FARM MANAGEMENT HANDBOOK OF KENYA

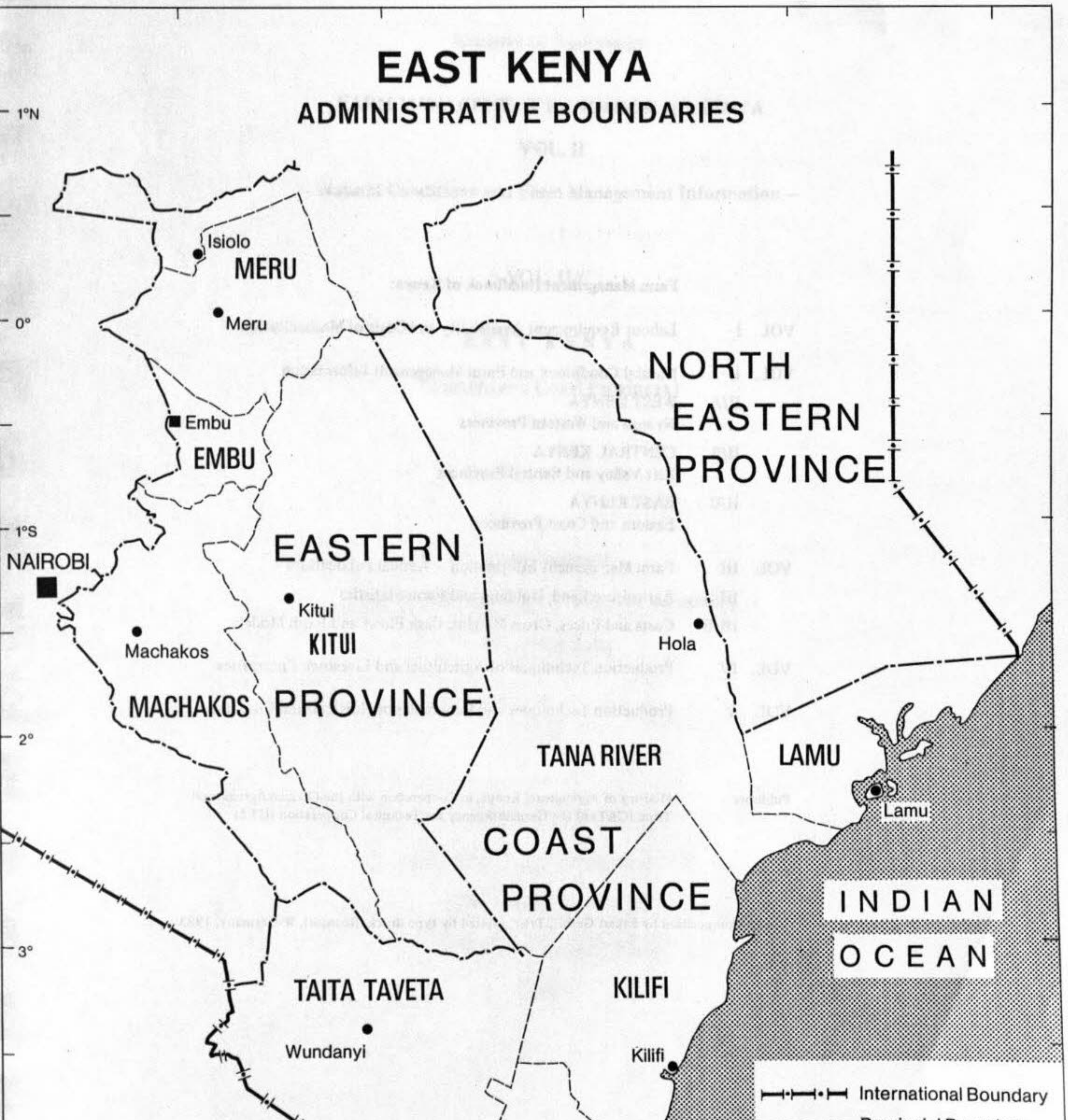
VOL. II

– Natural Conditions and Farm Management Information –

Part C

EAST KENYA

(Eastern and Coast Provinces)


EAST KENYA
ADMINISTRATIVE BOUNDARIES
1°N
0°
1°S
2°
3°
4°
Isiolo
MERU
Meru
Embu
EMBU
NAIROBI
EASTERN
Kitui
KITUI
Machakos
MACHAKOS
PROVINCE
NORTH
EASTERN
PROVINCE
Hola
TANA RIVER
LAMU
Lamu
COAST
PROVINCE
INDIAN
OCEAN
TAITA TAVETA
Wundanyi
KILIFI
Kilifi
KWALE
Kwale
MOMBASA
International Boundary
Provincial Boundary
District Boundary
Provincial Headquarter
District Headquarter
0
50 km
38° 30'
39°
40°

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 Agricultual and Livestock Enterprises
VOL. V	Production Techniques and Economics of Horticultural Enterprises

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Ministry of Agriculture

FARM MANAGEMENT HANDBOOK OF KENYA

VOL. II

– Natural Conditions and Farm Management Information –

VOL. II/C

EAST KENYA

(Eastern and Coast Provinces)

by

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German Agricultural Team

Nairobi

Contributions by: R. Swoboda – execution of Small Farm Survey; C.M. Kang'e & J.G.M. Muasya – assessment of farm management data; W. 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; M. Klee – 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; C.G. Wenner and S.N. Njoroge – soil conservation

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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VOL II B

List of Abbreviations

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

EXPLANATION OF THE EVALUATION OF THE NATURAL POTENTIAL

METHOD OF THE AGRO-ECOLOGICAL ZONATION

by Ralph Jaetzold

An Agro-Ecological Zone is a zone which is defined by its relevant agro-climatic factors (in the Tropics mainly moisture supply) and differentiated by soil pattern. The aim is to provide a frame-work for the ecological (natural) land use potential.

Generalized 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 district 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 in Vol. II A)[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 Vol. IIA, p. 19). The zones are roughly parallel with Braun's climatic zones of the Precipitation/Evaporation Index (see map in back cover of Vol. IIA), 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 potentially leading crops here; many of them can be grown in some other zones, too:

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
Unirrigated rice in zones:	L 1–3; LM 1–2
Irrigated rice 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

   ( ) mean that in these zones the crop is normally not competitive to related crops (f.i. sorghum to maize)

   Livestock is possible in all zones. Decreasing stocking rates from 1 to 7 (from 0.4 ha up to more than 25 ha per livestock unit of 300 kg)

   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_o (i.e. > 40 % of the open water evaporation), coming up to > E_o (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 Vol. IIA, p. 19).[7)]

   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

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

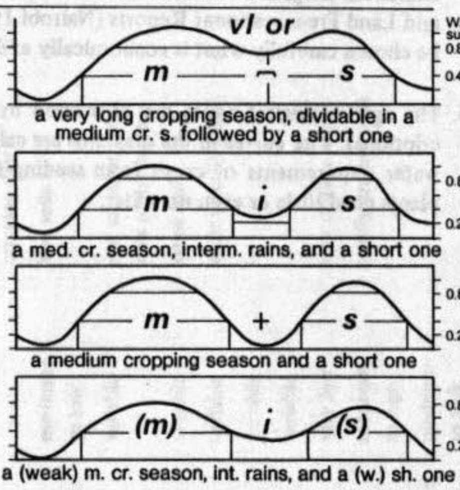
Belts of Z. \ Main Zones	0 (perhumid)	1 (humid)	2 (subhumid)	3 (semi-humid)	4 (transitional)	5 (semi-arid)	6 (arid)	7 (perarid)
TA Tropical Alpine Zones Ann. mean 2-10° C	Glacier / Mountain swamps	I. Cattle-Sheep Zone	II. Sheep Zone					High altitude deserts
UH Upper Highland Zones Ann. mean 10-15° Seasonal night frosts		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		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°		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°		L. Mid. 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°		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°		Coco-Oil- [illegible]	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
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] "

Samples of combination during the year in Kenya



a very long cropping season, dividable in a medium cr. s. followed by a short one

a med. cr. season, interm. rains, and a short one

a medium cropping season and a short one

a (weak) m. cr. season, int. rains, and a (w.) sh. one

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 ($>0.8 E_O$).
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

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_O 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".

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.
7) Heavy soil means heavy loam; clay may have less *available* water for plants. Light soil means loamy sand.

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	Enterprises: 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 15. 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 scientifically proven data basis for such information is available yet.[1)]

On the other hand, some research work and a large number of fertilizer trials and demonstrations on farms have been implemented to get an insight into the fertilizer requirements and response of the major crops to nutrient application. Almost all data available on fertilizer application response in Kenya has been studied for the compilation of the data shown in table 15. 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	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.

DISTRICT INFORMATION AND STATISTICS

INTRODUCTION TO EAST KENYA AND TO THE LAND USE POTENTIAL

East Kenya includes both Eastern Province and the Coast Province. The distribution of rainfall is typically bimodal with two distinct rainy seasons, the first rains with their peak in April and the second with their peak in November; the intervening dry season is distinct, except in the misty and cloudy altitudes above 1500 m. On the coast, after the first rains, showers may still be expected up to September which means that relay-planting of simsim and cowpeas in the ripening maize fields is possible. On the other hand the second rains are weak but they increase towards the interior.

The pattern of the Agro-Ecological Zones is typical, starting on Mt. Kenya with the Tropical Alpine Zones TA I and II. They are National Park now but some parts of TA I could possibly be opened up for seasonal grazing of stock from the over-populated zones below the forest. The forest reserves are mainly situated in steep wet areas unsuitable for agriculture use (UH 0 and LH 0). The Agro-Ecological Zones LH 1, UM 1–4, LM 3–5 and L 6 occur at descending altitudes towards the coast, which is not such a high potential area as is often thought. It consists mainly of the zones L 4 and L 5.

The land use potentials are climatically based. Good husbandry, crop protection and rotation are also essential, especially for combating diseases (for instance fungus in the wet climates)[1] and insect pests. The yield expectations given in the AEZ are only valid if these farm management standards are optimal and the soils are suitable and well manured.

It must be remembered that the classification of yield expectations in > 80 %; 60–80 %, 40–60 % and 20–40 % of the optimum (under field conditions) is still a rough calculation or even only an estimate (for these crops for which exact water requirements are not yet available).

The growing seasons and yields potentials are calculated for medium textured soils, if not otherwise stated. For heavy soils they are roughly 1–2 decades longer (if the agro-humid period is not weak), on light soils about one decade shorter.[6] There are very good volcanic soils in this region but also very poor ones which need considerable improvement. 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. An introduction is given to the soils of each district, extracted from the analyses of SIDERIUS (1979)[2].

The annual crops in the potentials are listed in the following order: cereals; pulses; tubers; oil seed; real cash crops; fruits and vegetables[3]. The perennial crops are listed more or less according to their importance.

Some new crops are recommended, e.g. the early and very early maturing varieties of the cereals foxtail and proso millet, or the perennial drought resistant crops, buffalo gourds and Marama beans[4]. The information available about them is still limited but they may be suitable for drier areas beyond the limits of reliable maize cultivation. Although these new crops may not fit into the present nutrition patterns, customs will change due to population pressure on food supplies.

Runoff-catching systems may not be as successful as in Baringo District because of the brevity and intensity of the rains, but for soil conservation reason, these methods should be applied in parts of the cropland in the AEZ LM 4 and 5 (see Kitui District table 5) and could enable some substistence cropping in the Ranching Zone L 6 with very early maturing crops (millets) or drought resistant permanent ones (buffalo gourds, Marama beans, jojoba).

Very little information exists about pasture and forage apart from real rangeland (PRATT and GWYNNE 1977)[5]. The recommendations given are therefore only a very rough guide, and fodder cultivation depends on many factors besides climate and soil. The main problems outside the largescale farming area and Masailand are overgrazing and soil erosion, which are destroying the means of livelihood of coming generations. The livestock unit (LU) in our estimated stocking rates is 300 kg liveweight (a local bull or seven sheep or goats). This is for smallholders with mainly indigenous cattle, a more realistic figure nowadays than the Standard Stock Unit (SSU) of 1000 1b (450 kg) introduced by the British.

1) Phytosanitary aspects have been considered as far as possible, but more information is necessary.
2) SIDERIUS, W.: Simplified Soil Maps of Kenya. Kenya Soil Survey, Misc. Papers 19, 2nd ed. Nairobi 1979.
3) 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 obtained from Kirchhoffs Seed Company, Box 30472, Nairobi.
4) Buffalo gourds and Marama beans produce big tubers after some seasons. Bitter substances may be washed out by salty water. Seeds contain protein and oil. Marama beans see Nat. Academy of Sciences: Tropical Legumes. Washington, D.C. 1979; Buffalo gourds see N.A. of Sc.: Underexploited Plants with Promising Economic Value. Washinton 1975.
5) PRATT, D.J. and M.D. GWYNNE (Eds.): Rangeland Management and Ecology in East Africa. London 1977.
6) Heavy soil means heavy loam, clay may have less *available* water for plants.

EASTERN PROVINCE

EMBU DISTRICT

Contents District page

NATURAL POTENTIAL

INTRODUCTION

Embu District shows the typical agro-ecological profile of the windward side of Mt. Kenya, from the cold and wet upper zones to the hot and dry lower zones in the Tana River Basin. The average annual rainfall reflects this contrast: more than 2 200 mm at 2 500 m to less than 650 mm near the Tana River at 700 m. The variation is mainly due to the mountain but also to the "water recycling" effect of the forest. Above 2 500 m, rainfall decreases due to the lower moisture content of the colder air and the stronger influence of the trade wind system, but nevertheless the area is still very wet. Some herbaceous parts of the Tropical Alpine Zone (TA I) may be opend for seasonal grazing of livestock for the farmers living below the forest, due to the demands of increasing land pressure.

The Upper Highlands are so wet and steep that forest is the best land use (UH 0). The same is true for the upper and north-eastern parts of the Lower Highland Zones (LH 0). Even in the Tea-Dairy Zone LH 1 precipitation is still 1 800 mm per year on average. Compared to the Livestock-Millet Zones LM 5 and L 5, with 650–800 mm, it would seem that the potential there is about a half or a third that of the Tea-Dairy Zone LH 1 or the Coffee-Tea Zone UM 1, but in fact, the climatic potential is already less than a tenth, and if the poor soils are considered, then the potential is even less. The reason for this low potential is the rapidly decreasing rainfall expectation during the agro-humic periods (i.e. the growing periods for annual crops) which also decreases very quickly in length from permanent cropping possibilities at LH 1 and UM 1 to less than 40 days in the 1st rains and about 50 days in the 2nd rains at the driest subzone of LM 5 and at L 5. Rainfall expectation of the first rains in 6 years out of 10 exceeds 900 mm in LH 1 but drops to only 150 mm in zones LM 5 and L 5. New, very early maturing crops should therefore be introduced.

A transitional belt exists between zones LM 4 and LM 5 where, on the good black soils found there, the maize of zone 4 can still be successfully cultivated; on the red soils of the soil catena there, less demanding crops like millet or sorghum should be chosen. The poor soils outside the volcanic area are a special problem. For soil and land use see detailed studies and maps 1:50,000, R.F. van de WEG and J.P. MBUVI (eds.): Soils of the Kindaruma Area. Kenya Soil Survey R 1, Nairobi 1975.

EMBU 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	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Monthly rainfall in mm											
9037008	Embu,	64	Average	1 065	24	25	98	277	163	31	24	30	23	123	192	55
1 433 m	Distr. Office		60 % rel.[1]	930	8	6	79	215	98	16	12	21	11	101	176	31
9037039	Kiritiri	35	Av.	849	20	21	121	227	68	4	2	5	7	75	209	91
1 143 m	Chief's Camp		60 %	706	1	4	88	192	28	0	0	0	0	34	118	42
9037050	Embu, Prov. Agric.	33	Av.	1 230	22	25	91	301	224	28	45	43	42	147	203	59
1 494 m	Training College		60 %	1 181	10	6	79	238	122	15	36	30	19	124	195	36
9037053	Kevote	30	Av.	1 559	27	31	120	383	264	37	48	67	46	186	268	84
1 524 m	Prim. School		60 %	1 311	19	15	77	321	121	19	45	39	12	126	242	43
9037077	Embu	23	Av.	1 992	42	43	135	381	336	70	139	128	77	250	291	103
1 936 m	Forest Station		60 %	1 739	15	13	50	315	232	48	112	84	37	208	250	50
9037104	Machanga	13	Av.	830	35	25	102	161	85	6	3	4	24	85	213	89
1 219 m																
9037122	Runyejes	18	Av.	1 547	25	40	146	396	218	25	41	42	21	284	321	73
1 478 m			60 %	1 166	6	0	72	344	115	8	34	35	10	113	238	38
9037133	Kanyuambora	11	Av.	1 264	27	49	161	359	127	6	4	16	7	109	318	75
1 265 m																
9037135	Kiambere	11	Av.	834	43	26	118	198	69	13	1	3	6	55	244	67
1 189 m	Market															
9037146	Kindaruma	10	Av.	644	19	20	96	151	58	3	0	4	7	44	211	31
793 m	Dam Site															

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

EMBU DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ[1]	Kind of records	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Years of rec.
				Temperature in °C													
9037039	Kabondori	LM	Mean max.	28.6	30.4	29.8	28.7	27.8	26.6	25.9	26.1	28.3	29.4	27.2	26.8	28.0	
1143 m	Cotton Exp.	4	Mean temp.	21.0	22.3	22.8	23.0	22.2	20.9	19.9	20.4	21.4	22.6	22.0	21.0	21.6	
	Station	hp	Mean min.	13.4	14.2	15.9	17.3	16.6	15.2	14.0	14.7	14.6	15.8	16.8	15.2	15.3	11
	(operating to 1948)		Abs. min.	8.3	9.4	12.2	12.8	11.7	10.0	8.1	6.4	8.3	10.0	11.1	9.4	6.4	
9037050	Embu Prov.	UM	Mean. max.	26.4	29.3	27.9	25.8	24.0	22.8	21.4	21.7	24.4	25.9	24.2	25.7	25.0	
1494 m	Agricult.	2	Mean temp.	20.0	21.4	21.9	20.8	19.8	18.6	17.2	17.3	18.8	20.0	19.4	19.6	91.5	
	Training		Mean min.	13.6	13.6	14.9	15.8	15.7	14.4	13.1	13.0	13.3	14.2	14.6	13.6	14.1	11
	College	lp	Abs. min.	10.6	10.0	10.0	11.7	11.1	10.0	8.3	7.8	9.4	9.4	11.1	9.4	7.8	

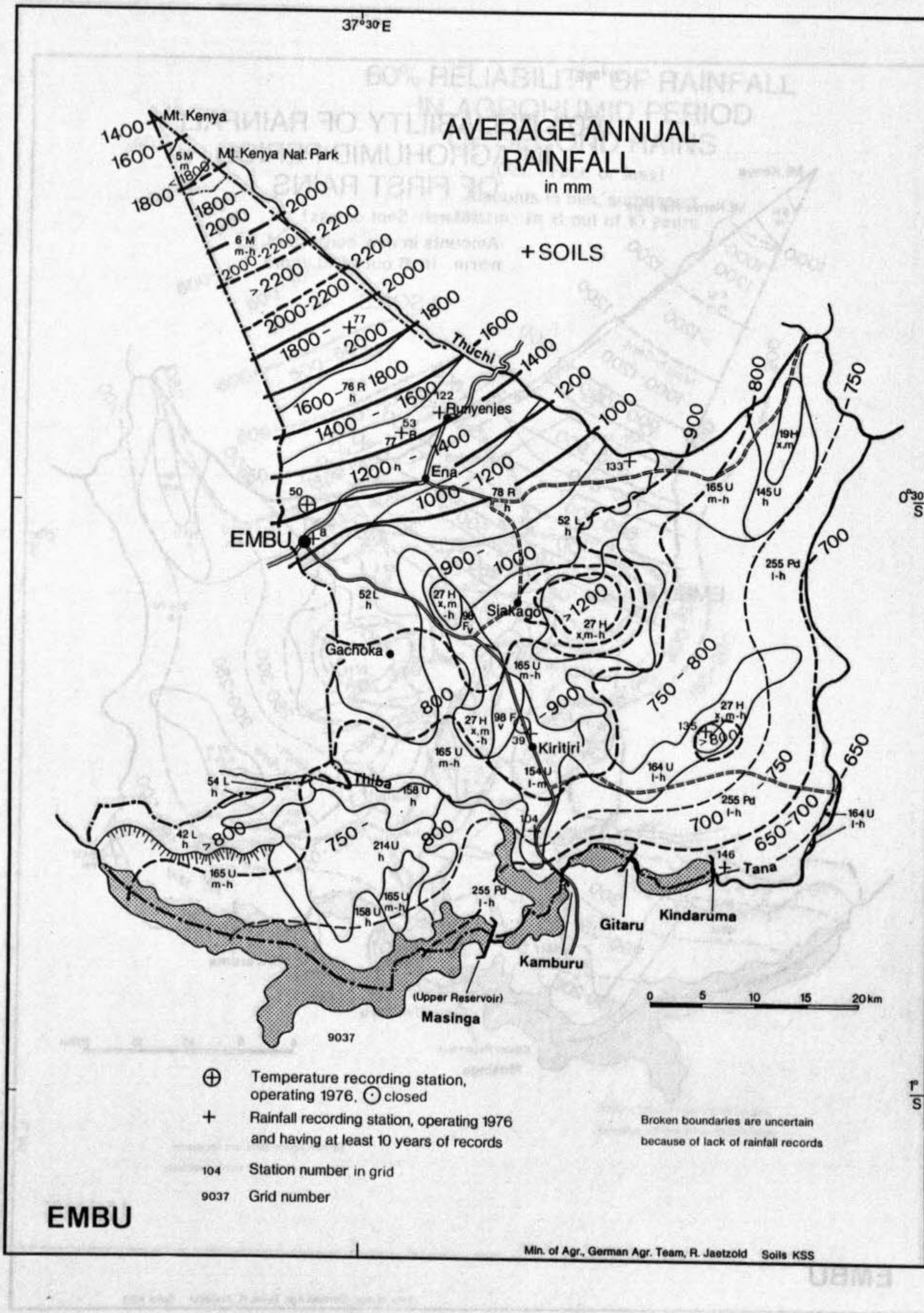
1) AEZ = Agro-ecological zone; lp = lower places; hp = higher places within the zone

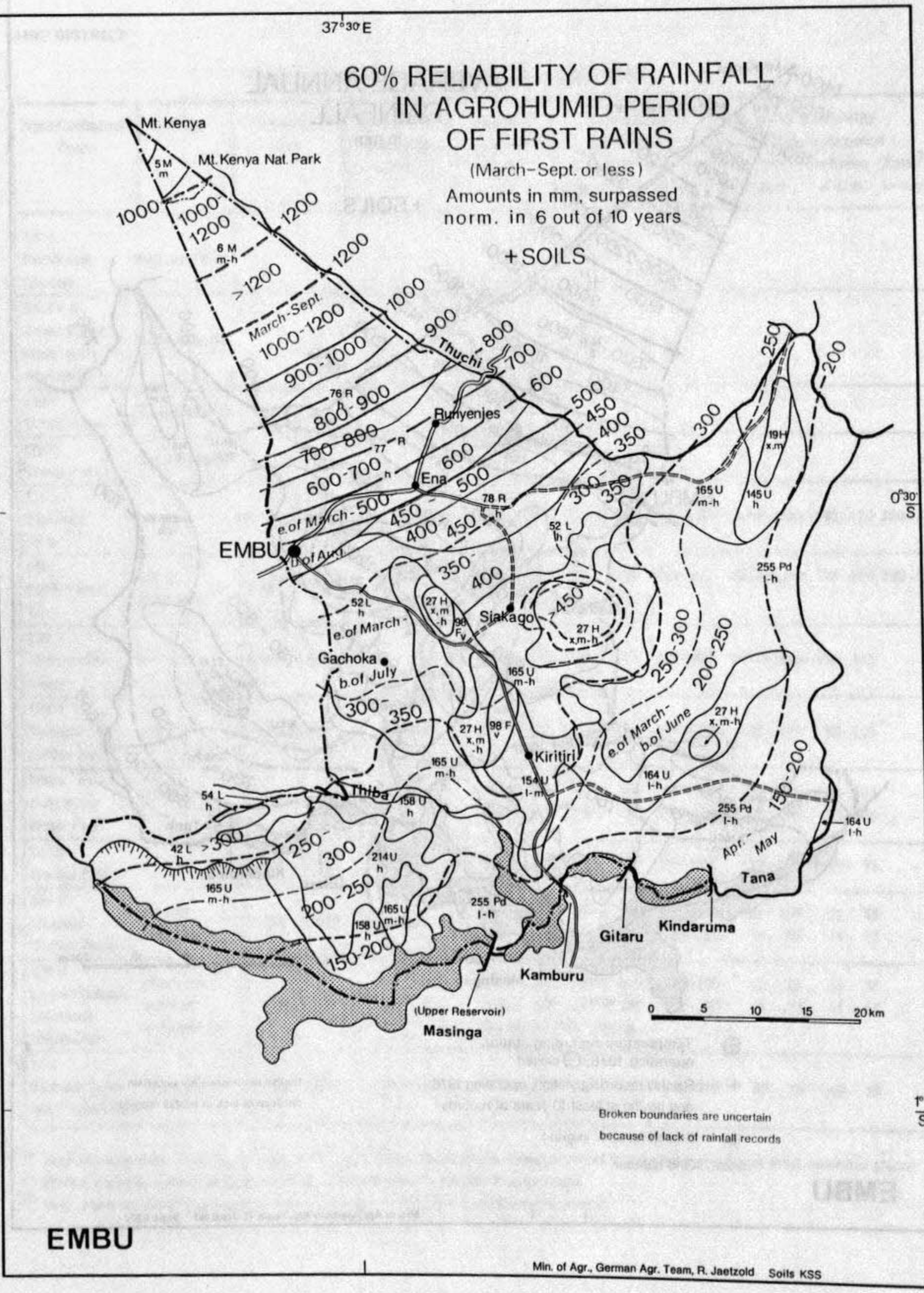
EMBU DISTRICT

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

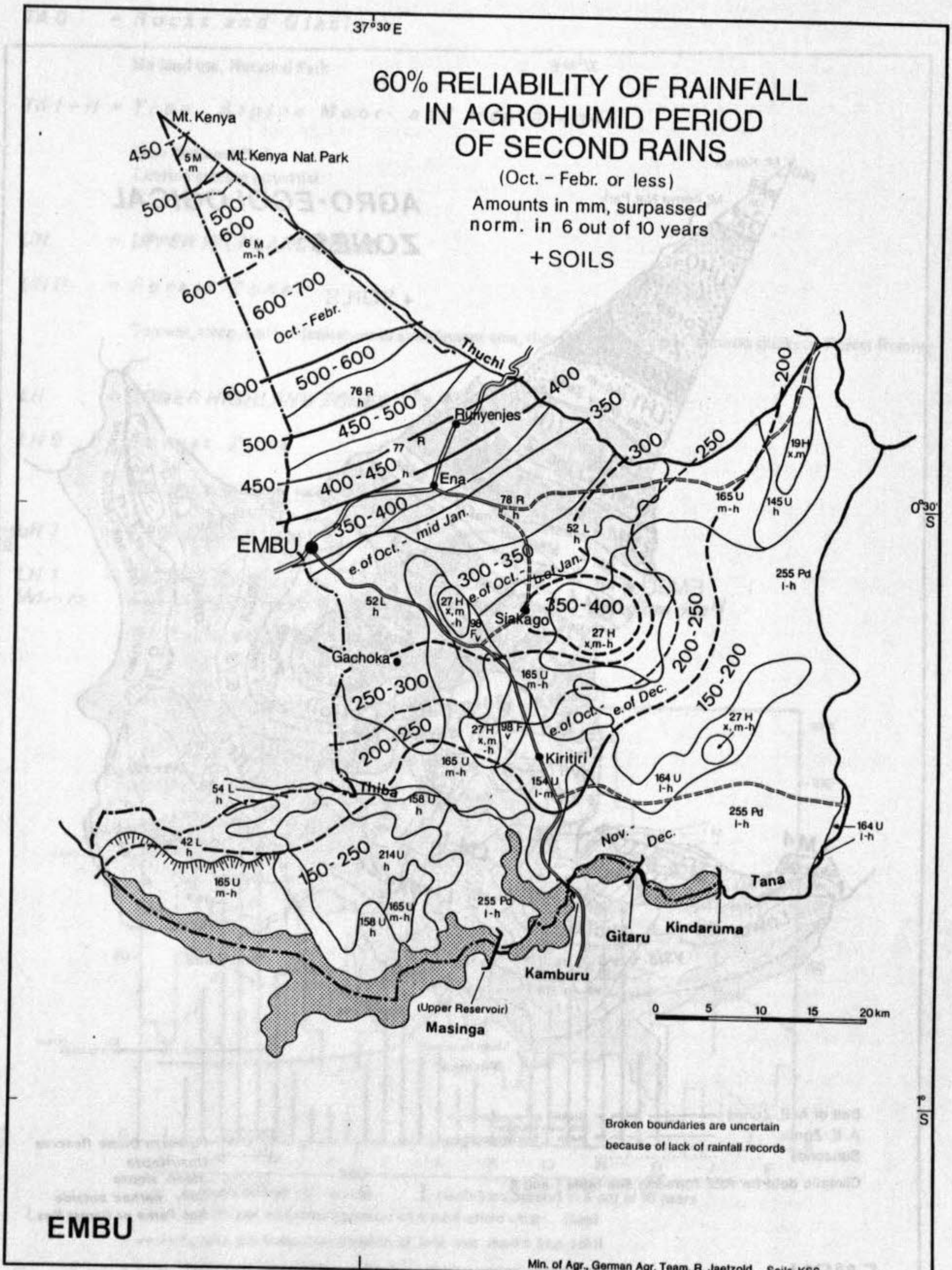
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1)] 1st rains in mm	60 % reliability of rainfall[1)] 2nd rains in mm	60 % reliability of growing period 1st rains[2)] in days	60 % reliability of growing period 2nd rains in days	60 % reliability of growing period Total[3)] in days
TA 0 Rocks and Glaciers	National Park								
TA I + II Trop.-Alpine Moor- and Heathlands	National Park								
UH 0 Forest Zone	Forest Reserve								
LH 0 Forest Zone	Forest Reserve								
LH 1 Tea-Dairy Zone	l/vl ⌢ m	1 770–2 070	17.7–15.8	1 750–2 000	950–1 100	550–620	210 or more	140–150	350–360
UM 1 Coffee-Tea Zone	f l i m m/l + m/s	1 590–1 830	18.9–17.5	1 400–1 800 Very small, see Meru District	700– 950	450–550	200 or more	130–150	330–350
UM 2 Main Coffee Zone	m + s/m	1 400–1 590	20.1–18.9	1 200–1 500	580– 720	380–450	160 or more	105–115	–
UM 3 Marginal Coffee Zone	m/s + s	1 280–1 460	20.7–19.6	1 000–1 250	480– 600	350–400	120–140	85–105	–
UM 4 Sunflower-Maize Zone	s/m + s s + s	1 280–1 400	20.7–20.0	980–1 100 960– 980	420– 500 380– 450	330–350 300–330	105–115 85–105	85–105 85–105	– –
LM 3 Cotton Zone	s + s	1 070–1 280	22.0–20.7	900–1 100	350– 480	300–350	85–105	80– 95	–
LM 4 Marginal Cotton Zone	s + s/vs s/vs + vs/s	980–1 220	22.5–21.0	800– 900 780– 900	300– 370 280– 340	250–310 200–260	85–105 75– 85	75– 85 55– 75	– –
LM 5 Lower Midland Livestock-Millet Zone	s/vs + vs/s vs/s + vs vs + i or i + vs	830–1 130	23.5–21.7	780– 900 700– 800 Small, see Kitui District	250– 320 200– 280	180–280 150–220	75– 85 55– 75	55– 75 45– 55	– –
IL 5 Lowland Livestock Millet Zone	vs + i or i + vs	760– 830	23.9–23.5	640– 780	150– 220	150–200	40– 55	40– 50	–

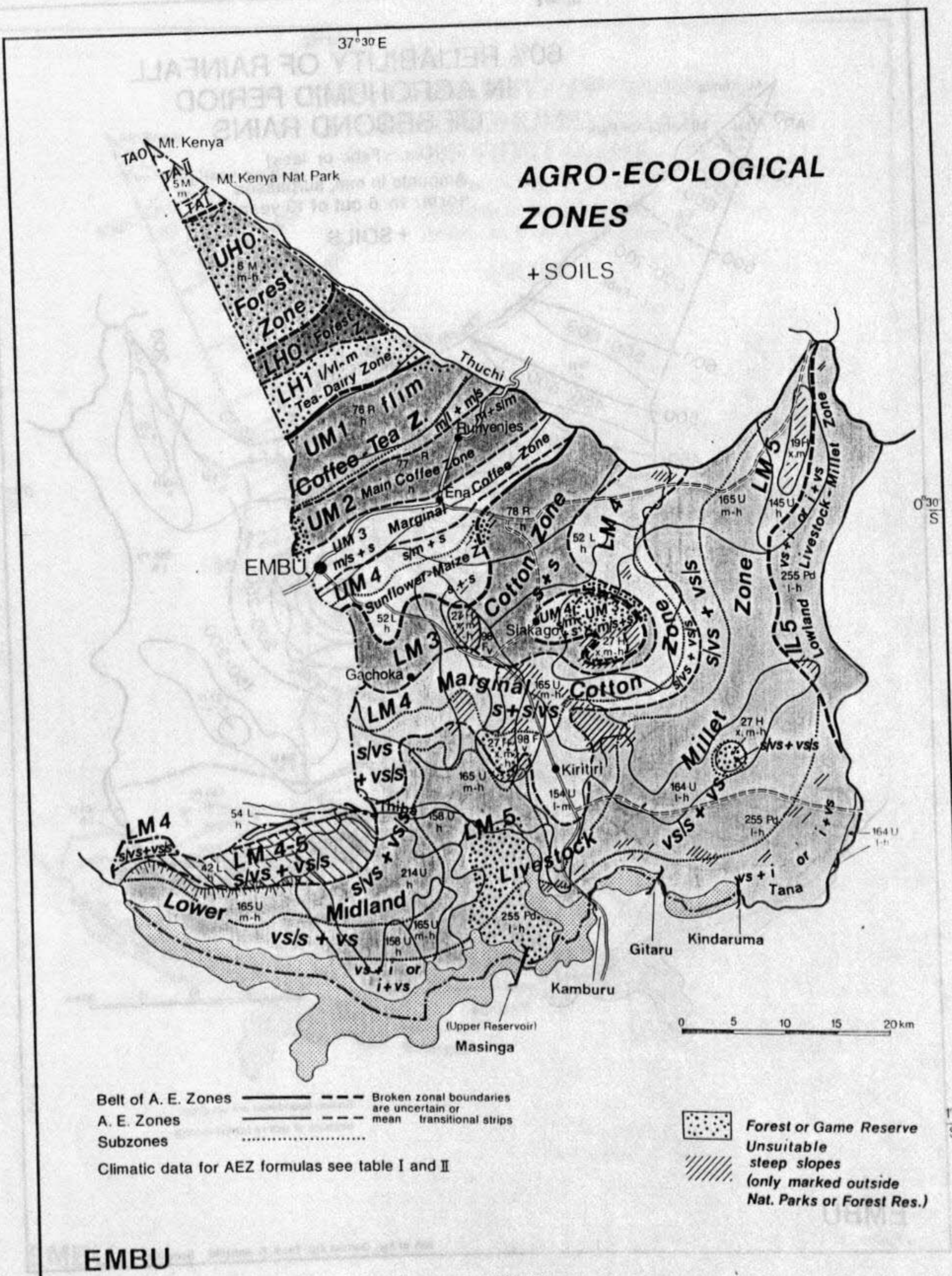
1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants.
2) More if growing cycle of cultivated plants continues into the period of second rains.
3) Only added if rainfall continues at least for survival (> 0.2 E_o) of most long term crops.


AVERAGE ANNUAL RAINFALL
in mm
+SOILS
37°30'E
0°30' S
1° S
Mt. Kenya
Mt. Kenya Nat. Park
Thuchi
Runyenjes
Ena
EMBU
Sjakago
Gachoka
Kiritiri
Thiba
Tana
Gitaru
Kindaruma
Kamburu
(Upper Reservoir)
Masinga
9037
0 5 10 15 20km
Temperature recording station, operating 1976, closed
Rainfall recording station, operating 1976 and having at least 10 years of records
104 Station number in grid
9037 Grid number
Broken boundaries are uncertain because of lack of rainfall records
EMBU
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS



37°30'E
60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF FIRST RAINS
(March–Sept. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
Mt. Kenya
Mt. Kenya Nat. Park
Thuchi
Runyenjes
Ena
EMBU
Siakago
Gachoka
Kiritiri
Thiba
Tana
Gitaru
Kindaruma
Kamburu
(Upper Reservoir)
Masinga
0°30' S
1° S
0 5 10 15 20 km
Broken boundaries are uncertain
because of lack of rainfall records
EMBU
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS


60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF SECOND RAINS
(Oct. – Febr. or less)
Amounts in mm, surpassed norm. in 6 out of 10 years
+ SOILS
37°30'E
0°30' S
1° S
Mt. Kenya
Mt. Kenya Nat. Park
Thuchi
Runyenjes
Ena
EMBU
Siakago
Gachoka
Kiritiri
Thiba
Nov. – Dec.
Tana
Gitaru
Kindaruma
Kamburu
(Upper Reservoir)
Masinga
450
500
500-600
600
600-700
Oct. - Febr.
500-600
450-500
400-450
350-400
e. of Oct. - mid Jan.
300-350
e. of Oct. - b. of Jan.
350-400
400
350
300
250
200
200-250
150-200
250-300
200-250
e. of Oct. - e. of Dec.
150-250
Broken boundaries are uncertain because of lack of rainfall records
0 5 10 15 20 km
EMBU
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS


AGRO-ECOLOGICAL ZONES
+ SOILS
37°30' E
0°30' S
1° S
Mt. Kenya
Mt. Kenya Nat. Park
TAO
TA I
UHO Forest Zone
LHO Forest Z.
LH1 Tea-Dairy Zone
UM1 Coffee-Tea Z.
UM2 Main Coffee Zone
UM3 Marginal Coffee Zone
UM4 Sunflower-Maize Z.
LM3 Cotton Zone
LM3 Marginal Cotton
LM4 Marginal Cotton Zone
LM5 Livestock-Millet Zone
LM 4-5
L5 Lowland Livestock-Millet Zone
Lower Midland Livestock
EMBU
Runyenjes
Ena
Thuchi
Siakago
Gachoka
Kiritiri
Thiba
Tana
Gitaru
Kindaruma
Kamburu
Masinga
(Upper Reservoir)
0 5 10 15 20 km
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
Forest or Game Reserve
Unsuitable steep slopes (only marked outside Nat. Parks or Forest Res.)
EMBU
Min. of Agr., German Agr. Team AEZ R. Jätzold'81 Soils KSS

AGRO-ECOLOGICAL ZONES

TA = *TROPICAL-ALPINE ZONES*

TA 0 = *Rocks and Glaciers*

No land use, National Park

TA I+II = *Trop. Alpine Moor- and Heathlands*

Here National Park
Limited grazing potential

UH = *UPPER HIGHLAND ZONES*

UH 0 = *Forest Zone*

Too wet, steep, and too important as a catchment area, therefore not cleared. Bamboo thickets. Forest Reserve

LH = *LOWER HIGHLAND ZONES*

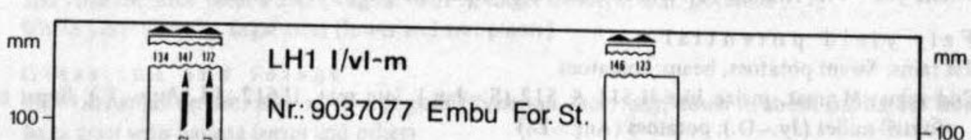
LH 0 = *Forest Zone*

The same as UH 0 but many valuable timbers. Forest Reserve

LH 1 = *Tea-Dairy Zone*

LH 1 = *Tea-Dairy Zone*
l/vl ⌐ m *with a long to very long cropping season followed by a medium one* 1)

(See Diagram Embu Forest Station)



1) On medium soils; on heavy soils permanent cropping possibilities. Given potential refers to predominating heavy red loams.

Very good yield potential (av. over 80 % of the optimum)
1st rains, start norm. b. to mid of March: Peas; cabbages, lettuce
2nd rains, start norm. mid Oct.: Peas

Good yield potential (av. 60–80 % of the optimum)
1st rains: Potatoes (e. of F.–July); carrots, leek, kales, endive
2nd rains: Potatoes; cabbages, carrots, kales
Whole year, best planting time mid March: Tea (high quality); loquats

Fair yield potential (av. 40–60 % of the optimum)
1st rains: Late mat. maize like H 611; beans (two times, 2nd end of Jy.–N.)
2nd rains: Beans; leek, lettuce
Whole year: Pyrethrum (too wet); plums

Grassland and forage
Around 0.5 ha/LU on sec. pasture of Kikuyu grass, suitable for grade dairy cows; clover for higher productivity

UM = UPPER MIDLAND ZONES

UM 1 = Coffee-Tea Zone

UM 1 f l i m = Coffee-Tea Zone with a fully long cropping season, intermediate rains and a medium one

Very good yield potential
1st rains, start norm. mid March: Cabbages, kales
2nd rains, start norm. mid Oct: Beans (Aug.–D./J.)
Whole year, best planting time mid March: Passion fruit, black wattle

Good yield potential
1st rains: Late mat. maize H 612, 614, finger millet; potatoes; late mat. sunflower like Kenya White; onions
2nd rains: Sweet potatoes; m. mat. sunflower like H S 301 A; cabbages (Aug.–D.), kales, onions, tomatoes
Whole year: Tea, Arabica coffee; bananas, yams, mountain pawpaws, loquats, avocadoes

Fair yield potential
1st rains: Sweet potatoes, beans; tomatoes
2nd rains: M. mat. maize like H 511 & 512 (S.–Jan.), late mat. H 612–14 (Aug.–F.), finger millet, Meru foxtail millet (Jy.–O.); potatoes (Aug.–D.)
Whole year: Citus, taro

Grassland and forage
0.5–0.6 ha/LU on sec. pasture of Kikuyu grass; down to about 0.15 ha/LU feeding Napier grass, banana stems and leaves, sweet potato vines, maize stalks

UM 1 m/l + m/s = Coffee-Tea Zone with a medium to long and a medium to short cropping season

Very small, potential see Meru District

UM 2 = Main Coffee Zone

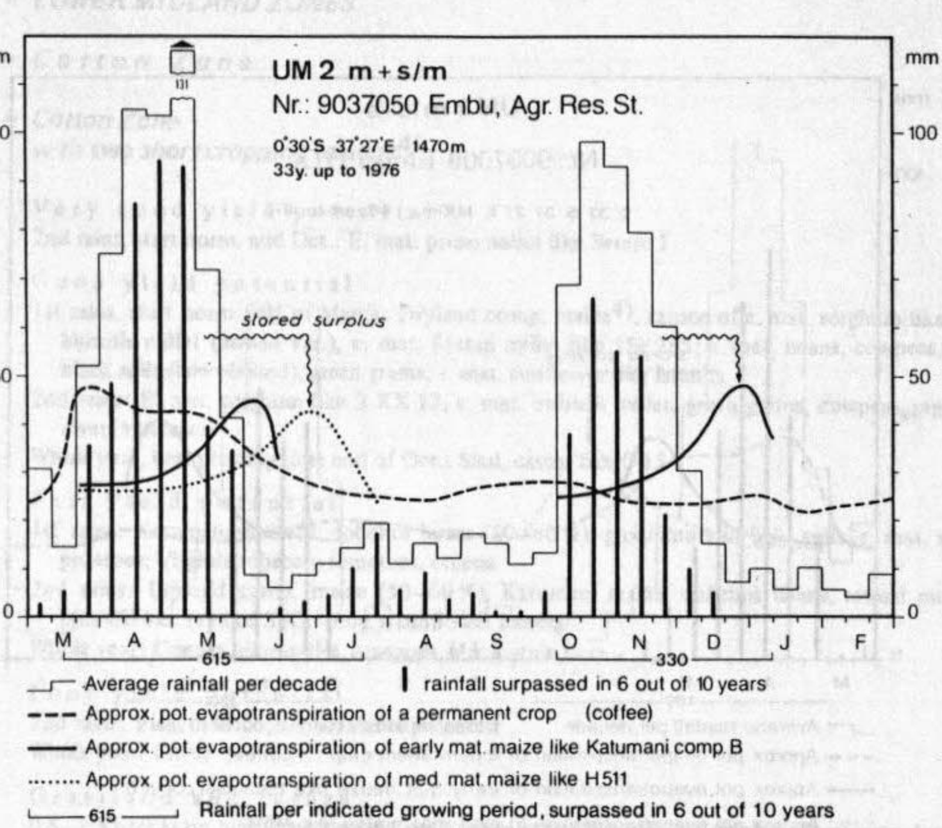
UM 2 m + s/m = Main Coffee Zone with a medium and a short to medium cropping season[2)]

(See Diagram Embu Agr. Res. St.)

Very good yield potential
1st rains, start norm. mid March: Sweet potatoes; m. mat. sunflower like Hybrid S 301 A
2nd rains, start norm. mid Oct.: Beans (S./O.–Jan./F.)
Whole year, best planting time mid March: Loquats, mountain pawpaws

Good yield potential
1st rains: M. mat. maize like H 511 & 512; beans; potatoes; cabbages, kales, tomatoes, onions
2nd rains: E. mat. maize like Katumani comp. B, Meru foxtail millet, e. mat. sorghum like 2 KX 17; sweet

2) On medium soils; on heavy soils there is a long to medium and a medium to short cropping season. Given potential refers to predominating heavy red loams



potatoes (Aug./S.–Jan.); e. mat. sunflower like Hybrid S 345 (< 1 500 m); kales, cabbages, onions, tomatoes

Whole year: Arabica coffee; bananas, citrus, avocadoes, passion fruit

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

2nd rains: M. mat. local maize (Aug./S.–J./F.), finger millet; e. mat. potatoes

Whole year: Cassava, sugar cane (lower and wet places)

G r a s s l a n d a n d f o r a g e

0.6–1.0 ha/LU on sec. pasture of star grass (Cynodon dactylon); down to about 0.2 ha/LU feeding Napier or Bana grass with banana leaves and others

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

UM 3 m/s + s = *Marginal Coffee Zone with a medium to short and a short cropping season*[3)]

(See Diagram Embu, Distr. Office)

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

1st rains, start norm. end of March: Katumani maize, H 511 (~ 60 %); e. mat. sorghum; e. mat. sunflower like Issanka (< 1 500 m); onions, cabbages, early mat. beans

2nd rains, start norm. mid Oct.: Meru foxtail millet; sunflower Issanka

Whole year: Pineapples, best planting time end of March

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

1st rains: Maize H 512, e. mat. finger millet; m. mat. beans, sweet potatoes; kales, tomatoes

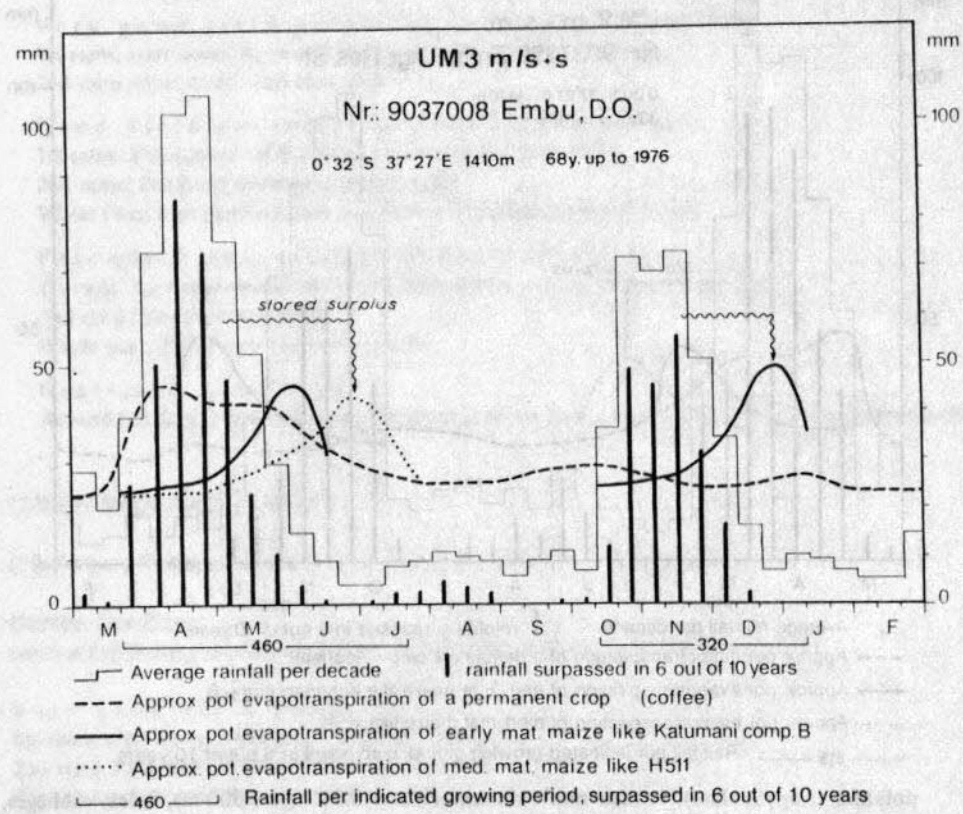
2nd rains: Katumani maize, e. mat. sorghum like Serena; e. mat. beans; cabbages, kales, tomatoes

Whole year: Arabica coffee (lower places poor, there add. irrigation profitable), bananas (lower places poor), avocadoes, citrus, pawpaws, cassava

G r a s s l a n d a n d f o r a g e

0.7–1.1 ha/LU on sec. high grass sav. with zebra grass (Hyparrhenia rufa) predom.; down to 0.23 ha/LU feeding Napier or Bana grass and others

3) On medium soils; on heavy soils first cropping season has a medium length, higher places even medium to long.. Given potential refers to predominating heavy red loams.



UM 4 = *Sunflower-Maize Zone*

UM 4 = *Sunflower-Maize Zone*
s/m + s *with a short to medium and a short cropping season*

Good yield potential
1st rains, start norm. end of March: Katumani maize, e. mat. sorghum like 2 KX 17; mwezi moja beans; e. mat. sunflower like Issanka
2nd rains, start norm. mid Oct.: V. e. mat. maize like Dryland composite; sunflower Issanka
Whole year, best pl. time end of Oct.: Sisal, pineapples

Fair yield potential
1st rains: Maize H 511, finger millet, Meru foxtail millet; dolichos beans; sweet potatoes, Virg. tobacco; tomatoes, onions, cabbages
2nd rains: Katumani maize, mwezi moja beans (50–60 %)
Whole year: Cassava, castor

Poor yield potential (av. 20–40 % of the opt.)
2nd rains: E. mat. sweet potatoes
Whole year: Bananas, citrus, mangoes, pawpaws

Grassland and forage
0.8–1.2 ha/LU on high grass sav. with zebra grass (Hyparrhenia rufa) predominant; down to 0.26 ha/LU feeding Bana grass, siratro (Macroptilium atropurpureum), horse tamarind (Leucaena leucocephala) a.o.

UM 4 = *Sunflower-Maize Zone*
s + s *with two short cropping seasons*

Crop potential almost the same as UM 4 s/m+s, but maize H 511, 512 not recommended any more except on very suitable soils. Stocking rates 0.8–1.5 ha/LU

LM = LOWER MIDLAND ZONES

LM 3 = Cotton Zone

LM 3 s + s = Cotton Zone with two short cropping seasons[4)]

Very good yield potential
2nd rains, start norm. mid Oct.: E. mat. proso millet like Serere 1

Good yield potential
1st rains, start norm. end of March: Dryland comp. maize[4)], ratoon of e. mat. sorghum like 2 KX 17, e. mat. bulrush millet (awned var.), e. mat. foxtail millet like 1Se 285; e. mat. beans, cowpeas, chick peas on h. black soils (late planted), green grams; e. mat. sunflower like Issanka
2nd rains: E. mat. sorghum like 2 KX 17, e. mat. bulrush millet; green grams, cowpeas, pigeon peas (O.–S.); dwarf sunflower
Whole year, best planting time end of Oct.: Sisal, castor like C-15

Fair yield potential
1st rains: Katumani maize[4)]; dolichos beans (50–60 %), groundnuts in light soils, e. mat. soya beans; sweet potatoes; Virginia tobacco; tomatoes, onions
2nd rains: Dryland comp. maize (50–60 %), Katumani maize; dolichos beans, mwezi moja beans; cotton bimodal var. (end of S./O.–Aug.), sunflower Issanka
Whole year: Cassava, pineapples, mangoes, Macadamia nuts

Poor yield potential
2nd rains: Virg. tobacco; e. mat. sweet potaotes
Whole year: Citrus

Grassland and forage
0.8–1.5 ha/LU on high grass savanna with zebra grass (Hyparrhenia rufa) predominant, down to 0.28 ha/LU feeding Bana grass, Siratro (Macroptilium atropurpureum), horse tamarind (Leucaena leucocephala) a.o.

LM 4 = Marginal Cotton Zone

LM 4 s + s/vs = Marginal Cotton Zone with a short and a short to very short cropping season

Potential almost the same as LM 3 s+s but cotton marginal (except on very suitable soils) and stocking rates a little bit lower

LM 4 s/vs + vs/s = Marginal Cotton Zone with a short to very short and a very short to short cropping season

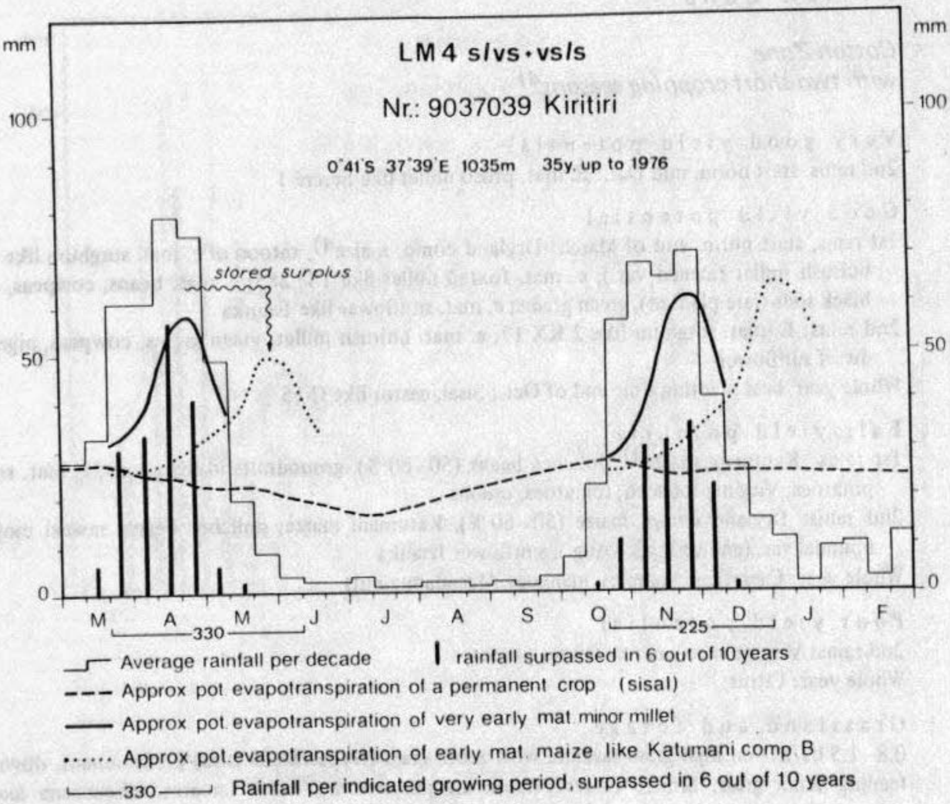
(See Diagram Kiritiri)

Good yield potential
1st rains, start norm. end of March: Katumani maize on well drained deep black soils (~ 60 %), Dryland comp. maize on medium red soils (~ 60 %), e. mat. bulrush millet, v. e. mat. sorghum like IS 8595, e. mat proso millet like Serere 1, e. mat. foxtail millet like 1Se 285; cowpeas; v. e. mat. dwarf sunflower
2nd rains, start norm. end of Oct.: E. mat. proso and foxtail millet, moth beans
Whole year: Buffalo gourds (Cucurbita foetidissima)[7)] and Marama beans (Tylosema esculentum)[7)] on sandy soils; castor, Jojoba (deep soils)

Fair yield potential
1st rains: Mwezi moja beans, chick peas (on heavy black soils, late planted), black and green grams (50–60 %), e. mat. soya beans, dolichos beans; v.e. mat. bambarra groundnuts (in light soils); sweet potatoes
2nd rains: Dryl. comp. maize on heavy soils (40–50 %), dwarf sorghum (50–60 %), e. mat. bulrush millet; dwarf sunflower; pigeon peas (O.–S.)
Whole year: Sisal (50–60 %), cassava

Poor yield potential
1st rains: Finger millet
2nd rains: Cotton bimodal var. (end of S./O.–Aug); Dryland comp. maize (nearly 40 % on medium soils, 30–40 % on light soils), sweet potatoes
Whole year: Macadamia nuts

4) On medium soils; on heavy soils first cropping season has a short to medium length. Given potential refers to medium soils, heavy ones occur especially in Northeastern parts. There H 511 fair and Katumani maize good 1st rains, cotton good 2nd to 1st rains



Grassland and forage
1.5–3 ha/LU on mixed medium grass savanna with red oats grass (Themeda triandra) predominant; if degraded well improvable by saltbush (Atriplex nummularia) and horse tamarind as palatable shrubs; additional forage: fast growing fodder legumes like moth beans

LM 5 = Lower Midland Livestock-Millet Zone

LM 5 vs/s + vs/s = Lower Midland Livestock-Millet Zone with a short to very short and a very short to short cropping season

Small transitional strip. Crop potential almost the same as LM 4 s/vs + vs/s, but Dryland comp. maize only fair, and 2–3 ha/LU

LM 5 vs/s + vs = Lower Midland Livestock-Millet Zone with a very short to short and a very short cropping season

Good yield potential
1st rains, start norm. end of March: E. mat. foxtail millet like 1Se 285 (~ 60 %), e. mat. proso millet like Serere 1; moth beans (~ 60 %)
2nd rains, start norm. end of Oct.: E. mat. proso millet like Serere 1
Whole year: Buffalo gourds[7] (light soils) and Marama beans[7], Jojoba (in valleys)

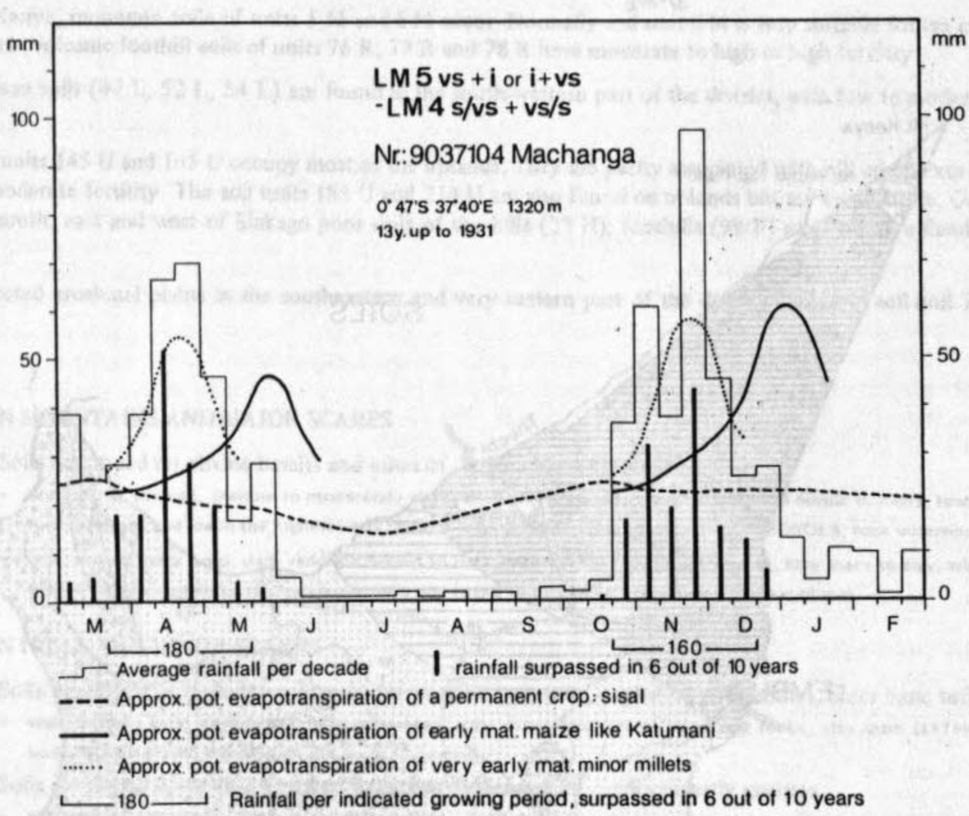
Fair yield potential
1st rains: Dwarf sorghum (50–60 %), e. mat. bulrush millet (bird rejecting awned var.); bl. and green grams, cowpeas, chickpeas (on h. bl. soils, late pl.), v. e. mat. bambarra groundnuts (on light soils); dwarf sunflower
2nd rains: E. mat. foxtail millet like 1 Se 285, dwarf sorghum (50–60 %); dwarf sunflower (40–50 %); bl. and green grams, cowpeas, moth beans, chickpeas (on h. bl. soils, late planted)
Whole year: Sisal, castor C-15

Poor yield potential
1st and 2nd rains: Dryland comp. maize

Grassland and forage
> 3 ha/LU on mixed short grass savanna with buffel grass (Cenchrus ciliaris) and horsetail grass (Chloris roxburghiana) predominant; saltbush best palatable shrub for re-establishing pasture on overgrazed and eroded places. Opuntia var. without prickles (also as vegetable and fruit)

LM 5 = *Lower Midland Livestock-Millet Zone*
vs + i *with a very short cropping season and intermediate rains*
or i + vs *or vice versa*[5)]

Small, potential see Kitui District, but it is almost the same as L5 vs + i or i + vs



L = *LOWLAND ZONES*

L 5 = *Lowland Livestock-Millet Zone*

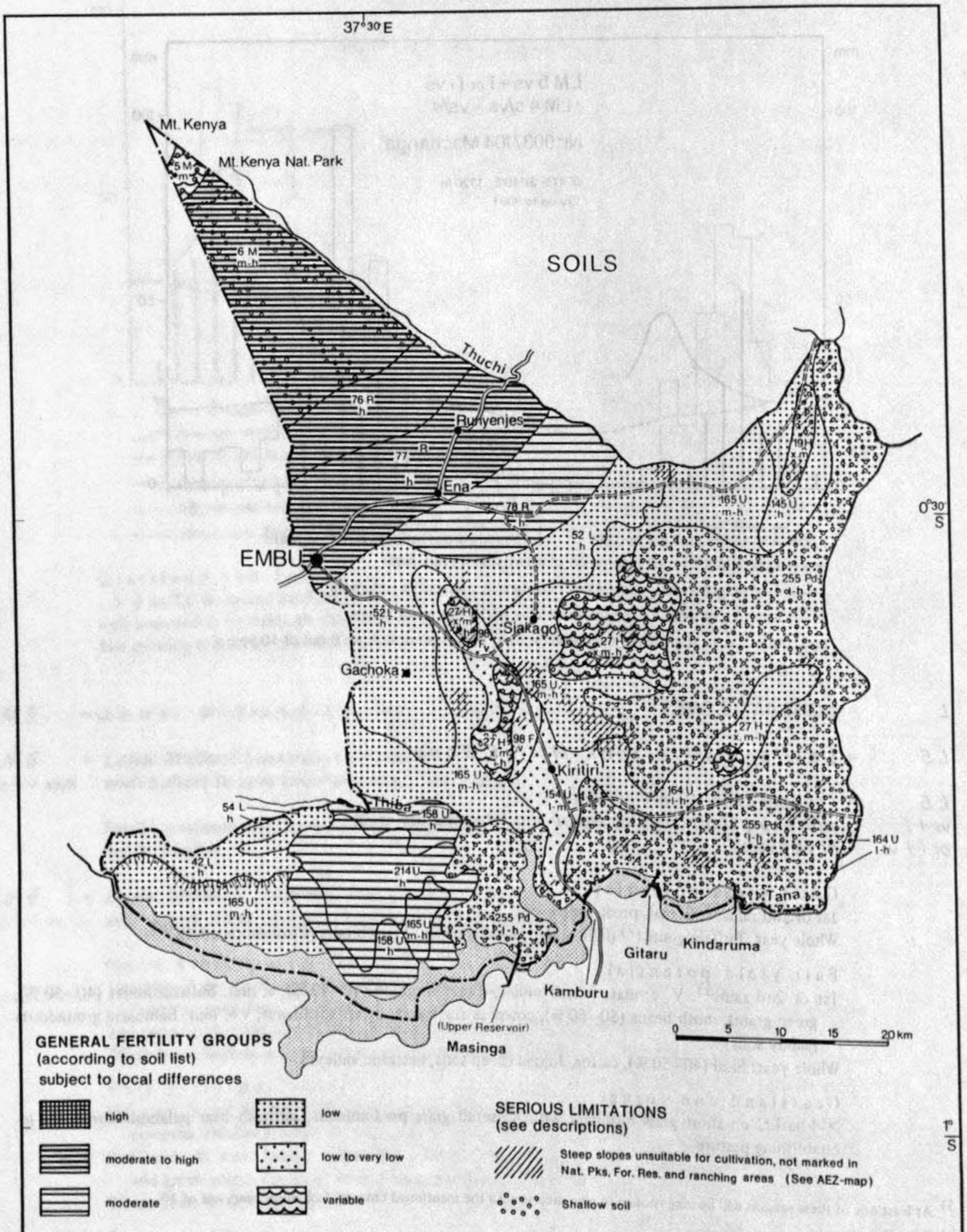
L 5 = *Lowland Livestock-Millet Zone*
vs + i *with a very short cropping season and intermediate rains*
or i + vs *or vice versa*[5)]

Good yield potential
1st or 2nd rains[5)]: E. mat. proso millet
Whole year: Buffalo gourds[7)] (light soils), Marama beans[7)], ye-eb nuts (Cordeauxia edulis)[6)]

Fair yield potential
1st or 2nd rains[5)]: V. e. mat. foxtail millet, dwarf sorghum (40–50 %), e. mat. bulrush millet (40–50 %); green grams, moth beans (50–60 %), cowpeas for leaves; dwarf sunflower, v.e. mat. bambarra groundnuts (sandy soils)
Whole year: Sisal (40–50 %), castor, Jojoba (deep soils, better in valleys)

Grassland and forage
> 4 ha/LU on short grass bushland with horsetail grass predominant; saltbush best palatable shrub for re-establishing pasture

5) At least one of these seasons will be long enough to give success with the mentioned crops in 6 or more years out of 10.
6) From Somalia
7) Still experimental. Plants produce edible seeds and, after some seasons, also tubers. Bitterness may be washed out in salty water.



37°30'E
SOILS
Mt. Kenya
Mt. Kenya Nat. Park
Thuchi
Runyenjes
Ena
EMBU
Sjakago
Gachoka
Kiritiri
Thiba
Tana
Gitaru
Kindaruma
Kamburu
(Upper Reservoir)
Masinga
0°30' S
1° S
0 5 10 15 20 km
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
low
low to very low
variable
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (See AEZ-map)
Shallow soil
EMBU
Fert. M. Buch
Soils KSS

SOIL DISTRIBUTION, FERTILITY AND MAJOR CHARACTERISTICS

Mt. Kenya forms the northwestern corner of the district. Towards the southwest, the topography becomes more level and the underlying volcanic bedrock gives the way mainly to different types of gneisses of Basement System. The soils occur in broad zones which run southwest-northeast and they are mainly heavy (h) in the upper middle parts, mainly medium to heavy (m–h) in the lower middle parts, and light to heavy (l–h) in the lower parts. Some "Inselbergs" have stony soils (x).

On Mt. Kenya, mountain soils of units 5 M and 6 M occur. Normally soil unit 6 M is very suitable for tea cultivation. On the lower parts, volcanic foothill soils of units 76 R, 77 R and 78 R have moderate to high or high fertility.

Footplateau soils (42 L, 52 L, 54 L) are found in the south-western part of the district, with low to moderate natural fertility.

The soil units 145 U and 165 U occupy most of the uplands. They are partly associated with hill complexes (19 H) and are of low to moderate fertility. The soil units 158 U and 214 U are also found on uplands but are more fertile. On the surrounding uplands south, east and west of Siakago poor soils of the hills (27 H), foothills (98 F) and related uplands (145 U, 164 U) occur.

The dissected erosional plains in the southeastern and very eastern part of the district consist of soil unit 255 Pd of low fertility.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on olivine basalts and ashes of major older volcanoes

5 M = imperfectly drained, shallow to moderately deep, dark greyish brown, very friable, acid humic to peaty, loam to clay loam, with
m[1)] rock outcrops and ice in the highest parts (dystric HISTOSOLS, lithic phase; with LITHOSOLS, rock outcrops and ice)

6 M = well drained, very deep, dark reddisch brown to dark brown, very friable and smeary, clay loam to clay, with thick, acid humic
m–h topsoil; in places shallow to moderately deep and rocky (humic ANDOSOLS, partly lithic phase)

SOILS ON HILLS AND MINOR SCARPS

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

19 H = well drained, very shallow to moderately deep, very dark brown, firm, stony and rocky, clay loam (LITHOSOLS; with verto-
x, m luvic PHAEOZEMS, lithic phase and Rock Outcrops)

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

27 H = complex of excessively drained to well drained, shallow, dark red to brown, friable, sandy clay loam to clay; in many places
x, m–h 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 Tertiary basic igneous rocks (olivine basalts, nepheline phonolites; older, basic tuffs included)

42 L = well drained, very deep, dark reddish brown to dark brown, friable to firm, slightly cracking clay; in places with humic topsoil
h (verto-eutric NITOSOLS; with mollic NITOSOLS)

52 L = well drained, very deep, dark red, very friable clay (nito-rhodic FERRALSOLS)
h

54 L = imperfectly drained, very deep, dark grey to black, firm to very firm, bouldery and stony, cracking clay; in places with calca-
h reous, slightly saline deeper subsoil (pellic VERTISOLS, stony phase and partly saline phase)

SOILS ON VOLCANIC FOOTRIDGES

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

76 R = well drained, extremely deep, dark reddish brown to dark brown, friable and slightly smeary clay, with acid humic topsoil (ando-
h humic NITOSOLS; with humic ANDOSOLS)

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

78 R = well drained, extremely deep, dusky red to dark reddish brown, friable clay; with inclusions of well drained, moderately deep, dark
h red to dark reddish brown, friable clay over rock, pisoferric or petroferric material (eutric NITOSOLS; with nito-chromic CAMBISOLS and chromic ACRISOLS, partly pisoferric or petroferric phase)

SOILS ON FOOTSLOPES

Soils developed on colluvium from undifferentiated Basement System rocks

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

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

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

145 U h	=	well drained very deep, dusky red to dark red, friable clay (nito-rhodic FERRALSOLS)

Soils developed on quartzites

154 U l–m	=	complex of somewhat excessively drained to well drained, shallow to very deep, dark reddish brown to yellowish brown, loose to friable, loamy sand to sandy clay loam; in places rocky and stony (ferralic ARENOSOLS; with orthic FERRALSOLS, ACRISOLS a.o.; partly lithic and stony phase)

Soils developed on Basement System rocks rich in ferromagnesian minerals

158 U h	=	well drained, very deep, dark red, friable to firm, clay (nito-rhodic FERRALSOLS)

Soils developed on undifferentiated Basement System rocks

164 U l–m	=	well drained, moderately deep to very deep, dark reddish brown to dark yellowish brown, friable to firm, sandy clay to clay; in many places with topsoil of loamy sand to sandy loam (ferralo-chromic/orthic/ferric ACRISOLS; with LUVISOLS and FERRALSOLS)
165 U m–h	=	well drained, moderately deep to deep, dark red to yellowish red, friable, sandy clay loam to clay (rhodic and orthic FERRALSOLS; with ferralo-chromic/orthic/ferric ACRISOLS)

SOILS ON UPLAND-PLAIN TRANSITIONAL LANDS

Soils developed on gneisses rich in ferromagnesian minerals

214 U h	=	complex of well drained to imperfectly drained, shallow to very deep, dark red to black, friable to firm, cracking clay; in places sodic (pellic VERTISOLS, with verto-eutric NITOSOLS, verto-eutric PLANOSOLS and orthic SOLONETZ, partly lithic phase)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated Basement System rocks

255 Pd 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)

1) Soil texture-classes

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

Soil description from Kenya Soil Survey: Exploratory Soil Map and Agro-climatic Zone Map of Kenya, Scale 1 : 1 000 000. Expl. Soil Survey Rep. E1, Nairobi 1982. See this map also for colours; symbols simplified here. Distribution and fertility remarks of all districts modified from Siderius, W.: Simplified Soil Maps of some Districts in Kenya. KSS, Misc. Soil Paper M 19, 2nd impr. Nairobi 1979

POPULATION AND LAND

The last population census of September 1979 showed that more than 260,000 people lived in Embu District (Table 4) on a total rural area of 256,000 ha (Table 6). Of this figure 78.6% (201,400 ha) were suitable for agriculture or livestock. Although the agro-ecological conditions here can be compared with other districts such as Kirinyaga or those of the eastern side of the Nyandarua Range, the actual situation differs in that in 1979 population density was less. Statistically, for an average household of 5.21 people (Table 5), 4.44 ha agricultural land were available, i.e. 0.82 ha per person. The critical figure of less than 1 ha per household was only found once in the whole district, in the Ngandori location (0.92 ha per household/0.15 ha per person), where coffee and tea were mostly cultivated. About 1.20 ha per family was still generally available here in the better areas, but in the dryer areas where the natural potential is much lower, 7 to 10 ha per family (Siakago and Gachoka Divisions) were just enough to make a living on an ordinary farm. This size is also necessary because relatively large areas of Zone 5 (LM 5 and L 5) are found here, where livestock plays the most important role. These areas could only be used for agricultural purposes, and so support more people, if very early maturing crops were established and yields secured by additional measures i.e. soil conservation and water catchment. But it must not be forgotten that in these areas the risk of drought and subsequently crop failures can never be excluded completely, but can only be diminished.

