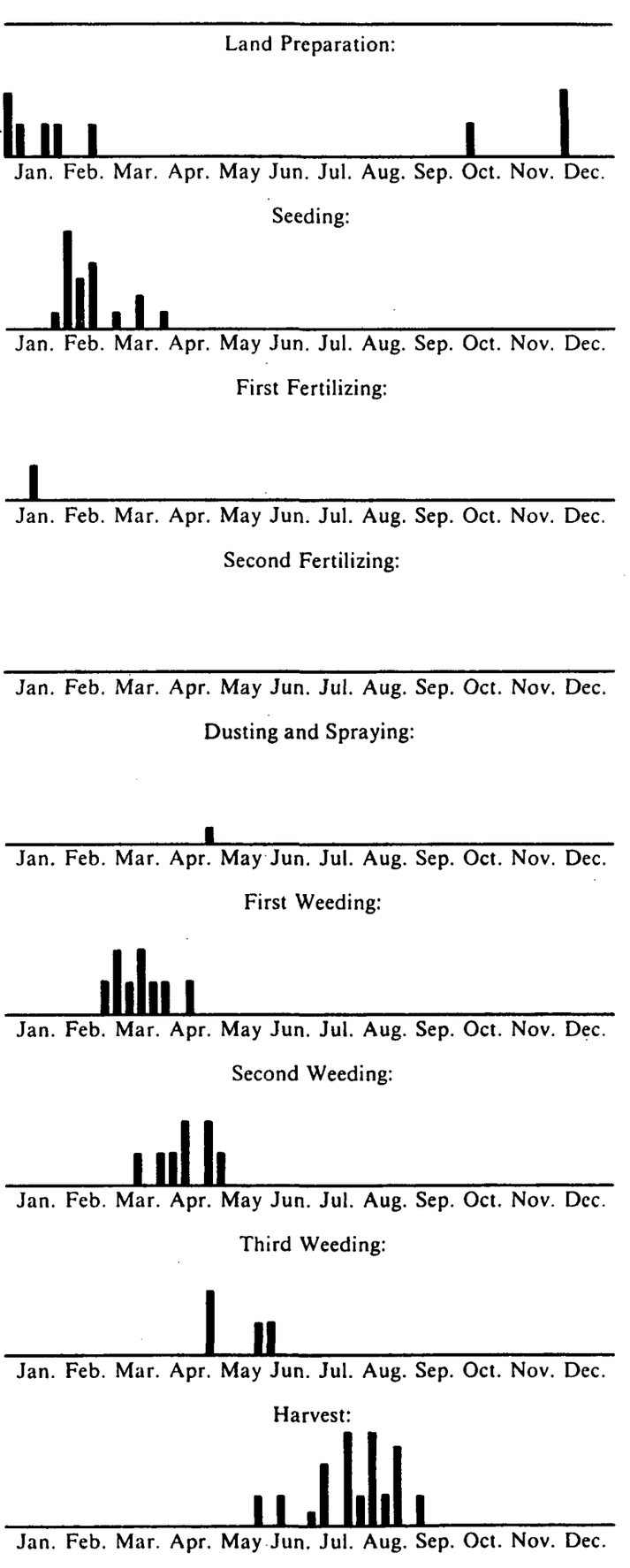
TABLE 14 j: **DISTRIBUTION OF FARMING ACTIVITIES**

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

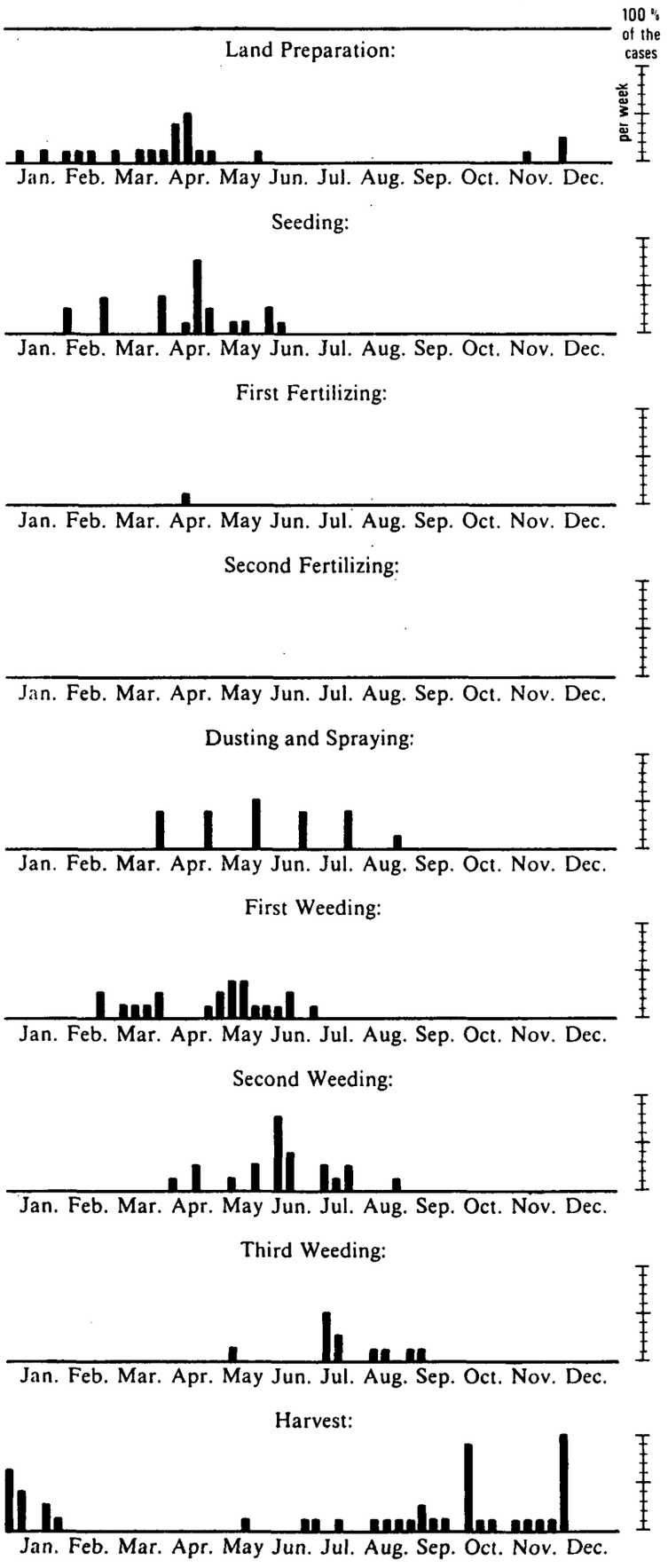


TABLE 15 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES

OUTPUT AND NUTRIENT INPUT

	A.E.Z.: LM 2 MARGINAL SUGAR CANE ZONE					A.E.Z.: LM 3 COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE			
	Vegt. Period 1st + 2nd: l/m~(m/s or s/m) in Days, 1st: 170 or more			2nd: 105-120	total: 275-290	m/l~(s or s/vs) 155-165		75-100	230-265	(m/s)+i 115-135		<45	
	Soil: PLANOSOLS					VERTISOLS				VERTISOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE/LEYS													
Farmers in Production Level	%												
Yields	kg	1,800			3,600	1,500			3,000	600			1,200
Fertilizer N	kg				100				83				33
P_2O_5	kg				50				41				16
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	3,600			7,800	3,000			7,000	1,200			2,600
Fertilizer N	kg				233				222				77
P_2O_5	kg				116				111				38
K_2O													
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

TABLE 15 b: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES

OUTPUT AND NUTRIENT INPUT

			A.E.Z.: LM 2 MARGINAL SUGAR CANE ZONE				A.E.Z.: LM 3 COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE			
			Vegt. Period 1st + 2nd: l/m-(m/s or s/m) in Days 1st: 170 or more		2nd: 105-120	total: 275-290	m/l-(s or s/vs) 155-165		75-100	230-265	(m/s)+i 115-135		<45	
			Soil: PLANOSOLS				VERTISOLS				VERTISOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: BANANAS														
Farmers in Production Level		%												
Yields		kg	5,000	6,000	10,000	18,000								
Fertilizer	N	kg		18	90	234								
	P_2O_5	kg		7	35	91								
	K_2O	kg												
CROP: SUGAR CANE														
Farmers in Production Level		%												
Yields	year	kg	3,000	8,000	30,000	50,000								
Fertilizer	N	kg		10	54	94								
	P_2O_5	kg		34	186	324								
	K_2O													
CROP: COTTON														
Farmers in Production Level		%												
Yields		kg					450	200	-	1,300				
Fertilizer	N	kg								94				
	P_2O_5	kg								50				
	K_2O	kg												
CROP: MAIZE														
Farmers in Production Level		%												
Yields		kg	1,600	1,200	2,800	4,000	1,600	1,200	2,000	2,500				
Fertilizer	N	kg			30	60			12	27				
	P_2O_5	kg			34	67			10	21				
	K_2O	kg												
CROP: SORGHUM														
Farmers in Production Level		%												
Yields		kg	2,400	1,300	2,000	4,000	2,400	1,200	2,000	3,600	2,000	750	1,500	2,300
Fertilizer	N	kg				50				46				10
	P_2O_5	kg				50				46				8
	K_2O	kg												
CROP: MILLET														
Farmers in Production Level		%												
Yields		kg												
Fertilizer	N	kg												
	P_2O_5	kg												
	K_2O	kg												

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

OUTPUT AND NUTRIENT INPUT

			A.E.Z.: LM 2 MARGINAL SUGAR CANE ZONE				A.E.Z.: LM 3 COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE			
			Vegt. Period 1st + 2nd: l/m⌐(m/s or s/m) in Days 1st: 170 or more		2nd: 105-120	total: 275-290	m/l⌐(s or s/vs) 155-165		75-100	230-265	(m/s)+i 115-135		<45	
			Soil: PLANOSOLS				VERTISOLS				VERTISOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE & BEANS														
Farmers in Production Level		%												
Yields		kg	1,600	1,200/200	2,800/400	4,000/400	1,600	1,300/200	2,000/400	2,600/500				
Fertilizer	N	kg			39	69			11	44				
	P_2O_5	kg			37	70			14	35				
	K_2O	kg												
CROP: BEANS														
Farmers in Production Level		%												
Yields		kg	950	400	1,000	1,600	1,000	400	750	1,300				
Fertilizer	N	kg			3	39				18				
	P_2O_5	kg			2	23				10				
	K_2O													
CROP: SUNFLOWER														
Farmers in Production Level		%												
Yields		kg												
Fertilizer	N	kg												
	P_2O_5	kg												
	K_2O	kg												
CROP: SOYA BEANS														
Farmers in Production Level		%												
Yields		kg	1,100	500	900	1,600								
Fertilizer	N	kg				25								
	P_2O_5	kg				19								
	K_2O	kg												
CROP: GROUNDNUTS														
Farmers in Production Level		%												
Yields		kg	1,000	600	800	1,500	1,000	500	700	1,000				
Fertilizer	N	kg				16				-				
	P_2O_5	kg				15				-				
	K_2O	kg												
CROP: SIMSIM														
Farmers in Production Level		%												
Yields		kg					850		-	800				
Fertilizer	N	kg								-				
	P_2O_5	kg								-				
	K_2O	kg												

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

	A.E.Z.: LM 2 MARGINAL SUGAR CANE ZONE					A.E.Z.: LM 3 COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE			
	Vegt. Period 1st + 2nd: 1/m¬(m/s or s/m) in Days, 1st: 170 or more			2nd: 105-120	total: 275-290	m/l¬(s or s/vs) 155-165		75-100	230-265	(m/s)+i 115-135		<45	
	Soil: PLANOSOLS					VERTISOLS				VERTISOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	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_2O_5	kg			42	168			18	66				
K_2O	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_2O_5	kg			4	46				-				
K_2O													
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	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 probability[1)] 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

SIAYA DISTRICT

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

No. and altidude	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.
8934031	Yala, St. Mary's	34	Average	1 832	73	89	145	277	264	150	118	165	154	136	145	116
1 465 m.	School		60% prob.[1]	1 500	37	81	135	251	261	125	96	158	131	110	115	77
8934059	Buholo, Chief's Camp	32	Av.	1 858	66	87	158	306	289	113	109	147	150	164	157	115
1 219 m			60%	1 673	51	69	126	288	212	100	103	126	127	135	120	79
8934127	Ukwala, Distr. Office	17	Av.	1 618	56	117	156	264	191	89	61	120	141	171	158	94
1 256 m																
9034021	Maseno, Usigu Disp.	32	Av.	864	38	58	105	164	137	41	35	41	33	48	86	76
1 234 m			60%	727	3	16	66	136	88	14	12	24	18	23	47	53
9034036	Bondo Water Supply	28	Av.	1 106	40	57	107	182	135	67	51	83	88	104	108	86
1 219 m			60%	996	13	46	85	174	133	49	39	55	68	96	89	63
9034037	Akala Health Centre	23	Av.	1 615	72	62	169	328	243	87	64	106	127	129	152	77
1 220 m			60%	1 454	32	31	115	259	165	63	46	61	85	81	107	54

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

SIAYA DISTRICT

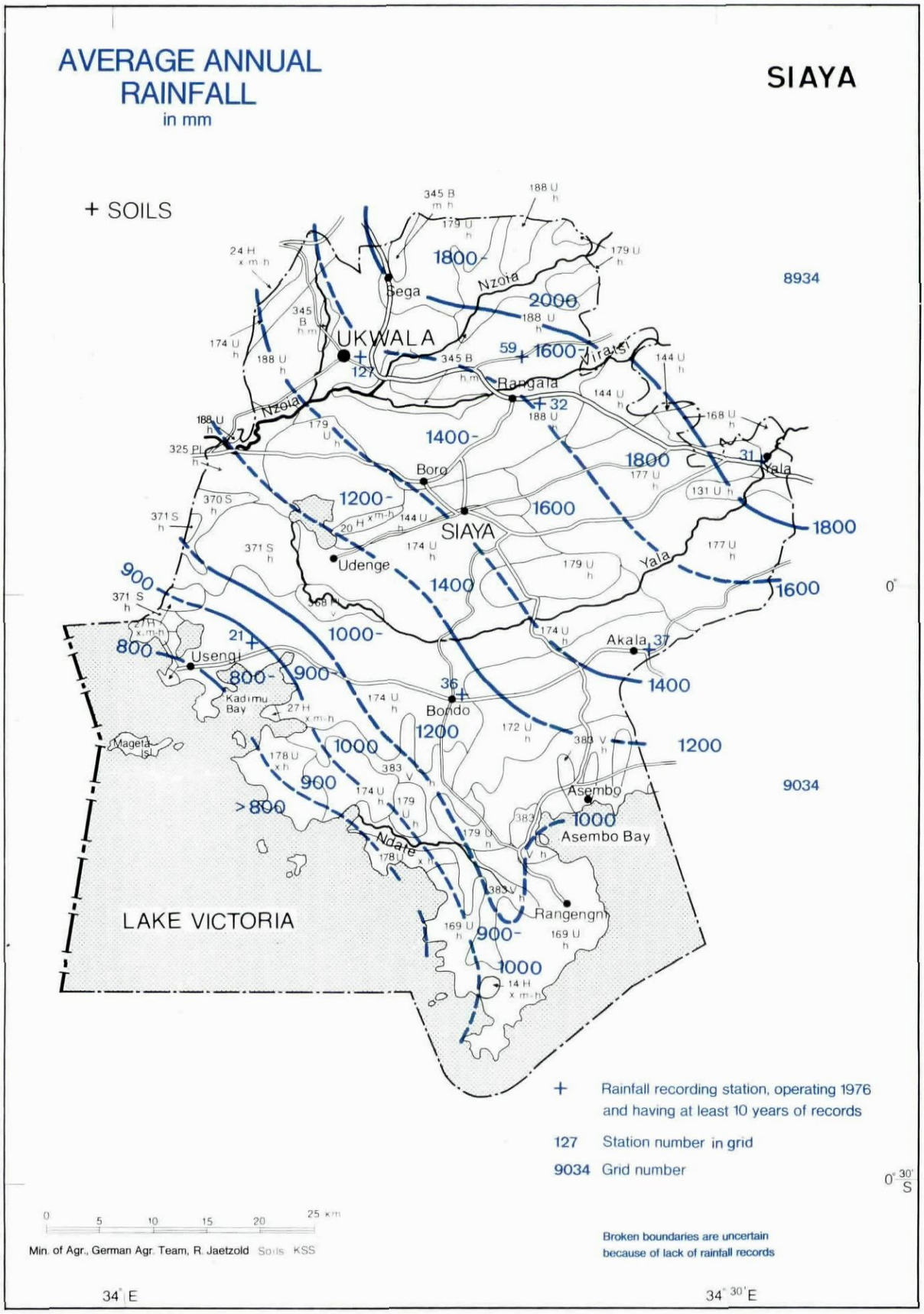
TABLE 2: **CLIMATE IN THE AGRO-ECOLOGICAL ZONES**

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, see Kakamega								
LM 1 L. Midland Sugar Cane Zone	p or two l ⌐ m i	very small, 1 300–1 500	see 21.7–20.5	Kakamega 1 500–1 900	750–950	600–800	200 or more	120–130	320–330
LM 2 Marginal Sugar Cane Zone	l ⌐ (m/s)i	1 200–1 350	22.3–21.4	1 450–1 600	700–800	500–680	190 or more	110–120	300–310
	l/m ⌐ (s/m)i			1 400–1 500	650–700	450–550	170 or more	105–120	275–290
LM 3 L. Midland Cotton Zone	m/l ⌐ (s or s/vs)	1 140–1 250	22.7–22.0	1 100–1 450	480–650	300–550	155–165	80– 90	235–255
	m+f(vs)			1 000–1 100	450–550	200–300	135–155	45– 75	
LM 4 Marginal Cotton Zone	(m/s)+i	1 135–1 200	22.7–22.3	800–1 000	350–480	50–250	125–135	<45	
LM 5 L. Midland Live = stock-Millet Zone	Very small, see South Nyanza								

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 ($> 0.2\ E_o$) of most long term crops

AVERAGE ANNUAL RAINFALL
in mm

SIAYA



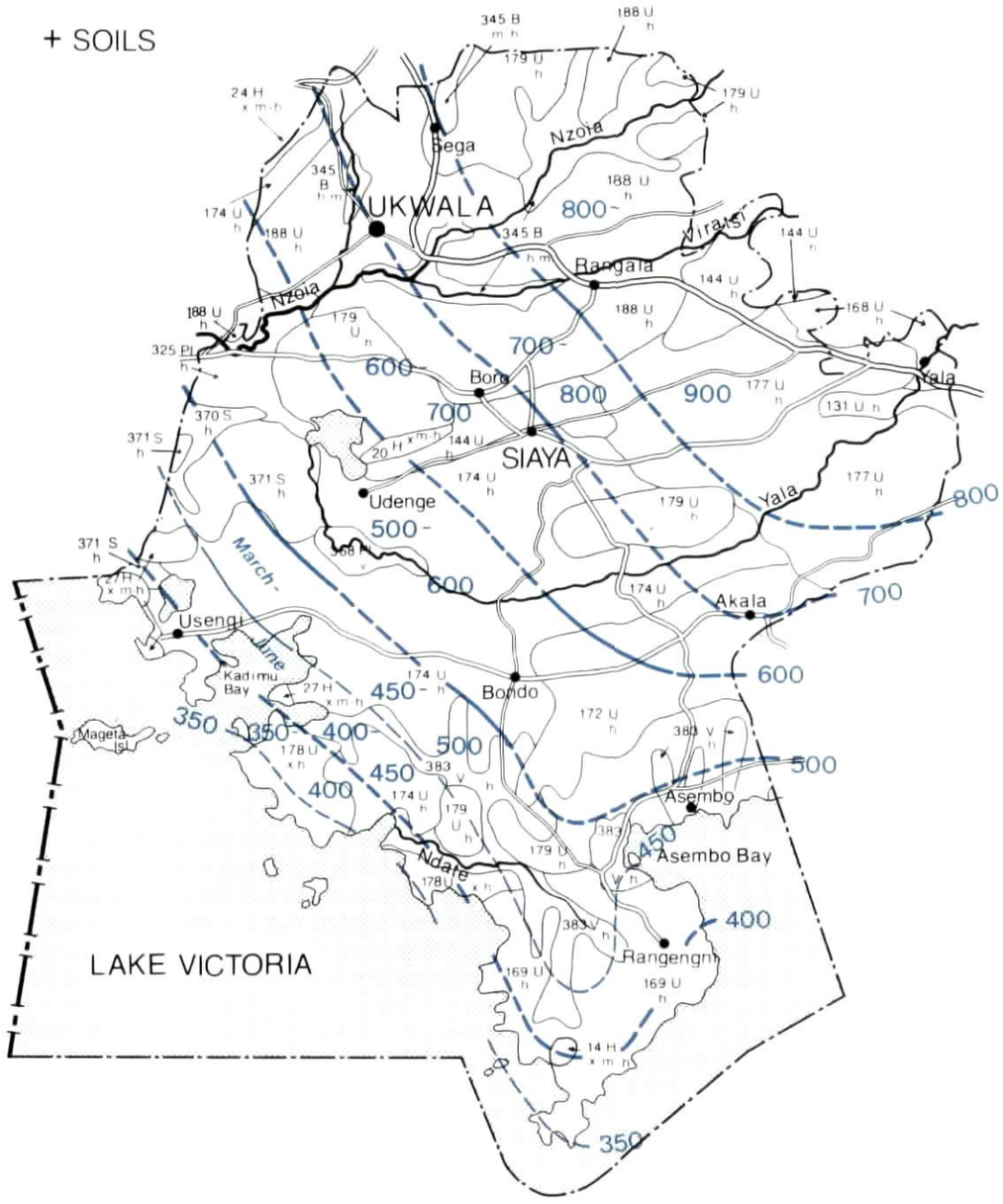
60% RELIABILITY OF RAINFALL IN FIRST RAINS

(Feb.- July or less)

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

SIAYA

+ SOILS



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

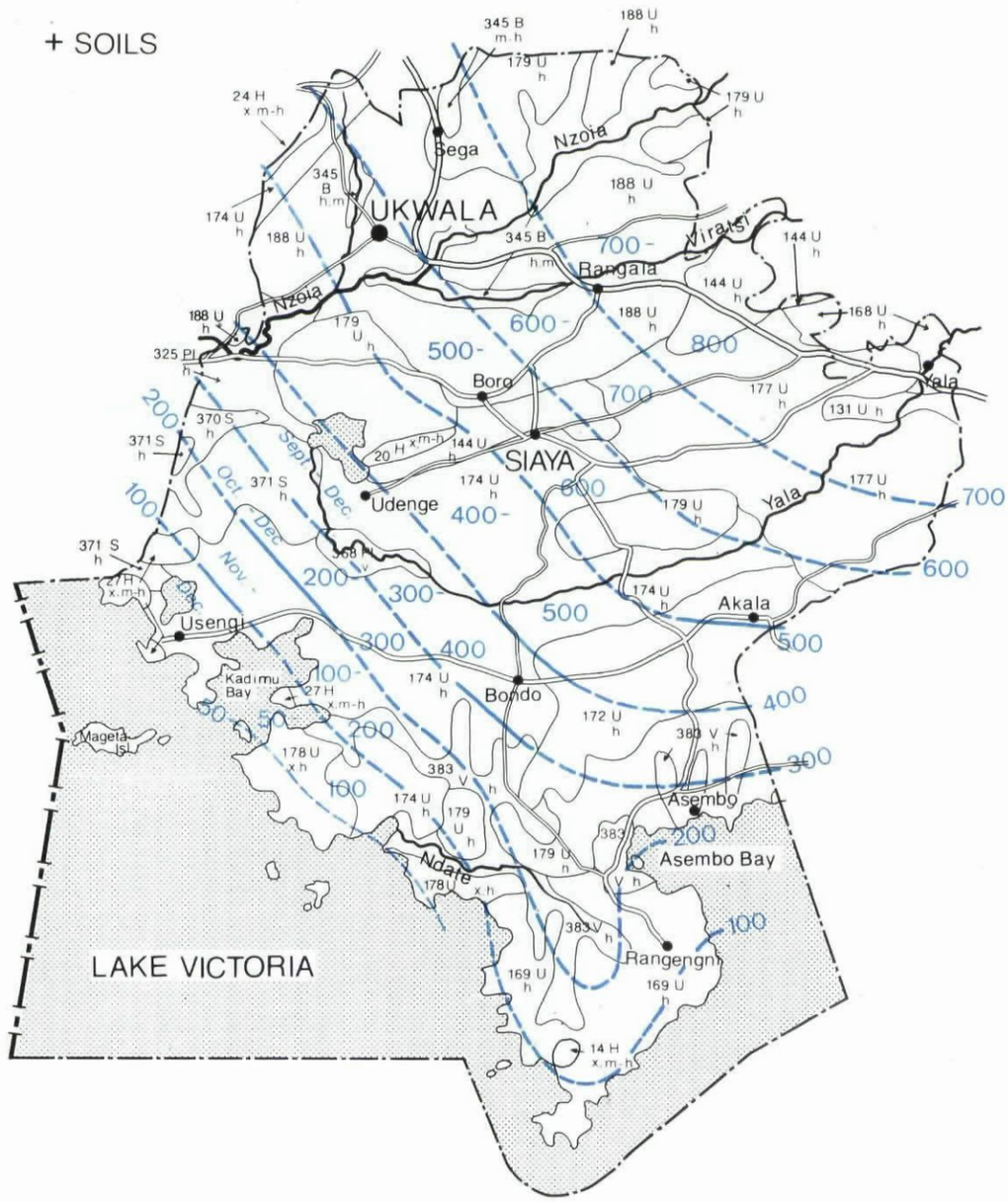
Broken boundaries are uncertain because of lack of rainfall records

60% RELIABILITY OF RAINFALL IN SECOND RAINS

(Aug.-Jan. or less)

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

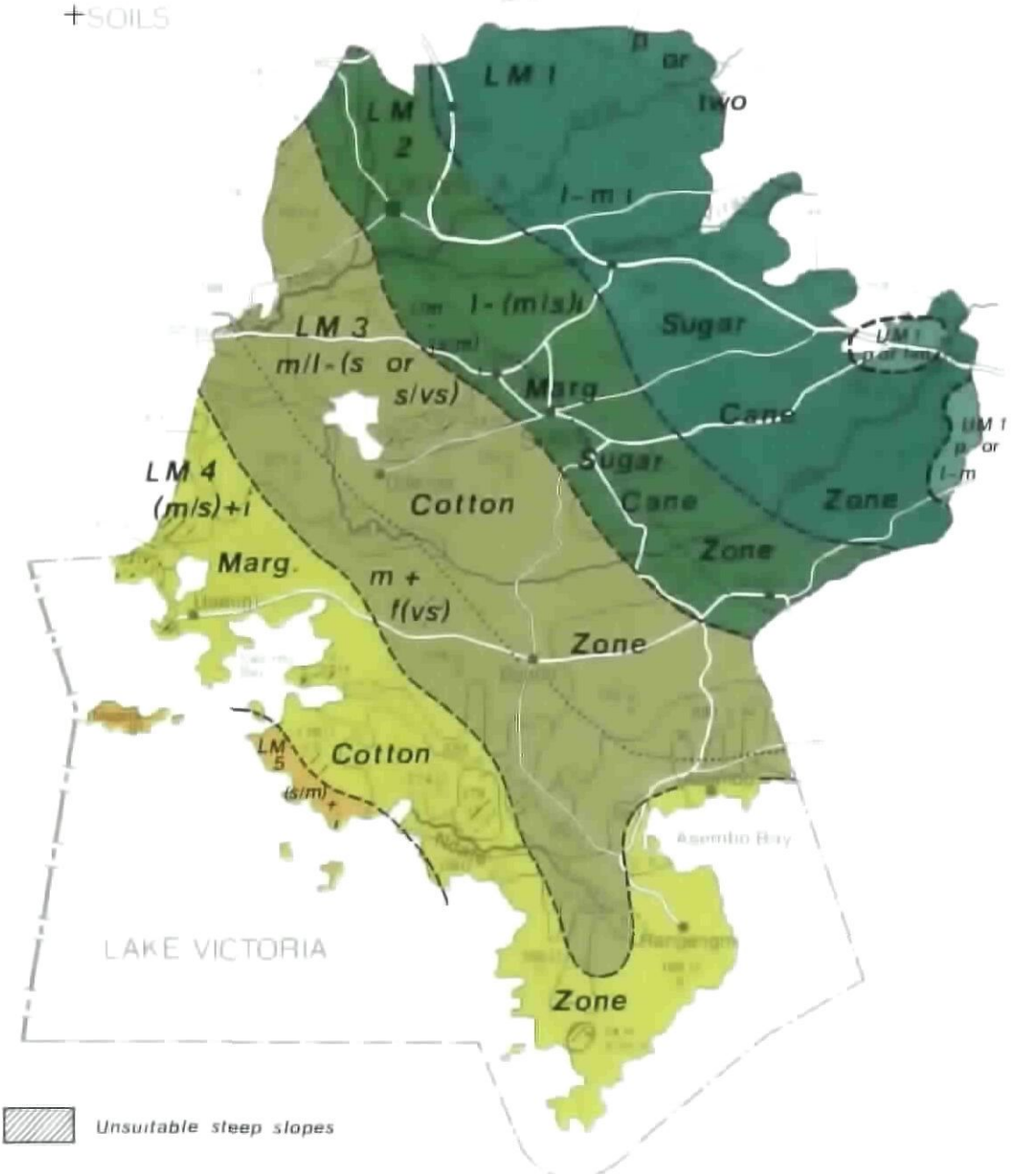
SIAYA



SIAYA

AGRO-ECOLOGICAL ZONES

+SOILS



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

Climatic data for AEZ formulas see table I and II

Min. of Agr. German Agr. Team

AGRO-ECOLOGICAL ZONES

UM = *UPPER MIDLAND ZONES*

UM 1 = *Coffee-Tea Zone*

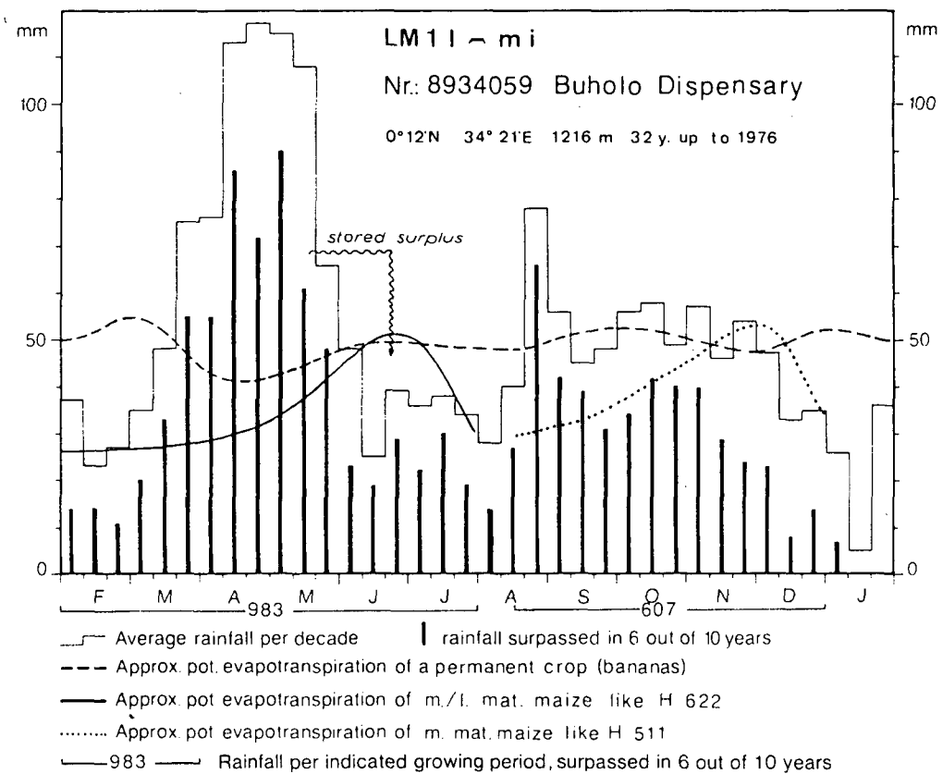
Very small, see Kakamega

LM = *LOWER MIDLAND ZONES*

LM 1 = *Lower Midland Sugar Cane Zone*

LM1 p or two = *Lower Midland Sugar Cane Zone with permanent cropping possibilities, dividable in two variable cropping seasons*

Very small, 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*
(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 danger)[1], cassava, tea in upper places (70–80 %, but medium to low quality), Robusta coffee (∿ 60 %)[1], avocadoes

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 l–(m/s) i = Marginal Sugar Cane Zone with a long cropping season 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 Vympel 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; beans[2], pigeon peas (March–F.); late mat. rosette resistant groundnuts (in light soils); roselle, 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 coffee[1], 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 l/m– (s/m) i = Marginal Sugar Cane Zone with a long to medium cropping season followed by a (weak) short to medium one and intermediate rains

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 m/l–(s or s/vs) = Lower Midland Cotton Zone with a medium to long cropping season 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 grams[4], cowpeas; groundnuts and bambarra gr. (both in light soils), simsim[4]; sweet pot.; cotton (∿ 60 %), m. mat. soya beans, m. mat. sunflower like Vympel; tomatoes, onions; chick peas (on h. bl. soils), dwarf castor[5], 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

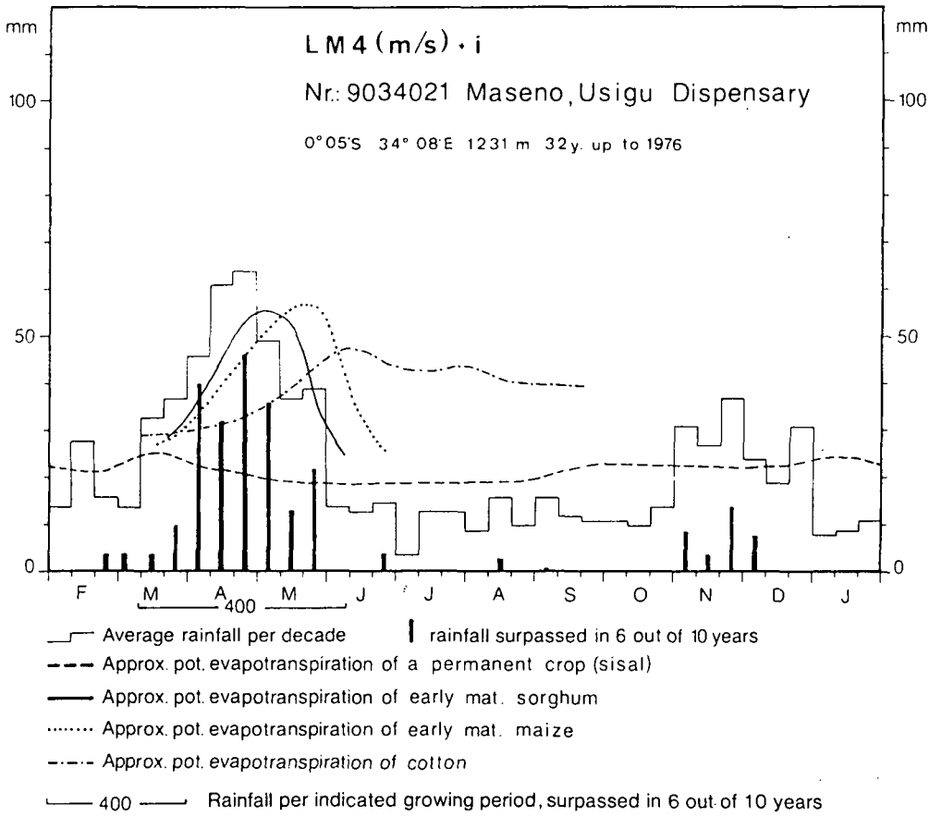
Pasture and forage
0.7–1.1 ha/LU on mixed savanna with star grass (Cynodon dactylon); down to 0.2 ha/LU feeding Bana or Napier grass and fodder legumes like Stylosanthes (also for pasture and soil improvement)

LM 3 m+f(vs) = *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 forage
0.9–1.2 ha/LU, down to 0.25 ha/LU feeding Bana grass and Stylosanthes



LM 4 = *Marginal Cotton Zone*

LM 4 (m/s) + i = *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

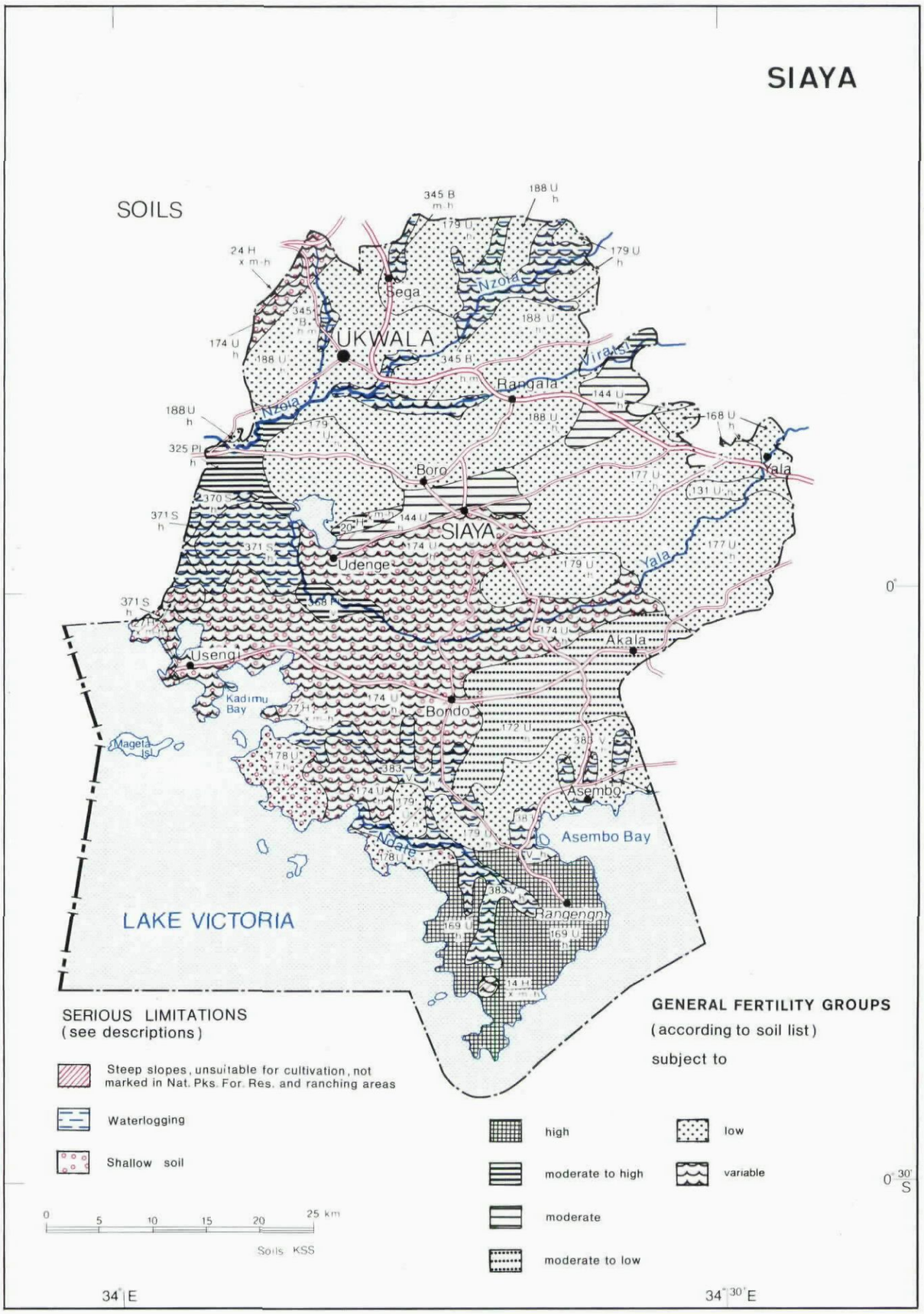
Pasture and forage
1–2 ha/LU; less than 0.8 ha/LU if horse tamarind (Leucaena leucocephala) and other palatable shrubs are planted in order to improve fodder situation during dry season

LM 5 = Lower Midland Livestock–Millet Zone

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

Very small on lakeside. Potential see South Nyanza District. Bulrush millet (bird rejecting 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
UKWALA
Sega
Rangala
Boro
SIAYA
Udenge
Usengi
Kadimu Bay
Bondo
Akala
Asembo
Asembo Bay
Rangengni
Yala
Nzoia
Viraisi
Ndate
Mageta Isl
LAKE VICTORIA
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks. For. Res. and ranching areas
Waterlogging
Shallow soil
0 5 10 15 20 25 km
Soils KSS
GENERAL FERTILITY GROUPS
(according to soil list)
subject to
high
moderate to high
moderate
moderate to low
low
variable
0°
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 Pl).

SOILS ON HILLS AND MINOR SCARPS

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

14 H x, m-h[1] = complex of well drained to moderately well drained, shallow to moderately deep, dark brown, firm stony, clay loam to clay; 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 x, m-h = somewhat excessively drained, shallow to moderately deep, dark reddish brown, friable, gravelly clay, with acid humic topsoil (humic CAMBISOLS, partly paralithic phase)

Soils developed on quartzites

24 H x, m-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)

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

27 H x, m-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)

SOILS ON PLATEAUS AND HIGH-LEVEL STRUCTURAL PLAINS

Soils developed on intermediate igneous rocks (syenites, trachytes, phonolites, etc.)

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

SOILS ON UPPER MIDDLE-LEVEL UPLANDS

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)

Soils developed on various rocks

139 U 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 various rocks (Kavirondian sediments, often mudstones)

168 U h = well drained, deep to very deep, dark reddish brown to strong brown, friable clay (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 underlaying a topsoil of different texture)

SOILS ON LOWER-LEVEL UPLANDS

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

69 U h = moderately well drained, shallow to moderately deep, dark brown, firm clay (verto-luvic PHAEOZEMS, lithic phase)

Soils developed on intermediate igneous rocks (andesites, etc.)