EMBU DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Ngandori	18 922	19 700	38 622	6 308	90	428
Gaturi	17 783	19 202	36 985	6 305	107	344
Kyeni	14 896	16 049	30 945	5 073	98	313
Kagaari	20 368	21 211	41 579	7 605	149	277
Runyenje's Division	71 969	76 162	148 131	25 291	446	332
Nthawa	7 723	8 799	16 522	3 707	364	45
Evurori	10 140	11 568	21 708	4 630	415	52
Siakago Division	17 863	20 367	38 230	8 337	779	49
Mbeti	6 712	7 031	13 743	2 503	220	62
Mavuria	11 515	12 926	24 441	5 033	622	39
Mwea	11 241	11 401	22 642	4 718	427	53
Embu Municipality	8 567	7 419	15 986	4 359	24	648
Gachoka Division	38 035	38 777	76 812	16 613	1 294	59
Embu District	127 867	135 306	263 173	50 241	2 714	96

EMBU DISTRICT

TABLE 5: COMPOSITION OF HOUSEHOLDS PER LOCATION AND DIVISION[a)]

LOCATION/DIVISION	No. of Households total	Farmers Family b) Adults >15 years	Children <15 years	Other Relatives	Non-Relatives	Persons per Households total b)
Location:						
Ngandori	6304	3.56	1.92	0.43	0.21	6.12
Kyeni	5043	3.48	1.94	0.47	0.20	6.08
Kagaari	7579	3.27	1.71	0.32	0.18	5.48
Division: Runyenje's	25222	3.43	1.84	0.39	0.20	5.86
Location:						
Nthawa	3730	2.79	1.25	0.23	0.16	4.43
Evurori	4620	2.95	1.30	0.28	0.16	4.68
Division: Siakago	8350	2.86	1.29	0.26	0.16	4.57
Location:						
Mbeti	2546	3.11	1.57	0.39	0.32	5.40
Mavuria	5016	2.97	0.48	0.33	0.13	4.87
Mwea	4699	2.85	1.31	0.41	0.23	4.81
Embu Minicipality	4319	2.23	0.54	0.31	0.36	3.43
Division: Gachoka	16580	2.78	1.18	0.36	0.25	4.56
DISTRICT: EMBU	50152	3.12	1.53	0.04	0.21	5.21

a) Source: Central Bureau of Statistics (CBS)

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

EMBU DISTRICT

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

Location/Division without townships	in '00 ha = sqkm: Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads, rivers...)	Agri-cultural land	in '00 ha = sqkm: Area in agro-ecological zones (AEZ): LH 1	UM 1	UM 2	UM 3	UM 4	LM 3	LM 4	LM 4 -LM 5	LM 5	L 5	in ha: Agric. land per house-hold	per person
Ngandori	90	14		18	58	11	34	11	2							0.92	0.15
Gaturi	107	11		19	77		15	17	18	26	1					1.22	0.21
Kyeni	98	15		19	64		11	15	10	4	20	4				1.26	0.21
Kagaari	149	21	F. 3	27	98		24	17	13	8	32	4				1.29	0.24
Runyenje's Division	444	61	3	83	297	11	84	60	43	38	53	8				1.17	0.20
Nthawa	364	48	F.21	36	259				3	13	87	46		92	18	6.98	1.57
Evurori	415	47		42	326						14	45		170	97	7.04	1.50
Siakago Division	779	95	21	78	585				3	13	101	91		262	115	7.01	1.54
Mbeti	220	21		22	177			6	13	32	44	60		22		7.07	0.13
Mavuria	622	29	F.16	62	515							71		444		10.23	2.11
Mwea	497 [2]	7		50	440							17	105	318		9.33	1.94
Gachoka Division	1 339 [2]	57	16	134	1 132			6	13	32	44	148	105	784		8.88	1.39
Total rural area	2 562	213	40	295	2 014	11	84	66	59	83	198	247	105	1 046	115	4.44	0.82

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

2) Included are 70 sqkm Game Reserve

AGRICULTURAL STATISTICS[1)]

The productive area of the Embu district is comparatively small, probably less than one-third of the district. Family farmers cultivate about 1,900 ha of **tea** yielding approximately 3,200 kg of grean leaves per ha p.a., while the smallholder **coffee** area covers 4,000 ha, producing about 900 kg clean coffee per ha p.a. A tea farmer owns roughly 0,35 ha of tea, while the coffee farmer possesses 0.25 ha of coffee trees. In addition, a small amount of **pyrethrum** is grown. Exact figures on cotton production are not known; it is however estimated that roughly 1,100 ha is planted annually, yielding roughly 500 kg per ha on average.

1) For more detailed and up to date information, see FMHB Vol. III/A

EMBU DISTRICT

TABLE 7a: **TEA**
AREA – PRODUCTION – GROWERS – YIELDS – RETURNS[a)]

Small Farmers

Division	Item	Unit	Year				
			75/76	76/77	77/78	78/79	79/80
Embu	Area	ha	1645	1725	1766	1809	1860
	Production	t	3179	5324	6356	7866	6024
	Value	'000 Shs	4069	18475	18433	19192	18496
	Growers	No	5052	5312	5405	5438	5508
	Yield p.ha	kg	1933	3086	3599	4348	3239
	Value p.ha	Shs	2474	10710	10438	10609	9944
	Area p.Grow.	ha	0.33	0.33	0.33	0.33	0.34
	Ret. p.Grow.	Shs	806	3478	3410	3529	3358

TABLE 7b: **COFFEE**
AREA – PRODUCTION – YIELDS[b)]

Co-operatives

Item	Unit	Year					
		74/75	75/76	76/77	77/78	78/79	79/80
Area	ha	3677	3677	3677	3677	3900	3995
Production	t	2876	2895	3212	4320	2690	3756
Yield	kg/ha	782	787	873	1175	690	940

Estates – Nil

TABLE 7c: **PYRETHRUM**
TRENDS IN PRODUCTION AND QUALITY[c)]

Item	Year				
	75/76	76/77	77/78	78/79	79/80
Production in t dried flowers	0.40	0.50	0.40	0.25	0.30
Pyrethrin content %	1.5	1.4	1.5	1.5	1.4

Sources: a) K.T.D.A. b) C.B.K. c) Pyrethrum Board

SMALL FARM SURVEY (SFS)[1]

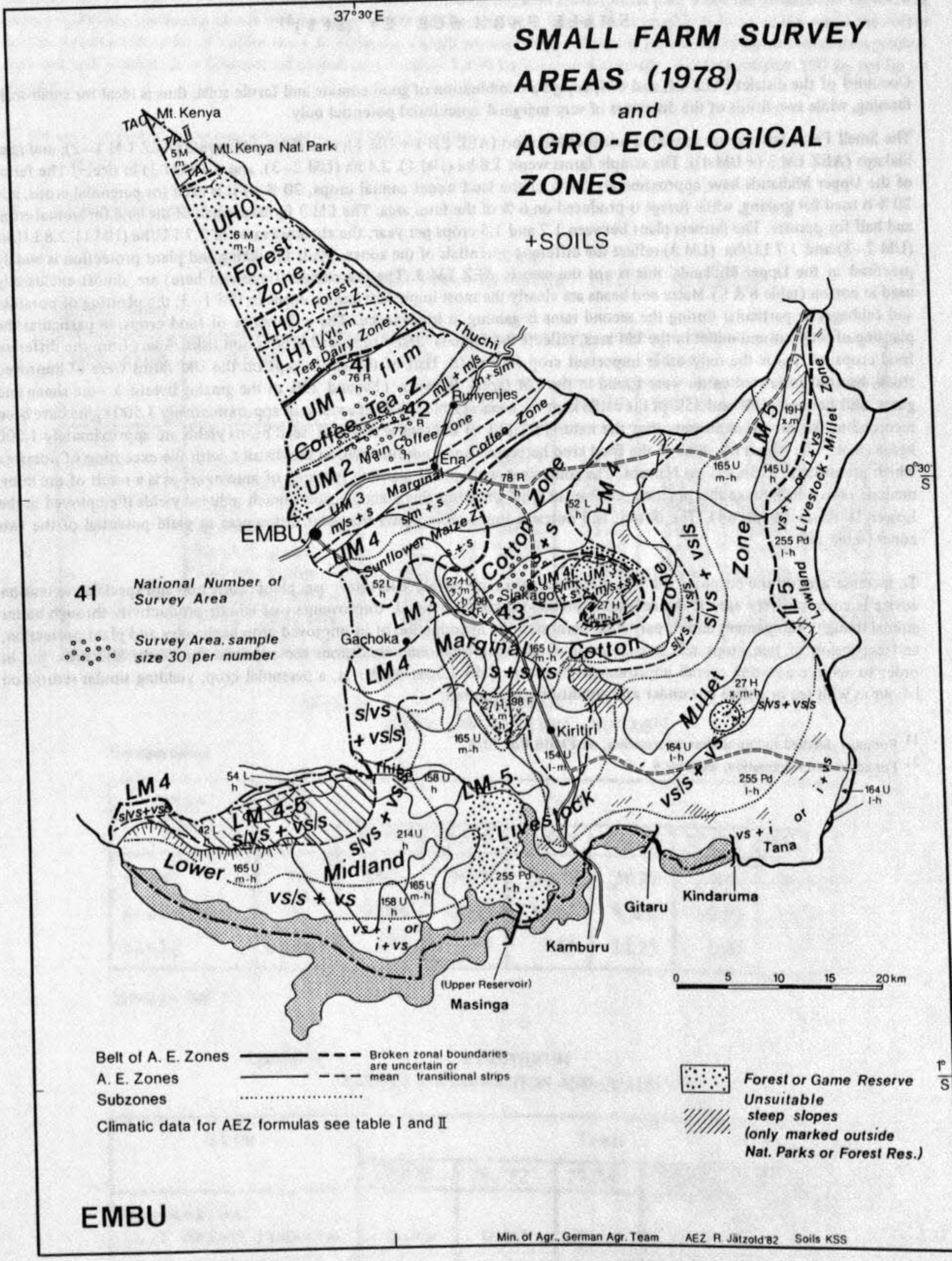
One-third of the district (AEZ LH and UM) enjoys a combination of good climate and fertile soils, thus is ideal for small-scale farming, while two-thirds of the district is of very marginal agricultural potential only.

The Small Farm Survey was executed north of Mbubori (AEZ LH 1 + UM 1), near Kibogi-Manyata (AEZ UM 1–2), and near Siakago (AEZ LM 3 (+ UM 4)). The sample farms were: 1.8 ha (UM 1), 2.4 ha (UM 2–3), and 4.1 (LM 3) in size.[2] The farms of the Upper Midlands have approximately 30 % of the land under annual crops, 20 % of it is used for perennial crops, and 20 % is used for grazing, while forage is produced on 6 % of the farm area. The LM 3 farms use half of the land for annual crops and half for pasture. The farmers plant between 1.2 and 1.5 crops per year, the stocking rates of 3.7 LU/ha (UM 1), 2.8 LU/ha (UM 2–3) and 1.7 LU/ha (LM 3) reflect the different potentials of the zones. While fertilizing and plant protection is widely practised in the Upper Midlands, this is not the case in AEZ LM 3. The insecticides (recorded here) are almost exclusively used in cotton (table 8 & 9). Maize and beans are clearly the most important annual crops in UM 1–3; the planting of potatoes and cabbages in particular during the second rains is gaining in importance. The wide range of food crops, in particular the planting of sorghum and millet in the LM area, reflects the farmers' desire to spread production risks. Apart from the different food crops, cotton is the only other important crop (table 10). Half of the cattle kept on the UM farms were of improved stock, but not improved cattle were found in the LM farms. Between 11% and 25% of the grazing livestock were sheep and goats, and between 16% and 35% of the cattle kept were male (table 11). Maize yields of approximatively 3,500 kg/ha have been recorded in the survey, indicating that the natural fertility of the soils is still high; seed beans yields are approximately 1,500 kg/ha (table 12). About 60–80% of the food crop harvested was consumed within the district, with the exception of potatoes which are usually 'exported' to Nairobi. The somewhat widespread planting (period) of annual crops is a result of the intermediate rains which make this practice possible (in AEZ UM), but this practice causes much reduced yields if employed in the Lower Midlands (graph 14). The output and nutrient input table shows the great differences in yield potential of the two zones (table 15).

To increase agricultural output in the Upper Midlands through increased fertilizer use, plant protection and specialist extension advice is comparatively easy if the economic preconditions are created. Improvement of labour productivity through better animal draught equipement and in particular harnesses, the introduction of an improved crop husbandry and plant protection, and expansion of tree crops will help to improve the sozio-economic conditions somewhat in the Lower Midlands. But in order to achieve a lasting overall improvement in most of the Lower Midlands, a perennial crop, yielding similar returns on labour as with tea or coffee but under arid conditions, is required.

[1] For more detailed and up to date information, see FMHB Vol. III/B

[2] For additional information, see table 6


SMALL FARM SURVEY AREAS (1978) and AGRO-ECOLOGICAL ZONES
+SOILS
37°30'E
0°30' S
1° S
Mt. Kenya
Mt. Kenya Nat. Park
UHO Forest Zone
LHO Forest Z.
LH1 Tea Dairy Zone
UM 1 Coffee Tea Z.
UM 2 Main Coffee Zone
UM 3 Marginal Coffee Zone
UM 4 Sunflower Maize Z.
LM 3 Cotton Zone
LM 4 Marginal Cotton
LM 4
LM 5 Livestock - Millet Zone
IL 5 Lowland Livestock - Millet Zone
LM 4-5
LM 5. Livestock Millet
Lower Midland
Thuchi
Runyenjes
Ena
EMBU
Siakago
Gachoka
Kiritiri
Thiba
Gitaru
Kindaruma
Kamburu
Tana
(Upper Reservoir)
Masinga
41
42
43
41 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
Forest or Game Reserve
Unsuitable steep slopes (only marked outside Nat. Parks or Forest Res.)
0 5 10 15 20 km
EMBU
Min. of Agr., German Agr. Team AEZ R. Jätzold '82 Soils KSS

AEZ: LH 1 (+ UM 4)

TABLE 8a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 41

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.2	2.0	4.5
Land Use: Annual Crops[1] First Season				
Maize	ha	0.1	0.3	-
Maize & Beans	ha	0.2	0.4	1.2
Beans	ha	0.1	-	0.2
English Potatoes	ha	-	-	0.2
Others	ha	-	-	-
Total	ha	0.4	0.7	1.6
Second Season[1]				
Beans	ha	0.1	-	-
Maize		-	0.1	-
Maize & Beans	ha	0.1	-	0.6
Others	ha	-	-	0.2
Total	ha	0.2	0.1	0.8
Permanent Crops[1]				
Tea	ha	0.2	0.2	0.2
Coffee	ha	0.1	0.3	1.1
	ha			
	ha			
Portion of total	%	25 %	25 %	29 %
Grazing & Forage	ha	0.4	0.5	1.1
portion of total	%	33 %	25 %	24 %
Other Land Use	ha	0.1	0.3	0.5
Livestock on Farm:				
Cattle: local	LU	1.5	-	-
improved	LU	2.3	1.2	1.4
Sheep & Goats	LU	0.4	0.2	0.3
Total	LU	4.2	1.4	1.7

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.8	0.6	0.8
Portion of improved cattle kept	%	66 %	1.0 %	1.0 %
Portion of Farmers owning a Plough	%	-	-	-
Labour on Farm:				
Family Adults	persons	2.3	2.2	1.5
Perm. Hired Labour	"	0.1	-	0.5
Children > 14 years	"	0.8	2.5	2.5
Persons living on Farm[2] -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.12	0.24	2.36
Children < 14 years	"	3.86	-	3.86
Subsistence Units	SU	4.43	0.24	4.67
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1114	2155	
Beans	kg	196	374	
English Potatoes	kg	162	63	
Cabbage	kg	8	1	
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Pineapples, Cabbage, Sugarcane, Passion Fruit

1) Major crops only considered

2) Based on 1979 Census figures

AEZ: UM 1–2

TABLE 8b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 42

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.5	2.6	6.o
Land Use: Annual Crops[1] First Season Maize & Beans	ha	o.5	o.4	o.1
Maize	ha	o.1	o.2	1.3
Beans	ha	o.1	o.1	o.4
English Potatoes	ha	-	o.1	o.2
Others	ha	-	-	o.4
Total	ha	o.7	o.8	2.4
Second Season[1] Maize & Beans	ha	o.4	o.4	o.1
Beans	ha	o.1	o.2	o.7
Maize	ha	-	o.1	o.7
Total	ha	o.5	o.7	1.5
Permanent Crops[1] Coffee	ha	o.3	o.4	1.1
Bananas	ha	-	o.1	o.1
	ha			
	ha			
Portion of total	%	2o %	19 %	2o %
Grazing & Forage	ha	o.4	o.8	1.9
portion of total	%	27 %	31 %	32 %
Other Land Use	ha	o.1	o.4	o.5
Livestock on Farm:				
Cattle: local	LU	o.2	1.1	1.4
improved	LU	o.9	1.1	2.6
Sheep & Goats	LU	o.2	o.4	o.2
Total	LU	1.3	2.6	4.2

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	1.o	o.8	o.8
Portion of improved cattle kept	%	82 %	5o %	65 %
Portion of Farmers owning a Plough	%	-	-	-
Labour on Farm:				
Family Adults	persons	1.9	2.4	2.3
Perm. Hired Labour	"	o.2	-	o.7
Children > 14 years	"	1.4	1.8	1.7
Persons living on Farm[2] -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	3.88	o.6	4.48
Children < 14 years	"	2.3o	-	2.3o
Subsistence Units	SU	5.26	o.6	5.86
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1o89	21o6	
Beans	kg	2o5	391	
English Potatoes	kg	258	1oo	
Sweet Potatoes	kg	38	26	
Sorghum	kg	4	-	
	kg			
	kg			
	kg			

Other Crops cultivated: Maize & Sorghum, Bulrush Millet, Onions, Cassava, Pineapples, Sweet Potatoes, Sugarcane

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

TABLE 8c: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group small	medium	large
Farm Size Total	ha	1.7	3.6	1o.6
Land Use: Annual Crops1) First Season Maize	ha	o.3	o.5	o.6
Beans	ha	o.3	o.4	o.8
Maize & Beans	ha	o.1	o.4	o.4
Cotton	ha	o.3	o.3	o.6
Others	ha	-	o.2	o.7
Total	ha	1.o	1.8	3.1
Second Season1) Maize	ha	o.2	o.3	o.6
Beans	ha	o.2	o.4	o.8
Bulrush	ha	o.1	o.2	o.2
Others	ha	o.1	o.2	o.4
Total	ha	o.6	1.1	2.o
Permanent Crops1)	ha			
	ha			
	ha			
	ha			
Portion of total	%			
Grazing & Forage	ha	o.4	1.4	6.9
portion of total	%	24 %	39 %	65 %
Other Land Use	ha	o.3	o.4	o.6
Livestock on Farm:				
Cattle: local	LU	2.2	1.5	7.1
improved	LU	-	-	-
Sheep & Goats	LU	o.4	o.8	1.3
Total	LU	2.6	2.3	8.4

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group small	medium	large
Farming Intensity:				
Cropping Intensity	-	o.9	o.8	o.5
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	3o %	1o %	4o %
Labour on Farm:				
Family Adults	persons	2.o	2.5	2.o
Perm. Hired Labour	"	o.3	o.1	o.2
Children > 14 years	"	1.o	1.7	1.4
Persons living on Farm2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	3.88	o.37	4.25
Children < 14 years	"	1.98	-	1.98
Subsistence Units	SU	5.o6	o.37	5.43
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1o15	1963	
Beans	kg	247	471	
Sorghum	kg	29	55	
Millet	kg	1o8	2o3	
Cowpeas	kg	35	69	
	kg			
	kg			
	kg			

Other Crops cultivated: Maize & Cowpeas, Cowpeas, Maize & Bulrush Millet, Sorghum

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

EMBU DISTRICT

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

AEZ: LH 1 + UM 1 — Survey Area 41

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	1.8	8.0	0.4	2.1	0.1	1.7
Avg. 1	1.8	9.0	1.7	2.3	1.0	2.9
Up. Qu.	2.0	6.0	-	2.0	-	3.0
Lo. Qu.	1.2	2.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	0.7	41	0.4	26	0.3	20	0.1	6	-	2	0.1	5
Avg. 1	0.7	33	0.5	23	0.4	19	0.2	8	0.2	11	0.1	5
Up. Qu.	0.8	50	0.6	32	0.4	27	0.1	7	-	-	0.1	6
Lo. Qu.	0.3	20	0.4	20	0.2	7	-	-	-	-	-	2
Total	18.6		11.6		9.2		2.5		0.9		2.2	

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	1.5	6.4	63.8
Avg. 1			3.7	65.2
Up. Qu.	1.5	1.3	5.5	100.0
Lo. Qu.	1.0	0.5	1.5	66.7

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	57.9	2.2	14.6	10.6	3.0	0.2	1.0	-	-	4.5	0.8	0.5	4.9
Avg. 1	57.9	15.1	19.4	12.7	4.6	5.0	3.5	0.5	0.1	4.8	1.6	3.8	5.4
Up. Qu.	80.0	-	23.2	15.0	5.0	-	1.3	-	-	7.3	0.8	-	6.7
Lo. Qu.	-	-	-	1.1	-	-	-	-	-	1.3	-	-	1.1

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

EMBU DISTRICT

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

AEZ: UM 1–2

Survey Area 42

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	2.4	6.1	1.0	2.2	0.2	1.6
Avg. 1	2.4	6.7	1.7	2.2	1.3	2.5
Up. Qu.	2.4	9.0	1.0	2.0	-	3.0
Lo. Qu.	1.6	2.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	0.8	35	0.5	20	0.6	25	0.1	6	0.2	8	0.1	6
Avg. 1	0.9	31	0.5	17	0.6	23	0.2	8	0.4	15	0.1	5
Up. Qu.	0.9	46	0.6	29	0.9	36	0.2	8	0.2	15	0.2	8
Lo. Qu.	0.4	25	0.2	13	0.2	13	-	-	-	-	0.1	4
Total	25.2		14.5		18.4		4.5		5.4		4.3	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.5	0.9	2.8	52.7
Avg. 1			2.8	70.2
Up. Qu.	2.0	1.1	4.8	73.0
Lo. Qu.	1.2	0.5	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	53.2	3.5	8.9	14.6	4.3	0.1	-	-	-	2.5	0.4	0.2	5.6
Avg. 1	53.2	9.7	10.5	19.0	23.7	2.3	-	-	0.1	2.7	1.1	1.0	6.2
Up. Qu.	40.0	6.3	10.7	25.0	-	-	-	-	-	4.5	0.8	-	8.1
Lo. Qu.	-	-	5.4	-	-	-	-	-	-	0.3	-	-	2.3

Notes:

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

EMBU DISTRICT

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

AEZ: LM 3 (+ UM 4)

Survey Area 43

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	4.1	13.1	0.7	2.2	0.2	1.4
Avg. 1	4.1	15.1	2.1	2.2	1.0	2.5
Up. Qu.	4.0	21.0	1.0	2.0	-	2.0
Lo. Qu.	2.2	3.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	1.8	44	-	-	2.0	49	-	-	0.1	3	0.2	4
Avg. 1	1.8	40	0.1	3	2.0	46	-	-	0.4	8	0.2	3
Up. Qu.	2.2	74	-	-	1.6	54	-	-	0.1	2	0.2	7
Lo. Qu.	1.0	31	-	-	0.4	18	-	-	-	-	0.1	2
Total	53.3		0.1		58.9		-		3.0		4.5	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.5	0.8	1.7	0.5
Avg. 1			1.7	13.0
Up. Qu.	1.8	1.0	3.5	-
Lo. Qu.	1.3	0.1	0.3	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_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	45.7	2.2	-	4.9	-	-	-	0.2	-	2.4	-	-	-
Avg. 1	57.6	10.1	-	12.5	-	-	-	0.8	-	2.6	-	-	-
Up. Qu.	40.0	-	-	2.3	-	-	-	-	-	5.0	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	1.1	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of 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

EMBU DISTRICT

TABLE 10a: CROPPING PATTERN

AEZ: LH 1 + UM 1

Survey Area 41

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	%
Maize	0.2	0.6	0.12	0.00	5.2	26.4
Maize IPC	0.0	0.2	0.00	0.00	0.2	1.0
Beans	0.0	0.2	0.00	0.00	0.6	3.2
Engl. Potatoes	0.0	0.2	0.00	0.00	0.8	3.8
Cabbage	0.0	0.3	0.00	0.00	0.6	3.0
Sugarcane	0.0	0.4	0.00	0.00	1.2	6.0
Passionfruit	0.0	0.2	0.00	0.00	0.2	0.8
Pineapples	0.0	0.2	0.00	0.00	0.2	1.0
Others	0.0	0.1	0.00	0.00	0.1	0.6
Maize & Beans	0.4	0.6	0.60	0.00	10.8	54.1
Total					19.9	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	%
Maize	0.1	0.5	0.00	0.00	1.4	20.0
Beans	0.0	0.2	0.00	0.00	1.0	13.7
Engl. Potatoes	0.0	0.1	0.00	0.00	0.4	6.3
Cabbage	0.0	0.2	0.00	0.00	0.4	5.7
Sugarcane	0.0	0.4	0.00	0.00	1.2	17.1
Passionfruit	0.0	0.2	0.00	0.00	0.2	2.3
Pineapples	0.0	0.2	0.00	0.00	0.2	2.9
Maize & Beans	0.1	0.4	0.00	0.00	2.2	32.0
Total					7.0	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	%
Coffee	0.3	0.3	0.28	0.12	7.3	57.0
Tea	0.2	0.3	0.24	0.00	5.5	43.0
Total					12.8	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

EMBU DISTRICT

TABLE 10b: CROPPING PATTERN

AEZ: UM 1–2

Survey Area 42

First Rains
Annual & Semipermenent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.3	0.7	0.40	0.00	8.2	30.5
Bulrushmillet	0.0	0.1	0.00	0.00	0.1	0.4
Beans	0.1	0.4	0.12	0.00	2.8	10.3
Engl. Potatoes	0.0	0.3	0.00	0.00	1.4	5.2
Onions	0.0	0.1	0.00	0.00	0.1	0.3
Cassava	0.0	0.1	0.00	0.00	0.1	0.3
Sweet Potatoes	0.0	0.4	0.00	0.00	1.3	4.8
Sugarcane	0.0	0.2	0.00	0.00	0.7	2.7
Pineapples	0.0	0.3	0.00	0.00	0.3	1.0
Others	0.0	0.1	0.00	0.00	0.4	1.6
Maize & Beans	0.4	0.6	0.80	0.00	11.6	42.9
Total					26.9	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.1	0.5	0.20	0.00	3.2	15.1
Beans	0.2	0.7	0.12	0.00	5.1	23.9
Engl. Potatoes	0.0	0.2	0.00	0.00	0.8	3.7
Cassava	0.0	0.1	0.00	0.00	0.1	0.4
Sugarcane	0.0	0.2	0.00	0.00	0.7	3.4
Pineapples	0.0	0.3	0.00	0.00	0.3	1.3
Maize & Sorgm	0.0	0.6	0.00	0.00	0.6	2.8
Maize & Beans	0.4	0.6	0.60	0.00	10.6	49.3
Total					21.4	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Sweet Bananas	0.0	0.1	0.00	0.00	0.4	3.2
Cookng Bananas	0.0	0.2	0.00	0.00	0.9	7.4
Coffee	0.4	0.4	0.56	0.12	11.0	89.3
Total					12.4	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

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TABLE 10c: CROPPING PATTERN

AEZ: LM 3 (+ UM 4)

Survey Area 43

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.4	0.8	0.80	0.00	12.8	24.0
Sorghum	0.1	0.8	0.00	0.00	1.6	3.0
Bulrushmillet	0.0	0.2	0.00	0.00	0.9	1.7
Beans	0.4	0.7	0.80	0.00	13.1	24.5
Cowpeas	0.1	0.3	0.00	0.00	1.5	2.9
Sunflower	0.0	0.4	0.00	0.00	0.4	0.8
Cotton	0.3	0.5	0.60	0.00	10.0	18.7
Tobacco	0.1	0.9	0.00	0.00	3.4	6.4
Others	0.0	0.6	0.00	0.00	0.6	1.1
Maize & Beans	0.3	0.7	0.40	0.00	8.0	15.0
Maize & Cowps	0.0	0.2	0.00	0.00	0.2	0.4
Maize & Others	0.0	0.8	0.00	0.00	0.8	1.5
Total					53.3	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.3	0.7	0.60	0.00	9.3	27.5
Sorghum	0.0	0.2	0.00	0.00	0.2	0.6
Bulrushmillet	0.2	0.5	0.40	0.00	4.6	13.6
Beans	0.4	0.7	0.80	0.00	11.6	34.3
Cowpeas	0.0	0.2	0.00	0.00	0.7	2.1
Sunflower	0.0	0.4	0.00	0.00	0.4	1.2
Others	0.0	0.4	0.00	0.00	0.4	1.2
Maize & BulMlt	0.0	0.4	0.00	0.00	0.4	1.2
Maize & Beans	0.1	0.5	0.20	0.00	3.8	11.2
Maize & Cowps	0.0	0.2	0.00	0.00	0.2	0.6
Maize & Others	0.1	0.7	0.00	0.00	2.2	6.5
Total					33.8	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Cooking Bananas	0.0	0.1	0.00	0.00	0.1	100.0
Total					0.1	100.0

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

TABLE 11a: HERD COMPOSITION (GRAZING LIVESTOCK)

- in Head & Livestock Units -

AEZ: LM 1 + UM 1

Jan. '78 Survey Area 41

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year,	Average	0.11	0.04	-	0.14				0.07			0.07
	Upper Qu.	-	-	-	-				-			-
1 - 2 years,	Average	0.14	0.07	0.04	0.18				0.21			0.21
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	0.04	0.04	0.04		1.32			1.41			1.41
	Upper Qu.	-	-	-		1			1.0			1.0
Subtotal(improved)	Total	8	4	2	9	37			47.4			47.4
	Average	0.29	0.14	0.07	0.32	1.32			1.69			1.69
	Upper Qu.	-	-	-	1	1			1.8			-
	Lower Qu.	-	-	-	-	1			1.0			-
LU Male Cattle =		14.6 % of total cattle,				Calves + Heifers =			24.3 % of dairy cows			
Unimproved Livestock:												
Under 1 year,	Average	3.21	-	-	-		1.25	0.43	0.81	-		0.81
	Upper Qu.	-	-	-	-		-	1	0.1	-		0.1
1 - 2 years,	Average	-	-	-	-				-			-
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	-	-	-		0.04	0.43	0.82	0.15	-	10.54	0.15
	Upper Qu.	-	-	-		-	-	1	-	-	1	-
Subtotal (unimp.)	Total	90	-	-	-	1	47	35	26.9	-	295	26.9
	Average	3.21	-	-	-	0.04	1.68	1.25	0.96	-	10.54	0.96
	Upper Qu.	-	-	-	-	-	1	2	0.3	-	10	0.3
	Lower Qu.	-	-	-	-	-	-	-	-	-	1	-
LU Male Cattle =		96.5 % of total cattle,				Calves + Heifers =			0.0 % of dairy cows			
LU Goats + Sheep =		30.5 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	98	4	2	9	38	47	35	74.3	-	295	74.3
	Average	3.50	0.14	0.07	0.32	1.36	1.68	1.25	2.65	-	10.54	2.65
	Upper Qu.	-	-	-	1	1	-	2	2.0	-	10	0.3
	Lower Qu.	-	-	-	-	-	-	-	1.0	-	1	-
LU Male Cattle =		37.7 % of total cattle,				Calves + Heifers =			23.7 % of dairy cows			
LU Goats + Sheep =		11.0 % 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

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TABLE 11b: HERD COMPOSITION (GRAZING LIVESTOCK)

- in Head & Livestock Units -

AEZ: UM 1–2

Jan. '78 Survey Area 42

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	-	-	0.23				0.07			0.07
Upper Qu.	-	-	-	-				-			-
1 - 2 years, Average	0.10	0.03	-	0.23				0.18			0.18
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	-	-	0.07		0.83			0.89			0.89
Upper Qu.	-	-	-		2			2.0			2.0
Subtotal(improved) Total	5	1	2	14	25			34.4			34.4
Average	0.17	0.03	0.07	0.47	0.83			1.14			1.14
Upper Qu.	-	-	-	1	2			2.0			-
Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =	11.9 % of total cattle,				Calves + Heifers =			56.0 % of dairy cows			
Unimproved Livestock:											
Under 1 year, Average	0.13	-	-	0.13		0.10	0.33	0.10	0.03		0.10
Upper Qu.	-	-	-	-		-	-	-	-		-
1 - 2 years, Average	0.07	0.03	0.07	0.23				0.13			0.18
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	0.07	-	0.17		0.53	1.17	1.37	0.75	0.07	14.37	0.76
Upper Qu.	-	-	-		1	2	2	-	-	6	-
Subtotal (unimp.) Total	8	1	7	11	16	38	51	30.9	3	431	31.3
Average	0.27	0.03	0.23	0.37	0.53	1.27	1.70	1.03	0.10	14.37	1.04
Upper Qu.	-	-	-	-	1	2	2	1.9	-	20	1.9
Lower Qu.	-	-	-	-	-	-	-	0.1	-	6	0.1
LU Male Cattle =	34.6 % of total cattle,				Calves + Heifers =			68.8 % of dairy cows			
LU Goats + Sheep =	28.8 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	13	2	9	25	41	38	51	65.2	3	431	65.7
Average	0.43	0.07	0.30	0.83	1.37	1.27	1.70	2.17	0.10	14.37	2.19
Upper Qu.	1	-	-	1	2	2	2	3.9	-	20	1.9
Lower Qu.	-	-	-	-	1	-	-	1.0	-	6	0.1
LU Male Cattle =	20.8 % of total cattle,				Calves + Heifers =			61.0 % of dairy cows			
LU Goats + Sheep =	13.7 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1–2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU

Unimproved Stock = Under 1 year 0.20 LU, 1–2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU

Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

TABLE 11c: HERD COMPOSITION (GRAZING LIVESTOCK)

- in Head & Livestock Units -

AEZ: LM 3 (+ UM 4)

Jan. '78 Survey Area 43

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	-	-	-		-			-			-
	Upper Qu.	-	-	-		-			-			-
Subtotal(improved)	Total	-	-	-	1	-			0.5			0.5
	Average	-	-	-	0.03	-			0.02			0.02
	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	0.73	-	-	0.67		0.77	2.13	0.57	-		0.57
	Upper Qu.	1	-	-	1		2	3	0.9	-		0.9
1 - 2 years,	Average	0.23	-	-	0.93				0.52			0.52
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	0.07	0.03	0.73		2.00	1.07	3.70	2.32	-	12.97	2.32
	Upper Qu.	-	-	-		3	1	6	-	-	6	-
Subtotal (unimp.)	Total	31	1	22	48	60	55	175	102.4	-	389	102.4
	Average	1.03	0.03	0.73	1.60	2.00	1.83	5.83	3.41	-	12.97	3.41
	Upper Qu.	2	-	-	1	3	4	10	3.8	-	16	3.8
	Lower Qu.	-	-	-	-	-	-	-	0.3	-	6	0.3
LU Male Cattle =		30.0 % of total cattle,				Calves + Heifers =			80.0 % of dairy cows			
LU Goats + Sheep =		22.5 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	31	1	22	49	60	55	175	102.9	-	389	102.9
	Average	1.03	0.03	0.73	1.63	2.00	1.83	5.83	3.43	-	12.97	3.43
	Upper Qu.	2	-	-	3	4	10	3.9	-	16	3.8	
	Lower Qu.	-	-	-	-	-	-	0.3	-	6	0.3	
LU Male Cattle =		29.8 % of total cattle,				Calves + Heifers =			81.7 % of dairy cows			
LU Goats + Sheep =		22.4 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1–2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU

Unimproved Stock = Under 1 year 0.20 LU, 1–2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU

Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

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TABLE 12a: INPUTS & YIELDS OF MAJOR CROPS

AEZ: LH 1 + UM 1 — Survey Area 41

Crop		Inputs: Improved Seeds %	Nutrients: N kg/ha	Nutrients: P_2O_5 kg/ha	Nutrients: K_2O kg/ha	Nutrients: Manure t/ha	Chemicals: Insec. kg/ha	Chemicals: Fungicide kg/ha	Yield kg/ha
First Rains									
Maize	Avg.	89	6	13	1	-	17	-	2,463
	UpQu	100	-	18	-	-	25	-	3,375
	LoQu	100	-	-	-	-	-	-	1,125
Maize & Beans									
Maize	Avg.	100	5	35	-	0.05	7	-	2,282
Beans	Avg.	-	-	-	-	0.05	2	-	500
Maize	UpQu	100	-	43	-	-	10	-	3,375
Beans	UpQu	-	-	-	-	-	-	-	667
Maize	LoQu	100	-	18	-	-	-	-	1,406
Beans	LoQu	-	-	-	-	-	-	-	281
Second Rains									
Maize	Avg.	80	13	58	1	0.05	33	33	4,176
	UpQu	100	31	1	-	-	50	50	3,600
	LoQu	-	-	-	-	-	-	-	1,530
Engl. Potatoes	Avg.	40	-	15	-	-	20	49	12,833
	UpQu	100	-	18	-	-	-	100	17,500
	LoQu	-	-	-	-	-	-	-	8,000
Maize & Beans									
Maize	Avg.	100	6	39	-	-	18	18	2,726
Beans	Avg.	13	-	-	-	-	-	6	510
Maize	UpQu	100	-	29	-	-	30	30	3,825
Beans	UpQu	-	-	-	-	-	-	-	833
Maize	LoQu	100	-	-	-	-	-	-	1,266
Beans	LoQu	-	-	-	-	-	-	-	200
Perennial Crops									
Passion fruit	Avg.	-	-	-	-	-	-	1	15,625
Coffee	Avg.	-	55	24	1	0.15	6	29	9,691
	UpQu	-	104	42	-	-	7	45	12,500
	LoQu	-	-	-	-	-	-	8	2,363
Tea	Avg.	-	52	2	7	-	-	-	4,219
	UpQu	-	104	2	13	-	-	-	6,250
	LoQu	-	-	-	-	-	-	-	900

EMBU DISTRICT

TABLE 12b: INPUTS & YIELDS OF MAJOR CROPS

AEZ: UM 1–2 Survey Area 42

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	14	42	1	-	12	-	2,650
	UpQu	100	25	50	-	-	12	-	2,800
	LoQu	100	-	4	-	-	1	-	1,800
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	4,583
Maize & Beans									
Maize	Avg.	100	6	27	-	-	5	-	1,824
Beans	Avg.	-	-	4	-	-	-	-	417
Maize	UpQu	100	17	58	-	-	8	-	2,250
Beans	UpQu	-	-	-	-	-	-	-	563
Maize	LoQu	100	-	-	-	-	-	-	1,350
Beans	LoQu	-	-	-	-	-	-	-	225
Second Rains									
Maize	Avg.	100	18	17	2	-	11	11	1,254
	UpQu	100	11	5	-	-	10	10	1,800
	LoQu	100	-	-	-	-	-	-	300
Beans	Avg.	11	-	12	-	-	1	1	892
	UpQu	-	-	5	-	-	-	-	1,350
	LoQu	-	-	-	-	-	-	-	450
Maize & Beans									
Maize	Avg.	100	5	26	-	-	10	10	2,656
Beans	Avg.	-	-	4	-	-	-	-	383
Maize	UpQu	100	17	58	-	-	15	15	1,800
Beans	UpQu	-	-	-	-	-	-	-	500
Maize	LoQu	100	-	-	-	-	1	1	900
Beans	LoQu	-	-	-	-	-	-	-	200
Perennial Crops									
Coffee	Avg.	-	65	21	-	0.08	3	37	6,689
	UpQu	-	93	-	-	-	7	40	10,000
	LoQu	-	-	-	-	-	-	13	3,521

EMBU DISTRICT

TABLE 12c: INPUTS & YIELDS OF MAJOR CROPS

AEZ: LM 3 (+ UM 4) | Survey Area 43

Crop		Inputs: Improved Seeds %	Nutrients: N kg/ha	Nutrients: P_2O_5 kg/ha	Nutrients: K_2O kg/ha	Manure t/ha	Chemicals: Insec. kg/ha	Chemicals: Fungicide kg/ha	Yield kg/ha
First Rains									
Maize	Avg.	61	7	13	-	0.19	1	-	2,111
	UpQu	100	-	17	-	-	1	-	2,700
	LoQu	-	-	-	-	-	-	-	1,125
Beans	Avg.	31	-	-	-	0.06	-	-	994
	UpQu	100	-	-	-	-	-	-	1,200
	LoQu	-	-	-	-	-	-	-	600
Cowpeas	Avg.	-	-	-	-	-	-	-	693
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	450
Maize & Beans									
Maize	Avg.	60	-	1	-	0.36	1	-	1,286
Beans	Avg.	10	-	-	-	0.13	-	-	497
Maize	UpQu	100	-	-	-	-	-	-	1,479
Beans	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	-	-	-	-	-	-	-	900
Beans	LoQu	-	-	-	-	-	-	-	400
Second Rains									
Maize	Avg.	64	9	16	-	0.28	3	3	1,824
	UpQu	100	13	17	-	-	3	3	2,250
	LoQu	-	-	-	-	-	-	-	788
Bulrushmillet	Avg.	-	-	-	-	0.21	8	8	1,019
	UpQu	-	-	-	-	-	-	-	1,125
	LoQu	-	-	-	-	-	-	-	600
Beans	Avg.	21	-	-	-	0.04	-	-	1,383
	UpQu	-	-	-	-	-	-	-	1,575
	LoQu	-	-	-	-	-	-	-	350
Cowpeas	Avg.	-	-	-	-	-	-	-	738
Cotton	Avg.	83	-	-	-	-	32	32	948
	UpQu	100	-	-	-	-	40	40	1,400
	LoQu	100	-	-	-	-	-	-	404
Tobacco	Avg.	100	30	38	-	-	53	53	3,188
	UpQu	100	28	69	-	-	25	25	1,875
	LoQu	100	-	-	-	-	8	8	625
Perennial Crops									

EMBU DISTRICT

TABLE 13a: DISPOSAL OF CROPS

AEZ: LH 1 + UM 1 | Survey Area 41

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	11,070	0	0	3,870	35	7,200	65
Maize & Beans	16,550	0	0	6,590	40	9,960	60
Beans	685	0	0	480	70	205	30
Engl. Potatoes	9,020	0	0	7,340	81	1,680	19
Cabbage	6,000	0	0	5,800	97	200	3
Second Rains							
Maize	5,670	0	0	3,240	57	2,430	43
Maize & Beans	16,395	0	0	4,340	26	12,055	74
Beans	1,380	0	0	720	52	660	48
Engl. Potatoes	7,380	0	0	4,700	64	2,680	36
Cabbage	2,200	0	0	2,200	100	0	0
Permanent Crops							
Tea	8,882	8,882	100	0	0	0	0
Coffee	1,200	1,200	100	0	0	0	0
Passionfruit	2,500	2,500	100	0	0	0	0

EMBU DISTRICT

TABLE 13b: DISPOSAL OF CROPS

AEZ: UM 1–2 | Survey Area 42

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	25,530	11,430	45	3,340	13	10,760	42
Maize & Beans	23,370	450	2	5,845	25	17,075	73
Beans	2,210	900	41	320	14	990	45
Bulrushmillet	100	0	0	70	70	30	30
Engl. Potatoes	18,490	0	0	14,160	77	4,330	23
Sweet Potatoes	4,340	0	0	3,200	74	1,140	26
Onions	218	0	0	160	73	58	27
Second Rains							
Maize	6,480	3,060	47	0	0	3,420	53
Maize & Beans	15,636	0	0	2,760	18	12,876	82
Maize & Sorgm	1,200	0	0	550	46	650	54
Beans	3,575	1,150	32	270	8	2,155	60
Engl. Potatoes	4,600	0	0	1,200	26	3,400	74
Permanent Crops							
Cassava	250	0	0	100	40	150	60

EMBU DISTRICT

TABLE 13c: DISPOSAL OF CROPS

AEZ: LM 3 (+ UM 4) — Survey Area 43

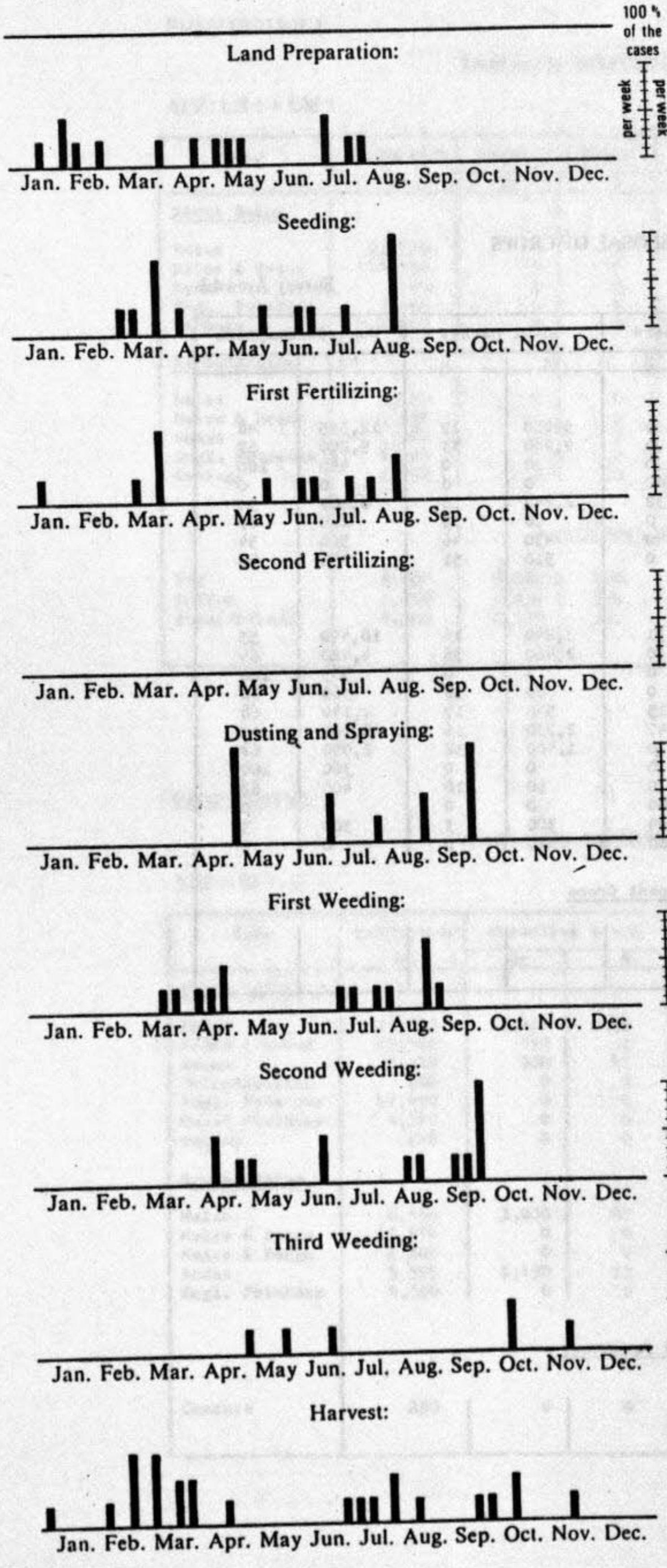
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	26,055	8,640	33	5,020	19	12,395	48
Maize & Beans	13,660	0	0	4,460	33	9,200	67
Maize & Cowps	440	0	0	0	0	440	100
Maize & Others	1,260	1,260	100	0	0	0	0
Beans	12,292	3,965	32	2,240	18	6,087	50
Bulrushmillet	270	0	0	90	33	180	67
Sorghum	930	0	0	430	46	500	54
Cowpeas	995	0	0	510	51	485	49
Second Rains							
Maize	19,850	6,120	31	3,240	16	10,490	53
Maize & Beans	6,880	0	0	2,460	36	4,420	64
Maize & BulMlt	385	0	0	0	0	385	100
Maize & Cowps	440	0	0	80	18	360	82
Maize & Others	3,160	480	15	540	17	2,140	68
Beans	16,599	7,760	47	2,730	16	6,109	37
Bulrushmillet	4,390	0	0	1,400	32	2,990	68
Sorghum	360	0	0	0	0	360	100
Cowpeas	495	0	0	90	18	405	82
Sunflower	120	120	100	0	0	0	0
Cotton	10,063	9,463	94	300	3	300	3
Tobacco	18,870	18,870	100	0	0	0	0
Permanent Crops							
Nil							

EMBU DISTRICT

TABLE 14a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 14

AEZ: LH 1 + UM 1 Survey Area 41 Sample Size: 28

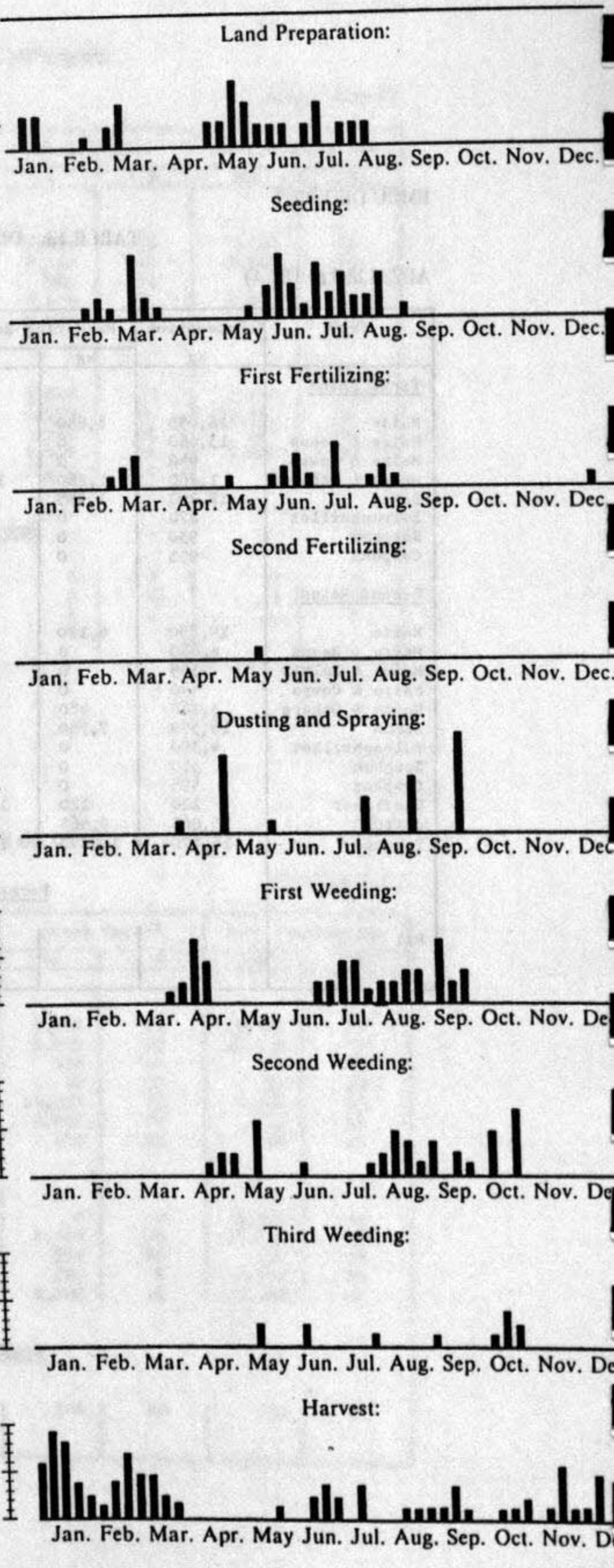


EMBU DISTRICT

TABLE 14b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 47[1)]

AEZ: LH 1 + UM 1 Survey Area 41 Sample Size: 28



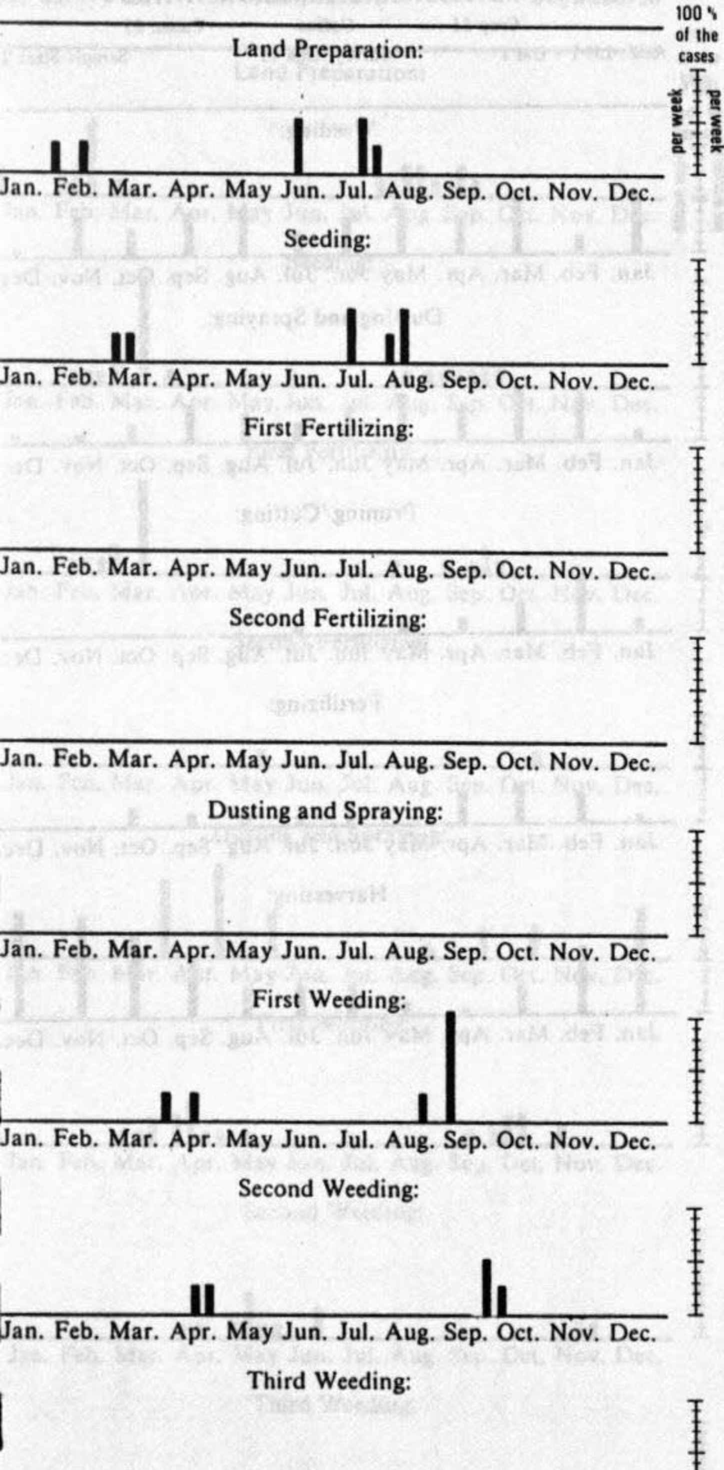
1) Maximum 30 per crop and season

MBU DISTRICT

TABLE 14c: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 7

EZ: LH 1 + UM 1 Survey Area 41 Sample Size: 28

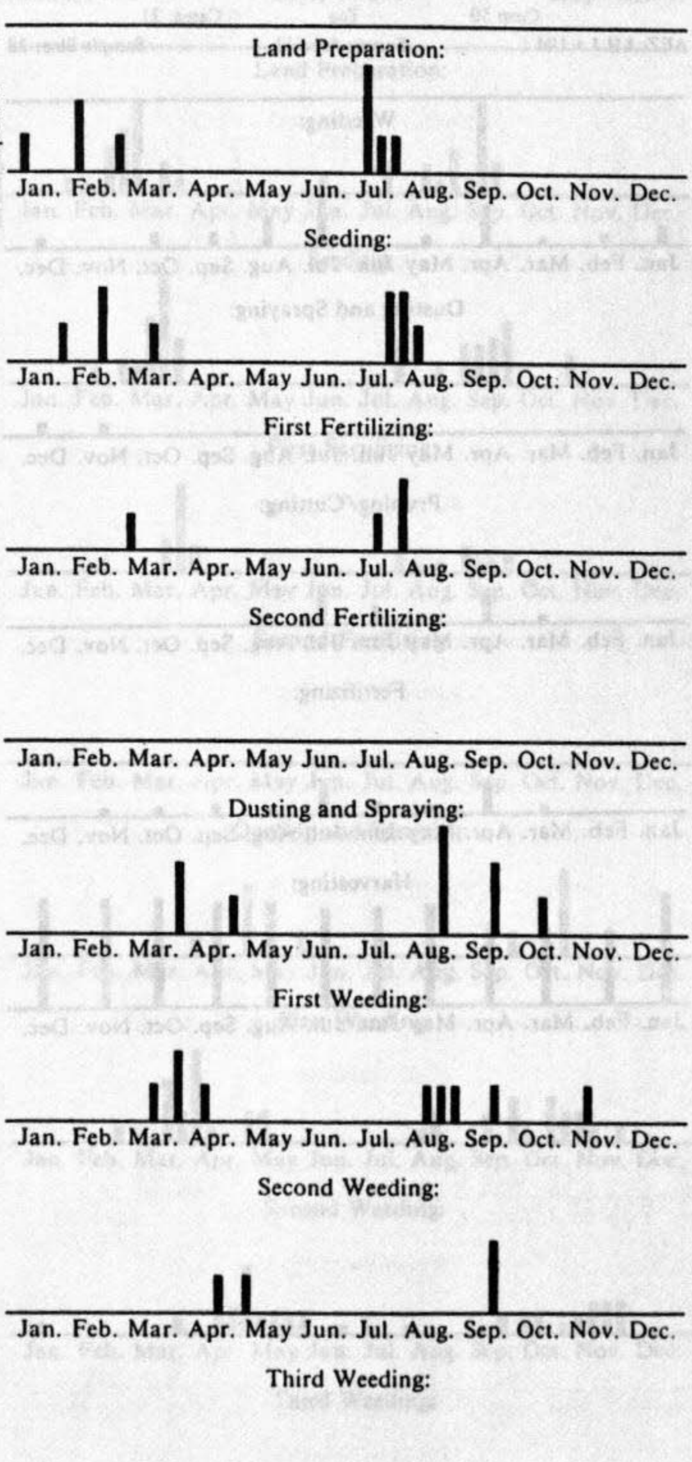


EMBU DISTRICT

TABLE 14d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 28 Engl. Potatoes Cases: 9

AEZ: LH 1 + UM 1 Survey Area 41 Sample Size: 28

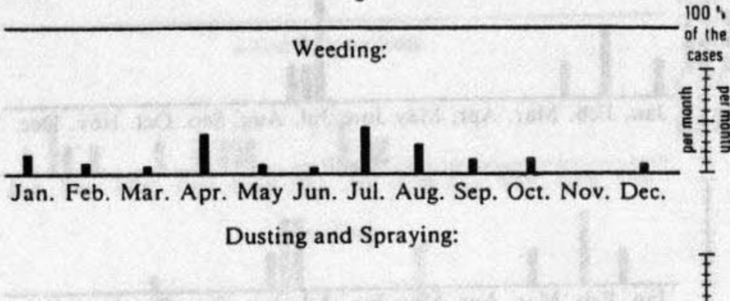


EMBU DISTRICT

TABLE 14e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 50 Tea Cases: 21

AEZ: LH 1 + UM 1 Survey Area 41 Sample Size: 28

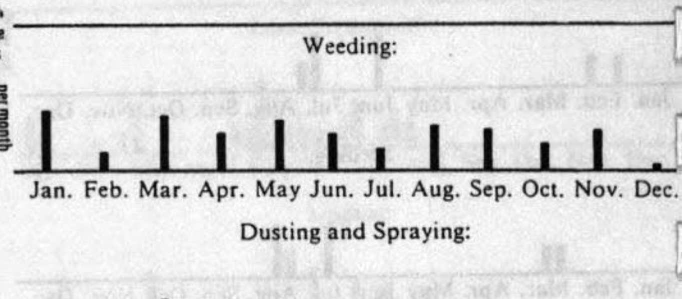


EMBU DISTRICT

TABLE 14f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 27

AEZ: LH 1 + UM 1 Survey Area 41 Sample Size: 28

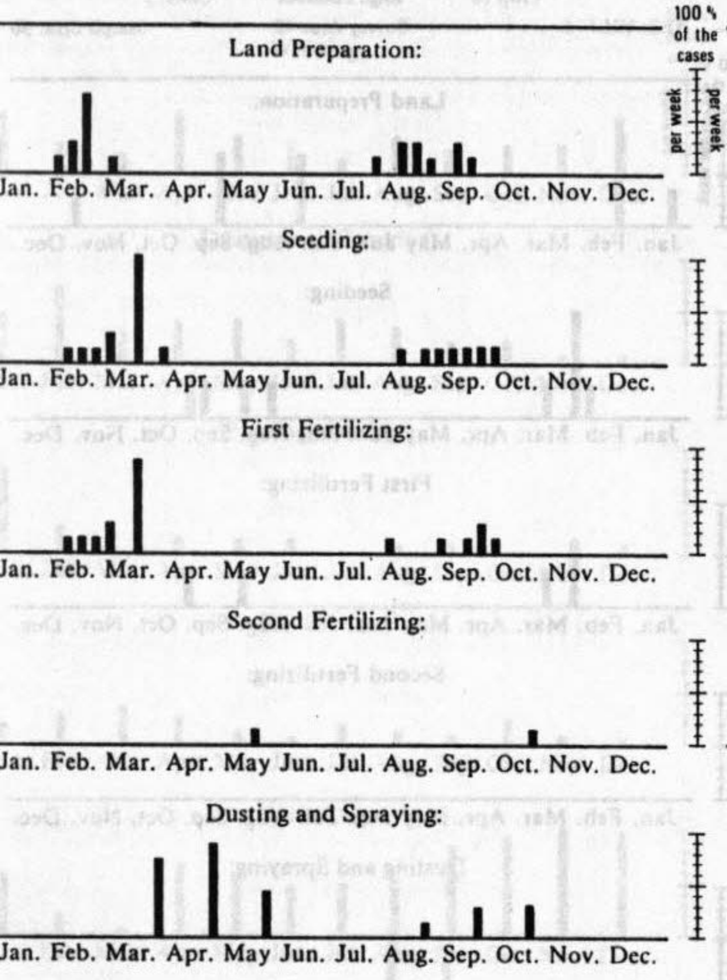


EMBU DISTRICT

TABLE 14g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 20

AEZ: UM 1–2 Survey Area 42 Sample Size: 30

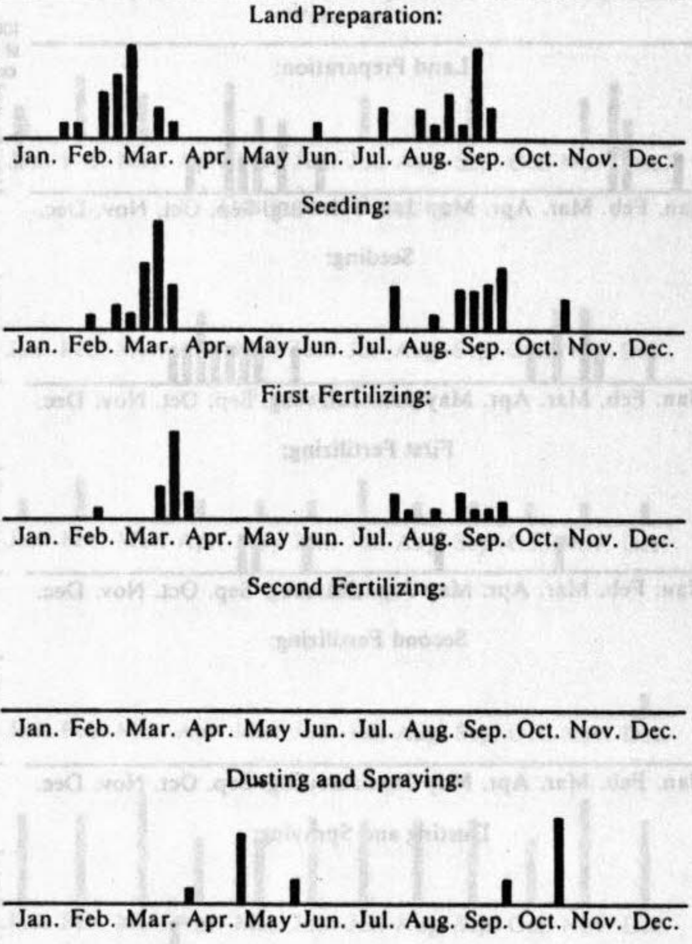


EMBU DISTRICT

TABLE 14h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 72[1)]

AEZ: UM 1–2 Survey Area 42 Sample Size: 30



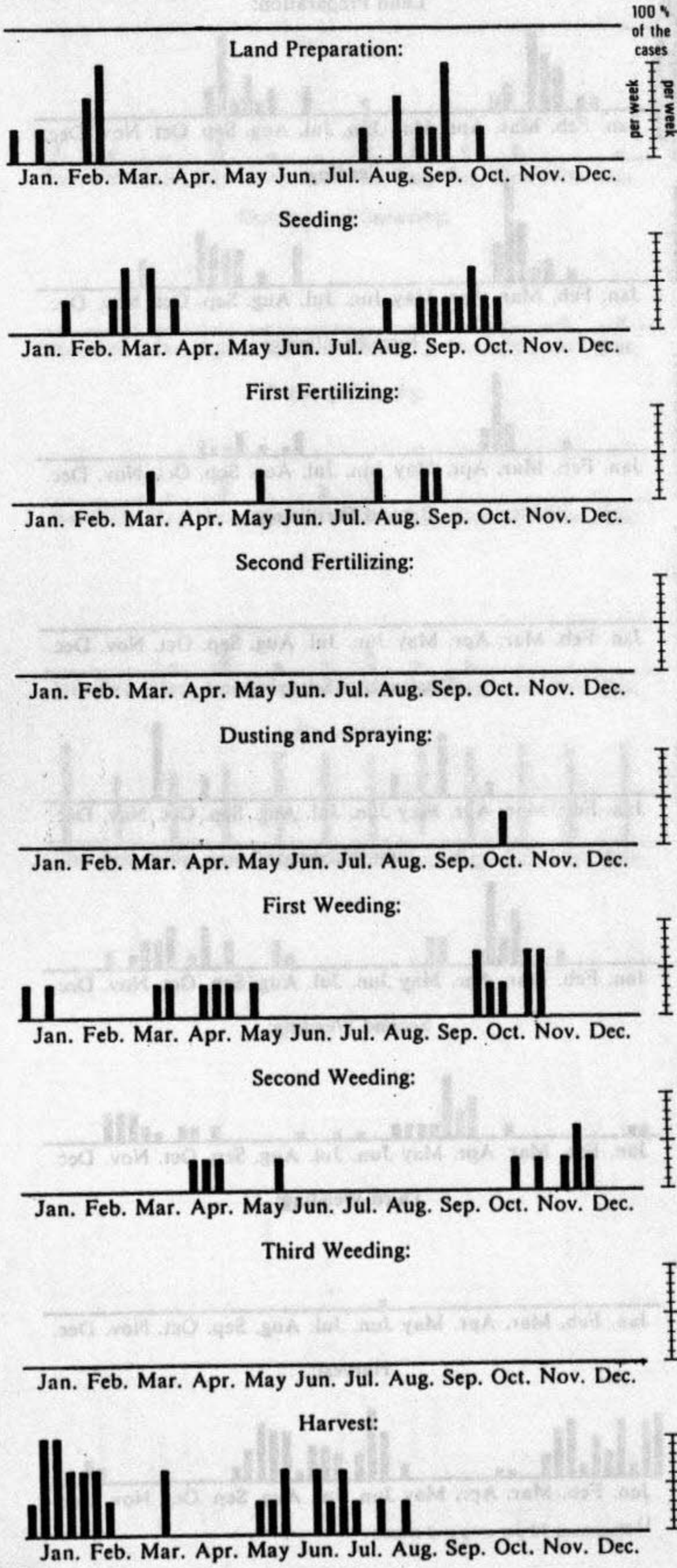
1) Maximum 30 per crop and season

EMBU DISTRICT

TABLE 14i: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 16

AEZ: UM 1–2 Survey Area 42 Sample Size: 30

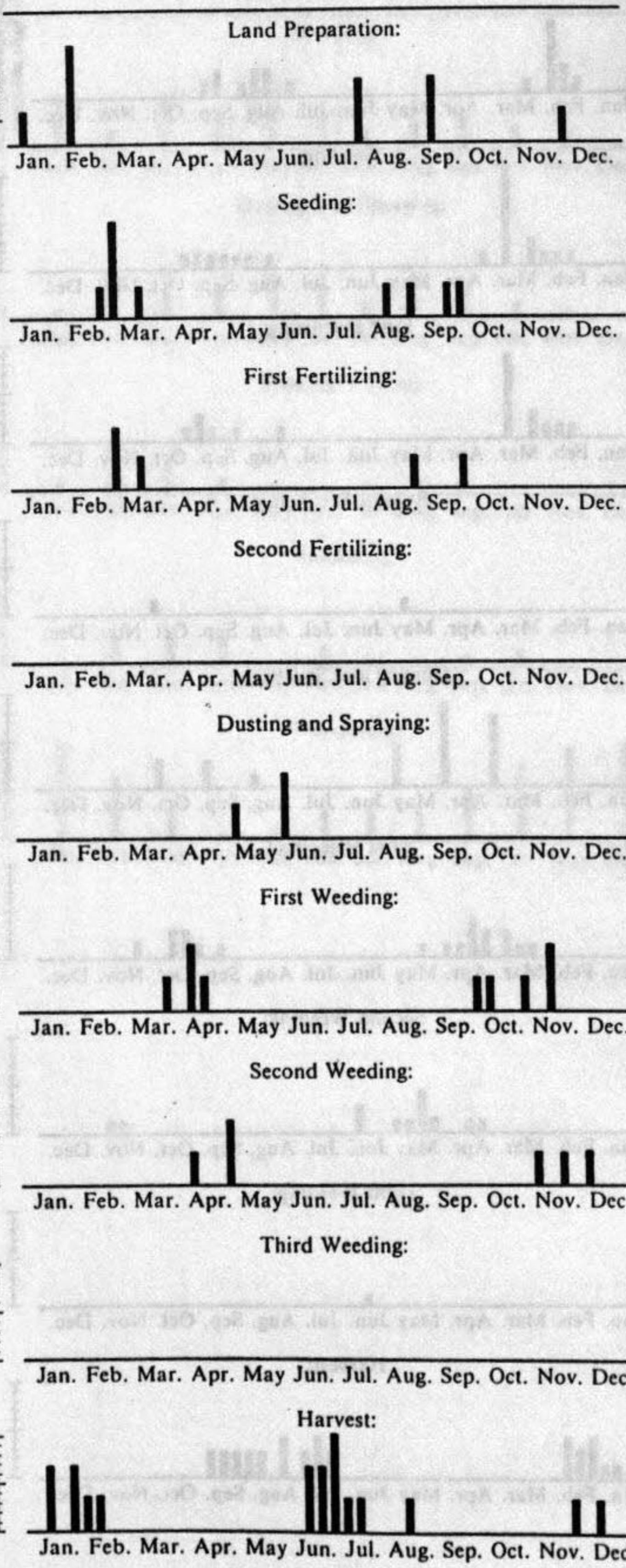


EMBU DISTRICT

TABLE 14j: DISTRIBUTION OF FARMING ACTIVITIES

Crop 28 Engl. Potatoes Cases: 9

AEZ: UM 1–2 Survey Area 42 Sample Size: 30

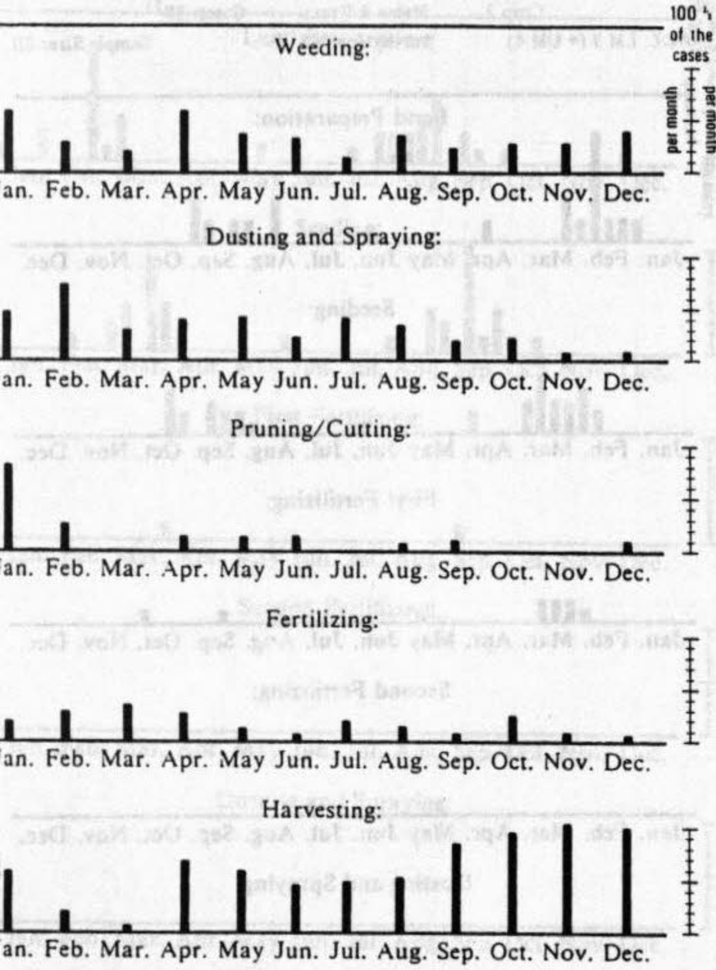


EMBU DISTRICT

TABLE 14k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 30

AEZ: UM 1–2 Survey Area 42 Sample Size: 30

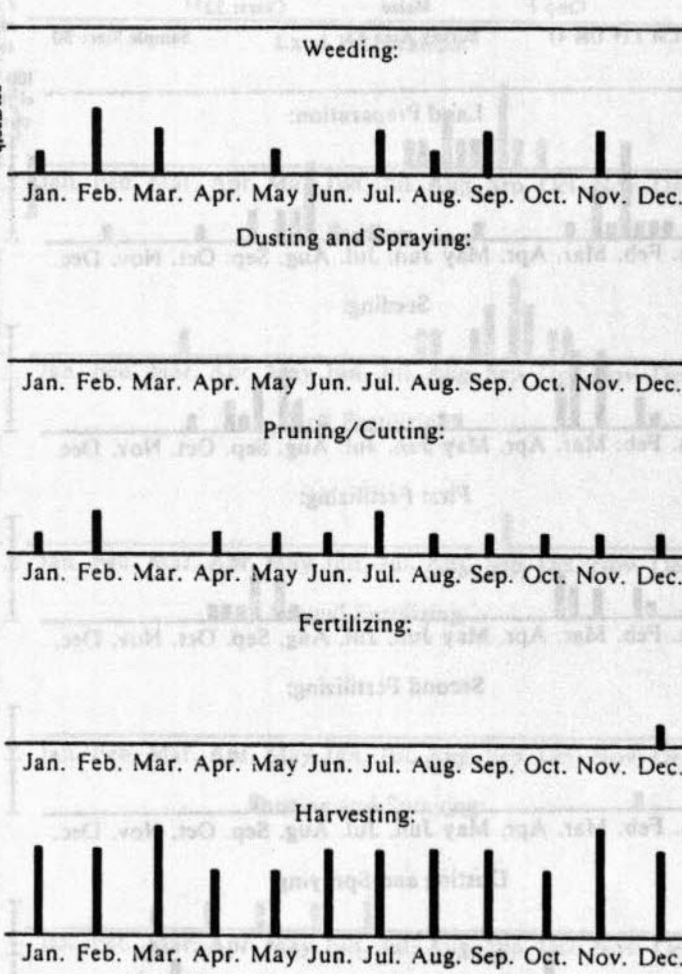


EMBU DISTRICT

TABLE 14l: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 5

AEZ: UM 1–2 Survey Area 42 Sample Size: 30

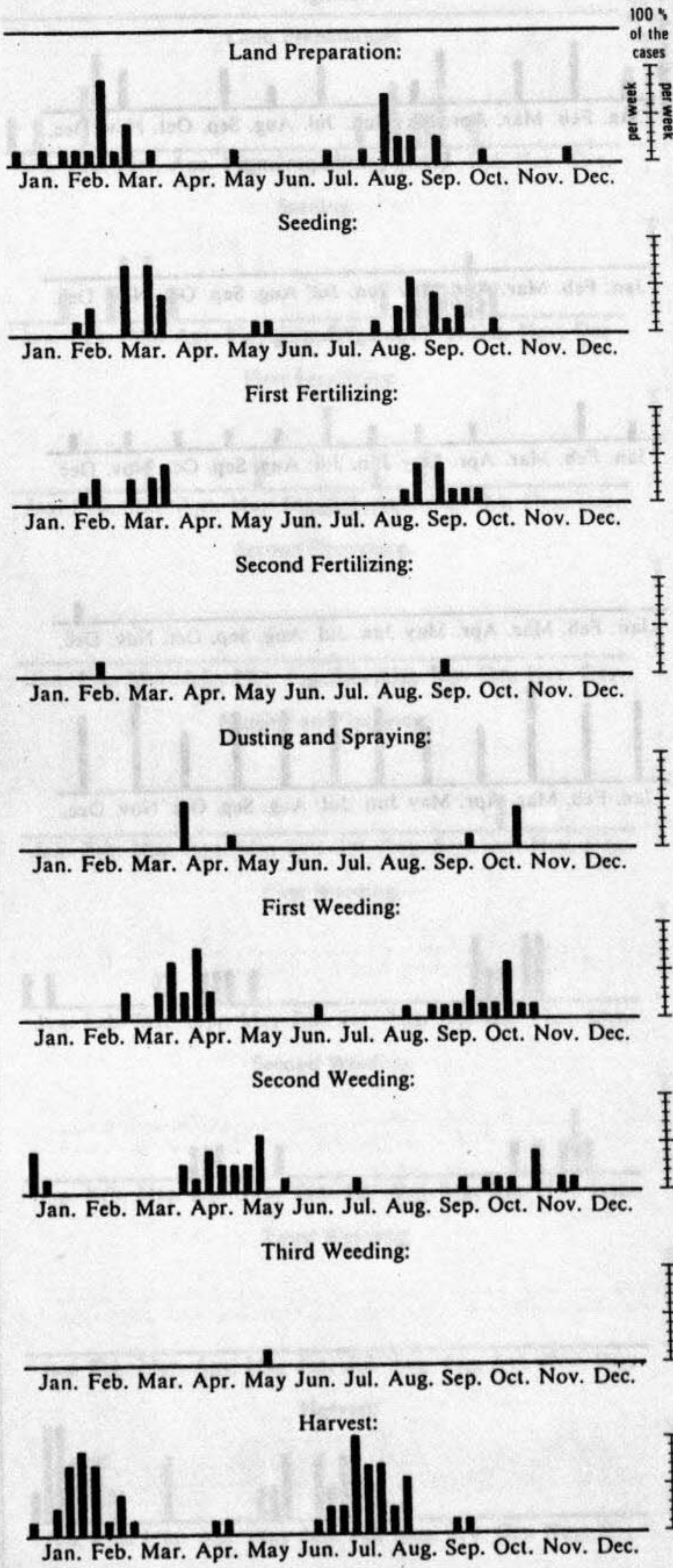


EMBU DISTRICT

TABLE 14m: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 32[1)]

AEZ: LM 3 (+ UM 4) Survey Area 43 Sample Size: 30



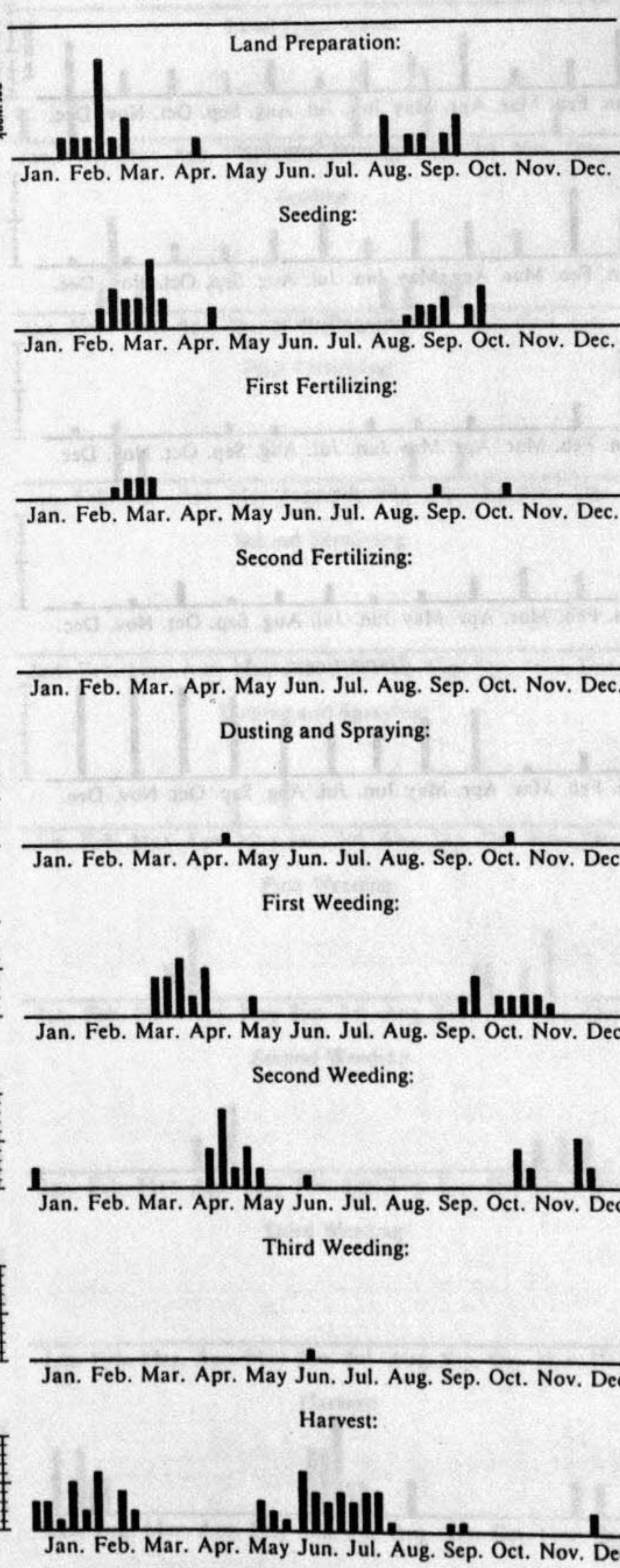
1) Maximum 30 per crop and season

EMBU DISTRICT

TABLE 14n: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 38[1)]

AEZ: LM 3 (+ UM 4) Survey Area 43 Sample Size: 30



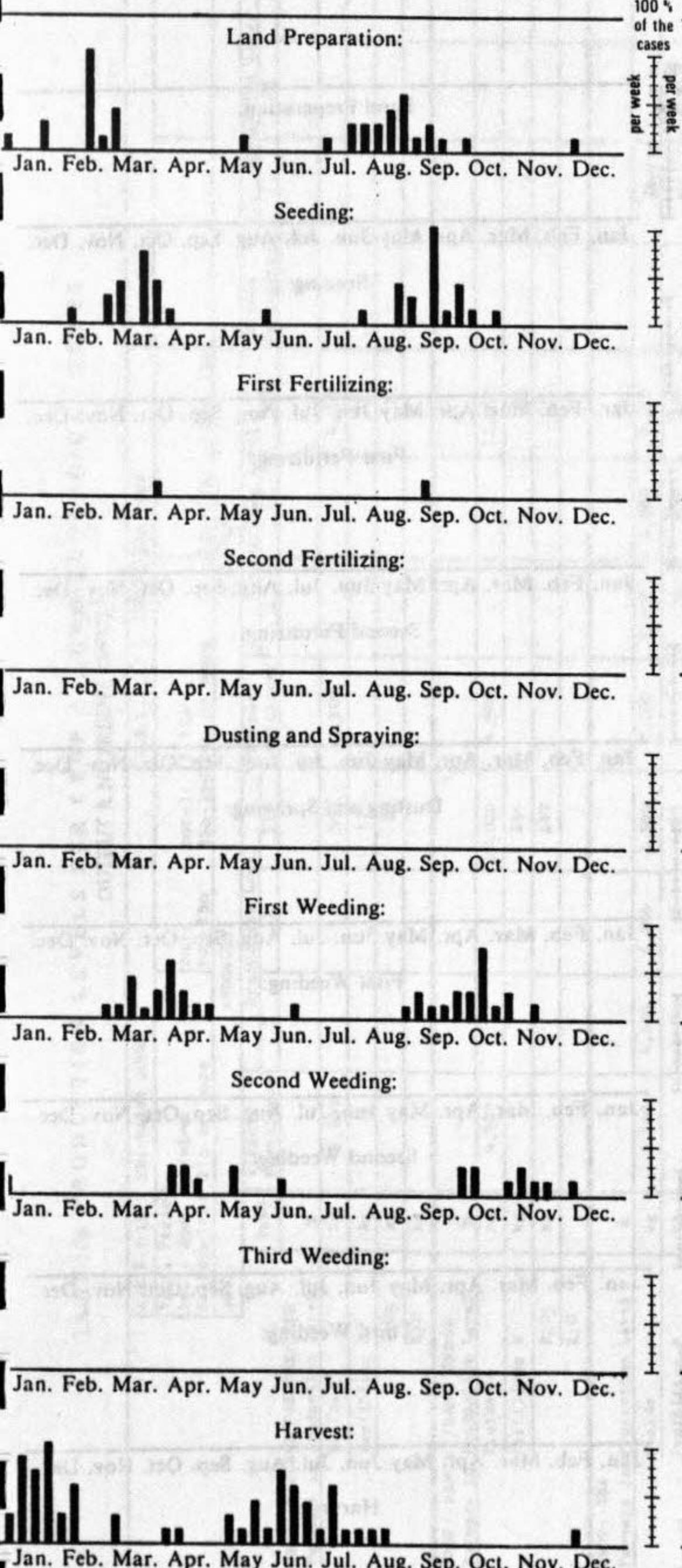
1) Maximum 30 per crop and season

EMBU DISTRICT

TABLE 14o: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 35[1]

AEZ: LM 3 (+ UM 4) Survey Area 43 Sample Size: 30



1) Maximum 30 per crop and season

EMBU DISTRICT

TABLE 14p: DISTRIBUTION OF FARMING ACTIVITIES

Crop 15 Bulrush Millet Cases: 13

AEZ: LM 3 (+ UM 4) Survey Area 43 Sample Size: 30

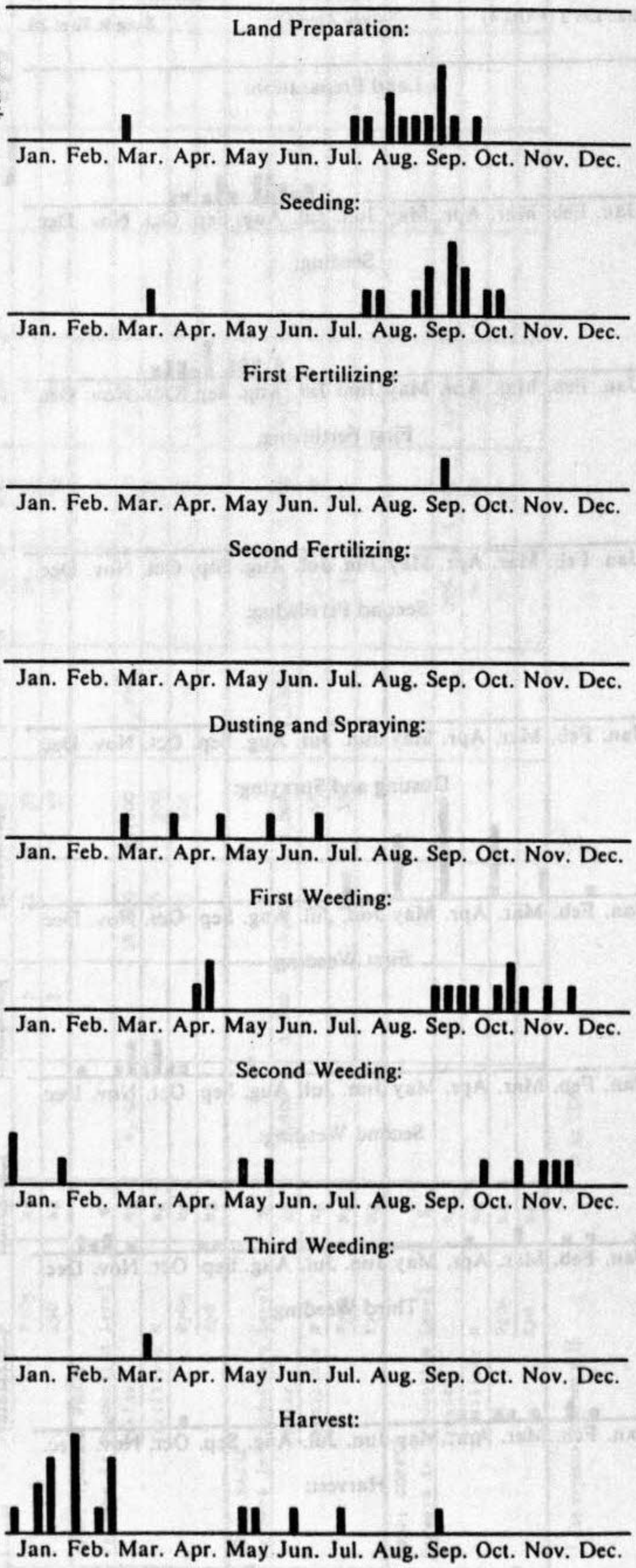


TABLE 15b: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES

OUTPUT & NUTRIENT INPUT

		A.E.Z.: LH 1 TEA-DAIRY ZONE				A.E.Z.: UM 1 COFFEE-TEA ZONE							
		Vegt. Period 1st + 2nd: 1/vl-m in Days,1st: 21o or more		2nd: 14o-15o	total: 35o-36o	f lim 2oo or more		13o-15o	33o-35o				
		Soil: ANDOSOLS				NITOSOLS							
		Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer	Production Level		
	Unit		I	II	III		I	II	III		I	II	III
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg					2,100	2,500/400	4,000/500					
Fertilizer N	kg						29	72					
P_2O_5	kg						21	61					
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg					1,100	1,000	1,800	2,000				
Fertilizer N	kg							34	43				
P_2O_5	kg							21	27				
K_2O													
CROP: POTATOES													
Farmers in Production Level	%												
Yields	kg	8,000	8,000	16,000	40,000	6,000	6,000	12,000	30,000				
Fertilizer N	kg			64	256			48	192				
P_2O_5	kg			48	192			54	216				
K_2O	kg												
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	5,000	5,000	18,000	45,000	3,700	5,000	18,000	35,000				
Fertilizer N	kg			74	228		9	95	208				
P_2O_5	kg			52	160		5	59	130				
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg					900	400	900	1,600				
Fertilizer N	kg								24				
P_2O_5	kg								105				
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg					10,000	8,000	20,000	40,000				
Fertilizer N	kg							66	200				
P_2O_5	kg							50	187				
K_2O	kg												

TABLE 15c: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT[1)]

		A.E.Z.: UM 2 MAIN COFFEE ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE			
		Vegt. Period 1st + 2nd: m + s/m in Days,1st: 16o or more		2nd: 1o5-115	total: —	m/s + s 12o-14o		1o5-115	—	s/m + s 1o5-115		85-1o5	—
		Soil: NITOSOLS				NITOSOLS				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 2)	kg	1,800			3,600	1,200			2,400	900			1,800
Fertilizer N	kg				100				66				50
P_2O_5	kg				50				33				25
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields 2)	kg	4,000			8,000	2,500			5,500	2,400			3,900
Fertilizer N	kg				222				166				83
P_2O_5	kg				111				83				41
K_2O													
CROP: COFFEE													
Farmers in Production Level	%												
Yields	kg		700	1,600	2,000		350	500	700				
Fertilizer N	kg		70	160	200		35	50	70				
P_2O_5	kg		90	100	100		90	90	90				
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	5,000	8,000	18,000	30,000								
Fertilizer N	kg		45	196	378								
P_2O_5	kg		18	78	150								
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												

1) for explanations see p.16 2) in kg TDN

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

		A.E.Z.: UM 2 MAIN COFFEE ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE			
		Vegt. Period 1st + 2nd: m + s/m in Days, 1st: 160 or more		2nd: 105-115	total: —	m/s + s 120-140		85-105	—	s/m + s 105-115		85-105	—
		Soil: NITOSOLS				NITOSOLS				FERRALSOLS			
			Production Level				Production Level				Production Level		
	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	2,100	2,500	4,000	5,000	2,100	1,500	2,500	3,000	1,000	1,300	2,500	2,800
Fertilizer N	kg		10	48	73			10	22		7	38	45
P_2O_5	kg		9	46	76			9	21		8	42	50
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg					2,400	1,800	2,800	3,500	1,600	2,000	2,500	3,200
Fertilizer N	kg							12	33		12	27	48
P_2O_5	kg							10	30		10	24	43
K_2O													
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg	2,100	2,500/400	4,000/500		2,100		2,500/400	3,000/400				
Fertilizer N	kg		29	72				29	41				
P_2O_5	kg		21	61				21	33				
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg	1,200	900	1,700	2,000	1,200	900	1,500	1,800	800	600	1,000	1,200
Fertilizer N	kg			24	38			15	30			9	19
P_2O_5	kg			15	24			9	18			6	12
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	1,000	700	900	1,500	800	400	600	1,200	600	450	600	900
Fertilizer N	kg				17				14				10
P_2O_5	kg				21				17				15
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

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

OUTPUT & NUTRIENT INPUT

		A.E.Z.: UM 2 MAIN COFFEE ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE			
		Vegt. Period 1st + 2nd: m + s/m in Days, 1st: 16o or more		2nd: 1o5-115	total: —	m/s + s 12o-14o		85-1o5	—	s/m + s 1o5-115		85-1o5	—
		Soil: NITOSOLS				NITOSOLS				FERRALSOLS			
		Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer	Production Level		
	Unit		I	II	III		I	II	III		I	II	III
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	3,300	6,000	12,000	30,000								
Fertilizer N	kg		22	70	213								
P_2O_5	kg		16	52	160								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O													
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	8,000	8,000	18,000	25,000								
Fertilizer N	kg			66	113								
P_2O_5	kg			62	106								
K_2O	kg												
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg					5,000		6,000	12,000	3,800	4,000	6,000	8,000
Fertilizer N	kg							4	28		1	9	17
P_2O_5	kg							6	42		1	15	29
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 15f: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES

OUTPUT & NUTRIENT INPUT

		A.E.Z.: LM 3 LOWER MIDLAND COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 LIVESTOCK-MILLET ZONE			
		Vegt. Period 1st + 2nd: s + s in Days,1st: 85-1o5		2nd: 8o-95	total: —	s/vs + vs/s 75-85		55-75	—	vs/s + vs 55-75		45-55	—
		Soil: FERRALSOLS				FERRALSOLS				CAMBISOLS			
			Production Level				Production Level				Production Level		
	Unit	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III	Without Fertilizer	I	II	III
CROP: NATURAL PASTURE													
Farmers in Production Level	%												
Yields	kg	600			1,200	450			900	450			900
Fertilizer N	kg				33				25				25
P_2O_5	kg				16				12				12
K_2O	kg												
CROP: BANA GRASS													
Farmers in Production Level	%												
Yields	kg	1,100			2,600	900			2,000				
Fertilizer N	kg				83				60				
P_2O_5	kg				41				30				
K_2O													
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg	450	350	900	1,600								
Fertilizer N	kg			50	137								
P_2O_5	kg			43	108								
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	1,100	1,200	2,000	2,900	1,100	900	1,500	2,000				
Fertilizer N	kg		3	23	45			10	23				
P_2O_5	kg		2	22	43			11	25				
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	1,600	1,800	2,800	3,800								
Fertilizer N	kg		6	36	66								
P_2O_5	kg		5	33	60								
K_2O	kg												
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg	1,300	700	1,500	1,700	1,100	400	1,000	1,500	700	200	700	1,100
Fertilizer N	kg			8	12				12				12
P_2O_5	kg			6	10				10				10
K_2O	kg												

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

OUTPUT & NUTRIENT INPUT

A.E.Z.: LM 3 LOWER MIDLAND COTTON ZONE, Vegt. Period 1st + 2nd: s + s; in Days, 1st: 85-1o5; 2nd: 8o-95; total: —; Soil: FERRALSOLS

	Unit	Without Fertilizer	Production Level I	Production Level II	Production Level III
CROP: MAIZE & BEANS					
Farmers in Production Level	%				
Yields	kg	1,100	1,200/300	2,000/400	2,900/400
Fertilizer N	kg		17	42	64
P_2O_5	kg		11	31	52
K_2O	kg				
CROP: BEANS					
Farmers in Production Level	%				
Yields	kg	700	1,000	1,200	1,300
Fertilizer N	kg		14	24	28
P_2O_5	kg		11	18	21
K_2O					
CROP: PIGEON PEAS					
Farmers in Production Level	%				
Yields	kg	650	450	900	1,200
Fertilizer N	kg				20
P_2O_5	kg				20
K_2O	kg				
CROP: COW PEAS					
Farmers in Production Level	%				
Yields	kg				
Fertilizer N	kg				
P_2O_5	kg				
K_2O	kg				
CROP: GRAMS					
Farmers in Production Level	%				
Yields	kg	1,000	400	1,000	1,500
Fertilizer N	kg				13
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				

A.E.Z.: LM 4 MARGINAL COTTON ZONE, s/vs + vs/s 75-85; 55-75; —; Soil: FERRALSOLS

	Unit	Without Fertilizer	Production Level I	Production Level II	Production Level III
CROP: MAIZE & BEANS					
Farmers in Production Level	%				
Yields	kg				
Fertilizer N	kg				
P_2O_5	kg				
K_2O	kg				
CROP: BEANS					
Farmers in Production Level	%				
Yields	kg	700	1,000	1,000	1,000
Fertilizer N	kg		14	14	14
P_2O_5	kg		11	11	11
K_2O					
CROP: PIGEON PEAS					
Farmers in Production Level	%				
Yields	kg	400	400	700	1,000
Fertilizer N	kg				20
P_2O_5	kg				20
K_2O	kg				
CROP: COW PEAS					
Farmers in Production Level	%				
Yields	kg				
Fertilizer N	kg				
P_2O_5	kg				
K_2O	kg				
CROP: GRAMS					
Farmers in Production Level	%				
Yields	kg	900	300	800	1,000
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				

A.E.Z.: LM 5 LIVESTOCK-MILLET ZONE, vs/s + vs 55-75; 45-55; —; Soil: CAMBISOLS

	Unit	Without Fertilizer	Production Level I	Production Level II	Production Level III
CROP: MAIZE & BEANS					
Farmers in Production Level	%				
Yields	kg				
Fertilizer N	kg				
P_2O_5	kg				
K_2O	kg				
CROP: BEANS					
Farmers in Production Level	%				
Yields	kg	700	400	700	700
Fertilizer N	kg				-
P_2O_5	kg				-
K_2O					
CROP: PIGEON PEAS					
Farmers in Production Level	%				
Yields	kg				
Fertilizer N	kg				
P_2O_5	kg				
K_2O	kg				
CROP: COW PEAS					
Farmers in Production Level	%				
Yields	kg				
Fertilizer N	kg				
P_2O_5	kg				
K_2O	kg				
CROP: GRAMS					
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 15h: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

		A.E.Z.: LM 3 LOWER MIDLAND COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 LIVESTOCK-MILLET ZONE			
Vegt. Period 1st + 2nd: in Days, 1st:		s + s 85-105		2nd: 80-95	total: —	s/vs + vs/s 75-85		55-75	—	vs/s + vs 55-75		45-55	—
Soil:		FERRALSOLS				FERRALSOLS				CAMBISOLS			
	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	500		600	1,000	700		600	800	400	400	500	500
Fertilizer N	kg			3	17				3			3	3
P_2O_5	kg			5	25				5			4	4
K_2O	kg												
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	700		800	1,600	750		800	1,200				
Fertilizer N	kg			4	36			2	18				
P_2O_5	kg			4	34			2	17				
K_2O													
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	3,800		6,000	10,000	4,000	3,000	5,000	8,000				
Fertilizer N	kg			86	242			8	32				
P_2O_5	kg			68	192			7	28				
K_2O	kg												
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg	3,000	4,000	10,000	15,000	3,000	4,000	8,000	10,000				
Fertilizer N	kg		4	29	50		4	16	29				
P_2O_5	kg		6	41	71		6	23	41				
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												

MERU DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

On the south-eastern slope of Mt. Kenya, the main agro-ecological zones form a typical pattern from Embu District to Meru District. However, the subzones and the diagrams show that the contrast between wet and dry seasons becomes more accentuated, which makes it more difficult for permanent crops like coffee to survive. The result is that a higher rainfall, and careful water and soil conservation is necessary to overcome the drought periods for tea, coffee, bananas, cotton and other crops which need more than one season for full growth. These measures are also beneficial for the annual crops, because the rainy seasons have high rainfall for a short time and then end abruptly.

On the northern side of Mt. Kenya there are typical wheat and barley zones (UH 3, LH 3). The rainfall is very scattered, due to the rain shadow of the mountain and the effects of the western Kenya rainfall pattern and is hazardous for maize and other typical small-holder crops. For this reason, the area is more suitable for large-scale agriculture.

The extension of cultivation north of the Nyambeni Range towards Isiolo is now reaching its limit. It can be only pushed further north if new crops like very early maturing millets are introduced.

In the lower part of Meru District, there is no reliable rainfall station with a long period of records in the livestock-millet zone LM 5 or L 5. In order to show the difficult climate there, a station just beyond the boundary of neighbouring Kitui district was used in a diagram (see Tharaka Chief's Camps): The first rains are relatively reliable, the second rains, however, show great irregularity towards the end of November, i.e. dry spells occur frequently. However a dry decade does not have a very great effect if the previous one was wet. To show this influence, we have drawn additional lines between the decades in the diagram, to represent half of the probability of twenty days (also moving ten to ten days). But even if we consider the reliability in such overlapping 20 day periods the uncertainity is still too big a risk for cotton or maize there, and therefore the area is placed in zone 5, where millet and sorghum should be the main crops.

MERU 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	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Monthly rainfall in mm											
8937002	Timau, Marania	43	Average	884	41	31	93	152	75	18	25	22	16	130	180	101
2 499 m			60 % rel.1)	741	17	14	67	116	28	5	5	11	0	105	129	35
8937019	Miatheni	27	Av.	1 624	33	20	127	372	167	24	13	12	17	270	415	157
1 433 m			60 %	1 369	42	0	31	305	54	0	3	0	0	59	312	40
8937021	Oringo Seed Farm	28	Av.	1 300	40	31	106	285	110	5	6	3	35	215	352	112
1 430 m			60 %	888	39	7	29	192	50	1	1	0	0	47	252	34
8937031	Muthara	20	Av.	1 164	27	34	106	249	96	17	7	8	9	228	288	84
1 478 m			60 %	763	10	4	54	163	33	0	0	0	0	41	150	35
8937034	Timau, Ardencaple F.	19	Av.	698	15	17	51	126	87	48	49	72	45	77	77	36
2 286 m			60 %	516	6	4	15	62	73	33	18	36	15	40	41	17
8937038	Meru Forest Station	24	Av.	1 403	57	48	136	316	157	11	13	10	15	184	310	144
1 585 m			60 %	1 151	27	15	69	252	94	3	0	1	3	118	271	56
8937041	Lare	10	Av.2)	2 640	69	94	207	653	340	30	75	30	35	361	498	245
1 775 m			60 %	1 628	14	24	58	360	62	1	14	0	12	149	425	28
8937051	Meru, Agr. Departm.	14	Av.	1 602	58	24	106	353	150	10	18	19	11	317	375	161
1 555 m			60 %	1 354	28	20	60	297	88	4	5	4	5	226	248	62
8937053	Mikinduri, Cath. Miss.	22	Av.	2 221	79	43	179	520	247	22	16	17	21	318	557	202
1 405 m			60 %	1 875	31	14	98	421	149	1	3	6	0	149	421	128
8937060	Muchiimukuru	26	Av.	2 525	37	70	216	666	254	22	25	45	45	495	528	126
1 905 m			60 %	2 046	24	15	146	627	192	15	22	18	32	206	391	63
9037011	Mwea, Mojwa (Mayna)	47	Av.	1 479	61	33	125	316	174	17	12	17	23	250	318	135
1 158 m	Cath. Mission		60 %	1 220	23	10	46	286	114	0	0	0	4	131	276	79
9037034	Chuka	30	Av.	1 500	43	32	134	369	177	20	30	32	25	184	332	123
1 494 m			60 %	1 190	22	1	64	299	116	6	20	12	13	133	300	62
9037065	Magutuni	17	Av.	1 323	34	20	137	405	109	7	5	13	2	171	275	142
1 158 m																
9037074	Nkubu Secondary	23	Av.	1 765	49	31	141	470	174	12	19	22	23	251	425	142
1 527 m	School		60 %	1 525	25	22	103	340	66	6	13	9	14	191	380	38
9037085	Mitunguu	19	Av.2)	1 401	21	24	149	305	142	9	7	10	9	213	374	137
1 189 m			60 %	1 078	6	1	67	206	50	0	0	1	3	94	294	14
9037086	Nkuriga	18	Av.	1 859	55	48	148	369	228	16	18	19	36	307	458	160
1 829 m			60 %	1 610	26	18	76	332	172	8	9	10	18	218	341	120
9037102	Marimba Centre	26	Av.	2 208	75	72	187	469	236	18	18	21	35	34	511	221
1 844 m			60 %	1 840	45	49	101	398	189	17	5	13	17	272	394	104
9037123	Chogoria For. St.	18	Av.	1 979	61	41	163	482	229	55	82	71	37	315	350	91
1 372 m			60 %	1 625	39	10	82	439	136	36	32	26	26	195	272	67
9037124	Mariene Coffee	18	Av.2)	1 914	62	77	157	398	184	22	13	20	27	361	443	154
1 524 m	Sub.-Station		60 %	1 374	17	28	69	316	84	10	9	10	16	170	294	80
9037160	Marimanti	12	Av.2)	879	19	33	79	268	97	10	2	1	3	88	225	54
610 m																
9038006	Tharaka Chief's Camp			see Kitui District												
914 m																

1) These figures of rainfall reliability should be exceeded normally in 6 out of 10 years
2) High figures because of unusually wet years

MERU DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ[1)]	Kind of records	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Years of rec.
8937003	Isiolo,	LM	Mean max.	30.8	32.3	31.7	30.1	29.9	29.5	28.9	29.4	30.8	30.9	28.6	29.0	30.2	
1 104 m	Part Time	6	Mean temp.	23.2	24.3	24.6	23.9	23.8	23.2	22.6	22.9	23.8	24.2	22.6	22.2	23.5	21
	Met. Station	lp	Mean min.	15.7	16.3	17.6	17.8	17.8	16.9	16.3	16.5	16.9	17.6	16.6	15.5	16.8	
	(Isiolo Distr.)		Abs. min.	10.6	9.0	12.2	13.0	14.4	13.3	11.1	12.2	13.9	13.5	12.4	11.1	9.0	
8937022	Nanyuki,	LH	Mean max.	24.8	25.9	25.3	23.5	23.1	23.1	22.5	22.8	23.0	23.5	22.1	22.9	23.5	
1 947 m	Met. Station	4	Mean temp.	17.7	18.5	16.4	13.1	13.2	14.6	14.0	14.4	15.1	14.9	12.7	14.9	16.1	30
	(Laikipia	lp	Mean min.	7.1	7.4	8.9	10.4	9.9	8.5	8.5	8.4	7.9	8.6	9.4	8.0	8.6	
	District)		Abs. min.	0.7	2.0	4.2	6.1	5.0	3.9	3.6	3.3	4.1	3.7	4.4	1.9	0.7	
8937038	Meru	LH	Mean max.	23.0	23.9	23.9	22.9	22.0	22.0	21.5	21.0	21.7	22.4	22.8	20.7	22.3	
1 765 m	Forest St.	2	Mean temp.	16.3	16.8	17.7	17.1	16.7	15.8	15.5	15.6	16.2	16.7	17.0	15.7	16.4	5
	(operating	lp	Mean min.	9.6	9.8	11.5	11.4	11.5	9.7	9.6	10.2	10.8	11.1	11.2	10.7	10.6	
	to 1963)		Abs. min.	4.4	5.0	4.4	7.2	7.2	5.6	4.4	4.4	5.6	7.2	4.4	7.2	4.4	
9037124	Marienne	UM	Mean max.	24.1	25.1	25.1	23.7	22.8	21.7	20.7	21.4	23.9	24.3	22.5	22.9	23.2	
1 524 m	Coffee	2	Mean temp.	17.5	18.1	18.4	17.8	16.9	15.8	15.3	15.7	17.1	18.2	17.5	17.1	17.1	10
	Research	hp	Mean min.	11.0	11.1	11.7	11.9	11.1	10.0	9.9	10.0	10.3	12.2	12.5	11.3	11.1	
	Sub -Station		Abs. min.	3.0	7.8	7.0	6.5	7.5	5.0	5.8	5.2	5.0	7.4	9.5	8.5	3.0	

Temperature in °C

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	60 % reliability of rainfall[1)] 2nd rains in mm	60 % reliability of growing period 1st rains[2)] in days	60 % reliability of growing period 2nd rains in days	60 % reliability of growing period Total[3)] in days
TA I + II Tropical Alpine Zone				National Park					
UH 0 Forest Zone				Forest Reserve					
UH 1 Sheep and Dairy Zone				Forest Reserve, important as a catchment area					
UH 2 Pyrethrum-Wheat Zone	l/m i m	2 440–2 740	13.7–11.7	950–1 600	450– 700	400–550	175 or more	135–155	310–330
	vl i			Steep slopes, Forest Reserve					
UH 3 Upper Wheat-Barley Zone	fm + m/s	2 230–2 900	14.9–10.5	700–1 000	280– 500	280–400	115–175	115–135	–
	(l/m) i f(s)			850–1 000	420– 550	220–270	175 or more	75–115	250–290
UH 4 Upper Highland Ranching Zone	b r			Not suitable for rainfed agriculture					
LH 1 Tea-Dairy Zone	l/vl – m	1 830–2 200	17.4–14.9	Forest Reserve					
	l i m			Small, transitional and partly Forest Reserve					
	m/l i m			1 700–2 600	700–1 100	600–900	165 or more	135–155	300–320
LH 2 Wheat/Maize-Pyrethrum Zone	m + m	1 890–2 130	17.0–15.4	1 200–1 800	450– 650	400–580	135–155	135–155	–
LH 3 Wheat/(Maize)-Barley Zone	f(m) i (s/vs)	2 070–2 220	15.8–15.0	750– 900	350– 400	180–220	115–175	75– 85	190–260
	m+m/s or s/m			700–1 400	280– 450	300–350	135–155	105–135	–

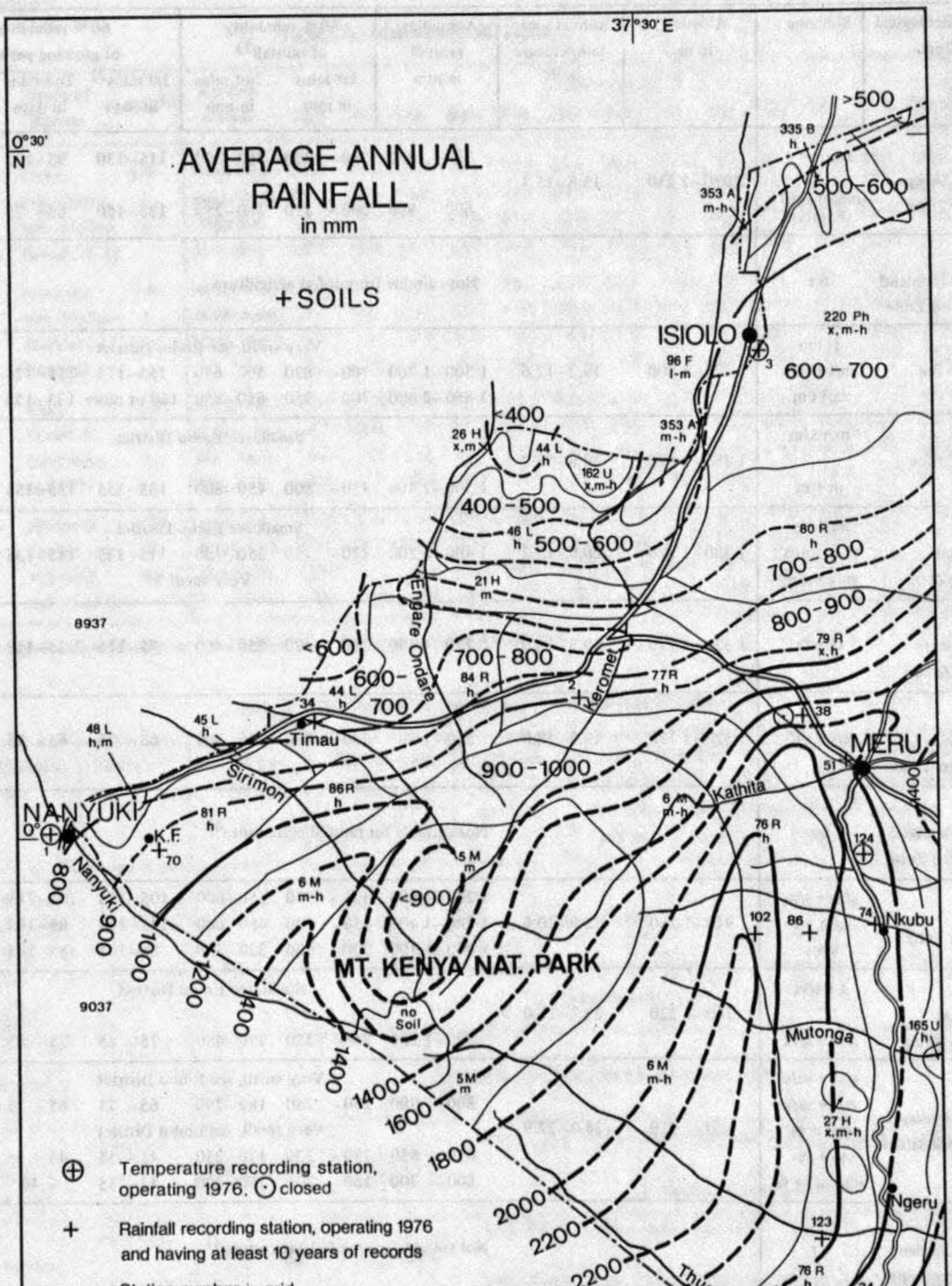
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1]		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains[2] in days	2nd rains in days	Total[3] in days
LH 4 Cattle-Sheep-Barley Zone	(m/s) + s	2 070–2 210	15.8–15.1	700– 850	250– 300	260–300	115–130	85–105	–
	(m/s or s/m) i + (vs/s)			600– 800	300– 350	180–250	135–150	65– 75	–
LH 5 Lower Highland Ranching Zone	b r			Not suitable for rainfed agriculture					
UM 1 Coffee-Tea Zone	fl i m	1 520–1 800	19.2–17.6	Very small, see Embu District					
	m/l + m/s			1 500–1 700	700– 820	500–630	155–175	115–135	–
	m/l i m			1 650–2 400	700– 850	650–850	160 or more	135–155	–
UM 2 Main Coffee Zone	m + s/m	1 280–1 680	20.6–18.2	Small, see Embu District					
	m + m			1 500–2 400	450– 800	450–800	135–155	135–155	–
UM 3 Marginal Coffee Zone	m/s + s	1 280–1 520	20.6–19.2	Small, see Embu District					
	m/s + m/s			1 400–2 200	420– 750	350–730	115–135	115–135	–
	m/s + s/m			Very small					
UM 4 Sunflower-Maize Zone	fs + fs	1 520–1 770	19.3–18.0	750–1 600	250– 400	250–450	75–115	75–115	–
UM 5 Livestock-Sorghum Zone	vs/s + vs/s	1 520–1 770	19.3–18.0	500–1 100	230– 300	240–300	65– 75	65– 75	–
UM 6 Upper Midland Ranching Zone	b r			Not suitable for rainfed agriculture[4]					
LM 3 Cotton Zone	s/m + s/m	910–1 280	22.9–20.6	1 200–1 600	400– 500	550–600	105–115	105–115	–
	s/m + s			1 200–1 400	450– 600	450–600	105–115	85–105	–
	s + s			1 000–1 400	300– 500	320–500	85–105	85–105	–
LM 4 Marginal Cotton Zone	s + s/vs	760–1 220	23.7–21.0	Small, see Embu District					
	s/vs + s/vs			800–1 200	250– 350	250–450	75– 85	75– 85	–
LM 5 Lower Midland Livestock-Millet Zone	s/vs + vs/s	700– 910	24.0–22.9	Very small, see Embu District					
	vs/s + vs/s			800– 900	230– 250	180–200	65– 75	65– 75	–
	vs/s + vs			Very small, see Embu District					
	vs + vs			650– 850	180– 230	170–250	45– 55	45– 55	–
	vs+i or i+vs			600– 700	180– 200	150–200	45– 55	< 40	–
LM 6 Lower Midland Ranching Zone	b r			Not suitable for rainfed agriculture[4]					
IL 5 Lowland Livestock-Millet Zone	vs/s + vs/s	610– 700	24.7–24.1	700– 850	200– 250	200–250	55– 75	55– 75	–
	vs + vs			650– 750	180– 200	150–200	40– 55	40– 55	–
	vs+i or i+vs			500– 750	130– 190	140–190	40– 55	< 40	–
IL 6 Lowland Ranching Zone	b r			Not suitable for rainfed agriculture					

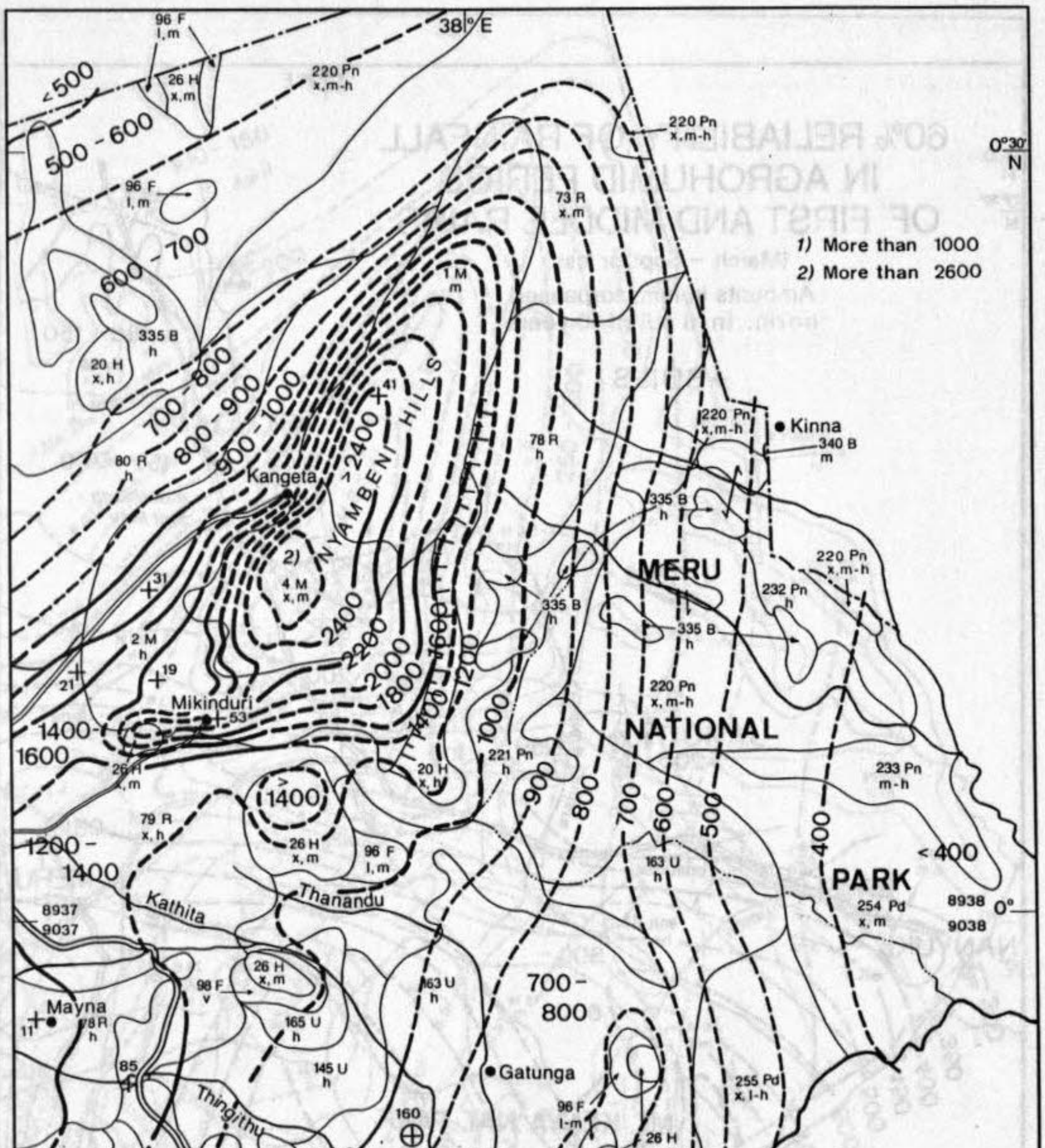
1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants

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

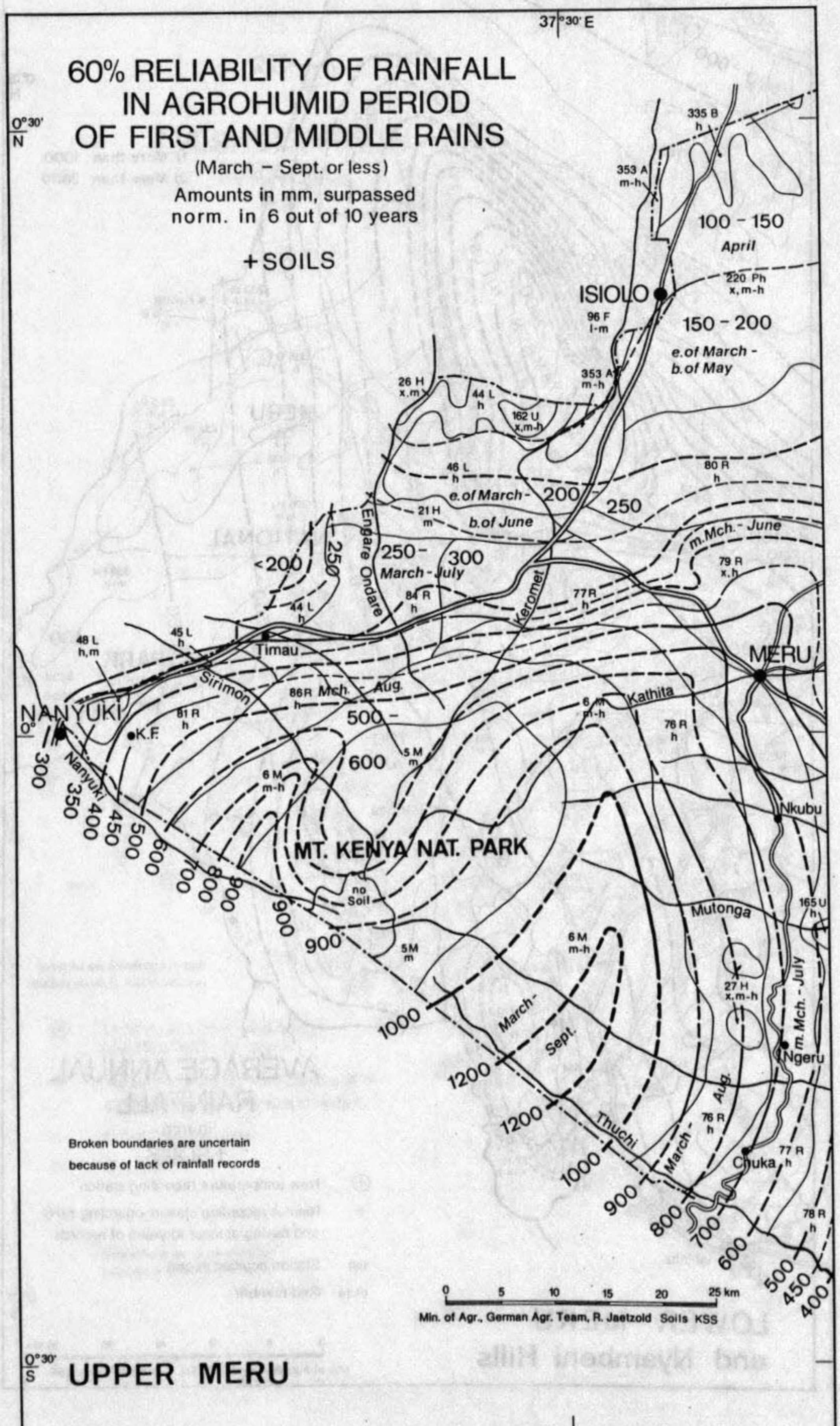
3) Only added if rainfall continues at least for survival ($> 0.2\ E_0$) of most long term crops

4) Except with runoff catching techniques (see Machakos District)

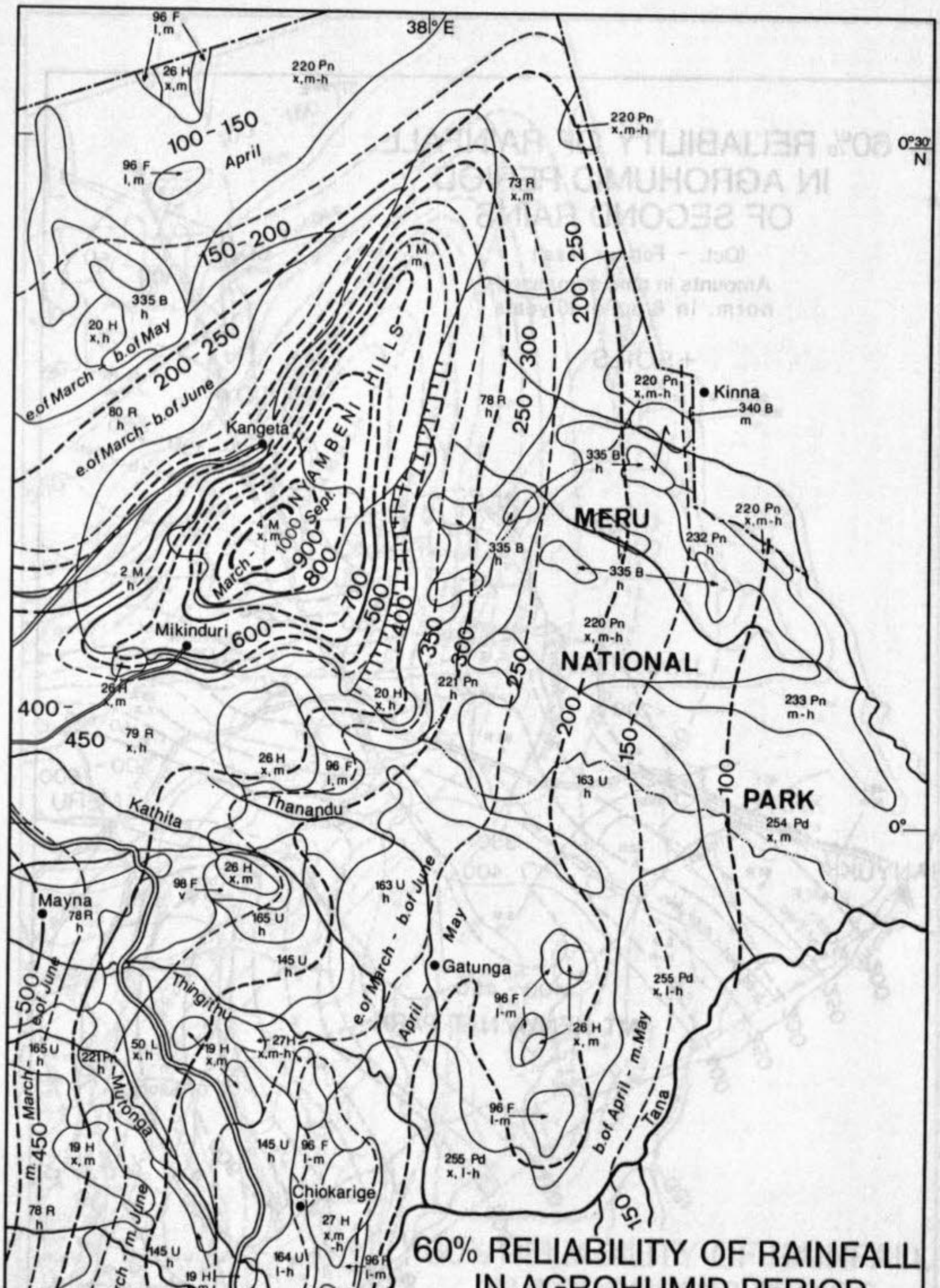

AVERAGE ANNUAL
RAINFALL
in mm
+SOILS
37°30' E
0°30' N
>500
500-600
600-700
<400
400-500
500-600
700-800
800-900
<600
600-
700
700-800
900-1000
<900
800
900
1000
1200
1400
1400
1400
1600
1800
2000
2200
2200
2000
1800
1600
1400
1200
1000
ISIOLO
NANYUKI
0°
Timau
K.F.
MERU
Nkubu
Ngeru
Chuka
Engare Ondare
Keromet
Sirimon
Nanyuki
Kathita
Mutonga
Thuchi
MT. KENYA NAT. PARK
no Soil
8937
9037
Temperature recording station, operating 1976. closed
Rainfall recording station, operating 1976 and having at least 10 years of records
70 Station number in grid
9037 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
0°30' S
UPPER MERU



AVERAGE ANNUAL
RAINFALL
in mm
+SOILS
New temperature recording station
Rainfall recording station, operating 1976
and having at least 10 years of records
160 Station number in grid
9038 Grid number
1) More than 1000
2) More than 2600
Broken boundaries are uncertain
because of lack of rainfall records
LOWER MERU
and Nyambeni Hills
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS
0 5 10 15 20 25 km
38°E
0°30' N
0°
0°30' S
MERU
NATIONAL
PARK
NYAMBENI HILLS
Kangeta
Mikinduri
Kinna
Mayna
Gatunga
Chiokarige
Ishiara
Kathita
Thanandu
Thingithu
Mutonga
Thuchi
Tana
<500
500 - 600
600 - 700
700 - 800
800 - 900
900 - 1000
>2400
2400
2200
2000
1800
1600
1400
1200
1000
900
800
700
600
500
400
<400
1400-
1600
1200 -
1400
700 -
800
>800
8937
9037
8938
9038



60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF FIRST AND MIDDLE RAINS
(March – Sept. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
37°30' E
0°30' N
0°
0°30' S
ISIOLO
MERU
NANYUKI
Timau
K.F.
Nkubu
Ngeru
Chuka
Kathita
Mutonga
Thuchi
Kiromet
Engare Ondare
Sirimon
Nanyuki
MT. KENYA NAT. PARK
no Soil
100 – 150
April
150 – 200
e.of March -
b.of May
e.of March- 200
250
b.of June
250- 300
March - July
<200
250
m.Mch.- June
Mch. - Aug.
500 -
600
March - Sept.
March - Aug.
m. Mch. - July
300
350
400
450
500
600
700
800
900
1000
1200
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
UPPER MERU



60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF FIRST RAINS

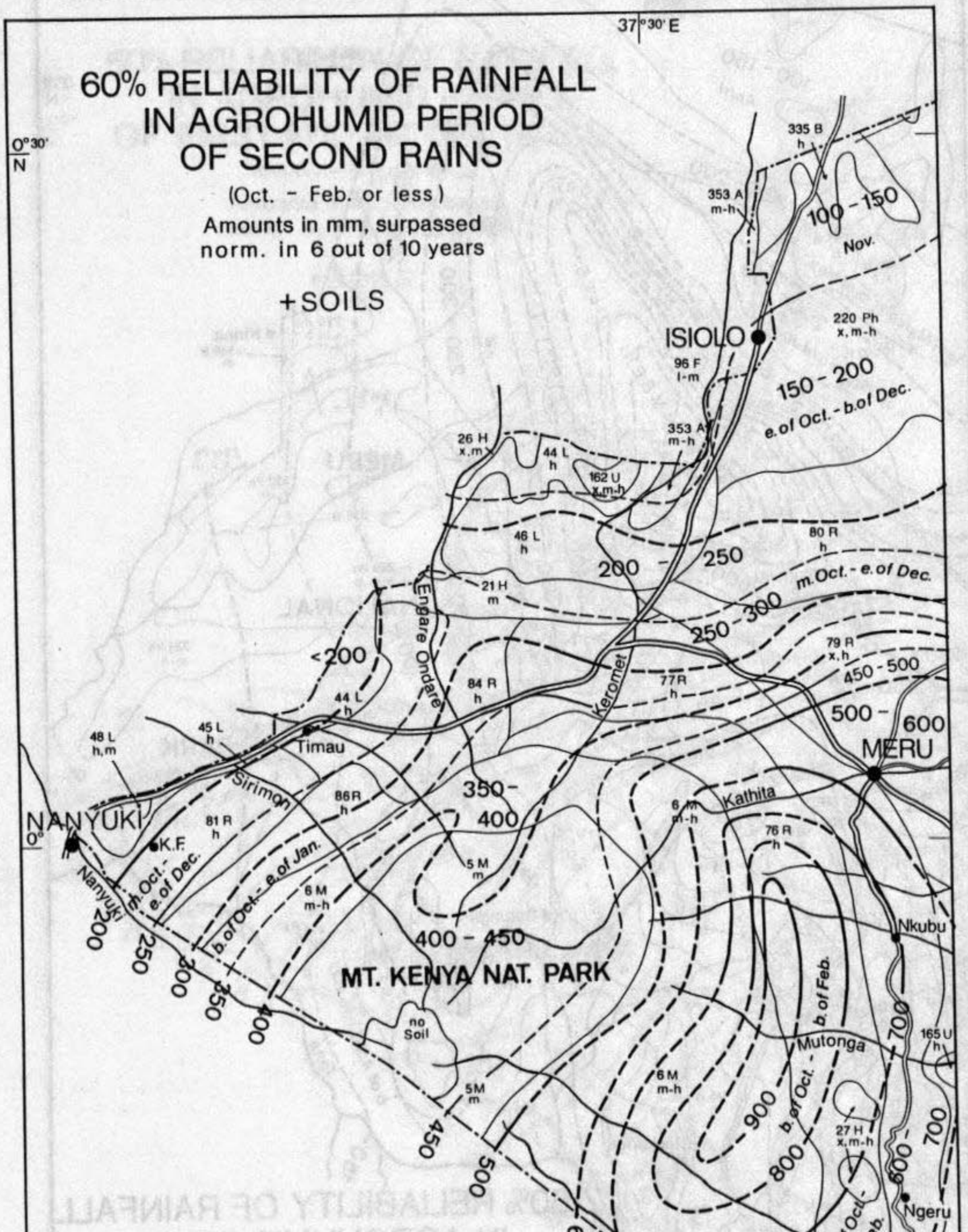
(March - Sept. or less)

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

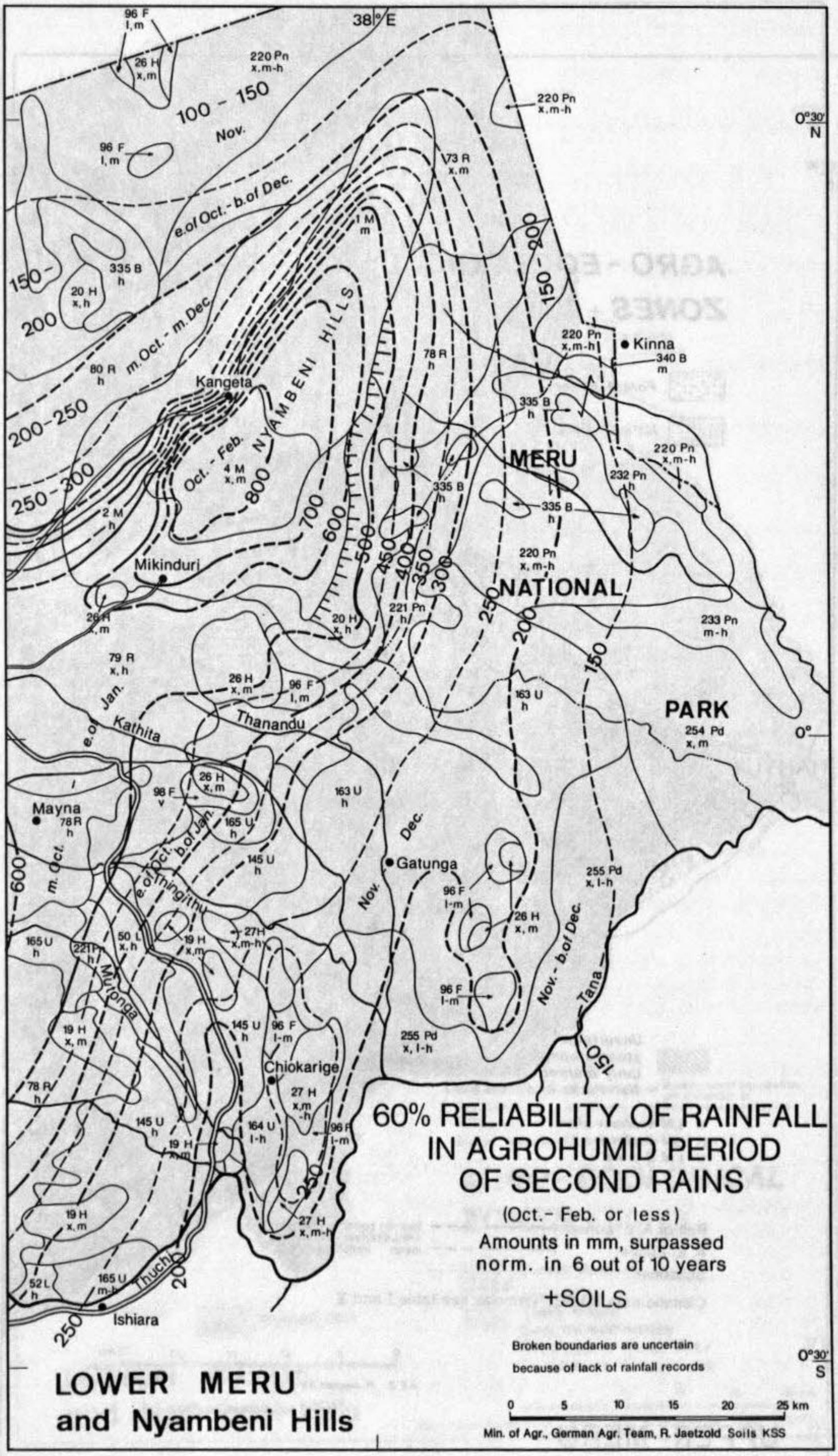
+SOILS

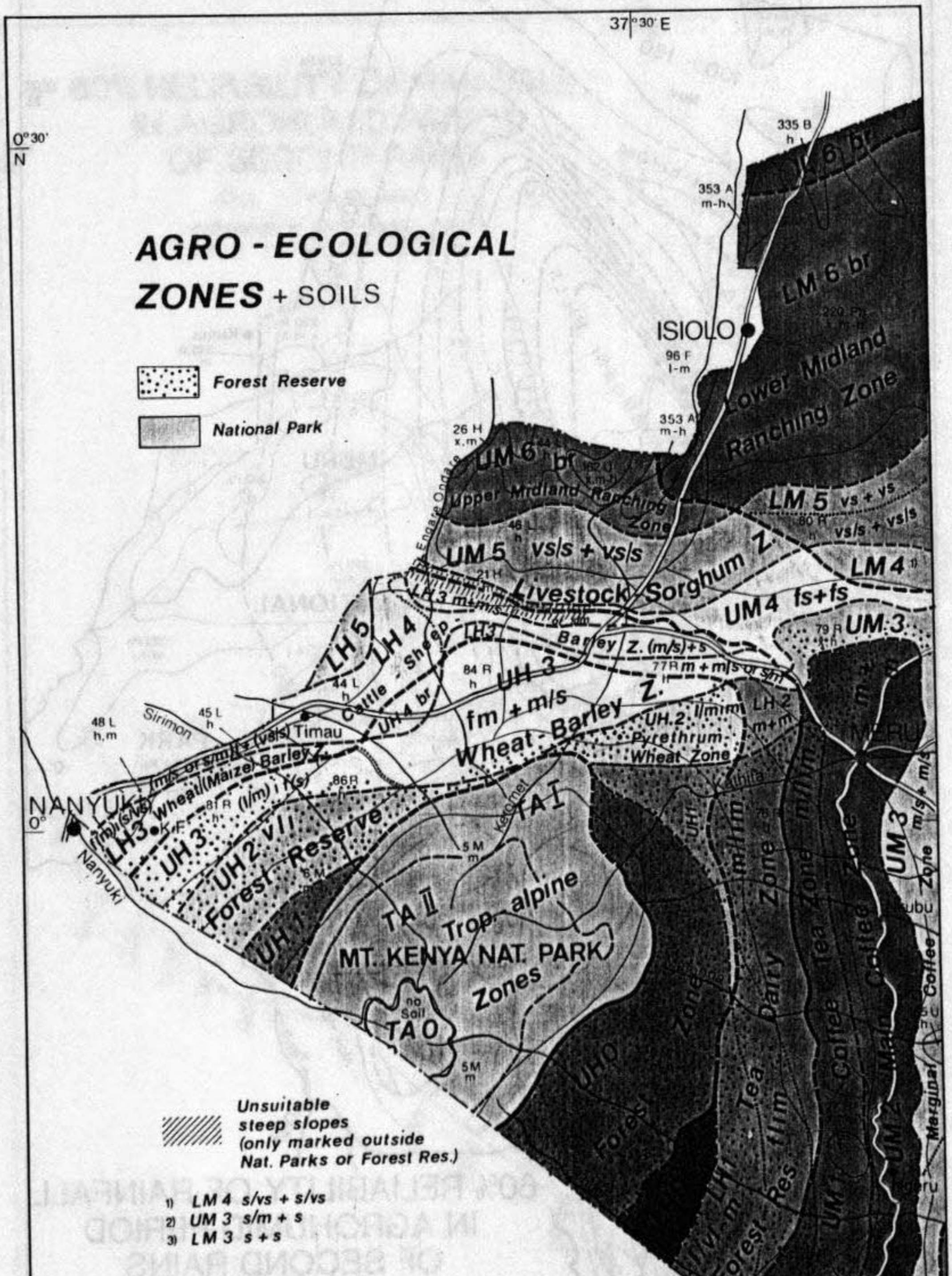
Broken boundaries are uncertain because of lack of rainfall records

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

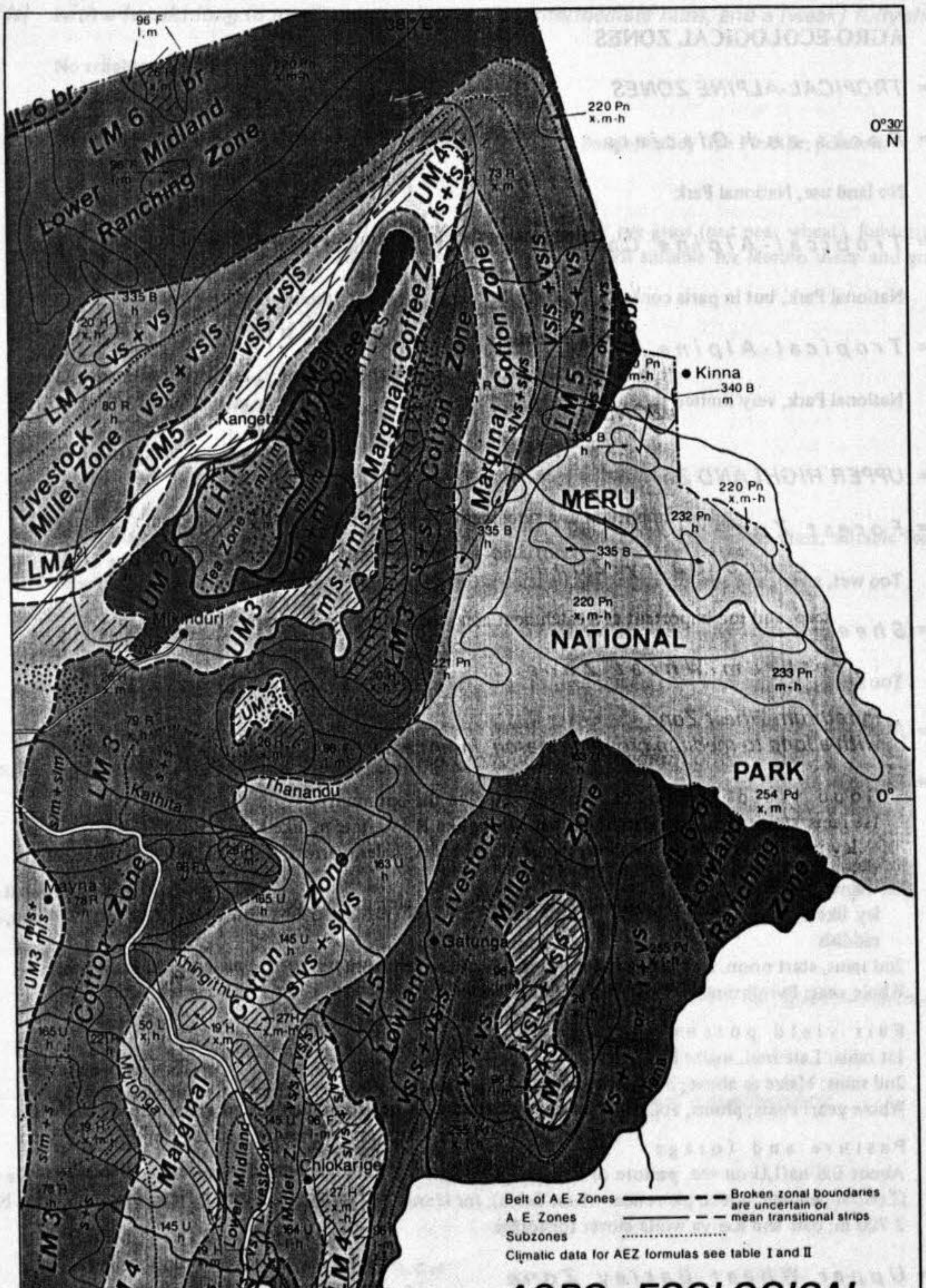


60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF SECOND RAINS
(Oct. - Feb. or less)
Amounts in mm, surpassed norm. in 6 out of 10 years
+SOILS
37°30' E
0°30' N
0°
0°30' S
ISIOLO
MERU
NANYUKI
Timau
K.F.
Kathita
Nkubu
Mutonga
Ngeru
Chuka
Thuchi
Keromet
Engare Ondare
Sirimon
Nanyuki
MT. KENYA NAT. PARK
no Soil
100 - 150
Nov.
150 - 200
e. of Oct. - b. of Dec.
200 - 250
m. Oct. - e. of Dec.
250 - 300
450 - 500
500 - 600
<200
350-400
400 - 450
b. of Oct. - e. of Jan.
m. Oct. - e. of Dec.
b. of Oct. - b. of Feb.
b. of Oct. - m. Feb.
900
800
700
600
500
450
400
350
300
250
200
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
UPPER MERU


60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF SECOND RAINS
(Oct.- Feb. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
Broken boundaries are uncertain
because of lack of rainfall records
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS
LOWER MERU
and Nyambeni Hills
MERU
NATIONAL
PARK
NYAMBENI HILLS
38°E
0°30' N
0°
0°30' S
Kinna
Kangeta
Mikinduri
Mayna
Gatunga
Chiokarige
Ishiara
Kathita
Thanandu
Thingithu
Mutonga
Thuchi
Tana
Nov.
e.of Oct. - b.of Dec.
m.Oct. - m.Dec.
Oct. - Feb.
e.of Jan.
e.of Oct. b.of Jan.
m. Oct.
Nov. Dec.
Nov. - b.of Dec.
100 - 150
150-200
200-250
250-300
800
700
600
500
450
400
350
300
250
200
150