172 U h = 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)

174 U h = association of: well drained to moderately well drained, shallow soils over petroplinthite (about 50 %); on interfluves („murram cuirass" soils)
well drained, very deep, dark reddish brown to strong brown, friable clay; on valley sides (dystric/eturic NITOSOLS and orthic FERRALSOLS)

Soils developed on acid igneous rocks

177 U h = 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)

178 U x, h = 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 ACRISOLS)

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 petreferric phase; with orthic ACRISOLS)
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)

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 m, h = 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 FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

368 A v = 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

370 S h = very poorly drained, very deep, very dark grey to black, firm, cracking clay, with acid humic topsoil (seasonal swamps) (humic GLEYSOLS)

371 S h = *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

381 Z m-h = 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

383 V h = 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 1982. 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 rural 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 severe situation as the figure of the lower quartile of the samples of the Small Farm Survey 1977 (Table 8b) was 2.0 ha per farm. 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 in 1979 (Table 5). This figure gives an idea of the critical situation in this area. Regarding the population growth, agricultural intensification 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 Uyoma	9 380	10 081	19 461	2 934	113	171
West Uyoma	8 894	10 098	18 992	2 812	109	173
West Asembo	8 274	9 808	18 082	2 961	93	193
East Asembo	8 499	9 884	18 383	3 325	83	220
South Sakwa	11 973	13 788	25 761	4 319	226	113
North Sakwa	8 849	10 652	19 501	2 985	161	120
Yimbo	9 426	10 647	20 073	3 448	187	107
Bondo Division	65 295	74 958	140 253	22 784	975	143
South Gem	12 808	15 288	28 096	6 319	150	187
North Gem	12 879	15 216	28 095	6 350	111	251
East Gem	17 518	20 321	37 839	8 118	145	260
Yala Division	43 205	50 825	94 030	20 787	407	230
East Alego	21 687	26 282	47 969	8 705	242	197
Central Alego	16 313	20 100	36 413	6 935	179	203
West Alego	10 691	13 574	24 265	3 501	117	207
Usonga	4 015	5 154	9 169	1 569	74	123
Boro 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	12248	15 745	27 993	6 258	138	202
North Ugenya	18 801	23 826	42 627	8 275	184	231
Uholo	11 106	14 129	25 235	5 489	108	232
Ukwala 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 Asembo	2970	3.32	1.28	1.22	0.30	6.05
East Asembo	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	0.44
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 Ukwala	25606	2.62	1.02	0.96	0.17	0.48
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

SIAYA DISTRICT

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 AEZ						Agric. land per	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads, rivers...)		UM 1	LM 1	LM 2	LM 3	LM 4	LM 5	household	person
East Uyoma	113	2		11	100				6	94		3.48	0.52
West Uyoma	109			11	98				48	50		3.52	0.52
West Asembo	93			9	84				77	7		2.84	0.47
East Asembo	83			8	75			4	67	4		2.26	0.41
South Sakwa	226	13	sw. 4	23	186				63	103	20	4.33	0.71
North Sakwa	161	8	sw. 2	16	135			6	110	19		4.54	0.69
Yimbo	187	10	sw. 33 lake 7	19	118				36	82		3.47	0.60
Bondo Division	975	33	46	97	799			10	407	359	20	3.49	0.56
South Gem	150			15	135		56	79				2.14	0.48
North Gem	88 (111)[1]			9	79		79					1.21	0.27
East Gem	145			15	130	30	100					1.61	0.35
Yala Division	383 (407)[1]			39	344	30	235	79				1.65	0.37
East Alego	242		sw. 4	24	214		12	98	104			2.45	0.44
Central Alego	179	6	sw. 5 lake 5	18	151		13	98	34			2.18	0.41
West Alego	117		sw. 12 lake 5	12	88			16	72			2.54	0.37
Usonga	74		sw. 39	7	28				28			1.78	0.31
Boro Division	612	6	70	61	481		25	212	238			2.32	0.41
South Ugenya	62 (95)[1]			6	56		56					0.96	0.20
East Ugenya	138			13	125		122	3				1.99	0.45
North Ugenya	184			18	166		13	103	50			2.01	0.39
Uholo	108			11	97		96	1				1.77	0.38
Ukwala 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 FM-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

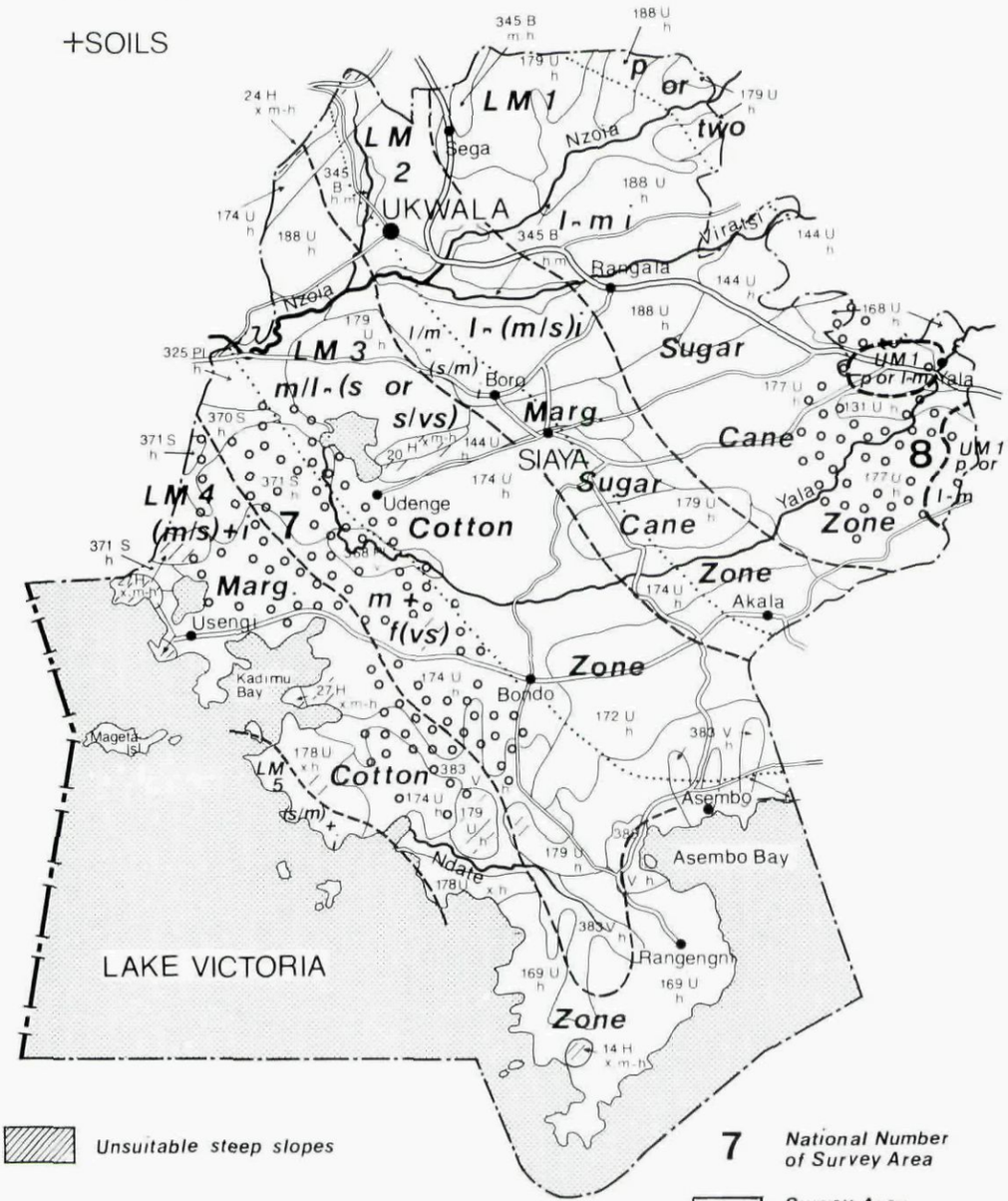
3) November 1977, sample size 30. For more detailed and up to date information see FMHB Vol. III B

4) See also notes on farm management information, output and nutrient input, page 51

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

SIAYA

+SOILS



Unsuitable steep slopes

7 National Number of Survey Area

Survey Area, sample size 30 per number

Belt of A E Zones

A E Zones

Subzones

Broken zonal boundaries are uncertain or mean transitional strips

Climatic data for AEZ formulas see table I and II

0 5 10 15 20 25 km

AEZ R. Jatzold 81 Soils KSS

Min. of Agr., German Agr. Team

SIAYA DISTRICT

AEZ: UM 1 – LM 1

TABLE 7 a: **FARM ORGANISATION ACCORDING TO FARM SIZE GROUP**

Survey Area 08

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.7	3.7	3.5
Land Use: Annual Crops[1]				
First Season: Others	ha			0.1
Maize	ha	0.3	0.3	0.6
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 Season[1]				
Maize	ha	0.1	0.4	0.1
Maize & Beans	ha	0.2	0.2	1.1
Sunflower	ha	0.1	0.1	0.2
Total	ha	0.4	0.7	1.4
Permanent Crops[1]				
Coffee	ha	0.1	0.1	0.1
Sugarcane	ha	0.1	0.4	1.4
Bananas	ha	-	0.1	0.1
	ha			
portion of total	%	12%	16%	19%
Grazing & Forage	ha	0.3	1.2	3.1
portion of total	%	18%	14%	36%
Other Land Use	ha	0.3	0.5	1.4
Livestock on Farm:				
Cattle: local	LU	2.3	4.1	2.4
improved	LU	-	-	0.4
Sheep & Goats	LU	0.3	0.3	0.3
Total	LU	2.5	4.4	3.1

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.9	0.7	0.6
Portion of improved cattle kept	%	-	-	14%
Portion of Farmers owning a Plough	%	30%	30%	30%
Labour on Farm:				
Family Adults	persons	2.3	3.3	3.3
Perm. Hired Labour	"	0.3	0.8	0.8
Children > 14 years	"	1.8	2.6	2.9
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.02	0.34	2.36
Children < 14 years	"	2.37	-	2.37
Subsistence Units	SU	3.44	0.34	3.78
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1071	1726	
Beans	kg	219	348	
Sweet Potatoes	kg	100	57	
Sorghum	kg	79	124	
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Maize & Sorghum, Onions, Groundnuts, Tea, Cassava, Sweet Potatoes

1) Major crops only considered

2) Based on 1979 Census figures

SIAYA DISTRICT

TABLE 7 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: LM 3–4

Survey Area 07

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	2.7	6.0	15.9
Land Use: Annual Crops[1]				
First Season				
Maize	ha	0.4	0.5	1.3
Sorghum	ha	0.4	0.2	1.3
Beans	ha	-	0.3	0.3
Cotton	ha	0.1	0.6	0.7
Maize & Beans	ha	0.1	0.3	1.2
Others	ha	0.4	0.5	1.3
Total	ha	1.4	2.4	6.1
Second Season[1]				
Cassava	ha	-	0.1	0.1
	ha			
	ha			
Total	ha	-	0.1	0.1
Permanent Crops[1]				
Bananas	ha	0.1	0.2	-
	ha			
	ha			
	ha			
portion of total	%	4%	3%	
Grazing & Forage	ha	0.6	2.7	7.2
portion of total	%	22%	45%	45%
Other Land Use	ha	0.6	0.7	2.8
Livestock on Farm:				
Cattle: local	LU	5.1	2.8	14.1
improved	LU	-	-	-
Sheep & Goats	LU	0.7	0.7	2.3
Total	LU	5.8	3.5	16.4

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.6	0.5	0.4
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	30%	30%	120%
Labour on Farm:				
Family Adults	persons	2.6	2.9	3.8
Perm. Hired Labour	"	0.2	0.4	1.8
Children > 14 years	"	1.4	1.7	7.2
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	1.96	0.10	2.06
Children < 14 years	"	2.02	-	2.02
Subsistence Units	SU	3.17	0.10	3.27
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1147	1849	
Beans	kg	132	210	
Finger Millet	kg	61		
Sweet Potatoes	kg	127	72	
Sorghum	kg	268	420	
Cowpeas	kg	5	8	
Groundnuts	kg	9	14	
	kg			

Other Crops cultivated: Finger Millet, Finger Millet & Sorghum, Cowpeas, Groundnuts, Maize & Cowpeas

1) Major crops only considered

2) Based on 1979 Census figures

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 ha	%	Perm. Crops ha	%	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	1.5	37	0.7	17	1.3	32	-	-	0.3	-	0.2	6
Avg. 1	1.5	32	1.0	20	1.3	28	0.1	3	0.5	12	0.3	6
Up. Qu.	2.0	60	0.8	20	1.2	46	-	-	0.5	13	0.4	10
Lo. Qu.	0.7	29	-	-	0.3	13	-	-	-	-	0.1	4
Total	45.0		20.2		38.9		0.1		9.9		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	1.2	0.8	2.5	3.9
Avg. 1			2.5	54.3
Up. Qu.	1.6	1.1	6.9	-
Lo. Qu.	0.9	0.3	0.7	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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

AEZ: LM 3-4

Survey Area 07

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 ha	%	Perm. Crops ha	%	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use 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		24.4		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

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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 9 a: **CROPPING PATTERN**

AEZ: UM 1 – LM 1

Survey Area 08

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	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 & Sorgm	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 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area 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 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	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 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area 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	1.4	1.6
Maize & Beans	0.2	0.9	0.00	0.00	5.2	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
FMlt & 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 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area 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 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	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

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TABLE 10 a: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: UM 1 – LM 1 — – 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	38	51	60	23	93.6	8	509	94.8
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 =			74.5 % 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 =	8.5 % 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

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TABLE 10 b: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: LM 3–4 — 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	5.09
	Upper Qu.	-	-	4		6	1	5	-	-	10	-
Subtotal (unimp.)	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	-	28	11.8
	Lower Qu.	-	-	-	-	-	-	-	-	-	10	-
LU Male Cattle =		40.3 % of total cattle,				Calves + Heifers =			58.1 % of dairy cows			
LU Goats + Sheep =		14.8 % 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	-	28	11.8
	Lower Qu.	-	-	-	-	-	-	-	-	-	10	-
LU Male Cattle =		40.3 % of total cattle,				Calves + Heifers =			58.1 % of dairy cows			
LU Goats + Sheep =		14.8 % 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 Area 08

Crop		Inputs							Yield
		Improved Seeds %	Nutrients N kg/ha	P_2O_5 kg/ha	K_2O kg/ha	Manure t/ha	Chemicals Insec. kg/ha	Fungicide kg/ha	kg/ha
First Rains									
Maize	Avg.	90	13	37	-	1.36	2	-	1,857
	UpQu	100	26	60	-	-	4	-	2,700
	LoQu	100	-	-	-	-	-	-	900
Sorghum	Avg.	-	-	20	-	-	2	-	716
	UpQu	-	-	-	-	-	-	-	750
	LoQu	-	-	-	-	-	-	-	300
Maize & Beans									
Maize	Avg.	80	12	29	-	0.90	2	-	2,336
Beans	Avg.	10	-	3	-	0.09	-	-	480
Maize	UpQu	100	33	60	-	0.60	5	-	3,000
Beans	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	100	-	-	-	-	-	-	1,688
Beans	LoQu	-	-	-	-	-	-	-	188
Second Rains									
Maize	Avg.	57	5	20	-	0.77	1	1	1,491
	UpQu	100	-	40	-	-	-	-	2,250
	LoQu	-	-	-	-	-	-	-	450
Beans	Avg.	-	-	4	-	-	2	2	928
	UpQu	-	-	-	-	-	-	-	1,200
	LoQu	-	-	-	-	-	-	-	500
Maize & Beans									
Maize	Avg.	50	8	17	-	0.15	3	3	1,646
Beans	Avg.	-	-	-	-	-	-	-	426
Maize	UpQu	100	-	58	-	-	-	-	2,250
Beans	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	-	-	-	-	-	-	-	1,125
Beans	LoQu	-	-	-	-	-	-	-	125
Perennial Crops									
Sugarcane	Avg.	-	11	-	-	-	-	-	32,175
	UpQu	-	-	-	-	-	-	-	42,000
	LoQu	-	-	-	-	-	-	-	-
Cookng Bananas	Avg.	-	-	-	-	0.15	-	-	3,299
	UpQu	-	-	-	-	-	-	-	2,250
	LoQu	-	-	-	-	-	-	-	-
Coffee	Avg.	-	23	-	-	0.71	-	16	1,232
	UpQu	-	-	-	-	-	-	13	1,635
	LoQu	-	-	-	-	-	-	-	313

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TABLE 11 b: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LM 3–4 Survey Area 07

Crop		Inputs							Yield
		Improved Seeds	Nutrients				Chemicals		
			N	P_2O_5	K_2O	Manure	Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
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	10	-	694
	UpQu	100	-	-	-	-	20	-	750
	LoQu	-	-	-	-	-	-	-	375
Maize & Beans									
Maize	Avg.	20	-	4	-	0.03	1	-	2,085
Beans	Avg.	-	-	-	-	0.03	-	-	440
Maize	UpQu	-	-	-	-	-	-	-	2,250
Beans	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	-	-	-	-	-	-	-	1,200
Beans	LoQu	-	-	-	-	-	-	-	160
Second Rains									
Maize	Avg.	-	-	-	-	0.63	-	-	1,913
Perennial Crops									
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	%
First Rains							
Maize	17,320	2,070	12	3,240	19	12,010	69
Maize & Beans	57,037	4,400	8	14,930	26	37,707	66
Maize & Sorgm	180	0	0	0	0	180	100
Beans	2,420	240	10	1,080	45	1,100	45
Beans IPC	620	80	13	120	19	420	68
Sorghum	2,940	0	0	620	21	2,320	79
Groundnuts	100	0	0	80	80	20	20
Sweet Potatoes	3,000	0	0	0	0	3,000	100
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	29
Second Rains							
Maize	8,695	1,285	15	270	3	7,140	82
Maize & Beans	30,440	380	1	11,580	38	18,480	61
Beans	1,390	40	3	1,000	72	350	25
Beans IPC	80	60	75	0	0	20	25
Sunflower	1,955	8,910	456	0	0	-6,955	-356
Onions	720	0	0	720	100	0	0
Permanent Crops							
Cookng Bananas	450	0	0	400	89	50	11

SIAYA DISTRICT

TABLE 12 b: **DISPOSAL OF CROPS**

AEZ: LM 3–4

Survey Area 07

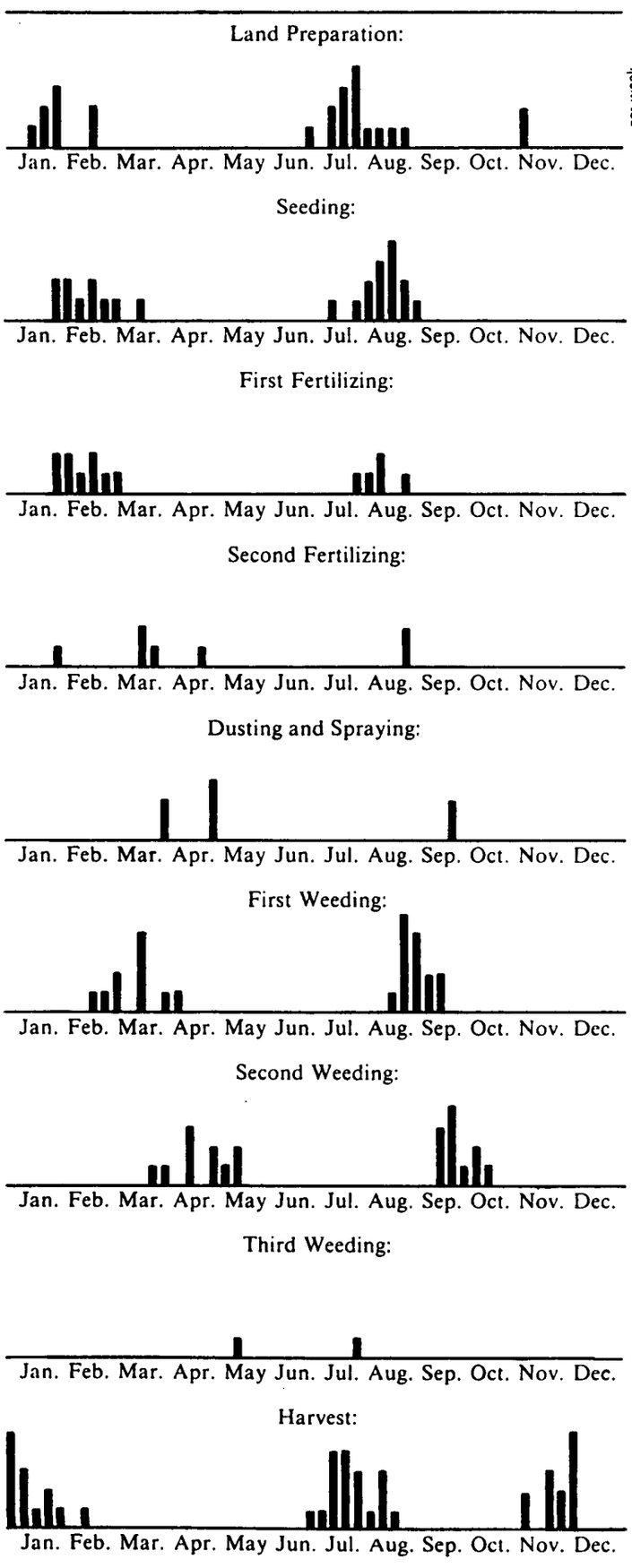
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	60,255	7,620	13	13,510	22	39,125	65
Maize & Beans	18,545	6,020	32	3,740	20	8,785	47
Maize & Cowps	490	0	0	90	18	400	82
Maize & Others	9,711	2,391	25	1,710	18	5,610	58
Beans	3,420	0	0	1,390	41	2,030	59
Fingermillet	350	140	40	70	20	140	40
FMlt & 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
Second Rains							
Maize	1,530	0	0	765	50	765	50
Maize & Beans	843	0	0	0	0	843	100
Permanent Crops							
Nil							

SIAYA DISTRICT

TABLE 13 a: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 Maize Cases: 24

AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30

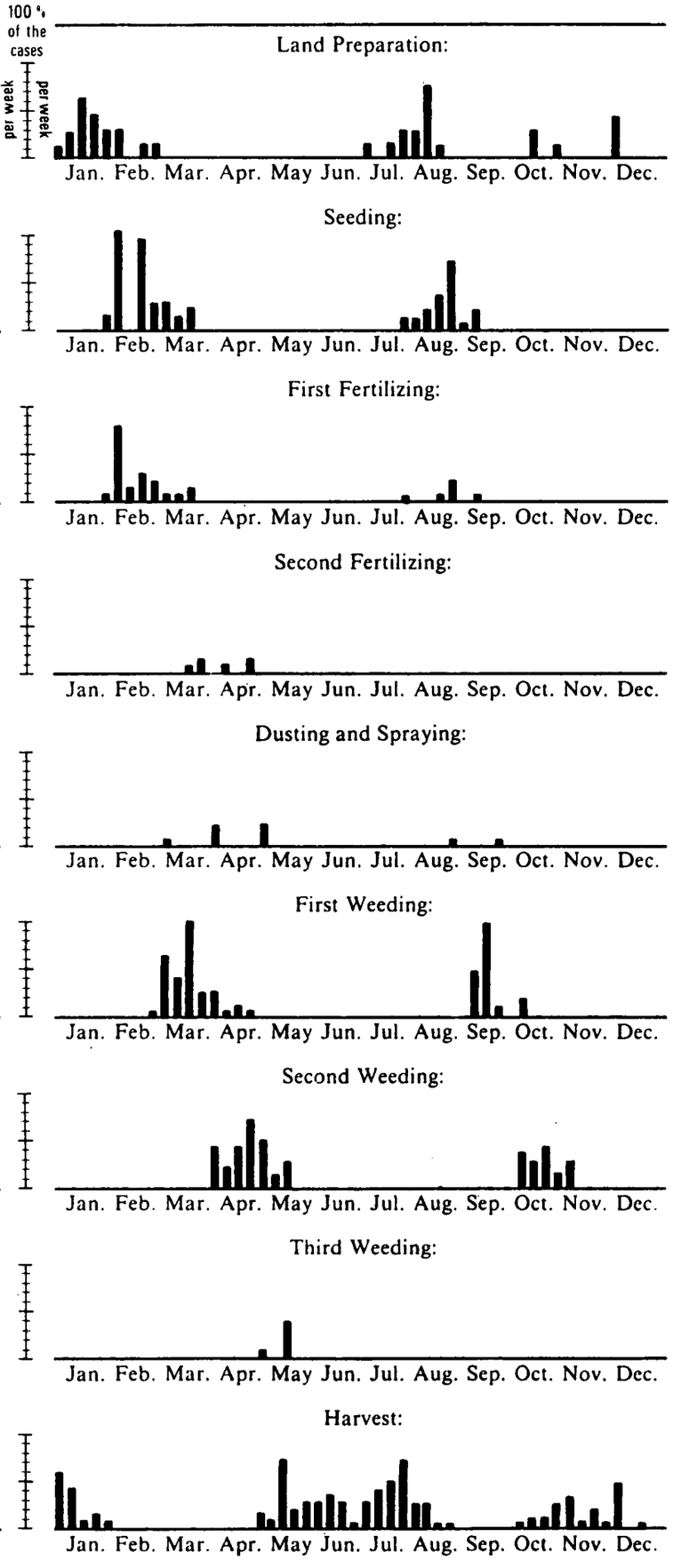


SIAYA DISTRICT

TABLE 13 b: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 Maize & Beans Cases: 60[1)]

AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30



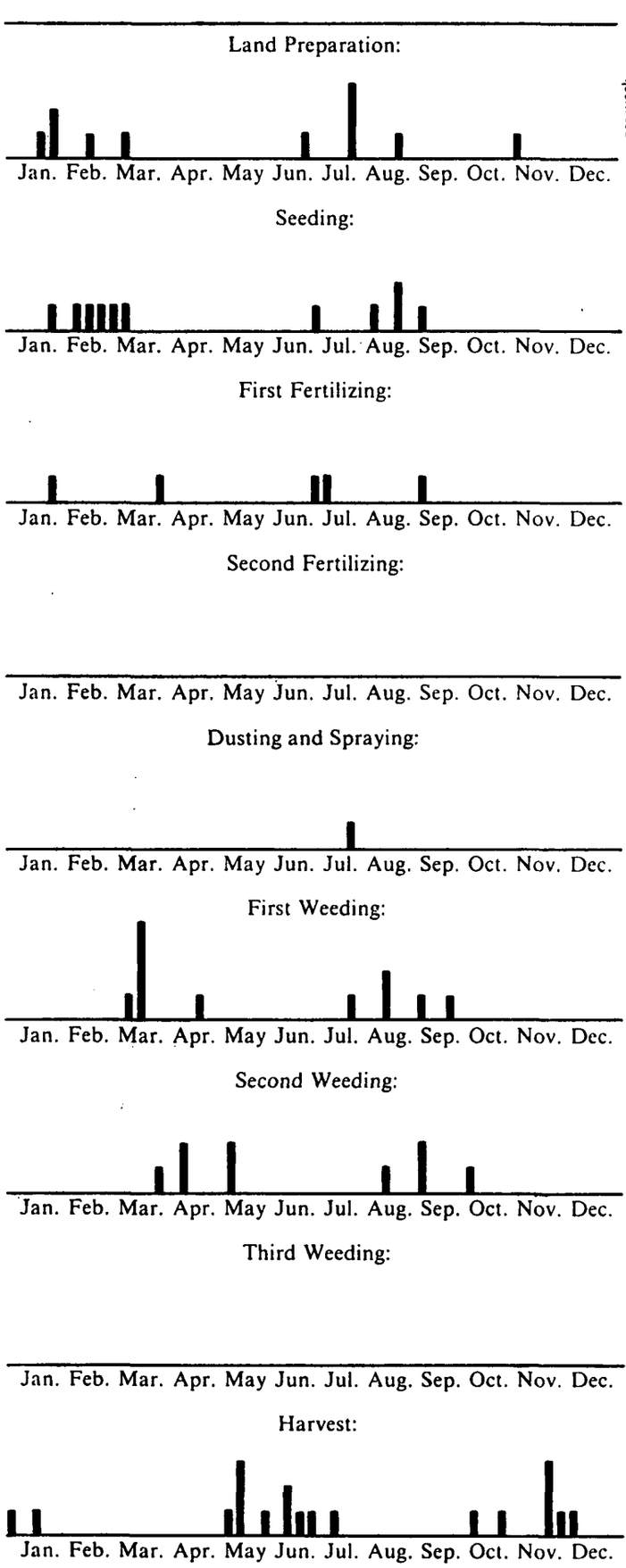
1) Maximum 30 per crop and season

SIAYA DISTRICT

TABLE 13 c: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 10 **Beans** Cases: 11

AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30

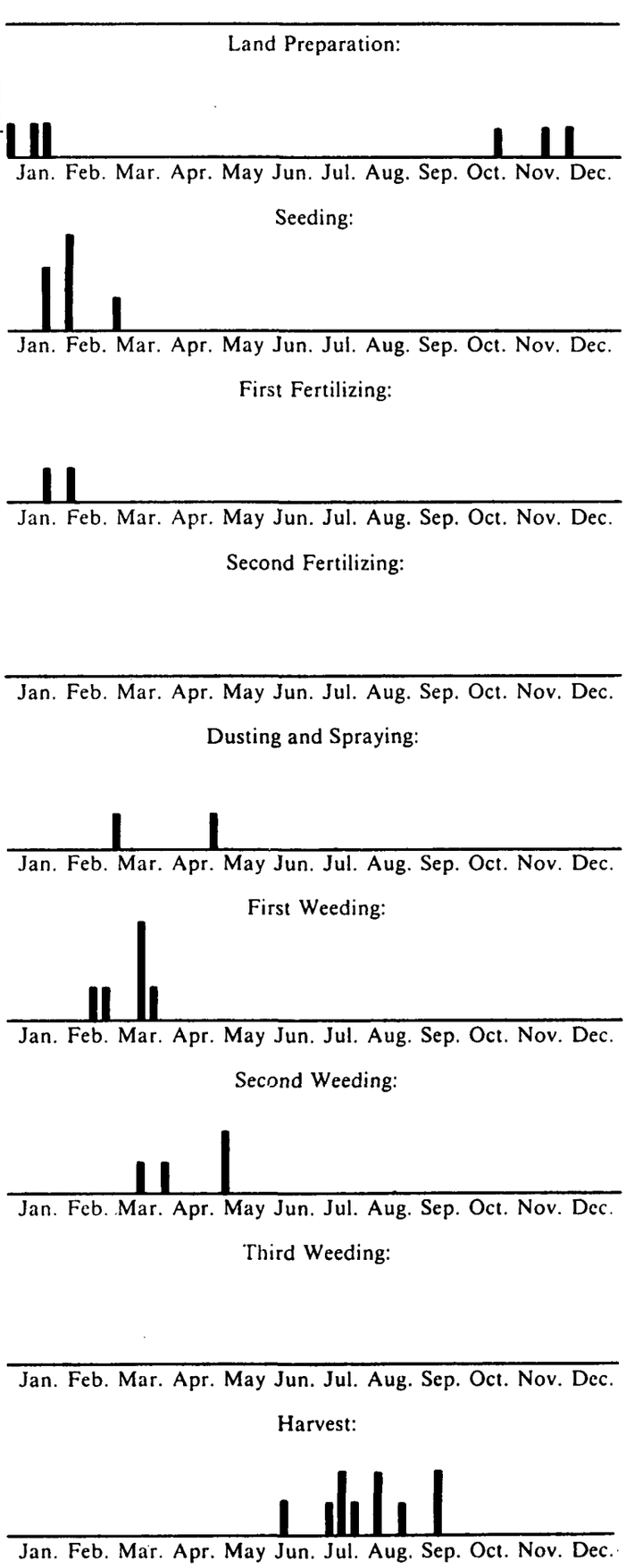


SIAYA DISTRICT

TABLE 13 d: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 18 **Sorghum** Cases: 6

AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30

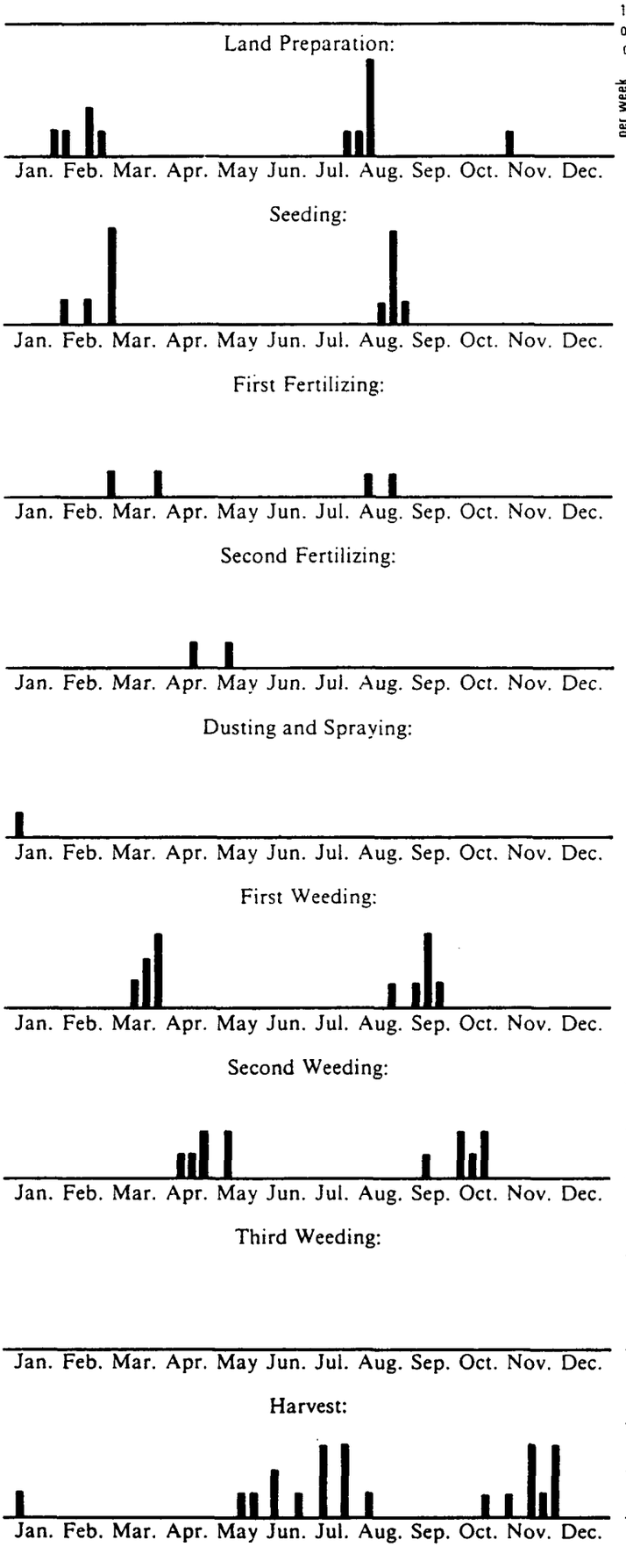


SIAYA DISTRICT

TABLE 13 e: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 34 **Sunflower** Cases: 12

AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30

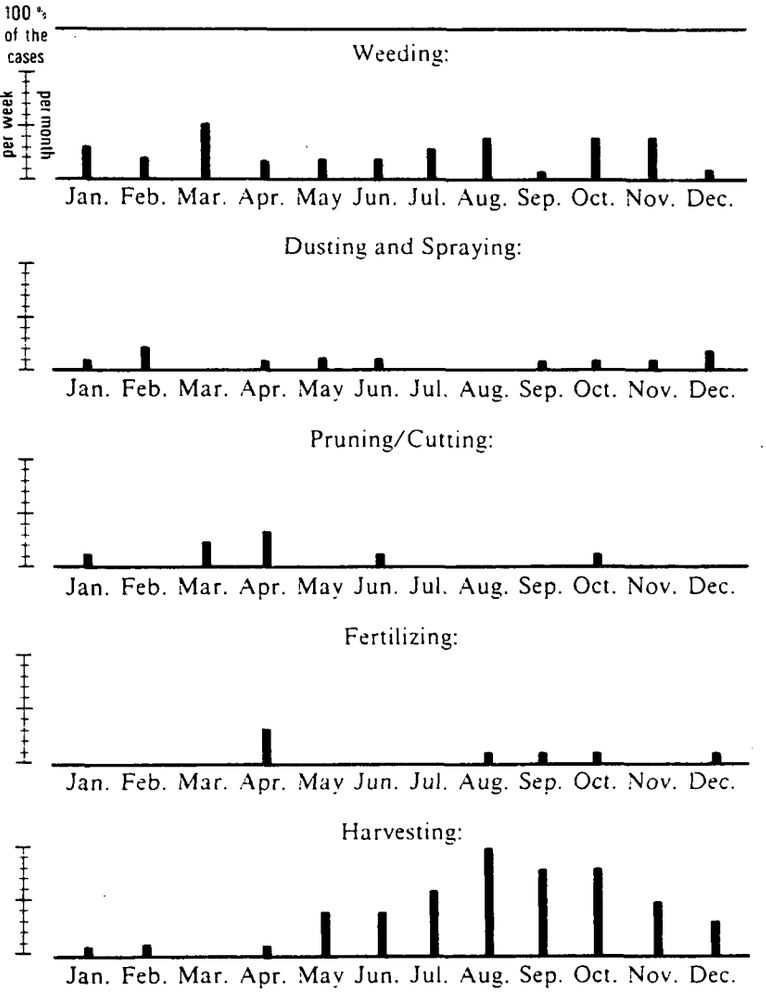


SIAYA DISTRICT

TABLE 13 f: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 51 **Coffee (Robusta)** Cases: 11

AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30

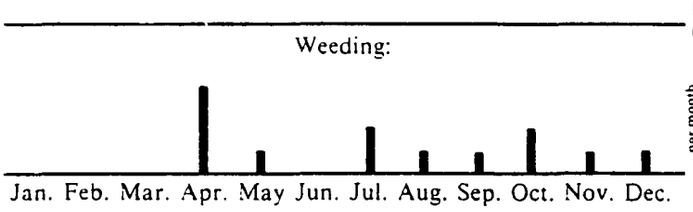


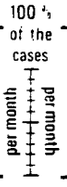
SIAYA DISTRICT

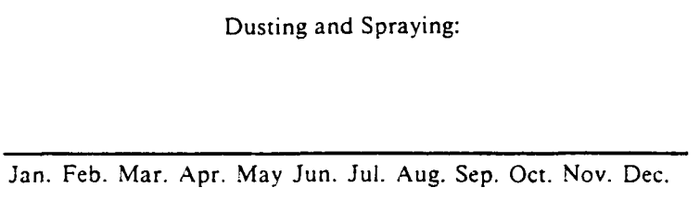
TABLE 13 g: **DISTRIBUTION OF FARMING ACTIVITIES**

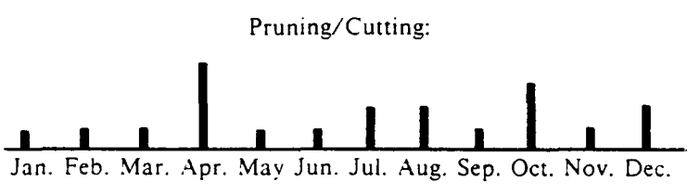
Crop 56 **Cooking Bananas** Cases: 6

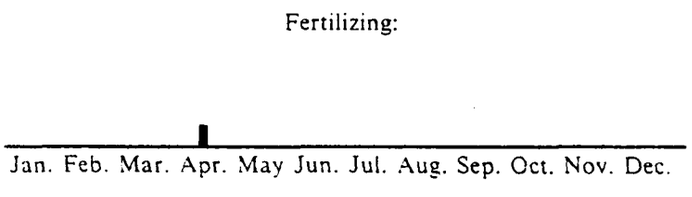
AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30

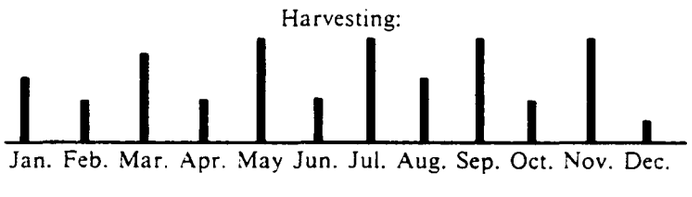










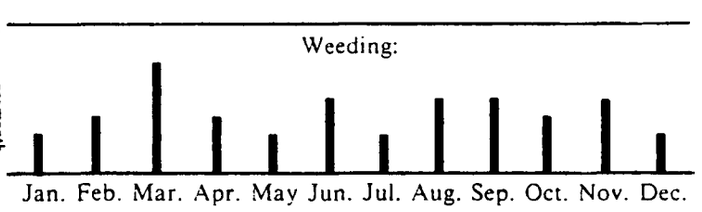


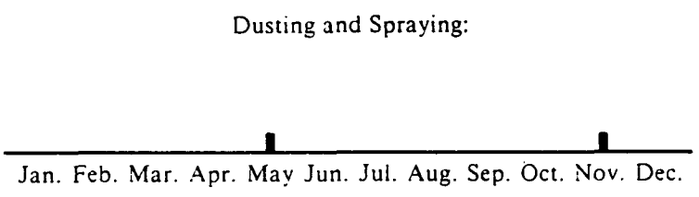
SIAYA DISTRICT

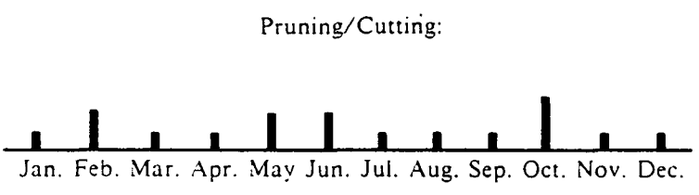
TABLE 13 h: **DISTRIBUTION OF FARMING ACTIVITIES**

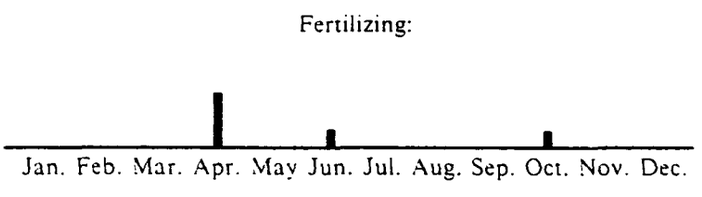
Crop 63 **Sugarcane** Cases: 14

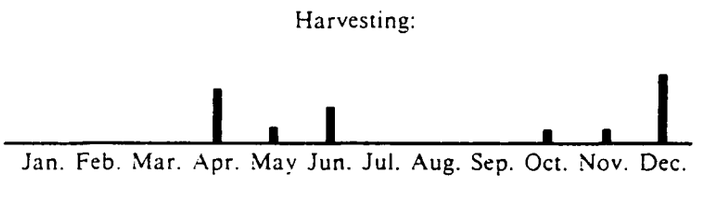
AEZ: UM 1 – LM 1 Survey Area 08 Sample Size: 30









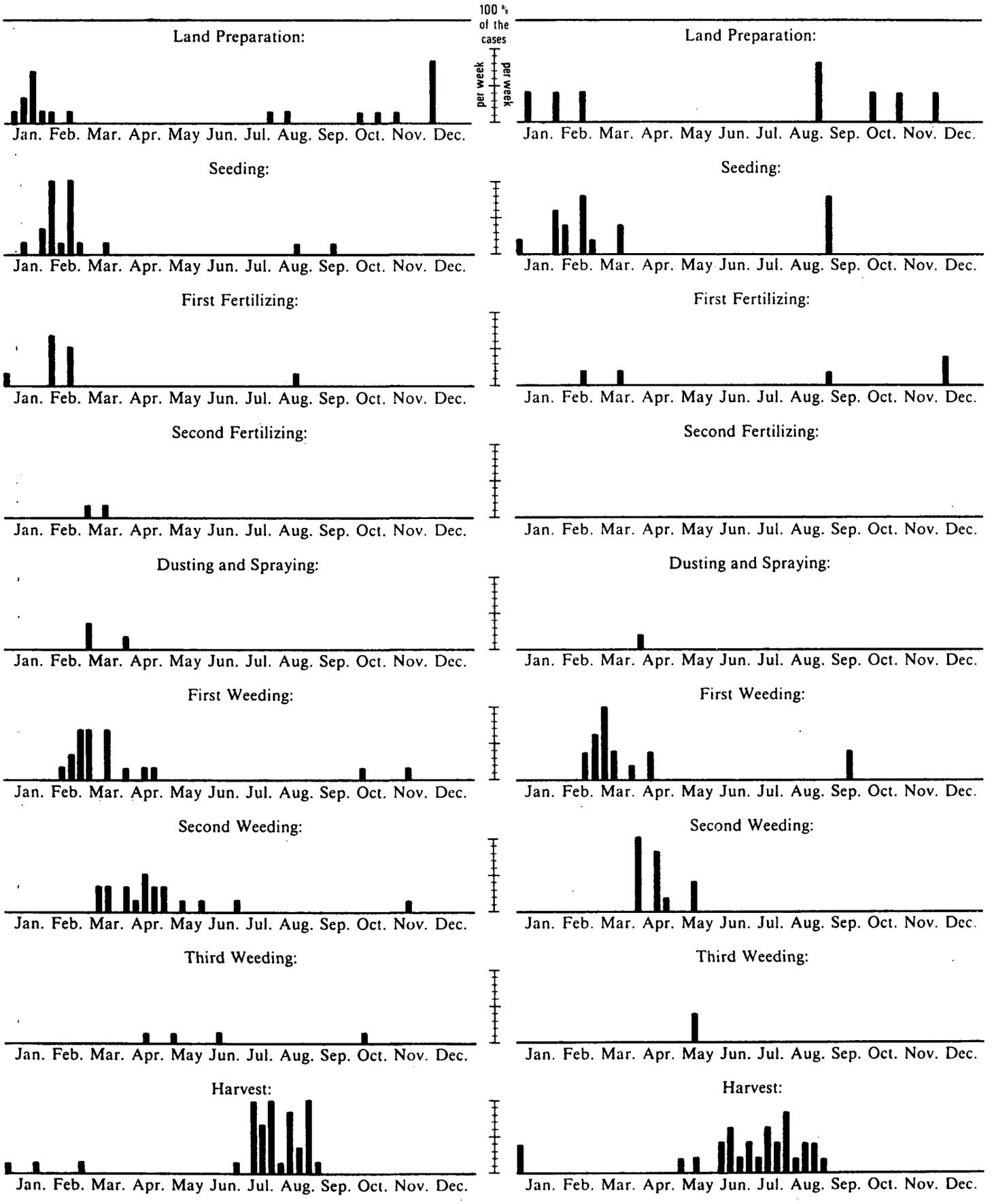


SIAYA DISTRICT

TABLE 13 i: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 **Maize** Cases: 20

AEZ: LM 3–4 Survey Area 07 Sample Size: 30



SIAYA DISTRICT

TABLE 13 j: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 17

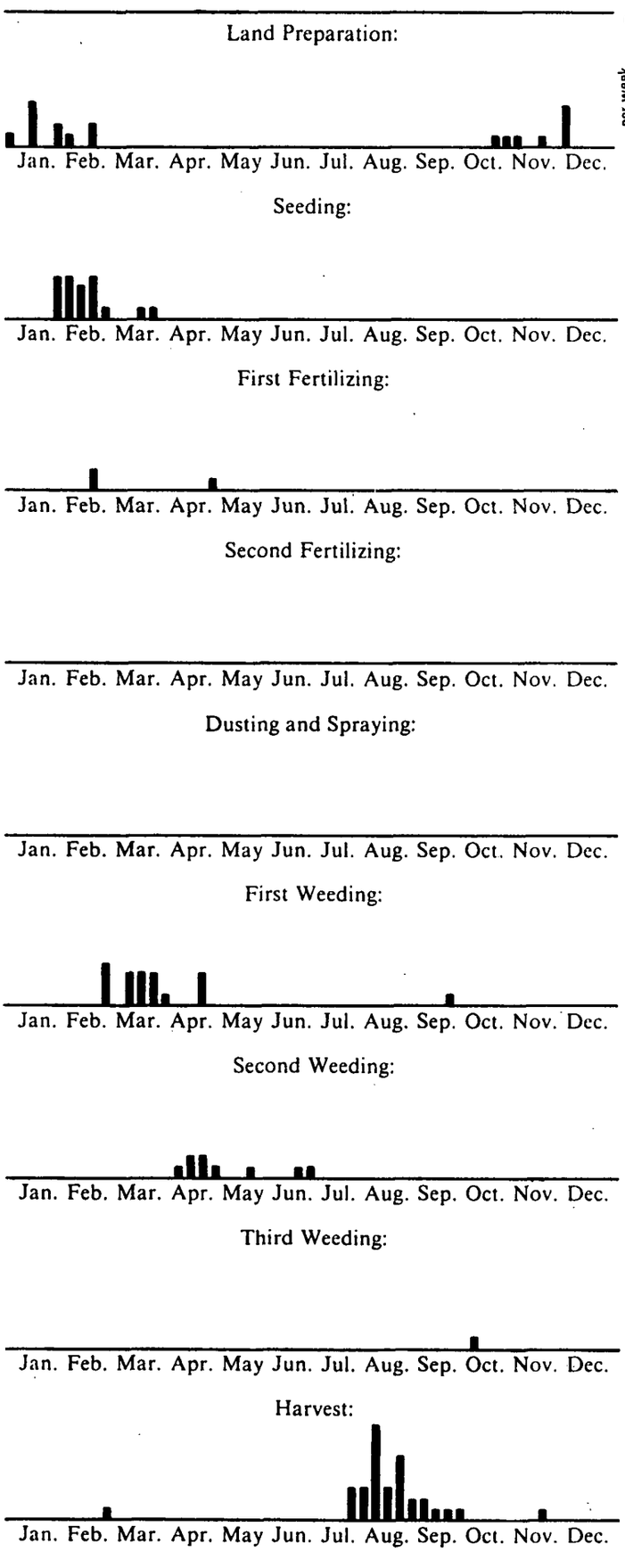
AEZ: LM 3–4 Survey Area 07 Sample Size: 30

SIAYA DISTRICT

TABLE 13 k: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 18 **Sorghum** Cases: 18

AEZ: LM 3–4 Survey Area 07 Sample Size: 30

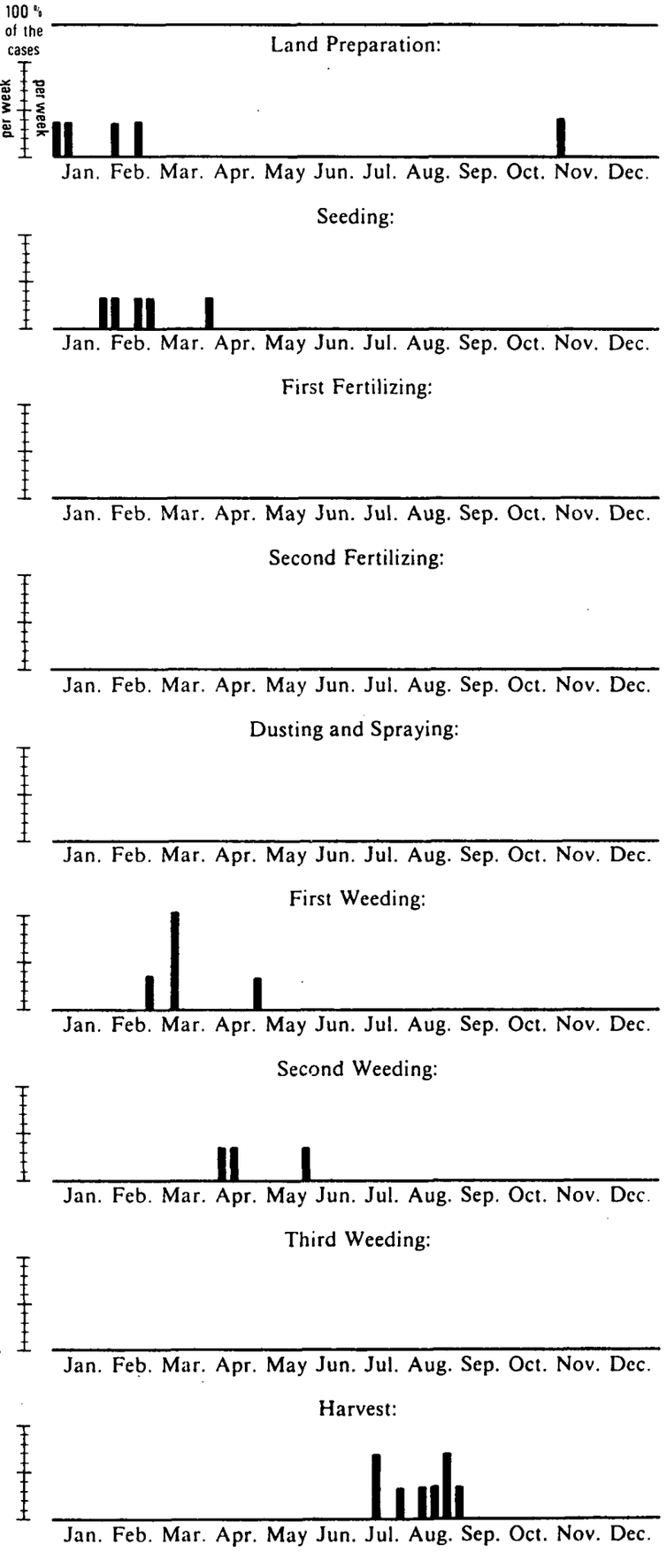


SIAYA DISTRICT

TABLE 13 l: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 24 **Groundnuts** Cases: 5