AGRO - ECOLOGICAL ZONES + SOILS
Forest Reserve
National Park
37°30' E
0°30' N
0°
0°30' S
ISIOLO
NANYUKI
Timau
MERU
Sirimon
Nanyuki
LM 6 br
Lower Midland Ranching Zone
UM 6 br
Upper Midland Ranching Zone
LM 5 vs + vs
vs/s + vs/s
UM 5 vs/s + vs/s
Livestock Sorghum Z.
LM 4 1)
UM4 fs+fs
UM 3
LH 3
Barley Z. (m/s)+s
UH 3
fm + m/s
Wheat - Barley Z.
UH 2 l/m/m
Pyrethrum-Wheat Zone
LH 2
LH 5
LH 4
Cattle - Sheep
UH 4 br
Wheat/(Maize) Barley Z.
LH3
UH 3
UH 2 v/i
Forest Reserve
UH 1
TA I
TA II
Trop. alpine
MT. KENYA NAT. PARK
Zones
TA 0
no Soil
UH 0
Forest Zone
Tea Dairy Zone
Tea Zone
Coffee Tea Zone
Main Coffee Zone
Marginal Coffee Zone
Forest Res.
335 B h
353 A m-h
96 F l-m
353 A m-h
26 H x,m
48 L h,m
45 L h
44 L h
84 R h
86 R
5 M m
Unsuitable steep slopes (only marked outside Nat. Parks or Forest Res.)
1) LM 4 s/vs + s/vs
2) UM 3 s/m + s
3) LM 3 s + s
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. Jaetzold '83
Soils KSS
Min. of Agr., German Agr. Team
UPPER MERU


LOWER MERU
and Nyambeni Hills
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
Forest Reserve
Unsuitable steep slopes (only marked outside Nat. Parks or Forest Res.)
National Park
1) LH2 m + m 2) s/vs + s/vs
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team AEZ R. Jätzold '82 Soils KSS
0°30' N
0°
0°30' S
MERU
NATIONAL
PARK
Kinna
Kangeta
Miathene
Mikinduri
Kathita
Thanandu
Mayna
Gatunga
Chiokarige
Thingithu
Mutonga
Thuchi
Ishiara
Lower Midland Ranching Zone
LM 6
Livestock - Millet Zone
LM 5
Marginal Coffee Z.
Marginal Cotton Zone
Cotton Zone
Lowland Livestock - Millet Zone
Lowland Ranching Zone
Marginal Cotton Zone
Lower Midland Livestock - Millet Z.
UM 2
UM 3
UM 4
UM 5
LM 3
LM 4
LH 1
Tea Zone

AGRO-ECOLOGICAL ZONES

TA = *TROPICAL-ALPINE ZONES*

TA 0 = *Rocks and Glaciers*

No land use, National Park

TA I = *Tropical-Alpine Cattle and Sheep Zone*

National Park, but in parts controlled grazing should be allowed, although limited potential

TA II = *Tropical-Alpine Sheep Zone*

National Park, very limited grazing potential

UH = *UPPER HIGHLAND ZONES*

UH 0 = *Forest Zone*

Too wet, steep, and too important as a catchment area, therefore Forest Reserve. Bamboo thickets

UH 1 = *Sheep and Dairy Zone*

Too steep, and too important as a catchment area, therefore Forest Reserve. Valuable timber

UH 2 = *Pyrethrum-Wheat Zone*

UH 2 l/m i m = *Pyrethrum-Wheat Zone with a long to medium cropping season, intermediate rains, and a medium one*

Good yield potential (av. 60–80 % of the optimum)
1st rains, start norm. mid March: M. mat. wheat like R 199, late m. like Kenya Bongo (60–70 %), m. mat. barley like Proctor; peas, potatoes, rapeseed; cabbages, kales, carrots, kohlrabi, celery, endive, rampion, leek, raddish
2nd rains, start norm. mid O.: Barley; peas, cabbages, kales, carrots, celery, endive, rampion, raddish
Whole year: Pyrethrum

Fair yield potential (av. 40–60 % of the optimum)
1st rains: Late mat. maize like High alt. composite or Cuzco
2nd rains: Maize as above, but 50–60 %; potatoes, kohlrabi
Whole year: Pears, plums, apples (below 2 600 m)

Pasture and forage
About 0.8 ha/LU on sec. pasture of Kikuyu grass with not too much tufted grass, improvable with rye grass (Lolium perenne, not to plant near wheat fields); for Merino sheep very well suited, for grade dairy cows below 2 700 m; oats and Kenya white clover for forage

UH 3 = *Upper Wheat-Barley Zone*

UH 3 fm + m/s = *Upper Wheat-Barley Zone with a fully medium and a medium to short cropping season*

Good yield potential
1st rains, start norm. mid March: M. mat wheat like Kenya Tembo, m. mat. barley; green onions, cabbages
2nd rains, start norm. mid O.: E. mat. wheat and barley; green onions, cabbages

Fair yield potential
1st or 2nd rains: M. mat. sunflower like Vympel (< 2 600 m); potatoes, peas (1st r.)
Whole year: Pyrethrum on deep soils

Pasture and forage
See UH 3 (l)i (s/vs)

UH 3 = Upper Wheat-Barley Zone
(l/m) i f (s) with a (weak) long to medium cropping season, intermediate rains, and a (weak) fully short one

No reliable good yield potential

Fair yield potential
1st rains, start norm. mid March: Late mat. wheat like Kenya Bongo, barley like Proctor; potatoes
Whole year: Pyrethrum (on deep soils)

Pasture and forage
1–2 ha/LU on nat. grassland, 0.9–1.2 ha/LU on art. pasture of rye grass (not near wheat). Subterranean or Kenya white clover and barley Amani for additional forage; well suitable for Merino sheep and grade beef cattle

UH 4 = Upper Highland Ranching Zone

UH 4 = Upper Highland Ranching Zone
b r with bimodal rainfall[1]

Not suitable for agriculture

Pasture and forage
More than 2 ha/LU on nat. grassland, improvable with Cocksfoot or Tall Fescue grass; suitable for Merino sheep and grade beef cattle. Subterranean clover as add. forage

LH = LOWER HIGHLAND ZONES

LH 1 = Tea-Dairy Zone

LH 1 = Tea-Dairy Zone
l/vl – m with a long to very long cropping season followed by a medium one

Here Forest Reserve
Agricultural potential see Embu District

LH 1 = Tea-Dairy Zone
l i m with a long cropping season, intermediate rains, and a medium one

Small, transitional and partly Forest Reserve.
Agr. potential see LH 1 m/l i m, but very good yield pot. of 1st rains there is only good here because of too much rain

LH 1 = Tea-Dairy Zone
m/l i m with a medium to long cropping season, intermediate rains, and a medium one

Very good yield potential
1st rains, start norm. b./mid March: Peas[2], cabbages
2nd rains, start norm. b. of Oct.: Peas[2]

Good yield potential
1st rains: Potatoes, carrots, leek, kales, endive
2nd rains: Potatoes, cabbages, carrots, kales
Whole year, best planting time mid March: Tea, loquats

Fair yield potential
1st rains: Maize H 611; beans
2nd rains: Maize H 611 if planted end of Aug./b. of S.; leek, lettuce
Whole year: Pyrethrum; plums

Pasture and forage
About 0.5 ha/LU on secondary pasture of Kikuyu grass, suitable for grade dairy cows; Louisiana white clover for higher productivity, Napier grass on lower places, green maize and fodder beets as add. forage

1) Rainy seasons not clearly defined, because this zone is transitional between rainfall pattern of the Rift Valley with one longer period and Eastern Kenya with two shorter periods of rainfall
2) Pest danger

LH 2 = Wheat/Maize-Pyrethrum Zone

LH 2 m + m = *Wheat/Maize-Pyrethrum Zone with two medium cropping seasons*

Good yield potential

1st rains, start norm. mid March: M. mat. wheat like Kenya Leopard, m. mat. barley; sunflower Kenya White, linseed; potatoes, peas, almost all vegetables

2nd rains, start mid O.: M. mat. wheat and barley, m. mat. sunflower and linseed; almost all vegetables

Whole year: Pyrethrum, black wattle

Fair yield potential

1st rains: Maize H 611, lower places 612 and beans; rapeseed (higher places)

2nd rains: Beans, peas, potatoes

Whole year: Apples, pears, plums, strawberries

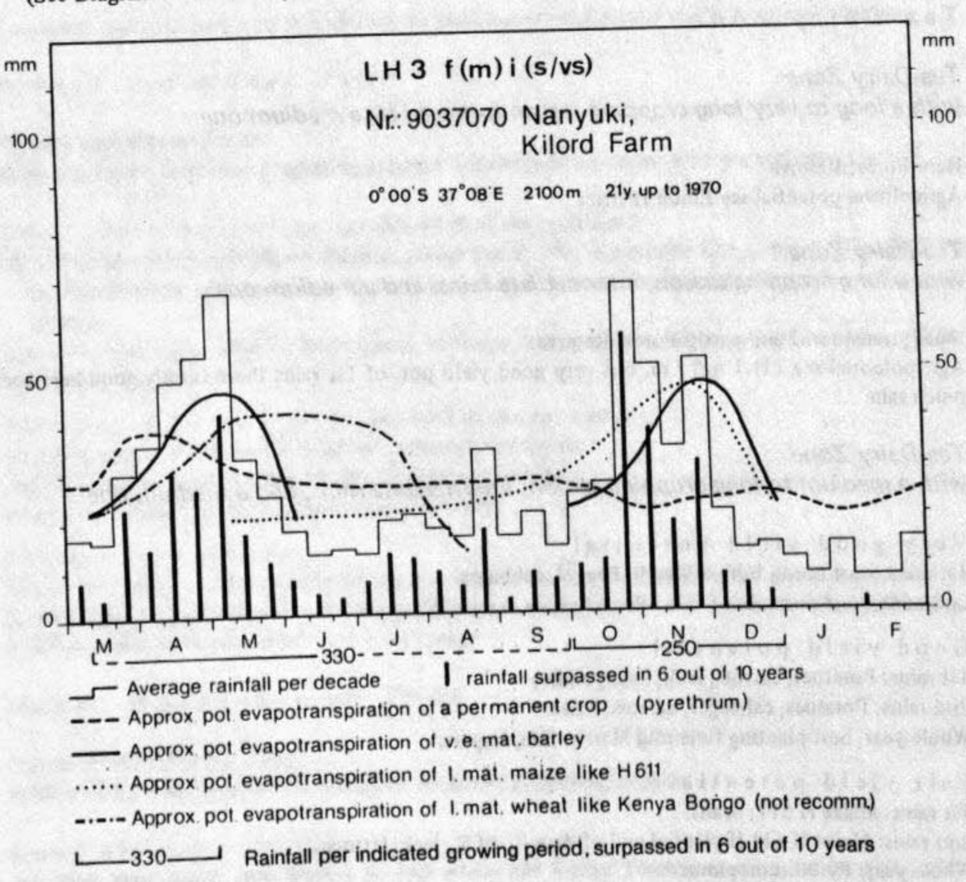
Pasture and forage

0.7–1 ha/LU on sec. pasture of Kikuyu grass: down to 0.45 ha/LU with Napier grass up to 2 000 m, Nandi Setaria above that, green maize, fodder beets, Louisiana white clover

LH 3 = Wheat/(Maize)[3]-Barley Zone

LH 3 f (m) i (s/vs) = *Wheat/(Maize)[3]-Barley Zone with a (weak) fully medium cropping season, intermediate rains, and a (weak) short to very short one*

(See Diagram Kilord Farm)



Good yield potential

1st rains, start norm. mid/end of March: E. mat. wheat (~ 60 %), barley like K. Research

Fair yield potential

1st rains: Maize H 611 (May-D.), beans (lower places, fair to poor), peas; linseed, late mat. sunflower Kenya White, m. mat. potatoes like Kenya Akiba; kales, green onions

2nd rains, start mid O.: V. e. mat. barley

Whole year: Avocadoes in lower places

3) Depending on farm scale, but maize ecologically less suitable

Pasture and forage
1–2 ha/LU on nat. grassland; 0.7–1.5 ha/LU on art. pasture of Rhodes grass or in higher places Nandi Setaria; barley Amani or B 106 in 1st rains for stockfeed

LH 3 = Wheat/(Maize)[3)]-Barley Zone
m+m/s with a medium and a medium to short
or s/m or short to medium cropping season

Good yield potential
1st rains, start norm. end of March: E. mat. wheat like K 6927–1, e. mat. barley like Tumaini, m. mat. wheat and barley (good to fair)

Fair yield potential
1st rains: Maize H 612-14; beans (lower places), peas, m. mat. sunflower like Vympel; kales, green onions
2nd rains, start norm. mid O.: E. mat. wheat and barley; beans (lower places), peas; kales, green onions

Pasture and forage
Almost as in LH 3 f (m) i (s/vs) but additionally e. mat. barley Amani in 2nd rains

LH 4 = Cattle-Sheep-Barley Zone

LH 4 = Cattle-Sheep-Barley Zone
(m/s) + s with a weak medium to short and a short cropping season

Fair yield potential
1st rains, start norm. end of March: E. mat. barley like Tumaini (50–60 %), e. mat. wheat like Kenya Ngiri (40–50 %); green onions
2nd rains, start norm. mid O.: E. mat. barley; green onions

Pasture and forage
2–4 ha/LU on nat. grassland, higher stocking rate when barley Amani is used as add. forage (both rains)

LH 4 = Cattle-Sheep-Barley Zone
(m/s or s/m) with a (weak) medium to short or short to medium cropping season,
i + (vs/s) intermediate rains, and a (weak) very short to short one

Fair yield potential
1st rains, start norm. end of March: E. or m. mat. barley (50–60 %), e. mat. wheat (40–50 %); green onions

Poor yield potential
1st rains: Late mat. maize like H 612[4)]
2nd rains, start norm. end of O.: V. e. mat. barley

Pasture and forage
2–4 ha/LU on nat. grassland; fodder barley B 106 (first rains)

LH 5 = Lower Highland Ranching Zone

LH 5 = Lower Highland Ranching Zone
b r with bimodal rainfall[1)]

Not suitable for rainfed agriculture (except for v. e. mat. barley 1st r.)

Pasture and forage
Normally 4–6 ha/LU on nat. short grass savanna; no proper forage. Severe erosion danger if overgrazed, then stocking rate much less

UM = UPPER MIDLAND ZONES

UM 1 = Coffee-Tea Zone

UM 1 = Coffee-Tea Zone
f l i m with a fully long cropping season, intermediate rains, and a medium one

Very small, potential see Embu District

4) A medium maturing variety for this rel. high altitude would be better but is not yet available

UM 1 = *Coffee-Tea Zone*
m/l + m/s *with a medium to long and a medium to short cropping season*

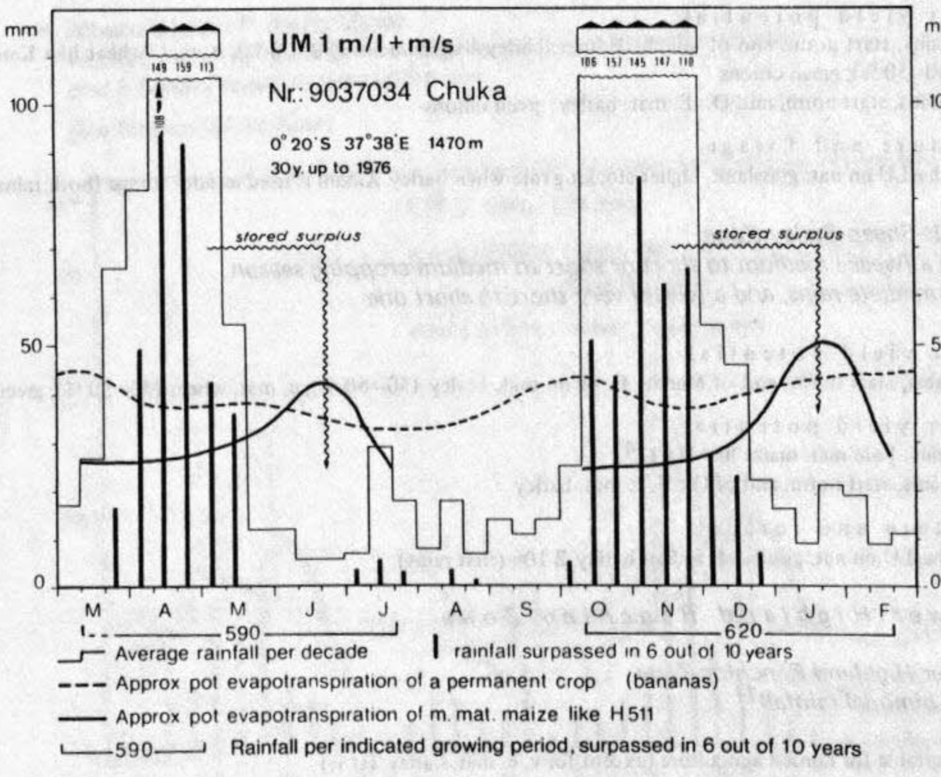
(see Diagram Chuka)

Very good yield potential
1st rains, start norm. mid March: Cabbages, kales
2nd rains, start norm. mid O.: Beans (S.–Jan.)

Good yield potential
1st rains: Maize H 511–512, finger millet; beans, dolichos beans, potatoes; m. mat. sunflower like HS 301 A; onions
2nd rains: Katumani Maize, finger millet; sunflower like 252 or HS 301 A; cabbages, kales, onions, tomatoes
Whole year: Tea, Arabica coffee, bananas, mountain pawpaws, passion fruit, yams, avocadoes, black wattle, miraa (Catha edulis)

Fair yield potential
1st rains: Sweet potatoes, tomatoes
2nd rains: Maize H 511–12, finger millet; potatoes
Whole year: Citrus

Pasture and forage
Potential almost as UM 1 m/l i m



UM 1 = *Coffee-Tea Zone*
m/l i m *with a medium to long cropping season, intermediate rains, and a medium one*

Very good yield potential
1st rains, start norm. mid March: Finger millet; cabbages
2nd rains, start norm. mid O.: Beans
Whole year: Passion fruit, black wattle

Good yield potential
1st rains: Potatoes, sunflower like 252 or HS 301 A; sweet potatoes; beans, onions; Meru foxtail millet (Gathano rains)
2nd rains: Finger millet; sunflower like 252 or HS 301 A; cabbages, kales, onions, tomatoes
Whole year: Tea, coffee, bananas, mountain pawpaws, yams, loquats, avocadoes

Fair yield potential
1st rains: Maize H 511–12; tomatoes
2nd rains: Maize H 612–14 (Aug.–F.), H 511–12 (O.–F.)
Whole year: Taro (near water good), miraa

Pasture and forage
About 0.5 ha/LU, feeding Napier grass, banana leaves and stems and sweet potato vines down to 0.2 ha/LU

UM 2 = Main Coffee Zone

UM 2 = Main Coffee Zone
m + s/m with a medium and a short to medium cropping season[5)]

Small, potential see Embu District

UM 2 = Main Coffee Zone
m + m with two medium cropping seasons

Good yield potential
1st rains, start norm. end of March: Finger millet, e. mat. sorghum (lower places); beans; sweet potatoes; e. mat. sunflower like 252 (70–80 %) or m. mat. like HS 301 A; cabbages, kales, tomatoes, onions
2nd rains, start norm. mid O.: The same as in 1st rains but more reliable and a little higher yields
Whole year: Arabica coffee[6)], bananas, mountain pawpaws, loquats, avocadoes, passion fruit, citrus (lower places), dolichos beans (per var.)

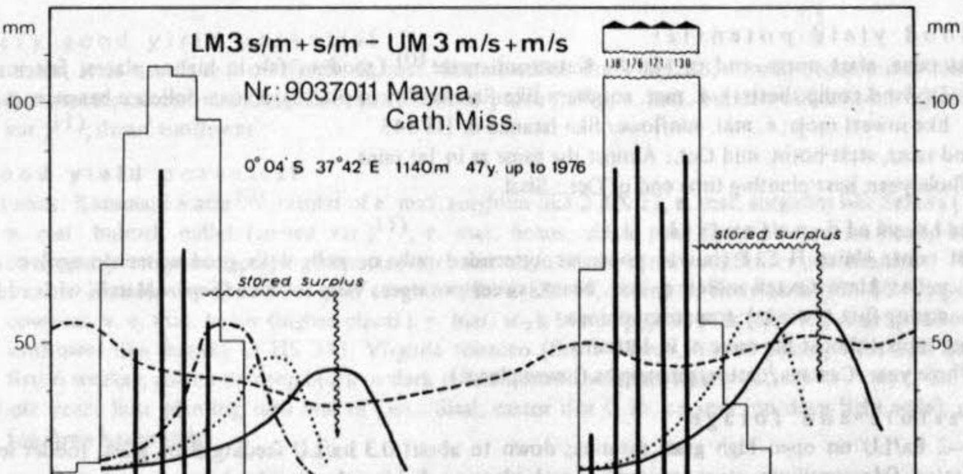
Fair yield potential
1st or 2nd rains: Maize H 511–12 (2nd rains 50–60 %); potatoes (higher places)
Whole year: Cassava, yams (50–60 %), sugar cane in lower valleys

Pasture and forage
About 0.8 ha/LU on sec. pasture of Star grass (Cynodon dactylon), down to about 0.2 ha/LU feeding Napier or Bana grass, banana leaves and stems, sweet potato vines, maize stalks

UM 3 = Marginal Coffee Zone

UM 3 = Marginal Coffee Zone
m/s + s with a medium to short and a short cropping season[7)]

Small, potential see Embu District



5) On medium soils, on heavy soils there is a long to medium and a medium to short cropping season. Given potential refers to the predominating heavy red loams
6) Very good yields on heavy deep soils with runoff-protection and mulching
7) On medium soils; on heavy soils first cropping season has a medium length, the second one becomes short to medium. Given potential in Embu refers to predom. heavy red loams

UM 3 = Marginal Coffee Zone
m/s + m/s with two medium to short cropping seasons[8)]

(See Diagram Mayna)

Good yield potential
1st rains, start norm. end of March: E. mat. maize like Katumani comp. B[10)], e. mat. sorghum like 2 KX 17 (70–80 %); e. mat. beans; e. mat. sunflower like HS 345 (< 1 500 m); onions, cabbages
2nd rains, start norm. mid O.: Almost the same as in 1st rains but due to higher rainfall normally about 10 % higher yield expectations, also m. mat. sorghum (60–70 %)
Whole year: Pineapples, per. castor

Fair yield potential
1st rains: Maize H 511–512[10)], m. mat. sorghum (50–60 %); m. mat. beans, sweet potatoes, pigeon peas; kales, tomatoes
2nd rains: Same crops but normally about 10 % higher yield expectations
Whole year: Arabica coffee (fair in higher places, poor in lower places, there add. irr. profitable, pawpaws, cassava, citrus, bananas (lower places poor)

Pasture and forage
0.7–1.1 ha/LU on sec. high grass savanna of zebra grass (Hyparrhenia rufa), down to 0.25 ha/LU feeding Napier or Bana grass and sweet potato vines

UM 3 = Marginal Coffee Zone
m/s + s/m with a medium to short and a short to medium cropping season

Very small, potential as UM 3 m/s+m/s in first rains, in second rains nearly 10 % less

UM 4 = Sunflower-Maize Zone

UM 4 = Sunflower-Maize Zone
fs + fs with two fully short cropping seasons[9)]

Good yield potential
1st rains, start norm. end of March: Katumani maize[10)] (good to fair in higher places, fair in s/vs, there Dryland comp. better), e. mat. sorghum like Serena (lower places); e. mat. dolichos beans, v. e. mat. beans like mwezi moja; e. mat. sunflower like Issanka or HS 345
2nd rains, start norm. mid Oct.: Almost the same as in 1st rains
Whole year, best planting time end of Oct.: Sisal

Fair yield potential
1st rains: Maize H 511 (fair to poor, recommended only on soils with good water storage), e. mat. finger millet, Meru foxtail millet; e. mat. beans, sweet potatoes; Virg. tobacco (Sept.–March, with add. irrigation during first 6 weeks); tomatoes, onions
2nd rains: Almost the same as in 1st rains
Whole year: Cassava, castor, pineapples (lower places)

Pasture and forage
1–2 ha/LU on open high grass savanna; down to about 0.3 ha/LU feeding Bana grass, fodder legumes like siratro (Macroptilium atropurpureum), and planting fodder shrubs like horse tamarind (Leucaena leucocephala) or saltbush (Atriplex nummularia)

UM 5 = Livestock-Sorghum Zone

UM 5 = Livestock-Sorghum Zone
vs/s + vs/s with two very short to short cropping seasons

Fair yield potential
1st or 2nd rains: V. e. mat. sorghum like IS 8595

Poor yield potential
1st or 2nd rains: Dryland comp. maize, v. e. mat. beans

8) On medium soils; on heavy ones both seasons are of medium length. Given potential refers to predominating heavy red loams
9) On medium soils, on heavy soils short to medium cropping seasons. Potential refers to predominating friable clay
10) Although Katumani comp. B has climatically a good yield potential here, it is on deep soils eventually more advisable to plant H 511 or 512 maize esp. in 2nd rains (except in UM 4 s/vs+s/vs); because of its higher productivity it may yield more, even if the climate is not so suitable for it.

P a s t u r e   a n d   f o r a g e
More than 2.5 ha/LU on nat. mixed grassland; down to about 0.5 ha/LU with hay or silage of fodder sorghum and fodder legumes

UM 6 = U p p e r   M i d l a n d   R a n c h i n g   Z o n e

UM 6 b r = Upper Midland Ranching Zone with bimodal rainfall

Not suitable for rainfed agriculture

P a s t u r e   a n d   f o r a g e
More than 5 ha/LU on nat. short grass savanna; with vines of Marama beans and palatable shrubs like saltbush (Atriplex nummularia) as dry season forage much higher capacity

LM = LOWER MIDLAND ZONES

LM 3 = C o t t o n   Z o n e

LM 3 s/m + s/m = Cotton Zone with two short to medium cropping seasons

Transitional strip. Potential between LM 3 s + s and UM 3 m/s + m/s but excluding coffee and including millets, grams, and groundnuts

LM 3 s/m + s = Cotton Zone with a short to short cropping season

Transitional strip. Potential between LM 3 s + s and UM 3 m/s + s/m but excluding coffee and including millets, grams, and groundnuts

LM 3 s + s = Cotton Zone with two short cropping seasons[9]

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. end of March: E. mat. foxtail millet like 1 Se 285, e. mat. proso millet like Serere I;
2nd rains, start norm. mid Oct.: E. mat. foxtail or proso millet, e. mat. bulrush millet (bird rejecting awned var.)[11]; dwarf sunflower

G o o d   y i e l d   p o t e n t i a l
1st rains: Katumani maize[10], ratoon of e. mat. sorghum like 2 KX 17, e. mat. sorghum like Serena (70–80 %) e. mat. bulrush millet (awned var.)[11]; e. mat. beans, chick peas (late planted on heavy black soils, cowpeas, green grams (spraying important), e. mat. soya beans; e. mat. sunflower like Issanka
2nd rains: Katumani maize[10], e. mat. sorghum like 2 KX 17, Serena or Early bulk (70–80 %); green grams, cowpeas, v. e. mat. beans (higher places), e. mat. soya beans, pigeon peas (O.–S.), sweet potatoes; e. mat. sunflower like Issanka or HS 345, Virginia tobacco (Sept.–March, higher places, with add. irrig. during first 6 weeks); cotton on deep black or dark reddish brown volcanic soils (~ 60 %)
Whole year: Best planting time end of Oct.: Sisal, castor like C 15, cassava (on deep light soils), pineapples (on deep heavy soils)

F a i r   y i e l d   p o t e n t i a l
1st rains: Maize H 511–512 (on deep heavy but well drained soils): e. mat. dolichos beans, groundnuts (in light soils); e. mat. sweet potatoes, tomatoes, onions
2nd rains: Maize H 511–512 (on deep soils); e. mat. dolichos beans, e. mat. sweet potatoes; cotton bimodal variety on medium soils (e. of S./O.–Aug.)
Whole year: Mangoes (but fungus diseases), Macadamia nuts

P a s t u r e   a n d   f o r a g e
0.9–1.3 ha/LU on high grass savanna with zebra grass (Hyparrhenia rufa) predominant; down to about 0.3 ha/LU feeding Bana grass, fodder legumes like siratro (Macroptilium atropurpureum), horse tamarind (Leucaena leucocephala) as a suitable palätable shrub

11) Bird rejecting awned varieties recommended, available at ICRISAT, Hyderabad, India

LM 4 = *Marginal Cotton Zone*

LM 4 s + s/vs = *Marginal Cotton Zone with a short and a short to very short cropping season*

Small, potential see Embu District

LM 4 s/vs + s/vs = *Marginal Cotton Zone with two short to very short cropping seasons*

Very good yield potential
2nd rains, start norm. end of Oct.: E. mat. foxtail and proso millet, v. e. mat. dwarf sunflower

Good yield potential
1st rains, start norm end of March: Dryland comp. maize (60–70 %), e. mat. bulrush millet[11])

Good yield potential
1st rains, start norm end of March: Dryland comp. maize (60–70 %), e. mat. bulrush millet[11]); e. mat. foxtail and proso millet, v. e. mat. dwarf sorghum; cowpeas, v. e. mat. dwarf sunflower, moth beans, rai[12])
2nd rains; Dryland comp. maize, e. mat. sorghum, e. mat. bulrush millet[11]); mwezi moja beans; rai[12]), e. mat. onions, e. mat. bambarra groundnuts (on light soils), chick peas (late planted on heavy soils), moth beans
Whole year: Buffalo gourds (on light soils)[13]), Marama beans[13]), per. castor like C 15

Fair yield potential
1st rains: Katumani maize, e. mat. sorghum; mwezi moja beans, chick peas (on heavy soils), black and green grams, e. mat. soya beans, dolichos beans, e. mat. bambarra groundnuts in light soils, e. mat. sweet potatoes
2nd rains: Katumani maize on deep soils, m. mat. bulrush millet; dolichos beans, pigeon peas (S.–O.), e. mat. sweet potatoes
Whole year: Cotton (fair on deep black cotton soils, poor on medium and light soils), sisal

Pasture and forage
1.2–3 ha/LU on mixed medium grass savanna with red oats grass (Themeda triandra) predom.; if degraded well improvable by saltbush (Atriplex nummularia), Mesquite (Prosopis chilensis), and horse tamarind (Leucaena leucocephala) as palatable shrubs; legumes like moth bean vines and Makueni guinea grass as fodder

LM 5 = *Lower Midland Livestock-Millet Zone*

LM 5 s/vs + vs/s = *Lower Midland Livestock-Millet Zone with a short to very short and a very short to short cropping season*

Very small, potential see Embu District

LM 5 vs/s + vs/s = *Lower Midland Livestock–Millet Zone with two very short to short cropping seasons*

Good yield potential
1st rains, start norm. end of March: V. e. mat. foxtail and proso millet, moth beans (~ 60 %); v. e. mat. sunflower like Russian dwarf, v. e. mat. rai[12])
2nd rains, start norm. end of Oct.: The same as above
Whole year: Buffalo gourds (light soils)[13]), Marama beans[13]), Vigna lobatifolia[16]), jojoba, Opuntia var. without prickles (fruit and vegetable, also fodder)

Fair yield potential
1st or 2nd rains: V. e. mat. dwarf sorghum (50–60 %), e. mat. bulrush millet[11]); black and green grams, cowpeas, chickpeas (late planted heavy black soils), v. e. mat. bambarra groundnuts (on light soils), v. e. mat. tepary beans; v. e. mat. pumpkins, e. mat. onions
Whole year: Sisal (50–60 %), castor C–15, cassava (~ 40 %)

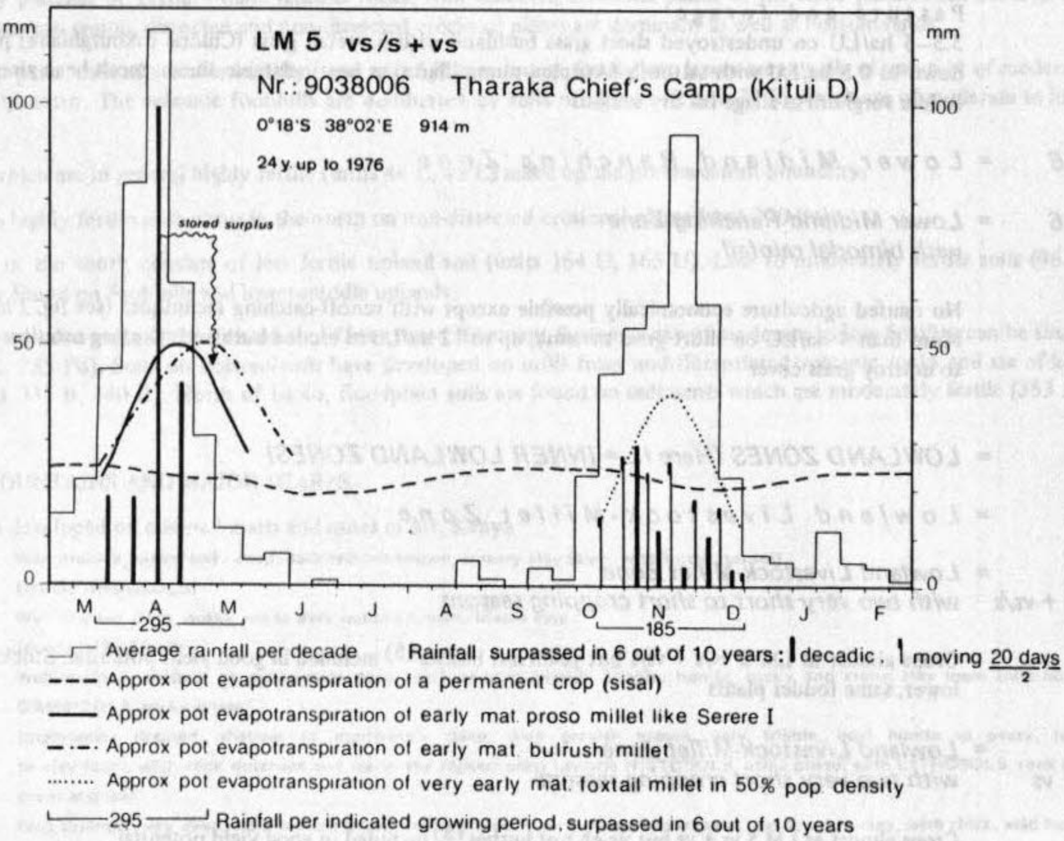
Poor yield potential
1st or 2nd rains: Dryland comp. maize (fair on very suitable soils)

Pasture and forage
More than 3 ha/LU on mixed short grass savanna with Buffalo grass (Cenchrus ciliaris) and Horsetail grass (Chloris roxburghiana) predominant. Saltbush (Atriplex nummularia) best palatable shrub for re-establishing pasture on overgrazed and eroded places; down to about 0.6 ha/LU with saltbush, Mesquite (Prosopis spec.), moth bean vines as hay, and silage of fodder sorghum for dry season

12) Oilseed (Brassica juncea), seeds obtainable at C.A.Z.R.I., Jodhpur, India
13) Palatable seeds and after some seasons tubers (bitter substances may be washed out in salty water); still experimental

LM 5 = Lower Midland Livestock-Millet Zone
vs/s + vs with a very short to short and a very short cropping season

Very small, potential see Embu District



LM 5 = Lower Midland Livestock-Millet Zone
vs + vs with two very short cropping seasons

Good yield potential

1st rains, start norm. b. of April: V. e. mat. foxtail and hog millet

2nd rains, start norm. end of Oct.: The same

Whole year: Buffalo gourds (light soils)[13] and Marama beans[13], jojoba (in valleys)

Fair yield potential

1st rains: E. mat. bulrush, foxtail and proso millet[11], v. e. mat. dwarf sorghum (~ 40 %); green grams, v. e. mat. cowpeas (~ 40 %), chickpeas (late planted on h. bl. soils); dwarf sunflower, v. e. mat. bambarra groundnuts (on light soils); v. e. mat. pumpkins, v. e. mat. rai[12]

2nd rains: The same but less risky

Whole year: Sisal, castor, jojoba (outside valleys), Vigna lobatifolia[16], Opuntia

Pasture and forage

3–4.5 ha/LU on undestroyed nat. pasture, improvable as in LM 5 vs/s + vs/s with about 20 % less carrying capacity

LM 5 = Lower Midland Livestock
vs+i or i+vs with a very short cropping season and intermediate rains or vice versa[14]

Good yield potential

1st or 2nd rains[14]: V. e. mat. foxtail and hog millet (good to fair)

Whole year: Buffalo gourds (light soils)[13], Marama beans[13]

Fair yield potential

1st or 2nd rains[13]: V. e. mat. dwarf sorghum (40–50 %), proso millet e. mat. bulrush millet[11]; green grams (40–50 %), moth beans, v. e. mat. cowpeas (40–50 %), v. e. mat. bambarra groundnuts (sandy soils); dwarf sunflower, v. e. mat. pumpkins

Whole year: Sisal (40–50 %), castor, jojoba (deep soils, better in valleys)

14) At least one of these seasons will be long enough to give success with the mentioned crops in 6 or more years out of 10

Runoff-catching agriculture see fig. 1 in Machakos District
Risk of total crop failure see table 4 Kitui District

Pasture and forage
3.5–5 ha/LU on undestroyed short grass bushland with horsetail grass (Chloris roxburghiana) predominant; down to 0.8 ha/LU with saltbush (Atriplex nummularia) as best palatable shrub, moth bean vines as hay and fodder sorghum as silage for dry seasons

LM 6 = ***Lower Midland Ranching Zone***

LM 6 = ***Lower Midland Ranching Zone***
b r ***with bimodal rainfall***

No rainfed agriculture economically possible except with runoff-catching techniques (see fig. 2 Machakos D.) More than 4 ha/LU on short grass savanna, up to 12 ha/LU in eroded bushland. Grazing rotation essential not to destroy grass cover

L = ***LOWLAND ZONES (Here IL = INNER LOWLAND ZONES)***

L 5 = ***Lowland Livestock-Millet Zone***

L 5 = ***Lowland Livestock-Millet Zone***
vs/s + vs/s ***with two very short to short cropping seasons***

Crops almost as LM 5 vs/s + vs/s but ye-eb nut bushes[15)] included in good yield potential. Stocking rate a bit lower, same fodder plants

L 5 = ***Lowland Livestock-Millet Zone***
vs + vs ***with two very short cropping seasons***

Crops almost as LM 5 vs + vs but ye-eb nut bushes[15)] included in good yield potential

L 5 = ***Lowland Livestock-Millet Zone***
vs+i or i+vs ***with a very short cropping season and intermediate rains or vice versa[14)]***

Crops almost as LM 5 vs+i or i+vs but ye-eb nut bushes[15)] included in good yield potential. Stocking rate nearly equal, same fodder plants

L 6 = ***Lowland Ranching Zone***

L 6 = ***Lowland Ranching Zone***
b r ***with bimodal rainfall***

Conditions like LM 6 but stocking rate more than 4.5 ha/LU. Game cropping and game ranching with eland, oryx, gerenuk and Grant's gazelle give higher production per ha than cattle and need no water for months

15) Cordeauxia edulis from Somalia
16) Tuber crop from Kalahari

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

Mt Kenya and its foot-hills determine the physiography of the upper part of Meru District. The mountains of olivine basalts and ashes occupy the southwest and centre of the district, followed by foot-hills. The northern and northwestern boundary is taken up by plateaus of Tertiary basic igneous rocks. Non-dissected erosional plains of the same parent rock occur in the north. In the eastern region, dissected and non-dissected erosional plains are dominant as well as bottom-lands.

On the highest parts, soils of variable fertility (map unit 5 M) are found. On slightly lower areas, soils of unit 6 M of moderate to high fertility occur. The volcanic foot-hills are dominated by soils of unit 76 R and 77 R, which are of moderate to high fertility also.

Plateau soils which are in general highly fertile (units 44 L, 45 L) make up the northwestern boundary.

Moderately to highly fertile soils occur in the north on non-dissected erosional plains (unit 220 Pn).

A small area in the south consists of less fertile upland soil (units 164 U, 165 U). Low to moderately fertile soils (96 F, 145 U) can be found on foot-hills and lower-middle uplands.

On the dissected erosional plains, soils on undifferentiated Basement System rocks of moderate to low fertility can be found (units 254 Pd, 255 Pd). Soils on bottomlands have developed on infill from undifferentiated volcanic rocks and are of high fertility (units 335 B, 340 B). North of Isiolo, floodplain soils are found on sediments which are moderately fertile (353 A).

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on olivine basalts and ashes of Mt. Kenya

1 M
m[1)] = Well drained, moderately deep, dark reddish brown, smeary clay loam, with humic topsoil (mollic ANDOSOLS)

2 M
h = Well drained, deep, dusky red to dark reddish brown, friable clay (eutric NITOSOLS)

4 M
x, m = 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).

6 M
m–h = Well drained, very deep, dark reddish brown to dark brown, very friable and smeary, clay loam to clay, with thick, acid humic topsoil; in places shallow to moderately deep and rocky (humic ANDOSOLS, partly lithic phase)

SOILS ON HILLS AND MINOR SCARPS

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

19 H
x, m = Well drained, very shallow to moderately deep, very dark brown, firm, stony and rocky, clay loam (LITHOSOLS; with verto-luvic PHAEOZEMS, lithic phase and Rock Outcrops)

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)

21 H
m = Well drained, shallow, dark reddish brown, friable, rocky and stony clay loam (nito-chromic CAMBISOLS, lithic phase; with Rock Outcrops)

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

26 H
x, m = Somewhat excessively drained, shallow, reddish brown, friable, rocky or stony, sandy clay loam (eutric REGOSOLS; with Rock Outcrops and calcic CAMBISOLS)

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 Tertiary basic igneous rocks (olivine basalts, nepheline phonolites; older tuffs included)

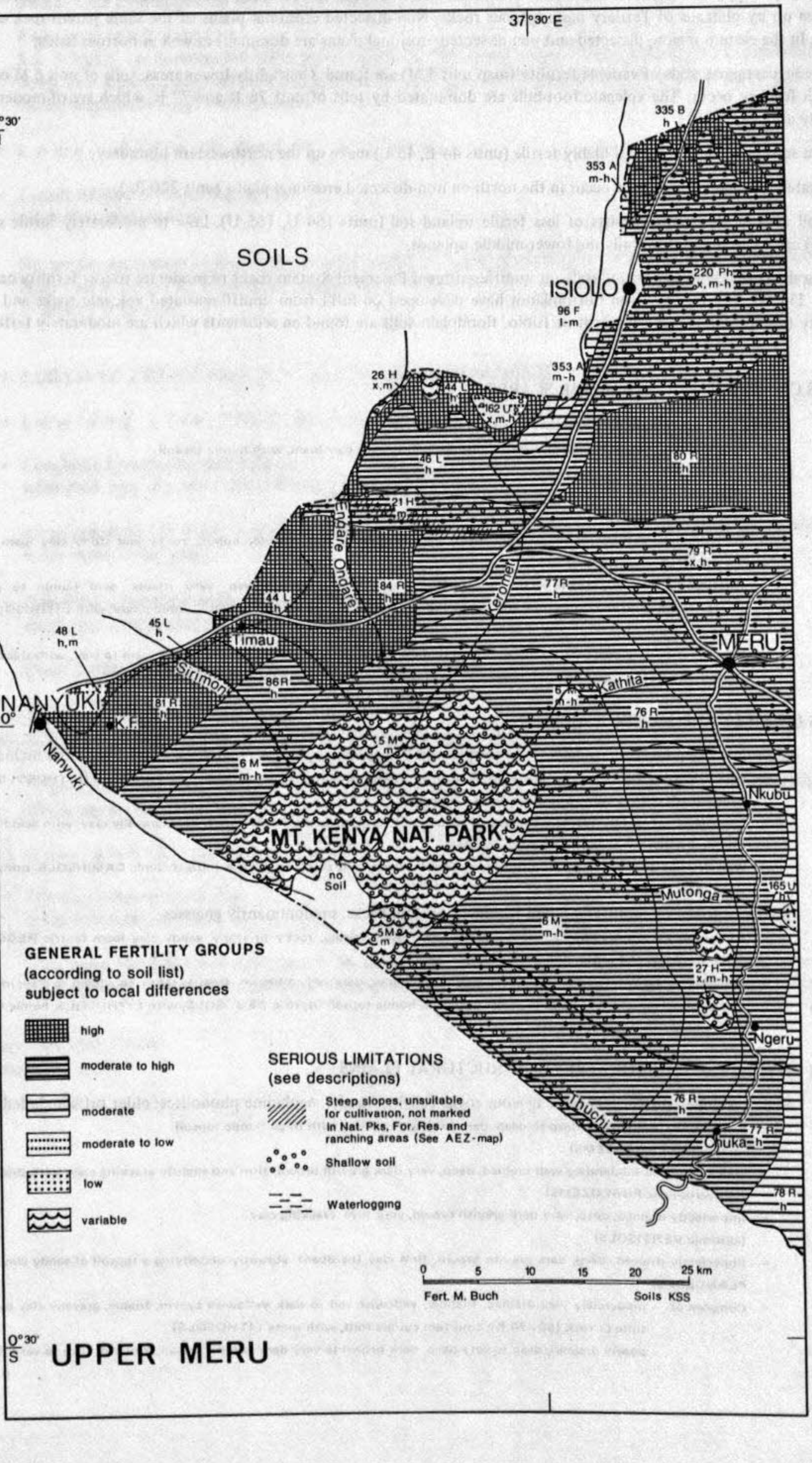
44 L
h = Well drained, moderately deep to deep, dark brown, firm clay, with thick humic topsoil (ortho-luvic PHAEOZEMS)

45 L
h = Well drained to moderately well drained, deep, very dark greyish brown, firm and slightly cracking clay, with thick humic topsoil (verto-luvic PHAEOZEMS)

46 L
h = Imperfectly drained, deep, very dark greyish brown, very firm, cracking clay (chromic VERTISOLS)

48 L
h, m = Imperfectly drained, deep, dark greyish brown, firm clay (hardpan), abruptly underlying a topsoil of sandy clay loam (eutric PLANOSOLS)

50 L
x, h = Complex of: - moderately well drained, shallow, yellowish red to dark yellowish brown, friable, gravelly clay over petroplinthite or rock (50–70 %), (murram cuirass soils, with some LITHOSOLS)
- poorly drained, deep to very deep, dark brown to very dark greyish brown, mottled, firm to very firm, cracking


SOILS
37°30' E
0°30'
N
0°
0°30'
S
UPPER MERU
ISIOLO
MERU
NANYUKI
Timau
K.F.
Nkubu
Ngeru
Chuka
MT. KENYA NAT. PARK
no Soil
Engare Ondare
Isiolo
Kerone
Sirimon
Nanyuki
Kathita
Mutonga
Thuchi
335 B
h
353 A
m-h
220 Ph
x, m-h
96 F
l-m
26 H
x,m
44 L
h
162 U
x,m-h
353 A
m-h
46 L
h
80 R
h
21 H
m
79 R
x,h
84 R
h
77 R
h
44 L
h
45 L
h
48 L
h,m
86 R
h
81 R
h
5 M
m-h
76 R
h
15 M
m
6 M
m-h
165 U
h
6 M
m-h
5 M
m
27 H
x,m-h
76 R
h
77 R
h
78 R
h
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
moderate to low
low
variable
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (See AEZ-map)
Shallow soil
Waterlogging
0 5 10 15 20 25 km
Fert. M. Buch
Soils KSS

SOILS
LOWER MERU
and Nyambeni Hills
MERU
NATIONAL
PARK
NYAMBENI HILLS
Kinna
Kangeta
Mikinduri
Mayna
Gatunga
Chiokarige
Ishiara
Kathita
Thanandu
Thingithu
Mutonga
Thuchi
Tana
38° E
0°30' N
0°
0°30' S
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (See AEZ-map)
Shallow soil
Sodic or saline soil
Waterlogging
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
moderate to low
low
very low
variable
National Park
0
5
10
15
20
25 km
Soils KSS

clay; in places moderately deep to deep over petroplinthite (VERTISOLS, undifferentiated and vertic GLEYSOLS)

52 L h = Well drained, very deep, dark red, very friable clay (nitorhodic FERRALSOLS)

SOILS ON VOLCANIC FOOTRIDGES

Soils developed on olivine basalts, ashes and other pyroclastic rocks

73 R x, m = Well drained, shallow to moderately deep, dark brown, firm, very calcareous, stony clay loam, with rocky and bouldery surface; in many places saline and sodic; with inclusions of recent lava flows (LITHOSOLS and calcic XEROSOLS, bouldery phase and partly saline-sodic phase

Soils developed on Tertiary basic igneous rocks (olivine basalts, nepheline phonolites; older 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 NITOSOLS; with humic ANDOSOLS)

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

78 R h = Well drained, extremely deep, dusky red to dark reddish brown, friable clay; with inclusions of well drained moderately deep, dark red to dark reddish brown, friable clay over rock, pisoferric or petroferric material (eutric NITOSOLS; with nito-chromic CAMBISOLS and chromic ACRISOLS, partly pisoferric or petroferric phase)

79 R x, h = Well drained, deep to extremely deep, dark reddish brown to dark brown, friable to firm clay; in places gravelly (eutric NITOSOLS and nito-chromic CAMBISOLS; with chromoluvic PHAEOZEMS)

80 R h = Well drained, moderately deep, dark reddish brown, firm, slightly cracking clay, with humic topsoil (verto-luvic PHAEOZEMS)

81 R h = Well drained, moderately deep to deep, dark reddish brown, friable to firm clay, with humic topsoil (chromo-luvic PHAEOZEMS)

86 R h = Well drained, moderately deep to very deep, dark reddish brown, friable to firm clay (nito-ferric LUVISOLS; with humic NITOSOLS)

Soils developed on ashes and other pyroclastic rocks from recent volcanoes

84 R h = Well drained, very deep, dark reddish brown, friable to firm, clay, with humic topsoil (chromo-luvic PHAEOZEMS; over buried NITOSOLS)

SOILS ON FOOTSLOPES

Soils developed on colluvium from undifferentiated Basement System rocks

96 F l–m = Well drained, very deep, yellowish red to dark reddish brown, friable, coarse loamy sand to sandy clay loam (chromic LUVISOLS; with rhodic FERRALSOLS and luvic/ferralic ARENOSOLS)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

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

145 U h = Well drained, very deep, dusky red to dark red, friable clay (nito-rhodic FERRALSOLS)

Soils developed on undifferentiated Basement System rocks

162 U x, m–h = Complex of well drained, shallow to deep, red to dark red, friable to firm, sandy clay loam to sandy clay; in places rocky (chromic and ferralo-chromic LUVISOLS; with chromic CAMBISOLS and Rock Outcrops)

163 U h = Well drained, moderately deep to deep, dark red to yellowish red, friable to firm, sandy clay to clay, often with topsoil of loamy sand (chromic LUVISOLS and ferralo-ferric/chromic/orthic LUVISOLS)

164 U l–h = Well drained, moderately deep to very deep, dark reddish brown to dark yellowish brown, friable to firm, sandy clay to clay; in many places with topsoil of loamy sand to sandy loam (ferralo-chromic/orthic/ferric ACRISOLS; with LUVISOLS and FERRALSOLS)

165 U m–h = Well drained, moderately deep to deep, dark red to yellowish red, friable, sandy clay loam to clay (rhodic and orthic FERRALSOLS; with ferralo-chromic/orthic/ferric ACRISOLS)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

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

220 Pn x, m–h = Well drained, shallow, very dark reddish brown, slightly calcareous, stony and bouldery, clay loam to clay (chromic CAMBISOLS, bouldery and lithic phase)

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

Soils developed on crystalline or sedimentary limestones and gypsiferous rocks (plio-pleistocene Wajir-El Wak beds)

232 Pn h = Well drained, moderately deep, dark reddish brown, friable clay (chromic CAMBISOLS)

Soils developed on undifferentiated Basement System rocks

233 Pn m–h	= Well drained, moderately deep to deep, dark red to strong brown, friable to firm, sandy clay loam to clay (ferralo-chromic/orthic LUVISOLS)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated Basement System rocks

254 Pd x, m	= Complex of well drained, shallow to moderately deep, dark red to yellowish brown, non to moderately calcareous, stony sandy clay loam, over petrocalcic material or quartz gravel (calcic CAMBISOLS, lithic or petrocalcic phase; with chromic LUVISOLS, petric phase)
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 BOTTOMLANDS

Soils developed on infill from undifferentiated volcanic rocks

335 B h	= Poorly drained, deep, very dark greyish brown, firm, moderately to strongly calcareous and slightly sodic clay, with humic topsoil (calcic CHERNOZEMS)

Soils developed on infill from limestones

340 B m	= Poorly drained, deep, very dark grey to very dark brown, firm, moderately calcareous, clay loam to clay, with humic topsoil (haplic CHERNOZEMS)

SOILS ON FLOODPLAINS

Soils developed on sediments mainly from olivine basalts

353 A m–h	= Imperfectly drained, very deep, dark brown to dark reddish brown, firm, moderately to strongly calcareous, stratified clay loam to clay, with a deeper subsoil of varying salinity and sodicity (calcaric FUVISOLS, saline-sodic phase)

1) Soil texture-classes

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

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

POPULATION AND LAND

The population of Meru District at the time of the census in September 1979 was 830,179 people (Table 4) of whom 72,049 lived in Meru Municipality and about 7,000 in the trading centres. Assuming that most of the people registered in Meru Municipality are still rural, the percentage of the population depending directly on agriculture is well over 90 %. The agricultural area statistically available per household was 3.97 ha, but only one third of the agricultural land may be included in the better zones 1–3 (Table 6).

The densely populated Upper Midland Zone which stretches from Nairobi to Mt. Kenya continues into Meru District up to the Nyambeni Range. Many locations have an average of less than 1.5 ha per household or 0.3 ha per person in the coffee zones UM 1–3. In addition, during the last 10 years even the Lower Midland Zones have become overpopulated. Statistically this does not seem to be the case as in LM 3, about 0.5 ha per person, in LM 4 about 0.7 ha/person and in LM 5 about 3 ha/person were still available, but according to the productivity of these zones this is close to the maximum carrying capacity.

The expansion of the population towards the north is also reaching its optimum level unless very early maturing crops are introduced. Settlement on the estates in the northwest is no solution, because they are well utilised at present, so productivity would not be improved, and in any case it is not a maize area.

The only area not yet overpopulated is the triangle in the east which formerly belonged to the Meru Game Reserve or National Park, and some adjoining land to the east. There is no advantage in taking any more land from the Park because the climate becomes rapidly drier towards the southeast. Intensification of agriculture and family planning to stop the population pressure is urgently necessary in this district.

MERU DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Kiirua	12 400	12 411	24 811	4 120	229	108
Giaki	5 348	5 188	10 536	1 740	99	106
Meru Municipality	36 691	35 358	72 049	14 305	128	561
Mwangathia	13 574	14 043	27 617	4 965	209	131
Kibirichia	8 436	8 297	16 733	2 830	132	125
Upper Abothuguchi	22 907	23 781	46 688	7 892	117	396
Timau	12 662	10 727	23 389	5 467	790	29
North Imenti Division	112 018	109 805	221 823	41 319	1 708	129
Abogeta	15 901	15 998	31 899	5 415	138	229
Nkuene	20 281	20 515	40 796	7 797	134	303
Igoji	15 542	15 306	30 848	5 350	119	257
South Imenti Division	51 724	51 819	103 543	18 562	392	263
Chogoria	10 857	10 593	21 450	3 297	54	390
Muthambi	11 233	11 143	22 376	3 884	81	274
Karingani	18 782	19 161	37 943	6 741	176	215
Kiera	15 034	15 600	30 634	5 442	172	177
Magumoni	14 588	15 297	29 885	5 208	155	192
Nithi Division	70 494	71 794	142 288	24 572	640	222
Mikinduri	20 962	22 653	43 615	8 376	243	178
Kianjai	20 667	22 481	43 148	7 548	209	205
Muthara	13 237	15 636	28 873	5 760	130	220
Akithii	11 547	13 468	25 015	4 473	68	367
Tigania Division	66 413	74 238	140 651	26 157	652	215
North Tharaka	8 280	8 811	17 091	3 258	784	21
South Tharaka	15 961	17 225	33 186	6 205	711	46
Tharaka Division	24 241	26 036	50 277	9 463	1 496	33
Maua	17 490	17 948	35 438	6 415	298	118
Akachiu	14 602	15 636	30 238	5 764	161	187
Mutuati	18 258	18 990	37 248	5 909	714	381
Ithima	15 166	15 742	30 908	5 518	354	87
Njia	17 900	19 465	37 365	6 768	174	213
Meru National Park	290	110	400	215	870	0
Igembe Division	83 706	87 891	171 597	30 589	2 572	66
Meru District	408 596	421 583	830 179	150 662	9 922	83

MERU 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 14 years	Children 14 years	Other Relatives		
Location:						
Meru Municipality	14317	2.99	1.18	0.49	0.37	5.02
Location:						
Mwangathia	4942	3.34	1.46	0.57	0.27	5.56
Kibirichia	2833	3.21	1.34	0.64	0.71	5.91
Kiirua	4115	3.32	1.62	0.67	0.41	6.01
Giaki	1740	2.88	1.64	0.55	0.46	6.05
Upper Abothuguchi	7873	3.48	1.51	0.68	0.25	5.92
Timau	5449	2.48	0.86	0.39	0.55	4.29
Division: North Imenti	41269	3.12	1.31	0.55	0.39	5.37
Location:						
Abogeta	5409	4.31	0.78	0.54	0.27	5.87
Akuene	7757	3.03	1.36	0.38	0.29	5.18
Igoji	5337	3.38	1.61	0.45	0.33	5.77
Division: South Imenti	18503	3.31	1.51	0.44	0.29	5.56
Location:						
Chogoria	3292	3.65	1.59	0.67	0.46	6.37
Muthambi	3863	3.44	1.66	0.50	0.22	5.79
Karingani	6728	3.30	1.58	0.56	0.18	5.63
Kiera	5415	3.35	1.53	0.59	0.19	5.65
Magumoni	5197	3.34	1.69	0.49	0.21	5.75
Division: Nithi	24495	3.40	1.59	0.56	0.23	5.78
Location:						
Mikinduri	8410	3.13	1.41	0.39	0.25	5.18
Kianjai	7532	3.28	1.62	0.56	0.27	5.73
Muthara	5741	3.01	1.45	0.35	0.20	5.00
Akithi	4492	3.25	1.69	0.44	0.18	5.57
Division: Tigania	26178	3.18	1.51	0.44	0.23	5.36
Location:						
North Tharaka	3251	3.08	1.41	0.48	0.29	5.25
South Tharaka	6194	3.12	1.46	0.47	0.29	5.35
Division: Tharaka	9445	3.10	1.44	0.47	0.29	5.32
Location:						
Maua	6411	3.09	1.39	0.46	0.38	5.47
Akachiu	5776	3.23	1.32	0.43	0.25	5.23
Mutlati	5908	3.75	1.50	0.61	0.41	6.28
Ithima	5494	3.42	1.45	0.45	0.27	5.59
Njia	6747	3.27	1.46	0.45	0.35	5.53
Meru National Park	204	1.55	0.05	0.06	0.29	1.96
Division: Igembe	30540	3.36	1.42	0.48	0.34	5.59
DISTRICT MERU	150430	3.25	1.45	0.50	0.31	5.50

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, include one and two persons per households as well

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON[1)]

Location/Division without townships	in '00 ha = sqkm: Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Non-agricultural land: Forest Res., lakes, swamps	Non-agricultural land: Others (roads, home-steads, rivers...)	Agri-cultural land	TA 1	UH 1	UH 2	UH 3	UH 4	LH 1	LH 2	LH 3	LH 4	LH 5	UM 1	UM 2	UM 3	UM 4	UM 5	UM 6	LM 3	LM 4	LM 4–5	LM 5	LM 6	L 4	L 5	L 6	in ha Agric. land per house-hold	in ha Agric. land per person
Mwangathi	209	4	F. 14	25	166												15					117	34							3.34	0.60
Kibirichia	132			17	115		7	26	7		8	3	10	15					4	30	5									4.06	0.69
Kiirua	229			30	199		1	2				22	9	1			9	12	35	24	7		7		24	46				4.83	0.80
Giaki	99			13	86																	66	20							4.94	0.82
Upper-Abothuguchi	117			19	98							22				17	22	26				11								1.24	0.21
Timau	790	24		53	713	9	26	75	164	23			51	134	8					109	102				12					13.04	3.05
North Imenti Div.	1 576	28	14	157	1 377	9	34	103	171	23	8	47	70	150	8	17	46	38	39	163	114	194	61		36	46				5.10	092
Abogeta	138			23	115						22					20	32	12				26	3							2.12	0.36
Nkuene	133			22	111						13					14	22	16				19	27							1.52	0.29
Igoji	119			20	99						17					17	27	11				27								1.85	0.32
South Imenti Div.	390			65	325						52					51	81	39				72	30							1.80	0.32
Chogoria	53			9	44						19					16	9													1.38	0.21
Muthambi	81			13	68						1					20	14	5				21	7							1.75	0.30
Karingani	176	4		28	144											11	18	12				48	43		12					2.29	0.39
Kiera	172	12	F. 25	22	113												7	10				50	28		16			2		2.08	0.37
Magumoni	155			26	129											13	19	8				22	29		38					2.48	0.43
Nithi Division	637	16	25	98	498						20					60	67	35				141	107		66			2		2.07	0.36
Mikinduri	243	19	F. 40	30	154											4	8	19				87	38							1.84	0.35
Kianjai	209	28	F. 5	28	148												6	34	8			39	23		38					1.96	0.34
Muthara	130	10	F. 2	20	98						9						9	6	6	13			6		50					1.74	0.34
Akithi	68			10	58												17	2	4				4		31					1.30	0.23
Tigania Division	650	57	47	88	458						9					4	40	61	18	13	126		71		119					1.78	0.33

Location/Division without townships	Area total Census 79 (in '00 ha = sqkm)	Non-agricultural land: Unsuit. steep slopes	Non-agricultural land: Forest Res., lakes, swamps	Non-agricultural land: Others (roads, home-steads, rivers...)	Agri-cultural land	TA 1	UH 1	UH 2	UH 3	UH 4	LH 1	LH 2	LH 3	LH 4	LH 5	UM 1	UM 2	UM 3	UM 4	UM 5	UM 6	LM 3	LM 4	LM 4–5	LM 5	LM 6	L 4	L 5	L 6	Agric. land per house-hold (in ha)	Agric. land per person (in ha)
						Area in agro-ecological zones AEZ (in '00 ha = sqkm)																									
North Tharaka	784	5	F. 35	36	708																			17	28		33	517	125	21.95	4.18
South Tharaka	711	42	F. 54	56	559																		224	17	112			221		9.01	1.68
Tharaka Division	1 495	47	89	92	1 267																		224		140		33	738	125	13.46	2.53
Maua	295		F. 10	37	248											5	20	31				46	66		57				23	4.15	0.74
Akachiu	161	28	F. 12	20	101											3	6	15				55	22							1.75	0.33
Mutuati	714	24	F. 32	47	611												12	34	10			41	46		207	249			12	10.75	1.70
Intima	354	25		43	286											5	22	8	15	12			6		40	166			12	5.18	0.93
Njia	174	10		26	138						6					20	4	5	10	5			4		28	46			10	2.04	0.37
Igembe Division	1 698	87	54	173	1 384						6					33	64	94	35	17		142	144		332	461			57	4.70	0.83
Total rural area	6 446	222	229	673	5 322	9	34	103	171	23	96	47	70	150	8	165	298	267	92	193	114	675	637	17	693	509	33	740	182	3.97	0.71

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

AGRICULTURAL STATISTICS[1)]

The Meru district is one of the largest agricultural districts in Kenya. Successful and productive rainfed agriculture is however limited to a comparatively small part of it, but the output from this area is one of the highest in the country.

Tea is cultivated by about 15,000 smallholders each owning 0.40 ha, the total tea area is roughly 6,000 ha, the yield per ha about 2,400 kg of green leaves. About 75,000 small family farmers grow **coffee** (about 0.25 ha each) harvesting roughly 750 kg of clean coffee per ha per year. The present **pyrethrum** (dried flower) output is roughly 100 t p.a., with a pyrethrin content of 1.5 %. The ginnery at Meru gins about 3,500 t of **seed cotton** p.a. Exact production figures are unknown but it is estimated that 4,000 ha of (rainfed) cotton is cultivated p.a., yielding between 500 and 1,000 kg per ha/year. The farmers of the Meru district make one of the highest contributions to the economy of Kenya.

1) For more detailed and up to date information, see FMHB Vol. III/A

MERU 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	12452	12452	12453	12457	6300	15100
Production	t	9185	7626	10894	11498	4850	11358
Yield	kg/ha	738	612	875	923	770	752

Estates – Nil

TABLE 7 b: **PYRETHRUM**
TRENDS IN PRODUCTION AND QUALITY[b)]

Item	Year				
	75/76	76/77	77/78	78/79	79/80
Production in t dried flowers	374	232	127	81	101
Pyrethrin content %	1.5	1.6	1.5	1.5	1.5

TABLE 7 c: **COTTON PRODUCTION**[c)]

Ginnery Zone	Year				
	75/76	76/77	77/78	78/79	79/80
Meru					
Seed Cotton in t		243	390	-	3586
Bales		427	685	-	6292

Sources: a) C.B.K.
b) Pyrethrum Board
c) C.L. & S.M.B., does not refer to district area only

MERU DISTRICT

TABLE 7 d: TEA

AREA – PRODUCTION – GROWERS – YIELDS – RETURNS[a)]

Small Farmers

Division	Item	Unit	Year				
			1975/76	1976/77	1977/78	1978/79	1979/80
Nyambene (Igembe) & (Tigania)	Area	ha	1,660	1,881	2,035	2,109	2,220
	Production	t	3,228	2,678	5,133	6,649	5,398
	Value	'000 Shs	4,313	9,240	11,908	13,431	12,740
	Growers	No	4,337	5,034	5,326	5,433	5,661
	Yield per ha	kg	1,945	1,424	2,522	3,153	2,431
	Value per ha	Shs	2,839	4,912	5,851	6,368	5,738
	Area per Grower	ha	0.38	0.37	0.38	0.39	0.39
	Returns per Grower	Shs	1,087	1,835	2,235	2,472	2,250
Tigeni	Area	ha					
	Production	t	1,899				
	Value	'000 Shs	6,551				
	Growers	No					
	Yield per ha	kg					
	Value per ha	Shs					
	Area per Grower	ha					
	Returns per Grower	Shs					
South Imenti	Area	ha	1,739	2,020	2,146	2,200	2,252
	Production	t	4,174	5,259	4,827	6,778	6,576
	Value	'000 Shs	6,511	18,563	13,178	15,251	17,361
	Growers	No	4,408	5,263	5,391	5,410	5,454
	Yield per ha	kg	2,400	2,603	2,249	3,081	2,920
	Value per ha	Shs	3,744	9,190	6,140	6,932	7,709
	Area per Grower	ha	0.39	0.38	0.40	0.41	0.41
	Returns per Grower	Shs	1,477	3,527	2,444	2,819	3,183
North Imenti	Area	ha	634	680	737	728	736
	Production	t	1,541	1,579	1,597	1,905	1,531
	Value	'000 Shs	2,405	5,668	4,329	5,086	4,852
	Growers	No	1,871	2,045	2,102	2,116	2,119
	Yield per ha	kg	2,431	2,322	2,167	2,617	2,080
	Value per ha	Shs	3,793	8,335	5,873	6,986	6,592
	Area per Grower	ha	0.34	0.33	0.35	0.34	0.35
	Returns per Grower	Shs	1,285	2,772	2,059	2,404	2,290
Nithi	Area	ha	576	669	698	722	744
	Production	t	80	482	400	741	548
	Value	'000 Shs	124	1,702	1,092	1,666	1,446
	Growers	No	1,595	1,883	1,950	1,985	2,025
	Yield per ha	kg	1,339	720	573	1,026	737
	Value per ha	Shs	2,153	2,544	1,564	2,307	1,944
	Area per Grower	ha	0.36	0.36	0.36	0.36	0.37
	Returns per Grower	Shs	777	904	1,564	839	2,396

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

SMALL FARM SURVEY (SFS)[1]

The Meru district includes practically all agro-ecological zones of Kenya, reaching from the cool Upper Highlands to the hot and arid Lowlands. Ideal conditions for small-scale farming, i.e. fertile, easily worked soils and high, well-distributed rainfall exist however in less than 15 % of the district area.

The SFS was carried out in three areas of the more productive regions only: in the Kithirune (AEZ LH 1/UM 1), the Nkubu (AEZ UM 2), and the Kaongo (AEZ LM 3) areas. The farms found in the LH 1 and UM 2 group areas are very similar, while the LM 3 group farms are very different from the other two areas. The LH 1 and UM 2 farms were 2.1 and 1.9 ha in size and used roughly one-quarter of their area for annual crops, one-quarter for perennial crops and one-quarter for pasture. The rest of the land is used for forage production or left fallow. The farms in the Lower Midlands (LM 3) were 7.2 ha in size, planted 50 % of their area with annual crops and used the rest for grazing, forage production, and left 17 % of the land fallow.[2] The LH 1 and UM 2 farmers planted 1.3 and 1.4 crops annually, kept approximately 4 LU per ha of pasture/forage area, and between 65 % and 90 % of their cattle are of improved stock. Also LM 3 farmers claimed to plant 1.4 crops p.a., kept 2.2 LU/ha, but only one-third of their cattle are of improved stock. The farmers of the LH 1/UM 2 samples used considerable amounts of fertilizers and practised plant protection, while the farmers in the LM 3 sample used practically no fertilizer and practised plant protection in cotton only (table 8 & 9). The cropping pattern in table 10 shows a great similarity between the two (LH 1 and UM 2) sample farms. Roughly 65 % is used for staple food crops (maize, beans, and maize & beans). English potatoes are the next most important crop on both farms. The high proportion of pyrethrum recorded does not reflect the overall situation in the farms of the two AEZs. The staple food crops cover roughly half of the arable area of the LM 3 farms, the next most important crop here is cotton; its proportion (30 %) is above district average in the cotton zone (LM 3). The high proportion of sunflower planted was a result of a crop promotion project and is probably much lower now (table 10). The proportion of goats/sheep was between 7 % and 25 % (table 11). The farmers claimed to harvest fairly good maize, beans and potatoes yields but used fertilizer for potatoes and cabbages only (table 12). Table 13 indicates that all food produced within the district is consumed there and that the area is increasingly dependent on imports of staple food. Planting of annual crops is more pronounced during the second rains; exceptions are beans and potatoes. The cotton graph demonstrates clearly that this crop occupies the field for a 12 month period (graph in table 14). The high yields possible for crops like maize, cabbage, potatoes and sweet potatoes are a result of a fertile soil and suitable climate in the Lower Highlands and Upper Midlands respectively. The farmers in the Lower Midlands can only expect half the output, or less, but this does not take into account the fluctuations in rainfall there which often lead to complete crop failures (table 15).

Increased biomass production through increased use of N-fertilizers in order to safeguard the soil fertility, and increased food output per area unit, should be a major goal in future for the intensively cultivated smallholdings of AEZ LH and UM. Specialist advice on plant protection and promotion of semi-zero and zero grazing would be welcomed by the farmer. No mechanisation other than improved hand tools is required. Manual labour will also be highly productive and secure a good income for the farmers in future.

The labour productivity in the Lower Midlands and Lowlands is probably only one-fifth of that of their counterparts at higher altitudes. Mechanisation of field work is therefore a must. Improved implements and better harnesses for the draught animals are most important. Extension advice on crop husbandry based on sound agro-climatic information should help to improve the standard of living in this region. A marked and lasting improvement however requires a perennial crop which yields similar return on labour to tea and coffee, but under arid conditions.