AEZ: LM 3–4 Survey Area 07 Sample Size: 30

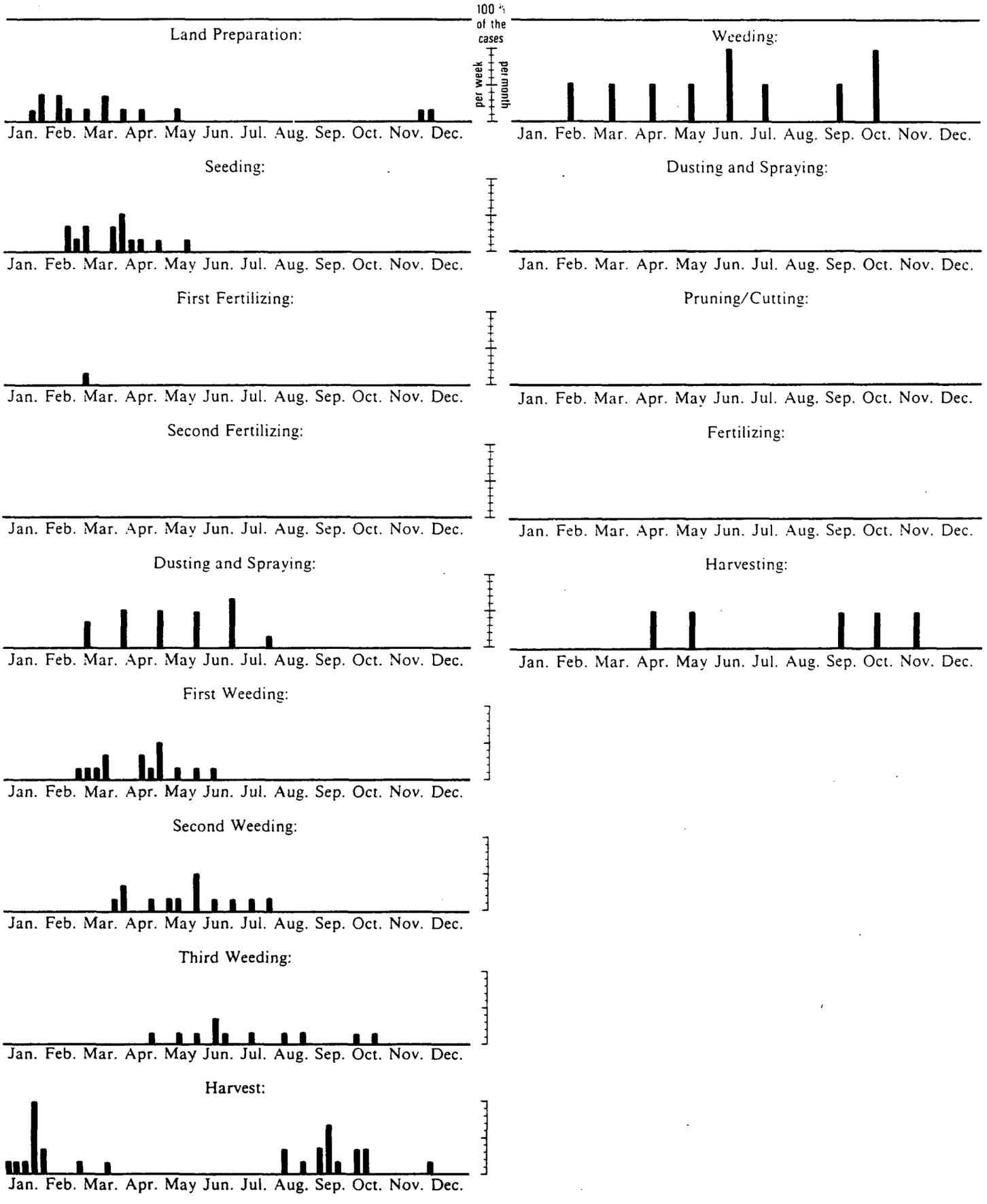


SIAYA DISTRICT

TABLE 13 m: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 35 **Cotton** Cases: 14

AEZ: LM 3–4 Survey Area 07 Sample Size: 30



SIAYA DISTRICT

TABLE 13 n: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 64 **Cassava** Cases: 4

AEZ: LM 3–4 Survey Area 07 Sample Size: 30

TABLE 14 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 MARGINAL S.CANE ZONE				A.E.Z.: LM 3 COTTON ZONE			
	Vegt. Period 1st + 2nd: 1-mi in Days, 1st: 200 or more			2nd: 120-130	total: 320-330	1-(m/s) i 190 or more		110-120	300-310	m/1-(s or s/vs) 155-165	80-90		235-255
	Soil: FERRALSOLS					FERRALSOLS				ACRISOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE/LEYS													
Farmers in Production Level	%												
Yields	kg	1,800			3.600	1.500			3,000	1,200			2,400
Fertilizer N	kg				100				83				66
P_2O_5	kg				50				41				33
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	3,000			8,000	2,800			7,000	2,500			5,000
Fertilizer N	kg				277				233				138
P_2O_5	kg				138				116				69
K_2O													
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	1,400	2,500	4,000	8,500								
Fertilizer N	kg		36	86	284								
P_2O_5	kg		7	17	56								
K_2O	kg		7	17	56								
CROP: SUGAR CANE													
Farmers in Production Level	%												
Yields/year	kg	4,000	10,000	32,000	55,000								
Fertilizer N	kg		12	56	102								
P_2O_5	kg		42	196	357								
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	5,000	3,100	8,000	20,000	6,500	3,000	8,000	14,000				
Fertilizer N	kg			54	270			27	135				
P_2O_5	kg			21	105			11	53				
K_2O	kg												
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg									300	180		1,500
Fertilizer N	kg												132
P_2O_5	kg												96
K_2O	kg												

TABLE 14 b: 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 MARGINAL S.CANE ZONE				A.E.Z.: LM 3 COTTON ZONE			
			Vegt. Period 1st + 2nd: 1-mi in Days, 1st: 200 or more		2nd: 120-130	total: 320-330	1-(m/s)i 190 or more		110-120	300-310	m/1-(s or s/vs) 155-165	80-90		235-255
			Soil: FERRALSOLS				FERRALSOLS				ACRISOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE														
Farmers in Production Level		%												
	Yields	kg	1,200	1,500	2,200	4,000	2,000	1,400	2,000	3,100	1,000	1,300	2,000	2,200
	Fertilizer N	kg			30	84				28		10	30	36
	P_2O_5	kg			28	78				31		8	28	34
	K_2O	kg												
CROP: SORGHUM														
Farmers in Production Level		%												
	Yields	kg	2,000	1,000	2,000	3,800	2,100	1,000	2,200	4,200	1,600	1,000	1,800	3,000
	Fertilizer N	kg				78				70			10	61
	P_2O_5	kg				57				50			8	43
	K_2O													
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	2,000/400	3,100/500	1,000	1,300/250	2,000/350	2,200/500
	Fertilizer N	kg			49	108				36		22	47	60
	P_2O_5	kg			42	96				33		17	40	52
	K_2O	kg												
CROP: BEANS														
Farmers in Production Level		%												
	Yields	kg					1,000	600	900	1,700	800	500	700	1,000
	Fertilizer N	kg								42				12
	P_2O_5	kg								25				7
	K_2O	kg												
CROP: SUNFLOWER														
Farmers in Production Level		%												
	Yields	kg	700	600	850	1,200								
	Fertilizer N	kg			5	17								
	P_2O_5	kg			6	20								
	K_2O	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_2O_5	kg			7	23								
	K_2O	kg												

SIAYA DISTRICT

TABLE 14 c: **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 MARGINAL S.CANE ZONE				A.E.Z.: LM 3 COTTON ZONE			
			Vegt. Period 1st + 2nd: 1-mi		2nd:	total:	1-(m/s)i				m/l-(s or s/vs)			
			in Days, 1st: 200 or more		120-130	320-330	190 or more		110-120	300-310	155-165	80-90		235-255
			Soil: FERRALSOLS				FERRALSOLS				ACRISOLS			
		Unit	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	900	500	800	1,400	1,200	700	900	1,200	800	700	800	1,200
Fertilizer	N	kg				20								22
	P_2O_5	kg				20								22
	K_2O	kg												
CROP: SIMSIM														
Farmers in Production Level		%												
Yields		kg									550			900
Fertilizer	N	kg												10
	P_2O_5	kg												12
	K_2O													
CROP: SWEET POTATOES														
Farmers in Production Level		%												
Yields		kg	5,000	5,000	12,000	25,000	7,000	6,000	8,000	25,000	3,000	6,000	8,000	16,000
Fertilizer	N	kg			70	200			10	180		30	50	130
	P_2O_5	kg			49	140			7	127		21	35	91
	K_2O	kg												
CROP: CASSAVA														
Farmers in Production Level		%												
Yields		kg	4,000	3,000	5,000	12,000	7,500	5,000	6,000	9,000	4,000	5,000	6,000	8,000
Fertilizer	N	kg			4	32				6		4	8	16
	P_2O_5	kg			7	56				11		7	14	28
	K_2O	kg												
CROP: CABBAGE														
Farmers in Production Level		%												
Yields		kg	4,000	3,500	6,000	18,000								
Fertilizer	N	kg			14	98								
	P_2O_5	kg			14	98								
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer	N	kg												
	P_2O_5	kg												
	K_2O	kg												

TABLE 14 d: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

	A.E.Z.: LM 4 MARGINAL COTTON ZONE												
	Vegt. Period 1st + 2nd: (m/s)+i in Days, 1st: 130			2nd: <45									
	Soil: REGOSOLS												
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE													
Farmers in Production Level	%												
Yields	kg	1,500			3,000								
Fertilizer N	kg				83								
P_2O_5	kg				41								
K_2O	kg												
CROP: BANA GRASS													
Farmers in Production Level	%												
Yields	kg	2,800			5,800								
Fertilizer N	kg				167								
P_2O_5	kg				83								
K_2O													
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	800	600	1,700	2,800								
Fertilizer N	kg			30	70								
P_2O_5	kg			30	70								
K_2O	kg												
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	900	500	800	1,200								
Fertilizer N	kg				10								
P_2O_5	kg				13								
K_2O	kg												

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 Siaya 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 dominated by the lake wind. Therefore, the difference concerning rainfall between the lake shore and the interior is less, but 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 zone LM 1 l⌐ m i this means that "a long season followed by a medium one" is one possibility to divide the more or less continuing growing period provided that second planting is intented to start in beginning of September. The planting may start earlier if 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 now tarmac road from Kisumu. There are large sugar cane zones to be developed[1] and potential cotton areas.

The poor soils are the main problem, often underlain by hard-pans. Cassava, which is now very 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 bananas. There are important, well-suited crops resistant to nematodes, i.e. roselle. Striga (whitchweed) is a problem for cereals. A chance to fight it is more ploughing in order to sow a trap crop (sorghum) and to plough it in with the upsprung 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 45 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 due to 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

No. and altidude	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.
8933026	Port Victoria Cath.	32	Average	925	49	57	133	189	137	48	29	45	46	69	88	34
1 250 m	Mission															
8934030	Nangina Cath. Mission	37	Av.	1 420	41	59	124	246	155	79	72	108	151	160	156	70
1 219 m			60% prob.[1]	1 278	13	43	114	224	144	62	52	90	118	135	121	51
8934037	Lukoli Dispensary	21	Av.	1 613	38	58	143	241	234	116	96	118	106	140	214	110
1 219 m			60%	1 473	12	11	103	179	130	107	73	41	88	126	133	57
8934039	Butula Cath. Mission	29	Av.	1 990	64	124	155	289	311	172	122	175	167	163	145	107
1 295 m			60%	1 786	34	53	113	283	241	130	81	132	129	120	115	68
8934105	Busia, Cotton Exp.	19	Av.	1 766	70	80	156	278	245	102	84	141	157	182	172	100
1 220 m	Station															

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.

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	Busia Cotton	LM	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
1 220 m	Experimental	1	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	
	Station	hp	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

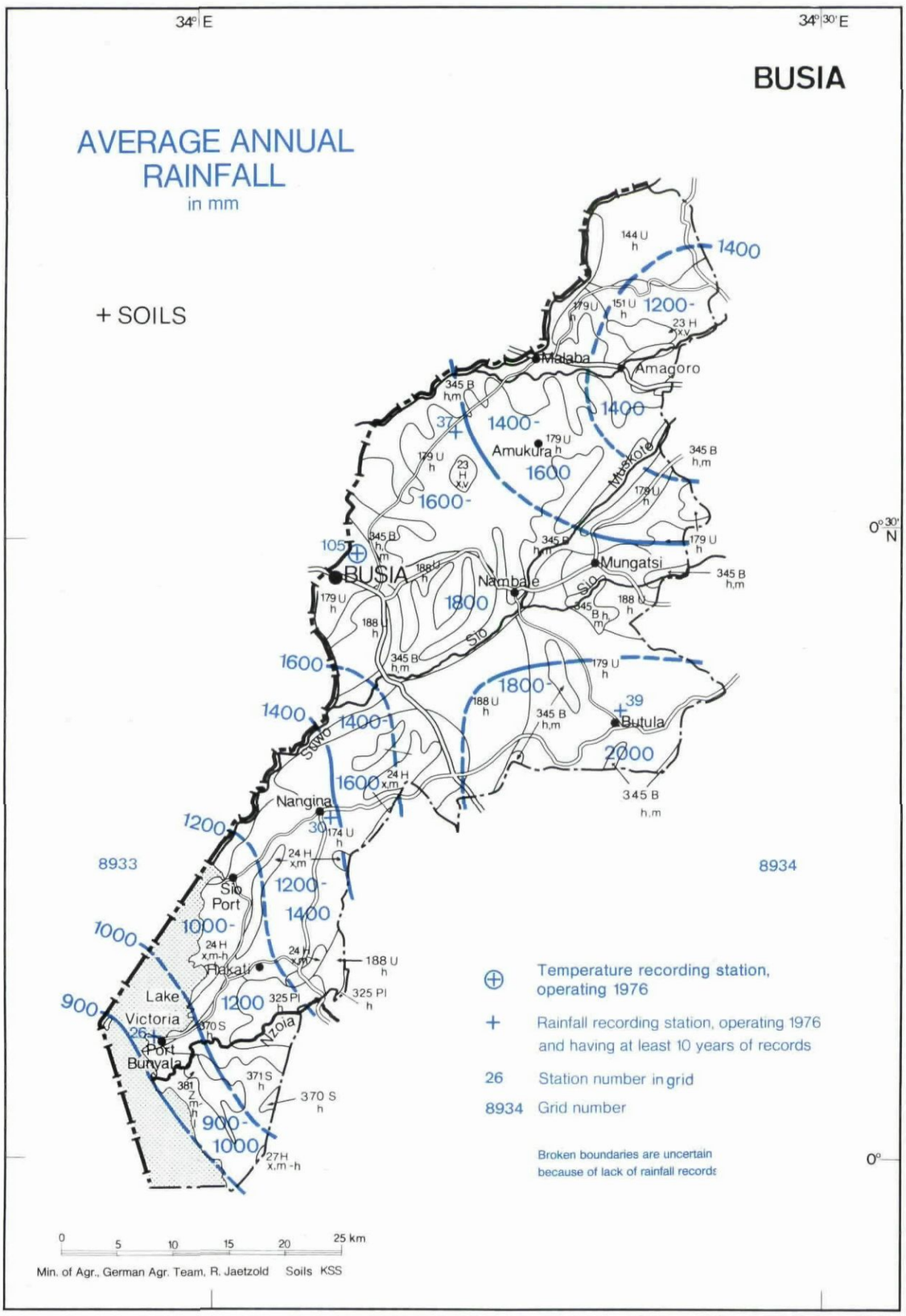
TABLE 3: **CLIMATE IN THE AGRO-ECOLOGICAL ZONES**

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
	l – 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	

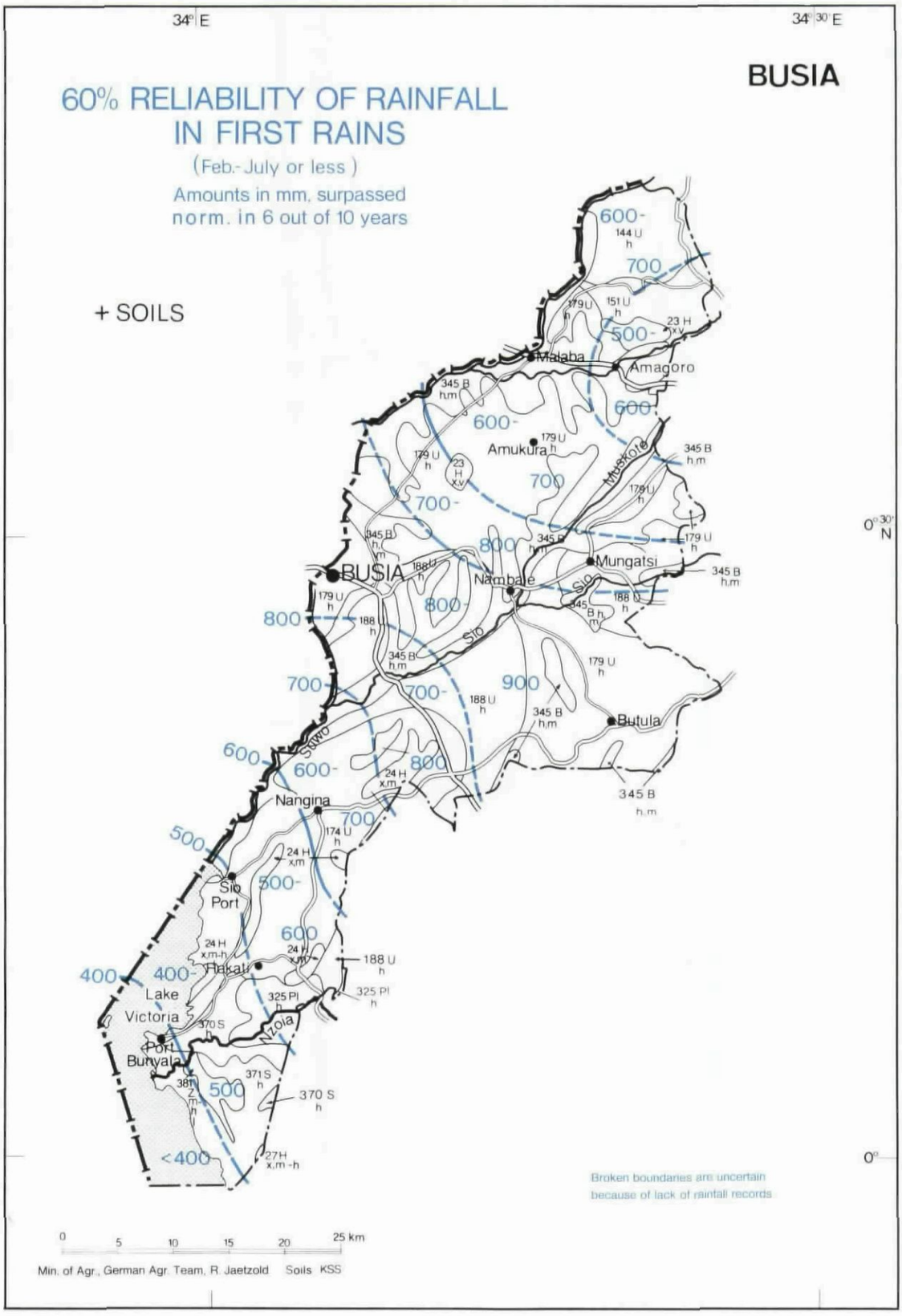
[1] Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants

[2] More if growing cycle of cultivated plants continues into the period of second rains

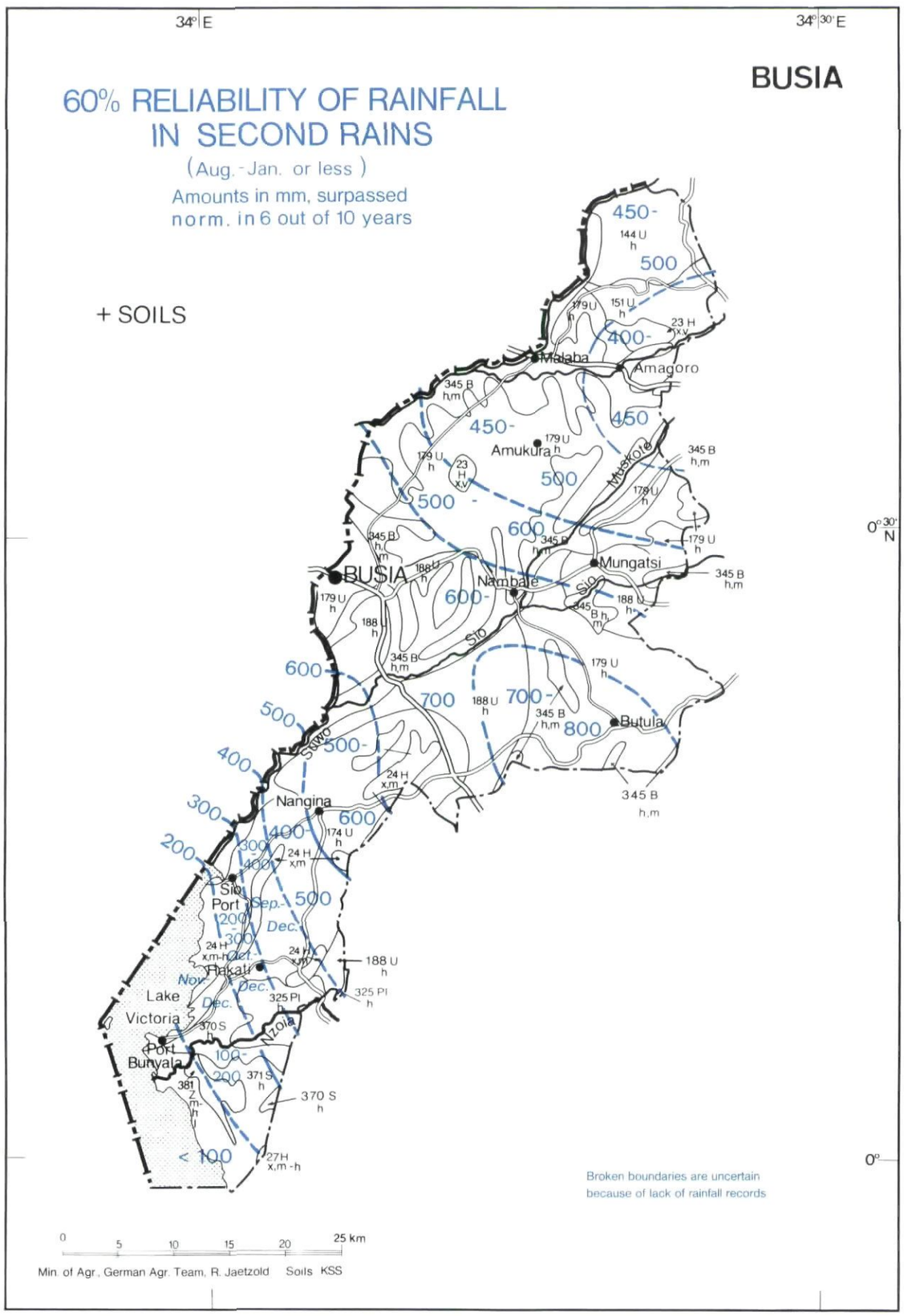
[3] Only added if rainfall continues at least for survival ($> 0.2\ E_o$) of most long term crops



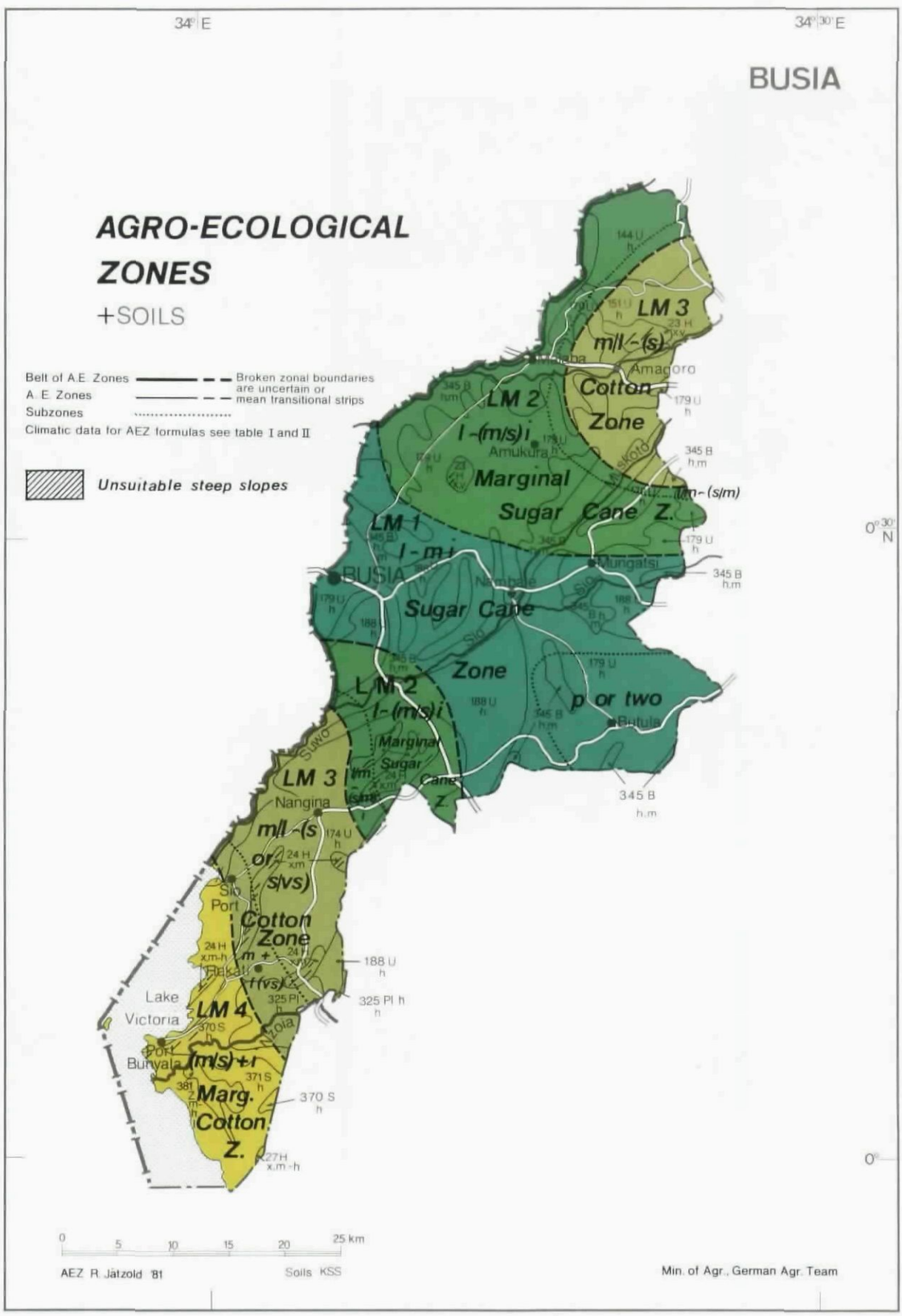
34° E
34° 30' E
BUSIA
AVERAGE ANNUAL RAINFALL
in mm
+ SOILS
0° 30' N
0°
8933
8934
Malaba
Amagoro
Amukura
Mungatsi
Nambale
BUSIA
Butula
Nangina
Sio Port
Hakati
Lake Victoria
Port Bunyala
Muskote
Sio
Sowo
Nzoia
1400
1200-
1400-
1600
1600-
1800
1800-
2000
1600
1400
1400-
1600
1200
1200-
1400
1000-
1000
1200
900
900-
1000
Temperature recording station, operating 1976
Rainfall recording station, operating 1976 and having at least 10 years of records
26 Station number in grid
8934 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



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
0° 30' N
0°
Malaba
Amagoro
Amukura
Muskote
Mungatsi
BUSIA
Nambale
Sio
Butula
Suwo
Nangina
Sio Port
Hakati
Lake Victoria
Port Bunyala
Nzoia
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
60% RELIABILITY OF RAINFALL
IN SECOND RAINS
(Aug.-Jan. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+ SOILS
0° 30' N
0°
Malaba
Amagoro
Amukura
Mungatsi
BUSIA
Nambale
Butula
Nangina
Sio Port
Hakati
Lake Victoria
Port Bunyala
Muskote
Sio
Sio
Suwo
Nzoia
450-
500
400-
450
500
600
600-
700
700-
800
600
500
400
300
200
500
600
400
300
200
100
< 100
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
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
Unsuitable steep slopes
LM 3
m/l -(s)
Amagoro
Cotton Zone
LM 2
l -(m/s) i
Amukura
Marginal Sugar Cane Z.
LM 1
l - m i
BUSIA
Mungatsi
Sugar Cane Zone
LM 2
l -(m/s) i
p or two
Butula
Marginal Sugar Cane Z.
LM 3
Nangina
m/l -(s or s/vs)
Sio Port
Cotton Zone
Lake Victoria
LM 4
Port Bunyala
(m/s) + i
Marg. Cotton Z.
0° 30' N
0°
0 5 10 15 20 25 km
AEZ R. Jätzold '81
Soils KSS
Min. of Agr., German Agr. Team

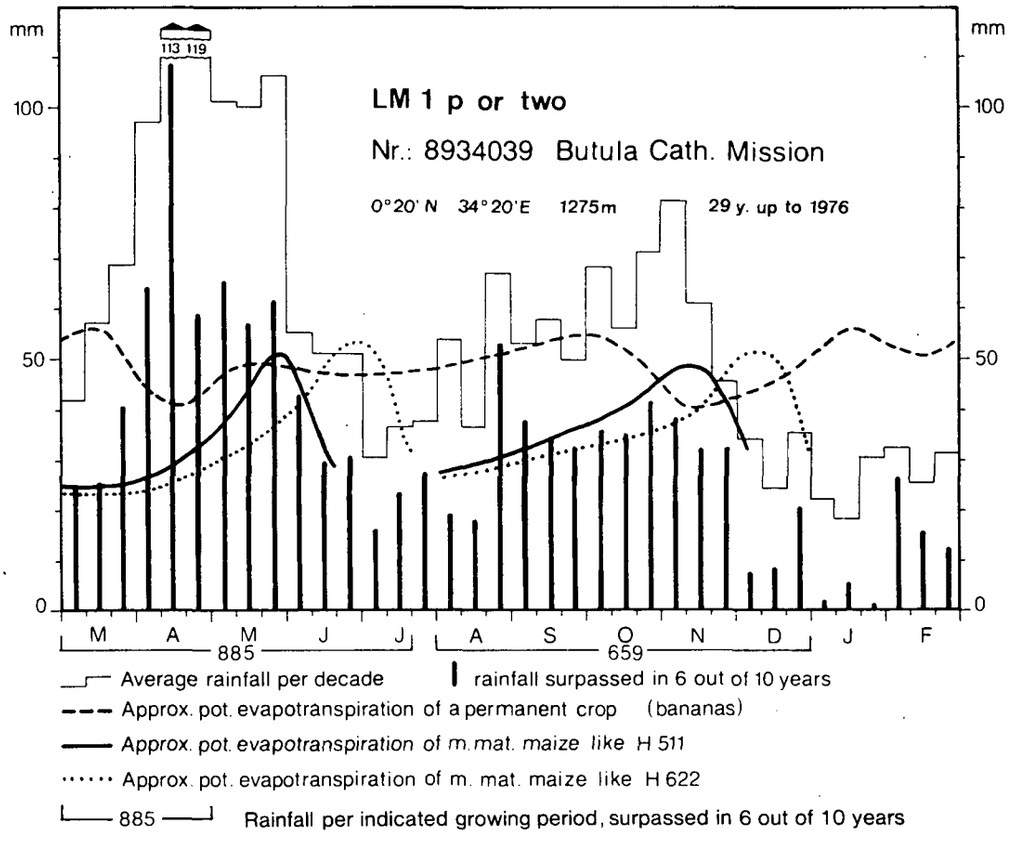
AGRO-ECOLOGICAL ZONES

LM = LOWER MIDLAND ZONES

LM 1 = L o w e r M i d l a n d S u g a r C a n e Z o n e

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

V e r y g o o d y i e l d p o t e n t i a l (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

G o o d y i e l d p o t e n t i a l (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], avocadoes, cassava

F a i r y i e l d p o t e n t i a l (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

P a s t u r e a n d f o r a g e

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 l⌐(m/s) i = Marginal Sugar Cane Zone with a long cropping season 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; beans[2], 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]

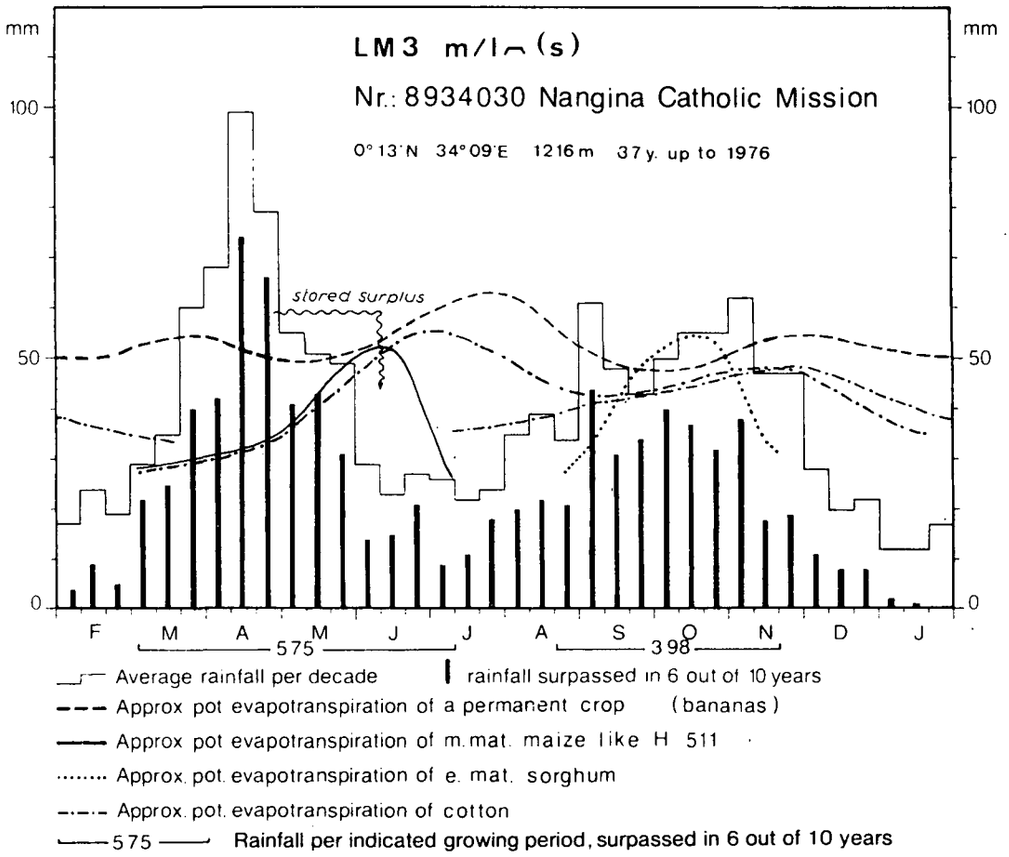
Whole year: Sugar cane (on less suitable soils and near LM 3 marginal), Robusta coffee, citrus, mangoes

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 l/m⌐ (s/m) i = Marginal Sugar Cane Zone with a long to medium cropping season 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 m/l–(s or s/vs) = *Lower Midland Cotton Zone with a medium to long cropping season 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); simsim[4]; sweet potatoes; cotton (∿ 60 %), m. mat. soya beans, sunflower 252 or H S 345, chick peas (on heavy black soils), dwarf castor[5]; 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]
Wohle 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 m + f(vs) = *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) 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 (m/s) + i = *Marginal Cotton Zone 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

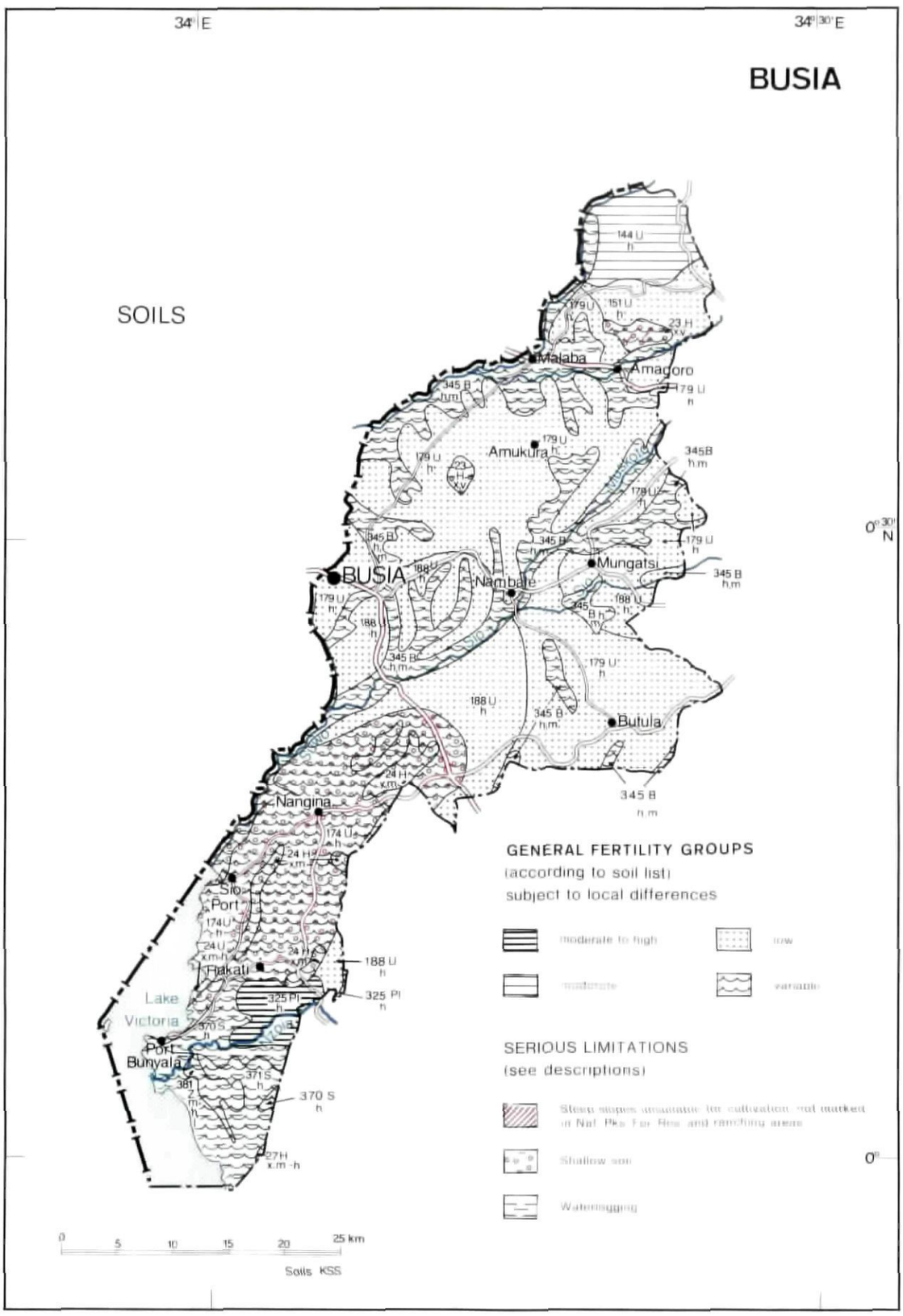
Fair yield potential
1st rains: E. mat. maize (40–50 %), e. mat. bulrush millet; pigeon peas (∿ 40 %), soya beans (40–50 %), e. mat. groundnuts and e. mat. bambarra groundnuts (both in light soils); onions

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
Malaba
Amagoro
Amukura
BUSIA
Nambale
Mungatsi
Butula
Nangina
Sio Port
Hiakati
Lake Victoria
Port Bunyala
0° 30' N
0°
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 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 on 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 a 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 a 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, v[1)] = 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-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)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

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

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 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 interfluves („murram cuirass" soils)
- well drained, very deep, dark reddish brown to strong brown, friable clay; on valley sides (dystric/eutric NITOSOLS and orthric 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 petroferric 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 h = very poorly drained, very deep, very dark grey to black, firm, cracking clay, with acid humic topsoil (seasonal swamps) (humic GLEYSOLS)

371 S h = 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

381 Z m-h, l = 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 underlaying 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
North Teso	15 809	16 628	32 437	6 285	200	162
South Teso	23 585	25 060	48 645	8 642	306	158
Northern Division	39 394	41 688	81 082	14 927	507	159
Bukhayo	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
Bukhayo	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

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 AEZ				Agric. land per	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads rivers...)		LM 1	LM 2	LM 3	LM 4	household	person
North Teso	200	2		20	178		81	97		2.83	0.55
South Teso	306	2		31	273	85	180	8		3.15	0.56
Northern Division	506	4		51	451	85	261	105		2.99	0.55
Bukhayo	407	2		41	364	221	118	25		3.40	0.62
Marachi	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
Bunyala	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).