[1] For more detailed and up to date information, see FMHB Vol. III/B

[2] For holding sizes, see also table 6

MERU DISTRICT

AEZ: LH 1 + UM 1

TABLE 8 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 44

Item	Unit	Farm Size & Land Use, Livestock on Farm, Farm Size Group: small	medium	large
Farm Size Total	ha	1.o	1.8	3.7
Land Use: Annual Crops1) First Season		o.1		
Maize	ha	-	o.1	o.3
Beans	ha	o.1	-	o.1
English Potatoes	ha	-	o.2	o.2
Maize & Beans	ha	o.2	o.3	o.3
Others	ha	-	-	-
Total	ha	o.4	o.6	o.9
Second Season1) Beans	ha	o.1	o.1	o.1
English Potatoes	ha	-	o.1	o.3
Maize & Beans	ha	o.1	-	-
Total	ha	o.2	o.2	o.4
Permanent Crops1) Pyrethrum	ha	-	-	o.1
Tea	ha	-	-	o.3
Coffee	ha	o.2	o.2	-
	ha			
Portion of total	%	2o %	11 %	32 %
Grazing & Forage	ha	o.3	o.8	1.4
portion of total	%	3o %	44 %	38 %
Other Land Use	ha	o.1	o.2	o.2
Livestock on Farm:				
Cattle: local	LU	o.1	-	-
improved	LU	2.2	2.1	4.o
Sheep & Goats	LU	o.2	o.1	o.3
Total	LU	2.5	2.2	4.3

Item	Unit	Intensity, Labour/Persons on Farm, Home Consumption, Farm Size Group: small	medium	large
Farming Intensity:				
Cropping Intensity	-	o.8	o.6	o.6
Portion of improved cattle kept	%	96 %	-	-
Portion of Farmers owning a Plough	%			
Labour on Farm:				
Family Adults	persons	2.1	2.2	2.1
Perm. Hired Labour	"	o.1	-	1.o
Children > 14 years	"	1.7	1.o	2.3
Persons living on Farm2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.33	o.14	2.47
Children < 14 years	"	3.57	-	3.57
Subsistence Units	SU	4.47	o.14	4.61
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1o45	2o21	
Beans	kg	139	265	
English Potatoes	kg	515	2oo	
Sweet Potatoes	kg	15	1o2	
Cabbage	kg	88	1o.6	
	kg			
	kg			
	kg			

Other Crops cultivated: Wheat, Sweet Potatoes, Cabbage, Maize & Sorghum, Bananas

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

MERU DISTRICT

AEZ: LM 3

TABLE 8 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 45

Item		Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
			small	medium	large
Farm Size Total		ha	2.7	5.8	17.2
Land Use:	Annual Crops1) First Season				
	Maize	ha	o.3	1.4	1.6
	Beans	ha	o.2	o.7	o.8
	Sunflower	ha	o.3	o.2	o.7
	Cotton	ha	o.8	o.9	2.o
	Maize & Beans	ha	o.5	o.3	o.4
	Total	ha	2.1	3.5	5.5
	Second Season1)				
	Maize	ha	o.2	1.2	1.6
	Beans	ha	o.2	o.6	o.8
	Sunflower	ha	o.2	o.2	o.7
	Maize & Beans	ha	o.4	o.2	o.4
	Total	ha	1.o	2.2	3.5
	Permanent Crops1)				
	Bananas	ha	-	o.1	o.6
	Citrus	ha	-	o.1	o.4
		ha			
		ha			
	Portion of total	%	-	3 %	6 %
	Grazing & Forage	ha	o.5	1.5	8.4
	portion of total	%	25 %	26 %	49 %
	Other Land Use	ha	o.1	o.6	2.3
Livestock on Farm:					
	Cattle: local	LU	1.1	2.5	3.3
	improved	LU	o.6	1.2	4.o
	Sheep & Goats	LU	o.3	1.3	2.4
Total		LU	2.o	5.o	1o.2

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	1.2	1.o	o.6
Portion of improved cattle kept	%	35 %	32 %	51 %
Portion of Farmers owning a Plough	%	-	1o %	2o %
Labour on Farm:				
Family Adults	persons	1.4	2.3	2.4
Perm. Hired Labour	"	-	o.6	2.o
Children > 14 years	"	1.4	3.1	1.8
Persons living on Farm2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.37	o.22	2.59
Children < 14 years	"	3.o2	-	3.o2
Subsistence Units	SU	4.18	o.22	4.4o
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1o74	2o77	
Beans	kg	243	463	
Millet	kg	69	129	
	kg			
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Bulrush Millet

1) Major crops only considered

2) Based on 1979 Census figures

MERU DISTRICT
AEZ: UM 2

TABLE 8 c: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 46

Item	Unit	Farm Size & Land Use, Livestock on Farm, Farm Size Group: small	medium	large
Farm Size Total	ha	1.1	1.9	4.o
Land Use: Annual Crops1) First Season				
Maize	ha	-	o.1	o.1
English Potatoes	ha	-	-	o.2
Maize & Beans	ha	o.2	o.3	o.4
Beans	ha	o.1	-	o.1
Others	ha	-	-	-
Total	ha	o.3	o.4	o.8
Second Season1) Maize	ha	-	-	o.1
Beans	ha	-	o.1	o.1
Maize & Beans	ha	o.3	o.1	o.4
Total	ha	o.3	o.2	o.6
Permanent Crops1) Coffee	ha	o.3	o.6	o.6
Bananas	ha	-	o.1	o.1
	ha			
	ha			
Portion of total	%	27 %	37 %	18 %
Grazing & Forage	ha	o.3	o.7	1.8
portion of total	%	27 %	37 %	45 %
Other Land Use	ha	o.2	o.1	o.7
Livestock on Farm:				
Cattle: local	LU	o.3	o.7	o.7
improved	LU	1.9	1.6	2.o
Sheep & Goats	LU	o.4	o.3	1.1
Total	LU	2.6	2.6	3.8

Item	Unit	Intensity, Labour/Persons on Farm, Home Consumption, Farm Size Group: small	medium	large
Farming Intensity:				
Cropping Intensity	-	o.8	o.7	o.5
Portion of improved cattle kept	%	86 %	7o %	74 %
Portion of Farmers owning a Plough	%	-	-	-
Labour on Farm:				
Family Adults	persons	2.2	2.9	1.8
Perm. Hired Labour	"	o.3	o.3	1.2
Children > 14 years	"	1.5	1.7	1.o
Persons living on Farm2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.36	o.17	2.53
Children < 14 years	"	3.28	-	3.28
Subsistence Units	SU	4.32	o.17	4.49
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	917	1774	
Beans	kg	268	511	
Fingermillet	kg	4	8	
English Potatoes	kg	2o1	78	
Sweet Potatoes	kg	7	5	
	kg			
	kg			
	kg			

Other Crops cultivated: Fingermillet, Sweet Potatoes, Sugarcane

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

MERU DISTRICT

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

AEZ: LH 1 + UM 1

Survey Area 44

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	2.1	6.6	0.9	2.1	0.4	1.8
Avg. 1	2.1	6.9	1.4	2.1	1.7	2.7
Up. Qu.	3.0	10.0	1.0	2.0	-	2.0
Lo. Qu.	1.2	3.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	0.6	30	0.5	26	0.6	30	0.2	8	-	2	0.1	4
Avg. 1	0.6	24	0.6	26	0.7	28	0.2	9	0.2	8	0.1	4
Up. Qu.	0.8	40	0.5	30	0.9	40	0.2	12	-	-	0.1	8
Lo. Qu.	0.4	23	0.1	9	0.1	9	-	-	-	-	-	3
Total	18.1		15.6		18.0		4.6		1.4		2.5	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.3	1.5	4.1	90.0
Avg. 1			3.9	90.0
Up. Qu.	1.7	2.9	7.9	100.0
Lo. Qu.	1.0	1.0	2.3	85.7

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	42.5	3.8	9.9	13.1	0.5	-	0.7	-	-	0.6	0.1	1.0	2.6
Avg. 1	50.0	10.0	12.5	24.5	1.1	2.1	2.0	0.1	0.3	1.3	1.2	2.1	4.9
Up. Qu.	100.0	8.1	18.1	22.1	-	-	-	-	-	1.4	-	1.2	6.7
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

MERU DISTRICT

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

AEZ: LM 3 Survey Area 45

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	7.2	21.3	1.5	2.2	0.7	2.6
Avg. 1	7.2	22.1	1.8	2.2	2.2	3.2
Up. Qu.	8.0	21.0	2.0	2.0	1.0	4.0
Lo. Qu.	4.0	9.0	1.0	2.0	-	1.0

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	3.6	51	0.3	4	2.3	33	0.1	2	0.5	7	0.2	3
Avg. 1	3.6	39	0.9	9	2.5	27	0.5	5	1.6	17	0.2	2
Up. Qu.	4.4	80	0.4	7	3.0	40	0.2	4	0.4	10	0.2	5
Lo. Qu.	2.4	40	-	-	0.5	11	-	-	-	-	0.1	2
Total	108.2		8.8		70.0		4.5		15.8		6.2	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.4	0.7	2.2	28.4
Avg. 1			2.1	55.7
Up. Qu.	1.6	0.9	5.5	44.6
Lo. Qu.	1.3	0.4	1.2	-

Inputs Applied

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	0.2	-	1.5	-	-	-	-	-	5.1	0.1	-	-
Avg. 1	64.1	6.3	-	22.6	-	-	-	0.3	0.1	5.1	3.0	-	1.0
Up. Qu.	61.5	-	-	-	-	-	-	-	-	8.3	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	2.1	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of 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

MERU DISTRICT

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

AEZ: UM 2

Survey Area 46

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	1.9	8.4	0.8	2.4	0.4	1.5
Avg. 1	1.9	8.7	1.2	2.4	1.3	2.8
Up. Qu.	2.2	11.0	1.0	3.0	1.0	2.0
Lo. Qu.	1.2	4.0	-	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	0.5	27	0.6	30	0.6	32	0.1	3	-	2	0.1	6
Avg. 1	0.5	22	0.6	25	0.7	29	0.2	6	0.3	13	0.1	5
Up. Qu.	0.6	33	0.9	47	0.7	38	0.1	8	-	-	0.1	8
Lo. Qu.	0.2	17	0.2	13	0.1	8	-	-	-	-	0.1	4
Total	15.0		16.7		17.8		1.8		1.3		3.3	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.4	1.5	4.3	63.7
Avg. 1			4.0	82.2
Up. Qu.	2.0	2.5	9.8	90.4
Lo. Qu.	1.0	0.9	2.1	-

Inputs Applied

Range	Improved Seed Used % of area	Fertilizer Applied pure nutrient kg/ha						Manure Applied t/ha		Plant Protection			
		N		P_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	42.5	4.3	13.2	14.5	5.2	-	-	-	0.1	0.8	0.3	0.3	6.4
Avg. 1	52.5	23.3	18.6	38.5	42.4	-	2.1	0.6	0.4	2.1	0.7	2.3	6.4
Up. Qu.	57.1	-	27.9	25.2	-	-	-	-	0.3	1.3	-	-	10.7
Lo. Qu.	-	-	3.3	-	-	-	-	-	-	-	-	-	3.0

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of 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

MERU DISTRICT

AEZ: LH 1 + UM 1

TABLE 10 a: CROPPING PATTERN

Survey Area 44

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.2	0.5	0.40	0.00	4.5	23.5
Wheat	0.0	0.1	0.00	0.00	0.1	0.4
Beans	0.1	0.3	0.00	0.00	1.9	10.0
Engl. Potatoes	0.1	0.3	0.20	0.00	3.2	16.8
Cabbage	0.1	0.2	0.12	0.00	1.7	8.7
Pyrethrum	0.0	0.2	0.00	0.00	1.1	5.6
Others	0.0	0.1	0.00	0.00	0.3	1.7
Maize & Sorgm	0.0	0.1	0.00	0.00	0.1	0.6
Maize & Beans	0.2	0.4	0.40	0.00	6.1	31.6
Maize & Others	0.0	0.2	0.00	0.00	0.2	1.0
Total					19.2	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Beans	0.1	0.4	0.20	0.00	3.0	34.1
Engl. Potatoes	0.1	0.3	0.20	0.00	2.3	26.4
Cabbage	0.0	0.2	0.00	0.00	1.2	13.2
Sweet Potatoes	0.0	0.2	0.00	0.00	0.2	2.3
Pyrethrum	0.0	0.2	0.00	0.00	1.1	12.3
Others	0.0	0.1	0.00	0.00	0.2	2.3
Maize & Beans	0.0	0.3	0.00	0.00	0.8	9.5
Total					8.8	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Cookng Bananas	0.0	0.1	0.00	0.00	0.1	0.9
Coffee	0.2	0.3	0.32	0.00	5.0	37.6
Tea	0.3	1.2	0.12	0.00	8.1	61.5
Total					13.2	100.0

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

MERU DISTRICT

AEZ: LM 3

TABLE 10 b: CROPPING PATTERN

Survey Area 45

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	1.1	1.5	1.60	0.00	32.0	29.0
Bulrushmillet	0.1	0.7	0.00	0.00	2.6	2.4
Beans	0.6	0.9	0.80	0.00	18.2	16.5
Sunflower	0.4	0.7	0.80	0.00	13.0	11.8
Cotton	1.1	1.3	1.60	0.40	33.4	30.3
Tobacco	0.0	0.4	0.00	0.00	0.4	0.4
Cassava	0.1	0.8	0.00	0.00	1.8	1.6
Sugarcane	0.0	0.6	0.00	0.00	0.6	0.5
Maize & Beans	0.3	1.0	0.40	0.00	8.2	7.4
Total					110.2	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.9	1.3	1.20	0.00	28.0	40.8
Bulrushmillet	0.0	0.4	0.00	0.00	0.4	0.6
Beans	0.6	0.9	0.80	0.00	19.4	28.3
Sunflower	0.3	0.6	0.80	0.00	10.2	14.9
Cassava	0.1	1.8	0.00	0.00	1.8	2.6
Sugarcane	0.0	0.6	0.00	0.00	0.6	0.9
Maize & Beans	0.3	1.0	0.40	0.00	8.2	12.0
Total					68.6	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Cookng Bananas	0.2	0.5	0.40	0.00	5.2	76.5
Citrus	0.1	0.8	0.00	0.00	1.6	23.5
Total					6.8	100.0

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

MERU DISTRICT

TABLE 10c: CROPPING PATTERN

AEZ: UM 2

Survey Area 46

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.0	0.5	0.00	0.00	1.0	6.7
Fingermillet	0.0	0.1	0.00	0.00	0.1	0.8
Beans	0.0	0.3	0.00	0.00	1.0	7.0
Engl. Potatoes	0.0	0.2	0.00	0.00	1.4	9.2
Sweet Potatoes	0.0	0.1	0.00	0.00	0.1	0.8
Sugarcane	0.0	0.2	0.00	0.00	0.2	1.3
Others	0.0	0.8	0.00	0.00	0.8	5.4
Maize & Beans	0.3	0.4	0.40	0.12	10.2	68.7
Total					14.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.0	0.6	0.00	0.00	0.6	6.2
Beans	0.0	0.3	0.00	0.00	1.4	14.9
Engl. Potatoes	0.0	0.2	0.00	0.00	0.5	5.0
Sugarcane	0.0	0.2	0.00	0.00	0.2	2.1
Maize & Beans	0.2	0.5	0.40	0.00	6.9	71.8
Total					9.6	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Cookng Bananas	0.0	0.2	0.00	0.00	0.8	4.7
Coffee	0.5	0.5	0.72	0.24	15.0	92.8
Tea	0.0	0.2	0.00	0.00	0.4	2.5
Total					16.2	100.0

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

TABLE 11 a: HERD COMPOSITION (GRAZING LIVESTOCK)

– in Head & Livestock Units –

AEZ: LH 1 + UM 1

Jan. '78, Survey Area 44

Improved Livestock		Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year,	Average	0.33	0.07	-	0.93				0.33			0.33
	Upper Qu.	1	-	-	1				0.5			0.5
1 - 2 years,	Average	0.13	0.03	-	0.60	,			0.38			0.38
	Upper Qu.	-	-	-	1				0.5			0.5
Over 2 years,	Average	-	0.07	-		2.00			2.05			2.05
	Upper Qu.	-	-	-		2			2.0			2.0
Subtotal(improved)	Total	14	5	-	46	60			83.1			83.1
	Average	0.47	0.17	-	1.53	2.00			2.77			2.77
	Upper Qu.	1	-	-	2	2			3.6			-
	Lower Qu.	-	-	-	-	1			1.3			-
LU Male Cattle =		8.5 % of total cattle,				Calves + Heifers =			76.7 % of dairy cows			
Unimproved Livestock:												
Under 1 year,	Average	-	-	-	-		0.80	0.03	0.08	-		0.08
	Upper Qu.	-	-	-	-		2	-	0.2	-		0.2
1 - 2 years,	Average	0.07	-	-	-				0.03			0.03
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	-	-	-		0.07	1.43	0.07	0.19	-	5.30	0.19
	Upper Qu.	-	-	-		-	2	-	-	-	1	-
Subtotal (unimp.)	Total	2	-	-	-	2	67	3	9.2	-	159	9.2
	Average	0.07	-	-	-	0.07	2.23	0.10	0.31	-	5.30	0.31
	Upper Qu.	-	-	-	-	-	4	-	0.4	-	7	0.4
	Lower Qu.	-	-	-	-	-	-	-	-	-	1	-
LU Male Cattle =		40.9 % of total cattle,				Calves + Heifers =			0.0 % of dairy cows			
LU Goats + Sheep =		73.1 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	16	5	-	46	62	67	3	92.3	-	159	92.3
	Average	0.53	0.17	-	1.53	2.07	2.23	0.10	3.08	-	5.30	3.08
	Upper Qu.	1	-	-	2	2	4	-	3.8	-	7	0.4
	Lower Qu.	-	-	-	-	1	-	-	1.8	-	1	-
LU Male Cattle =		9.4 % of total cattle,				Calves + Heifers =			74.2 % of dairy cows			
LU Goats + Sheep =		7.6 % 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)
– in Head & Livestock Units –

AEZ: LM 3 — Jan. '78, Survey Area 45

Improved Livestock	Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s Total
Under 1 year, Average	0.27	-	-	0.37				0.16			0.16
Upper Qu.	-	-	-	-				-			-
1 - 2 years, Average	0.07	0.10	-	0.37				0.27			0.27
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	-	0.07	0.13		0.93			1.09			1.09
Upper Qu.	-	-	-		1			1.0			1.0
Subtotal(improved) Total	10	5	4	22	28			45.6			45.6
Average	0.33	0.17	0.13	0.73	0.93			1.52			1.52
Upper Qu.	-	-	-	1	1			2.1			-
Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =	20.4 % of total cattle,				Calves + Heifers = 78.6 % of dairy cows						
Unimproved Livestock:											
Under 1 year, Average	0.50	0.07	0.33	0.87		1.50	3.13	0.82	0.30		0.86
Upper Qu.	1	-	-	2		2	2	1.0	-		1.0
1 - 2 years, Average	0.17	0.10	-	0.93				0.54			0.54
Upper Qu.	-	-	-	1				0.5			0.5
Over 2 years, Average	0.07	0.03	0.07		2.30	3.70	4.93	2.47	0.03	19.20	2.47
Upper Qu.	-	-	-		2	5	5	-	-	10	-
Subtotal (unimp.) Total	22	6	12	54	69	156	242	114.7	10	576	116.2
Average	0.73	0.20	0.40	1.80	2.30	5.20	8.07	3.82	0.33	19.20	3.87
Upper Qu.	1	-	-	3	2	6	7	4.4	-	20	4.4
Lower Qu.	-	-	-	-	-	-	-	1.4	-	10	1.4
LU Male Cattle =	16.4 % of total cattle,				Calves + Heifers = 78.3 % of dairy cows						
LU Goats + Sheep =	34.7 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	32	11	16	76	97	156	242	160.3	10	576	161.8
Average	1.07	0.37	0.53	2.53	3.23	5.20	8.07	5.34	0.33	19.20	5.39
Upper Qu.	2	-	-	3	3	6	7	5.4	-	20	4.4
Lower Qu.	-	-	-	1	1	-	-	2.2	-	10	1.4
LU Male Cattle =	17.9 % of total cattle,				Calves + Heifers = 78.4 % of dairy cows						
LU Goats + Sheep =	24.8 % 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

TABLE 11 c: HERD COMPOSITION (GRAZING LIVESTOCK)

– in Head & Livestock Units –

AEZ: UM 2

Jan. '78, Survey Area 46

Improved Livestock	Bulls	Steers	Oxen	Heifers	Cows	Sheep	Goats	Grazing LU Total	Pigs	Other L/Stock	L.U.s' Total
Under 1 year, Average	0.27	-	-	0.33				0.15			0.15
Upper Qu.	-	-	-	1				0.3			0.3
1 - 2 years, Average	0.03	-	-	0.37				0.20			0.20
Upper Qu.	-	-	-	1				0.5			0.5
Over 2 years, Average	0.13	-	-		1.33			1.44			1.44
Upper Qu.	-	-	-		2			2.0			2.0
Subtotal(improved) Total	13	-	-	21	40			53.7			53.7
Average	0.43	-	-	0.70	1.33			1.79			1.79
Upper Qu.	1	-	-	1	2			2.8			-
Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =	10.6 % of total cattle,				Calves + Heifers =			52.5 % of dairy cows			
Unimproved Livestock: Under 1 year, Average	0.07	-	-	0.17		0.50	1.03	0.20	0.03		0.20
Upper Qu.	-	-	-	-		1	2	0.3	-		0.3
1 - 2 years, Average	-	-	-	0.07				0.03			0.03
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	0.33	-	-		0.37	1.00	2.37	0.79	-	10.97	0.79
Upper Qu.	-	-	-		-	2	3	-	-	5	-
Subtotal (unimp.) Total	12	-	-	7	11	45	102	30.7	1	329	30.8
Average	0.40	-	-	0.23	0.37	1.50	3.40	1.02	0.03	10.97	1.03
Upper Qu.	-	-	-	-	-	3	4	1.5	-	15	1.5
Lower Qu.	-	-	-	-	-	-	-	0.2	-	5	0.2
LU Male Cattle =	43.3 % of total cattle,				Calves + Heifers =			63.6 % of dairy cows			
LU Goats + Sheep =	48.0 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	25	-	-	28	51	45	102	84.4	1	329	84.5
Average	0.83	-	-	0.93	1.70	1.50	3.40	2.81	0.03	10.97	2.82
Upper Qu.	1	-	-	1	3	3	4	4.3	-	15	1.5
Lower Qu.	-	-	-	-	1	-	-	0.5	-	5	0.2
LU Male Cattle =	18.1 % of total cattle,				Calves + Heifers =			54.9 % of dairy cows			
LU Goats + Sheep =	17.4 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1–2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU

Unimproved Stock = Under 1 year 0.20 LU, 1–2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU

Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

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TABLE 12 a: INPUTS & YIELDS OF MAJOR CROPS

AEZ: LH 1 + UM 1

Survey Area 44

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									
Beans	Avg.	-	-	-	-	-	-	-	777
	UpQu	-	-	-	-	-	-	-	1,200
	LoQu	-	-	-	-	-	-	-	375
Engl. Potatoes	Avg.	9	31	78	-	0.20	-	13	12,408
	UpQu	-	45	115	-	-	-	15	12,650
	LoQu	-	-	-	-	-	-	-	2,500
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	6,875
Second Rains									
Maize	Avg.	89	3	21	-	0.07	6	6	1,379
	UpQu	100	-	29	-	-	10	10	1,800
	LoQu	100	-	-	-	-	-	-	675
Engl. Potatoes	Avg.	11	23	70	-	0.14	-	19	8,131
	UpQu	-	45	115	-	-	-	20	12,000
	LoQu	-	-	-	-	-	-	-	2,250
Cabbage	Avg.	100	4	35	-	0.14	3	12	14,306
	UpQu	100	-	25	-	-	-	10	16,667
	LoQu	100	-	-	-	-	-	5	5,000
Maize & Beans									
Maize	Avg.	72	11	18	-	-	4	4	2,059
Beans	Avg.	6	-	-	-	-	-	-	857
Maize	UpQu	100	-	29	-	-	2	2	2,025
Beans	UpQu	-	-	-	-	-	-	-	900
Maize	LoQu	-	-	-	-	-	-	-	1,125
Beans	LoQu	-	-	-	-	-	-	-	250
Perennial Crops									
Pyrethrum	Avg.	-	6	6	-	-	1	5	835
	UpQu	-	-	-	-	-	-	-	995
	LoQu	-	-	-	-	-	-	-	40
Coffee	Avg.	-	82	-	-	0.32	1	36	10,177
	UpQu	-	108	-	-	-	-	33	10,000
	LoQu	-	34	-	-	-	-	16	5,556

MERU DISTRICT

AEZ: LM 3

TABLE 12 b: INPUTS & YIELDS OF MAJOR CROPS

Survey Area 45

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.	91	2	4	-	0.09	7	-	3,320
	UpQu	100	-	-	-	-	10	-	3,375
	LoQu	100	-	-	-	-	-	-	2,517
Beans	Avg.	14	-	-	-	0.02	2	-	1,487
	UpQu	-	-	-	-	-	-	-	1,350
	LoQu	-	-	-	-	-	-	-	700
Sunflower	Avg.	100	-	-	-	-	-	-	1,746
	UpQu	100	-	-	-	-	-	-	2,100
	LoQu	100	-	-	-	-	-	-	1,000
Second Rains									
Maize	Avg.	95	-	2	-	0.04	13	13	3,378
	UpQu	100	-	-	-	-	25	25	4,500
	LoQu	100	-	-	-	-	-	-	2,000
Bulrushmillet	Avg.	-	-	-	-	-	-	-	3,560
	UpQu	-	-	-	-	-	-	-	2,000
	LoQu	-	-	-	-	-	-	-	775
Beans	Avg.	14	-	-	-	0.05	5	5	1,672
	UpQu	-	-	-	-	-	-	-	1,750
	LoQu	-	-	-	-	-	-	-	900
Sunflower	Avg.	100	-	-	-	-	-	-	1,435
	UpQu	100	-	-	-	-	-	-	1,600
	LoQu	100	-	-	-	-	-	-	938
Cotton	Avg.	72	-	-	-	0.03	34	34	1,981
	UpQu	100	-	-	-	-	40	40	3,000
	LoQu	-	-	-	-	-	17	17	1,058
Tobacco	Avg.	100	-	-	-	-	10	10	750
Perennial Crops									
Cookng Bananas	Avg.	-	-	-	-	0.28	-	-	8,350
	UpQu	-	-	-	-	0.38	-	-	12,500
	LoQu	-	-	-	-	-	-	-	3,600

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TABLE 12 c: INPUTS & YIELDS OF MAJOR CROPS

AEZ: UM 2

Survey Area 46

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									
Beans	Avg.	20	-	-	-	-	-	-	2,124
	UpQu	-	-	-	-	-	-	-	2,200
	LoQu	-	-	-	-	-	-	-	200
Engl. Potatoes	Avg.	40	139	382	-	-	-	13	6,013
	UpQu	100	56	192	-	-	-	17	10,000
	LoQu	-	-	-	-	-	-	-	400
Sweet Potatoes	Avg.	-	-	-	-	-	-	-	4,167
Maize & Beans									
Maize	Avg.	85	-	38	-	0.19	3	-	2,242
Beans	Avg.	-	-	-	-	-	-	-	1,000
Maize	UpQu	100	-	60	-	-	5	-	2,813
Beans	UpQu	-	-	-	-	-	-	-	1,200
Maize	LoQu	100	-	-	-	-	-	-	1,350
Beans	LoQu	-	-	-	-	-	-	-	321
Second Rains									
Engl. Potatoes	Avg.	67	20	89	-	-	7	18	5,167
Maize & Beans									
Maize	Avg.	71	14	23	-	0.10	6	6	2,140
Beans	Avg.	-	-	-	-	-	-	-	760
Maize	UpQu	100	-	48	-	-	10	10	3,000
Beans	UpQu	-	-	-	-	-	-	-	900
Maize	LoQu	-	-	-	-	-	-	-	1,575
Beans	LoQu	-	-	-	-	-	-	-	214
Perennial Crops									
Cookng Bananas	Avg.	-	-	-	-	0.73	-	-	12,527
	UpQu	-	-	-	-	1.67	-	-	25,000
	LoQu	-	-	-	-	-	-	-	-
Coffee	Avg.	-	37	7	-	0.22	1	19	5,518
	UpQu	-	65	-	-	-	-	30	8,720
	LoQu	-	-	-	-	-	-	3	-

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TABLE 13 a: DISPOSAL OF CROPS

AEZ: LH 1 + UM 1

Survey Area 44

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize & Beans	540	0	0	180	33	360	67
Beans	2,090	0	0	860	41	1,230	59
Engl. Potatoes	29,390	0	0	11,430	39	17,960	61
Sweet Potatoes	2,250	0	0	1,800	80	450	20
Cabbage	23,680	0	0	22,450	95	1,230	5
Second Rains							
Maize	7,290	0	0	1,170	16	6,120	84
Maize & Beans	13,502	0	0	1,540	11	11,962	89
Maize & Others	2,450	0	0	2,000	82	450	18
Beans	720	0	0	240	33	480	67
Engl. Potatoes	26,970	0	0	13,950	52	13,020	48
Wheat	45	0	0	0	0	45	100
Cabbage	16,600	0	0	15,190	92	1,410	8
			Permanent Crops				
Pyrethrum	40	40	100	0	0	0	0

MERU DISTRICT

TABLE 13 b: DISPOSAL OF CROPS

AEZ: LM 3

Survey Area 45

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	108,350	8,100	7	72,970	67	27,280	25
Maize & Beans	26,270	0	0	10,945	42	15,325	58
Beans	25,250	480	2	16,480	65	8,290	33
Sunflower	25,810	20,290	79	12,120	47	-6,600	-26
Second Rains							
Maize	87,790	4,230	5	70,350	80	13,210	15
Maize & Beans	29,040	0	0	15,170	52	13,870	48
Beans	29,900	2,040	7	20,090	67	7,770	26
Bulrushmillet	8,280	0	0	6,200	75	2,080	25
Sunflower	22,424	6,750	30	15,674	70	0	0
Cotton	60,016	60,016	100	0	0	0	0
Tobacco	300	300	100	0	0	0	0
			Permanent Crops				
Nil							

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TABLE 13 c: DISPOSAL OF CROPS

AEZ: UM 2

Survey Area 46

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	630	0	0	315	50	315	50
Maize & Beans	21,535	0	0	8,780	41	12,755	59
Beans	2,904	0	0	2,080	72	824	28
Fingermillet	120	0	0	0	0	120	100
Engl. Potatoes	6,440	0	0	3,040	47	3,400	53
Sweet Potatoes	500	0	0	290	58	210	42
Second Rains							
Maize	720	0	0	0	0	720	100
Maize & Beans	31,755	0	0	11,415	36	20,340	64
Beans	3,190	0	0	2,580	81	610	19
Engl. Potatoes	4,120	0	0	1,500	36	2,620	64
Permenent Crops							
Coffee	20,000	10,000	50	3,000	15	7,000	35

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TABLE 14a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 9

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30

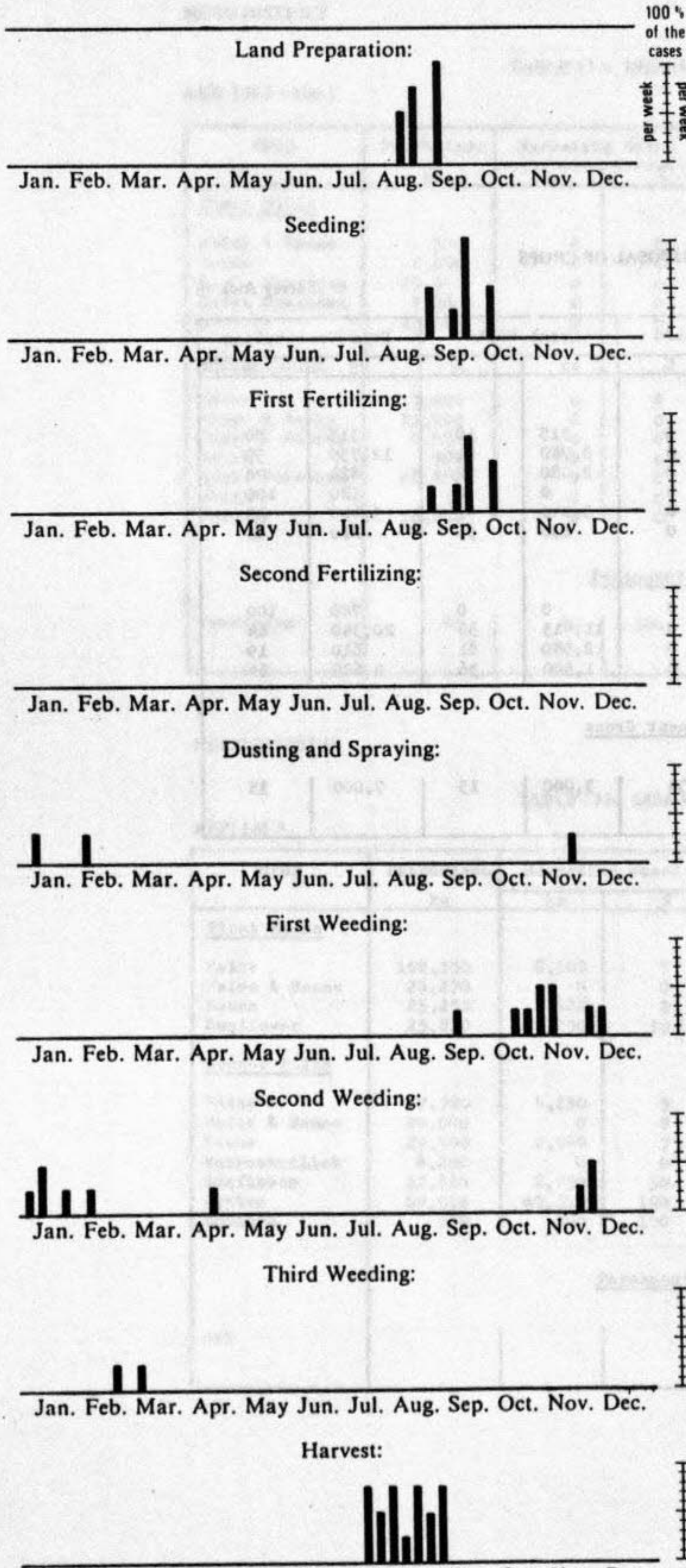

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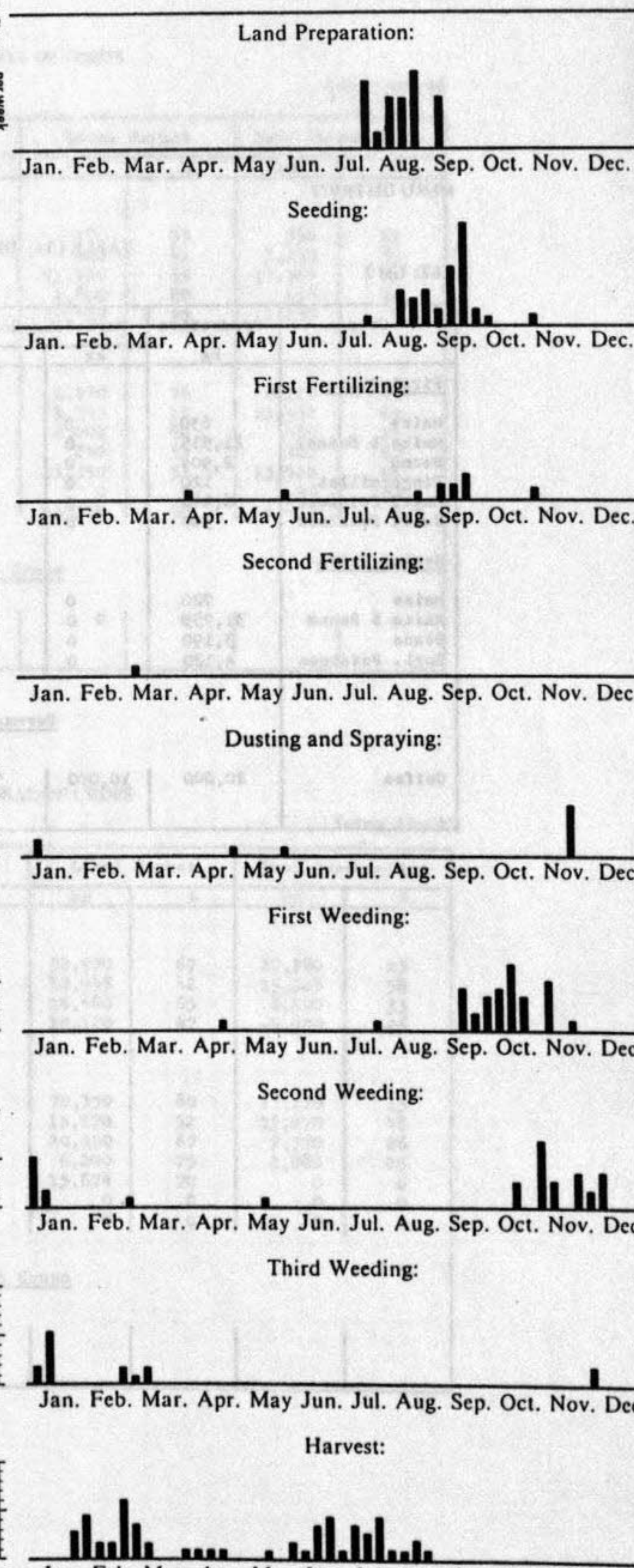
TABLE 14b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 37[1)]

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30



1) Maximum 30 per crop and season

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TABLE 14c: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 14

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30

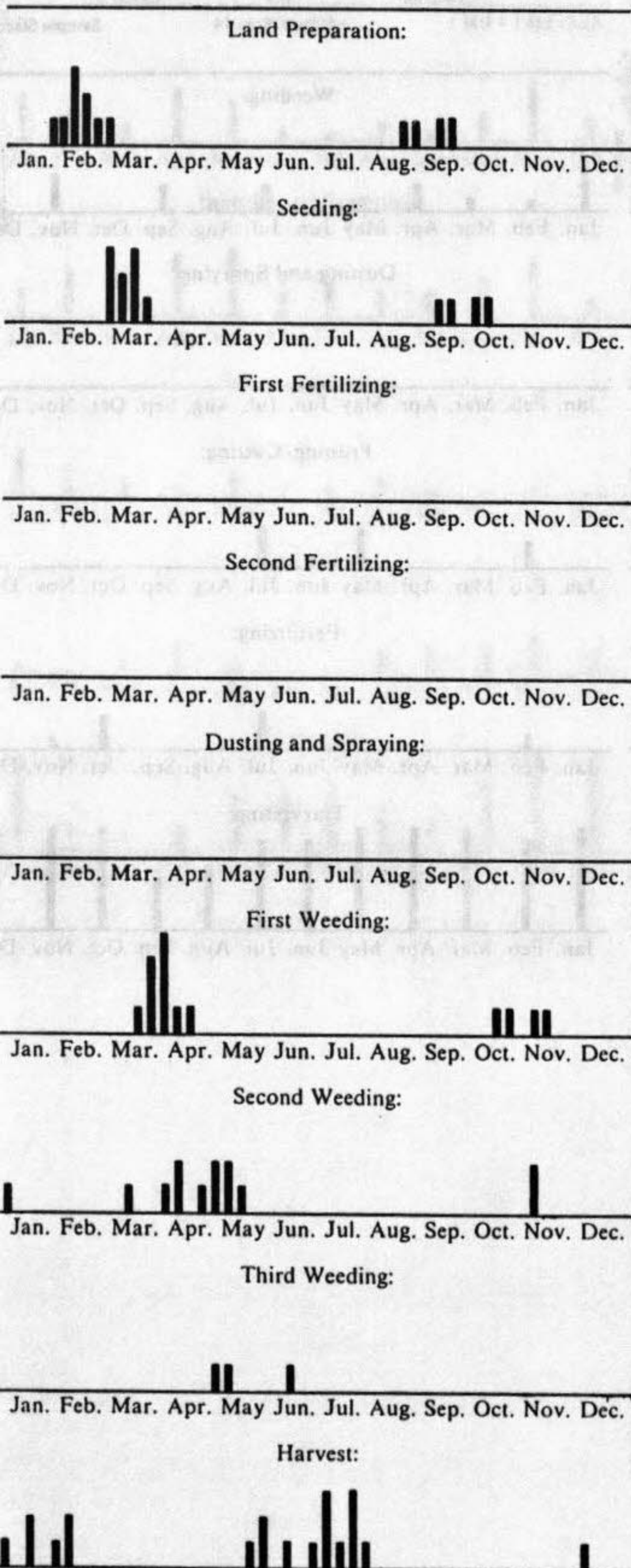

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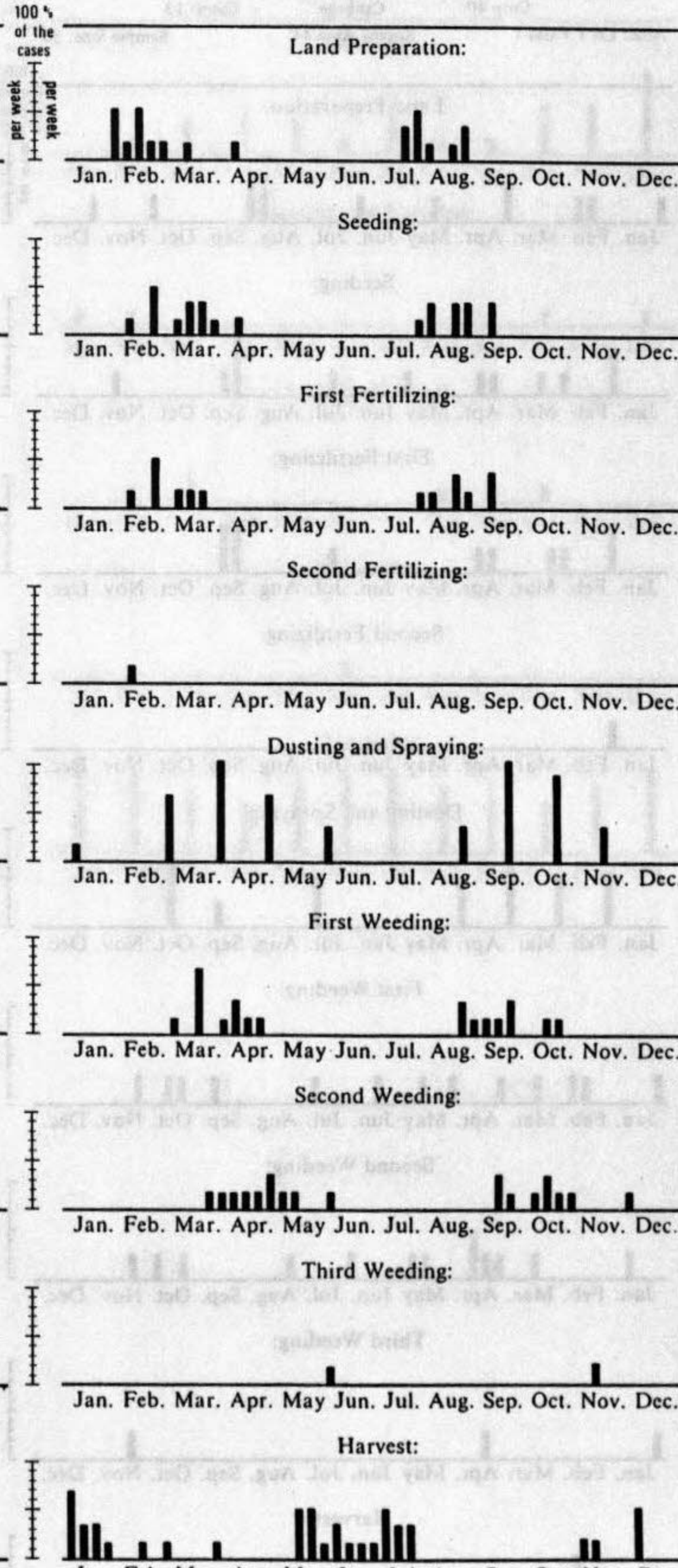
TABLE 14d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 28 Engl. Potatoes Cases: 20

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30

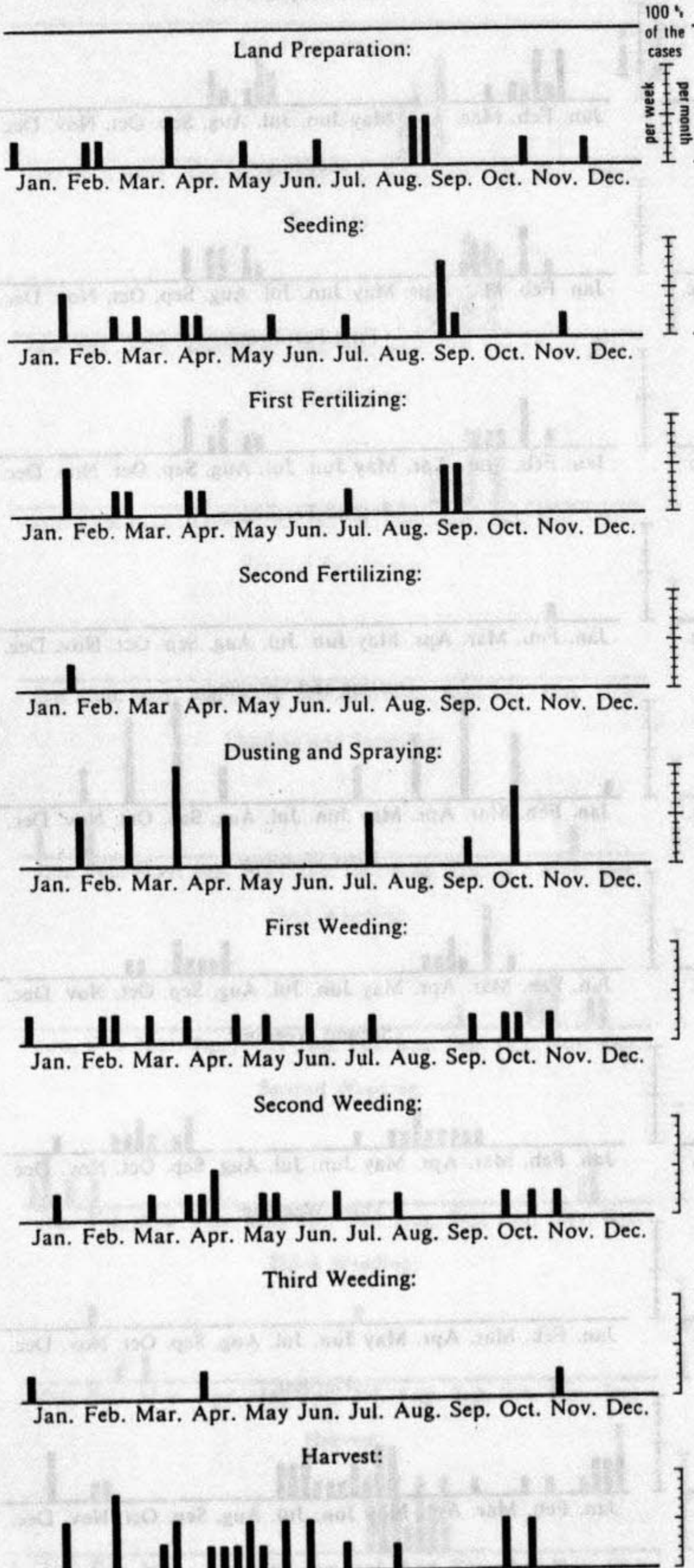


MERU DISTRICT

TABLE 14e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 40 Cabbage Cases: 13

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30

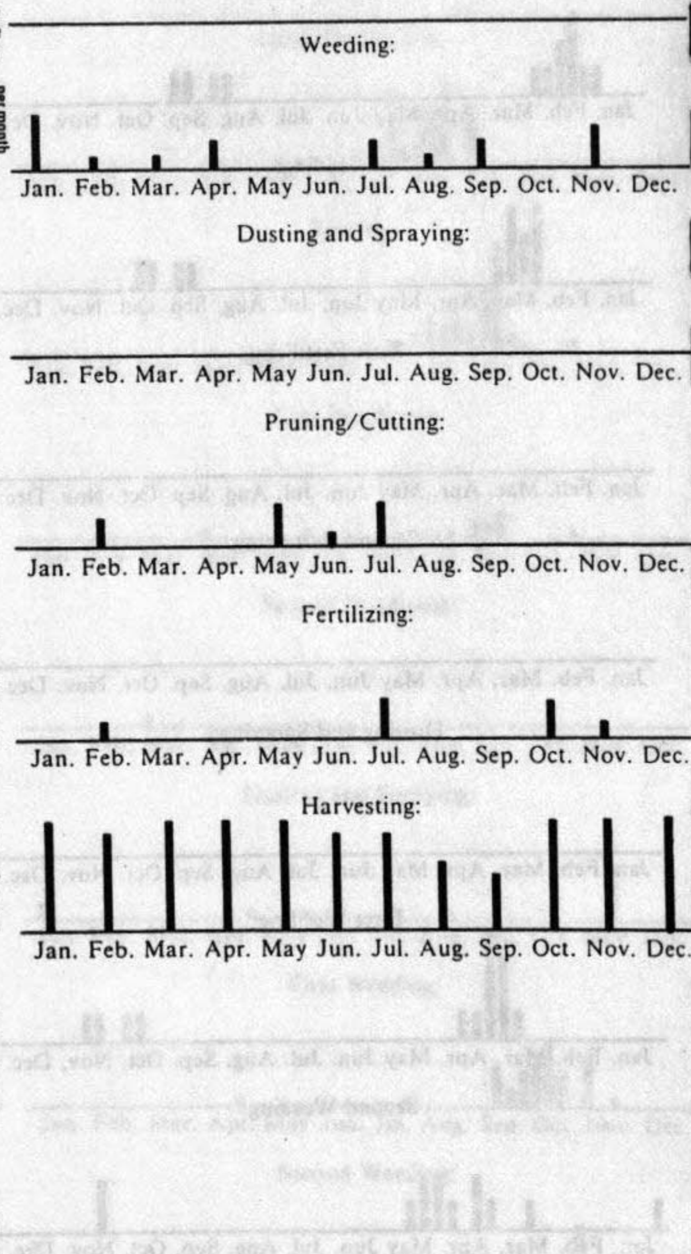


MERU DISTRICT

TABLE 14f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 50 Tea Cases: 8

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30

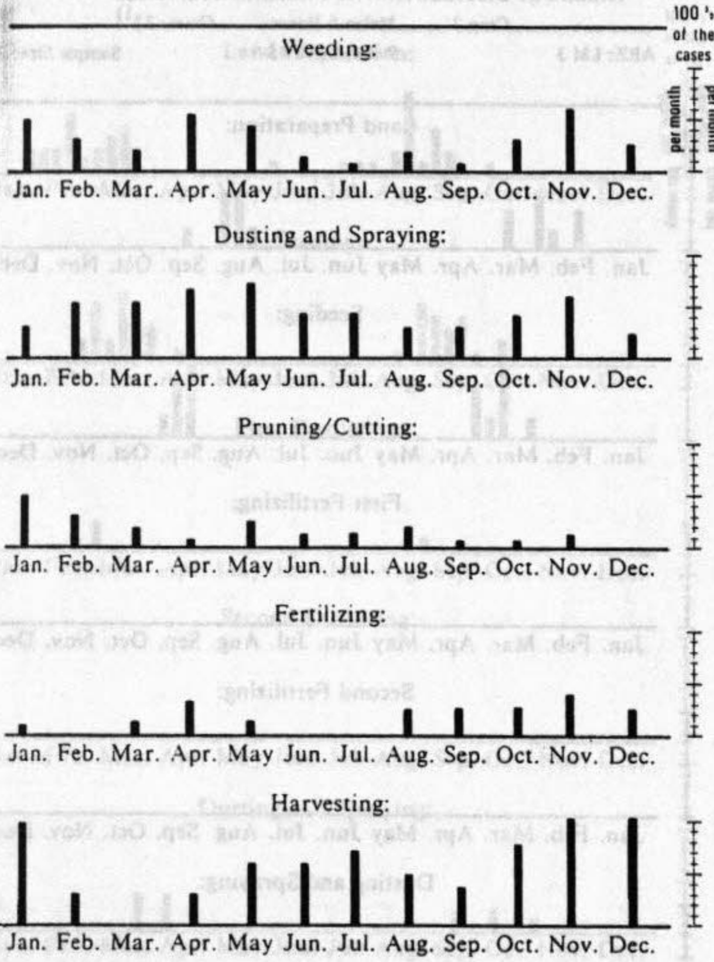


MERU DISTRICT

TABLE 14g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 18

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30

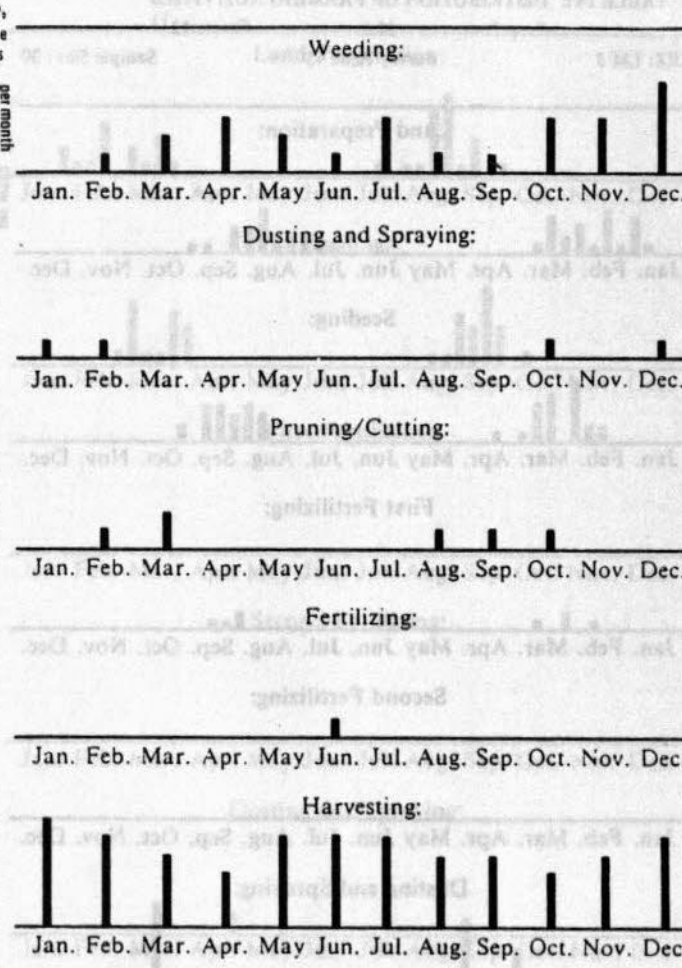


MERU DISTRICT

TABLE 14h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 52 Pyrethrum Cases: 6

AEZ: LH 1 + UM 1 Survey Area 44 Sample Size: 30

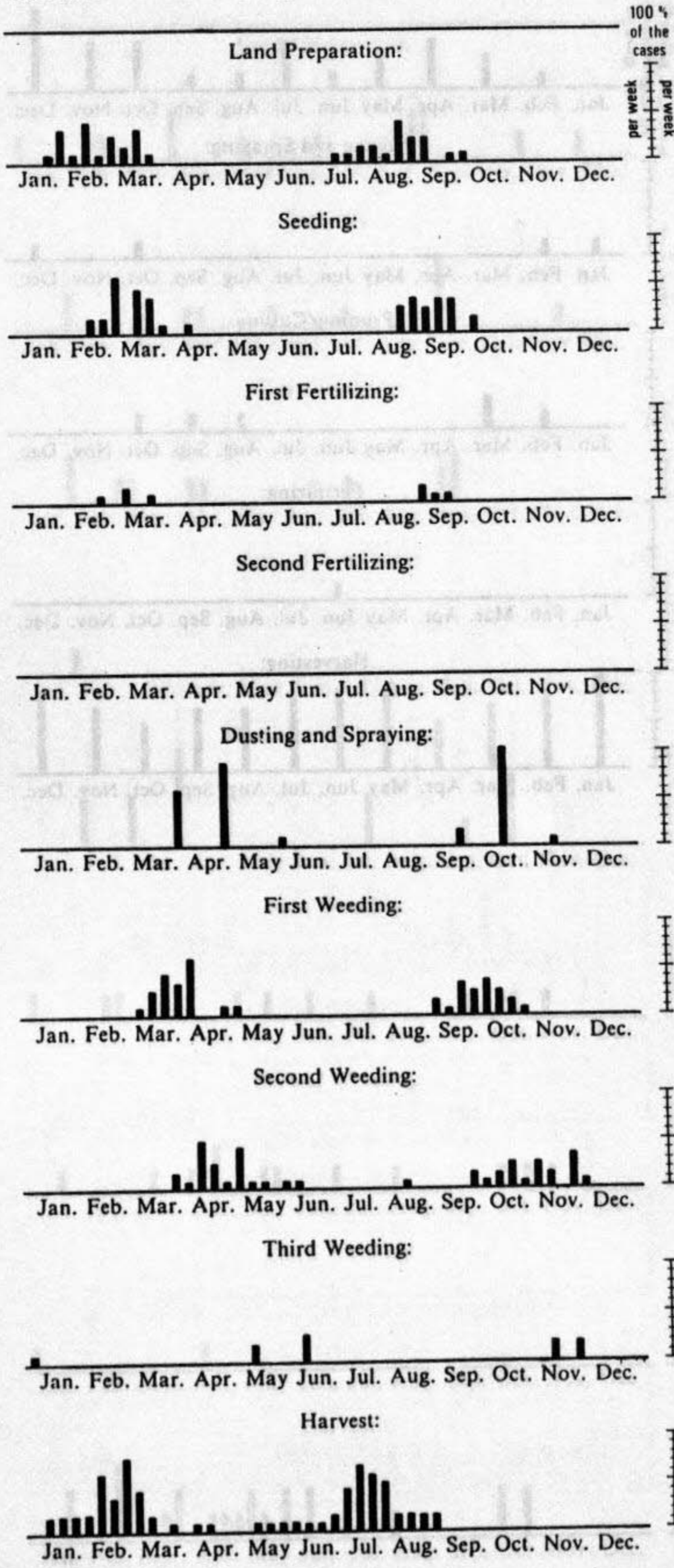


MERU DISTRICT

TABLE 14i: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 42[1)]

AEZ: LM 3 Survey Area 45 Sample Size: 30



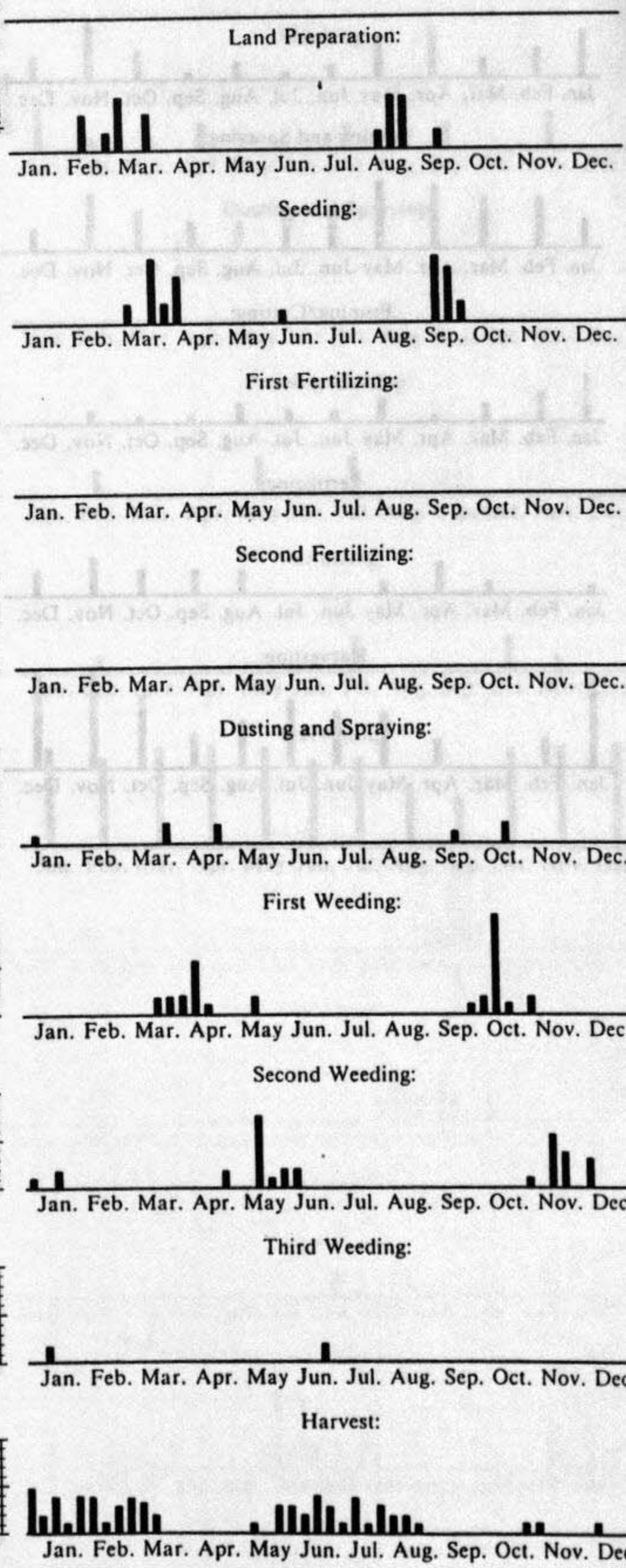
1) Maximum 30 per crop and season

MERU DISTRICT

TABLE 14j: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 32[1)]

AEZ: LM 3 Survey Area 45 Sample Size: 30



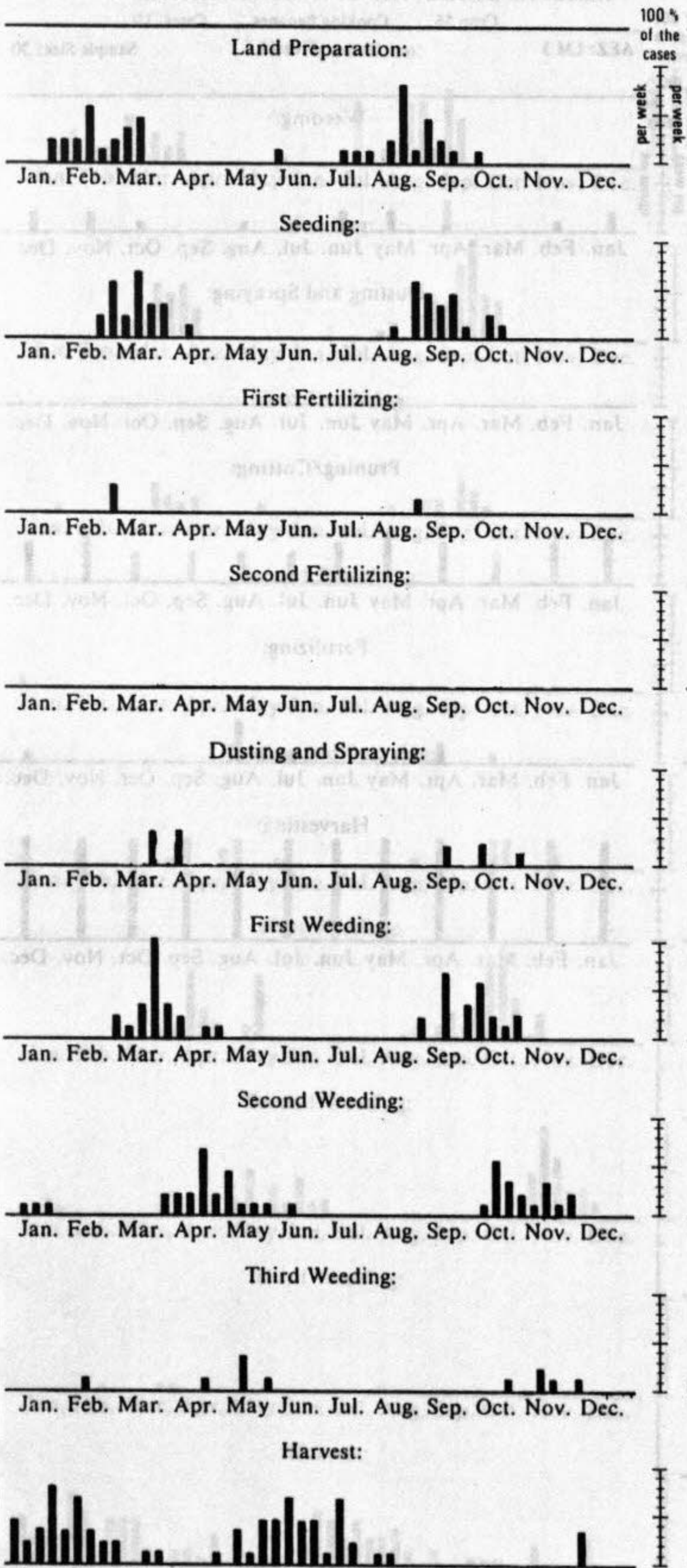
1) Maximum 30 per crop and season

MERU DISTRICT

TABLE 14k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 43[1)]

AEZ: LM 3 Survey Area 45 Sample Size: 30



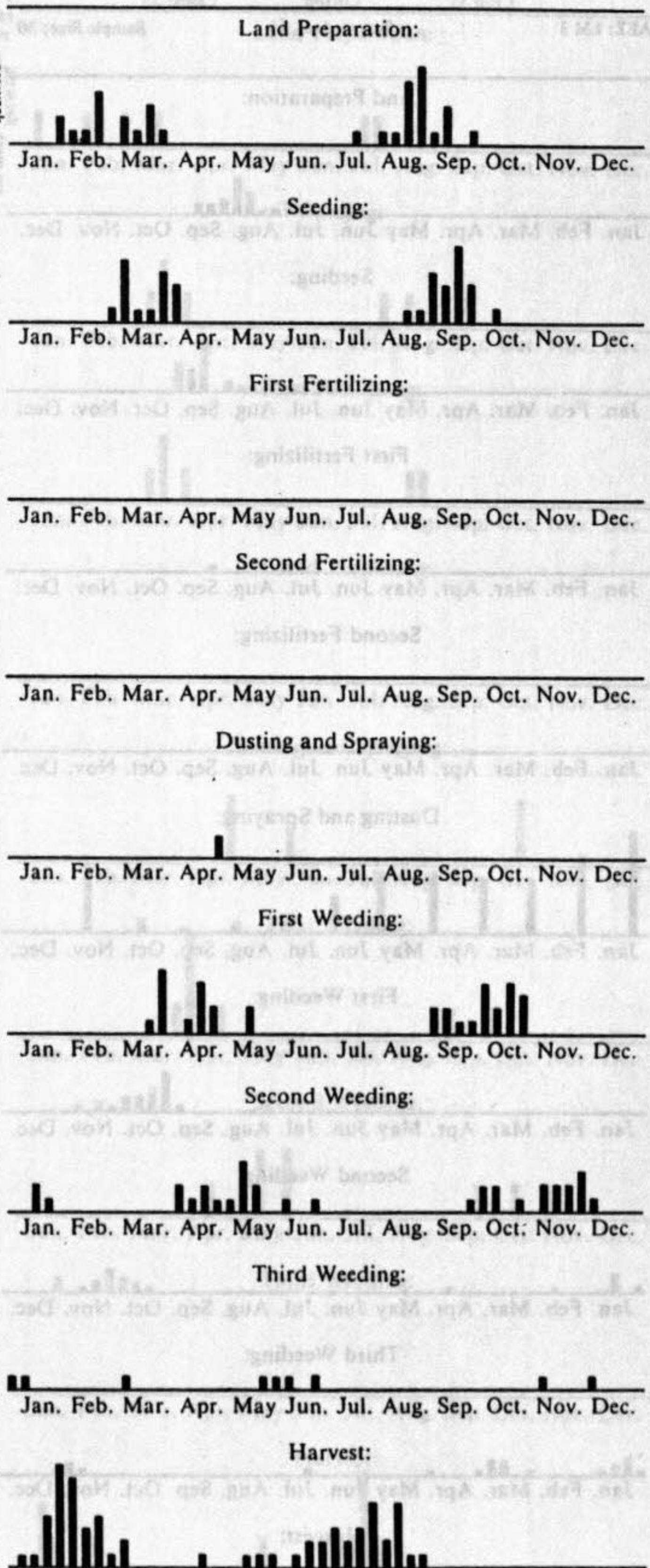
1) Maximum 30 per crop and season

MERU DISTRICT

TABLE 14l: DISTRIBUTION OF FARMING ACTIVITIES

Crop 34 Sunflower Cases: 34[1)]

AEZ: LM 3 Survey Area 45 Sample Size: 30



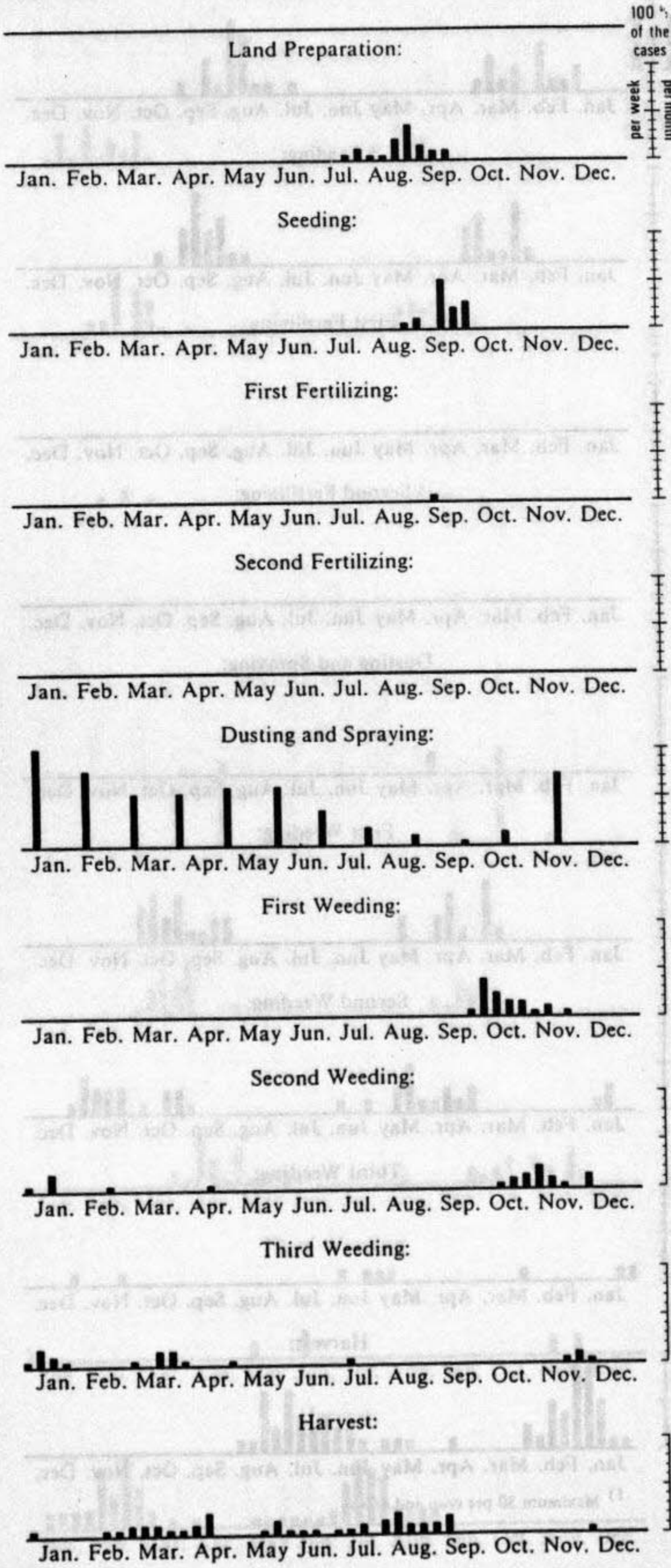
1) Maximum 30 per crop and season

MERU DISTRICT

TABLE 14 m: DISTRIBUTION OF FARMING ACTIVITIES

Crop 35 Cotton Cases: 25

AEZ: LM 3 Survey Area 45 Sample Size: 30

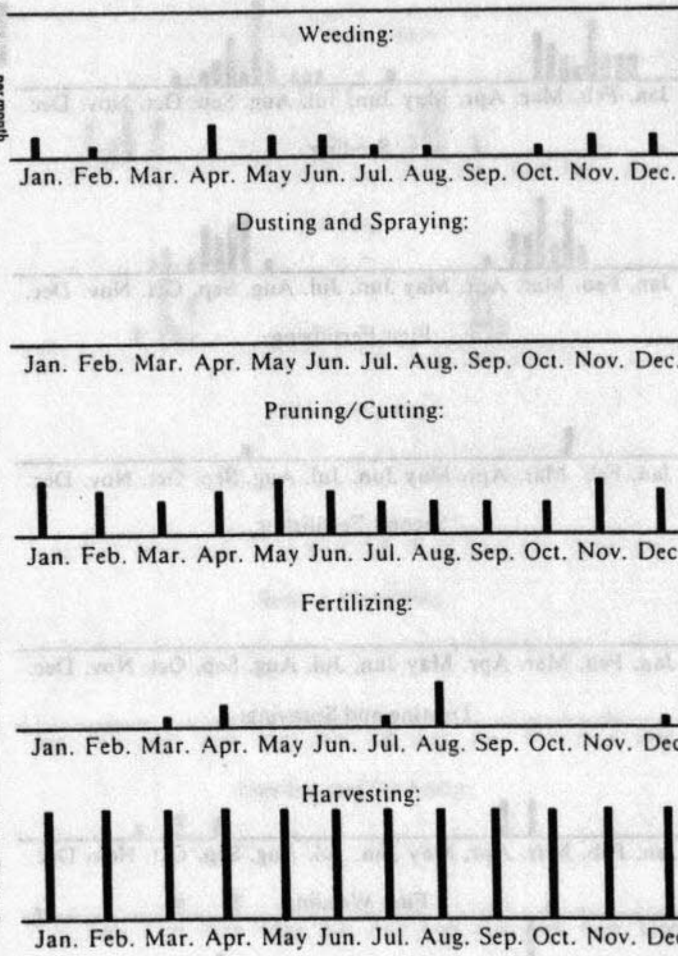


MERU DISTRICT

TABLE 14 n: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 10

AEZ: LM 3 Survey Area 45 Sample Size: 30

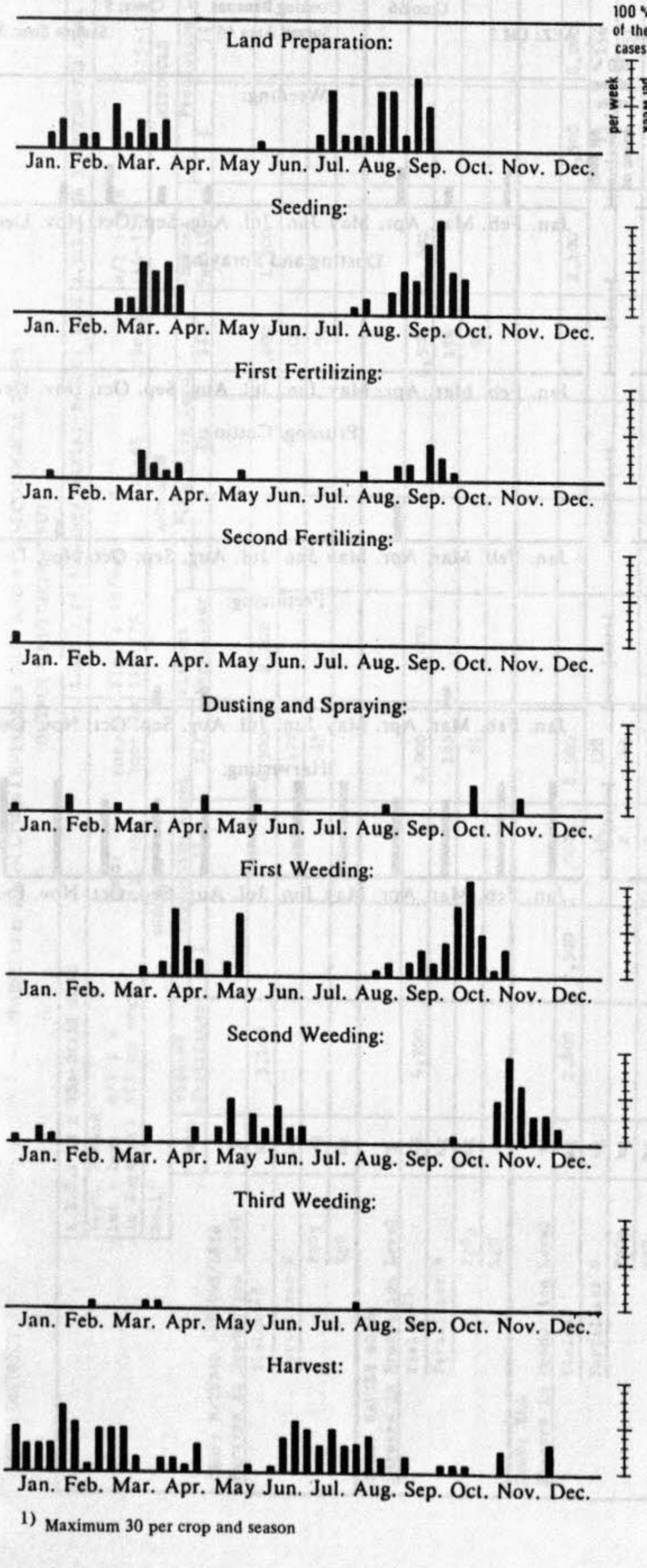


MERU DISTRICT

TABLE 14 o: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 60 1)

AEZ: UM 2 Survey Area 46 Sample Size: 30



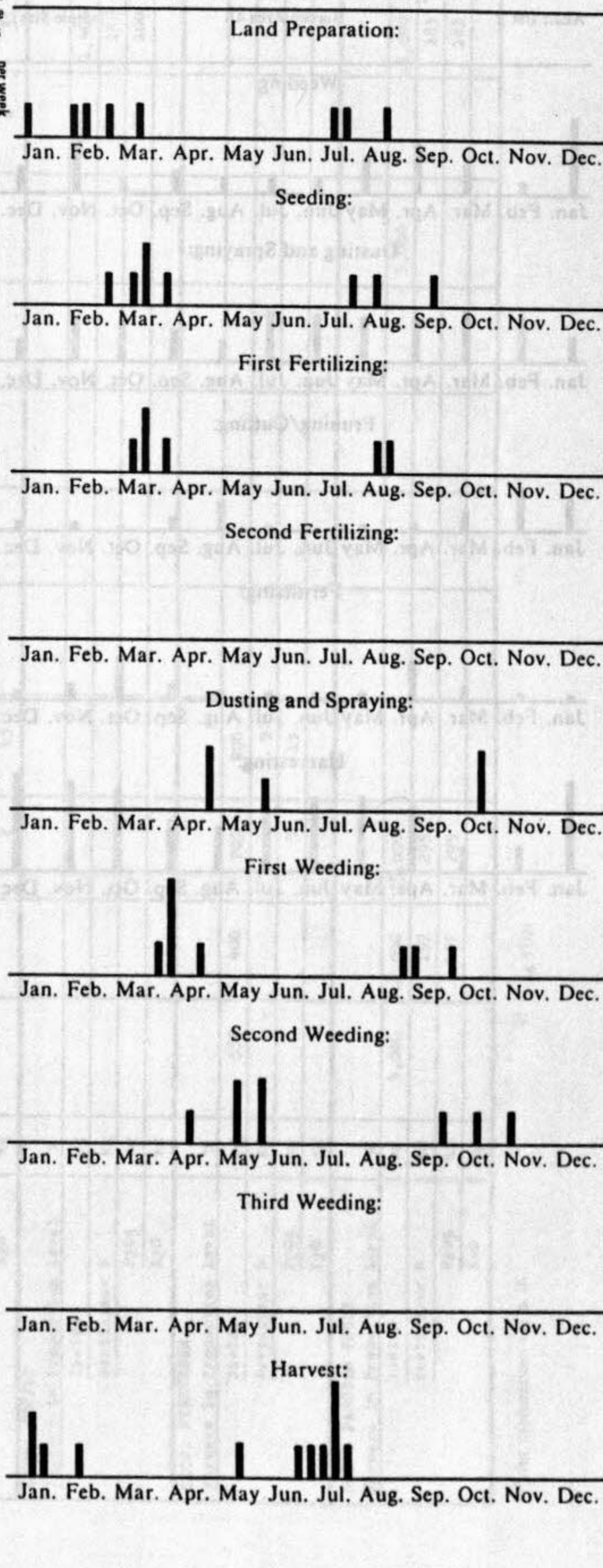
1) Maximum 30 per crop and season

MERU DISTRICT

TABLE 14 p: DISTRIBUTION OF FARMING ACTIVITIES

Crop 28 Engl. Potatoes Cases: 8

AEZ: UM 2 Survey Area 46 Sample Size: 30

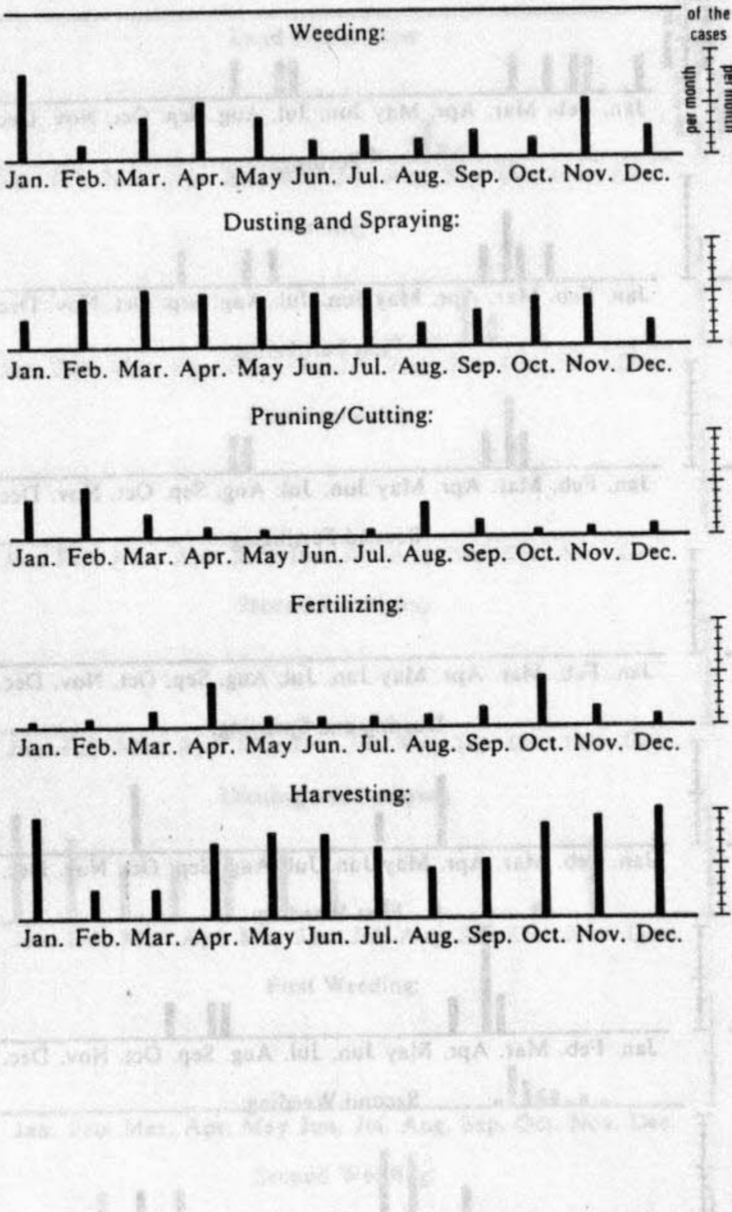


MERU DISTRICT

TABLE 14 q: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 38

AEZ: UM 2 Survey Area 46 Sample Size: 30



MERU DISTRICT

TABLE 14 r: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 5

AEZ: UM 2 Survey Area 46 Sample Size: 30

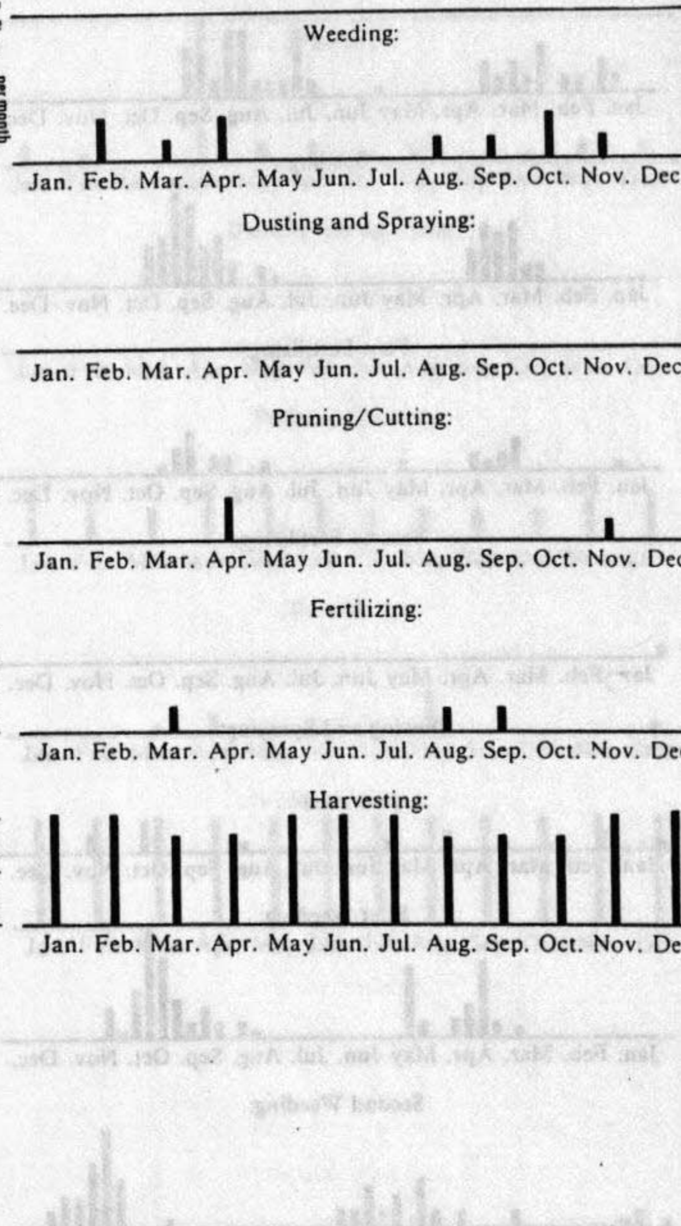


TABLE 15 a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

		A.E.Z.: LH 1 TEA-DAIRY ZONE				A.E.Z.: LH 3 WHEAT/(MAIZE)-BARLEY ZONE				A.E.Z.: UM 1 COFFEE-TEA ZONE			
Vegt. Period 1st + 2nd: in Days, 1st:		m/1 i m 165 or more		2nd: 135-155	total: 300-320	f(m) i (s/vs) 115-175		75-85	190-260	m/1 + m/s 155-175		115-135	–
Soil:		ANDOSOLS				ANDOSOLS				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 2)	kg	3,100			6,300	2,200			4,000	1,900			4,000
Fertilizer N	kg				177				100				116
P_2O_5	kg				88				50				58
K_2O	kg												
CROP: NAPIER GRASS													
Farmers in Production Level	%												
Yields 2)	kg	4,700			8,000	3,000			6,500	4,000			10,000
Fertilizer N	kg				183				194				270
P_2O_5	kg				91				97				135
K_2O													
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	2,800	2,500	3,000	8,500					2,100	2,500	6,000	9,500
Fertilizer N	kg			10	228						13	156	370
P_2O_5	kg			2	45						4	31	74
K_2O	kg			2	45						4	31	74
CROP: COFFEE													
Farmers in Production Level	%												
Yields	kg										800	1,400	1,800
Fertilizer N	kg										80	140	180
P_2O_5	kg										90	100	100
K_2O	kg												
CROP: PYRETHRUM													
Farmers in Production Level	%												
Yields	kg	550	400	700	900								
Fertilizer N	kg			4	9								
P_2O_5	kg			5	13								
K_2O	kg												
CROP: PASSION FRUIT													
Farmers in Production Level	%												
Yields	kg	4,000	18,000	25,000						3,000		16,000	20,000
Fertilizer N	kg		197	295								183	239
P_2O_5	kg		197	295								183	239
K_2O	kg												

1) for explanations see p. 16

2) in kg TDN

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

		A.E.Z.: LH 1 TEA-DAIRY ZONE				A.E.Z.: LH 3 WHEAT/(MAIZE)-BARLEY ZONE				A.E.Z.: UM 1 COFFEE-TEA ZONE			
Vegt. Period 1st + 2nd: in Days, 1st:		m/1 i m 165 or more		2nd: 135-155	total: 300-320	f(m) i (s/vs) 115-175		75-85	190-260	m/1 + m/s 155-175		115-135	–
Soil:		ANDOSOLS				ANDOSOLS				NITOSOLS			
		Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer	Production Level		
	Unit		I	II	III		I	II	III		I	II	III
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg									8,000	6,000	15,000	30,000
Fertilizer N	kg											105	330
P_2O_5	kg											42	132
K_2O	kg												
CROP: WHEAT													
Farmers in Production Level	%												
Yields	kg					1,700		1,800	2,600				
Fertilizer N	kg							2	21				
P_2O_5	kg							4	37				
K_2O													
CROP: BARLEY													
Farmers in Production Level	%												
Yields	kg					2,100		2,000	2,800				
Fertilizer N	kg								14				
P_2O_5	kg								17				
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	2,800	1,500	3,000	4,500	2,200	1,500	2,000	3,000	2,100	2,000	3,000	4,000
Fertilizer N	kg			5	43				20			23	48
P_2O_5	kg			2	14				19			24	46
K_2O	kg												
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg					2,200	1,500/200	2,000/400	3,000/400	2,100	2,000/400	3,000/500	4,000/600
Fertilizer N	kg								39			47	77
P_2O_5	kg								21			40	64
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg					1,100	400	800	1,000	1,100	800	1,800	2,200
Fertilizer N	kg								-			34	53
P_2O_5	kg								-			21	33
K_2O	kg												

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

OUTPUT & NUTRIENT INPUT

		A.E.Z.: LH 1 TEA-DAIRY ZONE				A.E.Z.: LH 3 WHEAT/(MAIZE)-BARLEY ZONE				A.E.Z.: UM 1 COFFEE-TEA ZONE			
Vegt. Period 1st + 2nd: in Days, 1st:		m/1 1 m 165 or more		2nd: 135-155	total: 300-320	f(m) 1 (s/vs) 115-175		75-85	190-260	m/1 + m/s 155-175		115-135	-
Soil:		ANDOSOLS				ANDOSOLS				NITOSOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	4,500	6,000	18,000	50,000					3,700	5,000	18,000	35,000
Fertilizer N	kg		11	95	319						9	100	219
P_2O_5	kg		6	54	182						9	59	130
K_2O	kg												
CROP: POTATOES													
Farmers in Production Level	%												
Yields	kg	8,000	10,000	20,000	50,000	7,000	3,000	12,000	22,000	6,500	10,000	15,000	30,000
Fertilizer N	kg		14	84	294			40	120		28	68	188
P_2O_5	kg		12	72	252			45	135		31	77	212
K_2O													
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg									8,000	7,000	18,000	35,000
Fertilizer N	kg											80	216
P_2O_5	kg											60	162
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg					900	400	600	1,000	900	400	800	1,600
Fertilizer N	kg								4				24
P_2O_5	kg								3				20
K_2O	kg												
CROP: KALE													
Farmers in Production Level	%												
Yields	kg					4,200	4,000	9,000	20,000				
Fertilizer N	kg							33	111				
P_2O_5	kg							20	65				
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

MERU DISTRICT

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

		A.E.Z.: UM 2 MAIN COFFEE ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE			
		Vegt. Period 1st + 2nd: m + m in Days, 1st: 135-155		2nd: 135-155	total: —	m/s + m/s 115-135		115-135	—	fs + fs 75-115		75-115	—
		Soil: NITOSOLS				NITOSOLS				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	1,900			3,900	1,300			2,700	750			1,500
Fertilizer N	kg				111				77				41
P_2O_5	kg				55				38				20
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields	kg	4,000			8,000	2,700			6,000	2,100			3,300
Fertilizer N	kg				222				183				66
P_2O_5	kg				111				91				33
K_2O													
CROP: COFFEE													
Farmers in Production Level	%												
Yields	kg		700	1,800	2,000		400	600	800				
Fertilizer N	kg		70	180	200		40	60	80				
P_2O_5	kg		90	100	100		90	90	90				
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	6,000	6,000	12,000	22,000								
Fertilizer N	kg			90	242								
P_2O_5	kg			37	98								
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 e: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT

		A.E.Z.: UM 2 MAIN COFFEE ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE			
Vegt. Period 1st + 2nd: in Days, 1st:		m + m 135-155		2nd: 135-155	total: —	m/s + m/s 115-135		115-135	—	fs + fs 75-115		75-115	—
Soil:		NITOSOLS				NITOSOLS				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	2,000	2,000	3,000	4,000	2,100	1,200	2,500	2,800	1,000	1,300	2,000	2,600
Fertilizer N	kg			25	50			10	17		7	25	40
P_2O_5	kg			24	48			9	16		8	28	45
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg					2,400	1,800	2,800	3,200	1,600	700	2,000	2,800
Fertilizer N	kg							8	16			8	24
P_2O_5	kg							7	14			7	22
K_2O													
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg	2,000	2,000/350	3,000/500	4,000/600	2,100		2,500/400	2,800/400				
Fertilizer N	kg			49	79			29	36				
P_2O_5	kg			39	66			21	28				
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg	1,100	700	1,700	2,000					700	300	800	1,000
Fertilizer N	kg			29	43							5	14
P_2O_5	kg			18	27							3	9
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

MERU DISTRICT

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

		A.E.Z.: UM 2 MAIN COFFEE ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE			
		Vegt. Period 1st + 2nd: m + m in Days, 1st: 135-155		2nd: 135-155	total: —	m/s + m/s 115-135		115-135	—	fs + fs 75-115		75-115	—
		Soil: NITOSOLS				NITOSOLS				FERRALSOLS			
	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	900	700	800	1,400	800	400	600	1,200	500	500	800	1,000
Fertilizer N	kg				17				14			10	17
P_2O_5	kg				21				17			15	25
K_2O	kg												
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg					3,100	4,000	8,000	25,000				
Fertilizer N	kg						7	39	175				
P_2O_5	kg						5	29	131				
K_2O	kg												
CROP: POTATOES													
Farmers in Production Level	%												
Yields	kg	5,000	3,000	8,000	20,000								
Fertilizer N	kg			17	.85								
P_2O_5	kg			19	96								
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	6,000	5,000	16,000	25,000								
Fertilizer N	kg			65	125								
P_2O_5	kg			60	114								
K_2O	kg												
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg					5,000		6,000	12,000	3,800	4,000	6,000	8,000
Fertilizer N	kg							4	28		1	9	17
P_2O_5	kg							6	42		1	15	29
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

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

		A.E.Z.: LM 3 COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 L.MIDL.LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: s + s in Days,1st: 85-105		2nd: 85-105	total: -	s/vs + s/vs 75-85		75-85	-	vs/s + vs/s 65-75		65-75	-
		Soil: FERRALSOLS				FERRALSOLS				CAMBISOLS			
	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	600			1,200	500			1,000	450			950
Fertilizer N	kg				33				27				25
P_2O_5	kg				16				14				12
K_2O	kg												
CROP: BANA GRASS													
Farmers in Production Level	%												
Yields	kg	1,000			2,400	800			2,000				
Fertilizer N	kg				77				66				
P_2O_5	kg				38				33				
K_2O													
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg	450	400	900	2,200	500	300	600	900				
Fertilizer N	kg			50	192			11	44				
P_2O_5	kg			43	165			8	32				
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	1,100	2,000	2,600	2,900	1,100	800	1,500	1,800				
Fertilizer N	kg		23	38	45			10	18				
P_2O_5	kg		22	36	43			11	20				
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	800	600	2,000	2,500	800	1,000	1,400	2,000				
Fertilizer N	kg			36	51		8	20	36				
P_2O_5	kg			30	46		6	18	30				
K_2O	kg												
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg	1,300		1,400	1,700	900		1,000	1,600	700	200	800	1,300
Fertilizer N	kg			5	16			5	21			5	20
P_2O_5	kg			5	12			5	18			5	18
K_2O	kg												

MERU DISTRICT

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

		A.E.Z.: LM 3 COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 L.MIDL.LIVESTOCK-MILLET Z.			
Vegt. Period 1st + 2nd: in Days, 1st:		s + s 85-105		2nd: 85-105	total: –	s/vs + s/vs 75-85		75-85	–	vs/s + vs/s 65-75		65-75	–
Soil:		FERRALSOLS				FERRALSOLS				CAMBISOLS			
	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	1,100	2,000/300	2,600/400	2,900/500								
Fertilizer N	kg		37	57	69								
P_2O_5	kg		31	45	58								
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg	700	1,000	1,200	1,400	700	400	700	1,000	700	400	600	800
Fertilizer N	kg		14	24	34				10				
P_2O_5	kg		11	18	25				7				
K_2O													
CROP: GRAMS													
Farmers in Production Level	%												
Yields	kg	1,000	400	1,000	1,500	900	300	800	1,000				
Fertilizer N	kg				13				3				
P_2O_5	kg				18				4				
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	700		800	1,400	700		800	1,100				
Fertilizer N	kg				25			3	14				
P_2O_5	kg				35			5	20				
K_2O	kg												
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	700		1,000	1,600								
Fertilizer N	kg			12	36								
P_2O_5	kg			11	34								
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	3,800	6,000	8,000	12,000					3,500	2,000	4,000	8,000
Fertilizer N	kg		86	164	320							4	36
P_2O_5	kg		68	130	254							3	32
K_2O	kg												

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

		A.E.Z.: LM 3 COTTON ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 L.MIDL.LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: s + s in Days, 1st: 85-1o5		2nd: 85-1o5	total: -	s/vs + s/vs 75-85		75-85	-	vs/s + vs/s 65-75		65-75	-
		Soil: FERRALSOLS				FERRALSOLS				CAMBISOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg	3,000	4,000	10,000	15,000	3,000	4,000	8,000	10,000				
Fertilizer N	kg		4	29	50		4	16	29				
P_2O_5	kg		6	41	71		6	23	41				
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												

MACHAKOS DISTRICT

Contents

District page

NATURAL POTENTIAL

INTRODUCTION

The centre of Machakos District mainly consists of hills and small plateaus, rising to 1 800–2 100 m, surrounded by a large plateau, elevated to about 1 700 m in the west and sloping down to 700 m in the southeast. This undulating peneplain is broken by isolated mountains like Oldoinyo Sabuk in the northwest, by the volcanic outflow of the Yatta Plateau in the east, and by a range of volcanic ashes, the Chyulu Hills in the southeast.

Rainfall is regionally very different: The total annual average ranges between 500 and 1 300 mm; the 60 % rainfall reliability during the growing period of the first rains is 50–450 mm, of the second rains 60–530 mm.

The rains are normally concentrated into two short seasons: end of March–May and end of October–December in the middle of the district. From June to August, the higher parts get additional rains and mists on their eastern slopes, caused by the effect of the hills on the southeastern trade winds blowing at that time, so the annual average exceeds 1 000 mm. This moist cool climate on the hill tops belongs to Agro-ecological Zone LH 2, generally a Wheat/Maize-Pyrethrum Zone. However, these crops are usually not cultivated here because the farms are too small for wheat, the rainy season are slightly too short for maize, so that only fair results can be expected, and pyrethrum has a low pyrethrin content due to high air moisture and relatively low altitude (LH ranges here from 1 800 to 2 100 mm). But potatoes and dairy have good prospects, so that the zone should in fact be named after them.

The lower coffee zone only get enough rain on the higher areas on the eastern slopes between 1 650 and 1 800 m (Main Coffee Zone = UM 2). Below that and on the rain-shadowed western slopes, coffee cultivation becomes marginal (Marginal Coffee Zone = UM 3). In the rain shadow, most of the Upper Midlands are too dry for coffee. Early maturing maize (Katumani) and sunflowers are the leading crops (Sunflower-Maize Zone = UM 4). A few kilometres westward, it is even too dry for this maize variety. Livestock is the economic mainstay and could be supplemented by early maturing sorghum (Livestock-Sorghum Zone = UM 5); on black soils some chickpeas could be grown up to the boundary of rainfed cultivation (Ranching Zone = UM 6). Down in the Lower Midlands to the east, the climate is so dry, that the Cotton Zone (LM 3) is very small and the yields are becoming increasingly poor (Marginal Cotton Zone = LM 4).

One advantage for cotton cultivation is the fact that towards the southeast, the second rains – the time for cotton planting – are more extensive. But below 1 200 m it soon becomes too dry for cotton and also for maize. It is a Livestock-Millet Zone (LM 5) but early maturing sorghum can also be grown there as well as bulrush, proso, and foxtail millet. At present people still rely too much on maize and famine often occurs.[1)] For especially dry years in which the rains are insufficient for even sorghum or millets, new perennial crops like buffalo gourds (from Arizona) and Marama beans (from Kalahari) could be a possibility. They have edible seeds rich in protein and form large nutritious tubers after a few years. Bitter substances can be washed out by salty water. For cash, jojoba, the wax plant, shoud be suitable.

1) For the unreliability of rainfall see H.M.H. BRAUN: The Reliability of Rainy Seasons in Machakos and Kitui Districts. Kenya Soil Survey M 12, Nairobi 1977.
Development proposals and activities see the G.O.K./USAID; Consortium of International Development: Marginal/Semi-Arid Land Preinvestment Inventory (Nairobi 1978) and the work of the team of the Machakos Integrated Agricultural Development Project (M.I.A.D.P.)

MACHAKOS 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	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Monthly rainfall in mm											
9137003	Ulu, Kilima Kiu	62	Average	737	42	36	83	165	72	96	3	4	9	37	122	69
1 853 m			60 % rel.1)	529	17	9	43	129	41	2	0	0	1	11	80	41
9137010	Machakos, District	81	Av.	898	52	51	124	205	74	12	5	6	8	53	189	120
1 640 m	Office		60 %	752	21	20	63	157	36	2	0	1	0	24	155	94
9137028	Matiliku	39	Av.	846	44	50	118	173	70	9	2	4	5	46	196	127
1 097 m			60 %	776	36	20	54	86	36	1	0	0	0	10	121	73
9317040	Matungulu	34	Av.	991	49	42	146	230	73	3	4	3	7	60	245	129
1 524 m			60 %	880	15	12	75	161	43	2	0	0	0	24	195	78
9137042	Konza, Kapiti Estate	34	Av.	569	36	26	69	144	64	11	3	3	6	32	102	73
1 707 m	Ltd.		60 %	395	19	9	33	96	38	3	0	0	0	4	62	40
9137054	Donyo Sabuk,	60	Av.	919	41	33	118	220	78	11	5	6	10	68	206	123
1 478 m	Kianzabe, Coffee Est.		60 %	773	8	13	57	164	36	3	0	0	2	25	170	56
9137056	Makueni	28	Av.	777	34	36	95	166	66	8	1	3	4	59	187	118
1 204 m			60 %	601	28	13	81	98	27	2	0	0	0	12	122	73
9137058	Kabaa Cath. Mission	23	Av.	731	31	28	102	169	63	9	4	3	4	64	197	58
1 219 m			60 %	566	9	11	80	55	12	2	0	0	0	19	119	14
9137065	Stony Athi Estate	27	Av.	557	41	31	55	143	71	10	7	5	6	34	92	64
1 615 m			60 %	438	16	7	24	87	38	6	0	0	0	7	56	42
9137071	Makabete	25	Av.	722	49	39	80	159	58	5	3	1	5	43	171	109
1 494 m			60 %	594	30	13	53	86	32	0	0	0	0	5	144	37
9137073	Ulu, Kiluma Kiu,	62	Av.	652	40	36	79	172	79	11	2	4	10	35	126	58
1 778 m	F.O.B., Wilson Ltd		60 %	542	18	16	44	115	32	1	0	0	0	19	111	27
9137075	Makueni, Kampi ya	22	Av.	698	28	37	80	131	46	13	2	4	5	58	194	92
1 120 m	Mawe															
9137082	Rohet Sisal Estate	17	Av.	614	51	35	59	113	97	17	6	9	16	41	120	51
1 529 m			60 %	482	20	14	36	73	65	12	0	0	14	15	86	13
9137089	Katumani Exp. Farm	18	Av.	717	41	41	42	142	72	8	3	3	4	37	177	98
1 600 m			60 %	585	18	20	40	101	37	6	0	0	1	9	125	42
9137090	Ngoliba	19	Av.	974	63	39	136	212	100	8	6	6	6	68	225	104
1 295 m	Sisal Estate		60 %	810	16	26	88	157	53	4	0	0	0	45	148	47
9137091	Kilome, Distr. Office	21	Av.	1 157	57	48	144	254	123	19	12	8	14	96	265	116
1 981 m			60 %	997	44	28	84	248	77	9	4	3	4	33	172	63
9137098	Machakos, Dam	13	Av.	781	50	50	105	183	60	11	4	4	5	43	175	99
1 573 m																
9137099	Mbooni For. Station	20	Av.	1 288	90	62	168	250	90	14	7	6	7	98	324	172
1 829 m			60 %	1 045	40	28	81	224	36	11	0	0	2	28	232	84
9137100	Nzau For. Station	20	Av.	1 253	45	41	149	256	104	32	15	15	19	121	306	153
1 615 m			60 %	845	44	2	40	171	55	6	4	3	10	17	194	67
9137101	Kitondo For. Station	20	Av.	1 369	71	65	135	257	121	22	12	24	19	131	346	167
1 494 m			60 %	1 101	45	13	65	257	64	9	7	15	15	38	224	79
9137102	Katende For. Station		Av.	1 295	78	64	135	267	96	24	14	22	15	120	307	155
1 524 m			60 %	974	51	8	62	266	44	14	9	10	12	34	214	64
9137103	Thika, Yatta Furrow	12	Av.	841	49	34	138	203	90	9	2	6	6	40	200	66
1 524 m			60 %	717	2	8	39	159	35	7	0	3	2	18	116	26

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

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.
9137104 2 073 m	Manza	16	Av.	608	44	41	106	150	36	10	0	0	2	47	221	21
			60 %	542	0	0	17	105	0	0	0	0	0	0	149	0
9137105 1 622 m	Uuni Forest Station	10	Av.	984	38	55	144	207	78	9	2	5	16	100	262	78
			60 %	768	30	23	41	166	28	8	0	0	0	23	157	27
9237002 914 m	Kibwezi, Dwa Plant. Ltd.	60	Av.	641	37	30	91	123	25	5	1	2	4	22	161	140
			60 %	547	6	5	28	75	11	0	0	0	0	1	134	105
9237000 997 m	Makindu, Met. Stat.	72	Av.	616	39	30	79	114	29	2	1	1	2	28	174	118
9237003 1 036 m	Simba Railway Stat.	45	Av.	636	43	39	76	128	40	5	0	2	5	27	163	108
			60 %	519	0	3	36	89	22	0	0	0	0	2	111	84
9237018 975 m	Kiboko Tsetse Control Camp	20	Av.	595	40	40	65	122	29	3	1	1	3	24	157	113
			60 %	530	17	14	35	77	8	0	0	0	0	4	84	48
9238003 855 m	Masongaleni Railway Station	52	Av.	613	29	31	69	118	32	2	1	1	61	25	164	138
9238007 784 m	Darajani Station	38	Av.	451	13	28	93	97	42	8	6	5	12	25	66	57
			60 %	405	13	0	0	75	0	0	0	0	0	0	65	55

MACHAKOS 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	Years of rec.
9137089 1 600 m	Machakos, Katumani Experim. Farm	UM 4	Mean max.	26.0	26.8	26.2	25.1	24.4	23.1	22.0	22.8	25.5	26.4	24.3	24.4	24.7	7
			Mean temp.	20.0	20.5	21.0	20.3	19.6	17.8	17.0	17.3	18.9	20.2	20.0	19.4	19.3	
			Mean min.	14.0	14.2	15.8	15.6	14.8	12.5	12.0	11.8	12.4	14.0	15.8	14.4	13.9	
			Abs. min.	8.9	10.0	10.0	10.0	7.8	8.9	6.1	5.6	6.3	6.7	11.1	10.0	5.6	

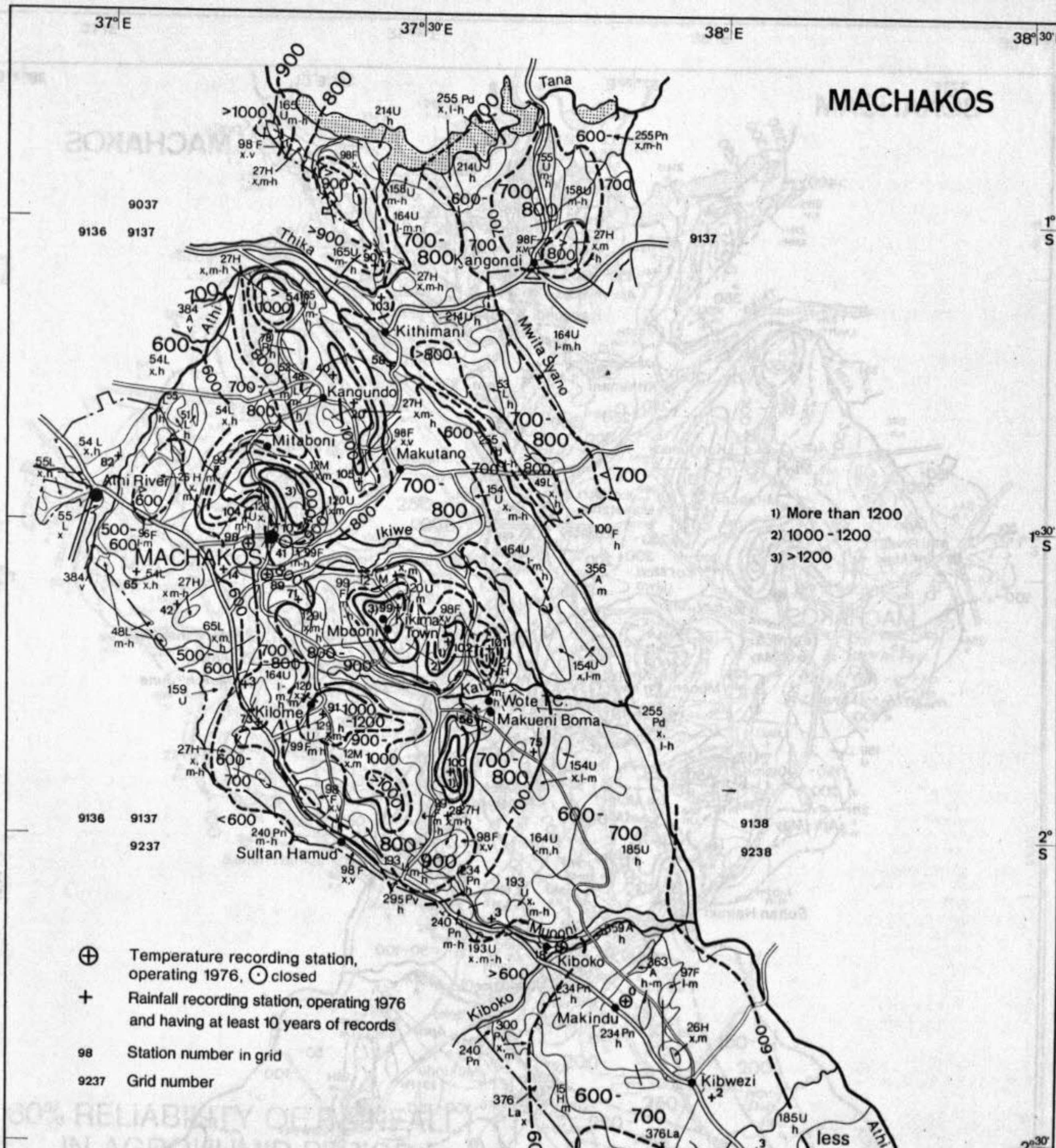
1) AEZ = Agro-ecological zone

MACHAKOS DISTRICT

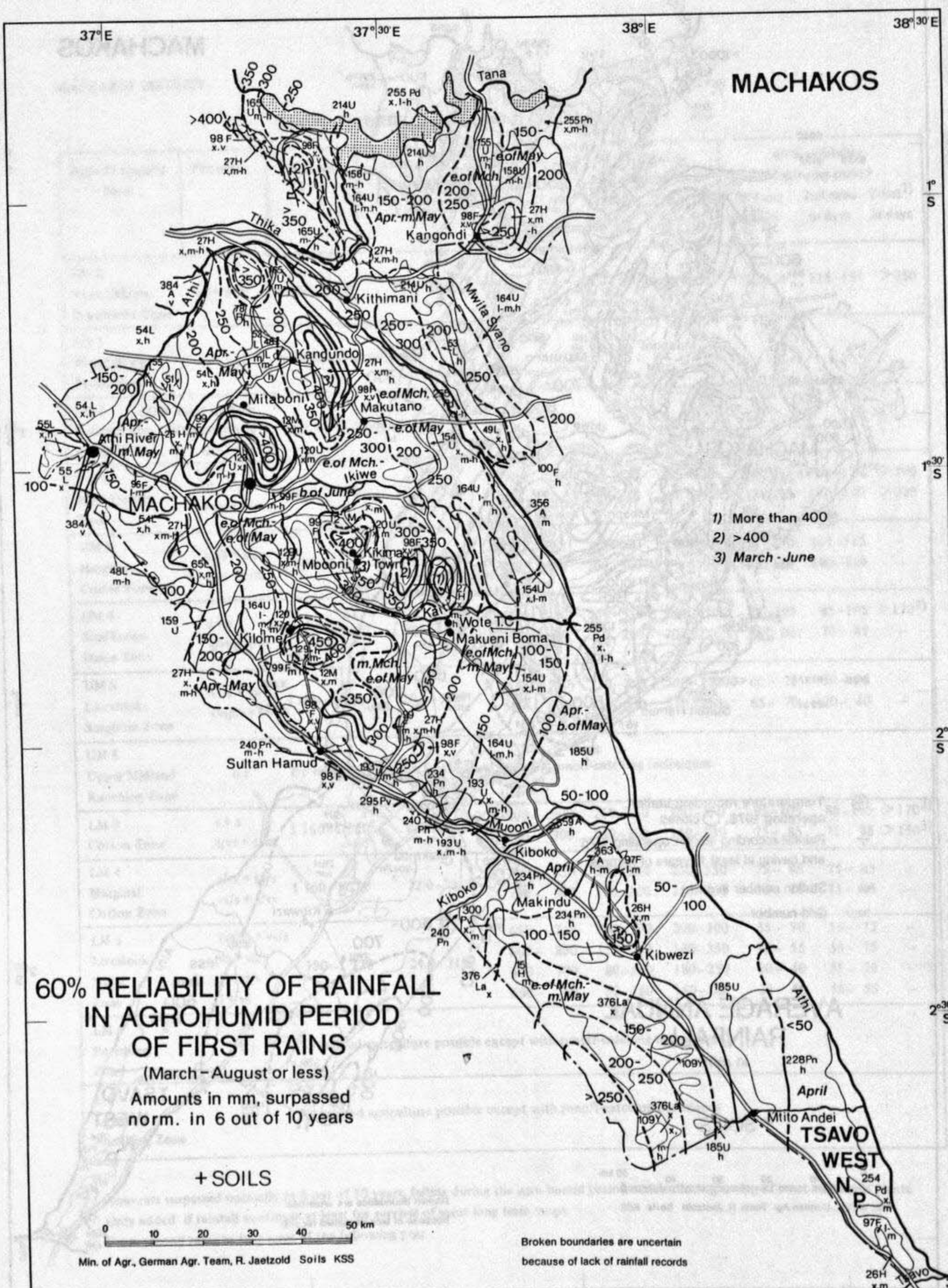
TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

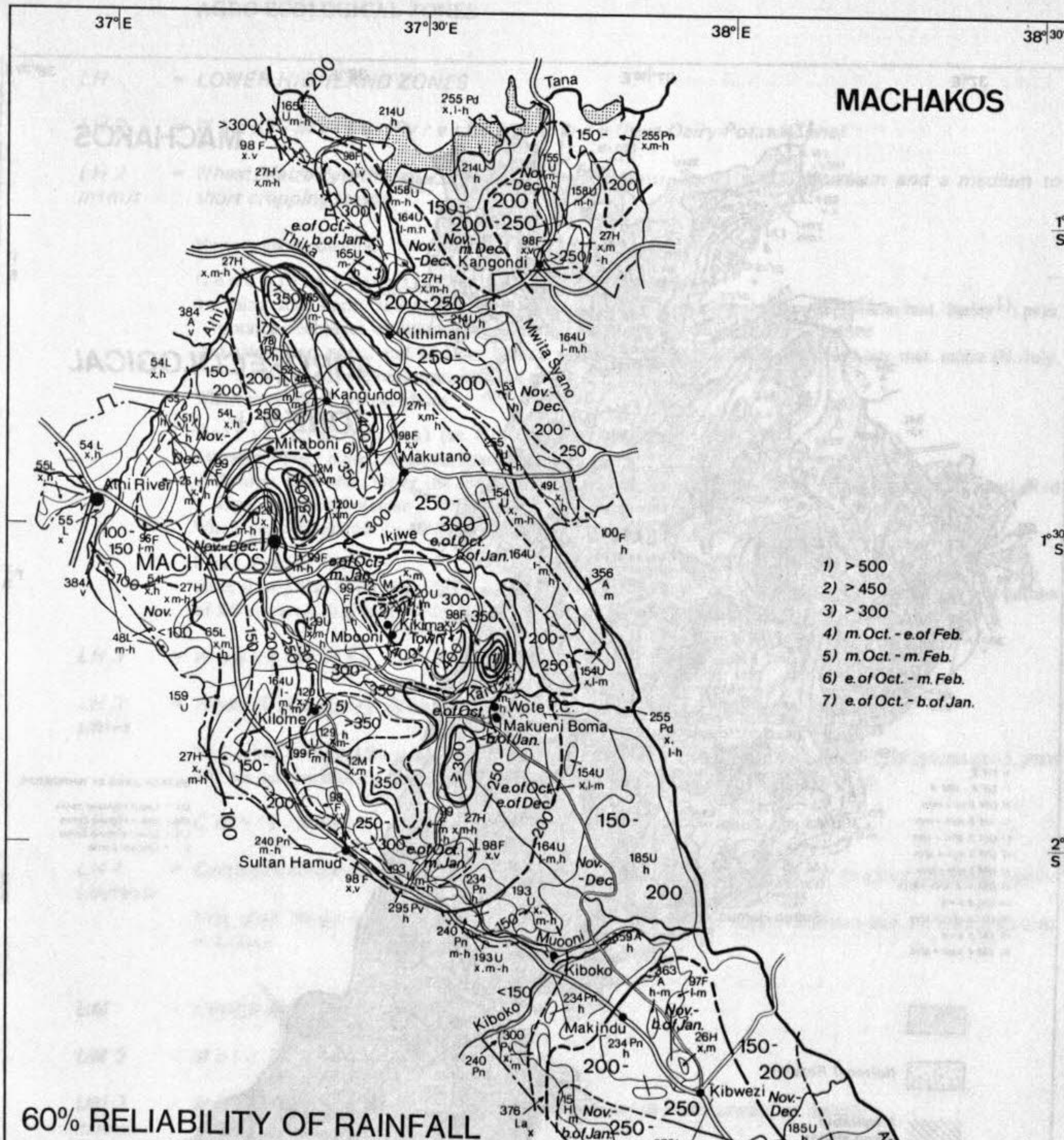
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1]		60 % reliability of growing period		
					1st rains in mm	2nd rains in mm	1st rains in days	2nd rains in days	Total[2] in days
LH 2 Wheat/Maize-Pyrethrum Zone	m + m/s	1 830–2 130	17.9–16.0	1 000–1 300	300–500	300–500	135–155	115–135	> 250
LH 3 Wheat/Maize-Barley Zone	s/m + s	Very small, unimportant							
LH 4 Cattle-Sheep-Barley Zone	s/vs + vs/s	Very small, unimportant							
UM 2 Main Coffee Zone	m + m/s m/s + m/s	1 400–1 770	20.5–18.1	980–1 200 970–1 100	350–430 350–410	350–500 350–450	130–150 115–130	110–130 110–130	> 240 > 225
UM 3 Marginal Coffee Zone	m/s + s/m s/m + s/m	1 400–1 830	20.5–17.9	950–1 050 900–1 000	350–400 300–390	350–400 300–390	110–130 105–115	105–115 100–110	– –
UM 4 Sunflower-Maize Zone	s + s s/vs + s/vs	1 340–1 830	20.9–17.9	800– 950 700– 800	250–350 200–280	250–350 200–250	85–105 75– 85	85–105 70– 85	> 170[3] –
UM 5 Livestock-Sorghum Zone	vs/s + vs (vs/s) + i	1 460–1 710	20.2–18.6	600– 750 550– 600	150–250 150–200	150–230 150–200	65– 75 65– 70	50– 65 20– 40	– –
UM 6 Upper Midland Ranching Zone	b r	No rainfed agriculture possible except with runoff-catching techniques							
LM 3 Cotton Zone	s + s s/vs + s/vs	1 160–1 350	22.0–20.9	800– 900 750– 900	250–350 250–300	250–350 250–300	85–105 75– 85	85–105 75– 85	> 170[3] > 150[3]
LM 4 Marginal Cotton Zone	s/vs + s/vs vs/s + s/vs	1 160–1 280	22.0–21.3	700– 850 700– 800	220–350 190–300	250–350 250–350	75– 85 55– 75	75– 85 75– 85	– –
LM 5 Livestock-Millet Zone	(vs/s) + vs/s vs + vs/s i + vs/s i + vs	790–1 220	24.0–21.6	650– 750 600– 800 600– 700 600– 700	180–300 150–250 80–160 50–160	200–300 180–250 180–250 150–220	55– 70 45– 55 20– 40 20– 40	55– 75 55– 75 55– 75 45– 55	– – – –
LM 6 Ranching Zone	b r	No rainfed agriculture possible except with runoff-catching techniques							
L 6 Lowland Ranching Zone	b r	No rainfed agriculture possible except with runoff-catching techniques							

1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants.
2) Only added if rainfall continues at least for survival of most long term crops.
3) From second rains to first rains of the following year



MACHAKOS
37° E
37°30' E
38° E
38°30' E
1° S
1°30' S
2° S
2°30' S
3° S
Tana
Thika
Athi
Mwita Syano
Kiboko
Tsavo
Kangondi
Kithimani
Kangundo
Mitaboni
Makutano
Athi River
MACHAKOS
Ikiwe
Mbooni
Kikima Town
Wote T.C.
Makueni Boma
Kilome
Sultan Hamud
Mungni
Kiboko
Makindu
Kibwezi
Mtito Andei
TSAVO WEST N.P.
less than 600
9037
9136
9137
9137
9136
9137
9237
9138
9238
1) More than 1200
2) 1000 - 1200
3) >1200
Temperature recording station, operating 1976, ⊙ closed
Rainfall recording station, operating 1976 and having at least 10 years of records
98 Station number in grid
9237 Grid number
AVERAGE ANNUAL RAINFALL
in mm
+ SOILS
0 10 20 30 40 50 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS
Broken boundaries are uncertain because of lack of rainfall records


MACHAKOS
37° E
37°30'E
38° E
38°30'E
1° S
1°30' S
2° S
Tana
Thika
Athi
Mwita Syano
Kangondi
Kithimani
Kangundo
Mitaboni
Makutano
Athi River
MACHAKOS
Ikiwe
Mbooni
Kikima Town
Kali
Wote T.C.
Makueni Boma
Kilome
Sultan Hamud
Muooni
Kiboko
Makindu
Kibwezi
Mtito Andei
TSAVO WEST N.P.
Tsavo
1) More than 400
2) >400
3) March - June
60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF FIRST RAINS
(March - August or less)
Amounts in mm, surpassed norm. in 6 out of 10 years
+ SOILS
50 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS
Broken boundaries are uncertain because of lack of rainfall records

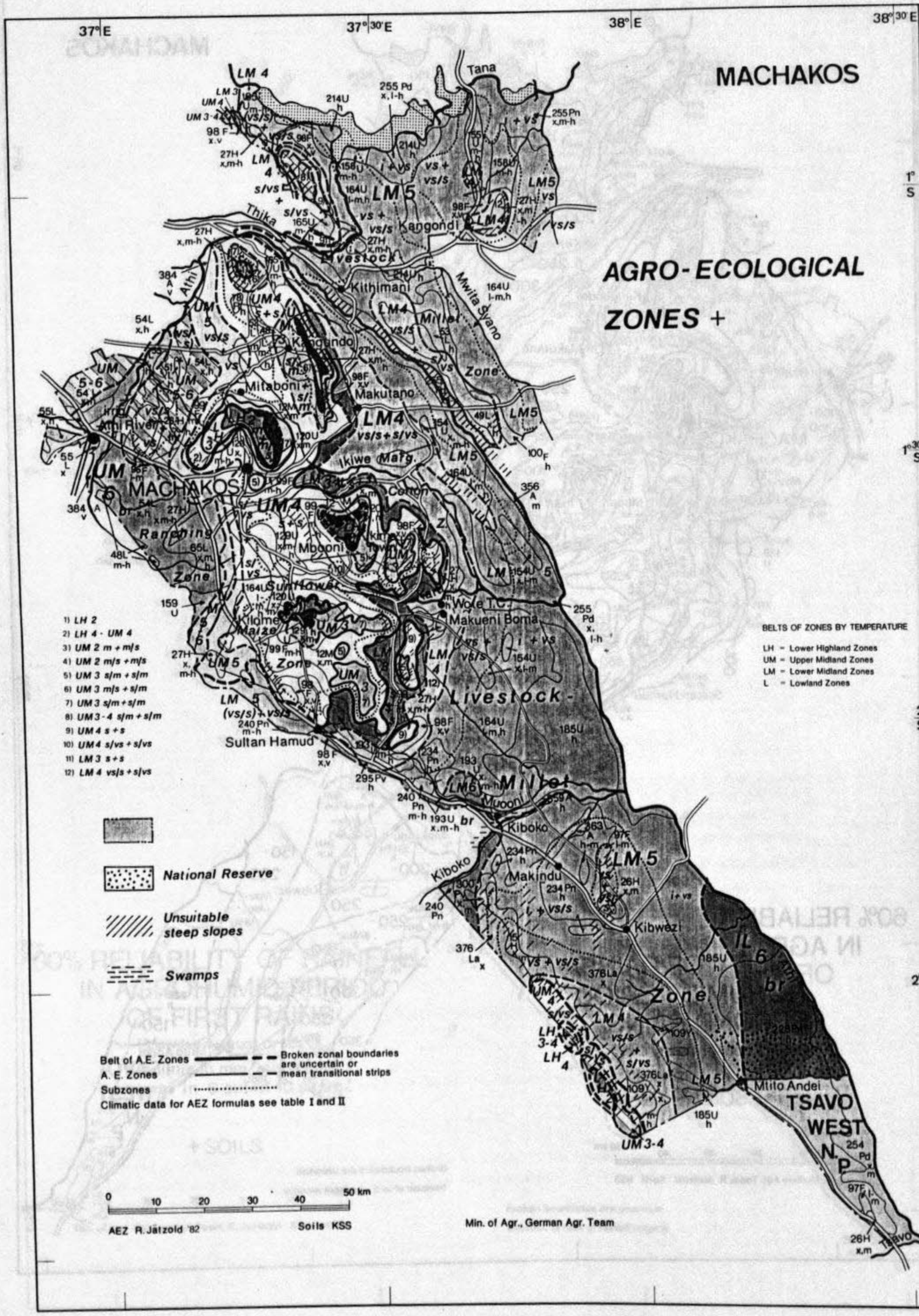


60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF SECOND RAINS

(Oct. - Febr. or less)

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

+ SOILS



MACHAKOS
AGRO-ECOLOGICAL ZONES +
37°E
37°30'E
38°E
38°30'E
Tana
Thika
Athi
Mwita Syano
Kangondi
Kithimani
Kangundo
Mitaboni
Makutano
Athi River
MACHAKOS
Mbooni
Wote T.C.
Makueni Boma
Sultan Hamud
Muooni
Kiboko
Makindu
Kibwezi
Mtito Andei
TSAVO WEST N.P.
Tsavo
Livestock
Millet
Zone
Ranching Zone
Sunflower
Maize Zone
Livestock-Millet Zone
Cotton
Ikiwe Marg.
1) LH 2
2) LH 4 - UM 4
3) UM 2 m + m/s
4) UM 2 m/s + m/s
5) UM 3 s/m + s/m
6) UM 3 m/s + s/m
7) UM 3 s/m + s/m
8) UM 3 - 4 s/m + s/m
9) UM 4 s + s
10) UM 4 s/vs + s/vs
11) LM 3 s + s
12) LM 4 vs/s + s/vs
BELTS OF ZONES BY TEMPERATURE
LH = Lower Highland Zones
UM = Upper Midland Zones
LM = Lower Midland Zones
L = Lowland Zones
National Reserve
Unsuitable steep slopes
Swamps
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 10 20 30 40 50 km
AEZ R. Jätzold '82
Soils KSS
Min. of Agr., German Agr. Team

AGRO-ECOLOGICAL ZONES

LH = *LOWER HIGHLAND ZONES*

LH 2 = *Wheat/Maize-Pyrethrum Zone (here Dairy-Potato Zone)*

LH 2 m+m/s = *Wheat/Maize-Pyrethrum Zone (resp. Dairy-Potato Zone) with a medium and a medium to short cropping season*

No very good potential

Good yield potential (av. 60–80 % of the optimum)
1st rains, start norm. end of March: M.mat. wheat like Kenya Tembo (~ 60 %)[1], m.mat. barley[1]; peas, potatoes; cabbages, cauliflower, kales, carrots, beetroot, spinach, lettuces, tomatoes
2nd rains, start norm. end of Oct.: M.mat. wheat (~ 70 %), m.mat. barley, very late mat. maize (N.-July, ~ 60 %); peas, potatoes; vegetables like above
Whole year: Black wattle, plums

Fair yield potential (av. 40–60 % of the optimum)
1st rains: Finger millet; rapeseed, linseed; sweet potatoes
2nd rains: Late mat. maize (N.-June), finger millet; sunflower Kenya White (40–50 %); e.mat. beans (Red Haricot), sweet potatoes
Whole year: Pyrethrum (~ 40 %)[2], tea (40–50 %), apples, pears, avocadoes, passion fruit

Pasture & forage
More than 1 ha/LU on secondary pasture (originally montane forest), around 0.6 ha/LU on artificial pasture of Kikuyu grass, less than 0.4 ha/LU with Napier grass and fodder legumes for dairy cows

LH 3 = *Wheat/Maize-Barley Zone*

LH 3 s/m+s = *Wheat/Maize-Barley Zone with a short to medium and a short cropping season*

Very small at Mua Hills. E.mat. wheat and barley 1st rains good[1], maize H 511 & 512 fair; plums good, pears fair; no tea possibilities, pyrethrum poor; most other crops mentioned in LH 2 only fair

LH 4 = *Cattle-Sheep-Barley Zone*

LH 4 s/vs+vs/s = *Cattle-Sheep-Barley Zone with a short to very short and a very short to short cropping period*

Very small. No good crop potentials except short to very short mat. barley varieties which are bred in Kashmir or Ladakh

UM = *UPPER MIDLAND ZONES*

UM 2 = *Main Coffee Zone*

UM 2 m+m/s = *Main Coffee Zone with a medium and a medium to short cropping season*

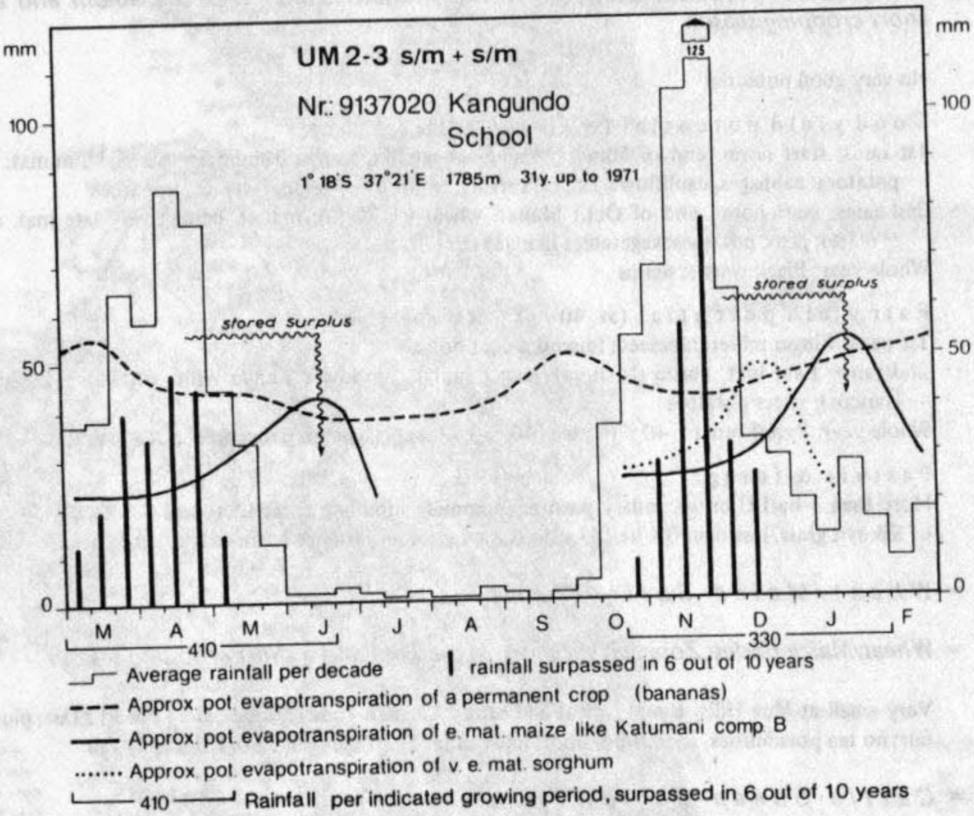
Good yield potential
1st rains, start norm. mid March: M.mat. maize like H 511 & 512; beans; potatoes, sweet potatoes; m.mat. sunflower like Hybrid S 301 A, cabbages, kales, tomatoes, onions
2nd rains, start norm. mid Oct.: E.mat. maize like Katumani comp. B, Meru foxtail millet, e.mat. sorghum like 2 KX 17; beans, sweet potatoes (Aug./S.-Jan.); m.mat. sunflower like Hybrid S 301 A; kales, cabbages, onions, tomatoes
Whole year: Arabica coffee; bananas, citrus, avocadoes, passion fruit , loquats, mountain pawpaws, guavas (pink), Macadamia nuts

Fair yield potential
2nd rains: M.mat. maize (Aug./S.-J./F.), finger millet; e.mat. potatoes
Whole year: Cassava, sugar cane in lower and wet places (valleys), coffee on less suitable soils, peaches, and abricots

Pasture & forage
0.6–1.0 ha/LU on sec. pasture of star grass (Cynodon dactylon); down to about 0.2 ha/LU feeding Napier or Bana grass with banana leaves and other forage

UM 2 m/s+m/s = *Main Coffee Zone with two medium to short cropping seasons*

Very small, yield potential in 1st rains like UM 3 m/s+s/m, in 2nd rains like UM 2 m+m/s. Yields of perennial crops and stocking rates like UM 2 m+m/s less 10%



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

UM 3 m/s+s/m = *Marginal Coffee Zone with a medium to short and a short to medium cropping season*

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

1st rains, start norm. mid March: E.mat. maize like Katumani comp.B (60–70 %), e.mat. sorghum like 2 KX 17 (below 1 500 m), ratoon of e.mat. sorghum from previous 2nd rains (70–80 %); m.mat. sunflower like Hybrid S 301 A; onions, cabbages

2nd rains, start norm. end of Oct.: E.mat. foxtail and proso millet (70–80 %), e.mat. sorghum like 2 KX 17, e.mat. sunflower like Hybrid S 345 or Issanka (below 1 500 m)

Whole year: Pineapples (lower places), Macadamia nuts, castor, guavas (pink)

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

1st rains: M.mat. maize like H 511 (~ 40 %), finger millet; e.mat. beans, sweet potatoes; kales, tomatoes

2nd rains: L.mat. maize (N.-June), Katumani maize; e.mat. beans (50–60 %), sweet potatoes; cabbages, kales, tomatoes

Whole year: Arabica coffee (lower places poor, there add. irrigation profitable), bananas, pawpaws, passion fruits, citrus, in higher places peaches and abricots

P a s t u r e & f o r a g e

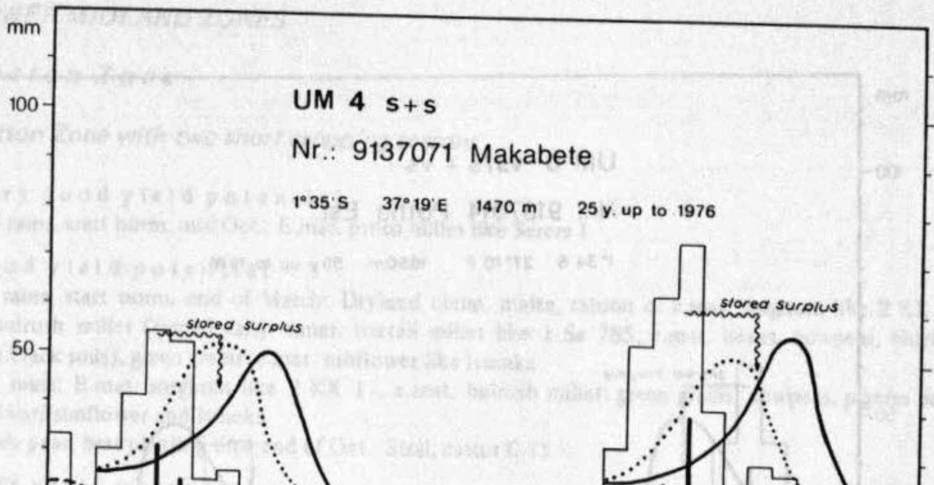
0.7–1.2 ha/LU on sec. high grass savanna with Zebra grass (Hyparrhenia rufa) and star grass (Cynodon dactylon); down to ~ 0.23 ha/LU feeding Napier or Bana grass (if well manured), maize stalks, and other forage

UM 3 s/m+s/m = *Marginal Coffee Zone with two short to medium cropping seasons*

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

1st rains, start norm. end of March: E.mat. sorghum like 2 KX 17 (below 1 500 m); dwarf sunflower, e.mat. sunflower like Hybrid S 345 (60–70 %, below 1 500 m); e.mat. cabbages, onions

2nd rains, whole year, and fair yield potential like UM 3 m/s+s/m but coffee and bananas mostly marginal; stocking rates on medium grass savanna a bit less than above



UM 4 = *Sunflower-Maize Zone*

UM 4 s+s = *Sunflower-Maize Zone with two short cropping seasons* (see Diagram Makabete)

Good yield potential
1st rains, start norm. end of March: Katumani maize (~ 60 %), v.e.mat. maize like Dryland composite, e.mat. sorghum (below 1 500 m), ratoon of sorghum; e. mat. beans; dwarf sunflower, Hybrid S 345, and Issanka (both below 1 500 m); tomatoes, onions
2nd rains, start norm. end of Oct.: The same but e.mat. sorghum up to 1 800 m, ratoon sorghum (N.-June)
Whole year: Sisal

Fair yield potential
1st rains: Finger millet; e.mat. cowpeas, bonavist beans (dolichos); sweet potatoes
2nd rains: The same
Whole year: Cassava (up to 1 500 m), Macadamia nuts, pigeon peas, citrus, pineapples, pawpaws, castor

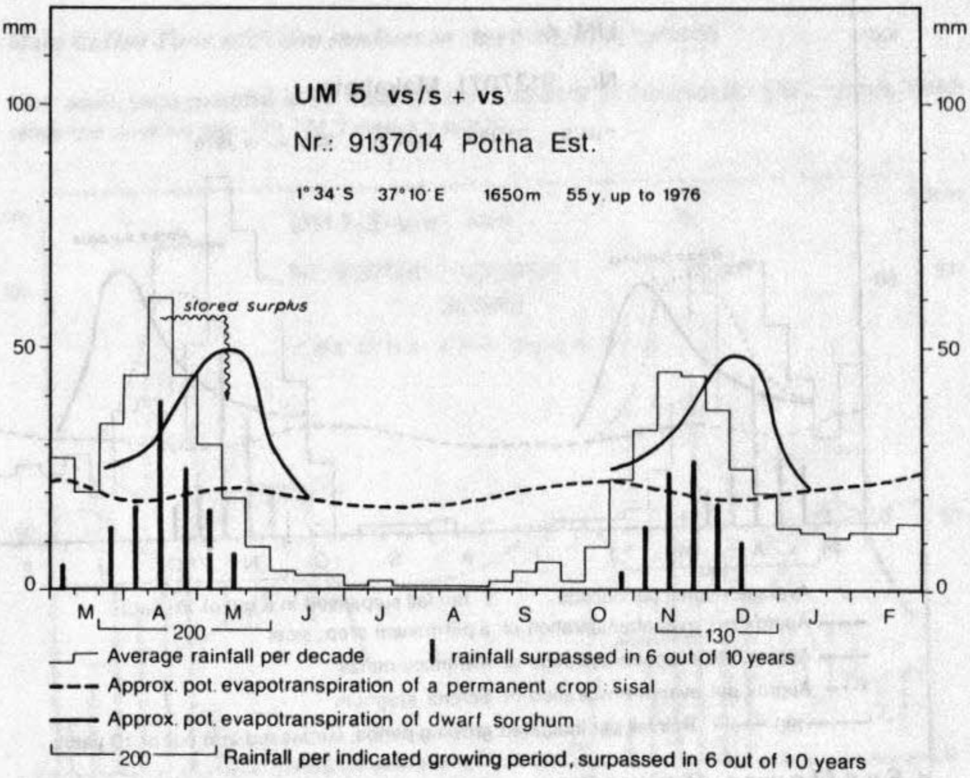
Pasture & forage
1–2 ha/LU on high grass savanna with Zebra grass (Hyparrhenia rufa) predominant; about 1 ha on art. pasture of Boma Rhodes; down to 0.25 ha/LU feeding Bana grass (if well manured) and planting horse tamarind (Leucaena leucocephala) and saltbush (Atriplex nummularia) as best palatable shrubs

UM 4 s/vs+s/vs = *Sunflower-Maize Zone with two short to very short cropping seasons*

Good yield potential
1st rains: V.e.mat. barley (above 1 500 m), v.e.mat. sorghum like IS 8 595 (below 1 500 m, ~ 60 %); dwarf sunflower, chick peas (on heavy black soils in lower places)
2nd rains: Dryland comp. maize (~ 60 %), e.mat. foxtail and proso millet, v.e.mat. barley (above 1 500 m), v.e.mat. sorghum (up to 1 800 m, 60–70 %); dwarf sunflower (60–70 %)
Whole year: Sisal

Fair yield potential
1st rains: Dryland comp. maize (50–60 %), Katumani maize (~ 40 %), ratoon of e.mat. sorghum; e.mat. beans (40–50 %), v.e.mat. cowpeas (50–60 %, below 1 500 m)
2nd rains: The same plus ratoon sorghum (50–60 %, N.-June)
Whole year: Castor

Pasture & forage
Stocking rates 10–20 % less than UM 4 s+s



UM 5 = *Livestock-Sorghum Zone*

UM 5 vs/s+vs = ***Livestock-Sorghum Zone with a very short to short and a very short cropping season*** (see Diagram Potha Estate)

No good yield potential

Fair yield potential
1st rains, start norm. end of March: V.e.mat. sorghum like I 8 595, dwarf sorghum; chick peas (on h.black soils in lower places); dwarf sunflower, rai (oilseed Brassica juncea from Jodhpur)
2nd rains, start norm. begin of Nov.: Yields a bit less, sunflower poor

Poor yield potential (av. 20–40 % of the optimum)
1st rains: Dryland comp. (30–40 %) and Katumani maize (20–30 %); v.e.mat. beans like Mwezi moja (30–40 %)

Pasture & forage
2–3 ha/LU on short grass savanna with red oats grass (Themeda triandra) predominant. No forage cultivation necessary on good grassland soils, on others saltbush (Atriplex numm.) advisable

UM 5 (vs/s)+i = ***Livestock-Sorghum Zone with a (weak) very short to short cropping season and intermediate rains***

No good yield potential

Fair yield potential
1st rains like UM 5 vs/s+s but only ~ 40 %
2nd rains too small and unreliable

Poor yield potential
1st rains: Dryland comp. (20–30 %) and Katumani maize (~ 20 %); Mwezi moja beans (20–30 %)

Pasture & forage
2.5–4 ha/LU on short grass savanna with buffel grass (Cenchrus ciliaris) predominant

UM 6 = *Upper Midland Ranching Zone*

UM 6 br = ***Upper Midland Ranching Zone with bimodal rainfall***

No rainfed agriculture advisable. Limited irrigation near Athi River

Pasture & forage
More than 4 ha/LU on nearly treeless short grass savanna. Dominating black soils not suitable for fodder shrubs. Especially short rains are diminishing considerably West of hillsides

LM = *LOWER MIDLAND ZONES*

LM 3 = *Cotton Zone*

LM 3 s+s = *Cotton Zone with two short cropping seasons*

Very good yield potential
2nd rains, start norm. mid Oct.: E.mat. proso millet like Serere I

Good yield potential
1st rains, start norm. end of March: Dryland comp. maize, ratoon of e.mat. sorghum like 2 KX 17, e.mat. bulrush millet (awned var.), e.mat. foxtail millet like 1 Se 285; e.mat. beans, cowpeas, chick peas (on h.black soils), green grams; e.mat. sunflower like Issanka
2nd rains: E.mat. sorghum like 2 KX 17, e.mat. bulrush millet; green grams, cowpeas, pigeon peas (O.-S.); dwarf sunflower and Issanka
Whole year, best planting time end of Oct.: Sisal, castor C-15

Fair yield potential
1st rains: Katumani maize; dolichos beans (50–60 %), groundnuts in light soils, e.mat. soya beans; sweet potatoes; virginia tobacco; tomatoes, onions
2nd rains: Dryland comp. maize (50–60 %), Katumani maize, dolichos beans, Mwezi moja beans; cotton bimodal var. (end of S./O.-Aug.), sunflower Issanka
Whole year: Cassava, pineapples, mangoes, Macadamia nuts

Poor yield potential
2nd rains: Virg. tobacco; e.mat. sweet potatoes
Whole year: Citrus

Pasture & forage
0.8–1.9 ha/LU on high grass savanna with Zebra grass (Hyparrhenia rufa) predominant, down to ~ 0.3 ha/LU feeding Bana grass, Siratro (Macroptilium atropurpureum), horse tamarind (Leucaena leucocephala) a.o.