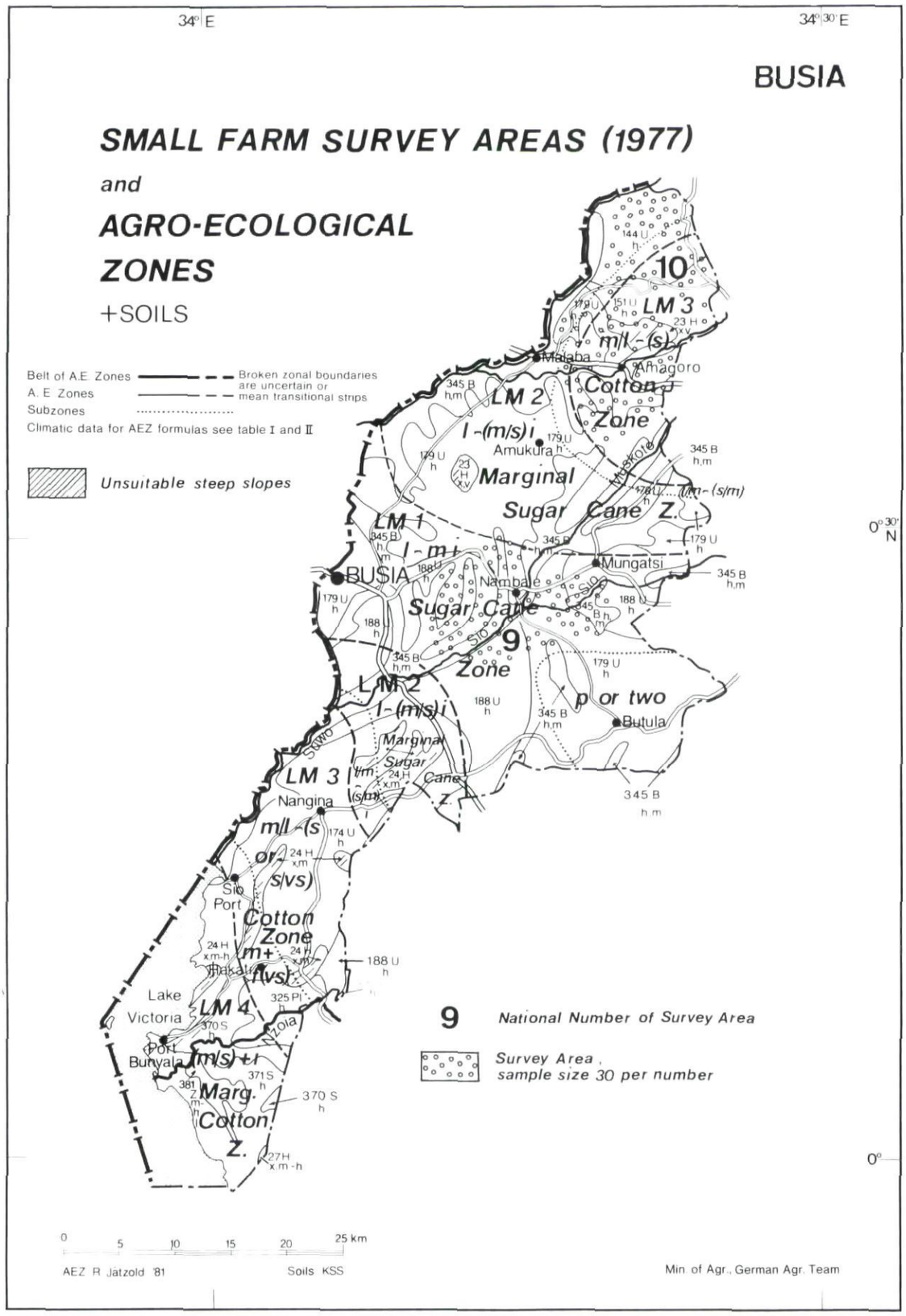
Maize, finger millet and cassava are the major food crops. The farms investigated planted sugar cane on 11 % (LM 1–2) and cotton on 14 % of their arable land area (LM 2–3). This proportion is above the district average; sugar cane is planted in a regionally confined area occupying roughly 3 % of the 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


34° E
34° 30' E
BUSIA
SMALL FARM SURVEY AREAS (1977)
and
AGRO-ECOLOGICAL ZONES
+SOILS
Belt of A.E. Zones
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
Unsuitable steep slopes
10
LM 3
m/l - (s)
Malaba
Amagoro
Cotton Zone
LM 2
l -(m/s) l
Amukura
Marginal Sugar Cane Z.
LM 1
l - m +
BUSIA
Nambale
Mungatsi
Sugar Cane Zone
9
LM 2
l -(m/s) l
p or two
Butula
Marginal Sugar Cane Z.
LM 3
Nangina
m/l - (s or s/vs)
Sio Port
Cotton Zone
m+
Lake Victoria
LM 4
(m/s) +l
Port Bunyala
Marg. Cotton Z.
9 National Number of Survey Area
Survey Area, sample size 30 per number
0° 30' N
0°
0 5 10 15 20 25 km
AEZ R. Jätzold '81
Soils KSS
Min. of Agr., German Agr. Team

BUSIA DISTRICT

TABLE 8 a: **FARM ORGANISATION ACCORDING TO FARM SIZE GROUP**

AEZ: LM 1

Survey Area 09

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	2.3	6.4	14.8
Land Use: Annual Crops[1] First Season				
Maize	ha	0.4	0.2	0.9
Sunflower	ha	0.2	0.5	0.4
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]				
Cassava	ha	0.1	0.1	0.2
Cotton	ha	0.1	-	-
Maize & Beans	ha	-	0.1	0.1
Total	ha	0.2	0.2	0.3
Permanent Crops[1]				
Sugarcane	ha	0.3	0.3	0.5
Bananas	ha	-	0.1	0.2
	ha			
	ha			
portion of total	%	13%	6%	5%
Grazing & Forage	ha	0.4	1.9	9.5
portion of total	%	17%	30%	64%
Other Land Use	ha	0.4	0.8	1.5
Livestock on Farm:				
Cattle: local	LU	2.0	3.3	4.5
improved	LU	-	-	-
Sheep & Goats	LU	0.1	0.5	0.5
Total	LU	2.1	3.8	5.0

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.7	0.6	0.3
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	10%	70%	100%
Labour on Farm:				
Family Adults	persons	2.1	3.3	3.0
Perm. Hired Labour	"	-	0.1	0.3
Children > 14 years	"	1.2	1.8	1.3
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.00	0.32	2.32
Children < 14 years	"	2.56	-	2.56
Subsistence Units	SU	3.53	0.32	3.85
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1226	1976	
Beans	kg	35	56	
Fingermillet	kg	105	164	
Cassava	kg	71	40	
Sorghum	kg	105	164	
Groundnuts	kg	5	8	
	kg			
	kg			

Other Crops cultivated: Sorghum, Fingermillet, Groundnuts, Beans

1) Major crops only considered

2) Based on 1979 Census figures

TABLE 8 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: LM 2–3

Survey Area 10

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.7	3.9	8.1
Land Use: Annual Crops[1]				
First Season: Others	ha	-	0.2	0.5
Maize	ha	0.4	0.5	0.7
Fingermillet	ha	0.2	0.3	0.6
Sunflower	ha	0.1	0.3	0.5
Cassava	ha	0.1	0.3	0.4
Cotton	ha	0.3	0.4	0.9
Total	ha	1.1	2.0	3.6
Second Season[1]				
	ha			
Cotton	ha	0.1	0.1	-
Cassava	ha	0.1	0.2	0.1
Total	ha	0.2	0.3	0.1
Permanent Crops[1]				
Sugarcane	ha	-	0.1	0.1
Bananas	ha	0.1	0.2	0.2
	ha			
	ha			
portion of total	%	6%	8%	4%
Grazing & Forage	ha	0.4	1.1	2.5
portion of total	%	6%	28%	31%
Other Land Use	ha	0.1	0.5	1.7
Livestock on Farm:				
Cattle: local	LU	4.8	3.7	4.5
improved	LU	-	-	0.6
Sheep & Goats	LU	0.2	0.3	0.5
Total	LU	5.0	4.0	5.6

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.8	0.7	0.5
Portion of improved cattle kept	%	-	-	12%
Portion of Farmers owning a Plough	%	80%	70%	90%
Labour on Farm:				
Family Adults	persons	2.4	2.8	3.4
Perm. Hired Labour	"	0.5	0.4	0.5
Children > 14 years	"	3.0	1.3	2.6
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.05	0.17	2.22
Children < 14 years	"	2.82	-	2.82
Subsistence Units	SU	3.74	0.17	3.91
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	959	1546	
Beans	kg	123	195	
Fingermillet	kg	242	379	
Sweet Potatoes	kg	670	212	
	kg			
	kg			
	kg			
	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 Crops ha	%	Perm. Crops ha	%	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

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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

BUSIA DISTRICT

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

AEZ: 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 ha	%	Perm. Crops ha	%	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use 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_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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

TABLE 10 a: **CROPPING PATTERN**

AEZ: LM 1 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

BUSIA DISTRICT

TABLE 10 b: **CROPPING PATTERN**

AEZ: 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

TABLE 11 a: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: LM 1 — 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	1.37	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

TABLE 11 b: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: LM 2–3 — in Head and Livestock Units — Nov. '77, Survey Area 10

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			5.8			5.8
	Average	0.07	-	-	0.10	0.13			0.19			0.19
	Upper Qu.	-	-	-	-	-			-			-
	Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =		13.0 % of total cattle,				Calves + Heifers =			75.0 % of dairy cows			
Unimproved Livestock:												
Under 1 year,	Average	1.87	-	0.07	1.53		0.37	0.77	0.81	0.10		0.82
	Upper Qu.	-	-	-	1		1	1	0.4	-		0.4
1 - 2 years,	Average	0.20	-	0.50	1.23				0.87			0.87
	Upper Qu.	-	-	-	2				0.9			0.9
Over 2 years,	Average	0.43	-	1.67		2.03	0.90	1.50	2.93	0.03	15.63	2.93
	Upper Qu.	1	-	3		3	2	1	-	-	6	-
Subtotal (unimp.)	Total	75	-	67	83	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	4.62
	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,				Calves + Heifers =			136.1 % of dairy cows			
LU Goats + Sheep =		7.7 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	77	-	67	86	65	38	68	143.9	4	469	144.5
	Average	2.57	-	2.23	2.87	2.17	1.27	2.27	4.79	0.13	15.63	4.31
	Upper Qu.	2	-	4	3	3	3	3	7.1	-	24	6.6
	Lower Qu.	-	-	-	1	-	-	-	2.2	-	6	2.2
LU Male Cattle =		47.1 % of total cattle,				Calves + Heifers =			132.3 % of dairy cows			
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

BUSIA DISTRICT

TABLE 12 a: INPUTS AND YIELDS OF MAJOR CROPS

AEZ: LM 1

Survey Area 09

Crop		Inputs							Yield
		Improved Seeds	Nutrients				Chemicals		
			N	P_2O_5	K_2O	Manure	Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
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.	88	-	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
Second Rains									
Groundnuts	Avg.	-	-	-	-	-	-	-	1,075
Sunflower	Avg.	100	-	6	-	-	-	-	1,725
	UpQu	100	-	-	-	-	-	-	1,000
	LoQu	100	-	-	-	-	-	-	540
Cotton	Avg.	75	-	10	-	-	21	21	908
	UpQu	100	-	-	-	-	25	25	925
	LoQu	-	-	-	-	-	4	4	700
Perennial Crops									
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

AEZ: LM 2–3 Survey Area 10

Crops		Inputs							Yield
		Improved Seeds	Nutrients				Chemicals		
			N	P_2O_5	K_2O	Manure	Insect.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
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
Second Rains									
Sunflower	Avg.	100	-	-	-	-	-	-	957
	UpQu	100	-	-	-	-	-	-	900
	LoQu	100	-	-	-	-	-	-	420
Cotton	Avg.	33	-	-	-	-	31	31	511
Perennial Crops									
Cassava	Avg.	-	-	-	-	-	-	-	4,642
	UpQu	-	-	-	-	-	-	-	8,125
	LoQu	-	-	-	-	-	-	-	-

BUSIA DISTRICT

TABLE 13 a: **DISPOSAL OF CROPS**

AEZ: LM 1 Survey Area 09

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
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
Second Rains							
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
Permanent Crops							
Cassava	6,860	0	0	2,600	38	4,260	62

BUSIA DISTRICT

TABLE 13 b: **DISPOSAL OF CROPS**

AEZ: LM 2–3 Survey Area 10

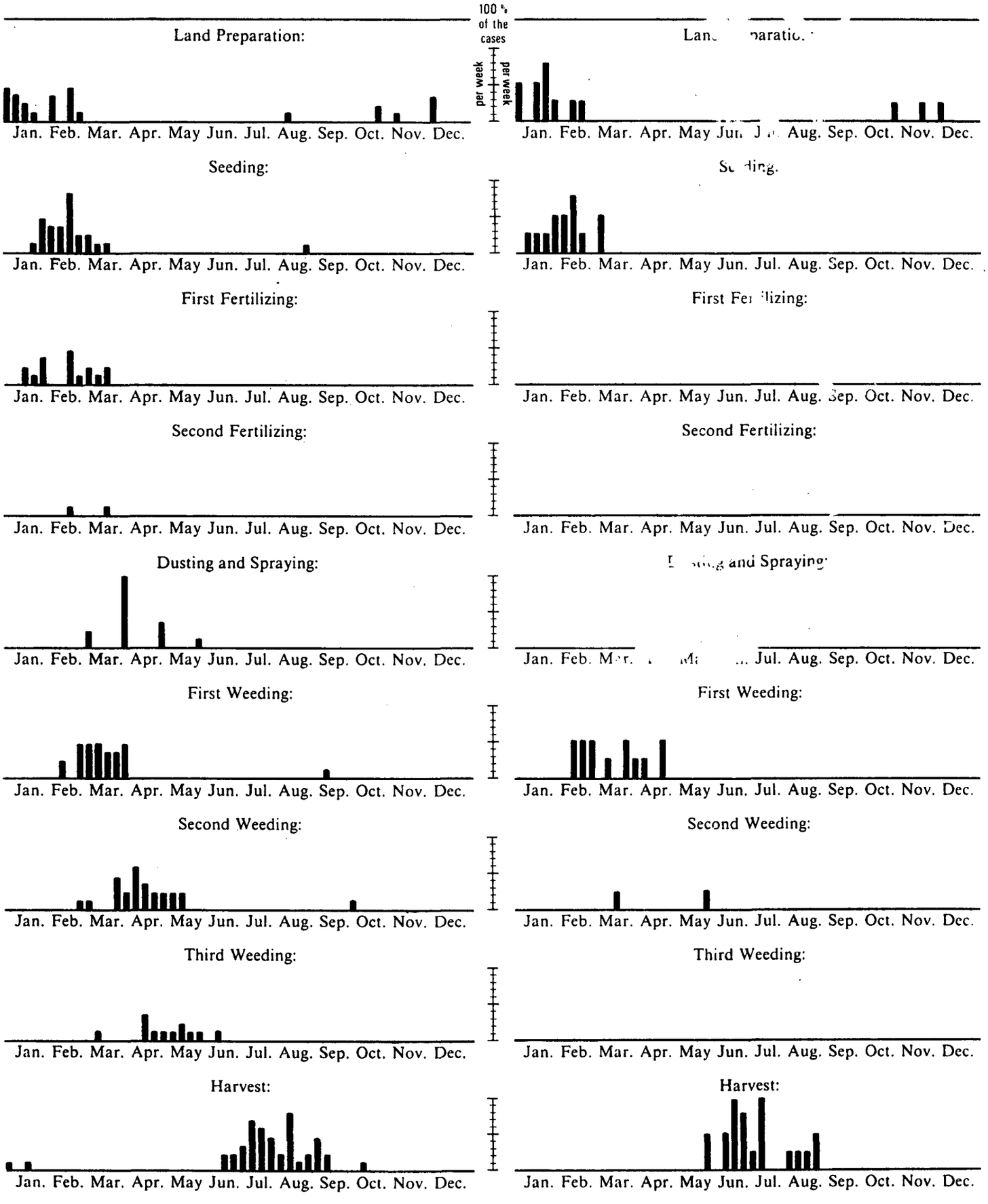
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	41,200	7,180	17	13,935	34	20,085	49
Maize & Beans	28,200	4,200	15	11,699	41	12,301	44
Beans	255	0	0	170	67	85	33
Fingermillet	9,570	160	2	2,460	26	6,950	73
Sorghum	240	0	0	0	0	240	100
Sweet Potatoes	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
Second Rains							
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
Permanent Crops							
Cassava	5,230	0	0	1,740	33	3,490	67

BUSIA DISTRICT

TABLE 14 a: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 Maize Cases: 25

AEZ: LM 1 Survey Area 09 Sample Size: 30



BUSIA DISTRICT

TABLE 14 b: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 12 Finger Millet Cases: 3

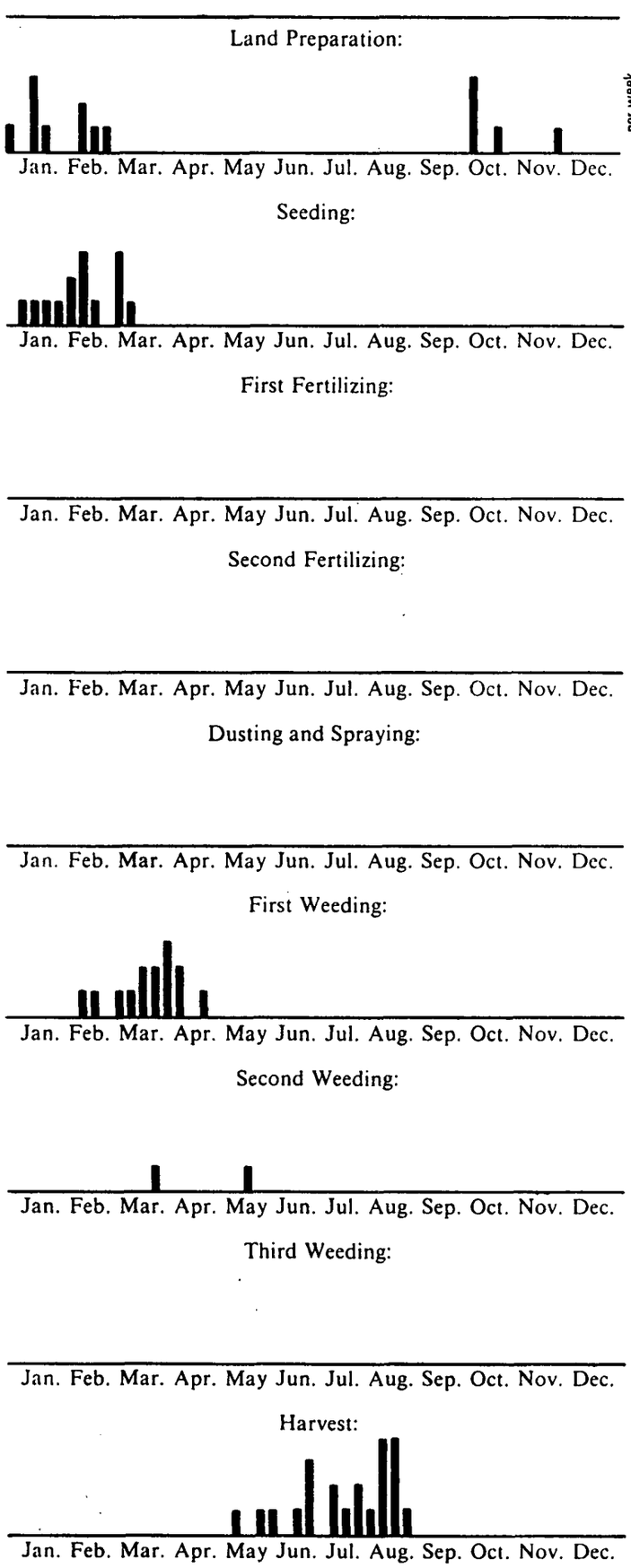
AEZ: LM 1 Survey Area 09 Sample Size: 30

BUSIA DISTRICT

TABLE 14 c: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 18 **Sorghum** Cases: 14

AEZ: LM 1 Survey Area 09 Sample Size: 30

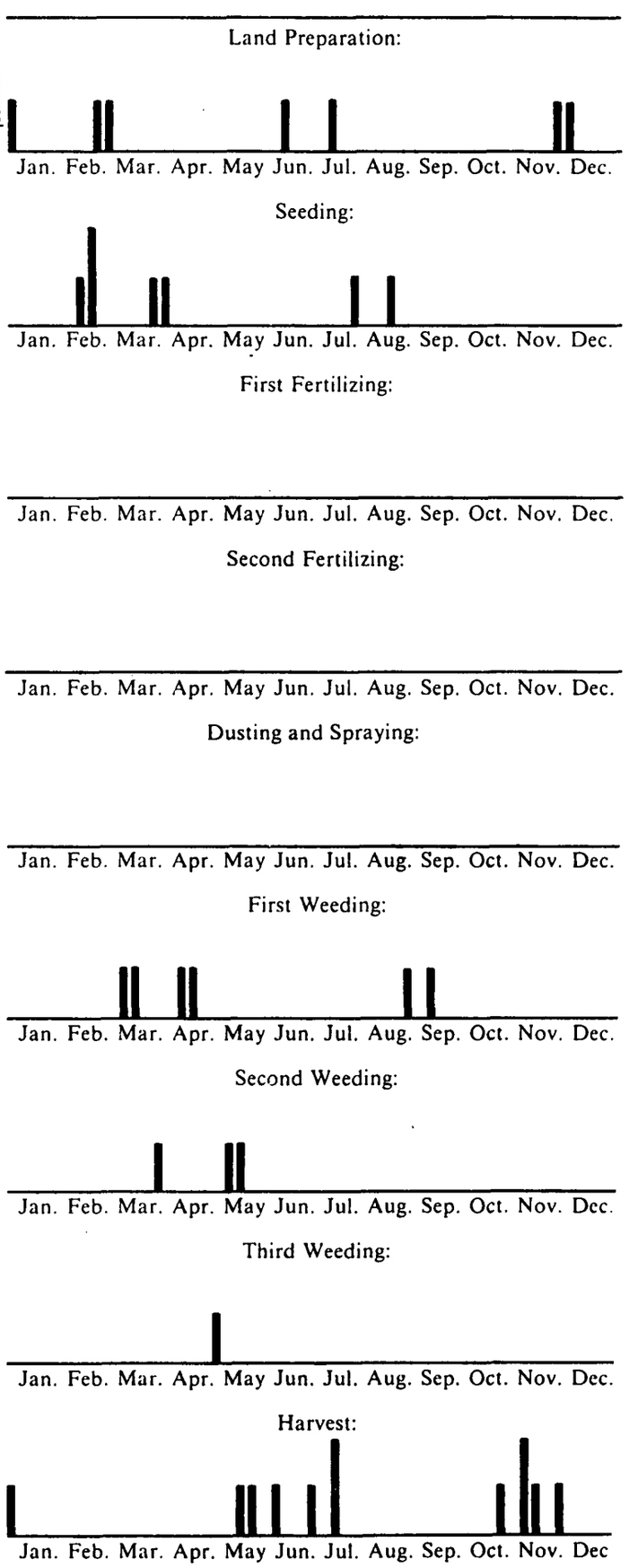


BUSIA DISTRICT

TABLE 14 d: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 24 **Groundnuts** Cases: 7

AEZ: LM 1 Survey Area 09 Sample Size: 30

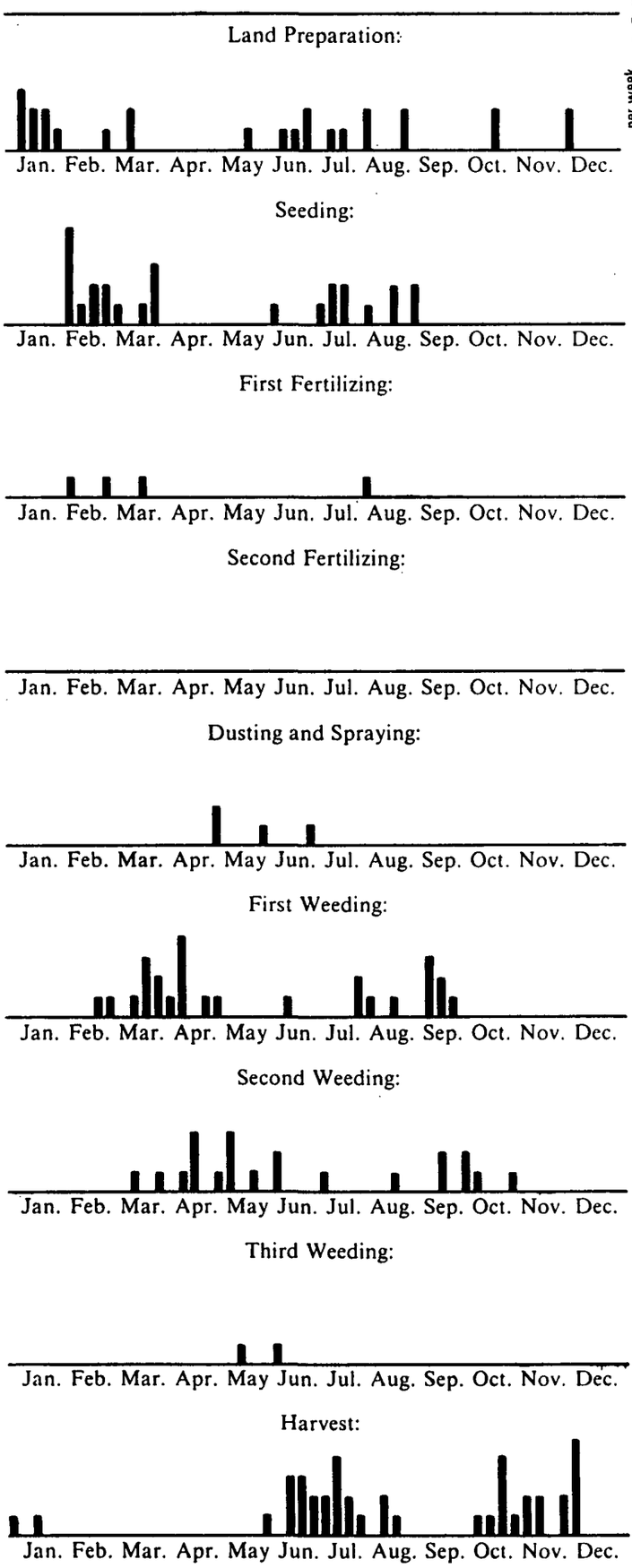


BUSIA DISTRICT

TABLE 14 e: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 34 **Sunflower** Cases: 26

AEZ: LM 1 Survey Area 09 Sample Size: 30

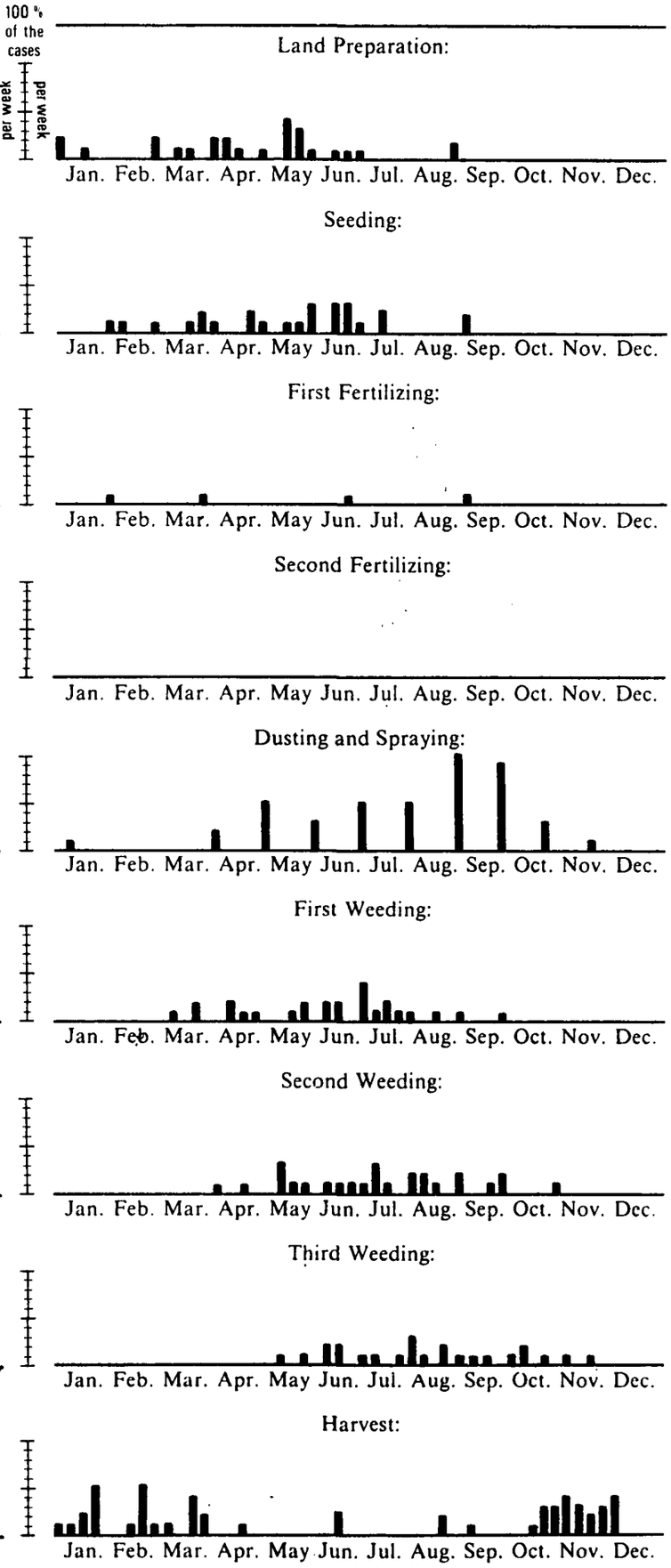


BUSIA DISTRICT

TABLE 14 f: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 35 **Cotton** Cases: 26

AEZ: LM 1 Survey Area 09 Sample Size: 30

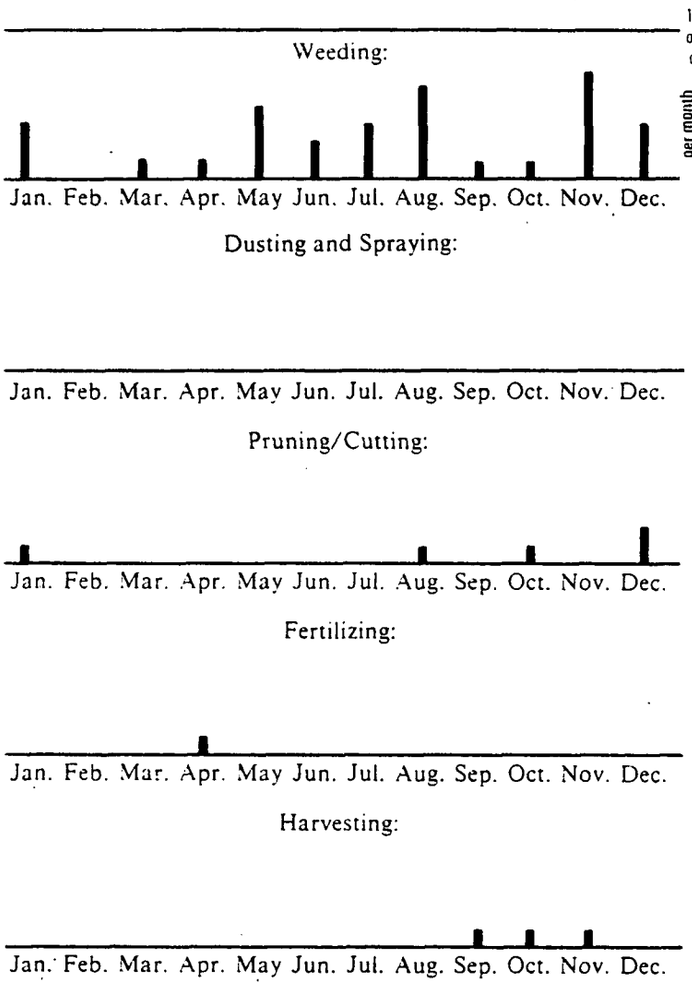


BUSIA DISTRICT

TABLE 14 g: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 63 **Sugarcane** Cases: 10

AEZ: LM 1 Survey Area 09 Sample Size: 30



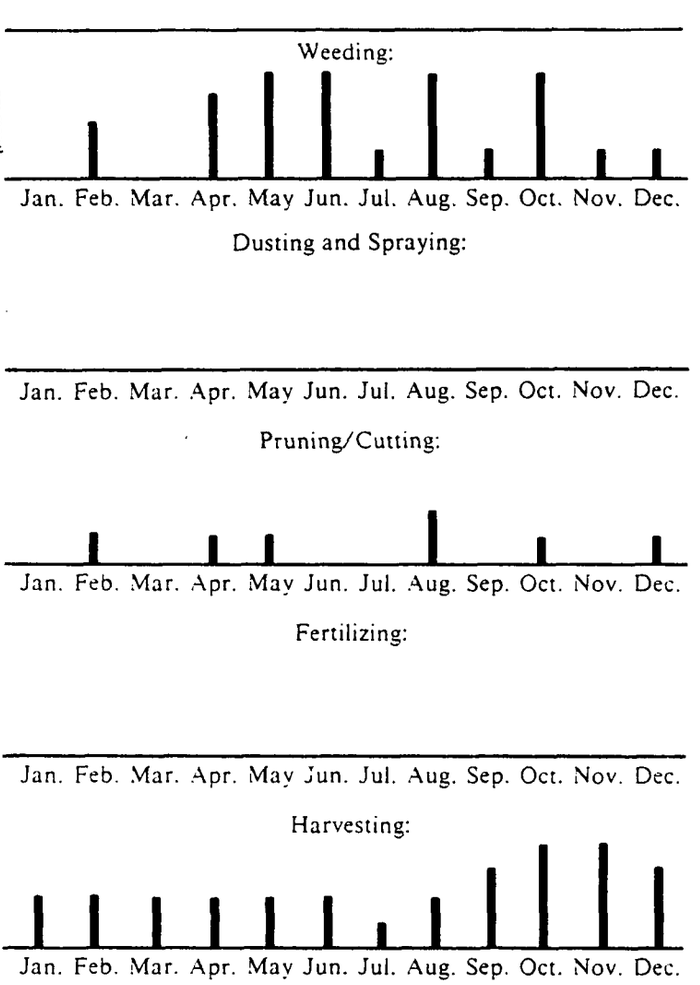
100 % of the cases per month

BUSIA DISTRICT

TABLE 14 h: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 64 **Cassava** Cases: 7

AEZ: LM 1 Survey Area 09 Sample Size: 30

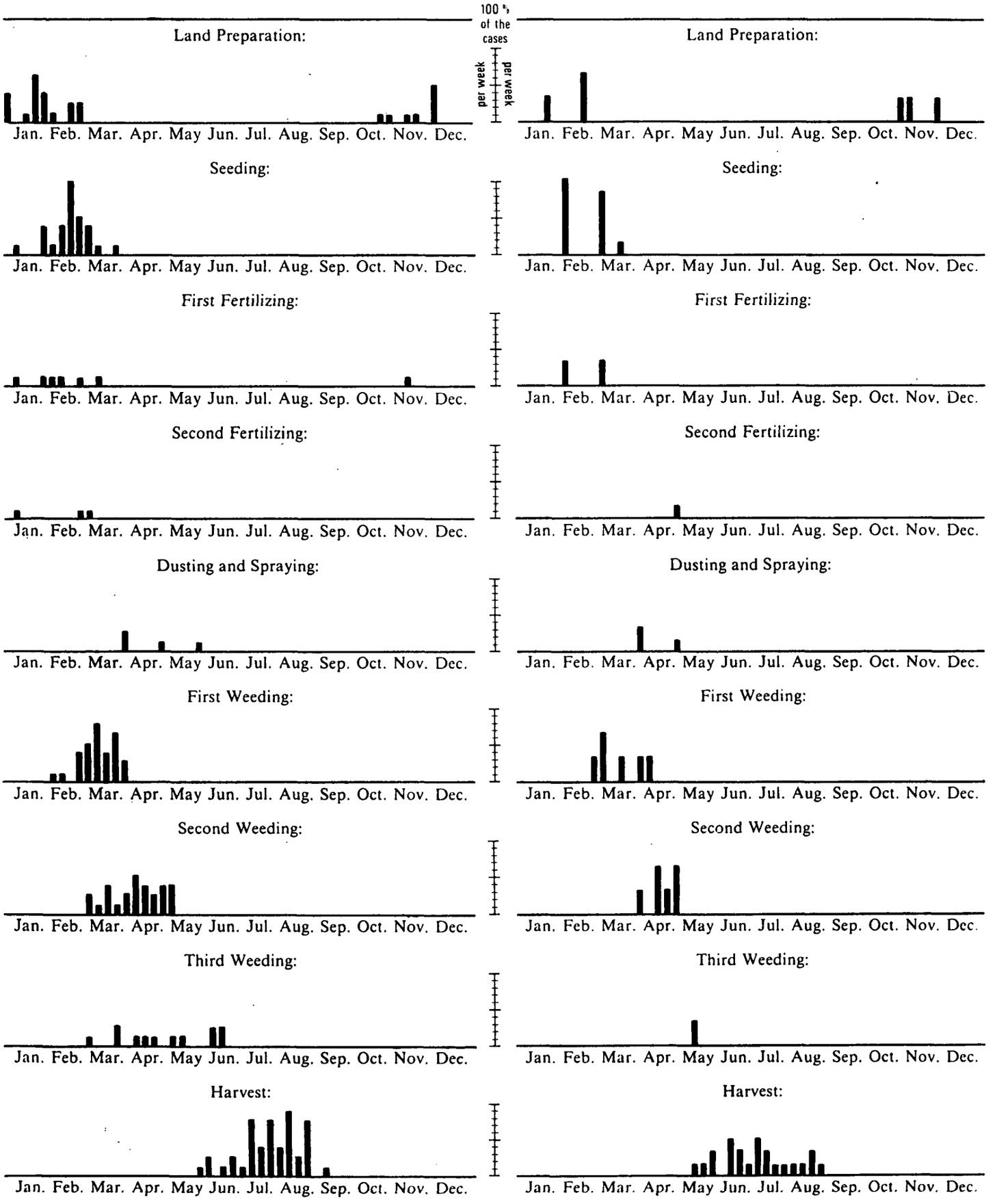


BUSIA DISTRICT

TABLE 14 i: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 **Maize** Cases: 25

AEZ: LM 2–3 Survey Area 10 Sample Size: 30



BUSIA DISTRICT

TABLE 14 j: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 12

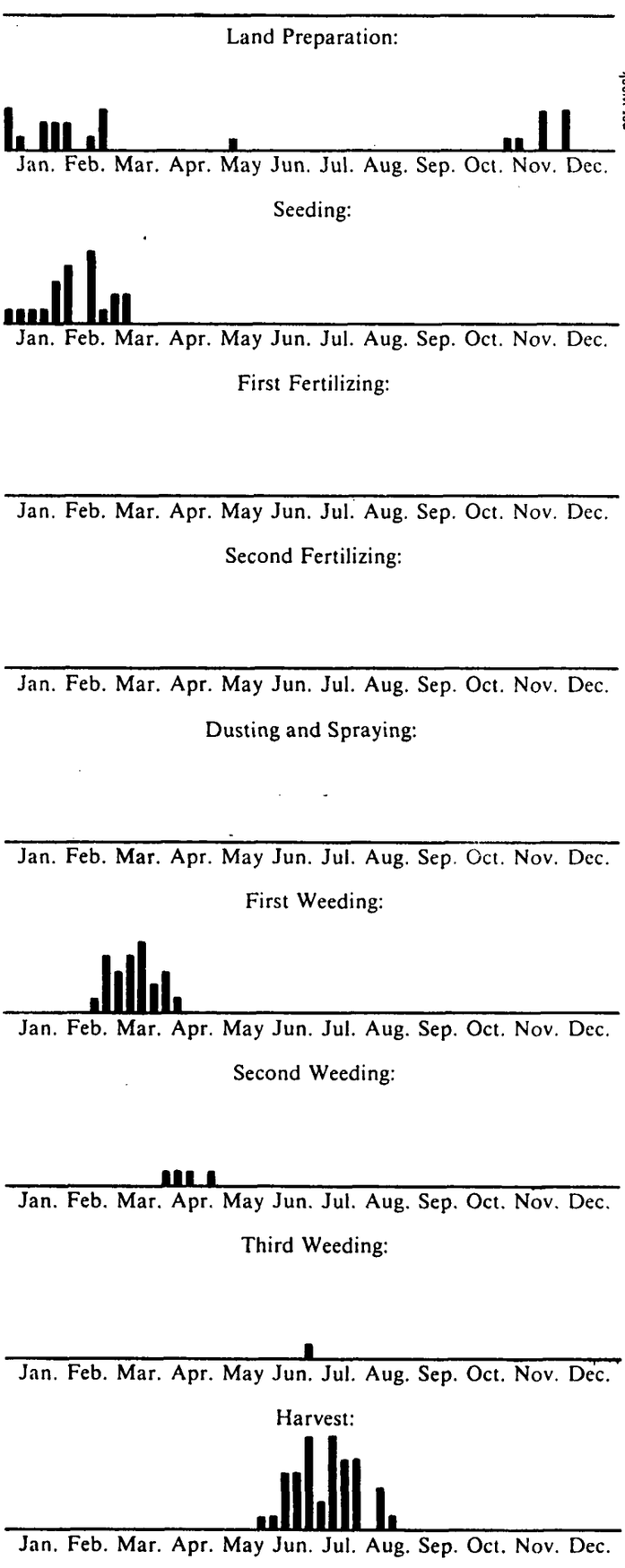
AEZ: LM 2–3 Survey Area 10 Sample Size: 30

BUSIA DISTRICT

TABLE 14 k: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 12 **Fingermillet** Cases: 23

AEZ: LM 2–3 Survey Area 10 Sample Size: 30

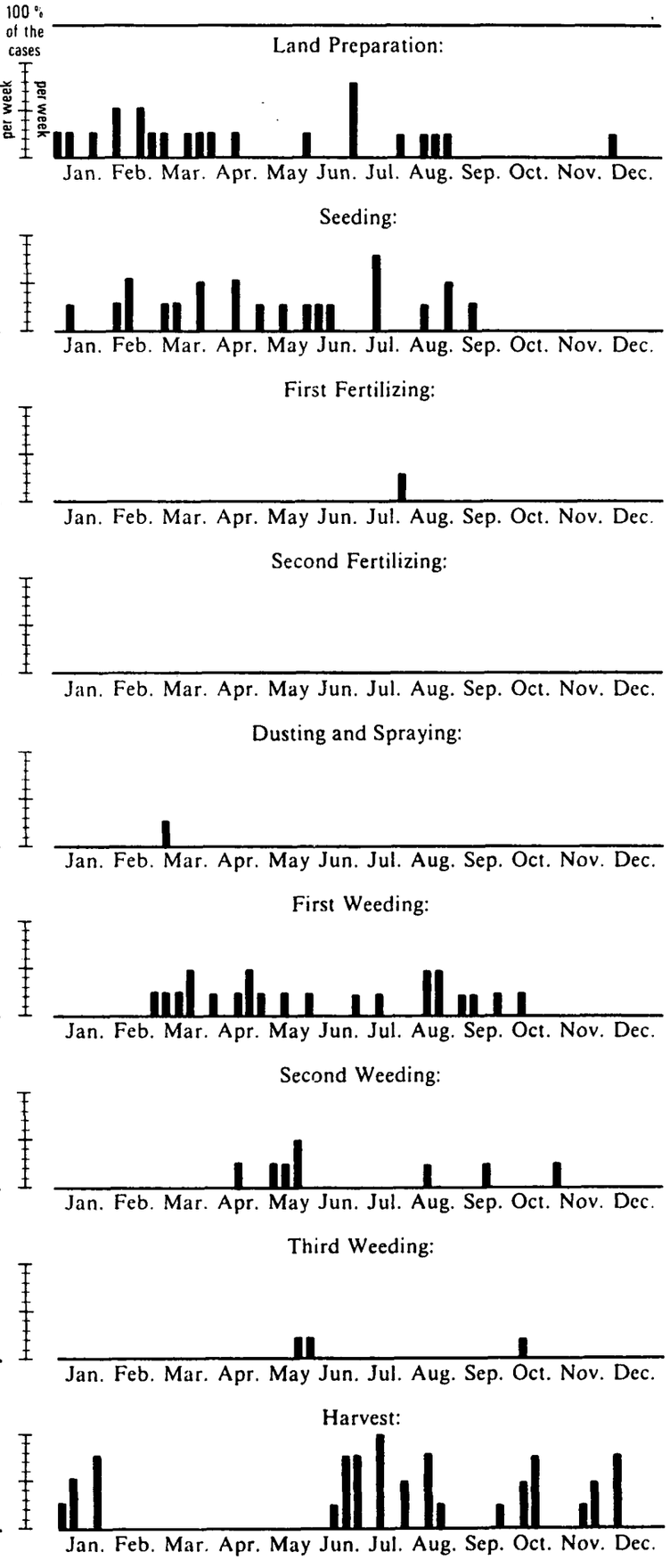


BUSIA DISTRICT

TABLE 14 l: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 18 **Sunflower** Cases: 22

AEZ: LM 2–3 Survey Area 10 Sample Size: 30



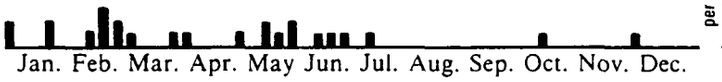
BUSIA DISTRICT

TABLE 14 m: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 35 **Cotton** Cases: 25

AEZ: LM 2–3 Survey Area 10 Sample Size: 30

Land Preparation:



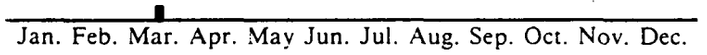
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Seeding:



Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

First Fertilizing:

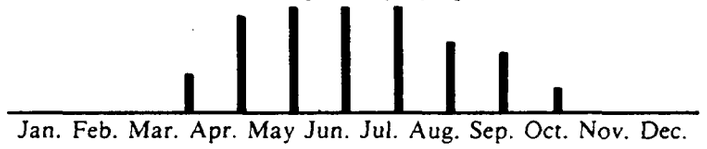


Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Second Fertilizing:

Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Dusting and Spraying:



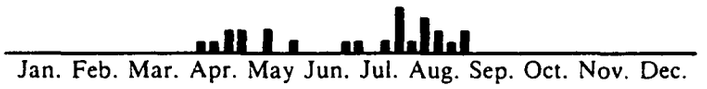
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

First Weeding:



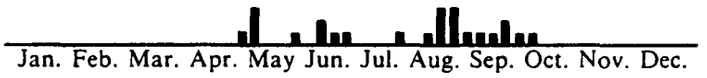
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Second Weeding:



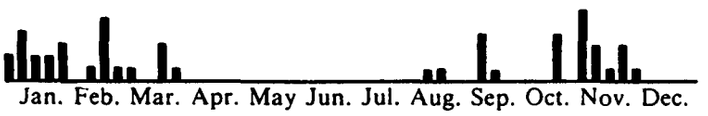
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Third Weeding:



Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Harvest:



Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

BUSIA DISTRICT

TABLE 14 n: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 64 **Cassava** Cases: 15

AEZ: LM 2–3 Survey Area 10 Sample Size: 30

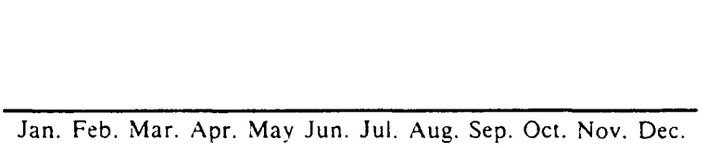
100 % of the cases per week per month

Weeding:



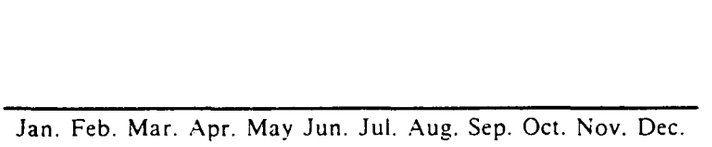
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Dusting and Spraying:



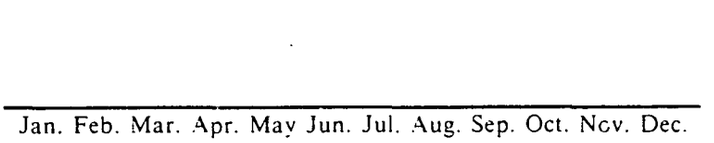
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Pruning/Cutting:



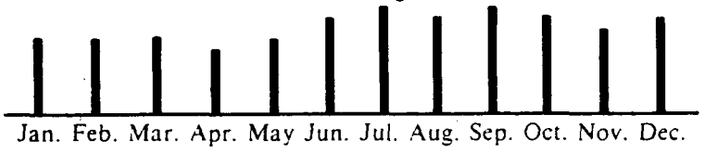
Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Fertilizing:



Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

Harvesting:



Jan. Feb. Mar. Apr. May Jun. Jul. Aug. Sep. Oct. Nov. Dec.