LM 3 s/vs + s/vs = *Cotton Zone with two short to very short cropping seasons*

Small, potential nearly as LM 3 s + s less about 10 %. First rains smaller and less reliable than second rains

LM 4 = *Marginal Cotton Zone*

LM 4 s/vs+s/vs = *Marginal Cotton Zone with two short to very short cropping seasons*

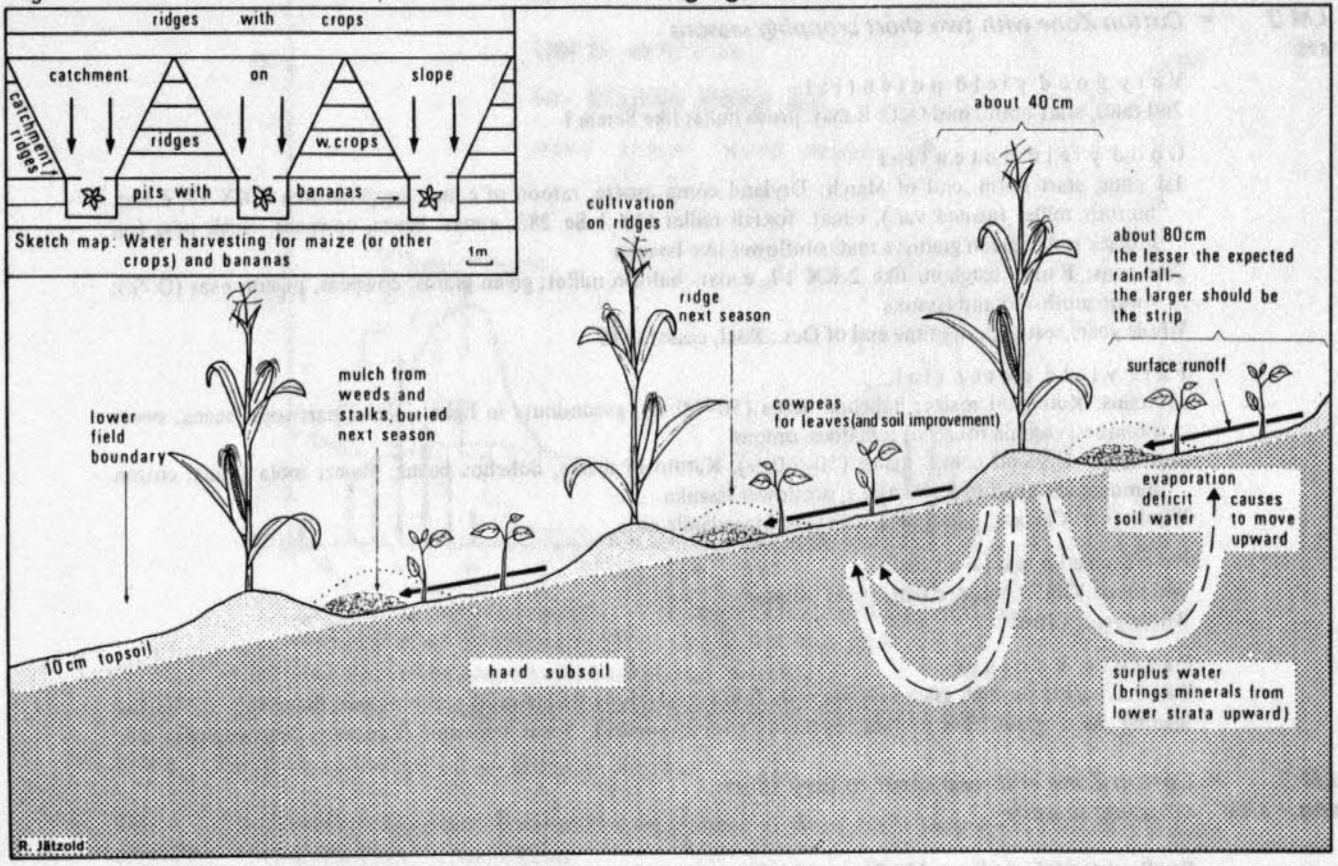
Good yield potential
1st rains, start norm. end of March: Dryland comp. maize (on contour ridges, 60–70 %), ratoon of e.mat. sorghum like Serena or v.e.mat. like IS 8595 (70–80 %), e.mat. bulrush millet (awned var. preferred), e.mat. foxtail or proso millet (70–80 %); v.e.mat. beans like Mwezi moja (~ 60 %); v.e.mat. cowpeas, black and green grams, chick peas (on h.black soils); dwarf sunflower, e.mat. sunflower like Issanka (~ 60 %), rai (oilseed, 70–80 %); v.e.mat. pumpkins
2nd rains, start norm. end of Oct.: The same but planting sorghum (for ratoon in next r.)
Whole year, best pl.time end of Oct.: Sisal, jojoba, cassava, buffalo gourds (on sandy soils) and Marama beans (both still experimental), Vigna, castor C-15 (~ 60 %)

Fair yield potential
1st rains: Katumani maize (on contour ridges), m.mat. sorghum; e.mat. beans, e.mat. soya beans, dolichos beans, e.mat. bambarra groundnuts (in light soils); sweet potatoes; onions, tomatoes
2nd rains: The same and cotton bimodal var. (O.–Aug., on good soils, otherwise poor); pigeon peas
Whole year: Macadamia nuts

Safe yields in dry years with runoff-catching agriculture (Fig. 1)

Pasture & forage
2–3.5 ha/LU on mixed undestroyed medium grass sav. with Makueni guinea (Panicum maximum) and red oats grass (Themeda triandra) predominant; if degraded reseeding with Masai love grass, buffel grass and Makueni guinea, and planting salt bushes (Atriplex nummularia), horse tamarinds and Mesquite (Prosopis juliflora) as palatable shrubs, and applering acacias (Gao tree, Ac. albida) for fruits and leaves.
Silage of fodder sorghum, vines of moth beans, and others

Fig. 1 **Runoff-catching agriculture**



for areas with 300-400 mm average precipitation per rainy season

LM 4 = *Marginal Cotton Zone with a very short to short and a short to very short cropping season*
vs/s+s/vs (see Diagram Makueni)

Good yield potential

1st rains, start norm. end of March: E.mat. proso millet like Serere I; v.e.mat. pumpkins

2nd rains, start b. of Nov.: E.mat. foxtail or proso millet; v.e.mat. cowpeas, green grams, dwarf sunflower, chick peas (on h.black soils); v.e.mat. pumpkins

Whole year : Buffalo gourds and Marama beans (both on sandy soils„still exp.), jojoba

Fair yield potential

1st rains: Dryland comp. maize (~ 40 %), v.e.mat. sorghum like IS 8595, e.mat. bulrush millet; black and green grams, v.e.mat. cowpeas, chick peas (on h. black soils); dwarf sunflower, rai (oilseed); v.e.mat. pumpkins

2nd rains: Dryland comp. maize (~ 50 %), v.e.mat. sorghum like IS 8595 50–60 %), e.mat. bulrush millet (50–60 %); pigeon peas (N.-Au., 40–50 %), Mwezi moja beans, Dolichos beans, black grams; e.mat. soya beans, cotton (on very good soils 40–50 % otherwise poor); sweet potatoes; tomatoes, onions

Whole year: Sisal, cassava (40–50 %), castor C-15

Pasture & forage

2.5–4 ha/LU on medium to short grass sav. and bushland; if degraded improvable like LM 4 s/vs+s/vs; down to 0.3–0.5 ha/LU with silage of fodder sorghum or hay of moth beans vines, fodder plants like in LM 4 s/vs+s/vs, and others

LM 5 = *Livestock-Millet Zone*

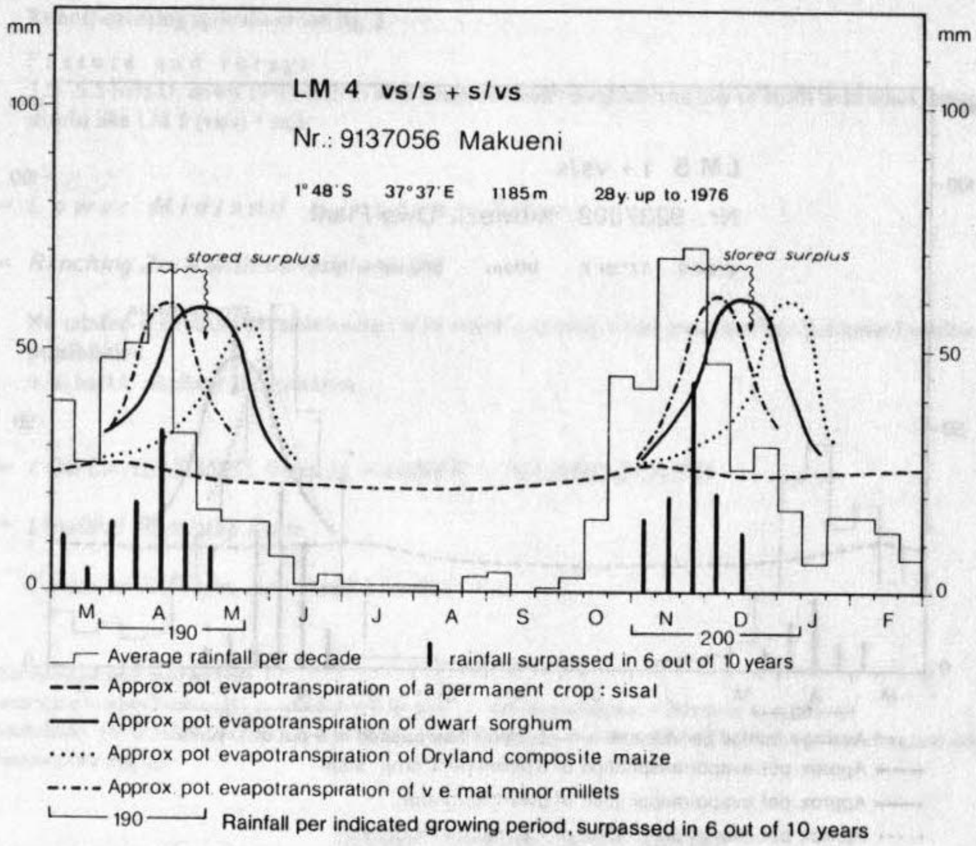
(Except of minor irrigation areas near Athi River, there vegetables mainly)

LM 5 = *Livestock-Millet Zone with a (weak) very short to short and a very short to short cropping*
(vs/s)+vs/s *season*

Good yield potential

2nd rains, start norm. b. of Nov.: E. mat. proso millet like Serere I; moth beans; v.e.mat. pumpkins

Whole year: Buffalo gourds (on sandy soils) and Marama beans (both still exp.) ,Opuntia (fruit and vegetable, also fodder)



Fair yield potential

1st rains, start norm. end of March: E. mat. bulrush millet (bird rej. awned var. pref.), v.e.mat. sorghum like IS 8595 (40–50 %), e.mat. proso millet like Serere I (50–60 %), e.mat. foxtail millet; black and green grams, v.e.mat. cowpeas, chick peas (on h. black soils); dwarf sunflower, v.e.mat. bambarra groundnuts (on light soils)

2nd rains: E. mat. bulrush millet (nearly 60 %), dwarf sorghum (nearly 60 %), e.mat. foxtail millet (nearly 60 %); Mwezi moja beans (40–50 %), black and green grams 50–60 %), moth beans (50–60 %), v.e.mat. cowpeas (50–60 %), chick peas (on h. bl. soils) (50–60 %); rai (oilseed), dwarf sunflower (50–60 %), v.e.mat. bambarra groundnuts (on light soils)

Whole year: Sisal, castor like C–15, jojoba

Poor yield potential

2nd rains: Dryland comp. maize (nearly 40 %), Katumani maize (~ 30 %), cotton (N.–Au. ~ 30 %, only on patches of good soils), pigeon peas

Yields improvable and risk of crop failure lowerable by runoff-catching agriculture (see fig. 2)

Pasture and forage

2.8–5 ha/LU on mixed short grass sav. or bushland with buffel grass (Cenchrus ciliaris) and horsetail grass (Chloris roxburghiana) predominant. Down to about 0.4–0.6 ha/LU with silage of fodder sorghum and hay of moth beans; saltbush best palatable shrub to improve degraded pasture and to establish fodder reserves for dry seasons or years. Good potential for bee-keeping

LM 5 vs+vs/s = *Livestock-Millet Zone with a very short and a very short to short cropping season*

Good yield potential in 1st rains v.e.mat. foxtail and hog millet, 2nd rains like above

Fair yield potential

1st rains, start end of March: E. mat. foxtail and proso millet; v.e.mat. cowpeas and green grams, v.e.mat. bambarra groundnuts (on light soils); dwarf sunflower (~ 40 %)

2nd rains like LM 5 (vs/s)+vs/s

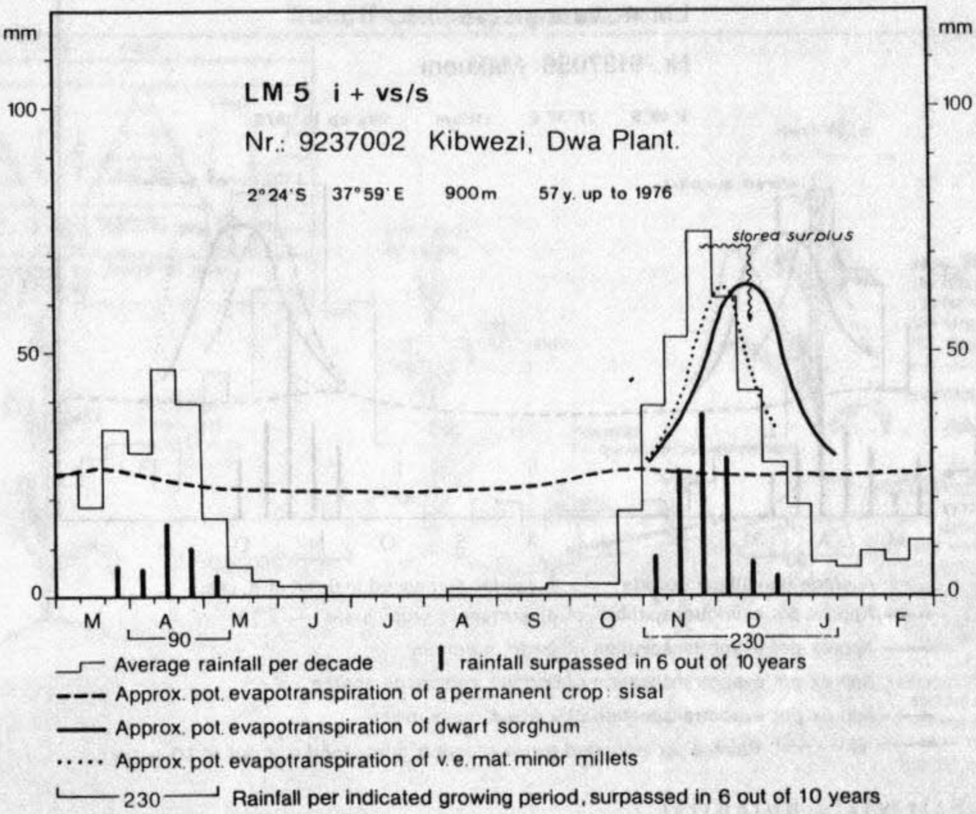
Whole year: Sisal, castor, jojoba

Poor yield potential

See LM 5 (vs/s)+vs/s but lesser averages

Pasture and forage

See LM 5 (vs/s)+vs/s but a bit lesser stocking rates



LM 5 i+vs/s = *Livestock-Millet Zone with intermediate first rains*[3)] *and a very short to short cropping season*
(see Diagram Kibwezi, Dwa Plantation)

Good yield potential
2nd rains, start end of Oct.: V. e. mat. foxtail and hog millet; dwarf sunflower, v. e. mat. rai (oilseed)
Whole year: Buffalo gourds (on light soils) and Marama beans (both still exp.)

Fair yield potential
2nd rains: Dryland comp. maize (~ 40 %), e. mat. proso millet, e. mat. bulrush millet (awned var., 50–60 %), v. e. mat. sorghum; v. e. mat. bambarra groundnuts, v. e. mat. tepary beans, v. e. mat. moth beans (50–60 %), v. e. mat. cowpeas (40–50 %), green grams, chick peas (on h. bl. soils); e. mat. sunflower like Issanka (~ 40 %), e. mat. soya beans (~ 40 %); v. e. mat. pumpkins, e. mat. onions
Whole year: Castor C–15, sisal, e. mat. cassava, jojoba

Poor yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail and hog millet
2nd rains: Katumani maize

Pasture and forage
3.5–5.5 ha/LU on undestroyed nat. pasture, if degraded well improvable with horsetail grass (Chloris roxburghiana) and grazing rotation; down to 0.7 ha/LU with saltbush, Mesquite (Prosopis juliflora) and Algarrobo (Pr. chilensis), moth bean vines as hay, silage of fodder sorghum for dry seasons, and other fodder plants

LM 5 i + vs = *Livestock-Millet Zone with intermediate first rains*[3)] *and a very short cropping season*

Fair to poor yield potential
2nd rains, start norm. b. of Nov.: V. e. mat. foxtail and hog millet
Whole year: Buffalo gourds (on light soils) and Marama beans (both still exp.)

Fair yield potential
2nd rains: E. mat. bulrush millet (~ 40 %), v. e. mat. sorghum (~ 40 %); moth beans, green grams, v. e. mat. cowpeas (40–50 %), chick peas (on h. bl. soils); dwarf sunflower (~ 40 %), v. e. mat. bambarra groundnuts (on light soils); v. e. mat. pumpkins
Risk of total crop failures of maize: 7 out of 10 seasons
Whole year: Sisal (40–50 %), castor

Runoff-catching agriculture see fig. 2

P a s t u r e a n d f o r a g e
3.5–5.5 ha/LU, down to 0.8 ha/LU with silage of fodder sorghum and hay of moth bean vines, grass and palatable shrubs like LM 5 (vs/s) + vs/s

LM 6 = L o w e r M i d l a n d R a n c h i n g Z o n e

LM 6 br = Ranching Zone with bimodal rainfall

No rainfed agriculture possible except with runoff-catching techniques (see Fig. 2). Limited small-scale irrigation possibilities.
4–6 ha/LU on short grass savanna

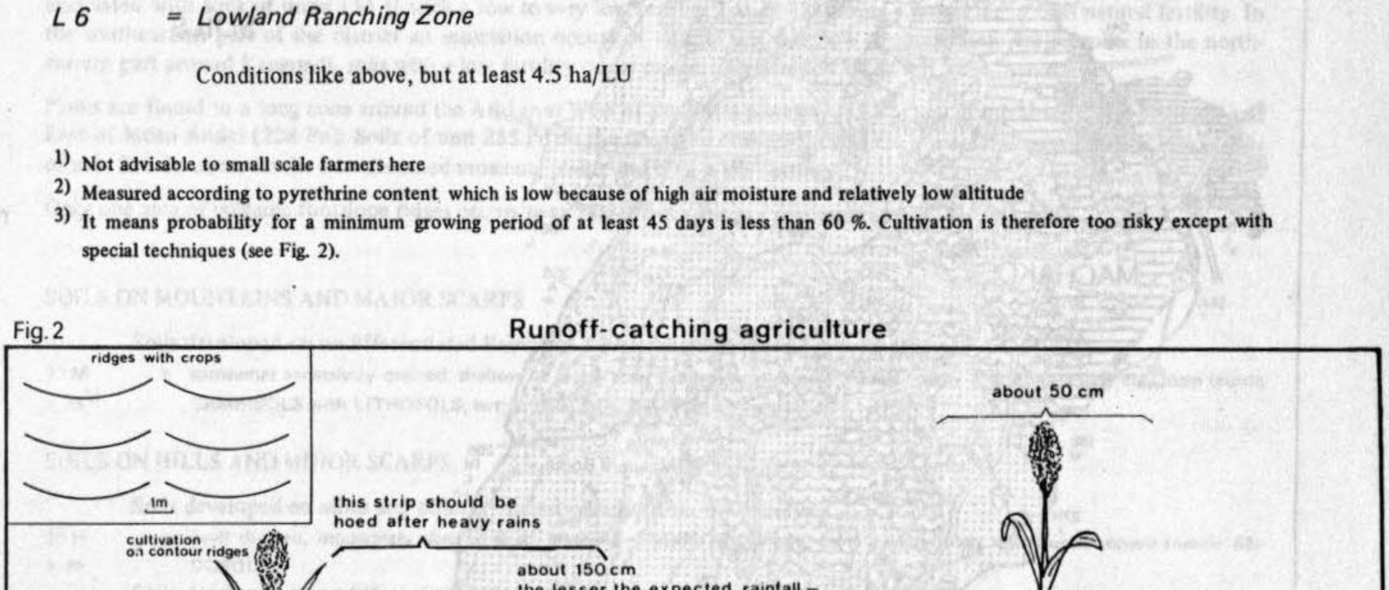
L = LOWLAND ZONES (here IL = INNER LOWLAND ZONES)

L 6 = Lowland Ranching Zone

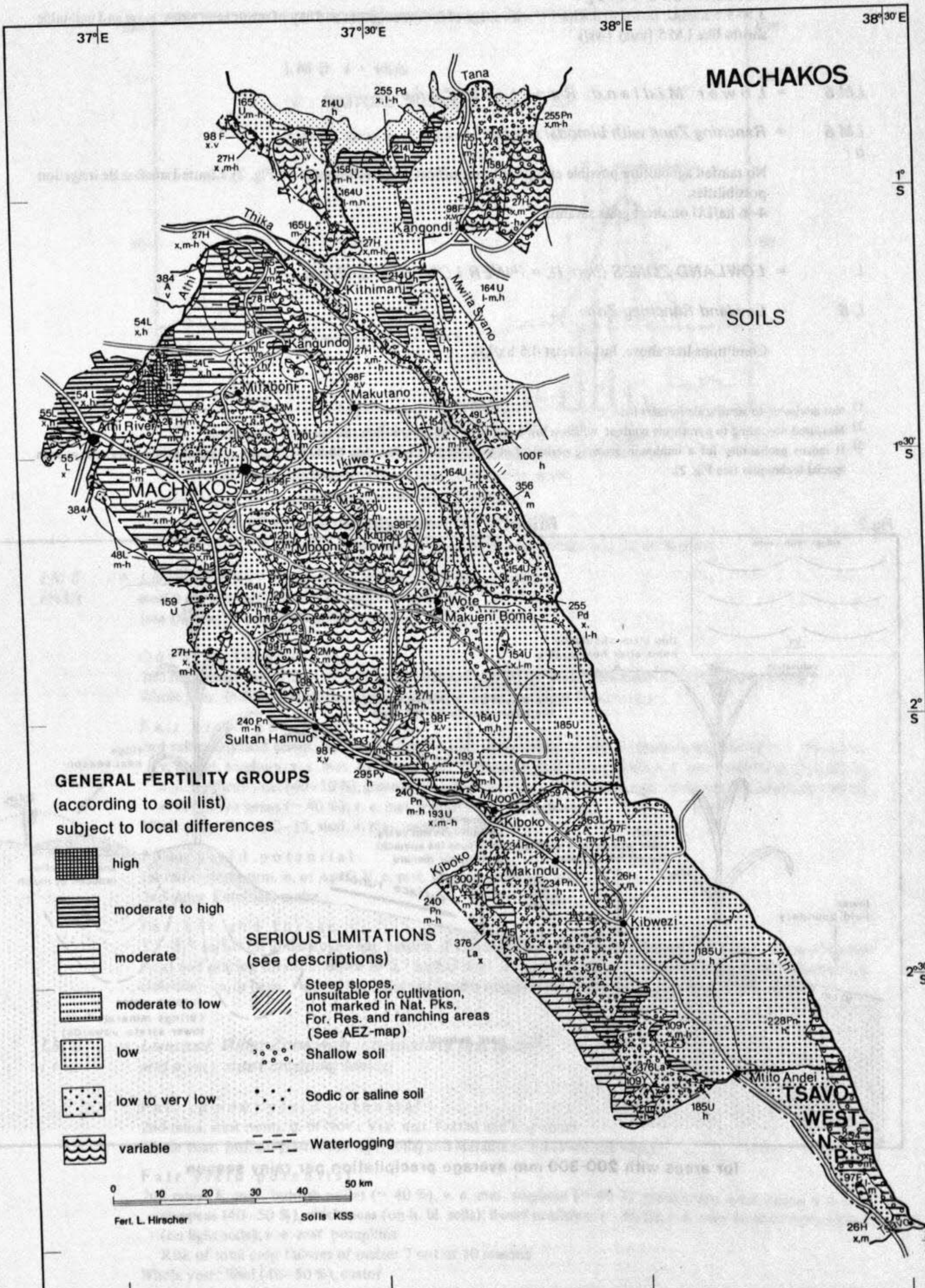
Conditions like above, but at least 4.5 ha/LU

1) Not advisable to small scale farmers here
2) Measured according to pyrethrine content which is low because of high air moisture and relatively low altitude
3) It means probability for a minimum growing period of at least 45 days is less than 60 %. Cultivation is therefore too risky except with special techniques (see Fig. 2).

Fig. 2 **Runoff-catching agriculture**



for areas with 200-300 mm average precipitation per rainy season



MACHAKOS
SOILS
37°E
37°30'E
38°E
38°30'E
1° S
1°30' S
2° S
2°30' S
Tana
Thika
Athi
Mwita Syano
Ikiwe
Kiboko
Kangondi
Kithimani
Kangundo
Mitaboni
Makutano
Athi River
MACHAKOS
Kikima
Mbooni Town
Kilome
Wote T.C.
Makueni Boma
Sultan Hamud
Muooni
Kiboko
Makindu
Kibwezi
Mtito Andei
TSAVO WEST N.P.
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate
moderate to low
low
low to very low
variable
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (See AEZ-map)
Shallow soil
Sodic or saline soil
Waterlogging
0 10 20 30 40 50 km
Fert. L. Hirscher
Soils KSS

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

The majority of the district lies to the west of the Yatta plateau, and the Tana river forms the boundary in the northeast. Relief differences are great in some parts, but generally lessen towards the southeast. Apart from the Chyulu Hills and an area near Tala, the underlying geology is Basement System rocks. These rocks are mainly gneisses which outcrop in a number of hills such as the Mua Hills, Machakos Hills etc.

The soils of the mountains (unit 12 M) have a variable fertility. The soils of the hills (27 H, also 26 H) have a variable fertility, too.

On the associated footslopes soils are found with an increase in clay with depth and they have a moderately low fertility (99 F). These soils are also found together with those of the uniform profile development and with a humic topsoil (129 U). On the piedmont plains East of the Chyulu Hills soils of unit 109 Y occur.

In the northwestern part of the district, a number of plateaus on top of basalts carry soils of unit 54 L with a moderate to high fertility, also soils with a humic topsoil (51 L) with a high fertility. Soils with a marked textural change below the topsoil (65 L) or a combination of soil units 65 L and 51 L occupy this area, too.

On the ondulating topography of the uplands, the dominant soils have a low natural fertility (164 U). In the North they are associated with soils of units 154 U with a low to very low fertility and 214 U having a moderate to high natural fertility. In the southeastern part of the district an association occurs of unit 185 U with low to moderately fertile soils. In the northeastern part around Kangondi, soils with a low fertility occur on the uplands (164 U).

Plains are found in a long zone around the Athi river West of the Yatta plateau (255 Pd) and in the area around Makindu and East of Mtito Andei (228 Pn). Soils of unit 255 Pd on the dissected erosional plains are low to moderately fertile, while soils of unit 228 Pn occur on the non-dissected erosional plains and have a low fertility.

Only one area of volcanic footslope ridges occurs near Tala (78 R). It has a moderate to high fertility.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on undifferentiated Basement System rocks predominantly gneisses

12 M x, m[1]	= somewhat excessively drained, shallow to moderately deep, reddish brown, friable, rocky and stony, sandy clay loam (eutric CAMBISOLS with LITHOSOLS, eutric REGOSOLS and Rock Outcrops)

SOILS ON HILLS AND MINOR SCARPS

Soils developed on ashes and other pyroclastic rocks of recent volcanoes

15 H x, m	= well drained, moderately deep to deep, black, very friable and smeary, very gravelly loam, with humic topsoil (mollic ANDOSOLS)

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

26 H x, m	= somewhat excessively drained, shallow, reddish brown, friable, rocky or stony, sandy clay loam (eutric REGOSOLS; with Rock Outcrops and calcic CAMBISOLS)
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)
29 H x, m – h	= somewhat excessively drained, predominantly moderately deep, red, very friable, sandy clay loam to sandy clay; in places rocky (ferralic CAMBISOLS; with rhodic or orthic FERRALSOLS and Rock Outcrops)

SOILS ON PLATEAUS AND HIGH-LEVEL STRUCTURAL PLAINS

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

48 L m – h	= imperfectly drained, deep, dark greyish brown, firm clay (hardpan), abruptly underlying a topsoil of sandy clay loam (eutric PLANOSOLS)
49 L x, h	= well drained, shallow to very deep, dark red, friable clay; in many places rocky and bouldery (nito-rhodic FERRALSOLS and nito-chromic CAMBISOLS, lithic and/or bouldery phase)
50 L h	= complex of: – moderately well drained, shallow, yellowish red to dark yellowish brown, friable, gravelly clay over petro plinthite or rock (30–70 %), (murram cuirass soils, with some LITHOSOLS) – poorly drained, deep to very deep, dark brown to very dark greyish brown, mottled, firm to very firm, cracking clay; in places moderately deep to deep over petroplinthite (VERTISOLS, undifferentiated and vertic GLEYSOLS)
51 L h	= moderately well drained, very deep, dark greyish brown, firm clay (verto-luvic PHAEOZEMS; with eutric PLANOSOLS)
52 L h	= well drained, very deep, dark red, very friable clay (nito-rhodic FERRALSOLS)
53 L h	= imperfectly drained to poorly drained, deep to very deep, dark grey to black, very firm, calcareous, saline and sodic, cracking clay (pellic VERTISOLS, saline-sodic phase)
54 L x, h	= imperfectly drained, very deep, dark grey to black, firm to very firm, bouldery and stony, cracking clay in places with calcareous, slightly saline deeper subsoil (pellic VERTISOLS, stony phase and partly saline phase)

55 L = imperfectly drained, moderately deep to deep, very dark grey to black, firm to very firm, slightly calcareous, cracking clay;
h, x in many places with gravelly calcareous deeper subsoil (pellic VERTISOLS and orthic RENDZINAS)

Soils developed on quartz-feldspar gneisses

65 L = association of: – imperfectly drained, moderately deep, dark greyish brown to black, very firm, gravelly cracking clay; in
x, h, m places saline (pellic VERTISOLS, partly saline phase)
– imperfectly drained, moderately deep, dark greyish brown to black, very firm, gravelly clay, abruptly underlying 10–30 cm of gravelly sandy clay loam (eutric PLANOSOLS)

SOILS ON VOLCANIC FOOTRIDGES

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

78 R = well drained, extremely deep, dusky red to dark reddish brown, friable clay; with inclusions of well drained, moderately
h deep, dark red to dark reddish brown, friable clay over rock, pisoferric or petroferric material (eutric NITOSOLS; with nito-chromic CAMBISOLS and chromic ACRISOLS, partly pisoferric or petroferric phase)

SOILS ON FOOTSLOPES

Soils developed on colluvium from undifferentiated Basement System rocks

96 F = well drained, very deep, yellowish red to dark reddish brown, friable, coarse loamy sand to sandy clay loam (chromic LU-
l – m VISOLS; with rhodic FERRALSOLS and luvic/ferralic ARENOSOLS)

97 F = well drained, very deep, dark red, friable, coarse loamy sand to sandy clay loam (rhodic FERRALSOLS; with ferralic ARENO-
l, m SOLS and ferralo-chromic LUVISOLS)

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

99 F = complex of somewhat excessively drained to well drained, deep to very deep, dark red to brown, sandy loam to clay (ACRI-
m – h SOLS, undifferentiated; with ARENOSOLS)

Soils developed on colluvium from various rocks

100 F = well drained, moderately deep to very deep, dark red to reddish brown, friable to firm, sandy clay to clay (chromic LUVI-
h SOLS; with rhodic FERRALSOLS)

SOILS ON PIEDMONT PLAINS

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

109 Y = well drained, shallow to deep, greyish brown to black, very friable and smeary, rocky or bouldery, gravelly sandy clay loam
x, m – h to clay (mollic ANDOSOLS, rocky phase and haplic CHERNOZEMS, stony and partly lithic phase)

SOILS ON HIGH-LEVEL UPLANDS

Soils developed on undifferentiated Basement System rocks

120 U = complex of: – well drained, shallow, black to very dark brown, acid humic, very friable loam; in places rocky (RANKERS)
x, m – well drained, moderately deep, dark brown, friable clay loam, with a very thick acid humic topsoil (humic CAMBISOLS)

Soils developed on undifferentiated Basement System rocks

129 U = well drained, moderately deep to very deep, dark red to reddish yellow, friable to firm, rocky sandy clay loam to clay
x, m – h (chromic ACRISOLS, rocky phase; with CAMBISOLS and FERRALSOLS)

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

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

143 U = well drained, extremely deep, dark reddish brown, friable clay (dystric NITOSOLS)
x, m – h,
m

Soils developed on quartzites

154 U = complex of somewhat excessively drained to well drained, shallow to very deep, dark reddish brown to yellowish brown,
x, l – m loose to friable, loamy sand to sandy clay loam; in places rocky and stony (ferralic ARENOSOLS; with orthic FERRALSOLS, ACRISOLS a.o.; partly lithic and stony phase)

Soils developed on biotite gneisses

155 U = well drained, moderately deep to deep, dark reddish brown to brown, friable to firm, sandy clay loam to clay, partly with
m – h acid humic topsoil (ferralo-orthic ACRISOLS; with dystric and humic CAMBISOLS and humic ACRISOLS)

Soils developed on Basement System rocks rich in ferromagnesian minerals

158 U = well drained, very deep, dark red, friable to firm; clay (nito-rhodic FERRALSOLS)
h

Soils developed on undifferentiated Basement System rocks

164 U = well drained, moderately deep to very deep, dark reddish brown to dark yellowish brown, friable to firm, sandy clay to
l – m, clay; in many places with topsoil of loamy sand to sandy loam (ferralo-chromic/orthic/ferric ACRISOLS; with LUVISOLS
m – h and FERRALSOLS)

165 U = well drained, moderately deep to deep, dark red to yellowish red, friable, sandy clay loam to clay (rhodic and orthic FERRAL-
m – h SOLS; with ferralo-chromic/orthic/ferric ACRISOLS)

Soils developed on undifferentiated Basement System rocks and on volcanic ash admixture

166 U = well drained, moderately deep to deep, reddish brown to red, firm, stony sandy clay to clay loam, with humic topsoil (chromic-
m – h luvic PHAEOZEMS)

SOILS ON LOWER-LEVEL UPLANDS

Soils developed on undifferentiated Basement System rocks

185 U = association of: – well drained, moderately deep to deep, dark red to dark reddish brown, friable to firm, sandy clay to clay;
h on slopes (chromic LUVISOLS)
– well drained, very deep, light brown to strong brown, very friable clay; on flat interfluves (orthic and xanthic FERRALSOLS)

SOILS ON UPLANDS, UNDIFFERENTIATED LEVELS

Soils developed on undifferentiated volcanic rocks (mainly basalts)

193 U = complex of: – well drained to imperfectly drained, moderately deep to very deep, dusky red to very dark greyish brown,
x, m – h, friable to firm, clay loam to clay; in many places stony and bouldery and/or cracking; with severe gully erosion and many
m rock outcrops (eutric NITOSOLS; with chromic CAMBISOLS, bouldery phase, VERTISOLS and Rock Outcrops)
– somewhat excessively drained, shallow, dark reddish brown, gravelly and bouldery, clay loam (on volcanic cones) (chromic CAMBISOLS, lithic and bouldery phase)

SOILS ON UPLAND-PLAIN TRANSITIONAL LANDS

Soils developed on gneisses rich in ferromagnesian minerals

214 U = complex of well drained to imperfectly drained, shallow to very deep, dark red to black, friable to firm, cracking clay; in
h places sodic (pellic VERTISOLS, with verto-eutric NITOSOLS, verto-eutric PLANOSOLS and orthic SOLONETZ, partly lithic phase)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

Soils developed on Basement System rocks rich in ferromagnesian minerals

228 Pn = well drained, deep to very deep, dusky red to dark red, friable sandy clay (rhodic FERRALSOLS)
h

Soils developed on undifferentiated Basement System rocks

234 Pn = well drained, deep to very deep, dark red to strong brown, friable, sandy clay to clay (rhodic and orthic FERRALSOLS)
h

Soils developed on undifferentiated Basement System rocks, with volcanic ash admixture

237 Pn = imperfectly drained, moderately deep, dark brown, extremely firm, moderately calcareous, moderately sodic and slightly
m, m – h saline, clay loam to sandy clay (hardpan), with topsoil of strongly sealing sandy loam (luvo-orthic SOLONETZ)

240 Pn = well drained, moderately deep to very deep, dusky red to dark browen, friable to firm, sandy clay loam to clay (ferric LUVI-
m – h SOLS)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated Basement System rocks

254 Pd = complex of well drained, shallow to moderately deep, dark red to yellowish brown, not to moderately calcareous, stony
x, m sandy clay loam, over petrocalcic material or quartz gravel (calcic CAMBISOLS, lithic or petrocalcic phase; with chromic LUVISOLS, petric phase)

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

SOILS ON VOLCANIC PLAINS

Soils developed on alluvium from early Pleistocene olivine basalts (and pyroclastic rocks)

295 Pv = well drained, extremely deep, dusky red to dark reddish brown, friable clay (eutric NITOSOLS)
h

Soils developed on ashes and pumice from recent volcanoes

300 Pv = somewhat excessively drained, very deep, strong brown to dark yellowish brown, very friable and smeary, slightly sodic,
x, m gravelly sandy clay loam (mollic ANDOSOLS, sodic phase)

SOILS ON FLOODPLAINS

Soils developed on sediments mainly from crystalline Basement System rocks

356 A = well drained to imperfectly drained, very deep, brown to dark brown, friable, slightly calcareous, micaceous, sandy loam to
m clay loam; in places with a saline-sodic deeper subsoil (eutric FLUVISOLS)

Soils developed on sediments from various sources (recent floodplains)

359 A = imperfectly drained to poorly drained, very deep, dark reddish brown to dark greyish brown, firm to very firm, cracking
h clay; in many places mottled and with a calcareous, saline and sodic deeper subsoil (chromic VERTISOLS, saline-sodic phase)

363 A h – m	=	moderately well drained, shallow to moderately deep, strongly calcareous, sandy clay to clay loam, over petrocalcic material (calcic CAMBISOLS, petrocalcic phase)
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 LAVA FLOWS

376 La	=	exessively drained, exceedingly bouldery to stony, extremely rocky land (Bouldery and Rock Outcrops)

SOILS IN MINOR VALLEYS

384 V x, h	=	complex of well drained to imperfectly drained, shallow to moderately deep, dark reddish brown to very dark greyish brown, firm, slightly to moderately calcareous, rocky, stony, or gravelly clay.

1) Soil texture-classes

- h = heavy
- l = light
- m = medium
- m – h = medium to heavy
- m, h = medium and heavy (e.g. abruptly underlaying a topsoil of different texture)
- x = stony or bouldery
- v = varying 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 Machakos District is comparatively large and densely populated. According to the population Census of September 1979, 1,022,522 people lived on a total rural area of 1,311,500 ha. Of this land 1,127,300 ha could be called agricultural land (including ranching) on which more than 90 % of the total population exist; about 9 % of the people registered in this administrative area lived in Machakos (= Masaku) Township (84,320 people), Athi River Township, and in the 5 trading centres of the district (Table 4).

A wide range of Agro-Ecological Zones is found (Table 6) in Machakos District; the largest part, with more than 76 % of the total rural area, is assigned to LM 5 (572,300 ha), LM 4 (147,800 ha) and UM 4 (144,700 ha). An average of 6.79 ha per household (5.48 people) and 1.23 ha per person was available in 1979. The usual pattern of agriculture in East Africa, the small farm, is typical for this district. In this context, it must be remembered that land-use potentials vary considerably. For instance, 1 ha agricultural land in UM 3, in the Marginal Coffee Zone, is equal to about 10 to 15 ha in LM 5, the Lower Midland Livestock-Millet Zone. Taking these variations into account, it becomes clear that big differences can occur from location to location, depending on the Agro-Ecological Zones. For example, in the Settlement Area, where UM 5 and 6 are predominant, 56.25 ha are necessary for one household to make a reasonable living. In contrast, in Kangundo location where UM 2 and 3 (Main and Marginal Coffee Zone) and some UM 4 (Sunflower-Maize Zone) are found, even 1.13 ha (Table 6) are enough for an average household to live on. This example of two extremes make clear how difficult it is in such a large district to give general advice.

MACHAKOS DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Masii	10 096	10 931	21 027	2 738	152	137
Settled Area	4 887	3 317	8 204	2 057	1 295	6
Iveti	9 695	10 810	20 505	2 959	52	391
Mitaboni	14 685	16 559	31 244	4 878	99	314
Wamunyu	6 964	7 613	14 577	2 487	188	77
Masaku Township	41 153	43 167	84 320	14 350	323	260
Okia	9 748	11 059	20 807	4 048	139	149
Kalama	12 507	14 668	27 175	4 871	171	158
Kilungu	24 443	29 163	53 606	9 515	223	239
Muputi	1 290	1 364	2 654	540	19	137
Mukaa	24 323	26 517	50 840	9 663	790	64
Western Division	72 311	82 771	155 082	28 637	1 344	115
Mbooni	27 183	30 878	58 061	10 927	243	238
Kibauni	10 113	11 391	21 504	4 030	368	58
Muthetheni	9 322	11 045	20 367	3 788	153	132
Kiteta	6 571	7 336	13 907	2 361	79	174
Kisau	9 459	11 239	20 698	3 939	213	96
Eastern Division	62 648	71 889	134 537	25 045	1 058	127
Makueni	33 195	36 532	69 727	9 833	1 320	52
Nzavi	16 774	19 073	35 847	5 966	608	58
Mbitini	13 122	14 743	27 865	5 028	231	120
Southern Division	63 091	70 348	133 439	20 827	2 160	61
Ngwata	30 618	29 750	60 368	13 839	1 718	35
Kikumbulyu	19 136	19 476	38 612	7 713	1 682	22
Makindu Division	49 754	49 226	98 980	21 552	3 400	29
Masinga	32 523	33 785	66 308	12 490	1 313	50
Kinyatta	14 084	15 755	29 839	5 316	563	52
Ndalani	20 666	20 445	41 111	8 738	583	70
Yatta Division	67 273	69 985	137 258	26 544	2 460	55
Kangundo	27 774	29 028	56 772	10 163	139	406
Matungulu	37 809	38 431	76 240	13 708	459	165
Mwala	9 841	1o 789	20 630	3 546	173	118
Mbiuni	9 577	10 370	19 947	3 873	148	134
Northern Division	84 971	88 618	173 589	31 290	921	188
Machakos District	492 937	529 585	1 022 522	185 934	14 178	72

MACHAKOS 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:						
Masii	2716	3.23	1.71	2.40	0.37	7.71
Settled Area	2048	2.15	0.53	0.49	0.73	3.90
Wamunyu	2476	2.80	1.37	1.30	0.40	5.88
Masaku Township	14299	2.88	1.32	1.30	0.34	5.83
Iveti	2948	3.30	1.78	1.71	0.17	6.95
Mitaboni	4904	3.02	1.60	1.54	0.20	6.35
Athi River Township	2566	2.26	0.65	0.38	0.49	3.78
Division: Central	31957	2.88	1.32	1.34	0.35	5.89
Location:						
Okia	4063	2.78	1.34	0.71	0.27	5.11
Kalama	4868	2.95	0.97	0.80	0.26	5.58
Kilungu	9495	2.97	1.63	0.90	0.13	5.64
Muputi	537	2.56	1.34	0.50	0.36	4.94
Mukaa	9630	2.88	1.50	0.58	0.28	5.25
Division: Western	28593	2.91	1.52	0.74	0.23	5.41
Location:						
Mbooni	10915	2.94	1.45	0.77	0.14	5.31
Kibauni	4033	2.94	1.54	0.59	0.25	5.33
Muthetheni	3775	2.87	1.50	0.78	0.23	5.39
Kiteta	2358	2.93	1.62	1.14	0.20	5.89
Kisau	3958	2.82	1.46	0.74	0.20	5.21
Division: Eastern	25039	4.25	0.15	0.77	0.19	5.36
Location:						
Makueni	9804	4.34	1.85	1.38	0.54	7.10
Nzavi	5947	3.11	1.65	0.91	0.33	5.99
Mbitini	5010	3.03	1.62	0.56	0.32	5.53
Division: Southern	20761	3.19	1.74	1.05	0.43	6.40
Location:						
Ngwata	13799	2.50	0.98	0.45	0.45	4.34
Kikumbulyo	7689	2.77	1.25	0.67	0.30	4.99
Division: Makindu	21488	2.59	1.08	0.53	0.37	4.57
Location:						
Masinga	12506	2.95	1.31	0.61	0.46	5.26
Kinyatta	5304	2.96	1.61	0.69	0.34	5.60
Ndalani	8696	2.63	1.13	0.47	0.35	4.63
Division: Yatta	26506	2.81	1.31	0.60	0.40	5.12
Location:						
Kangundo	10120	3.17	1.54	0.68	0.18	5.57
Matungulu	13683	3.10	1.49	0.71	0.26	5.56
Mwala	3533	3.07	1.55	0.76	0.31	5.69
Mbiuni	3860	2.93	1.49	0.52	0.21	5.15
Division: Northern	31196	3.10	1.50	0.68	0.24	5.53
DISTRICT: MACHAKOS	185540	2.91	1.44	0.83	0.31	5.48

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, include one and two persons per household as well.

MACHAKOS DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON[1)]

Location/Division without townships	Area total Census 79 (in '00 ha = sqkm)	Non-agricultural land: Unsuit. steep slopes	Non-agricultural land: Forest Res., lakes, swamps	Non-agricultural land: Others (roads, home-steads, rivers...)	Agri-cultural land	LH 2	LH 3	LH 3–4	LH 4	UM 2	UM 3	UM 3–4	UM 4	UM 5	UM 5–6	UM 6	LM 3	LM 4	LM 5	LM 6	L 5	L 6	Agric. land per house-hold (in ha)	Agric. land per person (in ha)
						Area in agro-ecological zones, AEZ (in '00 ha = sqkm)																		
Masii	152	1		15	136						8		50				19	59					4.93	0.64
Settled Area	1 295	8		130	1 157	2	19				3		56	111	420	527		19					56.25	14.10
Wamunyu	188			19	169													37	132				6.79	1.16
Iveti	100 (52)	2		15	83	16				9	16		40	2									2.97	0.43
Mitaboni	99	1		16	82	19	1			3	12		37	10									1.80	0.28
Central Division	1 834 (1 789)	12		195	1 627	37	20			12	39		183	123	420	527	19	115	132				10.76	1.70
Okia	139	4	F. 18	21	96						16		41				15	24					2.54	0.49
Kalama	171	9	F. 1	26	135								135										2.36	0.53
Kilungu	233		F. 2	38	183	15				4	41		123										2.09	0.37
Muputi	94 (19)		F. 4	10	80						12		67				1						14.81	3.01
Mukaa	790	8		79	703	3				2	21		354	129	70	28		5	91				7.36	1.39
Western Division	1 417 (1 341)	21	25	174	1 197	18				6	90		720	129	70	28	15	29	91				4.24	0.78
Mbooni	243	17	F. 5	51	170	22				3	28		96				18	3					1.87	0.35
Kibauni	368	15	F. 20	37	296													32	264				7.49	1.40
Muthetheni	153			23	130													121	9				3.64	0.67
Kiteta	79	2		12	65						5		17				16	27					2.92	0.50
Kisau	213	7	F. 17	25	164						35		53					67	9				4.27	0.81
Eastern Division	1 056	41	42	148	825	22				3	68		166				34	250	282				4.04	0.75

TABLE 6 CONTINUATION

Location/Division without townships	Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Non-agricultural land: Forest Res., lakes, swamps	Non-agricultural land: Others (roads, home-steads, rivers...)	Agri-cultural land	LH 2	LH 3	LH 3–4	LH 4	UM 2	UM 3	UM 3–4	UM 4	UM 5	UM 5–6	UM 6	LM 3	LM 4	LM 5	LM 6	L 5	L 6	Agric. land per house-hold	Agric. land per person
	in '00 ha = sqkm					in '00 ha = sqkm Area in agro-ecological zones AEZ																	in ha	
Makueni	1 320			132	1 188												6	138	1 044				12.08	1.70
Nzavi	567 (608)	7	F. 1	57	502						5		59					143	277	18			9.31	1.40
Mbitini	231			28	203						29		34				79	48	13				4.14	0.75
Southern Division	2 118 (2 159)	7	1	217	1 893						34		93				85	329	1 334	18			8.71	1.28
Ngwata	1 718	36		172	1 510	5		5	4			11	38					339	706			402	11.04	2.53
Kikumbulyo	1 682	120		168	1 394								13					14	1 251	106		10	19.56	3.91
Makindu Division	3 400	156		340	2 904	5		5	4			11	51					353	1 957	106		412	15.30	3.22
Masinga	1 313	4		131	1 178													58	1 120				9.43	1.78
Kinyatta	563	15		56	492													156	336				9.26	1.65
Ndalani	583	15		58	510							22	8					100	380				5.84	1.24
Yatta Division	2 459	34		245	2 180							22	8					314	1 836				8.18	1.56
Kangundo	139	7	F. 8	28	96					19	65		12										1.13	0.20
Matungulu	371 (459)	11		63	297	2				4	21		192	60				13	5				2.41	0.43
Mwala	173	3	F. 10	21	139						5		9				27	60	38				4.03	0.70
Mbiuni	148	7	F. 4	22	115					3	2		13				15	34	48				3.18	0.62
Northern Division	831 (919)	28	22	134	647	2				26	93		226	60			42	107	91				2.69	0.49
Total rural area	13 115	299	90	1 453	11 273	84	20	5	4	47	324	33	1 447	312	490	555	196	1 497	5 723	124		412	6.79	1.23

1) For official land statistics see supplementary publication to FMHB, Vol. III A: Agriculture Land Statistics

( ) = Census areas differing from measured areas in older maps

AGRICULTURAL STATISTICS[1)]

The district is one of the largest in terms of land area and one of the poorest in terms of agricultural potential. In the small parts suitable for cultivation about 5,500 ha of coffee arabica is grown by smallholders under rainfed conditions and by cooperatively owned plantations with the help of supplementary irrigation. The average small farmer owns as little as 0.15 ha of coffee but produces about 800 kg of clean coffee per ha. There is about 1,700 ha of estate coffee in the district, yielding roughly 1,500 kg of clean coffee per ha per year. Despite the fact that the climate is not very suitable for cotton it is estimated that farmers plant about 3,000 ha of this crop p.a. and harvest roughly 300 kg/ha.

1) For more detailed and up to date information, see FMHB Vol. III/A

MACHAKOS DISTRICT

TABLE 7a: COFFEE
AREA – PRODUCTION – YIELDS[a)]

Co-operatives

Item	Unit	Year					
		74/75	75/76	76/77	77/78	78/79	79/80
Area	ha	2432	2432	2432	2432	3700	5269
Production	t	2277	2295	2993	3675	3560	4339
Yield	kg/ha	936	944	1230	1511	962	824

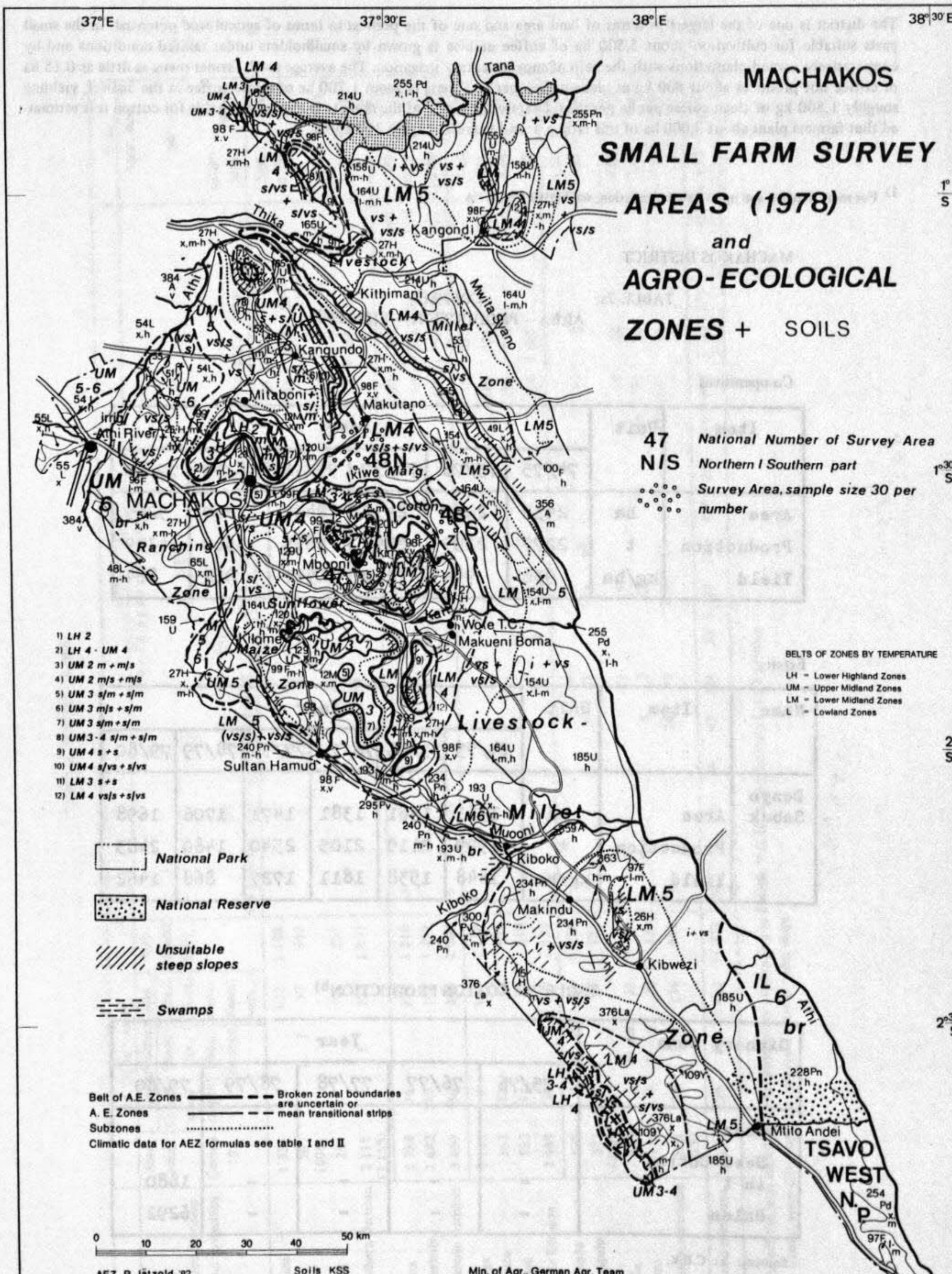
Estates

Name	Item	Unit	Year					
			74/75	75/76	76/77	77/78	78/79	79/80
Donyo Sabuk	Area	ha	1381	1381	1381	1471	1706	1698
	Production	t	1999	2119	2105	2540	1480	2483
	Yield	kg/ha	1448	1538	1811	1727	868	1462

TABLE 7b: COTTON PRODUCTION[b)]

Ginnery Zone	Year				
	75/76	76/77	77/78	78/79	79/80
Makueni					
Seed Cotton in t	-	-	-	-	1880
Bales	-	-	-	-	6292

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



MACHAKOS
SMALL FARM SURVEY
AREAS (1978)
and
AGRO-ECOLOGICAL
ZONES + SOILS
37° E
37°30'E
38° E
38°30' E
47 National Number of Survey Area
N/S Northern / Southern part
Survey Area, sample size 30 per number
BELTS OF ZONES BY TEMPERATURE
LH - Lower Highland Zones
UM - Upper Midland Zones
LM - Lower Midland Zones
L - Lowland Zones
1) LH 2
2) LH 4 - UM 4
3) UM 2 m + m/s
4) UM 2 m/s + m/s
5) UM 3 s/m + s/m
6) UM 3 m/s + s/m
7) UM 3 s/m + s/m
8) UM 3-4 s/m + s/m
9) UM 4 s + s
10) UM 4 s/vs + s/vs
11) LM 3 s + s
12) LM 4 vs/s + s/vs
National Park
National Reserve
Unsuitable steep slopes
Swamps
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 10 20 30 40 50 km
AEZ R. Jätzold '82
Soils KSS
Min. of Agr., German Agr. Team
MACHAKOS
Tana
Thika
Athi
Kangondi
Kithimani
Kangundo
Mitaboni
Makutano
Athi River
Ikiwe
Mbooni
Wote T.C.
Makueni Boma
Sultan Hamud
Muooni
Kiboko
Makindu
Kibwezi
Mtito Andei
TSAVO WEST N.P.
Tsavo
Livestock - Millet Zone
Ranching Zone
Sunflower Maize Zone
Cotton Zone
48N
48S

SMALL FARM SURVEY (SFS)[1)]

Poor soils and an unsuitable climate make successful smallholder rainfed agriculture difficult in more than 80 % of the district area. Altough the very small fertile areas near Machakos and Kangundo have some of the most productive small-scale farms in Kenya and the terracing of the whole area (suitable for agriculture) shows the industriousness of the people, harvests in the larger part of the district are barely sufficient to replace the calories used to produce the crop.

The SFS was carried out in two places: in the Mbooni Hills (AEZ (LH 2+) UM 2–3 (+ UM 4)) and near Mbumbuni and Masi (AEZ UM 4 + LM 3–4). The farms were 4.5 ha (UM 2–3) and 5.6 ha (LM 3–4) in size.[2)] The UM 2–3 farms planted annual crops on 30 % of the farm, perennial crops on 10 % and used the rest for grazing and forage production; the LM 3–4 farmers used 40 % for annual crops, 50 % for grazing, while the rest was fallow. Both farmers planted 1.7 crops p.a. and kept between 1 and 2 LU per ha. Roughly 20 % of the cattle kept in the UM 2–3 region were of improved stock, while in the LM 3–4 region 7 % of the cattle belonged to the improved category. The UM 2–3 sample farmers used fertilizer and applied plant protection mainly to their perennial crops. LM 3–4 farmers applied some to the annual crops (table 8 & 9). A large range of crops is found on both farms with maize and beans the most prominent. This reflects the farmers' desire to spread the growing risk as well as the need for some cash income (table 10). Sheep and goats accounted for 18 % (UM 2–3) and 23 % (LM 3–4) of the total grazing LU; 22 % of the cattle kept by the UM 2–3 farmers were male, while LM 3–4 farmers had as much as 60 % male cattle among their stock (table 11). The yields recorded and the inputs used were understandably low (table 12). Table 13 indicates that the district depends on imports of staple food from other regions, a situation which will probably involve famine relief in future as the income from livestock sales shrinks and less cash for staple food purchases is available. The farmers plant roughly one annual crop for the first rains and one for the second, which however does not indicate that they harvest two crops p.a., because crop failures in LM 4–5 are very common (graphs in table 14). The output and nutrient input table (table 15) reflects the severe natural limitations to which more than 80 % of the district is subjected. The table does not take into account crop failures due to reduced and/or variable rainfall patterns.

Increased biomass production with the help of heavy dosages of nitrogen fertilizer combined with a proper zero grazing system and milk production is most important for the stabilization of the soil fertility in the small pockets of high potential areas and stands a good chance of being implemented if the economic conditions are favourable. Specialist extension advice on growing horticultural crops should help to increase the returns per crop unit.

The farmers in the Lower Midlands must work roughly three times as much as their counterparts in the Lower Highlands and Upper Midlands (LH 1–2, UM 1–2) in order to achieve a similar income. In addition, the time available for field work is limited to a very short period by the extremely short vegetation periods. Erratic rainfall results in crop failures and/or re-planting. The number of stock a farmer is able to keep to make up for the low returns from his crop shrinks with the increase in population density.

The mechanisation of field work using cows as a source of draught power is one way of increasing yields and returns to the farmer. The production of proper harnesses and suitable equipment is however a precondition.[3)] Planting of perennial forages should help to increase the output from the livestock. A high yielding perennial cash crop which is drought-resistant could be a basis for a comparatively high standard of living in the Lower Midlands. Farm development, because of the extremely difficult natural conditions, will continue to be limited. Subsidies for suitable on-farm investment to a very high degree is necessary in order to furnish the farmer with the initial means to help himself – or a quick decline in the socio-economic condition requiring increasing amouts of capital for famine relief – are the two realistic alternatives for more than 80 % of the district area.

1) For more detailed and up to date information, see FMHB Vol. III/B

2) For holding sizes, see also table 6

3) Very suitable and highly developed equipment and harnesses are available which should double or treble the work output per draught animal. The use of draught oxen will cease in future because they are too expensive, see FMHB Vol. I

MACHAKOS DISTRICT

AEZ: (LH 2 +) UM 2–3 (+ UM 4)

TABLE 8a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 47

Item	Unit	Farm Size & Land Use, Livestock on Farm, Farm Size Group: small	medium	large
Farm Size Total	ha	1.5	3.7	1o.4
Land Use: Annual Crops[1] First Season				
Maize	ha	o.2	o.1	1.2
Beans	ha	o.1	-	o.2
Maize & Beans	ha	o.3	1.o	o.2
Others	ha	-	o.1	o.3
	ha			
Total	ha	o.6	1.2	1.9
Second Season[1]				
Maize	ha	o.2	-	o.6
Maize & Beans	ha	o.3	1.o	o.2
Beans	ha	o.1	-	o.1
Sunflower	ha	-	o.1	o.1
Total	ha	o.6	1.1	1.o
Permanent Crops[1]				
Sugarcane	ha	-	-	o.2
Coffee	ha	o.3	o.3	o.3
	ha			
	ha			
Portion of total	%	2o %	8 %	5 %
Grazing & Forage	ha	o.4	1.7	6.9
portion of total	%	27 %	46 %	66 %
Other Land Use	ha	o.2	o.5	1.1
Livestock on Farm:				
Cattle: local	LU	2.3	o.6	3.2
improved	LU	o.1	o.7	1.5
Sheep & Goats	LU	o.5	o.4	1.o
Total	LU	2.9	1.7	5.7

Item	Unit	Intensity, Labour/Persons on Farm, Home Consumption, Farm Size Group: small	medium	large
Farming Intensity:				
Cropping Intensity	-	1.o	o.7	o.3
Portion of improved cattle kept	%	4 %	54 %	32 %
Portion of Farmers owning a Plough	%	2o %	1o %	5o %
Labour on Farm:				
Family Adults	persons	2.2	2.8	2.8
Perm. Hired Labour	"	1.1	o.3	1.o
Children > 14 years	"	3.o	2.6	2.4
Persons living on Farm[2] -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.4o	o.42	2.82
Children < 14 years	"	3.12	-	3.12
Subsistence Units	SU	4.27	o.42	4.69
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	975	1886	
Beans	kg	34o	648	
Fingermillet	kg	9	17	
English Potatoes	kg	97	38	
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Cabbage, Fingermillet, English Potatoes, Tomatoes, Sweet Potatoes, Fingermillet & Cowpeas

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

MACHAKOS DISTRICT

AEZ: UM 4 + LM 3–4

TABLE 8b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 48

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group small	medium	large
Farm Size Total	ha	1.3	3.7	1o.5
Land Use: Annual Crops1) First Season				
Maize	ha	o.2	o.5	1.3
Beans	ha	o.1	o.2	o.7
Maize & Beans	ha	o.6	o.4	o.2
Cotton	ha	o.1	o.1	o.6
Others	ha	-	o.6	o.7
Total	ha	1.o	1.8	3.5
Second Season1)				
Maize	ha	o.2	o.3	1.1
Beans		o.2	o.3	o.7
Maize & Beans	ha	o.6	o.5	o.2
Sunflower	ha	-	o.3	o.5
Total	ha	1.o	1.4	2.5
Permanent Crops1)				
Citrus	ha	-	o.1	o.1
Coffee	ha	-	-	o.1
	ha			
	ha			
Portion of total	%		3 %	2 %
Grazing & Forage	ha	o.2	1.3	5.9
portion of total	%	15 %	35 %	56 %
Other Land Use	ha	o.1	o.5	o.8
Livestock on Farm:				
Cattle: local	LU	2.8	6.5	4.9
improved	LU	o.6	-	1.o
Sheep & Goats	LU	o.8	1.7	2.1
Total	LU	4.2	8.2	8.o

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group small	medium	large
Farming Intensity:				
Cropping Intensity	-	1.5	o.9	o.6
Portion of improved cattle kept	%	18 %	-	17 %
Portion of Farmers owning a Plough	%	9o %	1oo %	1oo %
Labour on Farm:				
Family Adults	persons	2.1	2.5	2.5
Perm. Hired Labour	"	o.3	o.2	o.7
Children > 14 years ·	"	1.4	2.4	2.2
Persons living on Farm2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.o9	o.2	2.29
Children < 14 years	"	3.26	-	3.26
Subsistence Units	SU	4.o4	o.2	4.24
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1281	177o	
Beans	kg	376	512	
Sorghum	kg	1o	13	
Millet	kg	21	28	
Cowpeas	kg	78	1o9	
	kg			
	kg			
	kg			

Other Crops cultivated: Maize & Cowpeas, Cowpeas, Sorghum, Bulrush Millet, Pigeon Peas, Cassava

1) Major crops only considered

2) Based on 1979 Census figures

MACHAKOS DISTRICT

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

AEZ: UM 4 + LM 3–4

Survey Area 48

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	4.5	12.1	0.9	2.5	0.8	2.7
Avg. 1	4.5	13.0	1.9	2.5	1.9	3.7
Up. Qu.	6.0	13.0	1.0	3.0	1.0	4.0
Lo. Qu.	1.6	4.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	1.2	28	0.3	8	2.3	55	0.2	4	-	1	0.2	4
Avg. 1	1.2	23	0.4	8	2.7	53	0.4	8	0.2	5	0.2	4
Up. Qu.	1.6	43	0.4	18	2.4	55	0.2	5	-	-	0.2	6
Lo. Qu.	0.6	22	0.2	3	0.4	20	-	-	-	-	0.1	2
Total	34.8		10.3		69.8		4.6		0.9		5.4	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.7	0.7	1.3	19.9
Avg. 1			1.1	59.8
Up. Qu.	2.0	1.1	3.3	19.6
Lo. Qu.	1.5	0.3	0.6	-

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	31.9	1.1	4.5	2.9	-	-	-	0.3	-	0.7	0.3	-	0.7
Avg. 1	57.7	19.9	13.1	23.0	-	-	-	0.6	0.2	1.7	0.7	0.8	1.3
Up. Qu.	-	-	10.7	-	-	-	-	0.1	-	0.7	0.8	-	2.3
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

MACHAKOS DISTRICT

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

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47

Range	Assets: Land ha	Assets: Livestock head	Assets: Equipment pieces	People on Farm: Family Adults	People on Farm: Perm.Hrd. Labourers	People on Farm: Children > 14 No.
Avg. 0	5.6	32.7	1.5	2.4	0.4	2.0
Avg. 1	5.6	32.7	1.8	2.4	1.3	2.3
Up. Qu.	8.0	38.0	2.0	3.0	1.0	3.0
Lo. Qu.	2.0	9.0	1.0	2.0	-	1.0

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	2.2	40	-	1	2.7	49	-	-	0.2	3	0.4	7
Avg. 1	2.2	30	0.3	5	3.3	44	0.3	4	0.9	13	0.4	5
Up. Qu.	2.4	70	-	-	3.9	47	-	-	-	-	0.3	8
Lo. Qu.	1.2	38	-	-	0.2	23	-	-	-	-	0.1	2
Total	66.6		1.4		81.7		0.6		4.7		10.9	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate: Farm Land LU/ha	Stocking Rate: Pasture & Forage LU/ha	Improved Cattle % of total
Avg. 0	1.7	1.3	2.6	7.1
Avg. 1			2.1	69.4
Up. Qu.	2.0	2.3	4.3	-
Lo. Qu.	1.7	0.7	1.0	-

Inputs Applied

Range	Improved Seed Used % of area AC	Fertilizer Applied pure nutrient kg/ha: N AC	N PC	P_2O_5 AC	P_2O_5 PC	K_2O AC	K_2O PC	Manure Applied t/ha AC	Manure PC	Plant Protection: Insecticide kg/ha AC	Insecticide PC	Fungicide kg/ha AC	Fungicide PC
Avg. 0	46.1	0.8	-	5.2	-	-	-	0.2	-	1.2	-	-	-
Avg. 1	54.1	17.8	-	10.7	-	-	-	1.0	-	1.7	-	-	-
Up. Qu.	33.3	-	-	5.0	-	-	-	-	-	2.0	-	-	-
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

MACHAKOS DISTRICT

TABLE 10a: CROPPING PATTERN

AEZ: (LH 2 +) UM 2–3 (+ UM 4)

Survey Area 47

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.4	0.9	0.80	0.00	12.8	34.3
Maize IPC	0.0	0.4	0.00	0.00	0.4	1.1
Fingermillet	0.0	0.2	0.00	0.00	0.4	1.1
Beans	0.1	0.3	0.20	0.00	3.0	7.9
Pigeonpeas	0.0	0.4	0.00	0.00	0.8	2.1
Sunflower	0.0	0.8	0.00	0.00	0.8	2.1
Engl. Potatoes	0.0	0.1	0.00	0.00	0.6	1.7
Cabbage	0.0	0.1	0.00	0.00	0.1	0.3
Tomatoes	0.0	0.1	0.00	0.00	0.2	0.6
Cotton	0.0	0.8	0.00	0.00	0.8	2.1
Sweet Potatoes	0.0	0.4	0.00	0.00	0.4	1.1
Sugarcane	0.1	0.4	0.00	0.00	2.1	5.7
Maize & Beans	0.5	0.8	0.80	0.00	14.6	39.2
FMlt & Cowpeas	0.0	0.2	0.00	0.00	0.2	0.5
Total					37.3	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.3	0.7	0.40	0.00	7.6	27.6
Beans	0.1	0.2	0.12	0.00	2.0	7.1
Sunflower	0.0	0.8	0.00	0.00	0.8	2.9
Engl. Potatoes	0.0	0.1	0.00	0.00	0.6	2.3
Cabbage	0.0	0.1	0.00	0.00	0.1	0.4
Tomatoes	0.0	0.1	0.00	0.00	0.2	0.9
Sugarcane	0.1	0.4	0.00	0.00	2.1	7.7
Maize & Beans	0.4	0.7	0.80	0.00	13.5	48.9
Maize Int.Oth.	0.0	0.6	0.00	0.00	0.6	2.2
Total					27.6	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Coffee	0.2	0.3	0.36	0.00	7.4	100.0
Total					7.4	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

MACHAKOS DISTRICT

AEZ: UM 4 + LM 3–4

TABLE 10b: CROPPING PATTERN

Survey Area 48

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.7	1.2	1.20	0.00	21.2	31.3
Sorghum	0.0	0.2	0.00	0.00	0.2	0.3
Bulrushmillet	0.0	0.8	0.00	0.00	0.8	1.2
Beans	0.4	0.6	0.80	0.00	11.1	16.4
Cowpeas	0.1	0.5	0.00	0.00	2.3	3.4
Cowpeas IPC	0.0	0.1	0.00	0.00	0.1	0.2
Pigeonpeas	0.0	0.4	0.00	0.00	0.7	1.1
Sunflower	0.1	0.5	0.20	0.00	3.9	5.8
Cotton	0.3	0.6	0.60	0.00	8.4	12.4
Cassava	0.0	0.2	0.00	0.00	0.2	0.4
Maize & BulMlt	0.0	0.8	0.00	0.00	0.8	1.2
Maize & Beans	0.4	1.2	0.80	0.00	11.5	17.0
Maize & Cowps	0.1	1.1	0.00	0.00	3.2	4.7
Maize & Others	0.1	1.6	0.00	0.00	3.2	4.7
Total					67.8	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.6	1.1	1.00	0.00	16.8	32.2
Sorghum	0.0	0.3	0.00	0.00	0.6	1.1
Bulrushmillet	0.0	0.2	0.00	0.00	0.2	0.4
Beans	0.4	0.6	0.80	0.00	12.2	23.4
Cowpeas	0.1	0.6	0.00	0.00	1.8	3.4
Cowpeas IPC	0.0	0.1	0.00	0.00	0.1	0.2
Sunflower	0.1	0.4	0.12	0.00	3.4	6.6
Cassava	0.0	0.2	0.00	0.00	0.2	0.5
Others	0.0	0.4	0.00	0.00	0.4	0.8
Maize & Beans	0.4	1.2	1.20	0.00	12.9	24.7
Maize & Cowps	0.1	1.2	0.00	0.00	2.3	4.4
Maize & Others	0.0	1.2	0.00	0.00	1.2	2.3
Total					52.2	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Citrus	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

TABLE 11a: HERD COMPOSITION (GRAZING LIVESTOCK)

– in Head & Livestock Units –

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Jan. '78, Survey Area 47

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	-	-	0.10				0.04			0.04
Upper Qu.	-	-	-	-				-			-
1 - 2 years, Average	-	-	-	0.23				0.12			0.12
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	-	-	-		0.50			0.50			0.50
Upper Qu.	-	-	-		-			-			-
Subtotal(improved) Total	2	-	-	10	15			19.8			19.8
Average	0.07	-	-	0.33	0.50			0.66			0.66
Upper Qu.	-	-	-	-	-			0.5			-
Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =	2.5 % of total cattle,				Calves + Heifers =			66.7 % of dairy cows			
Unimproved Livestock: Under 1 year, Average	1.13	-	-	0.73		0.80	1.33	0.59	0.33		0.64
Upper Qu.	-	-	-	1		1	2	0.5	-		0.5
1 - 2 years, Average	-	-	0.07	0.77				0.37			0.37
Upper Qu.	-	-	-	1				0.5			0.5
Over 2 years, Average	0.10	0.07	0.33		1.47	1.57	2.50	1.68	-	11.60	1.68
Upper Qu.	-	-	-		2	2	3	-	-	4	-
Subtotal (unimp.) Total	37	2	12	45	44	71	115	79.4	10	343	80.9
Average	1.23	0.07	0.40	1.50	1.47	2.37	3.83	2.65	0.33	11.60	2.70
Upper Qu.	-	-	-	2	2	4	5	3.9	-	17	3.9
Lower Qu.	-	-	-	-	-	-	-	0.7	-	4	0.7
LU Male Cattle =	28.7 % of total cattle,				Calves + Heifers =			102.3 % of dairy cows			
LU Goats + Sheep =	23.4 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	39	2	12	55	59	71	115	99.2	10	343	100.7
Average	1.30	0.07	0.40	1.83	1.97	2.37	3.83	3.30	0.33	11.60	3.35
Upper Qu.	-	-	-	2	3	4	5	4.2	-	17	3.9
Lower Qu.	-	-	-	-	-	-	-	1.1	-	4	0.7
LU Male Cattle =	22.3 % of total cattle,				Calves + Heifers =			93.2 % of dairy cows			
LU Goats + Sheep =	18.8 % 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

TABLE 11b: HERD COMPOSITION (GRAZING LIVESTOCK)
– in Head & Livestock Units –

AEZ: UM 4 + LM 3–4 Jan. '78, Survey Area 48

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	-	-	-	0.17				0.08			0.08
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	-	-	-		0.40			0.40			0.40
	Upper Qu.	-	-	-		-			-			-
Subtotal(improved)	Total	-	-	-	7	12			15.0			15.0
	Average	-	-	-	0.23	0.40			0.50			0.50
	Upper Qu.	-	-	-	-	-			-			-
	Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =		0.0 % of total cattle,				Calves + Heifers =			58.3 % of dairy cows			
Unimproved Livestock:												
Under 1 year,	Average	9.20	-	-	0.73		0.73	5.63	2.62	1.00		2.77
	Upper Qu.	2	-	-	1		1	4	1.1	-		1.1
1 - 2 years,	Average	0.33	-	0.13	0.70				0.52			0.52
	Upper Qu.	-	-	-	1				0.5			0.5
Over 2 years,	Average	0.23	0.20	1.53		1.73	3.00	6.90	3.39	-	12.80	3.39
	Upper Qu.	-	-	2		3	3	12	0.1	-	3	0.1
Subtotal (unimp.)	Total	293	6	50	43	52	112	376	196.3	30	384	200.3
	Average	9.77	0.20	1.67	1.43	1.73	3.73	12.53	6.54	1.00	12.80	6.69
	Upper Qu.	3	-	2	2	3	6	15	8.5	-	20	8.5
	Lower Qu.	-	-	-	-	-	-	2	1.8	-	3	1.8
LU Male Cattle =		67.7 % of total cattle,				Calves + Heifers =			82.7 % of dairy cows			
LU Goats + Sheep =		24.9 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	293	6	50	50	64	112	376	211.3	30	384	215.3
	Average	9.77	0.20	1.67	1.67	2.13	3.73	12.53	7.04	1.00	12.80	7.19
	Upper Qu.	3	-	2	2	3	6	15	9.3	-	20	8.5
	Lower Qu.	-	-	-	-	-	-	2	2.5	-	3	1.8
LU Male Cattle =		61.4 % of total cattle,				Calves + Heifers =			78.1 % of dairy cows			
LU Goats + Sheep =		23.1 % 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

MACHAKOS DISTRICT

TABLE 12a: INPUTS & YIELDS OF MAJOR CROPS

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47

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.	64	2	2	-	1.08	1	-	1,135
	UpQu	100	-	-	-	0.75	-	-	1,350
	LoQu	-	-	-	-	-	-	-	450
Beans	Avg.	-	6	-	-	0.98	-	-	915
	UpQu	-	-	-	-	1.20	-	-	1,200
	LoQu	-	-	-	-	-	-	-	333
Sunflower	Avg.	100	-	-	-	0.38	-	-	438
Maize & Beans									
Maize	Avg.	41	2	6	-	0.58	2	-	974
Beans	Avg.	-	1	-	-	0.34	-	-	454
Maize	UpQu	100	-	-	-	0.75	4	-	1,300
Beans	UpQu	-	-	-	-	-	-	-	640
Maize	LoQu	-	-	-	-	-	-	-	500
Beans	LoQu	-	-	-	-	-	-	-	200
Second Rains									
Maize	Avg.	62	2	2	-	0.89	3	3	1,149
	UpQu	100	-	-	-	0.63	7	7	1,350
	LoQu	-	-	-	-	-	-	-	675
Beans	Avg.	-	5	-	-	0.59	-	-	845
	UpQu	-	-	-	-	-	-	-	1,050
	LoQu	-	-	-	-	-	-	-	450
Engl. Potatoes	Avg.	20	11	46	-	2.17	-	4	6,817
	UpQu	-	-	-	-	2.50	-	-	10,000
	LoQu	-	-	-	-	-	-	-	1,500
Maize & Beans									
Maize	Avg.	40	2	6	-	0.54	3	3	1,053
Beans	Avg.	-	1	-	-	0.33	-	-	806
Maize	UpQu	100	-	-	-	0.17	8	8	1,238
Beans	UpQu	-	-	-	-	-	-	-	700
Maize	LoQu	-	-	-	-	-	-	-	675
Beans	LoQu	-	-	-	-	-	-	-	200
Perennial Crops									
Coffee	Avg.	-	57	-	-	1.54	5	13	3,007
	UpQu	-	108	-	-	0.10	10	21	3,857
	LoQu	-	-	-	-	-	-	-	-