BUSIA DISTRICT

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: lm mi in Days, 1st: 195 or more		2nd: 120-130	total: 315-325	lm(m/s)i 190 or more		110-120	300-310	m/lm(s or s/vs) 150-170		80-90	230-260
			Soil: FERRALSOLS				FERRALSOLS				ACRISOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE/LEYS														
Farmers in Production Level		%												
	Yields	kg	1,900			3,700	1,300			2,600	1,000			2,100
	Fertilizer N	kg				100				72				61
	P_2O_5	kg				50				36				30
	K_2O	kg												
CROP: NAPIER/BANA GRASS														
Farmers in Production Level		%												
	Yields	kg	8,800			18,500	3,200			6,000	2,000			4,000
	Fertilizer N	kg				538				155				111
	P_2O_5	kg				269				77				55
	K_2O													
CROP: TEA														
Farmers in Production Level		%												
	Yields	kg	1,500		5,000	8,500								
	Fertilizer N	kg			116	280								
	P_2O_5	kg			23	56								
	K_2O	kg			23	56								
CROP: BANANAS														
Farmers in Production Level		%												
	Yields	kg	5,000	4,000	10,000	25,000	4,500	3,000	9,000	16,000				
	Fertilizer N	kg			90	360			81	207				
	P_2O_5	kg			35	140			32	81				
	K_2O	kg												
CROP: SUGAR CANE														
Farmers in Production Level		%												
	Yields	kg	5,000	15,000	35,000	60,000								
	Fertilizer N	kg		20	60	110								
	P_2O_5	kg		70	210	385								
	K_2O	kg												
CROP: COTTON														
Farmers in Production Level		%												
	Yields	kg									400	200		1,600
	Fertilizer N	kg												132
	P_2O_5	kg												96
	K_2O	kg												

BUSIA DISTRICT

TABLE 15 b: 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: 1¬ mj in Days, 1st: 195 or more		2nd: 120-130	total: 315-325	1¬(m/s)i 190 or more		110-120	300-310	m/1¬(s or s/vs) 150-170		80-90	230-260
			Soil: FERRALSOLS				FERRALSOLS				ACRISOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE														
Farmers in Production Level		%												
	Yields	kg	1,200	1,200	2,000	4,000	1,300	1,500	2,500	3,200	1,100	1,400	2,000	2,300
	Fertilizer N	kg			24	84		5	30	48		10	27	36
	P_2O_5	kg			22	78		6	34	53		8	25	34
	K_2O	kg												
CROP: SORGHUM														
Farmers in Production Level		%												
	Yields	kg	2,000	600	2,200	4,000	2,300	600	1,600	3,800	1,700	600	2,000	3,300
	Fertilizer N	kg			10	90				60			14	71
	P_2O_5	kg			8	65				37			12	58
	K_2O													
CROP: MAIZE & BEANS														
Farmers in Production Level		%												
	Yields	kg	1,200	1,200/300	2,000/400	4,000/500	1,300	1,500/350	2,000/400	3,200/400	1,100	1,400/300	2,000/400	2,300/500
	Fertilizer N	kg			43	108		22	49	67		24	46	60
	P_2O_5	kg			36	96		18	46	67		17	37	49
	K_2O	kg												
CROP: BEANS														
Farmers in Production Level		%												
	Yields	kg					800	700	900	1,500	900	600	800	1,100
	Fertilizer N	kg							12	42				12
	P_2O_5	kg							7	25				6
	K_2O	kg												
CROP: SUNFLOWER														
Farmers in Production Level		%												
	Yields	kg	700	600	850	1,200								
	Fertilizer N	kg			5	17								
	P_2O_5	kg			7	25								
	K_2O	kg												
CROP: SOYA BEANS														
Farmers in Production Level		%												
	Yields	kg	800	700	1,200	1,800	900	700	1,000	1,500				
	Fertilizer N	kg			16	40			5	30				
	P_2O_5	kg			15	38			4	23				
	K_2O	kg												

BUSIA DISTRICT

TABLE 15 c: 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: 1¬ mi		2nd:	total:	1¬(m/s)i				m/1¬(s or s/vs)			
			in Days, 1st: 195 or more		120-130	315-325	190 or more		110-120	300-310	150-170		80-90	230-260
			Soil: FERRALSOLS				FERRALSOLS				ACRISOLS			
		Unit	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	900	500	1,000	1,500	800	700	1,100	1,500	700	700	1,100	1,400
Fertilizer	N	kg			3	19			10	22			12	23
	P_2O_5	kg			3	18			10	21			12	23
	K_2O	kg												
CROP: SIMSIM														
Farmers in Production Level		%												
Yields		kg									600			1,000
Fertilizer	N	kg												11
	P_2O_5	kg												14
	K_2O													
CROP: SWEET POTATOES														
Farmers in Production Level		%												
Yields		kg	5,000	5,000	12,000	28,000	4,500	5,000	9,000	28,000	3,000	4,000	8,000	17,000
Fertilizer	N	kg			70	210		5	45	235			50	140
	P_2O_5	kg			49	147		4	32	164			35	100
	K_2O	kg												
CROP: CASSAVA														
Farmers in Production Level		%												
Yields		kg	5,000	5,000	8,000	14,000	6,000	5,000	7,000	12,000	4,000	5,000	7,000	10,000
Fertilizer	N	kg			12	36			4	26			12	24
	P_2O_5	kg			21	63			7	42			21	42
	K_2O	kg												
CROP: CABBAGE														
Farmers in Production Level		%												
Yields		kg	4,000	3,000	8,000	17,000								
Fertilizer	N	kg			28	91								
	P_2O_5	kg			28	91								
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer	N	kg												
	P_2O_5	kg												
	K_2O	kg												

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

	A.E.Z.: LM 4 MARGINAL COTTON ZONE													
	Vegt. Period 1st + 2nd: (m/s)+i in Days, 1st: 130				2nd: <45									
	Soil: GLEYSOLS													
		Without	Production Level			Without	Production Level			Without	Production Level			
	Unit	Fertilizer	I	II	III	Fertilizer	I	II	III	Fertilizer	I	II	III	
CROP: NATURAL PASTURE														
Farmers in Production Level	%													
Yields	kg	600			1,200									
Fertilizer N	kg				33									
P_2O_5	kg				16									
K_2O	kg													
CROP: NAPIER/BANA GRASS														
Farmers in Production Level	%													
Yields	kg	1,100			2,500									
Fertilizer N	kg				77									
P_2O_5	kg				38									
K_2O														
CROP: MAIZE														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O	kg													
CROP: SORGHUM														
Farmers in Production Level	%													
Yields	kg	1,400	900	1,700	2,500									
Fertilizer N	kg			10	37									
P_2O_5	kg			8	34									
K_2O	kg													
CROP: MILLET														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O	kg													
CROP: BEANS														
Farmers in Production Level	%													
Yields	kg													
Fertilizer N	kg													
P_2O_5	kg													
K_2O	kg													

BUSIA DISTRICT

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

	A.E.Z.: LM 4 MARGINAL COTTON ZONE													
	Vegt. Period 1st + 2nd: (m/s)+1 in Days, 1st: 130			2nd: <45										
	Soil: GLEYSOLS													
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: SUNFLOWER														
Farmers in Production Level		%												
Yields		kg	800	500	700	800								
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O													
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
Yields		kg												
Fertilizer N		kg												
	P_2O_5	kg												
	K_2O	kg												

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 1 400 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.	1 627	40	57	116	226	254	163	135	150	165	155	97	63
			60% prob[1]	1 330	13	56	55	165	202	162	106	113	148	139	66	20
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.	1 699	42	63	135	251	251	136	143	153	155	176	111	84
			60%	1 475	24	49	101	176	176	107	113	123	121	143	82	23
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 Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Y. of rec.
8934107	Kamusinga	LH 1	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	
1 705 m	School	lp	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	8
		to	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	
		UM 2 hp	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

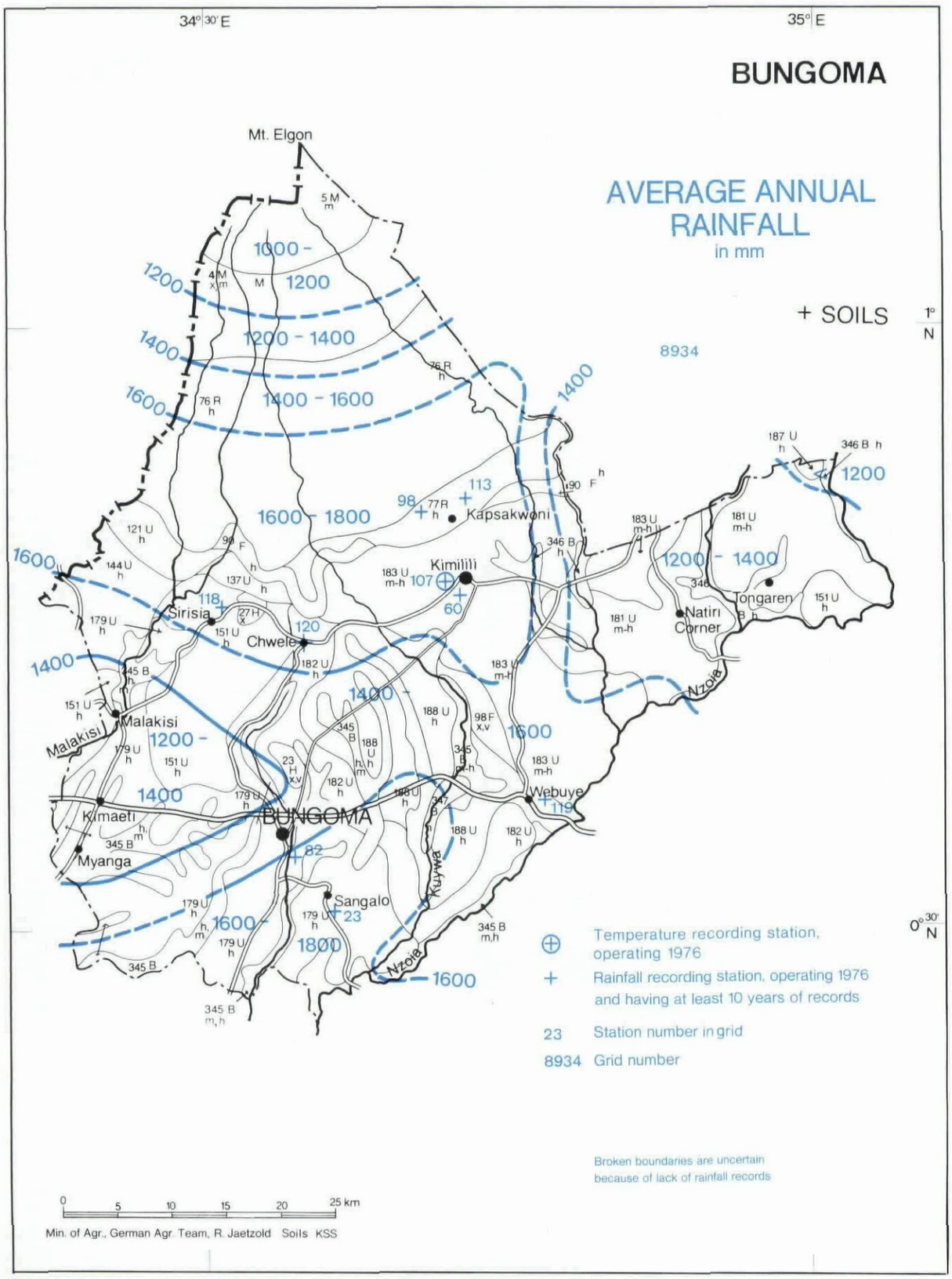
TABLE 3: **CLIMATE IN THE AGRO-ECOLOGICAL ZONES**

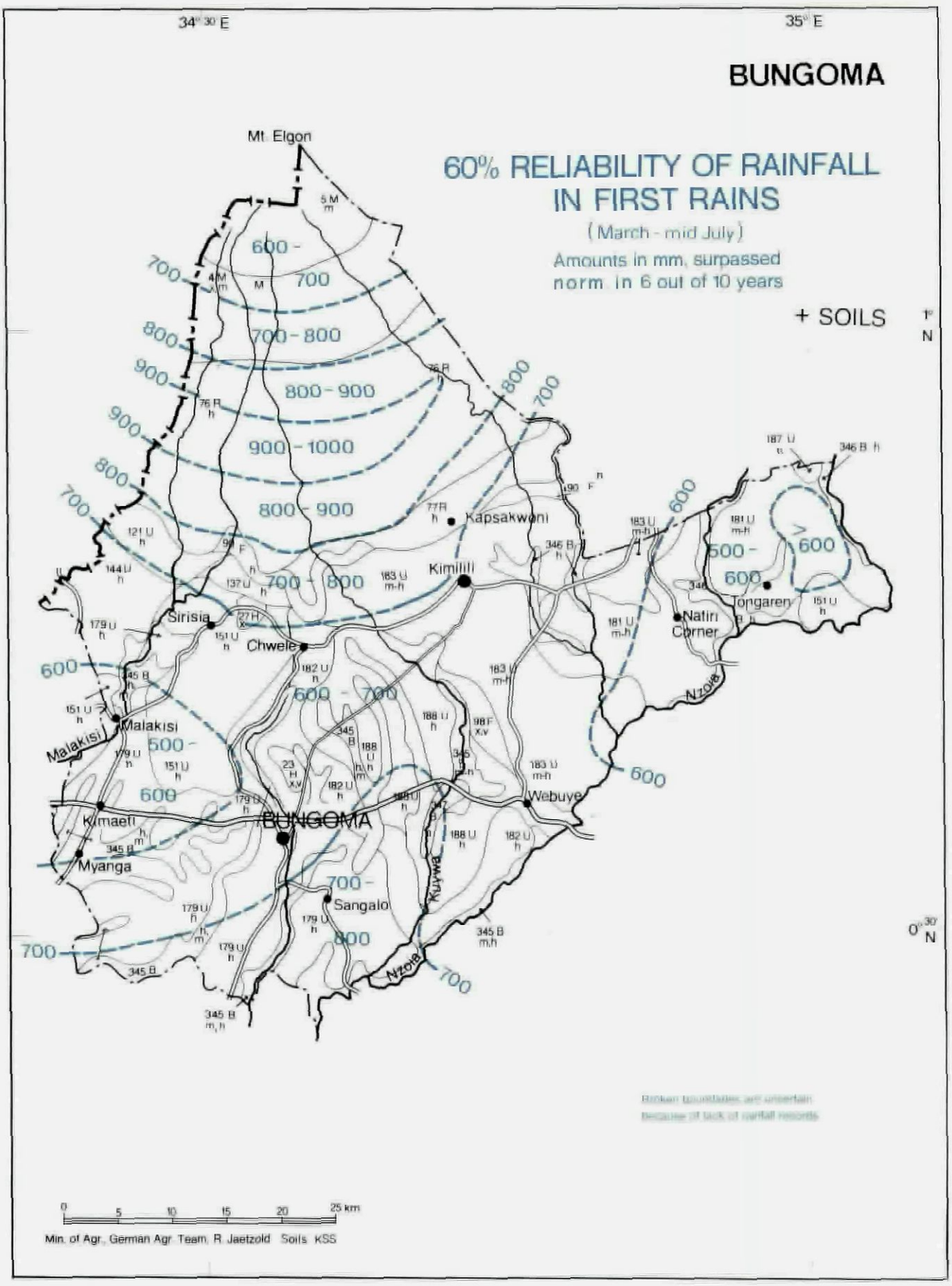
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1] 1st rains in mm	2nd rains in mm	60 % reliability of growing period 1st rains[2] in days	2nd rains in days	Total[3] in days
TA I Tropical-Alpine Cattle and Sheep Zone		3 000–3 500	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	1 500–1 950	20.6–18.0	1 620–1 800	650–800	620–700	170 or more	110–130	280–300
	m/l ⌢ s/m			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 ⌢ 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 ⌢ 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/s)i	1 350–1 500	21.5–20.6	1 400–1 650	650–750	480–580	195 or more	115–130	310–325
	l/m ⌢ (s/m)			1 400–1 600	650–700	460–580	180 or more	105–115	285–295
	m/l ⌢ s/m			1 500–1 650	630–700	480–630	155–175	105–115	260–290
LM 3 Lower Midland Cotton Zone	m/l ⌢ (s)	1 200–1 400	22.4–21.2	1 200–1 500	500–650	430–500	150–170	85–105	230–270

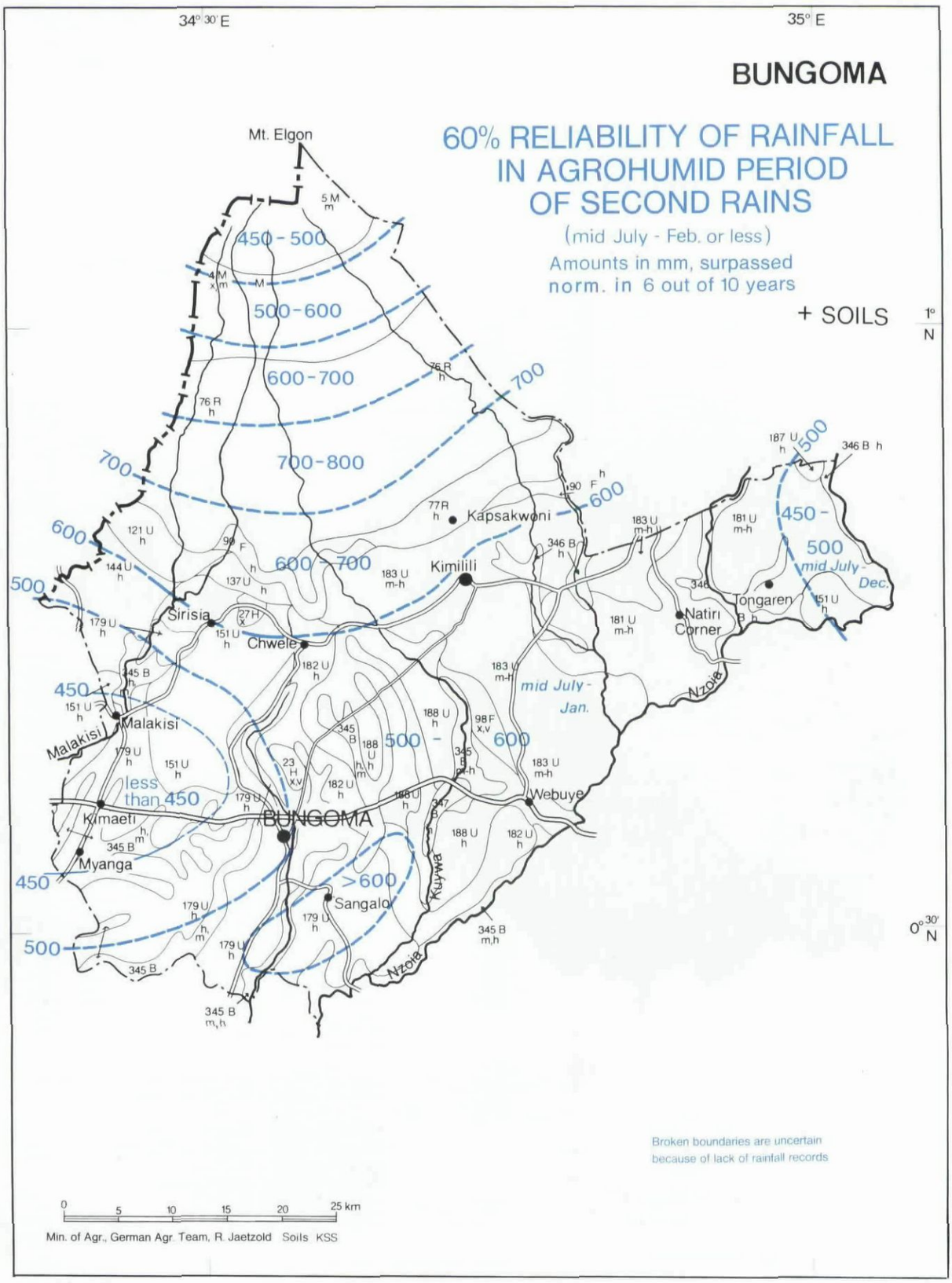
1) Amounts surpassed norm. in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants

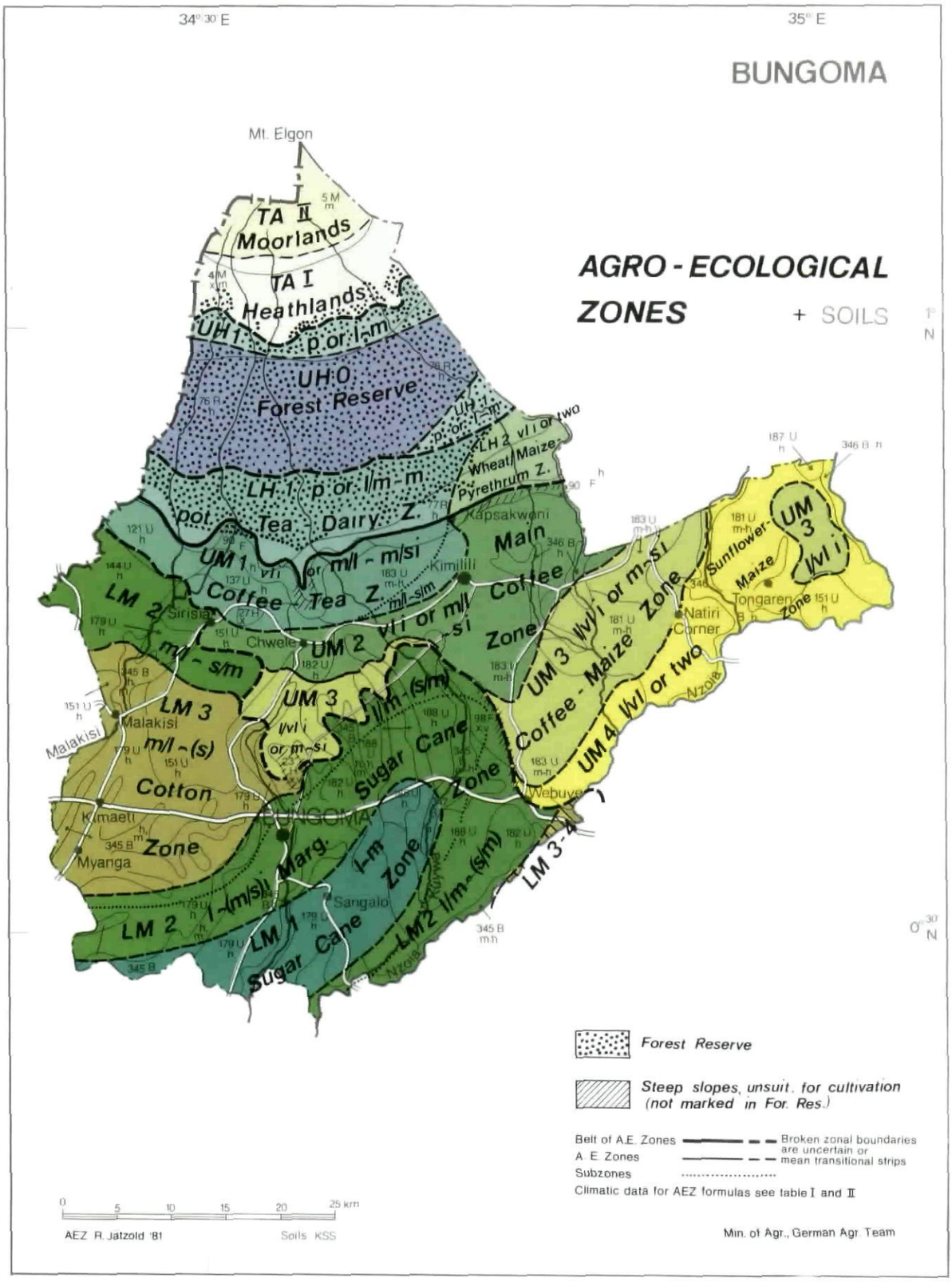
2) More if growing cycle of cultivated plants continues into the period of second rains

3) Agrohumid conditions continue from 1st to 2nd rains in the whole district


34° 30' E
35° E
BUNGOMA
Mt. Elgon
AVERAGE ANNUAL RAINFALL
in mm
+ SOILS
1° N
8934
1000 -
1200
1200 - 1400
1400
1400 - 1600
1600
1600 - 1800
1800
1200 - 1400
Kapsakwoni
Kimilili
Tongaren
Natiri Corner
Sirisia
Chwele
Malakisi
Kimaeti
Myanga
Webuye
Sangalo
Nzoia
Kuywa
0° 30' N
⊕ Temperature recording station, operating 1976
+ Rainfall recording station, operating 1976 and having at least 10 years of records
23 Station number in grid
8934 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


34° 30' E
35° E
BUNGOMA
Mt. Elgon
60% RELIABILITY OF RAINFALL
IN FIRST RAINS
(March - mid July)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+ SOILS
1° N
0° 30' N
600 -
700
700 - 800
800 - 900
900 - 1000
800 - 900
700 - 800
500 - 600
> 600
Kapsakwoni
Kimilili
Sirisia
Chwele
Malakisi
Kimaeti
Myanga
BUNGOMA
Sangalo
Webuye
Tongaren
Natiri Corner
Nzoia
Malakisi
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° 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
1° N
0° 30' N
Mt. Elgon
450 - 500
500 - 600
600 - 700
700 - 800
700
600
500
450
less than 450
>600
500 - 600
mid July - Jan.
mid July - Dec.
450 - 500
Kapsakwoni
Kimilili
Sirisia
Chwele
Malakisi
Kimaeti
BUNGOMA
Myanga
Sangalo
Webuye
Natiri Corner
Tongaren
Nzoia
Kuywa
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° 30' E
35° E
BUNGOMA
AGRO - ECOLOGICAL ZONES + SOILS
1° N
0° 30' N
Mt. Elgon
TA II Moorlands
TA I Heathlands
UH 1 p.or l-m
UH 0 Forest Reserve
LH 2 vl i or two
Wheat/Maize-Pyrethrum Z.
LH 1 p.or l/m-m
pot. Tea-Dairy Z.
Kapsakwoni
Main Coffee Zone
UM 1 vl i or m/l - m/si
Coffee Tea Z.
Kimilili
LM 2 m/l - s/m
Sirisia
Chwele
UM 2 vl i or m/l - si
LM 3 m/l - (s)
Malakisi
Cotton Zone
UM 3 l/vl i or m-si
l/m-(s/m)
Sugar Cane Zone
Kimaeti
Myanga
BUNGOMA Marg. l-m Zone
Sangalo
LM 2 l-(m/s)
LM 1 Sugar Cane
LM 2 l/m-(s/m)
LM 3-4
UM 3 l/vl i or m-si
Coffee-Maize Zone
UM 4 l/vl i or two
Nzoia
Webuye
Natiri Corner
Sunflower-Maize Zone
UM 3 l/vl i
Tongaren
Forest Reserve
Steep slopes, unsuit. for cultivation (not marked in For. Res.)
Belt of A.E. Zones
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
0 5 10 15 20 25 km
AEZ R. Jatzold '81
Soils KSS
Min. of Agr., German Agr. Team

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 (cultivatable 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 p or l/m — m = Tea-Dairy Zone with permanent cropping possibilities, dividable in a long to medium cropping season 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 vl i or two = Wheat/Maize-Pyrethrum Zone with a very long cropping season and intermediate rains, 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, potatoes[1] (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 grass[3] 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 vl i or m/l – m/s i = Coffee-Tea Zone with a very long cropping seson 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, avocadoes, 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 m/l – s/m = Coffee-Tea Zone with a medium to long cropping season 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 vl i or m/l – s i = 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, avocadoes, mountain pawpaws, guavas

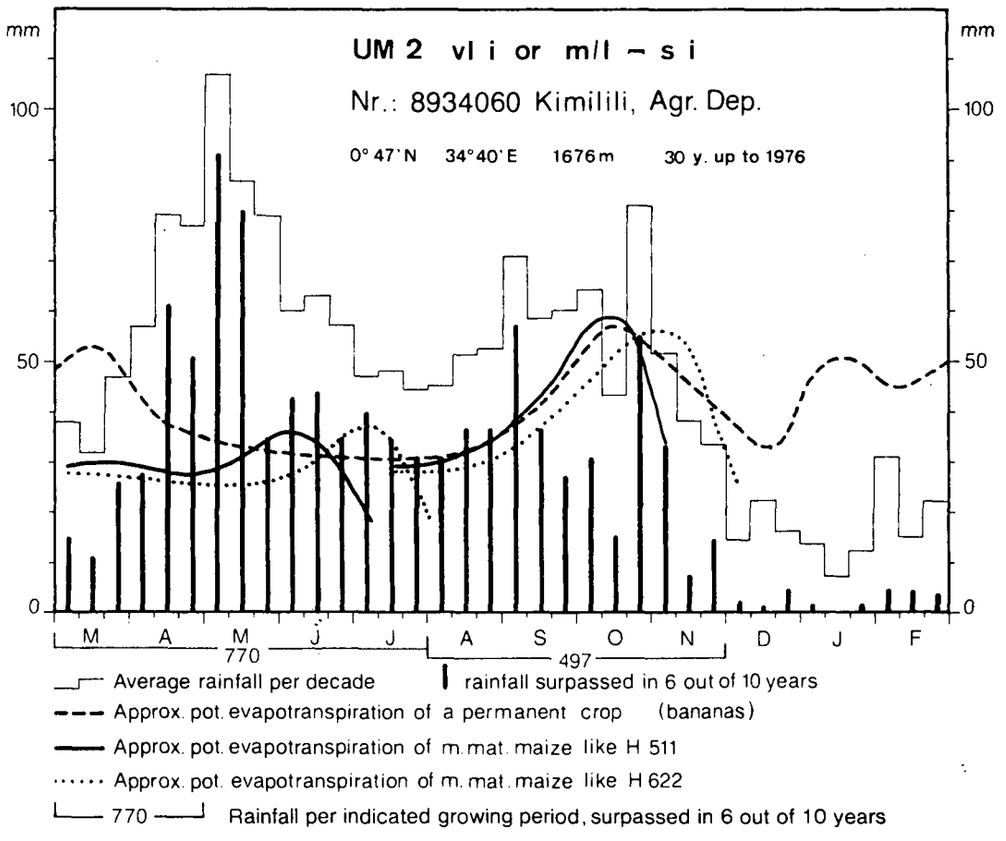
Fair yield potential
1st rains: M.mat. wheat and barley (only in northeastern higher places, May–S.); potatoes, pigeon peas (lower places)
2nd rains: Maize H 511–513 (50–60 %), 622, 632 (∿ 50 %); potatoes, sweet potatoes; tomatoes
Whole year: Arabica coffee (on less suitable soils), bananas (outside valleys), citrus, taro (in valleys), yams, pineapples (lower places)

[3] The bad tufted grassses Eleusine jaegeri and Pennisetum schimperi 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/vl i with a long to very long cropping season and intermediate rains,
or m – s i 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

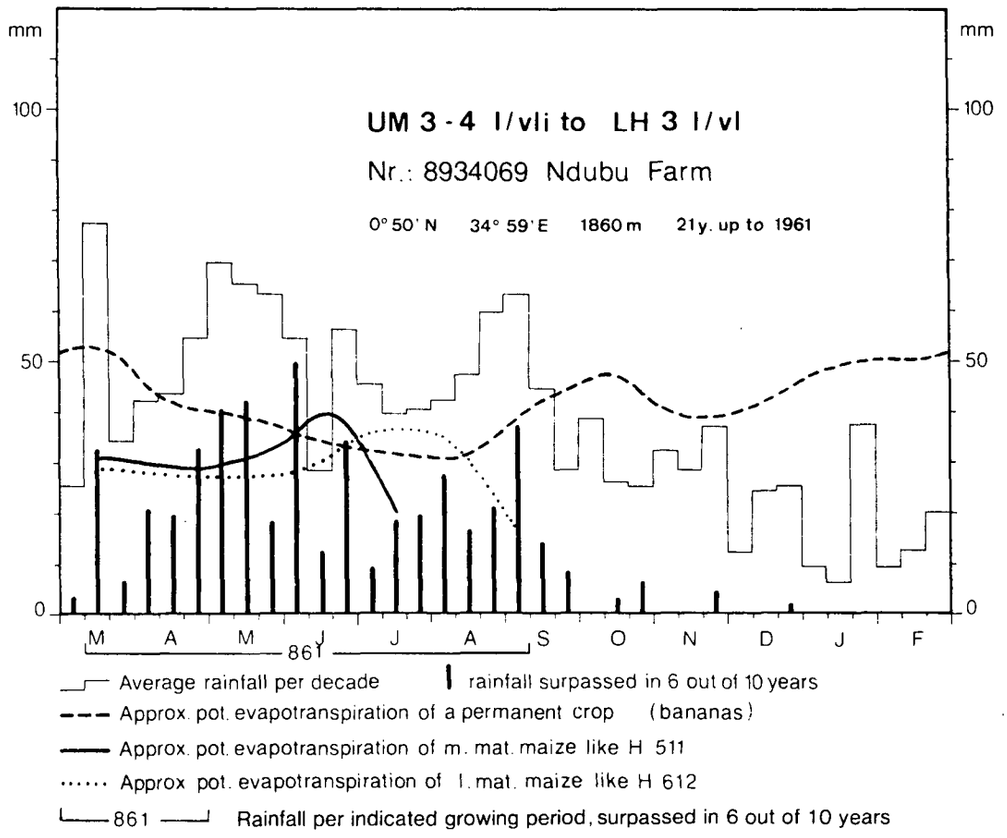
1st rains: M.mat. wheat and barley (only in northeastern higher places); potatoes (higher places)

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), avocadoes, citrus[5], 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 = *S u n f l o w e r - M a i z e Z o n e*

UM 4 = *Sunflower-Maize Zone*
I/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 = *L o w e r M i d l a n d S u g a r C a n e Z o n e*

LM 1 = *Lower Midland Sugar Cane Zone with a long cropping season*
l — m *followed by a medium one*

V e r y g o o d y i e l d p o t e n t i a l

1st rains, start norm. F.: M.mat. white sorghum; sweet potatoes; sunflower like 252 or HS 345, m.mat. soya beans like Black Hawkor Hill; sweet pepper, kales, Chinese cabbage, spinach

Whole year, best pl. time b. of March: Sugar cane on deep alluvial soils, cassava, pawpaws, guavas

G o o d y i e l d p o t e n t i a l

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, avocadoes, taro on alluvial soils

F a i r y i e l d p o t e n t i a l

2nd rains: Late mat. groundnuts (rosette danger, 50–60 % in light soils)

Whole year: Mangoes, citrus, taro on plateau soils

P a s t u r e a n d f o r a g e

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 l – (m/s)i = *Marginal Sugar Cane Zone with a long cropping season 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; 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; beans[1], 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 l/m – (s/m) = *Marginal Sugar Cane Zone 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 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 m/l – (s/m) = *Marginal Sugar Cane Zone with a medium to long cropping season followed by a short to medium one*

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 m/l – (s) = *Lower Midland Cotton Zone with a medium to long cropping season followed by a (weak) short one*

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), simsim[2]; 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

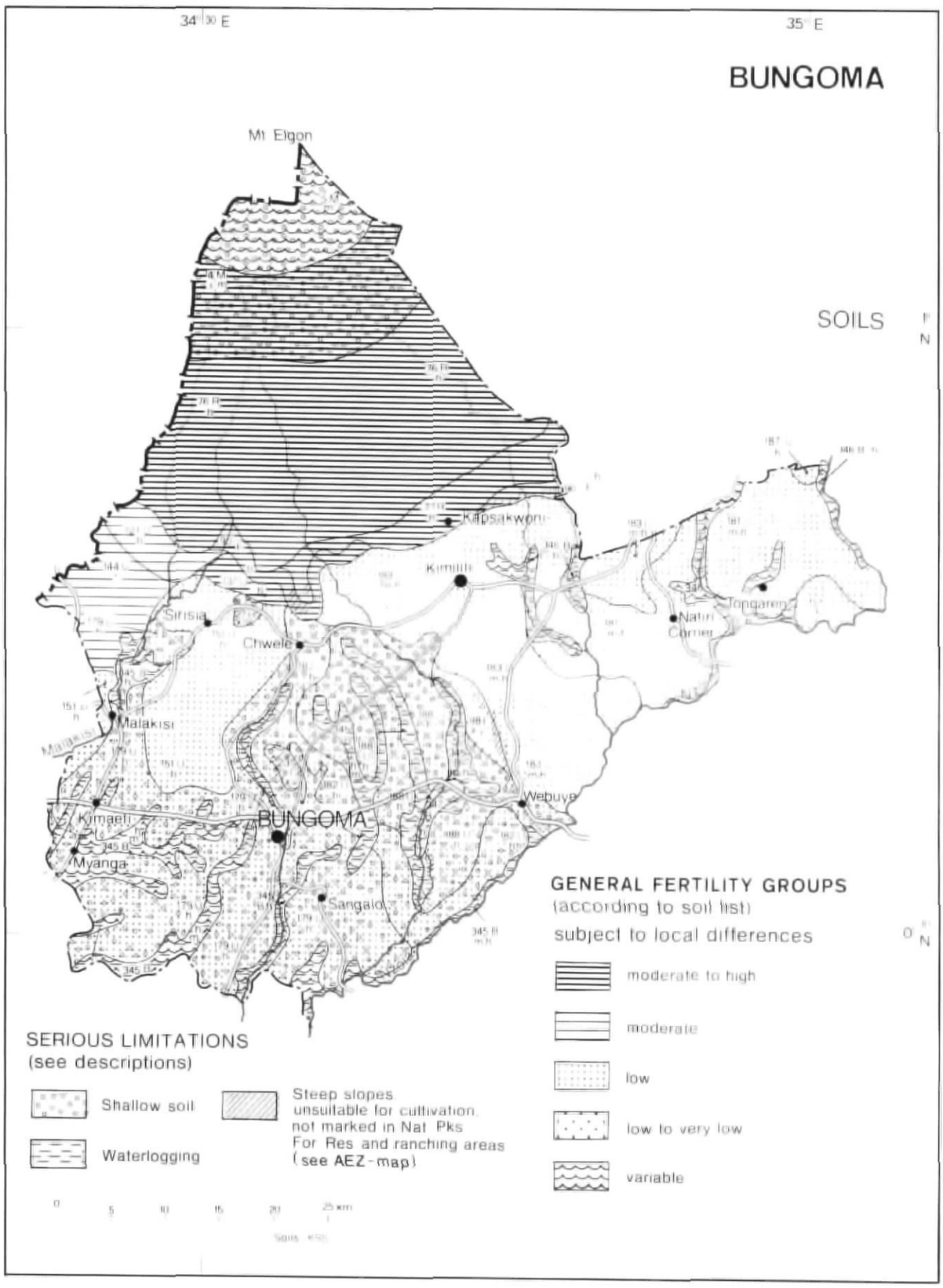
1st rains: Maize H 622, finger millet (50–60 %); pigeon peas (March-F.)

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
Mt Elgon
SOILS
N
Kapsakwoni
Kimilili
Sirisia
Chwele
Tongaren
Natiri Corner
Malakisi
Webuye
Kimaeli
BUNGOMA
Myanga
Sangalo
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
moderate to high
moderate
low
low to very low
variable
SERIOUS LIMITATIONS
(see descriptions)
Shallow soil
Waterlogging
Steep slopes unsuitable for cultivation, not marked in Nat. Pks For Res. and ranching areas (see AEZ-map)
0 5 10 15 20 25 km

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 x, m[1)] = well drained, shallow to moderately deep, dark reddish brown, friable, humic, rocky and stony clay loam (nito-humic CAMBISOLS, rocky phase)

5 M 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)

SOILS ON HILLS AND MINOR SCARPS

Soils developed on granites

23 H x, v = 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 undifferentiated Basement System rocks, predominantly gneisses

27 H x = 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 VOLCANIC FOOTRIDGES

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

76 R h = 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)

77 R h = well drained, extremely deep, dusky red to dark reddish brown, friable clay, with acid humic topsoil (humic NITOSOLS)

SOILS ON FOOTSLOPES

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

90 F h = well drained, very deep, dark reddish brown, firm, moderately calcareous clay (calcic CAMBISOLS)

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 biotite gneisses

137 U h = well drained, extremely deep, dark reddish brown, friable clay, with thick acid humic topsoil (humic NITOSOLS)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

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

144 U h = well drained, very deep, red to dark red, friable to firm, clay; in places moderately deep over petroplinthite (eutric NITOSOLS; with rhodic FERRALSOLS, partly petroferric 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 granites

179 U h = 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)

Soils developed on granites and quartz-feldspar gneisses

181 U m-h = well drained, deep, strong brown to reddish yellow, very friable, sandy clay loam to sandy clay (orthic FERRALSOLS; with ferralic CAMBISOLS)

Soils developed on biotite gneisses

182 U h = association of: – well drained, moderately deep to very deep, red, very friable, sandy clay to clay, over petroplinthite (rhodic FERRALSOLS, partly petroferric phase)
– shallow soils over petroplinthite (about 50 %) („murram cuirass" soils)

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

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 petroplinthite (orthic to rhodic FERRALSOLS, partly petroferric phase; with „murram cuirass" soils (10–40 %)

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)

346 B h = complex of imperfectly drained to very poorly drained, very deep, very dark grey to dark greyish brown, mottled, firm clay; in places peaty or with acid humic topsoil (dystric GLEYSOLS; with eutric PLANOSOLS and some dystric HISTOSOLS)

347 B h = poorly drained, very deep, dark greyish brown to black, very firm, slightly calcareous, cracking clay; in many places with a 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 underlaying 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
Sirisia 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
Kanduyi 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
Bokoli	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
Ndalu	2994	3.98	2.16	0.90	0.24	7.28
Division Tangarer	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**

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 AEZ									Agric. land per	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads, rivers...)		LH 1	LH 2	UM 1	UM 2	UM 3	UM 4	LM 1	LM 2	LM 3	household	person
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 STATISTICS[1)]

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

BUNGOMA 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

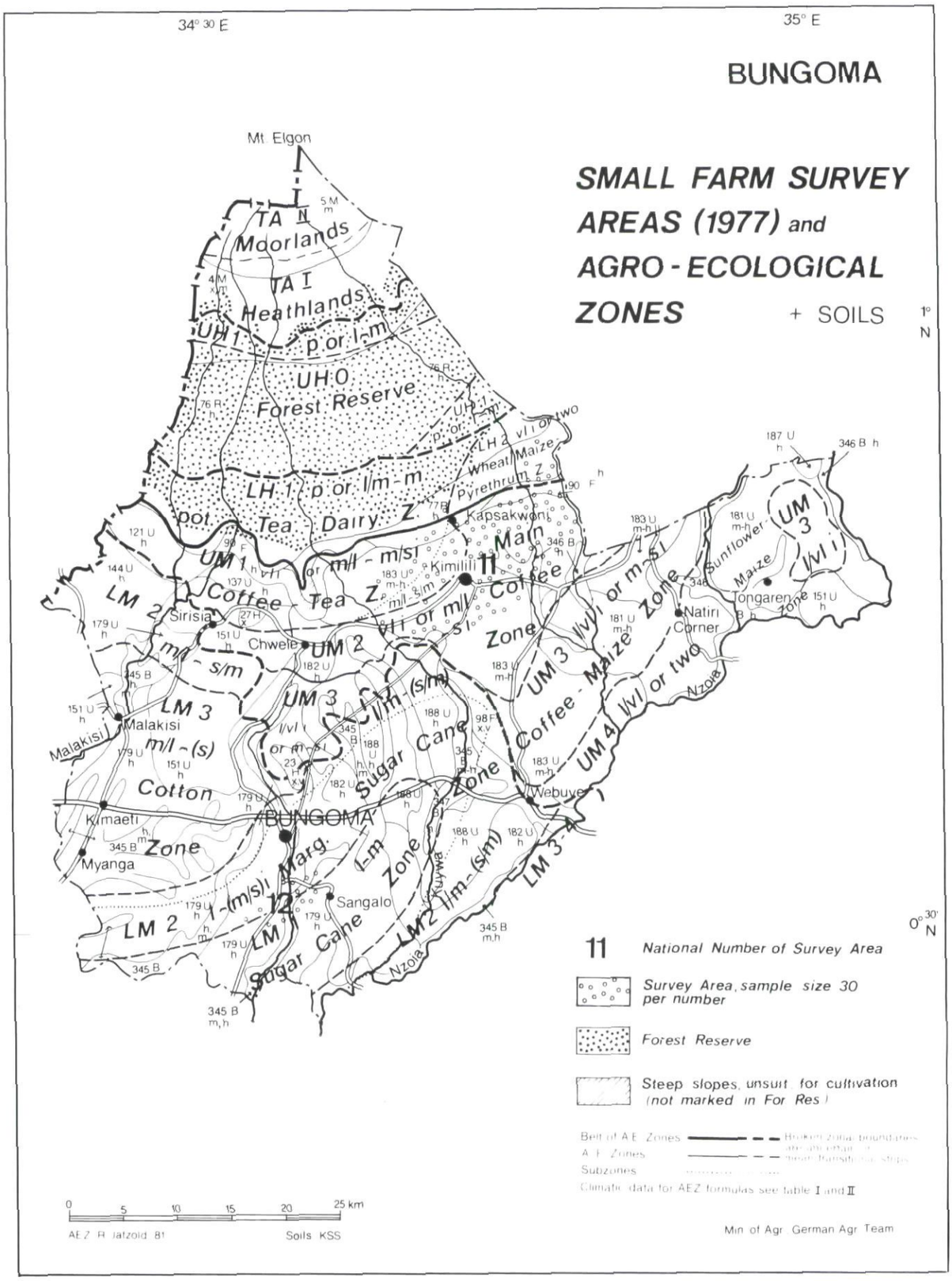
SMALL FARM SURVEY [1]

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



34° 30 E
35° E
BUNGOMA
SMALL FARM SURVEY AREAS (1977) and AGRO-ECOLOGICAL ZONES + SOILS
1° N
0° 30' N
Mt. Elgon
TA II Moorlands
TA I Heathlands
UH 1 p or l-m
UH 0 Forest Reserve
LH 1 p or l/m-m
pot. Tea - Dairy Z.
LH 2 vl i or two
Wheat/Maize
Pyrethrum Z.
Kapsakwoni
Main Coffee Zone
Kimilili
11
UM 1 vl i or m/l - m/si
Coffee - Tea Z.
LM 2 m/l - s/m
Sirisia
Chwele
UM 2 vl i or m/l - si
UM 3 l/vl i or m-si
Coffee - Maize Zone
UM 4 l/vl or two
Nzoia
Natiri Corner
Tongaren
Sunflower - Maize Zone
UM 3 l/vl i
LM 3 m/l - (s)
Malakisi
Cotton Zone
Kimaeti
Myanga
BUNGOMA
Sugar Cane Zone
Webuye
LM 2 l-(m/s)i
Marg.
12
LM 1
Sangalo
LM 2 l/m-(s/m)
LM 3-4
Kuywa
345 B m,h
11 National Number of Survey Area
Survey Area, sample size 30 per number
Forest Reserve
Steep slopes, unsuit. for cultivation (not marked in For. Res.)
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. Jatzold 81
Soils KSS
Min. of Agr. German Agr. Team

TABLE 8 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: LH 1–2 – UM 1–2

Survey Area 11

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	2.7	5.7	16.2
Land Use: Annual Crops[1] First Season				
Maize & Beans	ha	1.0	2.3	2.5
Maize	ha	0.3	0.1	1.5
Beans	ha	-	-	0.4
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	-
Cassava	ha			
	ha			
Total	ha		0.1	
Permanent Crops[1]				
Pyrethrum	ha	0.1	-	0.2
Coffee	ha	0.2	0.2	0.2
Bananas	ha	-	0.2	0.2
	ha			
portion of total	%	11%	7%	4%
Grazing & Forage	ha	0.9	2.0	8.8
portion of total	%	33%	35%	54%
Other Land Use	ha	0.3	0.4	2.3
Livestock on Farm:				
Cattle: local	LU	3.6	4.7	9.5
improved	LU	0.4	0.2	1.2
Sheep & Goats	LU	0.3	0.3	0.9
Total	LU	4.3	5.2	11.6

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.6	0.6	0.3
Portion of improved cattle kept	%	10%	4%	11%
Portion of Farmers owning a Plough	%	80%	90%	100%
Labour on Farm:				
Family Adults	persons	2.8	3.2	3.6
Perm. Hired Labour	"	0.1	0.3	1.4
Children > 14 years	"	2.8	2.8	5.8
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.60	0.23	2.83
Children < 14 years	"	3.41	-	3.41
Subsistence Units	SU	4.64	0.23	4.87
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1106	1784	
Beans	kg	346	550	
Fingermillet	kg	14	22	
Cabbage	kg	28	3	
Cooking Bananas	kg	16	6	
	kg			
	kg			
	kg			

Other Crops cultivated: cabbage, fingermillet, passion fruit, cassava

1) Major crops only considered

2) Based on 1979 Census figures

TABLE 8 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: LM 1–2

Survey Area 12

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	2.3	6.6	13.4
Land Use: Annual Crops[1]				
First Season				
Maize	ha	0.5	0.9	1.7
Fingermillet	ha	0.1	0.3	0.2
Sunflower	ha	0.1	-	0.4
Maize & Beans	ha	0.1	0.5	0.6
Others	ha	0.2	-	0.7
Total	ha	1.0	1.7	3.6
Second Season[1]				
Sunflower	ha	0.1	0.3	0.4
Cassava	ha	-	-	0.2
Sweet Potatoes	ha	-	0.1	-
Total	ha	0.1	0.4	0.6
Permanent Crops[1]				
Bananas	ha	0.1	0.4	0.6
Sugarcane	ha	-	-	0.8
	ha			
	ha			
portion of total	%	4%	6%	10%
Grazing & Forage	ha	0.9	3.4	6.7
portion of total	%	39%	52%	50%
Other Land Use	ha	0.4	1.1	1.7
Livestock on Farm:				
Cattle: local	LU	2.0	5.7	5.4
improved	LU	-	-	1.6
Sheep & Goats	LU	0.2	0.4	1.2
Total	LU	2.2	6.1	8.2

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.5	0.4	0.4
Portion of improved cattle kept	%	-	-	23%
Portion of Farmers owning a Plough	%	70%	60%	60%
Labour on Farm:				
Family Adults	persons	2.3	3.1	3.6
Perm. Hired Labour	"	0.1	-	-
Children > 14 years	"	2.3	2.4	2.8
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	3.12	0.11	3.23
Children < 14 years	"	3.64	-	3.64
Subsistence Units	SU	5.30	0.11	5.41
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1147	1849	
Beans	kg	140	222	
Fingermillet	kg	61	95	
Sweet Potatoes	kg	291	165	
Cabbage	kg	87	9	
Sorghum	kg	33	52	
	kg			
	kg			

Other Crops cultivated: beans, English potatoes, sorghum, cabbage

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 ha	%	Perm. Crops ha	%	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use 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

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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

BUNGOMA DISTRICT

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

AEZ: LM 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_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	AC	PC	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

BUNGOMA DISTRICT

TABLE 10 b: **CROPPING PATTERN**

AEZ: 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
Fingermillet	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	%
Cookng 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

TABLE 11 a: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: LH 1–2 – UM 1–2 – in Head and Livestock Units – Nov. '77, Survey Area 11

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
	Upper Qu.	–	–	–	–				–			–
1 - 2 years,	Average	–	–	–	0.03				0.02			0.02
	Upper Qu.	–	–	–	–				–			–
Over 2 years,	Average	0.03	–	0.17		0.33			0.49			0.49
	Upper Qu.	–	–	–		–			–			–
Subtotal(improved)	Total	3	–	5	5	10			16.8			16.8
	Average	0.10	–	0.17	0.17	0.33			0.56			0.56
	Upper Qu.	–	–	–	–	–			–			–
	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	0.80	0.50	–		0.50
	Upper Qu.	–	–	–	2		1	1	0.6	–		0.6
1 - 2 years,	Average	0.27	0.17	0.50	1.47				1.08			1.08
	Upper Qu.	–	–	–	2				0.9			0.9
Over 2 years,	Average	0.30	0.10	2.33		3.60	1.90	1.33	4.44	0.47	15.73	4.51
	Upper Qu.	1	–	4		4	1	2	0.7	–	7	0.7
Subtotal (unimp.)	Total	31	8	91	75	103	81	64	180.6	14	472	132.7
	Average	1.03	0.27	3.03	2.50	3.60	2.70	2.13	6.02	0.47	15.73	6.09
	Upper Qu.	1	–	4	3	4	3	3	7.0	–	19	7.0
	Lower Qu.	–	–	–	1	1	–	–	2.6	–	7	2.6
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	Total	34	8	96	80	118	81	64	197.4	14	472	199.5
	Average	1.13	0.27	3.20	2.67	3.93	2.70	2.13	6.58	0.47	15.73	6.65
	Upper Qu.	1	–	4	3	4	3	3	7.0	–	19	7.0
	Lower Qu.	–	–	1	1	2	–	–	3.1	–	7	2.6
LU Male Cattle =		41.1 % of total cattle,				Calves + Heifers =			67.8 % 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

BUNGOMA DISTRICT

TABLE 11 b: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: LM 1–2 — 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 =		9.7 % of total cattle,				Calves + Heifers =			100.0 % of dairy cows			
Unimproved Livestock:												
Under 1 year,	Average	0.93	-	-	0.93		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	0.33	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 =		48.4 % 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	0.33	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	-	-	1.8	-	4	1.8
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		Inputs							Yield
		Improved Seeds	Nutrients				Chemicals		
			N	P_2O_5	K_2O	Manure	Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
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	-	3,288
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
Second Rains									
Beans	Avg.	-	-	17	-	-	-	-	304
	UpQu	-	-	25	-	-	-	-	450
	LoQu	-	-	-	-	-	-	-	13
Cabbage	Avg.	100	-	23	-	-	67	67	2,000
Perennial Crops									
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

BUNGOMA DISTRICT

TABLE 12 b: **INPUTS AND YIELDS OF MAJOR CROPS**

AEZ: LM 1–2

Survey Area 12

Crop		Inputs							Yield
		Improved Seeds	Nutrients			Manure	Chemicals		
			N	P_2O_5	K_2O		Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
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
Second Rains									
Sunflower	Avg.	100	-	-	-	0.11	-	-	744
	UpQu	100	-	-	-	-	-	-	1,000
	LoQu	100	-	-	-	-	-	-	350
Perennial Crops									
Cassava	Avg.	-	-	-	-	-	-	-	8,405
	UpQu	-	-	-	-	-	-	-	4,875
	LoQu	-	-	-	-	-	-	-	2,400
Cookng Bananas	Avg.	-	-	-	-	0.20	-	-	9,605
	UpQu	-	-	-	-	-	-	-	5,625
	LoQu	-	-	-	-	-	-	-	2,000

BUNGOMA DISTRICT

TABLE 13 a: **DISPOSAL OF CROPS**

AEZ: LH 1–2 – UM 1–2 Survey Area 11

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
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
Second Rains							
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
Cookng Bananas	480	0	0	0	0	480	100

BUNGOMA DISTRICT

TABLE 13 b: **DISPOSAL OF CROPS**

AEZ: LM 1–2 Survey Area 12

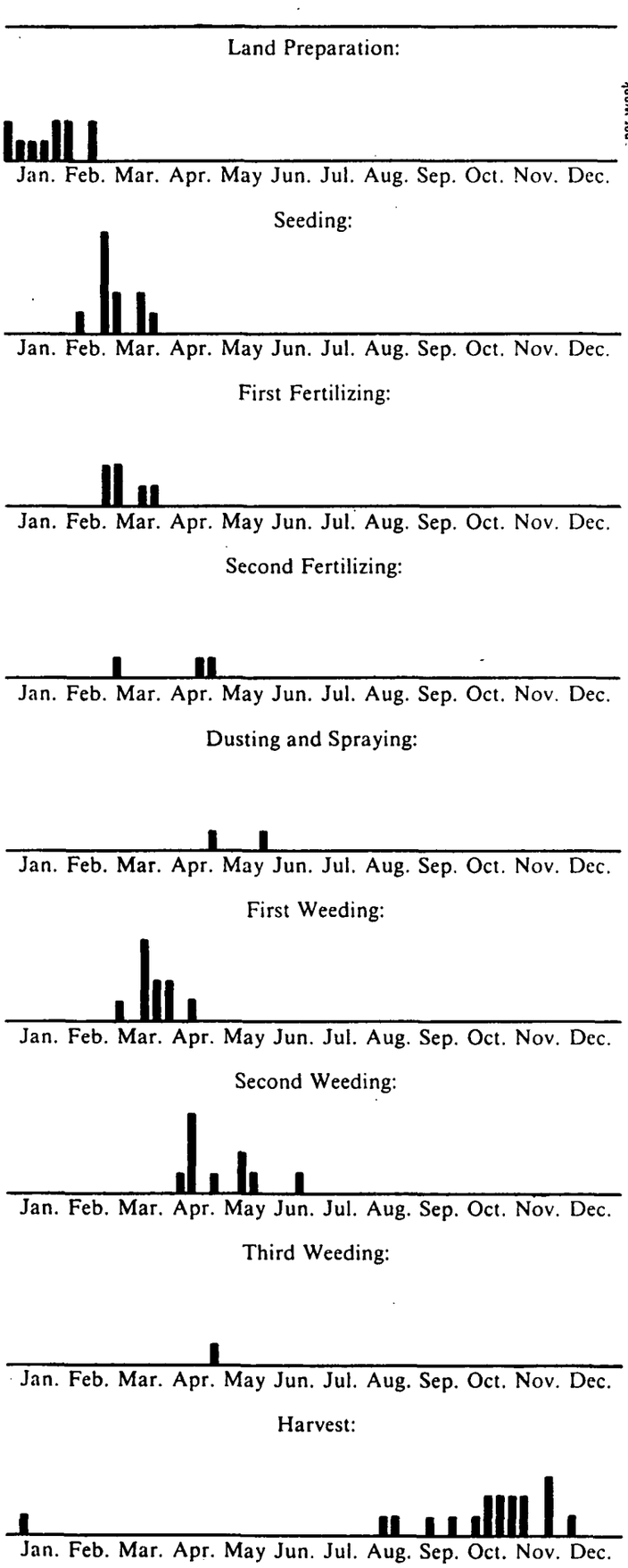
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	62,710	22,230	35	18,810	30	21,670	35
Maize & Beans	26,710	4,630	17	6,160	23	15,920	60
Beans	1,326	160	12	370	28	796	60
Fingermillet	2,080	0	0	240	12	1,840	88
Sorghum	870	0	0	320	37	550	63
Groundnuts	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
Second Rains							
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							

BUNGOMA DISTRICT

TABLE 14 a: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 **Maize** Cases: 11

AEZ: LH 1–2 – UM 1–2 Survey Area 11 Sample Size: 30

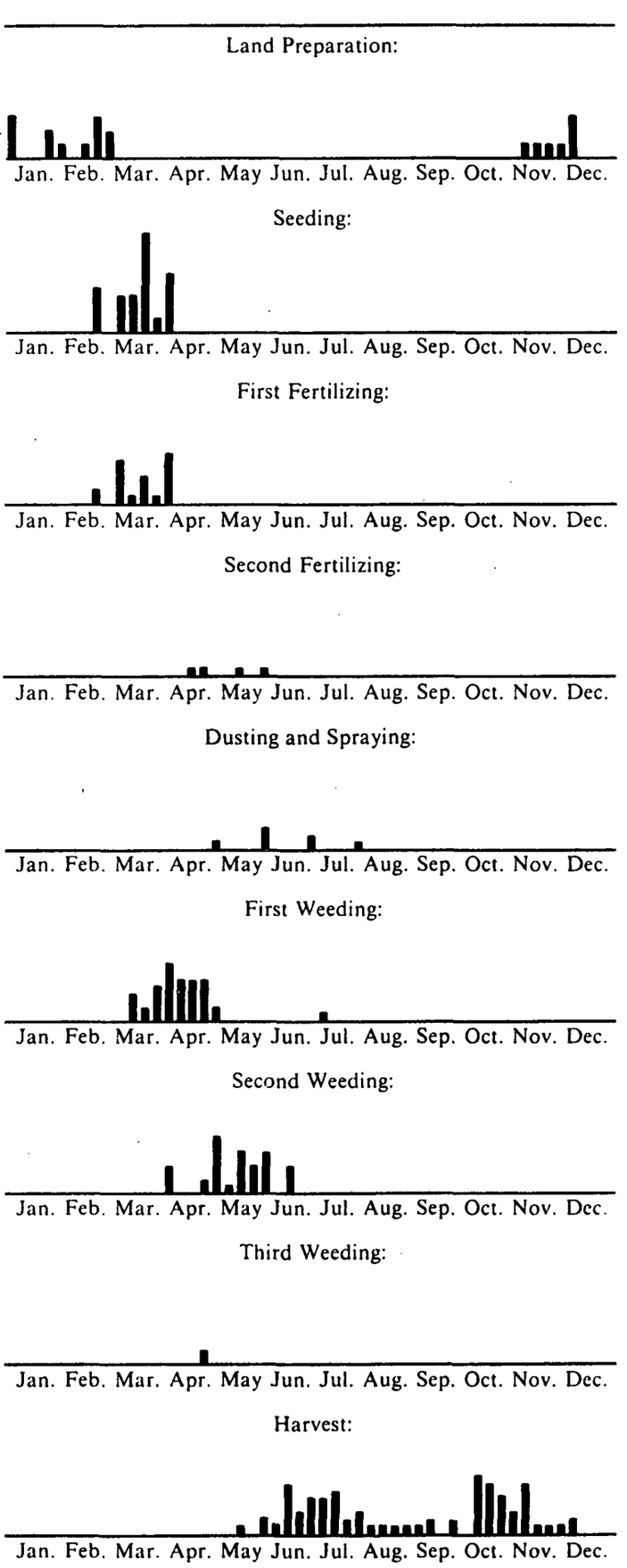


BUNGOMA DISTRICT

TABLE 14 b: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize &Beans** Cases: 40[1)]

AEZ: LH 1–2 – UM 1–2 Survey Area 11 Sample Size: 30



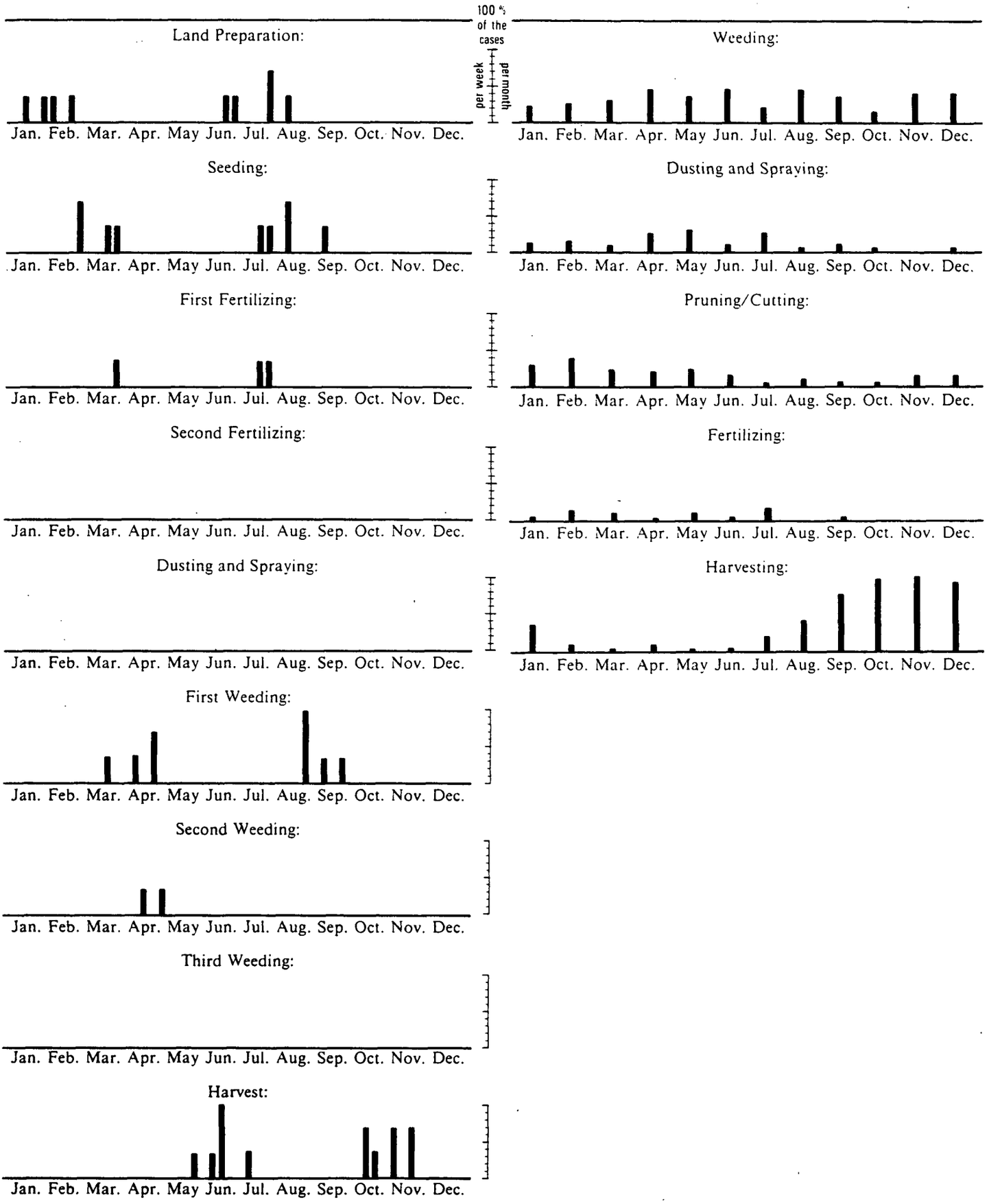
1) Maximum 30 per crop and season

BUNGOMA DISTRICT

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



BUNGOMA DISTRICT

TABLE 14 d: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 51 **Coffee** Cases: 21

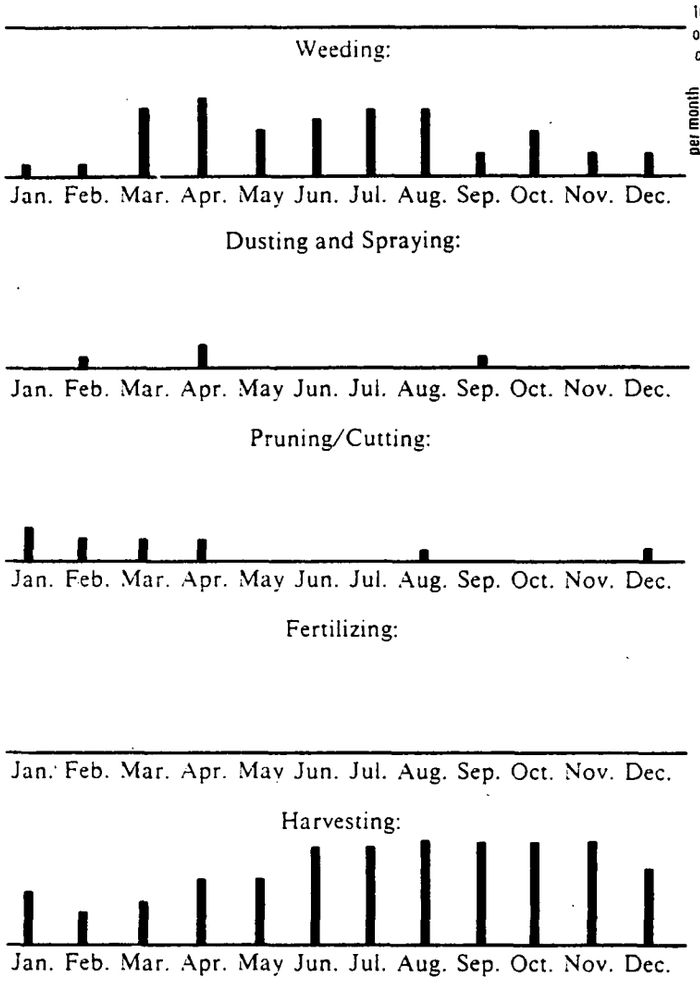
AEZ: LH 1–2 – UM 1–2 Survey Area 11 Sample Size: 30

BUNGOMA DISTRICT

TABLE 14 e: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 52 **Pyrethrum** Cases: 11

AEZ: LH 1–2 – UM 1–2 Survey Area 11 Sample Size: 30



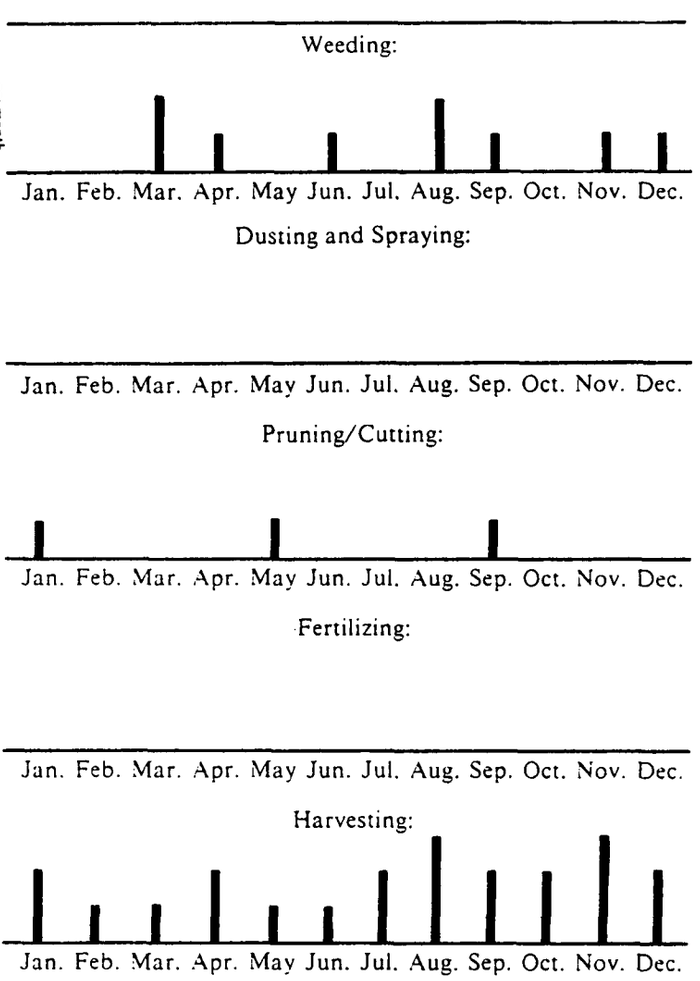
100 % of the cases per month

BUNGOMA DISTRICT

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



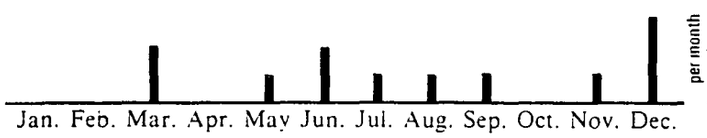
BUNGOMA DISTRICT

TABLE 14 g: **DISTRIBUTION OF FARMING ACTIVITIES**

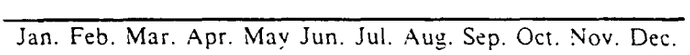
Crop 56 **Cooking Bananas** Cases: 4

AEZ: LH 1–2 – UM 1–2 Survey Area: 11 Sample Size: 30

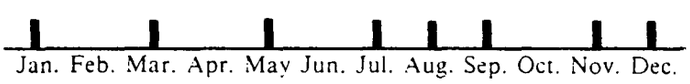
Weeding:



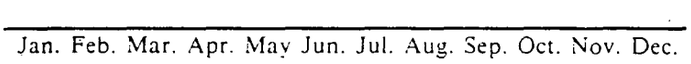
Dusting and Spraying:



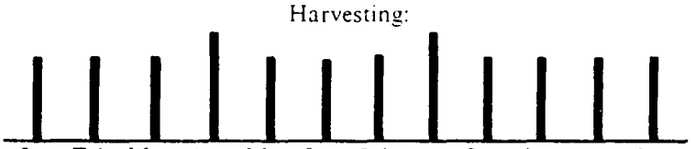
Pruning/Cutting:



Fertilizing:



Harvesting:



100% of the cases per week per month

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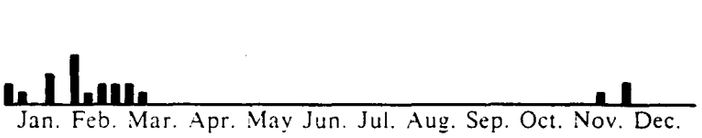
TABLE 14 h: **DISTRIBUTION OF FARMING ACTIVITIES**

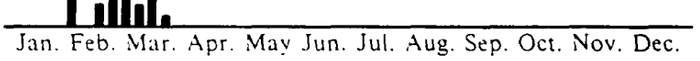
Crop 1 **Maize** Cases: 22

AEZ: LM 1–2 Survey Area 12 Sample Size: 30

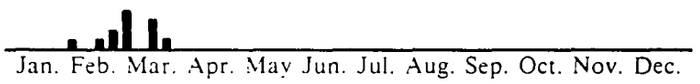
Land Preparation:



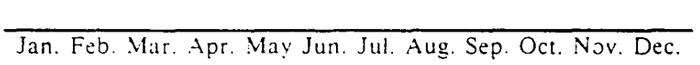
Seeding:



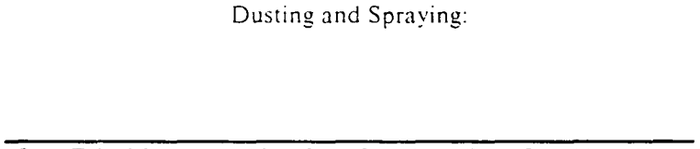
First Fertilizing:



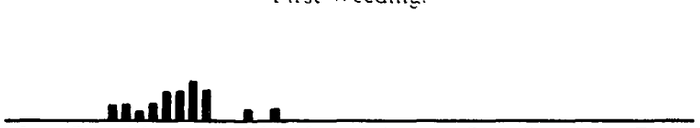
Second Fertilizing:



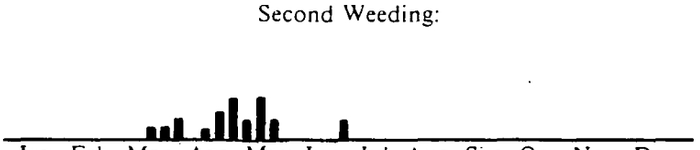
Dusting and Spraying:



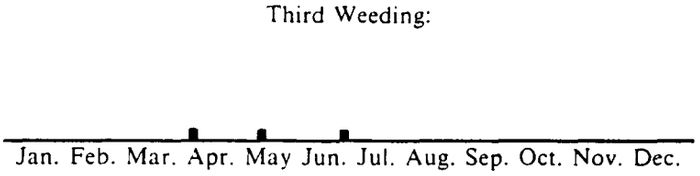
First Weeding:



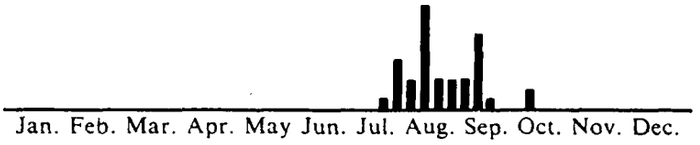
Second Weeding:



Third Weeding:



Harvest:

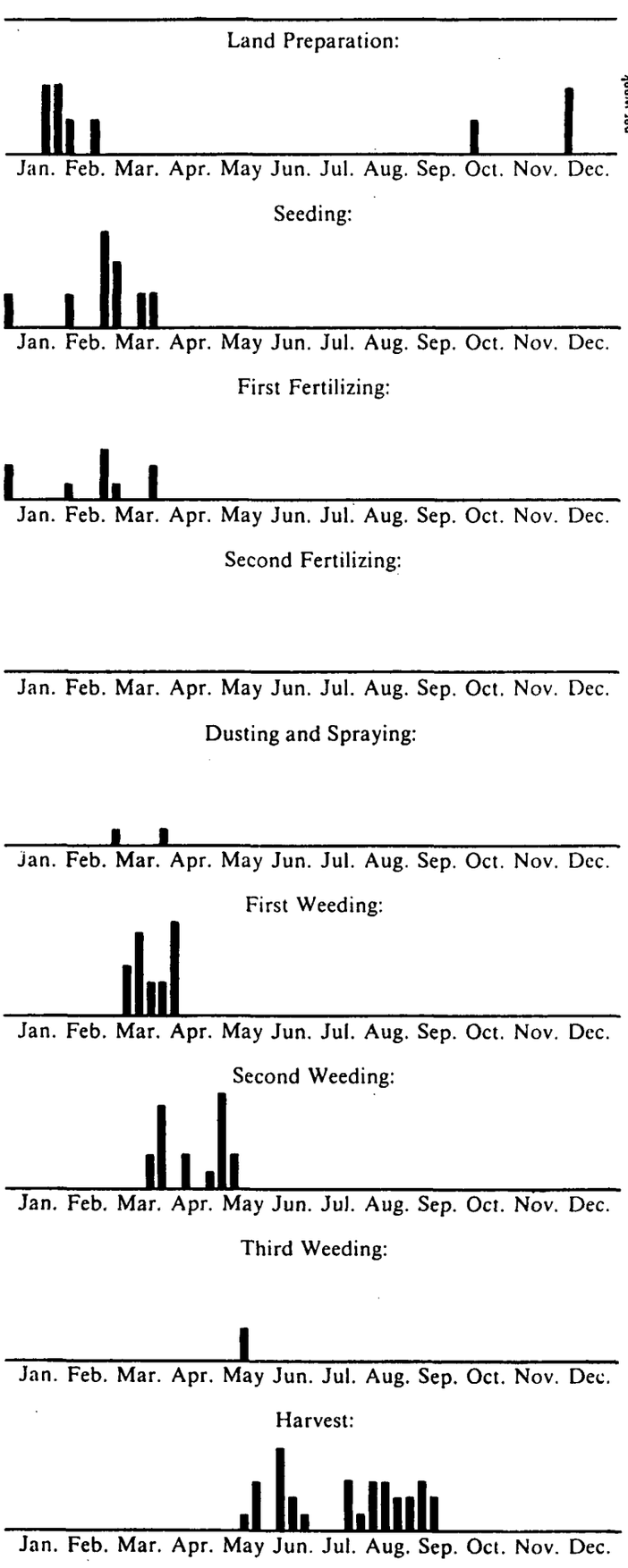


BUNGOMA DISTRICT

TABLE 14 i: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 18

AEZ: LM 1–2 Survey Area 12 Sample Size: 30

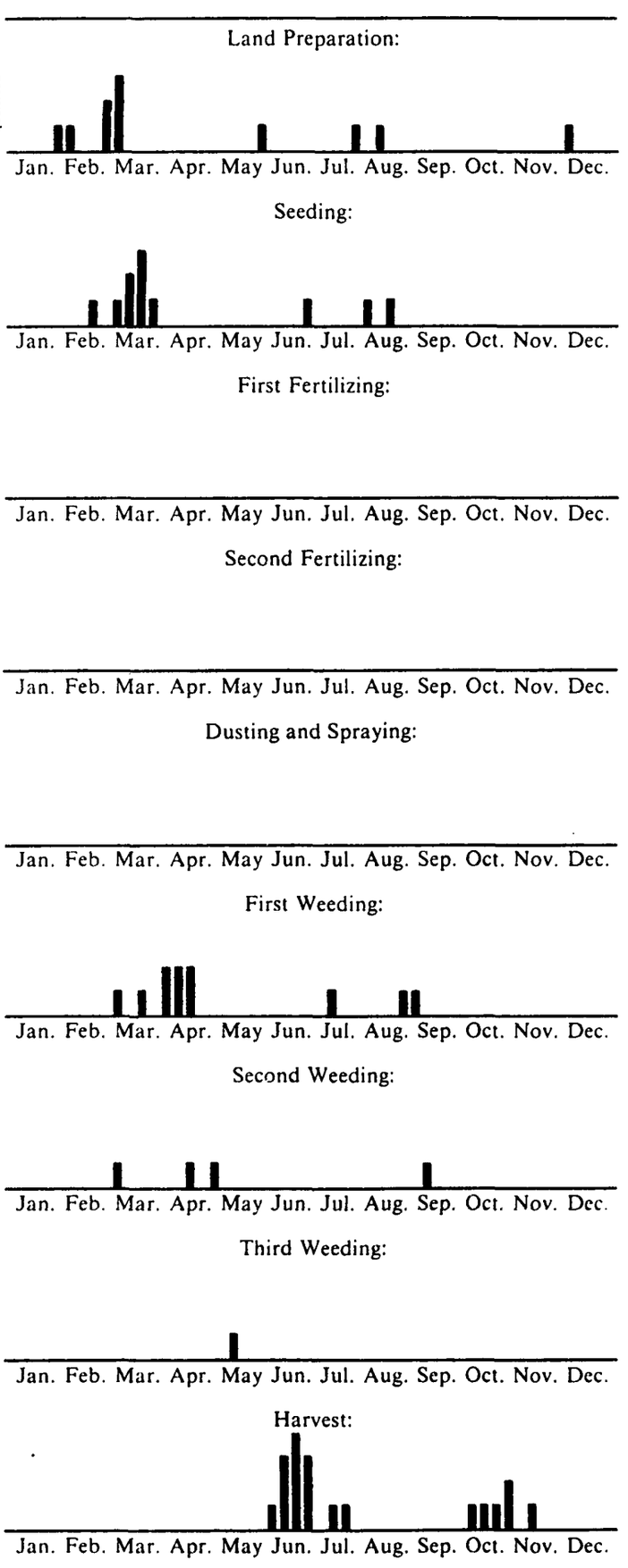


BUNGOMA DISTRICT

TABLE 14 j: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 10 **Beans** Cases: 11

AEZ: LM 1–2 Survey Area 12 Sample Size: 30

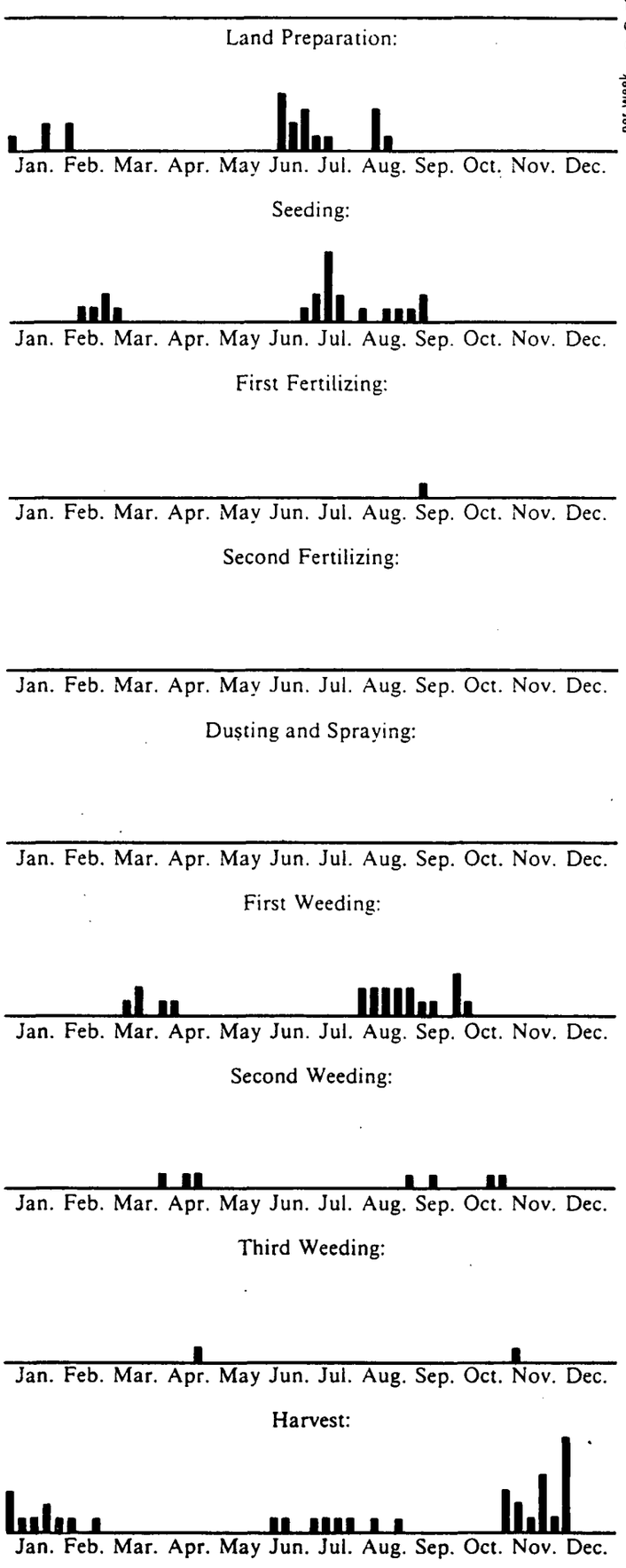


BUNGOMA DISTRICT

TABLE 14 k: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 34 **Sunflower** Cases: 21

AEZ: LM 1–2 Survey Area 12 Sample Size: 30



BUNGOMA DISTRICT

TABLE 14 l: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 56 **Cooking Bananas** Cases: 9

AEZ: LM 1–2 Survey Area 12 Sample Size: 30

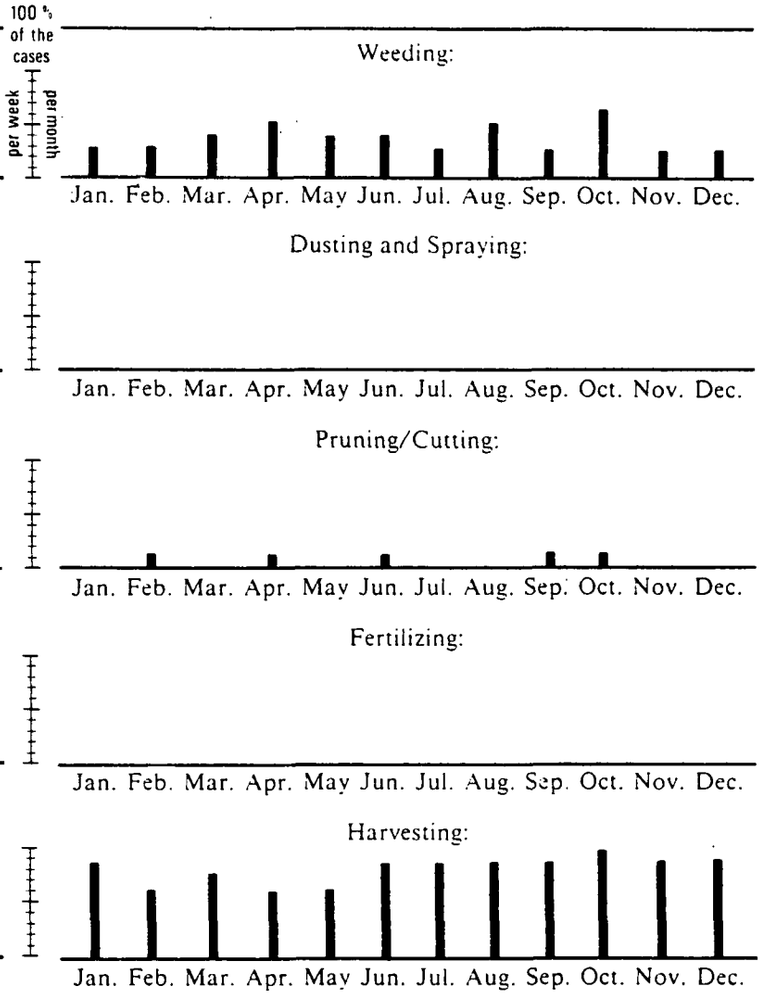


TABLE 15 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES

BUNGOMA DISTRICT — OUTPUT AND NUTRIENT INPUT

		A.E.Z.: LH 1 TEA/DAIRY ZONE				A.E.Z.: LH 2 WHEAT/MAIZE-PYRETHRUM ZONE							
		Vegt. Period 1st + 2nd: p or l/m-m in Days, 1st: 190 or more		2nd: 170-175	total: >360	vli or two 185 or more		1oo-13o	285-33o				
		Soil:	NITOSOLS			NITOSOLS							
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE/LEYS													
Farmers in Production Level	%												
Yields	kg	3,000			6,600	2,500			5,000				
Fertilizer N	kg				200				138				
P_2O_5	kg				100				69				
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	4,000			9,700	4,100			8,700				
Fertilizer N	kg				316				255				
P_2O_5	kg				158				127				
K_2O													
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	2,500		5,000	11,000	2,500		4,000	7,000				
Fertilizer N	kg			83	425			50	150				
P_2O_5	kg			17	85			10	30				
K_2O	kg			17	85			10	30				
CROP: PYRETHRUM													
Farmers in Production Level	%												
Yields	kg					600	200	500	1,300				
Fertilizer N	kg								18				
P_2O_5	kg								38				
K_2O	kg												
CROP: PASSION FRUIT													
Farmers in Production Level	%												
Yields	kg	3,600		8,000	14,000								
Fertilizer N	kg			70	166								
P_2O_5	kg			92	218								
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	2,500	2,600	4,200	7,000	2,220	1,500	4,000	7,000				
Fertilizer N	kg		3	43	113			45	120				
P_2O_5	kg		2	41	108			43	115				
K_2O	kg												

BUNGOMA DISTRICT

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

			A.E.Z.: LH 1 TEA/DAIRY ZONE				A.E.Z.: LH 2 WHEAT/MAIZE-PYRETHRUM ZONE							
			Vegt. Period 1st + 2nd: p or l/mm in Days, 1st: 190 or more		2nd: 170-175	total: >360	vli or two 185 or more		100-130	285-330				
			Soil: NITOSOLS				NITOSOLS							
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: POTATOES														
Farmers in Production Level		%												
	Yields	kg	7,200	3,000	10,000	25,000	6,400	3,000	10,000	40,000				
	Fertilizer N	kg			28	178			29	269				
	P_2O_5	kg			25	160			32	302				
	K_2O	kg												
CROP: BEANS														
Farmers in Production Level		%												
	Yields	kg					1,200	200	700	1,400				
	Fertilizer N	kg								10				
	P_2O_5	kg								6				
	K_2O													
CROP: CABBAGE														
Farmers in Production Level		%												
	Yields	kg	4,500	2,200	10,000	45,000	4,000	3,000	12,000	40,000				
	Fertilizer N	kg			44	324			56	252				
	P_2O_5	kg			33	243			48	216				
	K_2O	kg												
CROP: SUKUMAWIKI														
Farmers in Production Level		%												
	Yields	kg					4,000	3,000	7,000	35,000				
	Fertilizer N	kg							21	217				
	P_2O_5	kg							18	186				
	K_2O	kg												
CROP: MAIZE & BEANS														
Farmers in Production Level		%												
	Yields	kg	2,500	2,600/600	4,200/600		2,220	1,500/100	4,000/350					
	Fertilizer N	kg		31	71				44					
	P_2O_5	kg		14	53				30					
	K_2O	kg												
CROP: SUNFLOWER														
Farmers in Production Level		%												
	Yields	kg	1,000	500	1,000	2,500								
	Fertilizer N	kg				51								
	P_2O_5	kg				42								
	K_2O	kg												

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				A.E.Z.: UM 2 MAIN COFFEE ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE			
		Vegt. Period 1st + 2nd: m/l-s/m in Days, 1st: 170 or more		2nd: 105-115	total: 275-285	vli or m/l-si 160 or more		85-105	245-265	l/vli or m-si 130 or more		85-100	215-230
		Soil:	NITOSOLS			FERRALSOLS				FERRALSOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE/LEYS													
Farmers in Production Level	%												
Yields	kg	2,000			4,800	2,000			4,000	1,500			3,000
Fertilizer N	kg				155				111				83
P_2O_5	kg				77				55				41
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	4,900			10,400	3,900			8,400	2,900			7,500
Fertilizer N	kg				305				250				255
P_2O_5	kg				152				125				127
K_2O													
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	2,100		5,000	12,000								
Fertilizer N	kg			97	495								
P_2O_5	kg			19	99								
K_2O	kg												
CROP: COFFEE													
Farmers in Production Level	%												
Yields	kg		300	550	900		300	400	1,400				
Fertilizer N	kg		30	55	90		30	40	140				
P_2O_5	kg		90	90	100		90	90	90				
K_2O	kg												
CROP: PASSION FRUIT													
Farmers in Production Level	%												
Yields	kg	3,000		12,000	18,000	3,200		14,000	16,000				
Fertilizer N	kg			126	210			151	179				
P_2O_5	kg			189	315			259	307				
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	7,500	2,000	15,000	28,000	6,000	2,000	14,000	20,000				
Fertilizer N	kg			113	308			120	210				
P_2O_5	kg			45	123			56	98				
K_2O	kg												

BUNGOMA DISTRICT

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: m/l~s/m in Days, 1st: 170 or more		2nd: 105-115	total: 275-285	vli or m/l~si 160 or more		85-105	245-265	l/vli or m~si 130 or more		85-100	215-230
		Soil: NITOSOLS				FERRALSOLS				FERRALSOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	1,900	2,800	4,000	6,500	1,400	2,500	3,000	4,500	1,400	2,500	3,000	4,000
Fertilizer N	kg		23	53	115		28	40	78		28	40	65
P_2O_5	kg		22	50	110		31	45	87		31	45	73
K_2O	kg												
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg	1,900	1,800/150	2,500/250	4,000/400	1,400	2,000/200	3,000/500	4,000/500	1,400	2,500/200	3,000/500	4,500/500
Fertilizer N	kg		30	65	134		38	64	89		38	64	102
P_2O_5	kg		25	55	118		38	63	81		38	63	105
K_2O													
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg					1,100	350	1,000	1,400	500	400	1,000	1,200
Fertilizer N	kg								14			24	34
P_2O_5	kg								11			18	25
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	900	500	900	1,600	800	500	900	1,300	700	500	900	1,200
Fertilizer N	kg				24			3	17			7	17
P_2O_5	kg				29			5	25			25	25
K_2O	kg												
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	1,400		1,000	2,000	1,100		1,200	1,900	800		800	1,100
Fertilizer N	kg				24			3	27				12
P_2O_5	kg				20			4	30				11
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

BUNGOMA DISTRICT

TABLE 15 e: 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: m/las/m		2nd:	total:	vli or m/lasi				l/vli or masi			
			in Days, 1st: 170 or more		105-115	275-285	160 or more		85-105	245-265	130 or more		85-100	215-230
			Soil: NITOSOLS				FERRALSOLS				FERRALSOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: POTATOES														
Farmers in Production Level		%												
	Yields	kg	6,000	3,000	8,000	18,000								
	Fertilizer N	kg			13	80								
	P_2O_5	kg			15	90								
	K_2O	kg												
CROP: SWEET POTATOES														
Farmers in Production Level		%												
	Yields	kg	7,500	6,000	8,000	20,000	7,000	3,000	7,000	18,000	5,000	2,500	5,000	16,000
	Fertilizer N	kg			4	100				88				88
	P_2O_5	kg			3	75				77				77
	K_2O													
CROP: CABBAGE														
Farmers in Production Level		%												
	Yields	kg	3,000	2,500	8,000	20,000	2,700	4,000	6,000	18,000				
	Fertilizer N	kg			35	119		9	23	109				
	P_2O_5	kg			30	102		9	23	109				
	K_2O	kg												
CROP: SUKUMAWIKI														
Farmers in Production Level		%												
	Yields	kg	3,000	5,000	10,000	25,000	2,700	5,000	9,000	16,000	2,500	4,000	8,000	15,000
	Fertilizer N	kg		14	49	154		9	45	86		10	36	83
	P_2O_5	kg		12	42	132		9	45	86		10	36	83
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
	Yields	kg												
	Fertilizer N	kg												
	P_2O_5	kg												
	K_2O	kg												
CROP:														
Farmers in Production Level		%												
	Yields	kg												
	Fertilizer N	kg												
	P_2O_5	kg												
	K_2O	kg												

BUNGOMA DISTRICT

TABLE 15 f: **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: 1 ⌐ m		2nd:	total:	l⌢(m/s)i				m/l ⌐ (s)			
			in Days, 1st: 210 or more		13o-14o	34o-35o	195 or more		115-13o	31o-325	15o-17o		8o-1oo	23o-27o
			Soil: FERRALSOLS				FERRALSOLS				FERRALSOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE/LEYS														
Farmers in Production Level		%												
	Yields	kg	2,000			3,900	1,800			3,600	1,200			2,400
	Fertilizer N	kg				1o5				100				66
	P_2O_5	kg				52				50				33
	K_2O	kg												
CROP: NAPIER/BANA GRASS														
Farmers in Production Level		%												
	Yields	kg	4,000			9,000	3,400			8,000	2,400			5,500
	Fertilizer N	kg				277				255				172
	P_2O_5	kg				138				127				86
	K_2O													
CROP: TEA														
Farmers in Production Level		%												
	Yields	kg	1,500		4,000	8,500								
	Fertilizer N	kg			83	280								
	P_2O_5	kg			16	56								
	K_2O	kg			16	56								
CROP: BANANAS														
Farmers in Production Level		%												
	Yields	kg	6,000	10,000	12,000	30,000	7,000	2,000	8,000	16,000				
	Fertilizer N	kg		72	108	432			18	162				
	P_2O_5	kg		28	42	168			7	63				
	K_2O	kg												
CROP: SUGAR CANE														
Farmers in Production Level		%												
	Yields/year	kg	6,500		40,000	75,000								
	Fertilizer N	kg			67	137								
	P_2O_5	kg			235	479								
	K_2O	kg												
CROP: COTTON														
Farmers in Production Level		%												
	Yields	kg									400	200		1,600
	Fertilizer N	kg												132
	P_2O_5	kg												96
	K_2O	kg												

TABLE 15 g: **PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES**

BUNGOMA DISTRICT

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: 1 – m in Days, 1st: 210 or more		2nd: 130-140	total: 340-350	l–(m/s)i 195 or more		115-130	310-325	m/l – (s) 150-170		80-100	230-270
			Soil: FERRALSOLS				FERRALSOLS				FERRALSOLS			
		Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE														
Farmers in Production Level		%												
	Yields	kg	1,600	2,000	3,000	4,500	2,200	2,200	3,000	4,500	1,300	1,800	2,000	2,400
	Fertilizer N	kg		12	42	87			22	64		15	21	33
	P_2O_5	kg		11	39	81			20	58		14	20	31
	K_2O	kg												
CROP: SORGHUM														
Farmers in Production Level		%												
	Yields	kg	2,200	500	3,000	4,000	2,800	500	2,500	4,500	1,800	500	2,000	3,400
	Fertilizer N	kg			31	70				57			8	63
	P_2O_5	kg			25	57				50			6	51
	K_2O													
CROP: MAIZE & BEANS														
Farmers in Production Level		%												
	Yields	kg	1,600	2,000/300	3,000/450	4,500/400	2,200	2,200/400	3,000/500	4,500/500	1,300	1,800/250	2,000/400	2,400/500
	Fertilizer N	kg		26	64	106			44	82		27	40	57
	P_2O_5	kg		22	55	95			40	82		22	32	46
	K_2O	kg												
CROP: BEANS														
Farmers in Production Level		%												
	Yields	kg					1,200	800	1,200	1,800	900	500	900	1,200
	Fertilizer N	kg								36				18
	P_2O_5	kg								21				9
	K_2O	kg												
CROP: SUNFLOWER														
Farmers in Production Level		%												
	Yields	kg	850	600	850	1,300								
	Fertilizer N	kg				15								
	P_2O_5	kg				12								
	K_2O	kg												
CROP: SOYA BEANS														
Farmers in Production Level		%												
	Yields	kg	950	600	1,200	1,800	1,300	600	1,000	1,600				
	Fertilizer N	kg			10	34				15				
	P_2O_5	kg			9	32				11				
	K_2O	kg												

BUNGOMA DISTRICT

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: l ⌢ m in Days, 1st: 210 or more		2nd: 130-140	total: 340-350	l⌢(m/s)i 195 or more		115-130	310-325	m/l ⌢ (s) 150-170		80-100	230-270
			Soil: FERRALSOLS				FERRALSOLS				FERRALSOLS			
		Unit	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	1,000	350	900	1,500	1,200	400	700	1,600	1,000	400	900	1,600
Fertilizer	N	kg				16				13				19
	P_2O_5	kg				15				12				18
	K_2O	kg												
CROP: SIMSIM														
Farmers in Production Level		%												
Yields		kg									700			1,200
Fertilizer	N	kg												14
	P_2O_5	kg												17
	K_2O													
CROP: SWEET POTATOES														
Farmers in Production Level		%												
Yields		kg	6,500	6,000	10,000	28,000	7,000	8,000	12,000	28,000	4,500	6,000	10,000	18,000
Fertilizer	N	kg			35	215		10	50	210		15	55	135
	P_2O_5	kg			25	151		7	35	147		11	39	95
	K_2O	kg												
CROP: CASSAVA														
Farmers in Production Level		%												
Yields		kg	6,000	2,500	7,000	15,000	7,000	5,000	7,000	12,000	5,500	5,000	9,000	12,000
Fertilizer	N	kg			4	36				20			14	26
	P_2O_5	kg			7	63				35			25	46
	K_2O	kg												
CROP: CABBAGE														
Farmers in Production Level		%												
Yields		kg	6,000	3,000	8,000	20,000								
Fertilizer	N	kg			14	98								
	P_2O_5	kg			14	98								
	K_2O	kg												
CROP: SUKUMAWIKI														
Farmers in Production Level		%												
Yields		kg	6,000	4,000	6,000	18,000								
Fertilizer	N	kg				85								
	P_2O_5	kg				85								
	K_2O	kg												

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 troughout 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 variated 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 altidude	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	Kakamega District	55	Average	1 930	60	95	151	254	260	190	164	230	186	134	118	87
1 554 m	Office		60% prob.[1]	1 729	32	56	112	216	230	161	147	197	156	118	81	58
8934002	Bukura Farm Institute	52	Av.	1 788	52	91	161	257	247	157	131	187	161	127	123	94
1 463 m																
8934009	Kaimosi Mission	34	Av.	1 815	74	100	154	259	251	165	157	198	161	120	108	78
1 615 m			60%	1 543	34	39	101	242	229	120	127	172	118	77	57	59
8934013	Mumias, Girl's School	41	Av.	1 756	58	80	155	258	258	168	136	155	164	139	115	71
1 340 m			60%	1 579	31	56	106	236	240	147	115	127	154	122	72	50
8934028	Kakamega Forest	38	Av.	2 025	88	108	148	279	289	195	171	220	173	140	122	93
1 676 m	Station		60%	1 866	53	101	156	288	218	187	169	217	144	145	109	64
8934031	Yala, St. Mary's School	34	Av.	1 832	73	89	145	277	264	150	118	165	154	136	145	116
1 463 m			60%	1 613	37	98	135	251	261	125	96	158	131	137	146	77
8934040	Butere Health Centre	34	Av.	1 840	55	94	162	298	260	152	117	171	177	144	118	92
1 433 m			60%	1 649	22	44	131	270	235	144	90	144	143	117	92	51
8934061	Malava Dispensary	29	Av.	2 085	55	78	164	244	294	204	212	257	205	173	115	83
1 595 m			60%	1 871	25	32	85	214	251	163	162	190	147	147	65	34
8934071	Turbo, Stanley Estate	28	Av.	1 332	39	42	78	157	166	142	155	225	134	82	59	52
1 905 m																
8934078	Esirwa, Kaimosi F.T.C.	36	Av.	2 119	78	88	160	282	301	197	190	235	202	162	122	103
1 707 m																
8934096	Kakamega, Exp.	18	Av.	1 918	55	111	178	240	239	150	133	224	172	169	152	98
1 585 m	Station															
8934103	Vihiga, Maragoli	23	Av.	1 875	91	106	169	290	242	125	102	158	144	144	161	140
1 585 m																
8935015	Turbo, Forest Lands	59	Av.	1 258	36	43	75	151	153	141	184	229	112	60	53	21
1 829 m	Estate															
8935042	Lahre Farm	38	Av.	1 194	30	32	67	154	174	132	168	191	100	58	51	36
1 844 m																
8935076	Turbo, Selborne Estate	29	Av.	1 169	35	40	72	142	148	124	147	202	108	67	43	40
1 890 m																

[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 Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Y. of rec.
8934028	Kakamega	UM	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	
1 676 m	Forest Station	0	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	8
		lp	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	Kaimosi	UM	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	
1 615 m	Mission	1	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	8
	(operating	lp	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	
	to 1949)		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	Soy, Kazi	UM	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	
1 885 m	Moto Estate	4	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	11
	(operating	hp	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	
	to 1936)		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

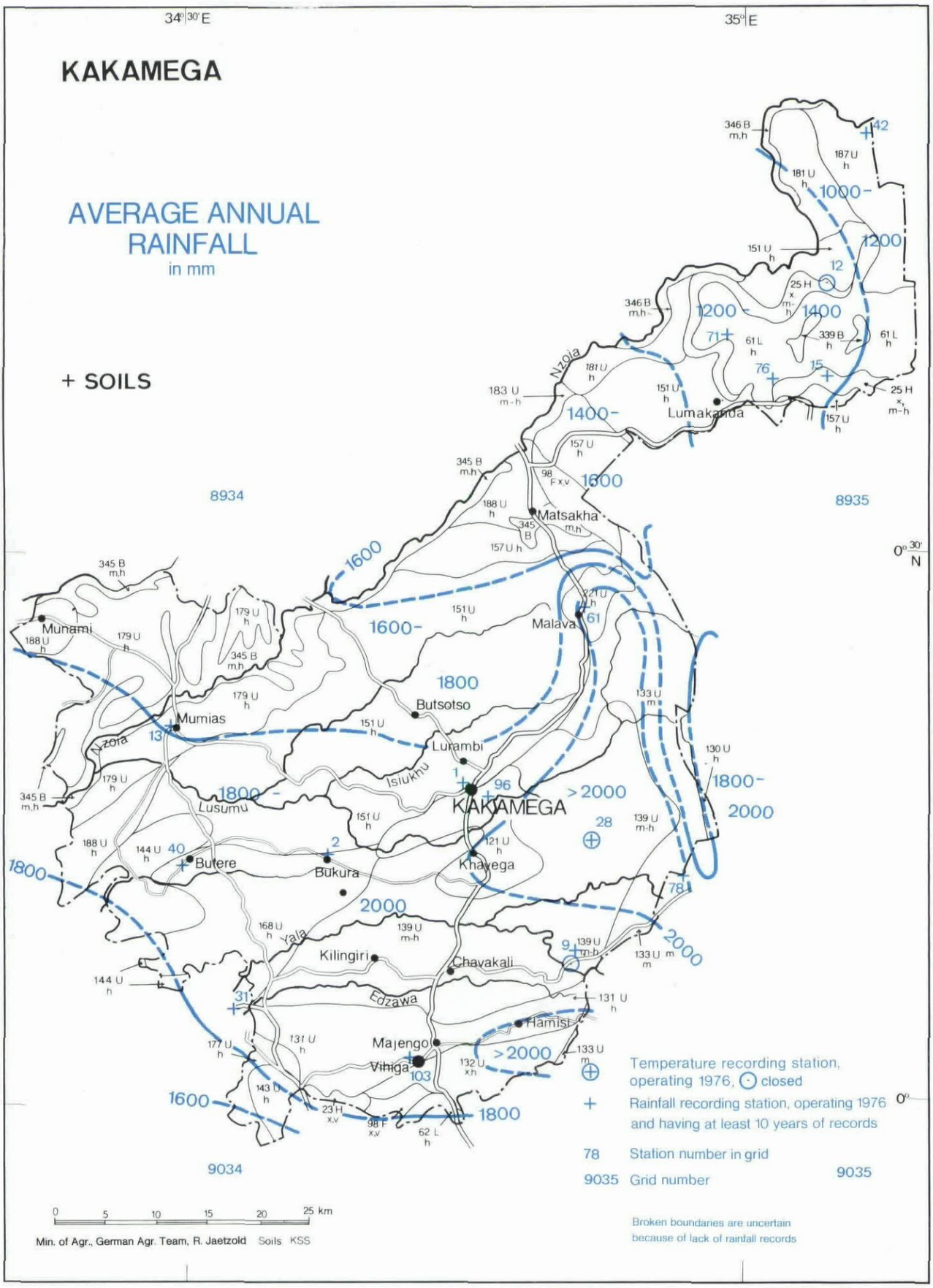
TABLE 3: **CLIMATE IN THE AGRO-ECOLOGICAL ZONES**

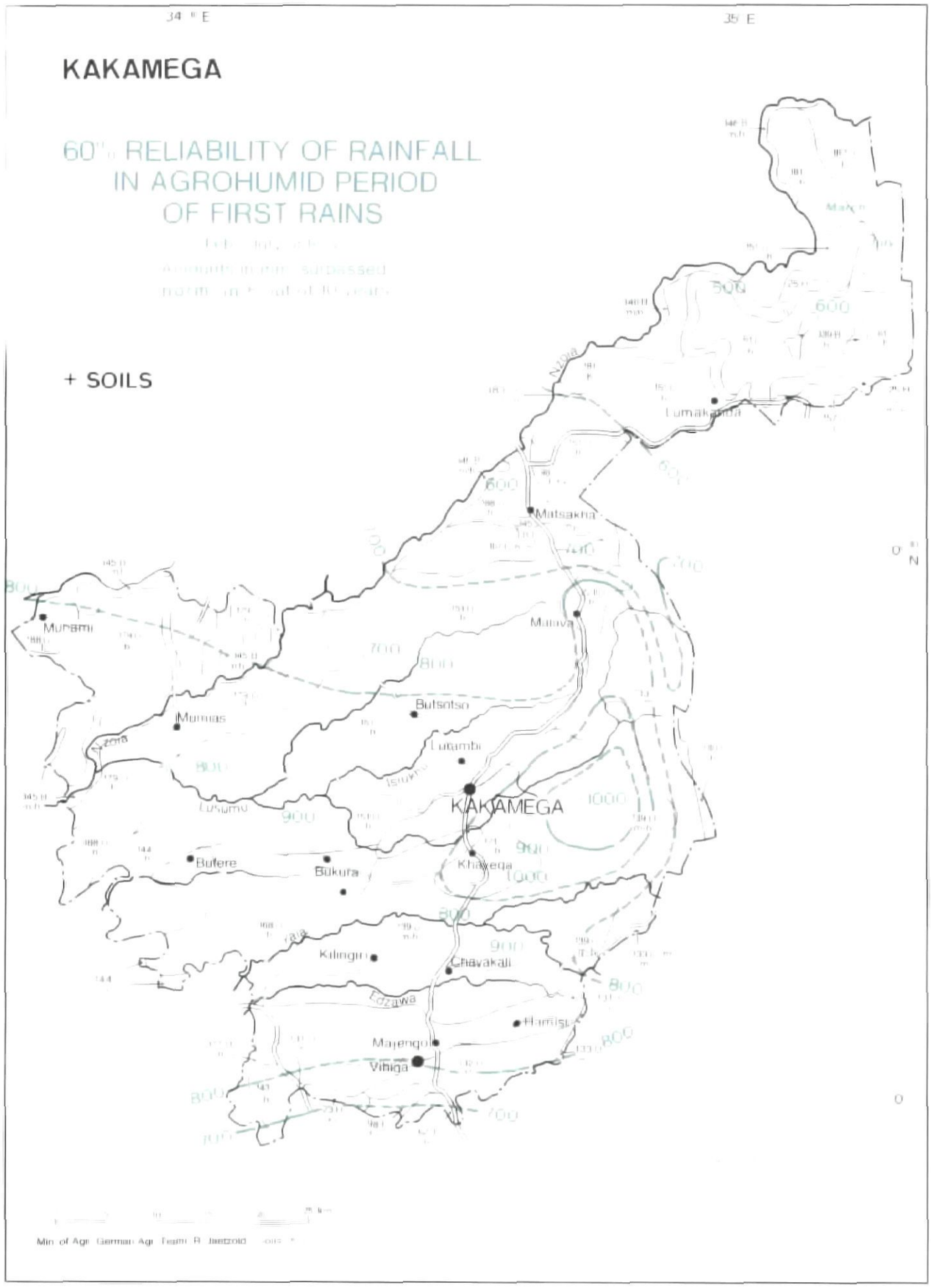
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1] 1st rains in mm	2nd rains in mm	60 % reliability of growing period 1st rains[2] in days	2nd rains in days	Total[3] in days
UM 0 Forest Zone		1 500–1 700	19.6–18.6	2 000–2 200	900–1 100	700–850	whole year	very wet	
UM 1 Coffee-Tea Zone	p or two/ three	1 500–1 800	20.4–18.1	1 800–>2 000	800–1 000	700–800	150 or more	210–215	365
	p or two			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 Sunflower-Maize Zone	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 Lower Midland Sugar Cane Zone	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
	vl i or l ⌐ m i			1 650–1 850	750–850	550–730	195 or more	135–145	330–340
LM 2 Marginal Sugar Cane Zone	l ⌐ (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
	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

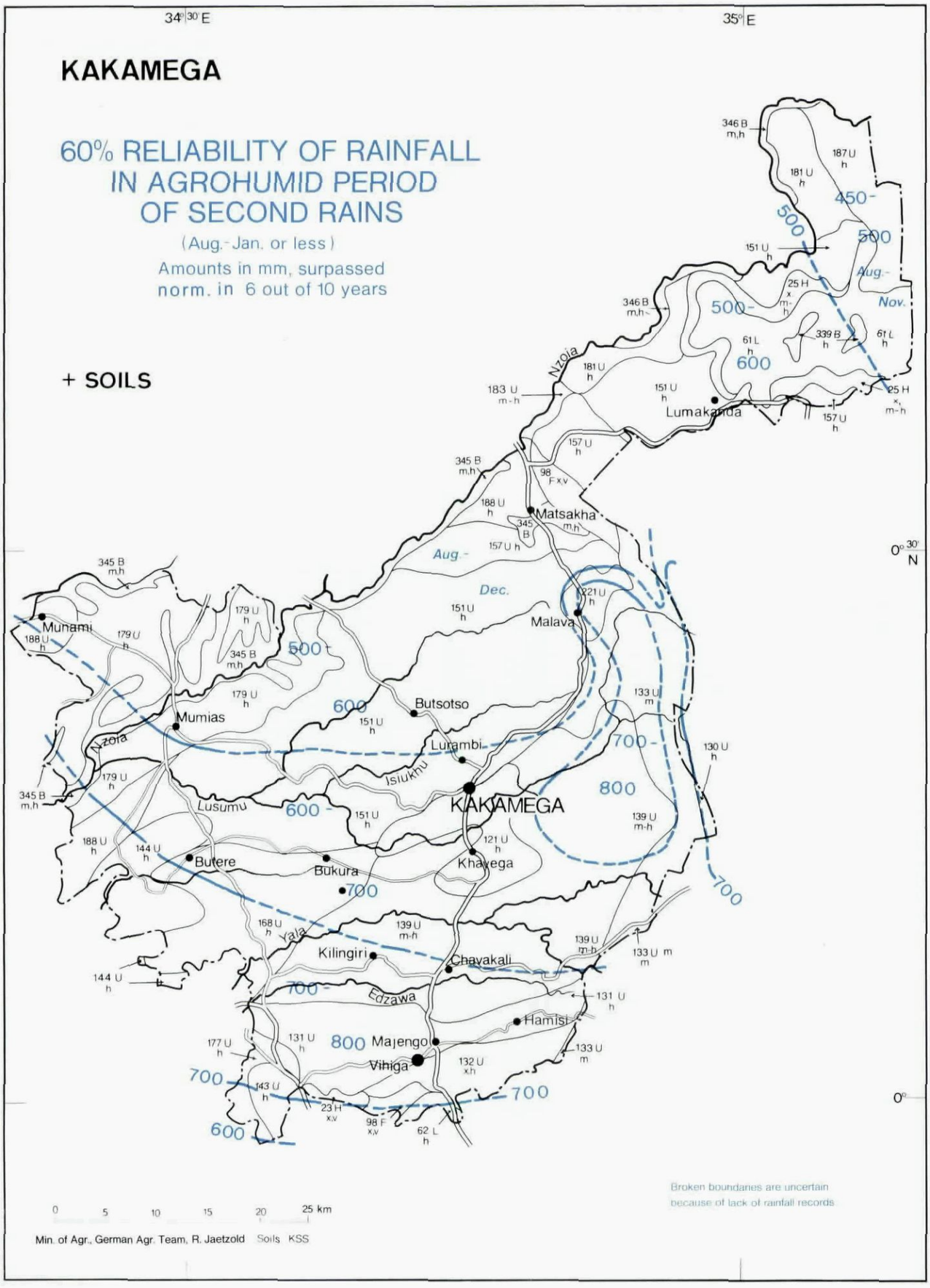
[2] More if growing cycle of cultivated plants continues into the period of second rains

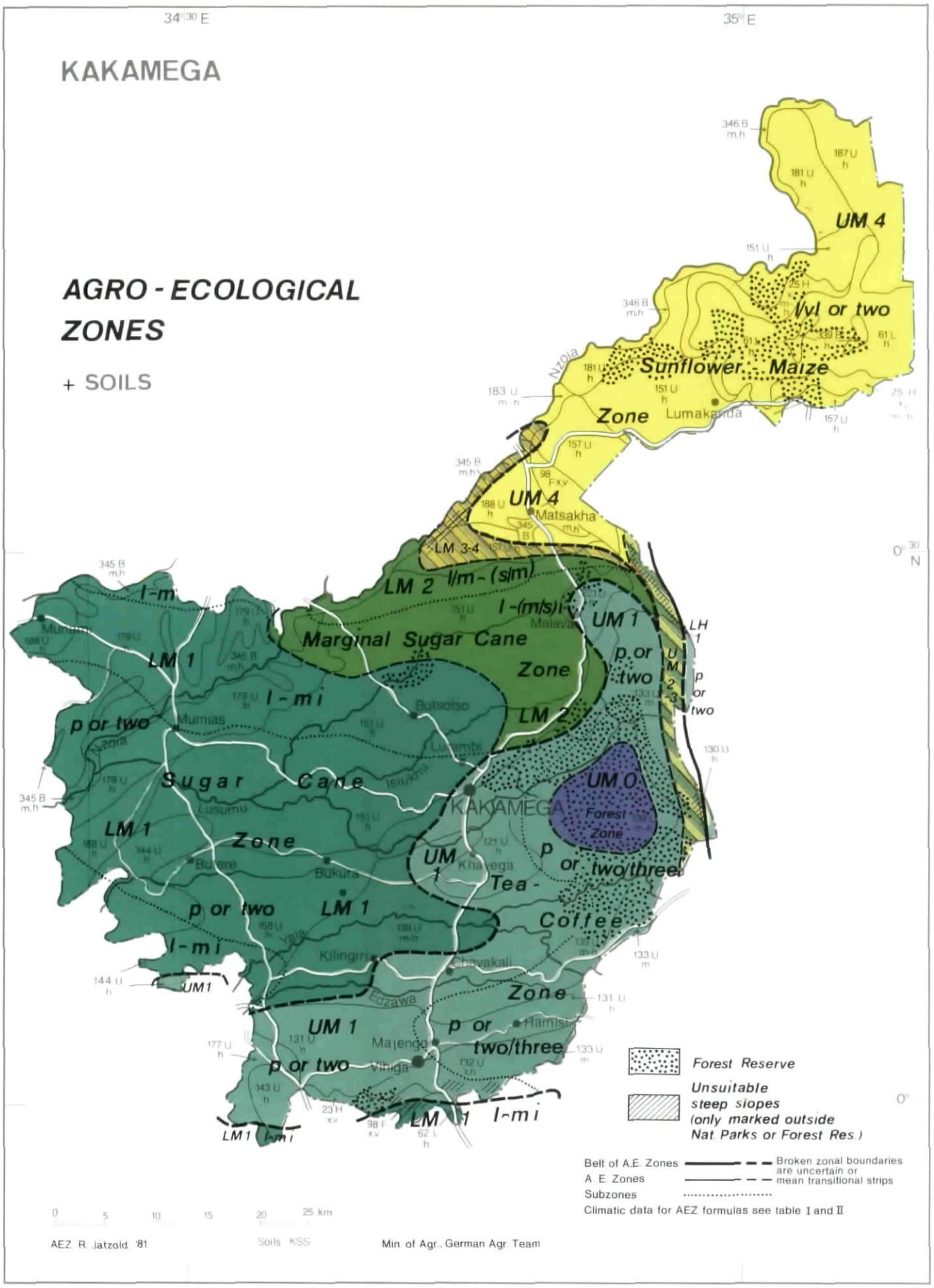
[3] Agrohumid conditions continue from 1st to 2nd rains in the whole district


34° 30' E
35° E
KAKAMEGA
AVERAGE ANNUAL RAINFALL
in mm
+ SOILS
8934
8935
9034
9035
0° 30' N
0°
1000-
1200
1400
1600
1800
2000
1400-
1600-
1800-
>2000
Nzoia
Yala
Edzawa
Isiukhu
Zoia
Lusumu
Lumakanda
Matsakha
Malava
Butsotso
Lurambi
KAKAMEGA
Khayega
Mumias
Munami
Butere
Bukura
Kilingiri
Chavakali
Hamisi
Majengo
Vihiga
Temperature recording station, operating 1976, ⊙ closed
Rainfall recording station, operating 1976 and having at least 10 years of records
78 Station number in grid
9035 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



34° E
35° E
KAKAMEGA
60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF FIRST RAINS
+ SOILS
Lumakanda
Matsakha
Malava
Butsotso
Lutambi
KAKAMEGA
Khayega
Mumias
Bufere
Bukura
Kilingiri
Chavakali
Hamisi
Majengo
Vihiga
Nzoia
Lusumu
Edzawa
Yala
Isiukhu
500
600
700
800
900
1000
0° N
0
Min. of Agr. German Agr. Team R. Jaetzold


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
0° 30' N
0°
Nzoia
Yala
Isiukhu
Lusumu
Edzawa
Aug.-
Nov.
Dec.
450-
500
500-
600
700-
800
700
600
Lumakanda
Matsakha
Malava
Butsotso
Lurambi
KAKAMEGA
Khayega
Mumias
Munami
Butere
Bukura
Kilingiri
Chavakali
Hamisi
Majengo
Viriga
0 5 10 15 20 25 km
Broken boundaries are uncertain
because of lack of rainfall records
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS


KAKAMEGA
AGRO - ECOLOGICAL ZONES
+ SOILS
34°30 E
35° E
0°30 N
0°
UM 4
l/vl or two
Sunflower - Maize
Zone
Lumakanda
Nzoia
UM 4
Matsakha
LM 3-4
LM 2
l/m - (s/m)
l - (m/s) i
Malava
UM 1
p or two
Marginal Sugar Cane
Zone
LM 2
LH 1
UM 2-3
p or two
l - m
LM 1
l - mi
p or two
Mumias
Butsotso
Lumbi
Sugar Cane
Zone
Lusumu
KAKAMEGA
UM 0
Forest Zone
LM 1
Butere
Bukura
UM 1
Khayega
p or two/three
Tea - Coffee
p or two
LM 1
l - mi
Kilingiri
Chavakali
Zone
Edzawa
UM 1
p or two/three
Hamisi
Majengo
Vihiga
p or two
LM 1
l - mi
Forest Reserve
Unsuitable steep slopes (only marked outside Nat. Parks or Forest Res.)
Belt of A.E. Zones
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
0 5 10 15 20 25 km
AEZ R. Jatzold '81
Soils KSS
Min. of Agr., German Agr. Team

AGRO-ECOLOGICAL ZONES

UM = UPPER MIDLAND ZONES

UM 0 = Forest Zone

Too wet for good yields of most crops. Forest best land use

UM 1 = Tea-Coffee Zone

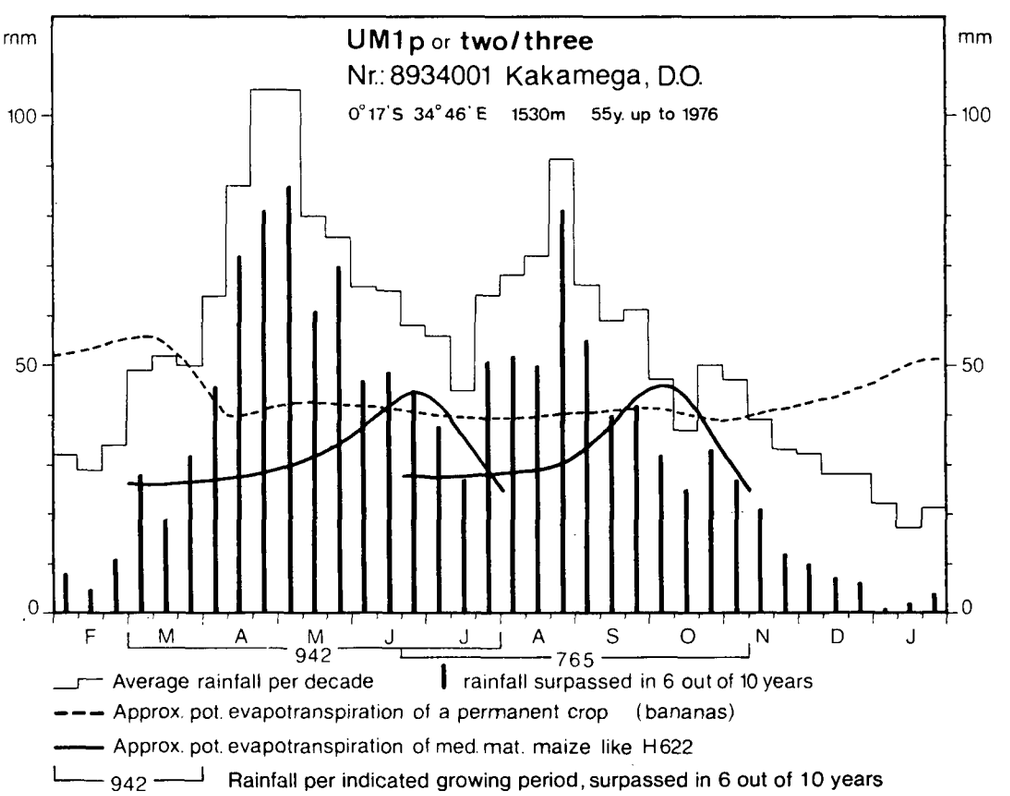
UM 1 p or two/three = Tea-Coffee Zone with permanent cropping possibilities, dividable in two to three variable cropping seasons

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 beans[1]), loquats, avocadoes

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 p or two = *Tea-Coffee Zone 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 l/vl or two = *Sunflower-Maize Zone 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 (∿ 60 %)[2], soya beans; sweet potatoes (∿ 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: Avocadoes[3], citrus[3], 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 p or two = *Lower Midland Sugar Cane Zone with permanent cropping possibilities, dividable in two variable cropping seasons*

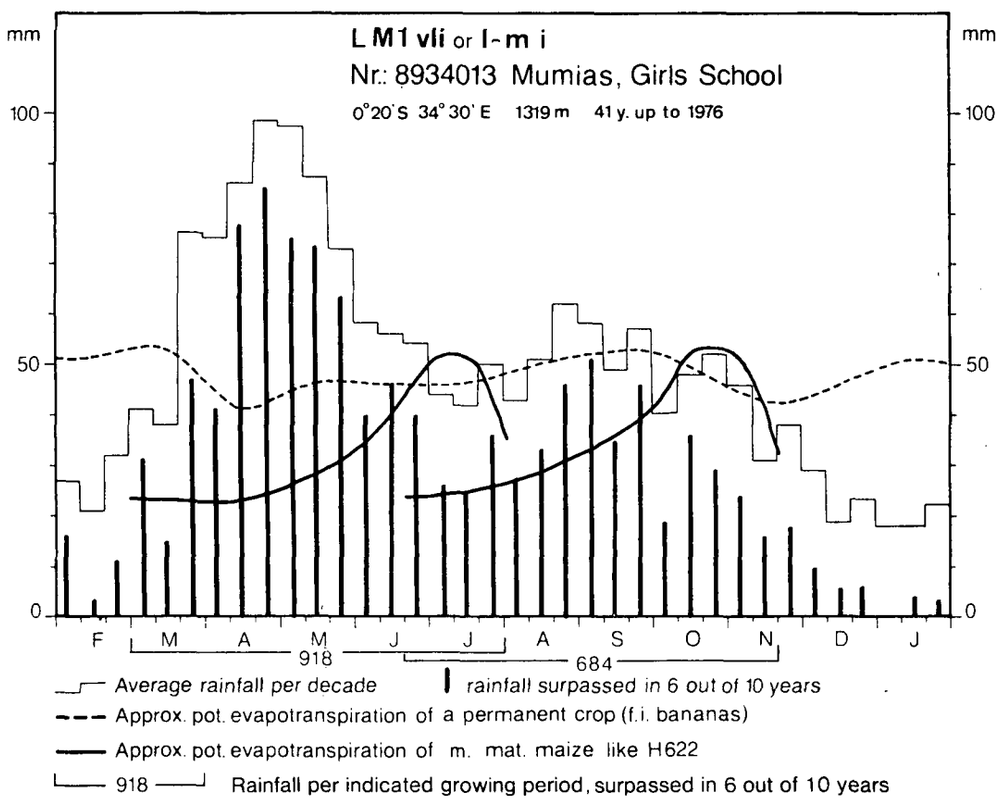
Very good yield potential (av. > 80 % of the optimum)
1st rains, start norm. end of F.: Late mat. sorghum; m. mat. sunflower like H S 301 A, late mat. soya beans; sweet potatoes
Whole year: Yam beans, pawpaws, guavas

Good yield potential (av. 60–80 % of the optimum)
1st rains: Maize H 622 and 632, finger millet; late mat. beans[2]; 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; beans[2]; 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 (∿ 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, mangoes[5], citrus[5]

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 vl i)



LM 1 vl i or l–m i = *Lower Midland Sugar Cane Zone 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. beans[2], 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 danger)[4], cassava, tea in upper places (70–80 %, but medium to low quality), Robusta coffee (∿ 60 %)[4], avocadoes

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, mangoes[5], citrus[5]

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 l–(m/s) i = Marginal Sugar Cane Zone with a long cropping season 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; beans[1)], 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 vl i)

LM 2 l/m –(s/m) = Marginal Sugar Cane Zone with a long to medium cropping season followed by a (weak) short to medium one

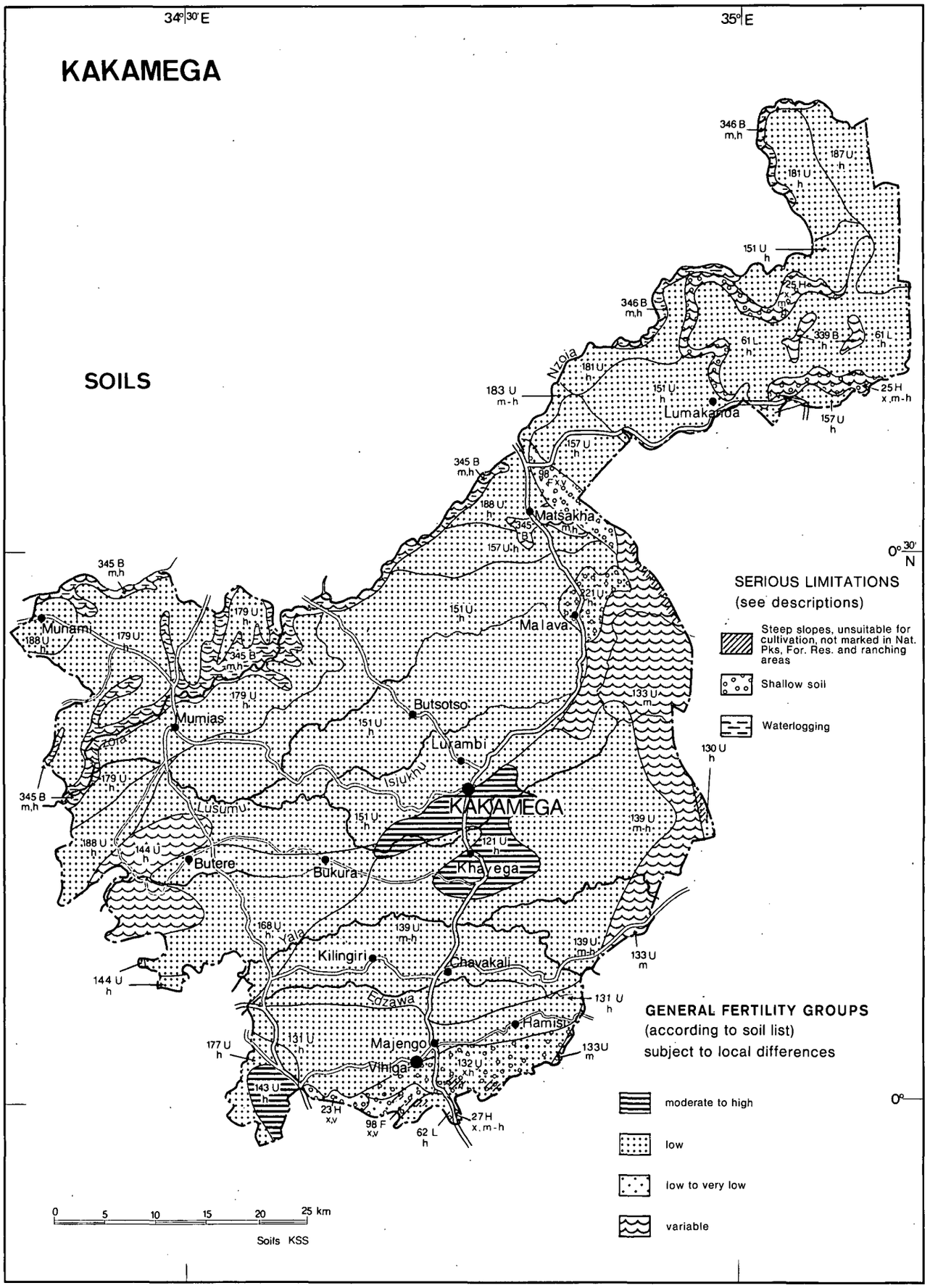
Small and transitional. Crop potential like LM 2 l–(m/s) i but m. mat. sorghum in 2nd rains and bananas only fair, maize H 511–13 in 2nd rains and sugar cane (also on good soils) only marginal. Ratooning sorghum 1st to 2nd rains also good. Stocking rates about 10 % less

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


34° 30' E
35° E
KAKAMEGA
SOILS
0° 30' N
0°
Lumakanda
Matsakha
Malava
Butsotso
Lurambi
KAKAMEGA
Mumias
Munami
Butere
Bukura
Khayega
Kilingiri
Chavakali
Hamisi
Majengo
Vihiga
Nzoia
Isiukhu
Yala
Edzawa
Lusumu
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas
Shallow soil
Waterlogging
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
moderate to high
low
low to very low
variable
0 5 10 15 20 25 km
Soils KSS

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, v[1] = 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, petroferric 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 h = well drained, deep to very deep, dark reddish brown to strong brown, friable clay (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 h = 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 ACRISOLS)
- *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 h = well drained, deep, strong brown to reddish yellow, very friable, sandy clay loam to sandy clay (orthic FERRALSOLS; with ferralic CAMBISOLS)

Soils developed on biotite gneisses

182 U = see Bungoma District

Soils developed on undifferentiated Basement System rocks

187 U h = well drained, very deep, red to dark red, very friable to friable, clay (rhodic FERRALSOLS)

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 petroferric phase; with "murram cuirass" soils (10–40 %)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

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

221 U h = well drained, very deep, dark reddish brown to dusky red, friable clay; in places bouldery (nito-rhodic FERRALSOLS)

SOILS ON BOTTOMLANDS

Soils developed on infill from intermediate igneous rocks (phonolites)

339 B h = poorly drained, moderately deep, dark grey to grey, mottled, firm clay, with humic topsoil; in many places over petro-plinthite (mollic GLEYSOLS, partly petro-ferric phase)

Soils developed on infill mainly from undifferentiated Basement System rocks

345 B m, h = 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*)

346 B m, h = complex of imperfectly drained to very poorly drained, very deep, very dark grey to dark greyish brown, mottled, firm clay; 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 underlaying 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
Butsotso	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

Location/Division without townships	in '00 ha = sqkm					in '00 ha = sqkm								in ha	
	Area total	Non-agricultural land			Agricultural land	Area in agro-ecological zones								Agric. land	
		Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, homesteads, rivers...)		AEZ								per household	per person
	Census 79					LH 1	UM 1	UM 2–3	UM 4	LM 1	LM 2	LM 3–4	UM 0		
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
Butsotso	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				83					3.13	0.48
Lumakanda	253			28	225				225					4.69	0.71
Soy	185			19	166				166					5.13	0.85
Lugari Division	534			60	474				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 AREAS[1)]

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 STATISTICS[1)]

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	3,284
	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

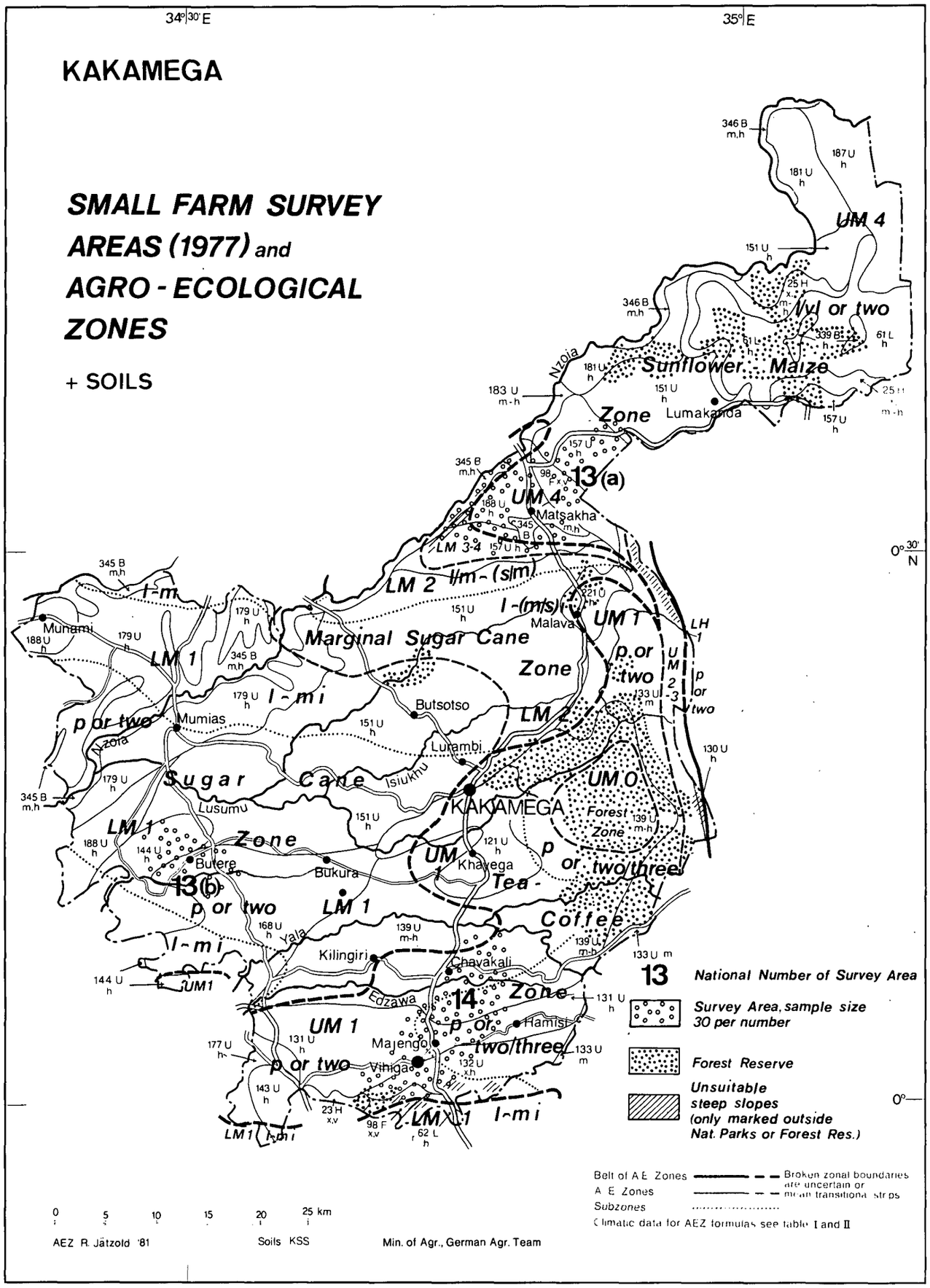
a) Source: C.B.K.

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


34°30' E
35° E
KAKAMEGA
SMALL FARM SURVEY AREAS (1977) and AGRO - ECOLOGICAL ZONES
+ SOILS
0°30' N
0°
Sunflower - Maize Zone
Marginal Sugar Cane Zone
Sugar Cane Zone
Tea - Coffee Zone
Forest Zone
13(a)
13(b)
14
KAKAMEGA
Lumakanda
Malava
Matsakha
Butsotso
Lurambi
Mumias
Bukura
Butere
Khayega
Kilingiri
Chavakali
Hamisi
Majengo
Vihiga
Munami
Lusumu
Yala
Isiukhu
Nzoia
Edzawa
LM 1
LM 2
LM 3-4
UM 1
UM 2-3
UM 4
UM 0
LH 1
p or two
p or two/three
l-mi
l-m
l-(m/s)
lm-(sm)
13 National Number of Survey Area
Survey Area, sample size 30 per number
Forest Reserve
Unsuitable steep slopes (only marked outside Nat. Parks or Forest Res.)
Belt of A E Zones
A E Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
0 5 10 15 20 25 km
AEZ R. Jätzold '81
Soils KSS
Min. of Agr., German Agr. Team

KAKAMEGA DISTRICT

TABLE 9 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

AEZ: UM 4 – LM 1–4

Survey Area 13

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	2.0	3.8	7.3
Land Use: Annual Crops[1]				
First Season: Others	ha	-	0.1	0.1
Maize	ha	0.1	0.8	0.7
Maize & Beans	ha	0.7	0.5	1.2
Beans	ha	0.1	-	0.1
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
	ha			
	ha			
Total	ha			0.2
Permanent Crops[1]				
Sugarcane	ha	-	-	0.4
Bananas	ha	0.1	0.1	0.1
	ha			
	ha			
portion of total	%	5%	3%	7%
Grazing & Forage	ha	0.6	1.3	4.0
portion of total	%	30%	34%	55%
Other Land Use	ha	0.3	0.6	0.5
Livestock on Farm:				
Cattle: local	LU	1.6	2.9	4.0
improved	LU	0.3	0.2	1.2
Sheep & Goats	LU	0.1	0.2	0.3
Total	LU	2.0	3.3	5.5

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.6	0.5	0.4
Portion of improved cattle kept	%	16%	6%	23%
Portion of Farmers owning a Plough	%	40%	40%	80%
Labour on Farm:				
Family Adults	persons	2.5	2.1	2.3
Perm. Hired Labour	"	0.1	0.1	0.8
Children > 14 years	"	1.1	1.9	3.8
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.34	0.07	2.41
Children < 14 years	"	3.15	-	3.15
Subsistence Units	SU	4.23	0.07	4.30
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1167	1887	
Beans	kg	237	377	
Fingermillet	kg	9	14	
Sweet Potatoes	kg	327	185	
Cabbage	kg	13	1	
Sorghum	kg	18	28	
Groundnuts	kg	27	43	
	kg			

Other Crops cultivated: Pyrethrum, Cowpeas, Groundnuts, Cassava, Sugarcane, Sweet Potatoes

1) Major crops only considered

2) Based on 1979 Census figures

KAKAMEGA DISTRICT

TABLE 9 b: **FARM ORGANISATION ACCORDING TO FARM SIZE GROUP**

AEZ: (LM 1) – UM 1

Survey Area 14

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.0	1.9	3.7
Land Use: Annual Crops[1]				
First Season: Others	ha			0.2
Maize	ha	0.1	0.1	0.1
Maize & Beans	ha	0.3	0.5	0.8
Sorghum	ha	-	0.1	0.1
Fingermillet	ha	-	-	0.1
Beans	ha	-	0.1	-
Total	ha	0.4	0.8	1.3
Second Season[1]				
Maize & Beans	ha	0.3	0.3	0.2
Sorghum	ha	0.1	-	-
Maize	ha	-	0.2	-
Cabbage	ha	-	-	0.4
Total	ha	0.4	0.5	0.6
Permanent Crops[1]				
Coffee	ha	0.1	0.2	0.2
Tea	ha	-	0.1	0.1
Bananas	ha	-	-	0.1
	ha			
portion of total	%	10%	16%	11%
Grazing & Forage	ha	0.3	0.5	1.4
portion of total	%	30%	26%	38%
Other Land Use	ha	0.2	0.3	0.6
Livestock on Farm:				
Cattle: local	LU	1.8	1.6	2.1
improved	LU	-	0.3	0.4
Sheep & Goats	LU	0.2	0.1	0.1
Total	LU	2.0	2.0	2.6

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.9	0.8	0.6
Portion of improved cattle kept	%	-	16%	16%
Portion of Farmers owning a Plough	%	30%	-	-
Labour on Farm:				
Family Adults	persons	2.6	2.5	2.1
Perm. Hired Labour	"	0.2	0.5	0.7
Children > 14 years	"	2.5	2.6	2.4
Persons living on Farm[2] - average household size -		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.34	0.22	2.55
Children < 14 years	"	3.43	-	3.43
Subsistence Units	SU	4.39	0.22	4.61
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1206	1944	
Beans	kg	250	397	
Fingermillet	kg	45	70	
Sweet Potatoes	kg	379	215	
Cabbage	kg	4		
Sorghum	kg	82	128	
Cowpeas	kg	9	15	
Groundnuts	kg	9	15	

Other Crops cultivated: Sorghum, Groundnuts, Sweet Potatoes, Cowpeas, Cabbage, Arrowroots

1) Major crops only considered

2) Based on 1979 Census figures

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 Crops ha	%	Perm. Crops ha	%	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_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	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 Crops ha	%	Perm. Crops ha	%	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

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_2O_5		K_2O				Insecticide kg/ha		Fungicide kg/ha	
	AC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC	AC	PC
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	0.2	7.2	0.00	0.00	7.2	33.5
Cassava	0.0	0.1	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	0.3	1.3
Pyrethrum	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	0.2	0.2	0.20	0.08	5.0	65.6
Tea	0.0	0.3	0.00	0.00	1.4	17.7
Total					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

TABLE 12 a: **HERD COMPOSITION** (GRAZING LIVESTOCK)

AEZ: UM 4 – LM 1–4 — – in Head and Livestock Units – — Nov. '77, Survey Area 13

Livestock Unit (LU)

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year,	Average	0.13	–	–	0.13				0.07			0.07
	Upper Qu.	–	–	–	–				–			–
1 - 2 years,	Average	–	–	–	0.23				0.12			0.12
	Upper Qu.	–	–	–	–				–			–
Over 2 years,	Average	–	–	0.03		0.43			0.46			0.46
	Upper Qu.	–	–	–		–			–			–
Subtotal(improved) Total		4	–	1	11	13			19.3			19.3
	Average	0.13	–	0.03	0.37	0.43			0.64			0.64
	Upper Qu.	–	–	–	–	–			–			–
	Lower Qu.	–	–	–	–	–			–			–
LU Male Cattle =		9.3 % of total cattle,				Calves + Heifers =			84.6 % of dairy cows			
Unimproved Livestock:												
Under 1 year,	Average	1.10	–	0.03	0.63		0.47	0.33	0.43	–		0.43
	Upper Qu.	1	–	–	1		1	–	0.5	–		0.5
1 - 2 years,	Average	0.20	–	0.17	0.47				0.37			0.37
	Upper Qu.	–	–	–	1				0.5			0.5
Over 2 years,	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	–
Subtotal (unimp.) Total		46	2	45	33	50	41	26	92.3	–	458	92.3
	Average	1.53	0.07	1.50	1.10	1.67	1.37	0.87	3.07	–	15.27	3.07
	Upper Qu.	2	–	4	2	3	2	1	5.0	–	20	5.0
	Lower Qu.	–	–	–	–	–	–	–	1.3	–	5	1.3
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 Total		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 =			69.8 % 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)

AEZ: (LM 1) – UM 1 — – in Head and Livestock Units – — Nov. '77, Survey Area 14

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	0.57	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 Grazing L/Stock	Total	11	–	–	38	66	5	37	64.6	–	533	64.6
	Average	0.37	–	–	1.27	2.20	0.17	1.23	2.15	–	17.77	2.15
	Upper Qu.	1	–	–	2	2	–	2	2.5	–	25	2.4
	Lower Qu.	–	–	–	–	1	–	–	1.3	–	6	1.3
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		Inputs							Yield
		Improved Seeds	Nutrients				Chemicals		
			N	P_2O_5	K_2O	Manure	Insec.	Fungicide	
		%	kg/ha	kg/ha	kg/ha	t/ha	kg/ha	kg/ha	kg/ha
First Rains									
Maize	Avg.	89	26	31	1	o.o3	-	-	5,721
	UpQu	loo	34	77	-	-	-	-	3,ooo
	LoQu	loo	-	-	-	-	-	-	1,8oo
Groundnuts	Avg.	-	-	-	-	-	-	-	1,327
	UpQu	-	-	-	-	-	-	-	1,4oo
	LoQu	-	-	-	-	-	-	-	6oo
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	5,312
	UpQu	-	-	-	-	-	-	-	4,167
	LoQu	-	-	-	-	-	-	-	2,667
Maize & Beans									
Maize	Avg.	loo	9	33	-	o.o5	1	-	2,779
Beans	Avg.	5	-	4	-	o.o4	-	-	245
Maize	UpQu	loo	-	6o	-	-	-	-	3,15o
Beans	UpQu	-	-	-	-	-	-	-	45o
Maize	LoQu	loo	-	-	-	-	-	-	1,841
Beans	LoQu	-	-	-	-	-	-	-	loo
Second Rains									
Sunflower	Avg.	loo	4	12	1	-	-	-	575
	UpQu	loo	-	-	-	-	-	-	1,ooo
	LoQu	loo	-	-	-	-	-	-	-
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	47,567
Perennial Crops									
Cassava	Avg.	-	-	-	-	-	-	-	3,545
	UpQu	-	-	-	-	-	-	-	5,ooo
	LoQu	-	-	-	-	-	-	-	2,2oo
Sugarcane	Avg.	-	-	-	-	-	-	-	2,963
	UpQu	-	-	-	-	-	-	-	-
	LoQu	-	-	-	-	-	-	-	-
Cookng Bananas	Avg.	-	-	-	-	o.6o	-	-	8,255
	UpQu	-	-	-	-	-	-	-	4,55o
	LoQu	-	-	-	-	-	-	-	-

KAKAMEGA DISTRICT

TABLE 13 b: **INPUTS AND YIELDS OF MAJOR CROPS**

AEZ: (LM 1) – UM 1 Survey Area 14

Crop		Inputs							Yield
		Improved Seeds %	Nutrients N kg/ha	P_2O_5 kg/ha	K_2O kg/ha	Manure t/ha	Chemicals Insec. kg/ha	Fungicide kg/ha	kg/ha
First Rains									
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
Second Rains									
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
Perennial Crops									
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	%
First Rains							
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
Second Rains							
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
	Permanent Crops						
Nil							

KAKAMEGA DISTRICT

TABLE 14 b: **DISPOSAL OF CROPS**

AEZ: (LM 1) – UM 1 Survey Area 14

Crops	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
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
FMlt & 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
Second Rains							
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
	Permanent Crops						
Nil							

KAKAMEGA DISTRICT

TABLE 15 a: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 44[1)]

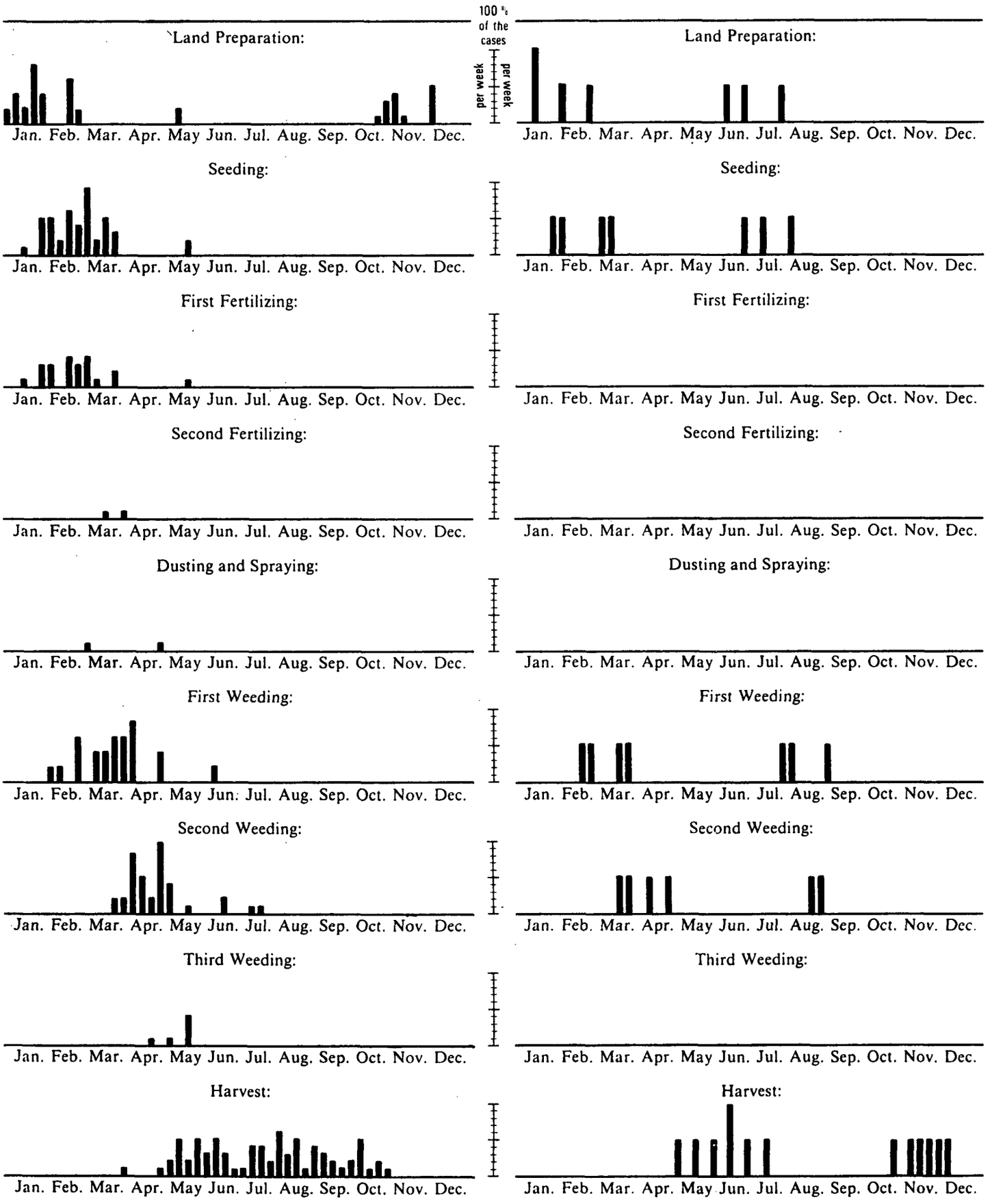
AEZ: UM 4 – LM 1–4 Survey Area 13 Sample Size: 30

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



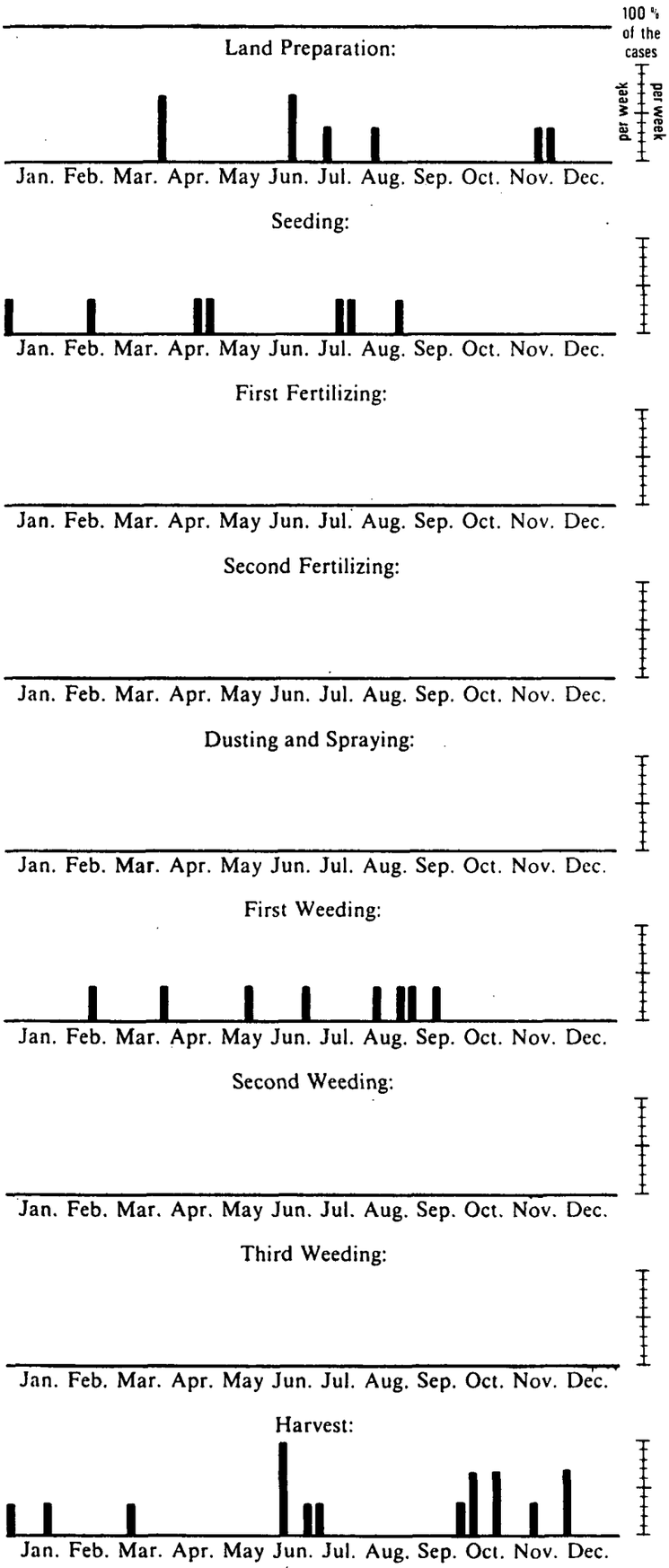
[1)] Maximum 30 per crop and season

KAKAMEGA DISTRICT

TABLE 15 c: **DISTRICT OF FARMING ACTIVITIES**

Crop 30 **Sweet Potatoes** Cases: 8

AEZ: UM 4 – LM 1–4 Survey Area 13 Sample Size: 30

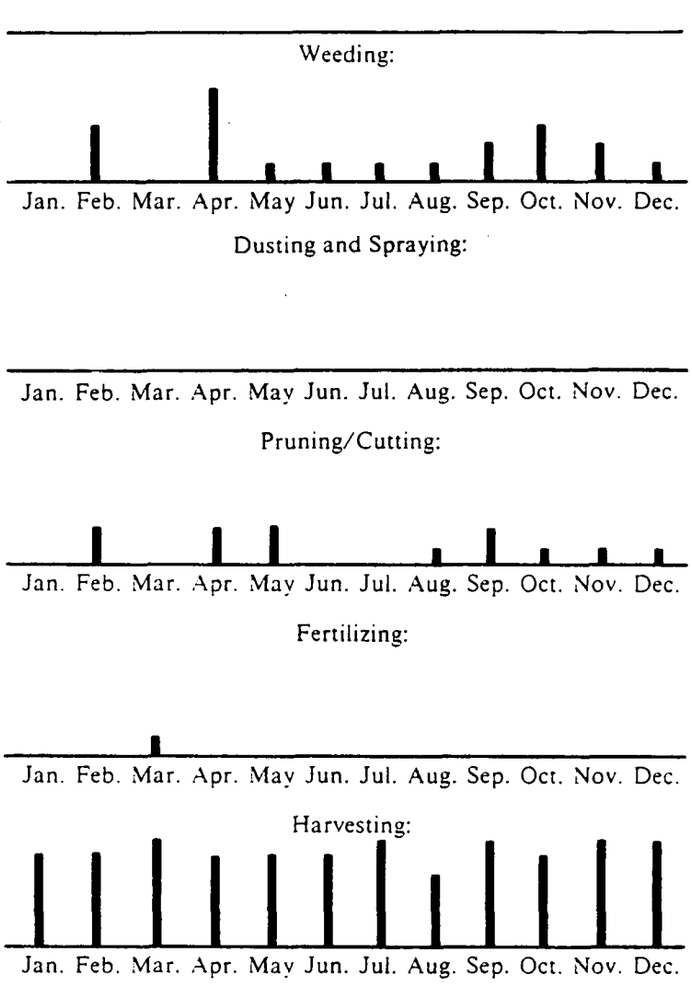


KAKAMEGA DISTRICT

TABLE 15 d: **DISTRICT OF FARMING ACTIVITIES**

Crop 56 **Cooking Bananas** Cases: 7

AEZ: UM 4 – LM 3–4 Survey Area 13 Sample Size: 30

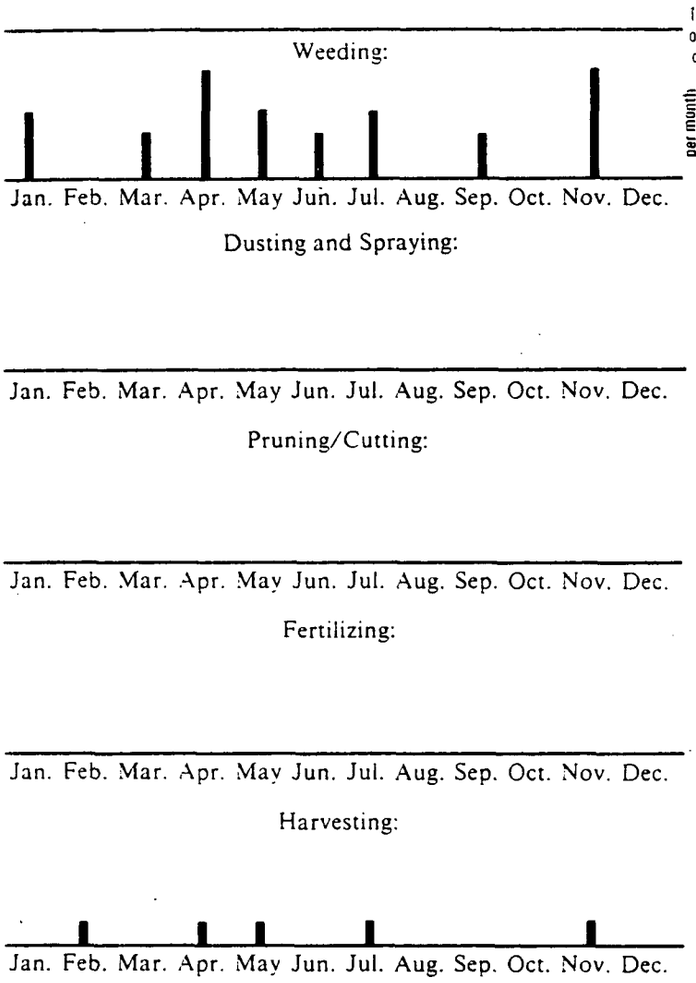


KAKAMEGA DISTRICT

TABLE 15 e: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 63 **Sugarcane** Cases: 9

AEZ: UM 4 – LM 1–4 Survey Area 13 Sample Size: 30



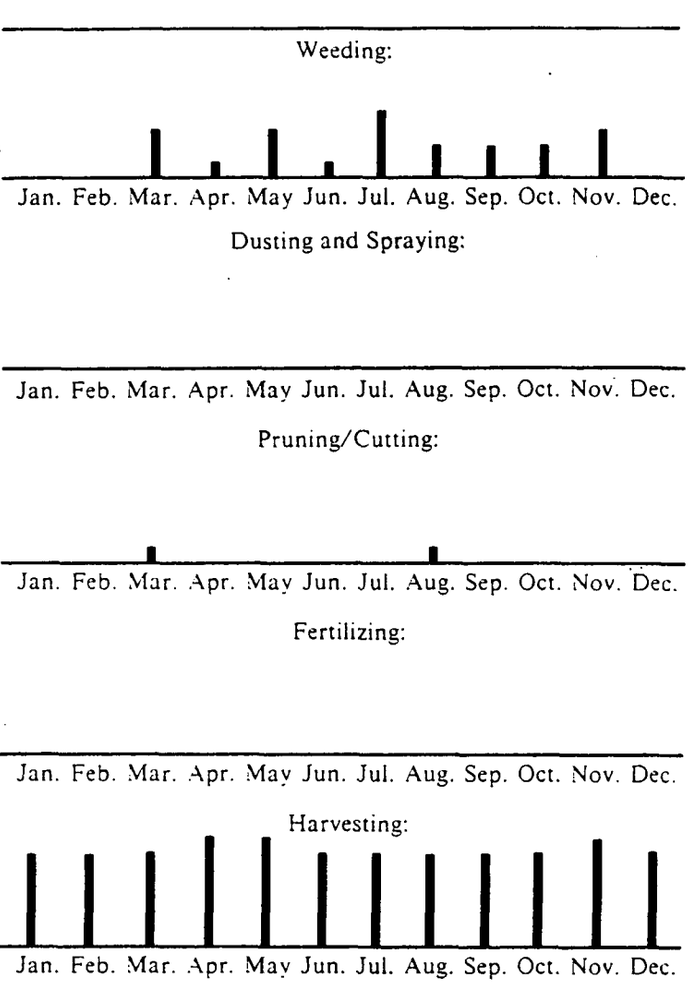
100 % of the cases per month per month

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

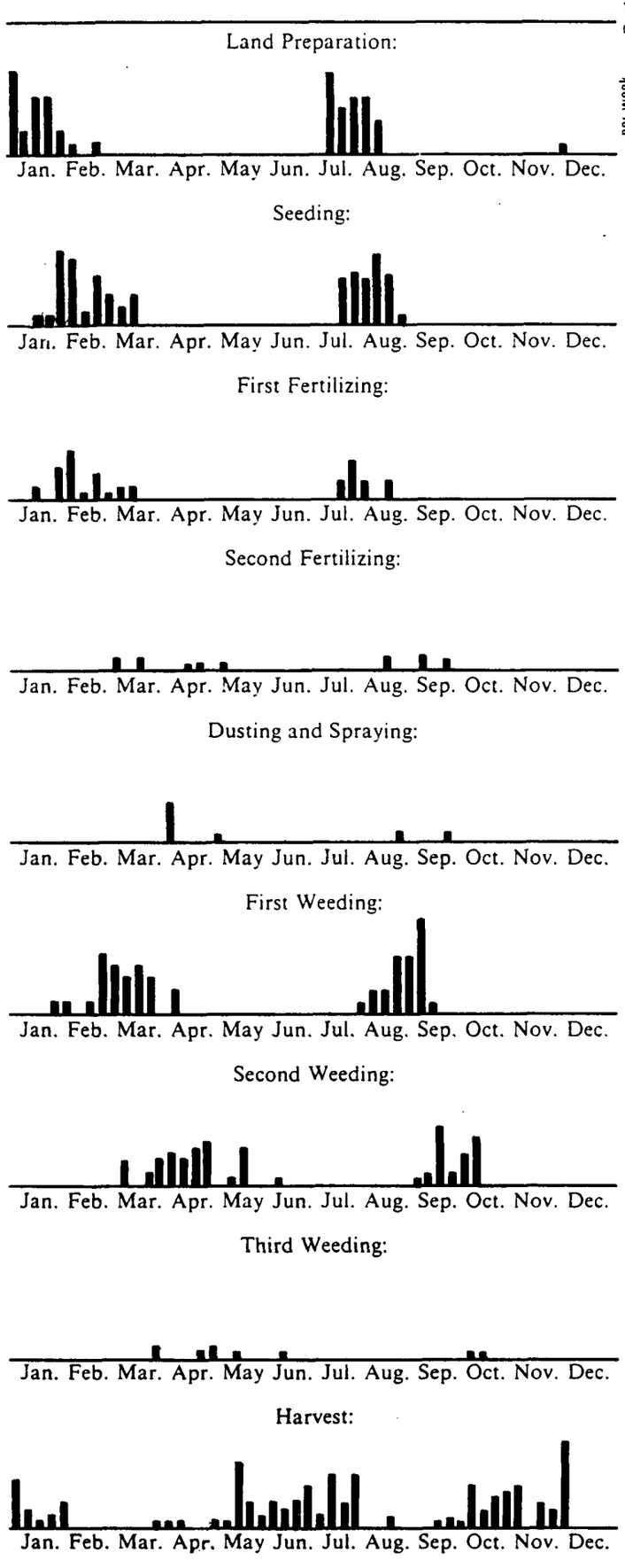


KAKAMEGA DISTRICT

TABLE 15 g: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 **Maize & Beans** Cases: 60[1)]

AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30

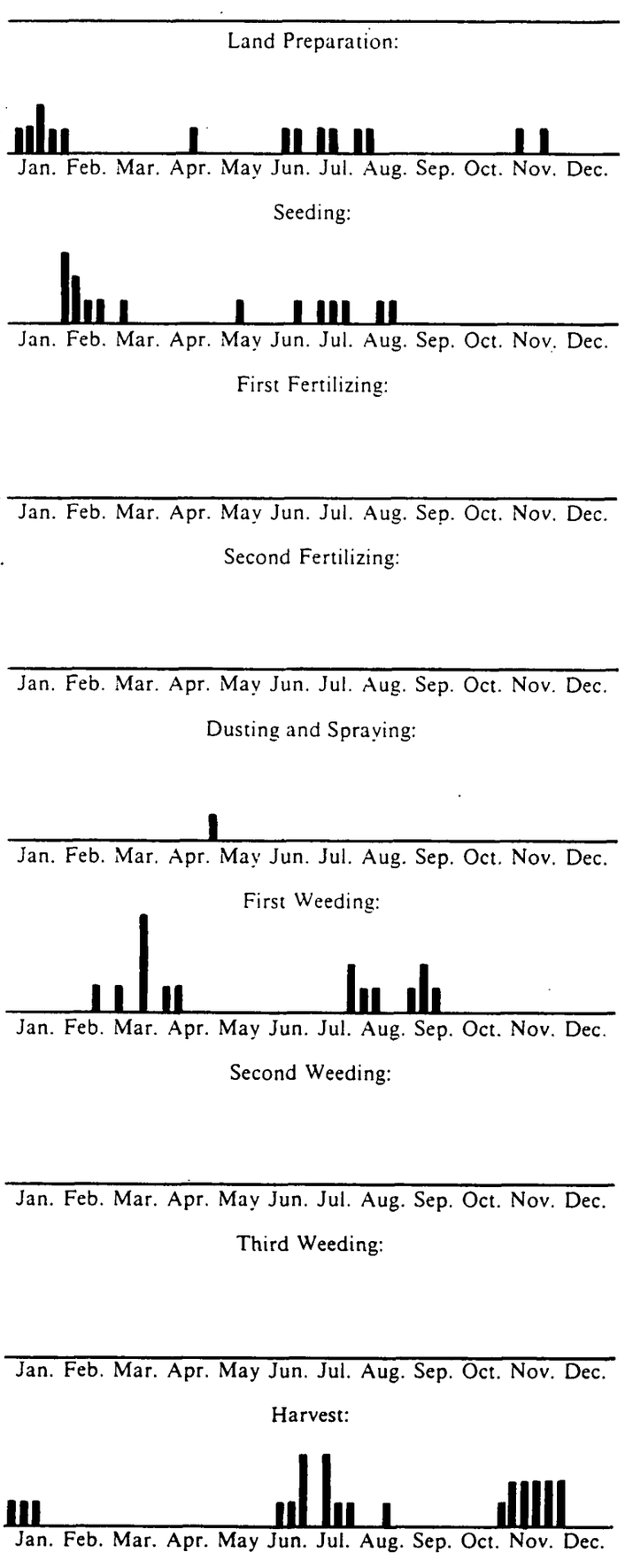


KAKAMEGA DISTRICT

TABLE 15 h: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 18 **Sorghum** Cases: 16

AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30



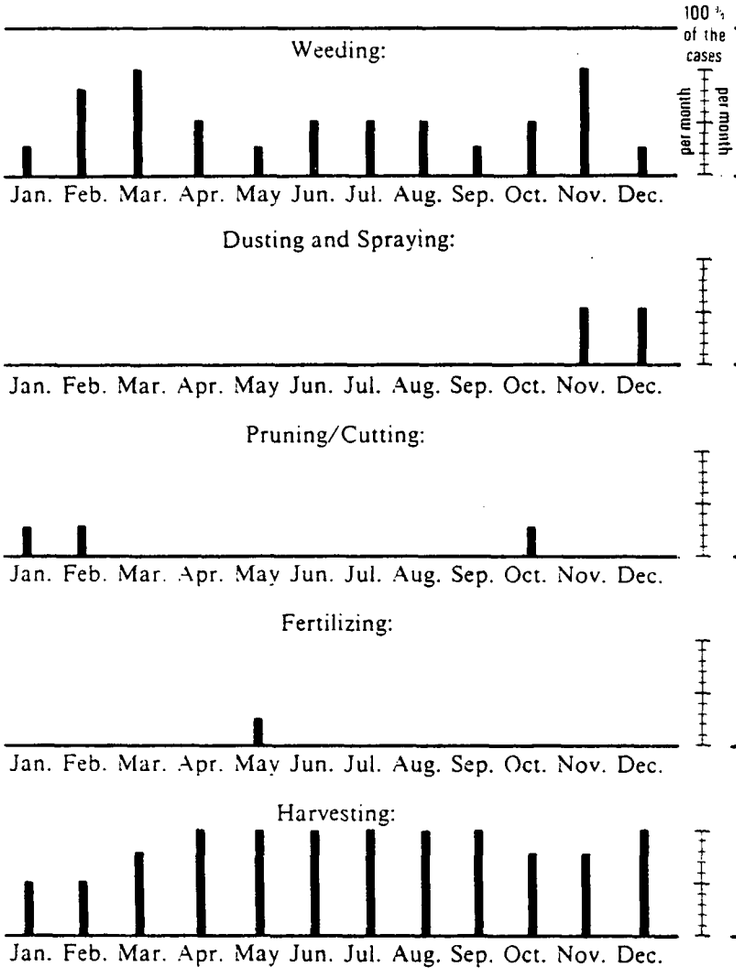
1) Maximum 30 per crop and season

KAKAMEGA DISTRICT

TABLE 15 i: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 50 **Tea** Cases: 4

AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30

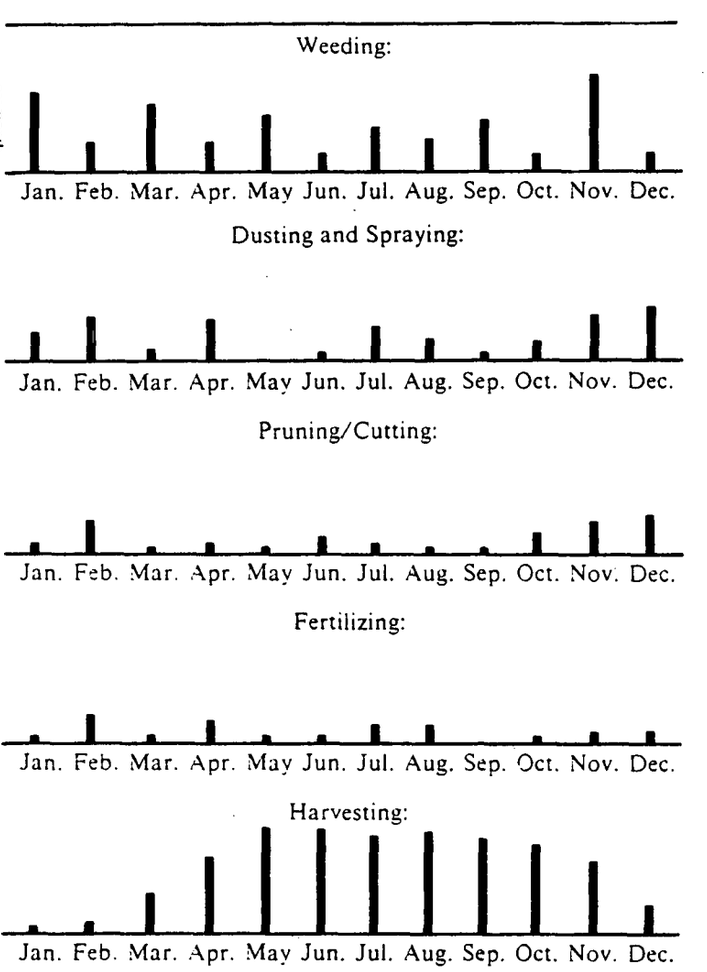


KAKAMEGA DISTRICT

TABLE 15 j: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 51 **Coffee** Cases: 25

AEZ: (LM 1) – UM 1 Survey Area 14 Sample Size: 30

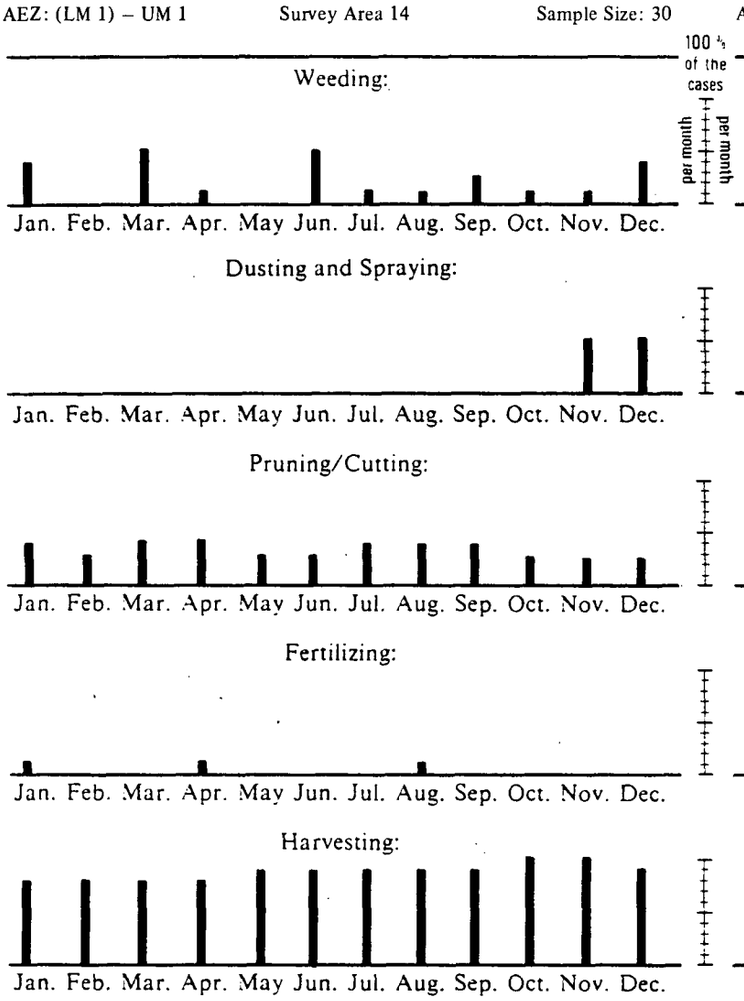


KAKAMEGA DISTRICT

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

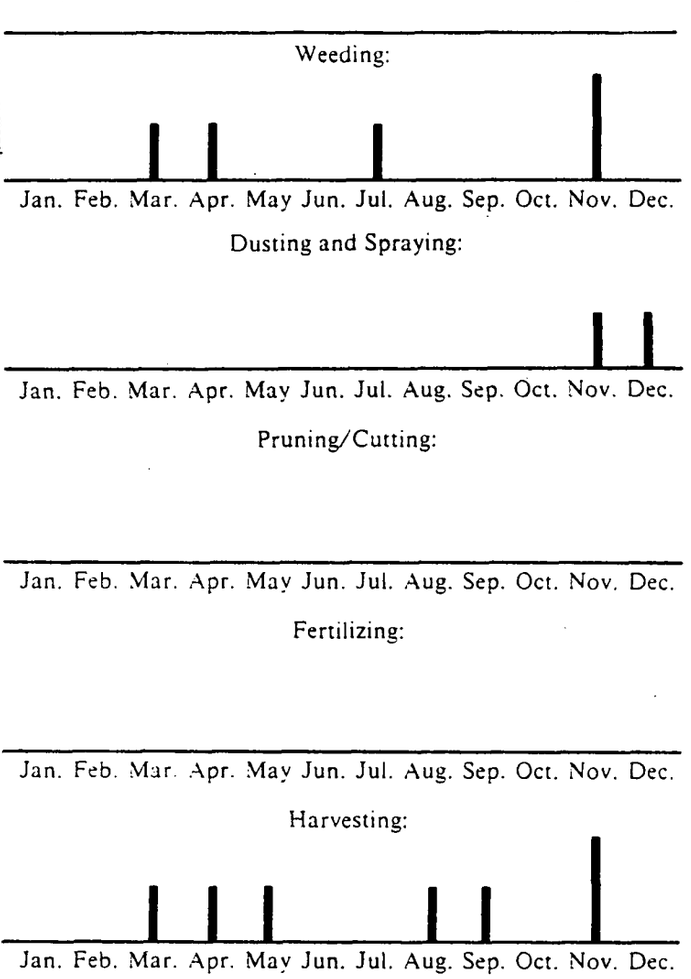


TABLE 16 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

	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 1st + 2nd: p or two/three in Days, 1st: 150 or more			2nd: 210-215	total: 365	p or two 170 or more		180-190	350-360	1→(m/s)i 195 or more		115-135	310-330
	Soil:		ACRISOLS				ACRISOLS				ACRISOLS		
	Unit	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					800	500	800	1,000	800	700	800	1,000
Fertilizer N	kg								13				13
P_2O_5	kg								12				12
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	7,500	6,000	8,000	20,000	4,000	4,000	11,000	25,000	3,500	3,500	8,000	25,000
Fertilizer N	kg			5	125			70	210			45	215
P_2O_5	kg			4	75			49	147			32	164
K_2O													
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg					5,000	5,000	8,000	14,000	6,000	5,000	7,000	12,000
Fertilizer N	kg							15	45			5	30
P_2O_5	kg							21	63			7	42
K_2O	kg												
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	2,000	2,000	7,000	19,000	3,000	3,000	7,000	16,000				
Fertilizer N	kg			40	152			32	104				
P_2O_5	kg			30	102			28	91				
K_2O	kg												
CROP: SUKUMAWIKI													
Farmers in Production Level	%												
Yields	kg	2,000	4,000	9,000	24,000								
Fertilizer N	kg		16	56	176								
P_2O_5	kg		12	42	132								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

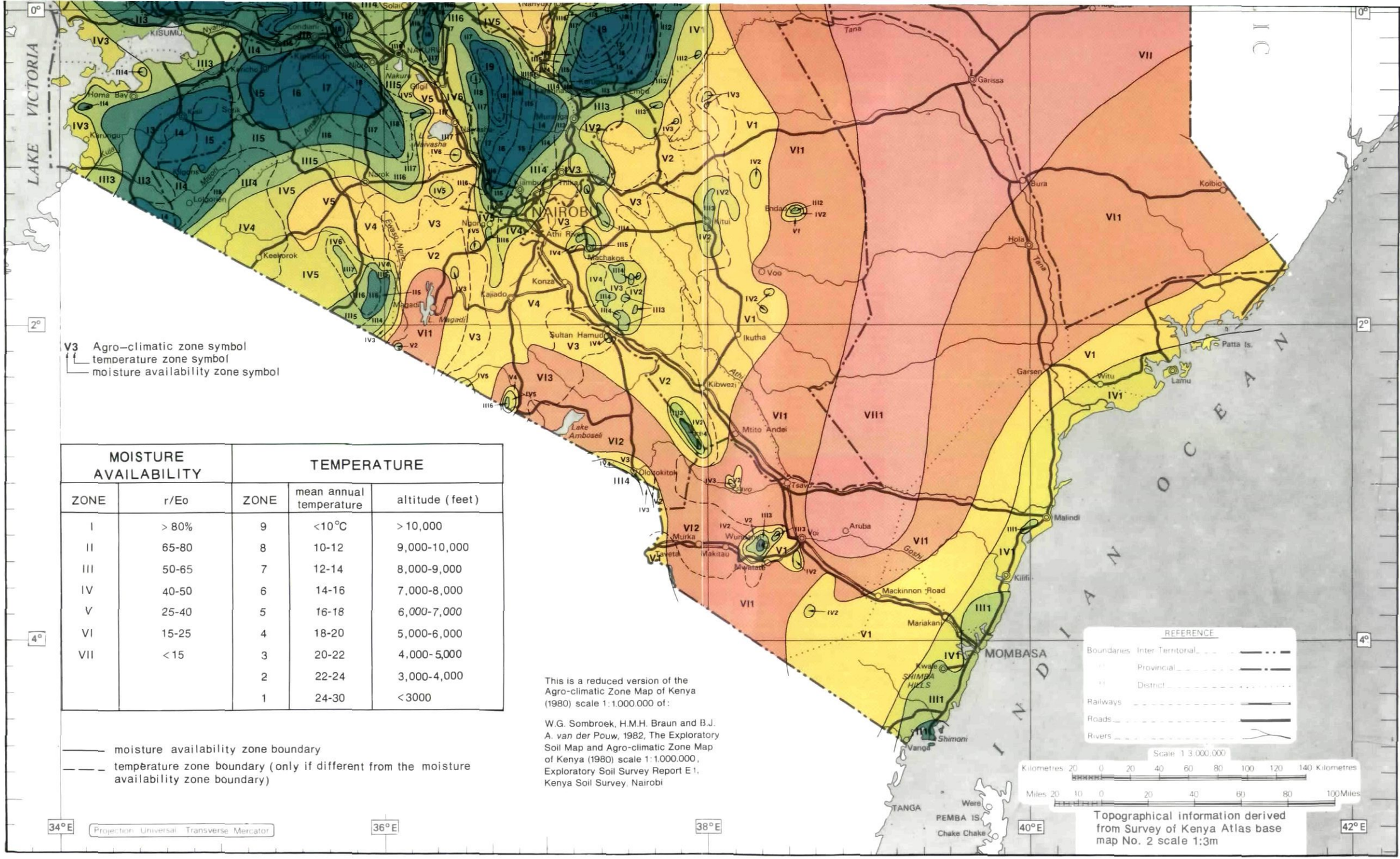
KAKAMEGA DISTRICT

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 1st + 2nd: p or two/three in Days, 1st: 150 or more		2nd: 210-215 total: 365		p or two 170 or more		180-190 350-360		1-(m/s)i 195 or more		115-135 310-330	
		Soil: ACRISOLS				ACRISOLS				ACRISOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	1,500	2,300	3,200	4,500	1,200	1,200	2,000	4,000	1,300	1,500	2,500	3,200
Fertilizer N	kg		20	43	95			20	71		5	30	48
P_2O_5	kg		20	40	90			22	78		6	34	53
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg					2,000	600	2,200	4,000	2,300	600	1,600	3,800
Fertilizer N	kg							5	52				32
P_2O_5	kg							4	42				22
K_2O													
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg	1,900	1,800/150	2,500/250	4,000/400	1,200	1,200/300	2,000/400	4,000/500	1,300	1,500/350	2,200/400	3,200/400
Fertilizer N	kg		30	65	134			43	108		22	49	67
P_2O_5	kg		25	55	118			36	96		18	46	67
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg									800	500	800	1,500
Fertilizer N	kg												42
P_2O_5	kg												25
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	800	500	800	1,500					700	600	850	1,200
Fertilizer N	kg				24							5	17
P_2O_5	kg				29							7	25
K_2O	kg												
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	1,100	-	1,000	1,500	800	700	1,200	1,800	900	700	1,000	1,500
Fertilizer N	kg				18			16	40			5	30
P_2O_5	kg				15			15	38			4	23
K_2O	kg												

TABLE 16 c: **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 1st + 2nd: p or two/three in Days, 1st: 150 or more		2nd: 210-215		total: 365	p or two 170 or more		180-190	350-360	1m(m/s)i 195 or more		115-135	310-330
	Soil: ACRISOLS					ACRISOLS				ACRISOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: NATURAL PASTURE/LEYS													
Farmers in Production Level	%												
Yields	kg	2,000			4,800	1,900			3,700	1,300			2,600
Fertilizer N	kg				155				100				72
P_2O_5	kg				77				50				36
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	4,400			10,000								
Fertilizer N	kg				305								
P_2O_5	kg				152								
K_2O													
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	2,100		5,000	10,000	1,500		5,000	7,500				
Fertilizer N	kg			97	495			116	280				
P_2O_5	kg			19	99			23	56				
K_2O	kg			19	99			23	56				
CROP: PASSION FRUIT													
Farmers in Production Level	%												
Yields	kg	3,000		12,000	16,000								
Fertilizer N	kg			126	210								
P_2O_5	kg			189	315								
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	6,500	2,000	14,000	27,000	5,000	4,000	10,000	25,000				
Fertilizer N	kg			150	410			100	400				
P_2O_5	kg			60	160			40	160				
K_2O	kg												
CROP: SUGAR CANE													
Farmers in Production Level	%												
Yields/year	kg					5,000	15,000	35,000	60,000				
Fertilizer N	kg						33	100	183				
P_2O_5	kg						70	210	385				
K_2O	kg												



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

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AGRO - CLIMATIC ZONES OF KENYA

by H.M.H.Braun