MACHAKOS DISTRICT

TABLE 12b: INPUTS & YIELDS OF MAJOR CROPS

AEZ: UM 4 + LM 3–4 | Survey Area 48

Crop		Inputs: Improved Seeds %	Nutrients: N kg/ha	Nutrients: P_2O_5 kg/ha	Nutrients: K_2O kg/ha	Manure t/ha	Chemicals: Insec. kg/ha	Chemicals: Fungicide kg/ha	Yield kg/ha
First Rains									
Maize	Avg.	89	3	11	-	0.52	2	-	1,756
	UpQu	100	-	14	-	0.25	5	-	2,250
	LoQu	100	-	-	-	-	-	-	900
Beans	Avg.	-	-	3	-	0.21	-	-	708
	UpQu	-	-	-	-	-	-	-	960
	LoQu	-	-	-	-	-	-	-	450
Maize & Beans									
Maize	Avg.	40	-	6	-	0.18	1	-	1,093
Beans	Avg.	-	-	-	-	0.13	-	-	431
Maize	UpQu	100	-	-	-	0.08	3	-	1,350
Beans	UpQu	-	-	-	-	-	-	-	400
Maize	LoQu	-	-	-	-	-	-	-	450
Beans	LoQu	-	-	-	-	-	-	-	150
Maize & Cowps									
Maize	Avg.	33	-	-	-	-	-	-	800
Cowps	Avg.	-	-	-	-	-	-	-	480
Second Rains									
Maize	Avg.	94	5	14	-	0.80	5	5	1,807
	UpQu	100	-	19	-	-	10	10	2,250
	LoQu	100	-	-	-	-	-	-	1,125
Sorghum	Avg.	-	-	-	-	0.63	-	-	475
Bulrushmillet	Avg.	-	-	-	-	-	-	-	1,000
Beans	Avg.	-	-	9	-	0.18	-	-	765
	UpQu	-	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	400
Cowpeas	Avg.	-	-	-	-	0.42	2	2	488
Pigeonpeas	Avg.	-	-	-	-	-	-	-	1,600
Cotton	Avg.	79	-	-	-	-	18	18	729
	UpQu	100	-	-	-	-	20	20	1,000
	LoQu	-	-	-	-	-	-	-	225
Maize & Cowps									
Maize	Avg.	-	-	-	-	-	-	-	788
Cowps	Avg.	-	-	-	-	-	-	-	119
Perennial Crops									
Cassava	Avg.	-	-	-	-	-	-	-	1,250

MACHAKOS DISTRICT

TABLE 13a: DISPOSAL OF CROPS

AEZ: (LH 2 +) UM 2–3 (+ UM 4)

Survey Area 47

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	10,215	1,260	12	1,990	19	6,965	68
Maize & Beans	17,770	0	0	2,370	13	15,400	87
Beans	2,220	80	4	500	23	1,640	74
Engl. Potatoes	4,960	0	0	3,100	63	1,860	38
Sunflower	350	350	100	0	0	0	0
Cabbage	2,000	0	0	2,000	100	0	0
Tomatoes	1,050	0	0	1,050	100	0	0
Second Rains							
Maize	13,260	810	6	2,900	22	9,550	72
Maize & Beans	24,557	0	0	5,280	22	19,277	78
Beans	1,970	0	0	350	18	1,620	82
Fingermillet	480	0	0	210	44	270	56
Engl. Potatoes	4,830	0	0	3,790	78	1,040	22
Sunflower	400	350	88	0	0	50	13
Cotton	460	460	100	0	0	0	0
Cabbage	2,000	0	0	2,000	100	0	0
Tomatoes	1,100	0	0	1,100	100	0	0
			Permanent Crops				
Nil							

MACHAKOS DISTRICT

TABLE 13b: DISPOSAL OF CROPS

AEZ: UM 4 + LM 3–4

Survey Area 48

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	39,255	4,410	11	14,050	36	20,795	53
Maize & Beans	14,754	0	0	5,527	37	9,227	63
Maize & Cowps	2,650	0	0	1,180	45	1,470	55
Maize & Others	900	0	0	0	0	900	100
Beans	7,532	980	13	1,790	24	4,762	63
Sorghum	100	0	0	0	0	100	100
Cowpeas	771	80	10	0	0	691	90
Cowpeas IPC	90	0	0	0	0	90	100
Sunflower	3,120	2,540	81	580	19	0	0
Cotton	440	440	100	0	0	0	0
Second Rains							
Maize	24,320	2,970	12	6,220	26	15,130	62
Maize & Beans	16,235	0	0	6,090	38	10,145	62
Maize & Cowps	1,414	0	0	0	0	1,414	100
Maize & Others	6,540	3,150	48	900	14	2,490	38
Beans	8,818	880	10	2,300	26	5,638	64
Bulrushmillet	1,000	0	0	370	37	630	63
Sorghum	260	0	0	60	23	200	77
Cowpeas	900	0	0	0	0	900	100
Cowpeas IPC	75	0	0	0	0	75	100
Sunflower	3,090	2,640	85	450	15	0	0
Cotton	5,321	4,901	92	450	8	-30	-1
			Permanent Crops				
Nil							

MACHAKOS DISTRICT

TABLE 14a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 24

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47 Sample Size: 30

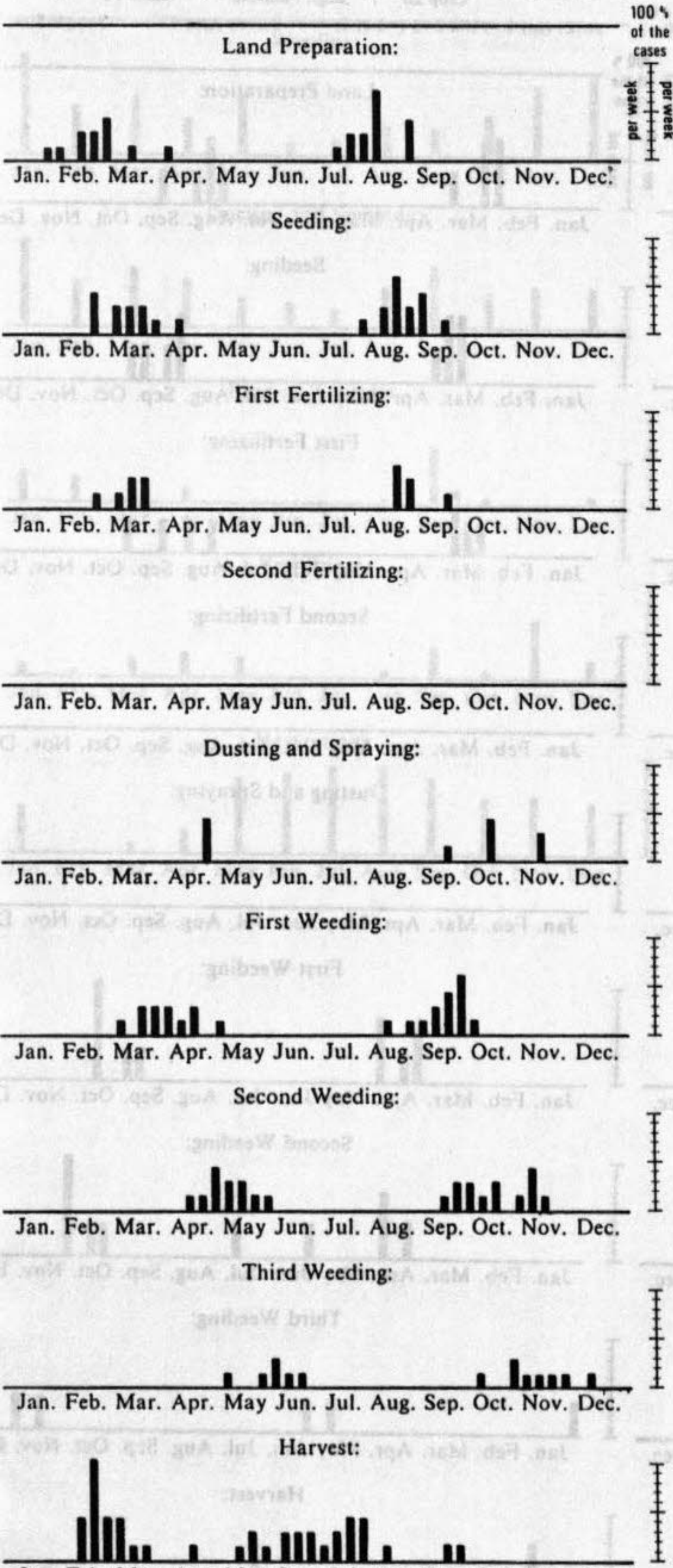


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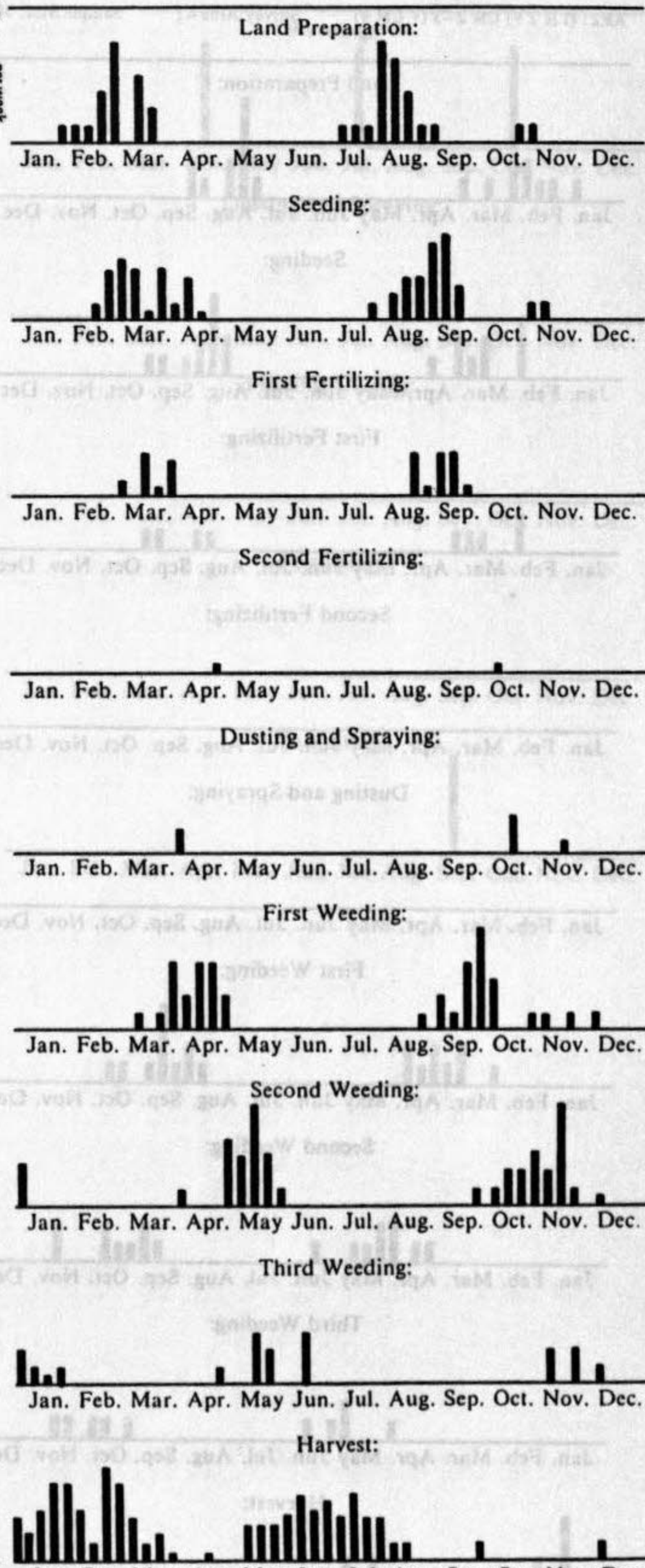
TABLE 14b: DISTRIBUTION OF FARMING ACTIVITIES

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

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47 Sample Size: 30



1) Maximum 30 per crop and season

MACHAKOS DISTRICT

TABLE 14c: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 20

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47 Sample Size: 30

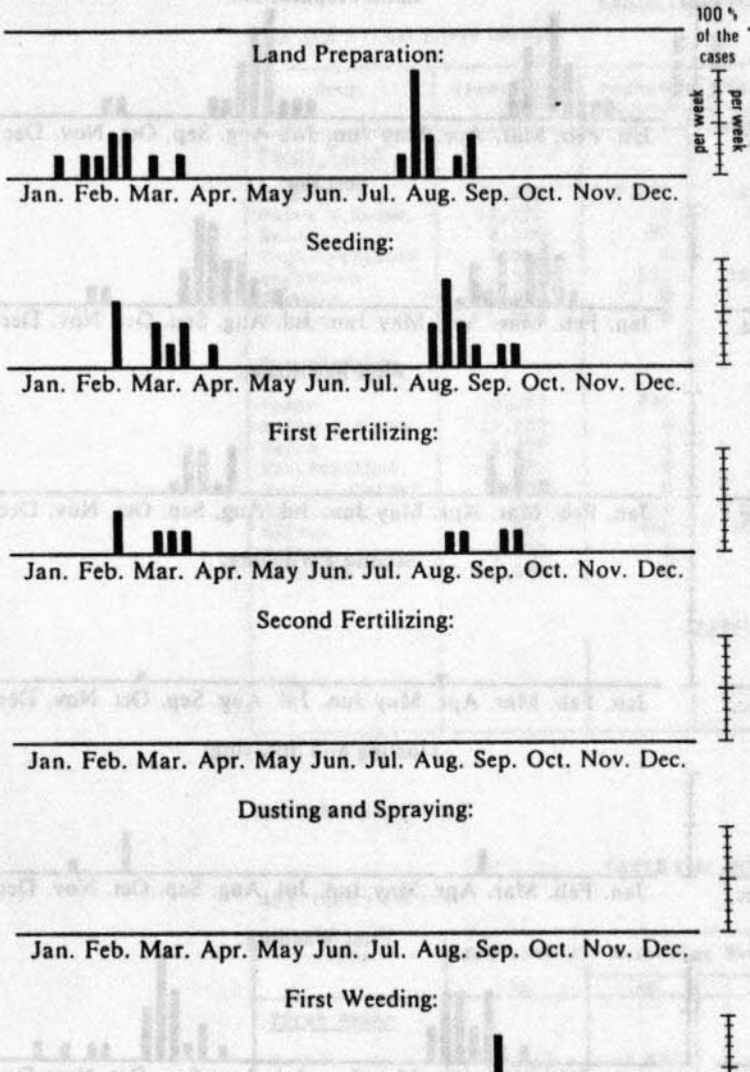


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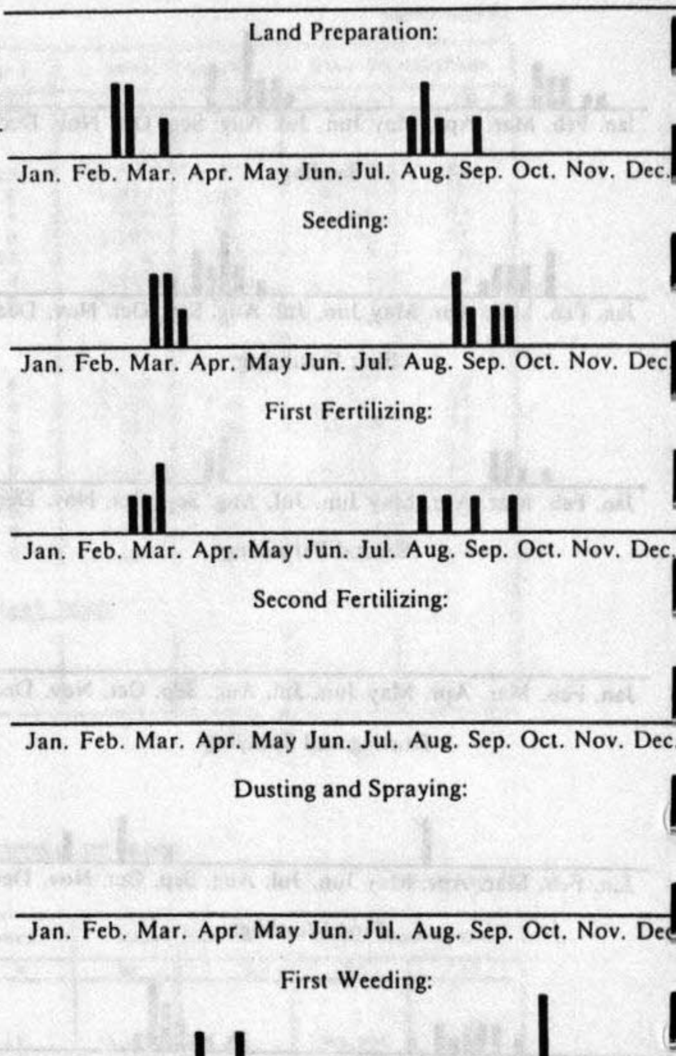
TABLE 14d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 28 Engl. Potatoes Cases: 10

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47 Sample Size: 30



MACHAKOS DISTRICT

TABLE 14e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 30

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47 Sample Size: 30

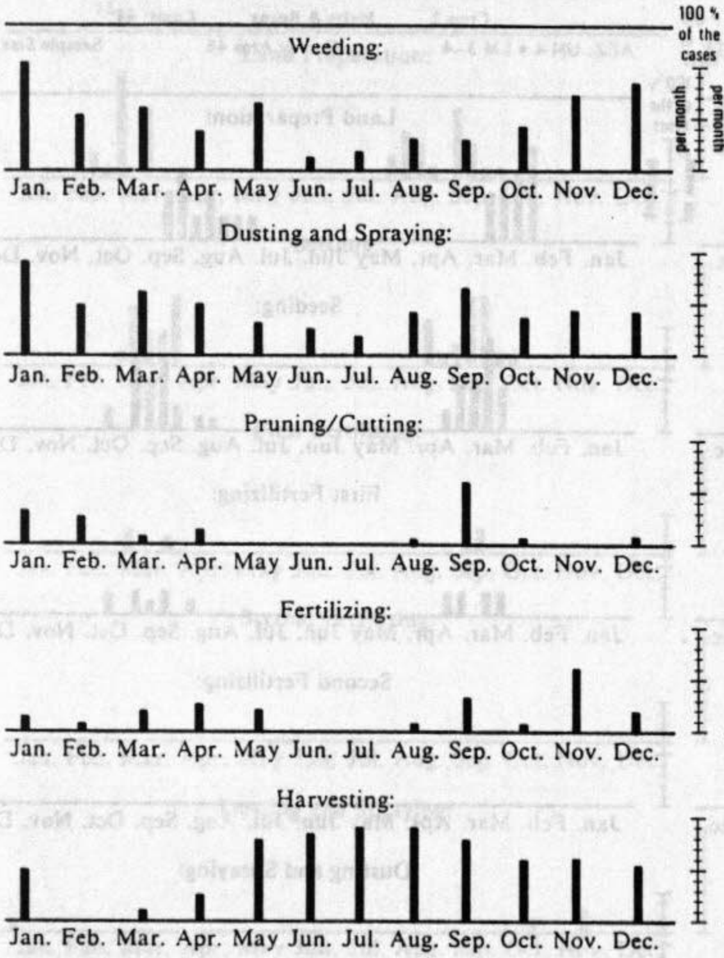


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TABLE 14f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 62 Pigeonpeas Cases: 2

AEZ: (LH 2 +) UM 2–3 (+ UM 4) Survey Area 47 Sample Size: 30

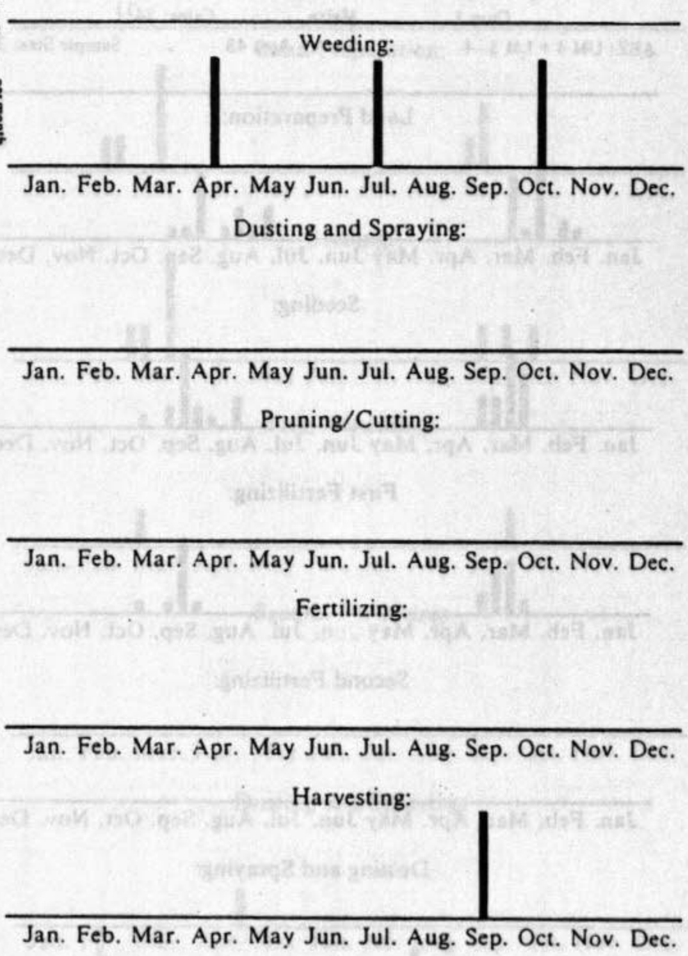

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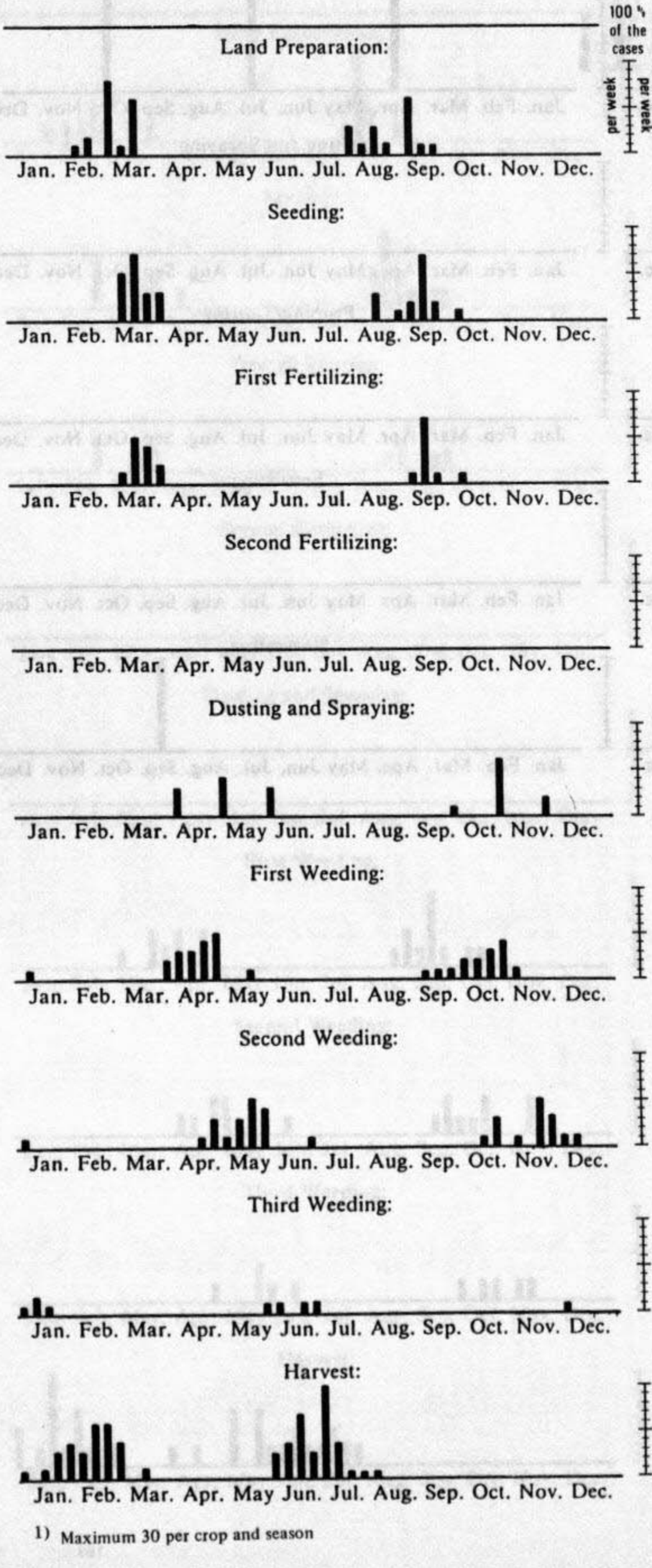
TABLE 14g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 34[1)]

AEZ: UM 4 + LM 3–4 Survey Area 48 Sample Size: 30



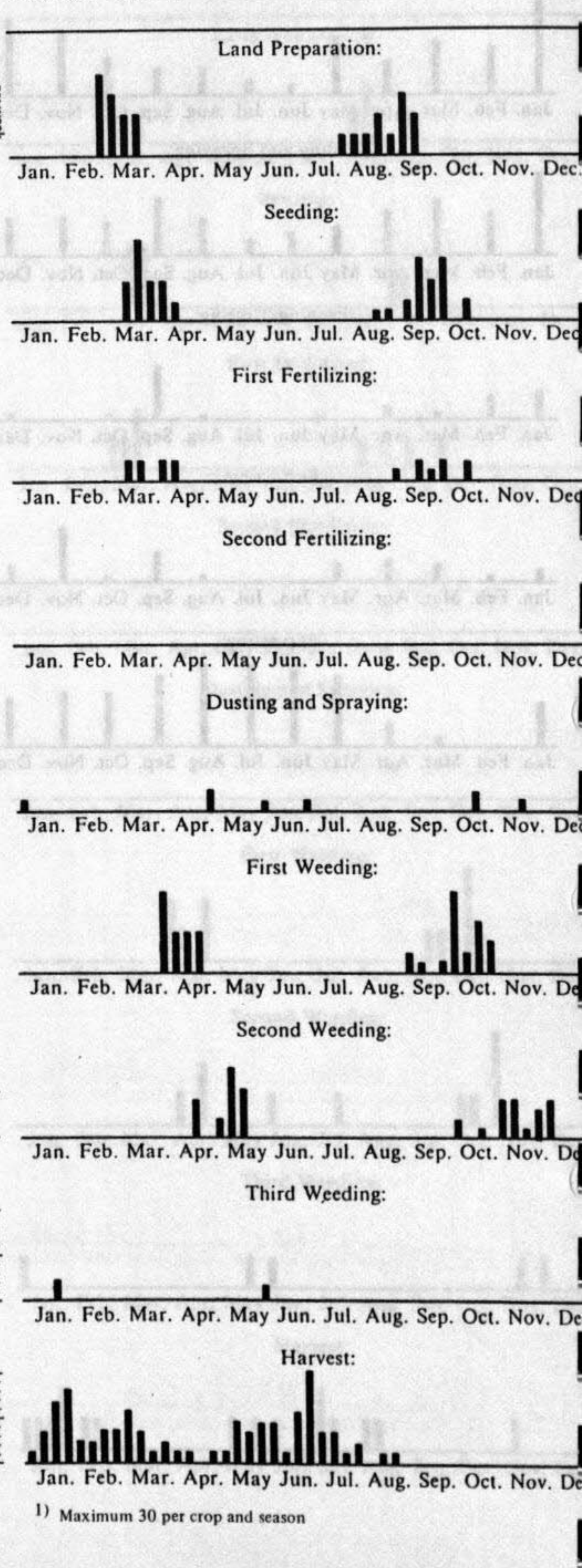
1) Maximum 30 per crop and season

MACHAKOS DISTRICT

TABLE 14h: DISTRIBUTION OF FARMING ACTIVITIES

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

AEZ: UM 4 + LM 3–4 Survey Area 48 Sample Size: 30



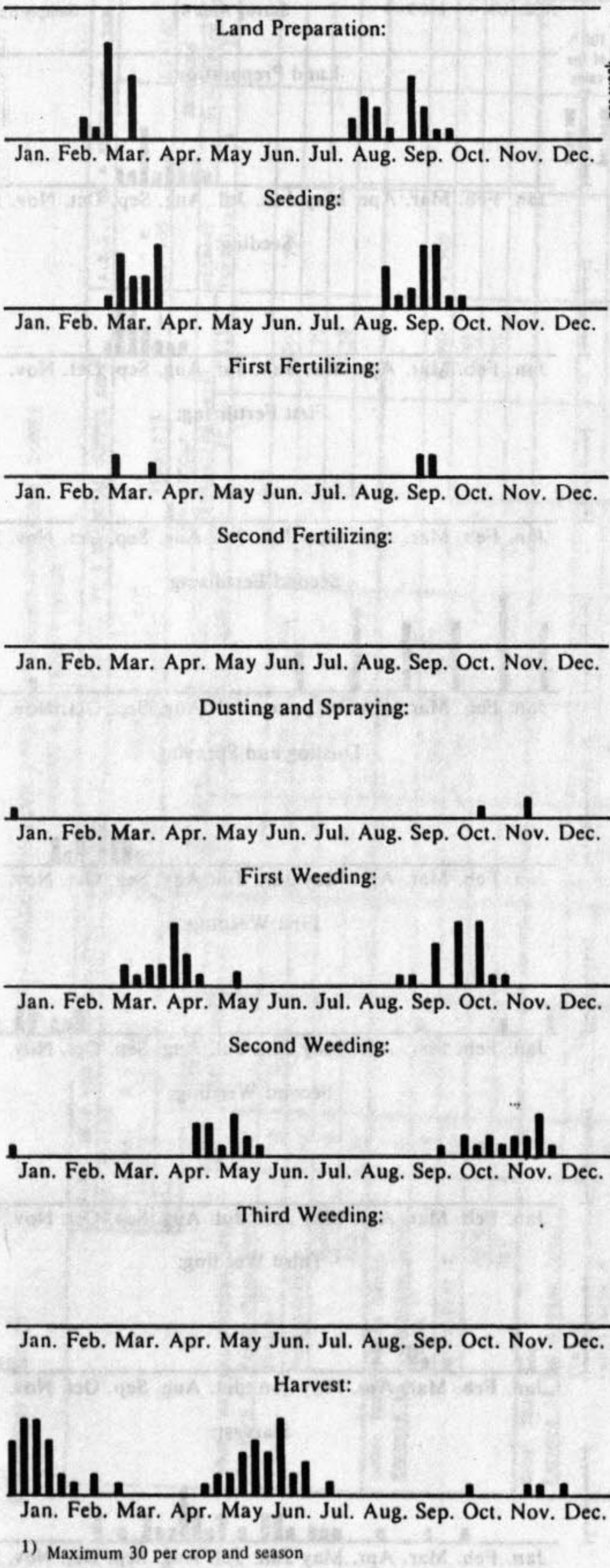
1) Maximum 30 per crop and season

MACHAKOS DISTRICT

TABLE 14i: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 39[1)]

AEZ: UM 4 + LM 3–4 Survey Area 48 Sample Size: 30



1) Maximum 30 per crop and season

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TABLE 14j: DISTRIBUTION OF FARMING ACTIVITIES

Crop 20 Cowpeas Cases: 8

AEZ: UM 4 + LM 3–4 Survey Area 48 Sample Size: 30

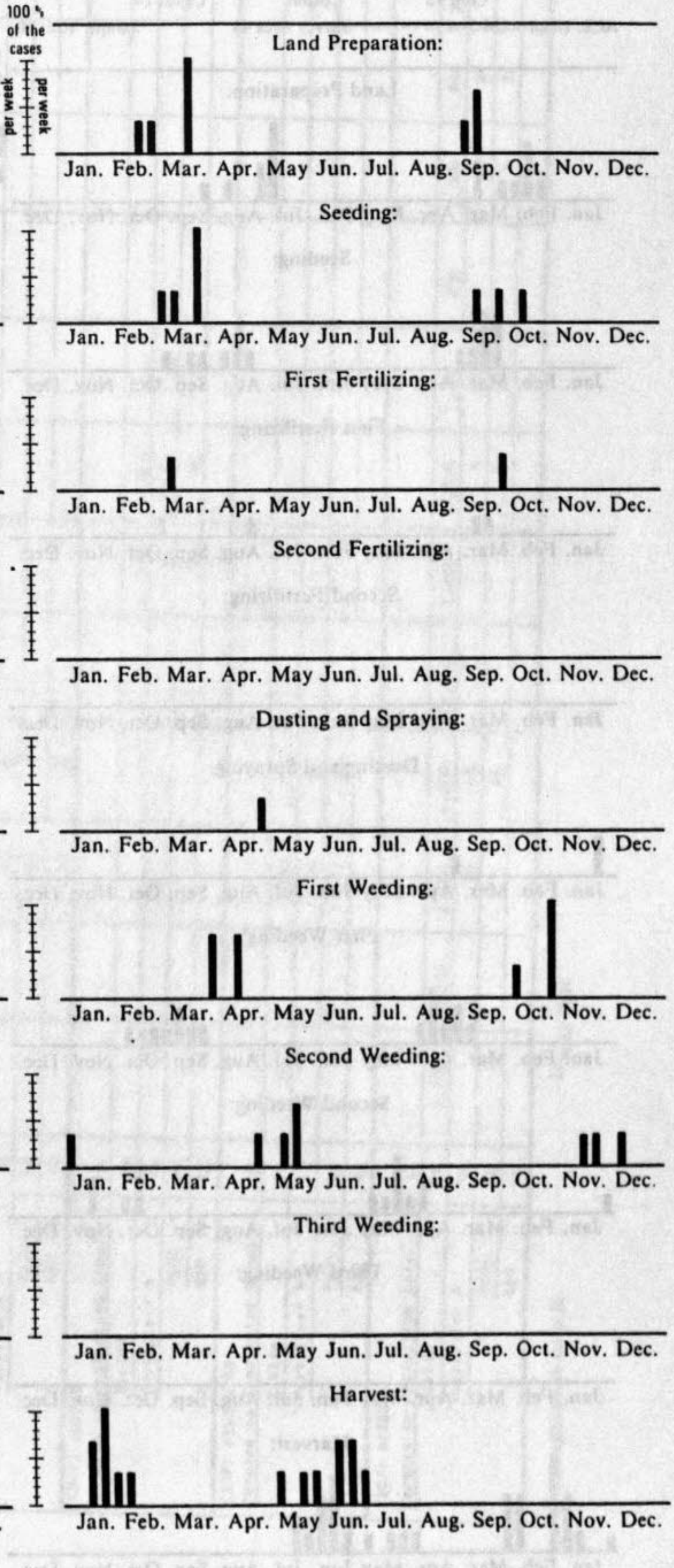

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TABLE 14 l: DISTRIBUTION OF FARMING ACTIVITIES

Crop 35 Cotton Cases: 14

AEZ: UM 4 + LM 3–4 Survey Area 48 Sample Size: 30

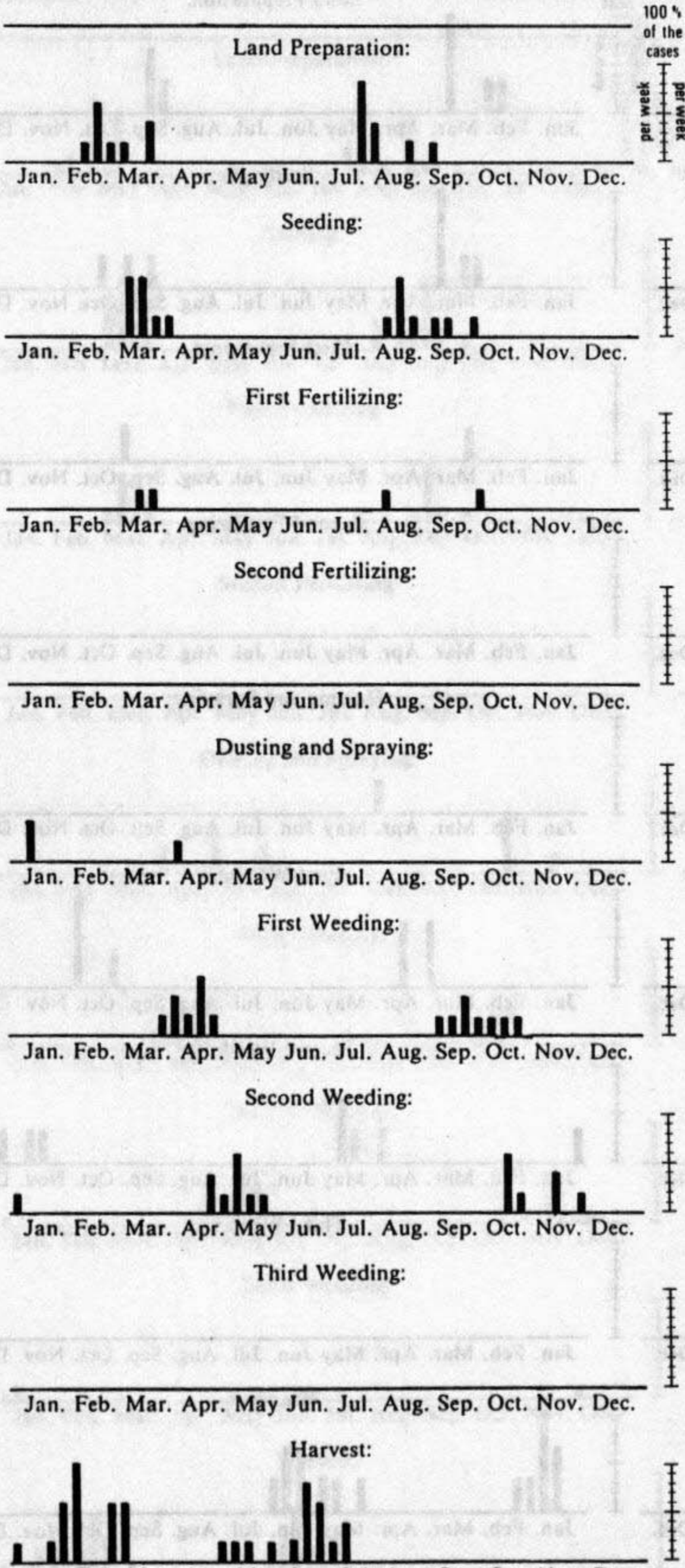

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TABLE 14k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 34 Sunflower Cases: 16

AEZ: UM 4 + LM 3–4 Survey Area 48 Sample Size:

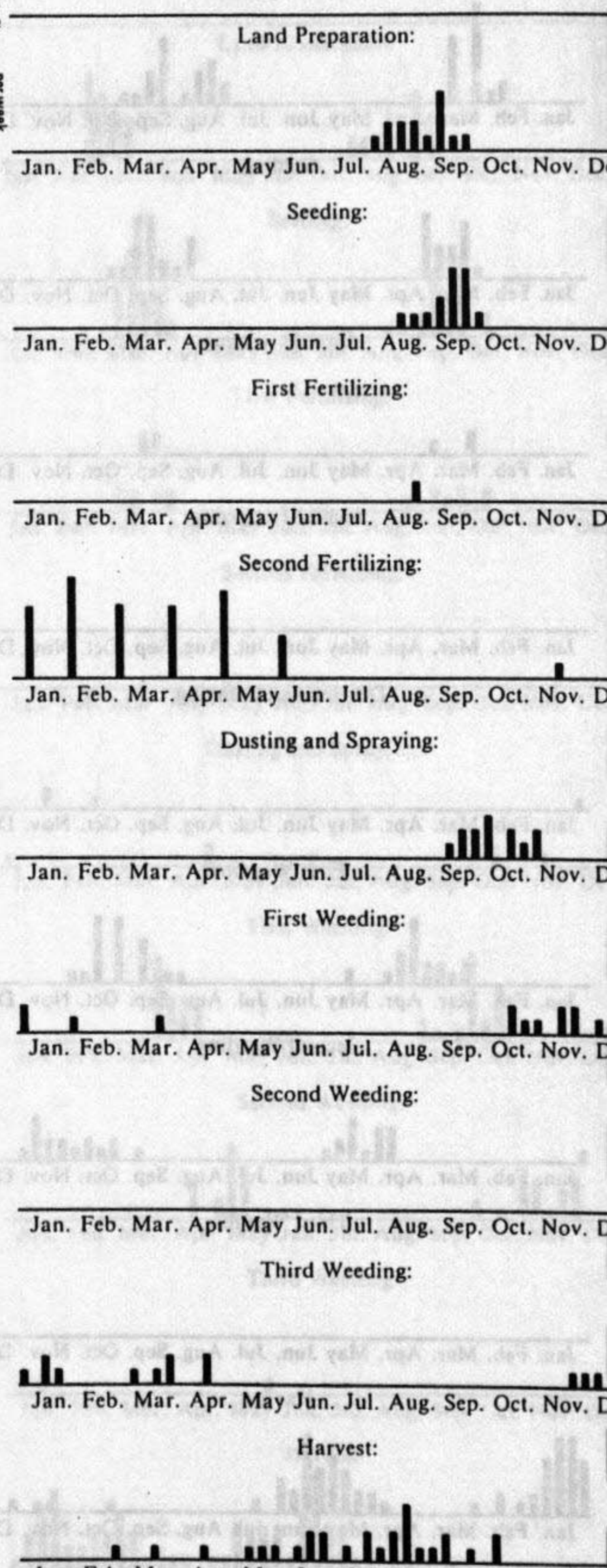

TABLE 15a: PRODUCTION LEVELS PER CROP & AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT[1)]

		A.E.Z.: LH 2 WHEAT/MAIZE-PYRETHRUM ZONE				A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE			
		Vegt. Period 1st + 2nd: m + m/s in Days, 1st: 135-155		2nd: 115-135	total: > 25o	m/s + s/m 11o-13o		1o5-115	–	s + s 85-1o5		85-1o5	> 17o
		Soil: NITOSOLS				CAMBISOLS				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/LEYS													
Farmers in Production Level	%												
Yields 2)	kg	1,900			3,900	1,200			2,600	750			1,500
Fertilizer N	kg				111				77				41
P_2O_5	kg				55				38				20
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields 2)	kg	3,000			6,500	2,700			6,000	1,300			3,400
Fertilizer N	kg				194				183				116
P_2O_5	kg				97				91				58
K_2O	kg												
CROP: TEA													
Farmers in Production Level	%												
Yields	kg	2,100		4,000	6,000								
Fertilizer N	kg			63	156								
P_2O_5	kg			13	31								
K_2O	kg			13	31								
CROP: COFFEE													
Farmers in Production Level	%												
Yields	kg						350	600	800				
Fertilizer N	kg						35	60	80				
P_2O_5	kg						90	90	90				
K_2O	kg												
CROP: PYRETHRUM													
Farmers in Production Level	%												
Yields	kg	500		900	1,200								
Fertilizer N	kg			10	18								
P_2O_5	kg			22	38								
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	2,100	1,200	2,500	4,000	1,900	1,200	2,000	2,500	850	1,000	1,800	2,400
Fertilizer N	kg			10	48			3	15		3	24	39
P_2O_5	kg			9	46			2	14		4	26	43
K_2O	kg												

1) for explanations see p. 16

2) in kg TDN

MACHAKOS DISTRICT

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

		A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 L.MIDL.LIVESTOCK-MILLET Z.							
		Vegt. Period 1st + 2nd: in Days, 1st: s/vs + s/vs 75-85		2nd: 75-85	total: –	(vs/s) + vs/s 55-7o		55-7o	–				
		Soil: 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													
Farmers in Production Level	%												
Yields	kg	600			1,200	450			900				
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: BANA GRASS													
Farmers in Production Level	%												
Yields	kg	1,200			2,500								
Fertilizer N	kg												
P_2O_5	kg												
K_2O													
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg	350	300	600	800								
Fertilizer N	kg			28	50								
P_2O_5	kg			20	36								
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	900	800	1,500	1,800								
Fertilizer N	kg			15	23								
P_2O_5	kg			17	25								
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	1,400	1,400	2,500	3,000								
Fertilizer N	kg			33	48								
P_2O_5	kg			30	43								
K_2O	kg												
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg	900	500	1,100	1,600	600	350	1,000	1,400				
Fertilizer N	kg			6	21			12	24				
P_2O_5	kg			5	20			12	22				
K_2O	kg												

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

		A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 L.MIDL.LIVESTOCK-MILLET Z.							
Vegt. Period 1st + 2nd: in Days, 1st:		s/vs + s/vs 75-85		2nd: 75-85	total: —	(vs/s) + vs/s 55-7o		55-7o	—				
Soil:		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: BEANS													
Farmers in Production Level	%												
Yields	kg	600	300	600	700								
Fertilizer N	kg				5								
P_2O_5	kg				4								
K_2O	kg												
CROP: GRAMS													
Farmers in Production Level	%												
Yields	kg	700	400	900	1,100	600	400	600	900				
Fertilizer N	kg			5	10				8				
P_2O_5	kg			7	14				9				
K_2O													
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	500		600	600								
Fertilizer N	kg			3	3								
P_2O_5	kg			5	5								
K_2O	kg												
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	750		600	1,000								
Fertilizer N	kg				10								
P_2O_5	kg				9								
K_2O	kg												
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg	3,000	3,000	6,000	12,000								
Fertilizer N	kg			21	50								
P_2O_5	kg			20	46								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

KITUI DISTRICT

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NATURAL POTENTIAL

INTRODUCTION

The central part of Kitui District consists of an undulating plateau about 1 100 m in altitude, surmounted by ridges and hills which rise to 1 700 m. There are only two short or very short rainy seasons with a 60 % rainfall reliability during the growing period of 250–390 mm and 280–490 mm, divided by two distinct arid seasons. The total annual average is between 750 and 1 150 mm. In view of the evaporation and the water requirement curves of the leading crops, the rainfall is just enough for the agro-ecological zones class 4, i.e. UM 4 = Sunflower-Maize Zone in the Upper Midlands and LM 4 = Marginal Cotton Zone in the Lower Midlands. Due to a localised, unfavourable anomaly of temperatures (Table 2), cotton can only be grown up to 1 080 m here, compared to 1 250–1 500 m further west. On the other hand, Zone UM 4 starts at such a low altitude that pigeon peas still grow and are widely planted, more so than sunflowers, so that the name "Maize-Pigeon Pea Zone" would actually be more suitable.

The highest hills catch some clouds from the southeast trade winds after the first rains, enabling coffee trees to survive on certain favourable locations. This is therefore a mixed Zone, UM 3–4.

Downhill towards the Lower Midlands, the climate is too dry for a cotton zone and even the Marginal Cotton Zone (LM 4), which is also the driest for successful maize cultivation, is fairly restricted. Therefore, the main area of the district, the peneplain around the central Upper Midlands, belongs to the Livestock-Millet Zone (LM 5), where early maturing bulrush millet, proso and foxtail millets should be the leading grain varieties. Very early maturing sorghum is also possible there. At present, maize is still widely planted, with subsequent crop failures and the risk of famine.[1)] For especially dry years in which the rains are insufficient even for sorghum and millets, new perennial crops like buffalo gourds (from Arizona) and marama beans (from Kalahari) may be advisable. They have edible seeds rich in protein and form nutritious tubers after a few rainy seasons. As a cash crop, jojoba, the wax plant, looks promising.

In the Ranching Zone (IL 6), the annual average rainfall is between 350 and 550 mm; the 60 % rainfall reliability during the first rains is only 80–100 mm, during the second rains 130–150 mm.

1) For the unreliability of rainfall see H.M.H. BRAUN: The Reliability of Rainy Seasons in Machakos and Kitui Districts. Kenya Soil Survey M 12, Nairobi 1977.
Development proposals and activities, see the G.O.K./USAID; Consortium of International Development: Marginal/Semi-Arid Lands Preinvestment Inventory (Nairobi 1978) and the work of the Machakos Integrated Development Project.

KITUI DISTRICT

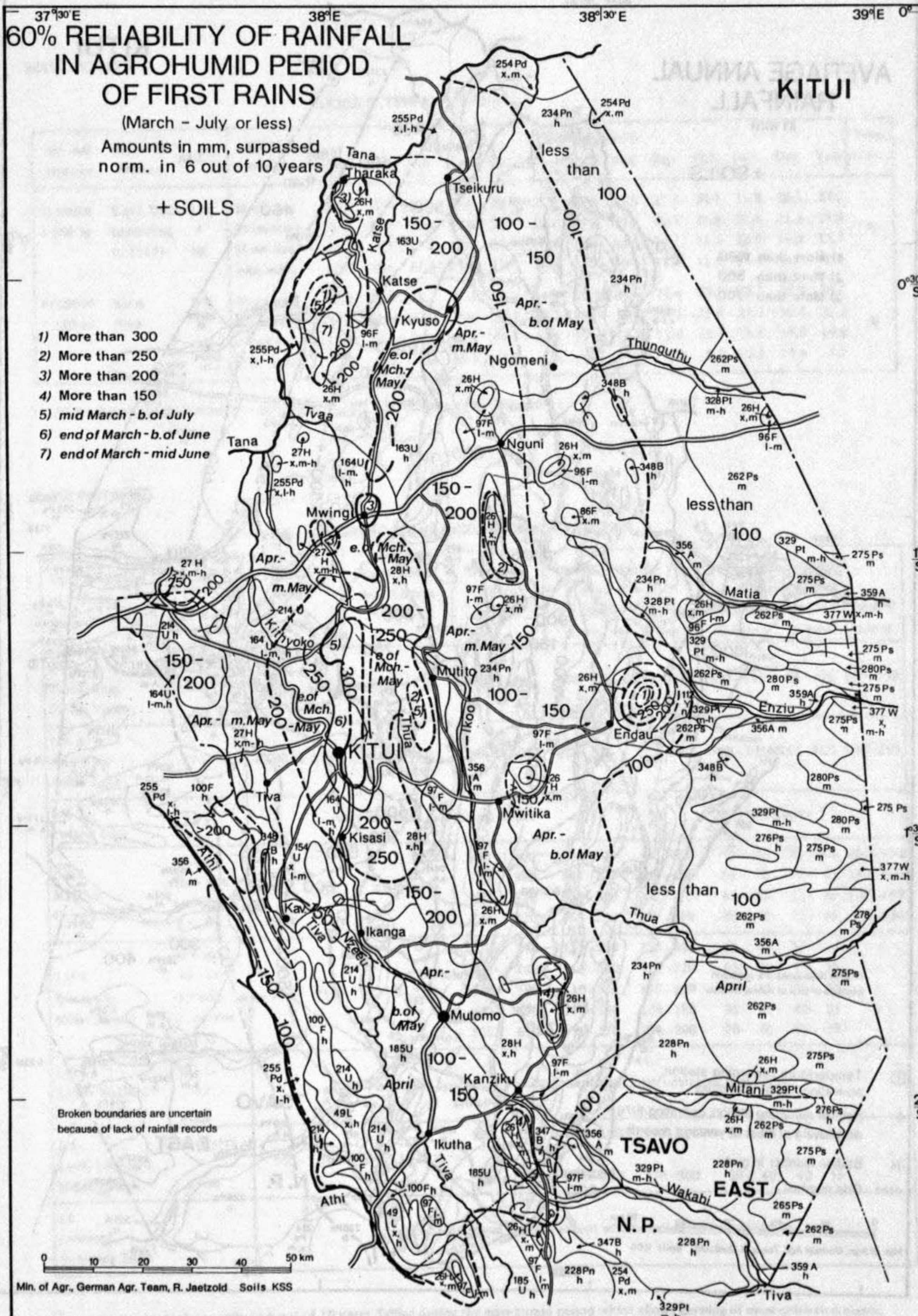
TABLE 1: RAINFALL FIGURES FROM VARIOUS STATIONS

having at least 10 years of records up to 1976

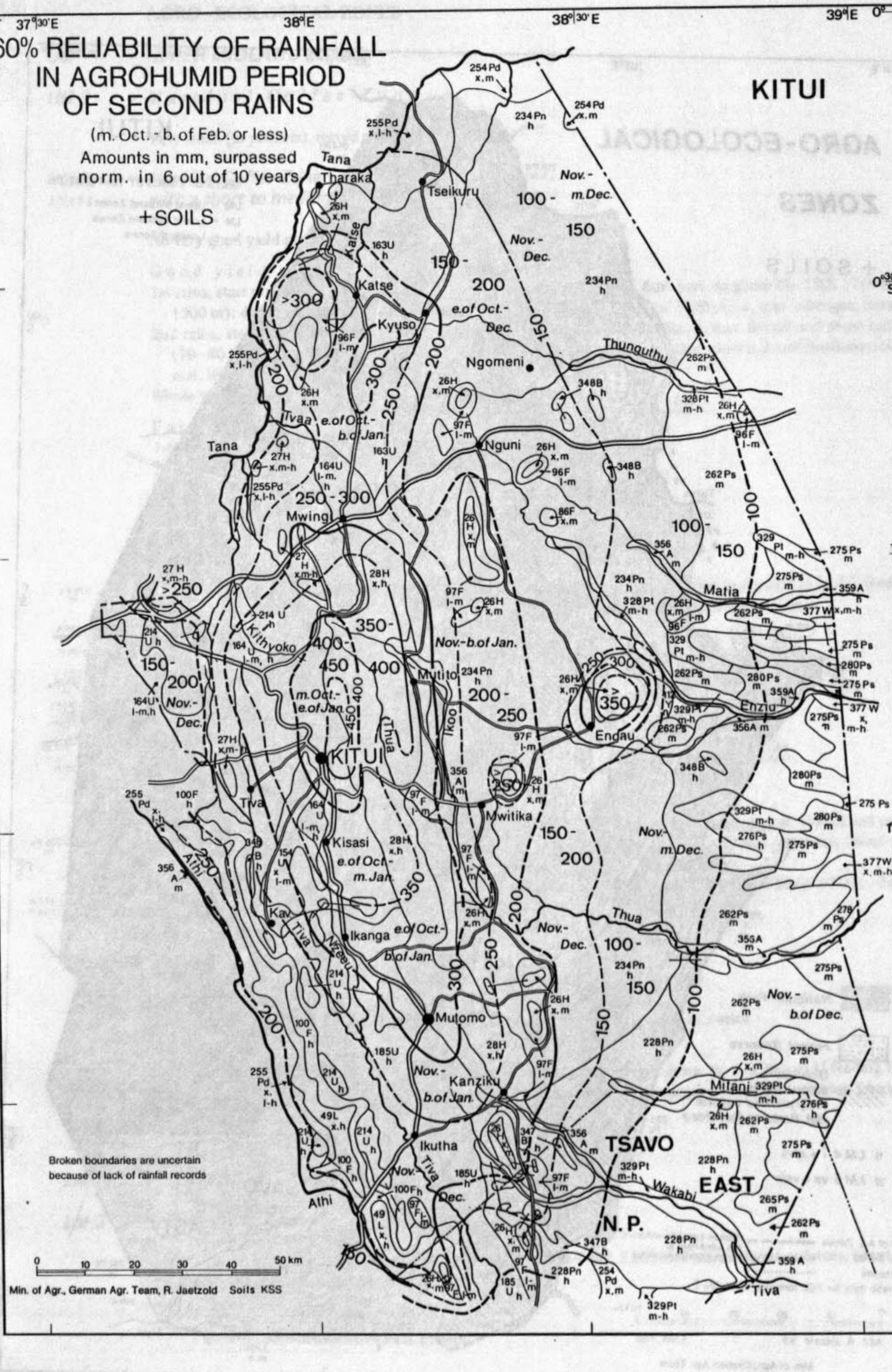
No. and altitude	Name of Station	Years of rec.	Kind of rec.	Ann. rainf. mm	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
9038002	Muvukoni, Dispensary	29	Average	476	161	27	55	124	17	0	1	0	1	19	128	96
884 m			60 % rel.[1]	366	0	0	10	89	0	0	0	0	0	0	116	43
9038003	Mwingi, Mission	23	Av.	745	28	26	99	147	34	3	2	2	3	48	258	96
1 036 m			60 %	637	7	6	37	122	15	0	1	0	0	19	193	66
9038004	Tseikuru, Health	23	Av.	578	17	142	46	135	37	0	0	0	0	48	193	88
594 m	Centre		60 %	428	0	0	8	74	0	0	0	0	0	0	132	17
9038005	Ngomeni, Dispensary	23	Av.	641	97	13	51	122	25	0	0	0	2	37	210	85
716 m			60 %	446	3	0	32	88	3	0	0	0	0	3	111	70
9038006	Tharaka, Chief's	24	Av.	787	32	18	83	232	61	5	0	3	1	58	209	87
914 m	Camp		60 %	579	4	3	46	184	10	0	0	0	0	28	111	32
9038007	Kyuso, Distr.	13	Av.[2]	1 136	46	48	139	255	67	1	0	0	1	125	357	93
747 m	Officer's Office		60 %	552	12	0	31	159	1	0	0	0	0	37	112	31
9038008	Mwingi, Agric.	15	Av.	766	24	32	94	154	35	3	0	1	6	56	275	88
1 052 m	Station		60 %	569	3	1	23	130	19	0	0	0	0	6	205	38
9137076	Katotenu Ranch (former	22	Av.	620	29	19	69	138	41	19	1	21	2	40	195	67
1 250 m	Vet. Dept. Yatta B2)		60 %	514	16	0	50	114	32	0	0	0	0	5	164	34
9137094	Mutonguni, Primary	13	Av.[2]	1 077	15	44	109	214	197	5	3	4	12	91	280	105
1 372 m	School		60 %	728	1	1	37	170	27	1	0	0	0	65	188	64
9137096	Tiva Market, Yatta	14	Av.	653	17	34	100	120	53	5	0	3	4	32	192	91
1 036 m			60 %	470	0	8	12	75	25	0	0	0	0	2	130	25
9138001	Mutomo, Agric.	31	Av.	817	33	23	83	118	25	5	3	3	7	56	280	185
914 m	Station		60 %	651	4	3	46	92	15	0	0	0	0	0	243	98
9138003	Kitui Secondary	29	Av.	1 015	32	26	123	242	58	3	1	3	7	67	289	163
1 158 m	School		60 %	782	19	19	73	103	19	1	0	0	2	8	227	101
9138006	Kanziko, Dispensary	34	Av.	630	21	24	87	113	24	3	2	2	6	30	203	117
914 m			60 %	536	5	10	25	72	13	0	0	0	0	2	103	100
9138008	Mui, Chief's Camp	34	Av.	807	29	17	86	174	33	3	2	4	3	54	264	139
853 m			60 %	685	17	4	40	104	17	0	0	0	0	23	186	53
9138011	Endau, Dispensary	24	Av.	875	26	31	85	133	38	6	2	2	1	69	351	136
457 m			60 %	654	1	5	52	101	9	0	0	0	0	3	174	46
9138012	Mutito, Chief's Camp	24	Av.	931	34	25	124	166	26	3	2	5	2	60	347	137
838 m			60 %	664	5	4	30	106	7	0	0	0	0	16	211	43
9138013	Ikanga, Chief's Camp	24	Av.	717	24	44	108	128	24	3	1	1	5	48	236	75
853 m			60 %	585	6	17	12	97	7	0	0	0	1	1	215	60
9138014	Kitui, Water Supply	12	Av.[2]	1 110	50	17	167	245	60	8	1	6	11	63	322	128
1 180 m	(Dam)		60 %	876	3	16	49	203	34	3	0	1	3	11	264	78
9238006	Ikutha, Agric. Stat.	25	Av.	648	27	30	95	130	15	4	1	2	4	27	201	112
732 m			60 %	474	7	4	22	54	10	0	0	0	0	3	163	95

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

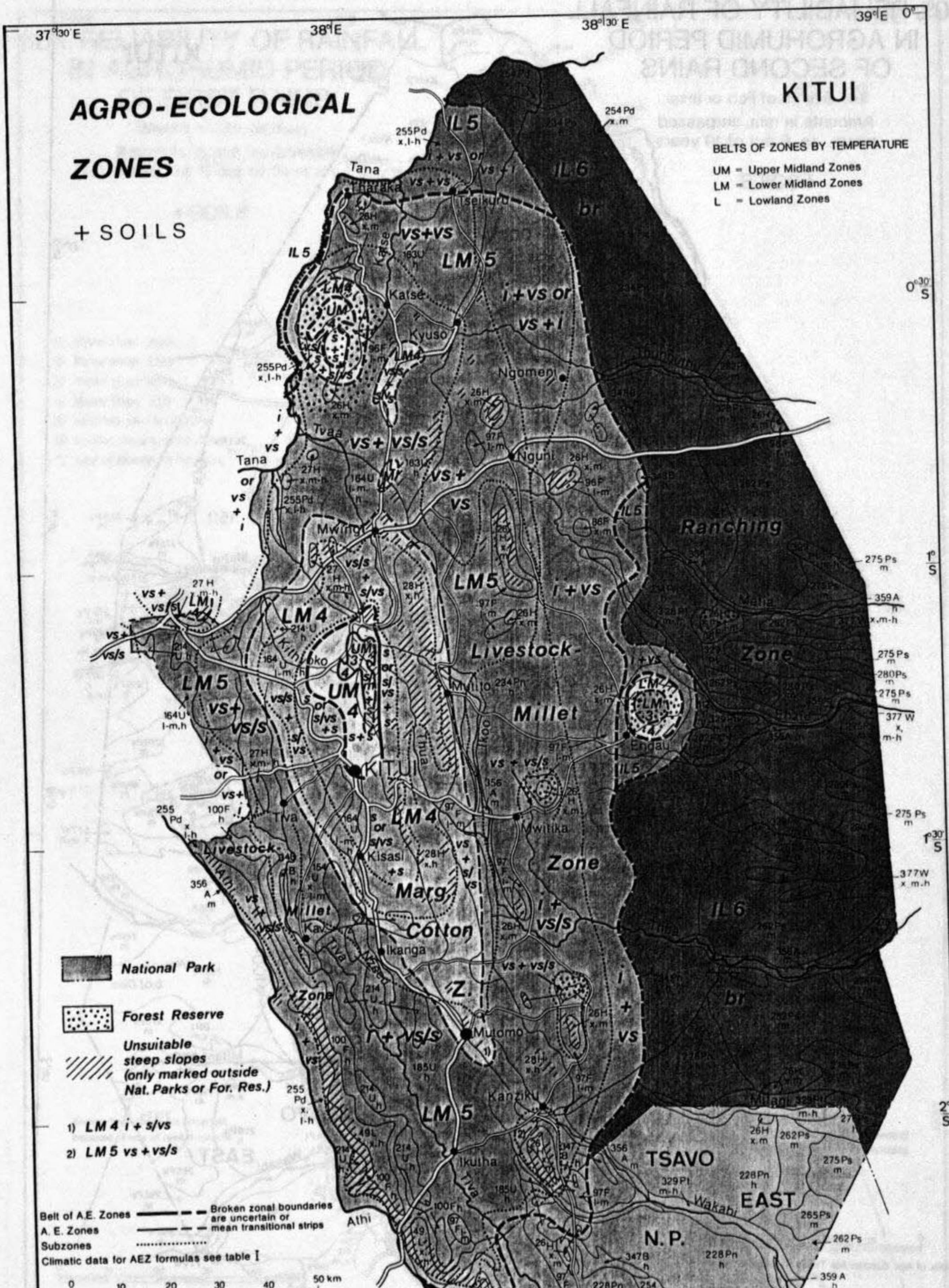
2) High average not typical because of very wet years.



60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF FIRST RAINS
(March - July or less)
Amounts in mm, surpassed norm. in 6 out of 10 years
+SOILS
1) More than 300
2) More than 250
3) More than 200
4) More than 150
5) mid March - b. of July
6) end of March - b. of June
7) end of March - mid June
Broken boundaries are uncertain because of lack of rainfall records
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS
0 10 20 30 40 50 km
37°30'E
38°E
38°30'E
39°E
0°
0°30' S
1° S
1°30' S
2° S
KITUI
Tana
Tharaka
Tseikuru
Katse
Kyuso
Ngomeni
Thunguthu
Tvaa
Nguni
Mwingi
Kimyoko
KITUI
Mutito
Ikoo
Thua
Endau
Enziu
Matia
Tiva
Kisasi
Mwitika
Athi
Kav.
Ikanga
Nzeeu
Mutomo
Kanziku
Ikutha
Mitani
Wakabi
TSAVO EAST N.P.
less than 100
150 - 200
100 - 150
200 - 250
Apr. - b. of May
Apr. - m. May
e. of Mch. - May
April



60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF SECOND RAINS
(m. Oct. - b. of Feb. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
KITUI
37°30'E
38°E
38°30'E
39°E
0°
0°30' S
1° S
1°30' S
2° S
Tana
Tharaka
Tseikuru
Katse
Kyuso
Ngomeni
Thunguthu
Nguni
Tana
Mwingi
Matia
Kithyoko
Mutito
Endau
Enziu
KITUI
Thua
Ikoo
Tiva
Mwitika
Kisasi
Athi
Kav.
Ikanga
Nzeeu
Thua
Mutomo
Kanziku
Mitani
Ikutha
Tiva
TSAVO
EAST
N.P.
Wakabi
Athi
Tiva
Broken boundaries are uncertain
because of lack of rainfall records
0 10 20 30 40 50 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS



AGRO-ECOLOGICAL
ZONES
+ SOILS
KITUI
BELTS OF ZONES BY TEMPERATURE
UM = Upper Midland Zones
LM = Lower Midland Zones
L = Lowland Zones
37°30' E
38° E
38°30' E
39° E
0°30' S
1° S
1°30' S
IL 5
IL 6
br
LM 5
LM 4
UM 4
LM 3
Ranching
Zone
Livestock-
Millet
Zone
Livestock-
Millet
Zone
Marg.
Cotton
Z.
Tana
Tseikuru
Katse
Kyuso
Ngomeni
Tvaa
Nguni
Mwingi
Mutito
Endau
KITUI
Tiva
Kisasi
Mwitika
Kavi
Ikanga
Mutomo
Kanziku
Ikutha
Athi
Tiva
TSAVO
EAST
N.P.
Wakabi
National Park
Forest Reserve
Unsuitable
steep slopes
(only marked outside
Nat. Parks or For. Res.)
1) LM 4 i + s/vs
2) LM 5 vs + vs/s
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
0 10 20 30 40 50 km
AEZ R. Jätzold '82
Soils KSS
Min. of Agr., German Agr. Team

AGRO–ECOLOGICAL ZONES

UM = *UPPER MIDLAND ZONES*

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

Very small (in pockets), mixed with UM 4

UM 3 s/m+s = *Marginal Coffee Zone with a short to medium and a short cropping season*

No very good yield potential

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. end of March: E. mat. maize like Katumani comp. B, e. mat. sorghum like 2 KX 17 (below 1500 m); dwarf sunflower, e. mat. sunflower like Hybrid S 345 (below 1500 m); e. mat. cabbages, onions
2nd rains, start norm. end of Oct.: V. e. mat. maize like Dryland composite, e. mat. foxtail and proso millet (70–80 %); v. e. mat. sorghum like IS 8595 and ratoon sorghum (e. of Oct.–July); dwarf sunflower or e. mat. like Issanka
Whole year: Pineapples on deep soils, Macadamia nuts, sisal

F a i r y i e l d p o t e n t i a l (av. 40–60 % of the opt.)
1st rains: Finger millet; e. mat. beans, sweet potatoes; kales, tomatoes
2nd rains: Katumani maize; e. mat. beans; cabbages, kales, tomatoes
Whole year: Pawpaws, citrus, passion fruit

P o o r y i e l d p o t e n t i a l (av. 20–40 % of the opt.)
Whole year: Arabica coffee, bananas

P a s t u r e a n d f o r a g e
0.9–1.5 ha/LU on sec. high grass savanna with Zebra grass (Hyparrhenia rufa); down to about 0.25 ha/LU feeding Bana grass, maize stalks, fodder legumes, and planting horse tamarinds (Leucaena leucocephala)

UM 4 = *S u n f l o w e r - M a i z e Z o n e*

UM 4 s+s = *Sunflower-Maize Zone with two short cropping seasons*

(see Diagram Kitui Agr. Office)

G o o d y i e l d p o t e n t i a l [1]
1st rains, start norm. end of March: Katumani maize (~ 60 %), Dryland comp. maize, e. mat. foxtail and proso millet, v. e. mat. sorghum like IS 8595, ratoon of sorghum; v. e. mat. beans, e. mat. cowpeas; dwarf sunflower and Hybrid S 345; onions (~ 60 %)
2nd rains, start norm. end of Oct.: The same but additionally ratoon sorghum like 2 KX 17 (e. of Oct.–July), e. mat. beans, dolichos = bonavist beans; sunflower Issanka; (~ 70 %)
Whole year: Sisal

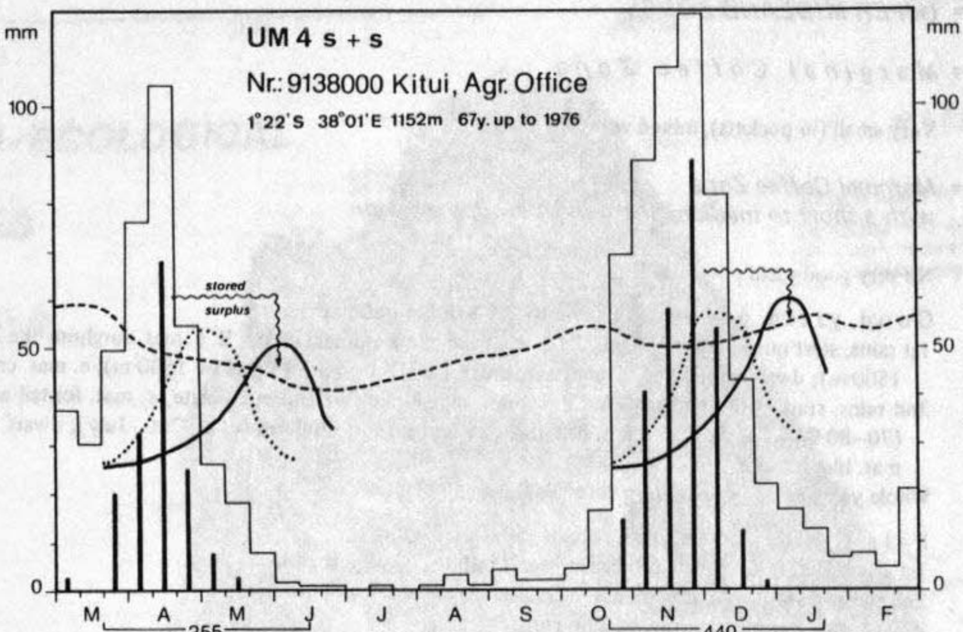
F a i r y i e l d p o t e n t i a l
1st rains: Finger millet; e. mat. beans, dolichos beans; sweet potatoes; tomatoes
2nd rains: Sweet potatoes; tomatoes
Whole year: Pigeon peas, cassava, pawpaws, pineapples, citrus, Macadamia nuts, castor

P a s t u r e a n d f o r a g e
1–2 ha/LU on high grass savanna with Zebra grass (Hyparrhenia rufa); down to ~ 0.28 ha/LU feeding Bana grass (if well manured), other forage, and planting horse tamarind (Leucaena leuc.) and saltbush (Atriplex nummularia) as best palatable shrubs

LM = *LOWER MIDLAND ZONES*

LM 3 = *C o t t o n Z o n e*

Very small and many steep slopes. Potential nearly as LM 4 but Katumani maize, sweet potatoes, beans, and cotton good on the few patches of good soils



Average rainfall per decade — rainfall surpassed in 6 out of 10 years
Approx. pot. evapotranspiration of a permanent crop (bananas)
Approx. pot. evapotranspiration of e. mat. maize like Katumani comp. B
Approx. pot. evapotranspiration of dwarf sorghum
255 Rainfall per indicated growing period, surpassed in 6 out of 10 years

LM 4 = *Marginal Cotton Zone*

LM 4 s/vs+s = *Marginal Cotton Zone with a short to very short and a short cropping season*

Very good yield potential (av. > 80 % of the opt.)
1st rains, start norm. end of March: E. mat. proso millet like Serere I
2nd rains, start norm. end of Oct.: E. mat. proso millet
Whole year, best planting time end of Oct.: Castor C–15, sisal, jojoba; buffalo gourds (light soils)[2] and Marama beans[3], Vigna lobatifolia[4]

Good yield potential
1st rains: Dryland comp. maize (~ 60%), v. e. mat. sorghum like IS 8595 or e. mat. like Serena, ratoon of Sorghum, e. mat. bulrush millet (bird rejecting awned variety from I.C.R.I.S.A.T.)[5]; v. e. mat. tepary beans, v. e. mat. bambarra groundnuts (on sandy soils), v. e. mat. cowpeas, black and green grams, chick peas (esp. on heavy black soils); v. e. mat. sunflower like Russian dwarf, v. e. mat. rai (oilseed Brassica juncea), e. mat. onions
2nd rains: The same but more reliable, plus ratoon sorghum 2 KX 17 (e. of O.–b. of July), Mwezi moja beans, dolichos beans, e. mat. sunflower like HS 345, and v. e. mat. pumpkins
Whole year, best planting time end of Oct.: Cassava (on light soils) and other crops (see LM 4 vs/s + s/vs)

Fair yield potential
1st rains: Katumani maize (~ 40 % on medium soils, preventing runoff 50–60 %); dolichos beans, v. e. mat. beans; v. e. mat. pumpkins
2nd rains: Katumani maize (~ 60 %); e. mat. beans like Canadian Wonder and Mexican 142, pigeon peas (2nd to 1st r.); e. mat. sweet potatoes; cotton (2nd to 1st r., on deep black soils), e. mat. groundnuts like Valencia, e. mat. soya beans; cabbages, tomatoes
Whole year: Cassava on less suitable medium soils

Poor yield potential
1st rains: Sweet potatoes near water to keep plant material (if well watered good yield potential)
2nd rains: Cotton on less suitable medium soils, tobacco (good yields with add. irrigation in youth stage)
Whole year: Pawpaws

Pasture and forage
1.5–2.5 ha/LU on undestroyed natural pasture with Red oats grass (Themeda triandra); if degraded well improvable with Masai love grass (Eragrostis superba) and grazing rotation; down to about 0.30 ha/LU feeding Bana grass and leaves of horse tamarinds (Leucaena leucocephala), add. forage like moth bean vines and fodder sorghum

LM 4 = Marginal Cotton Zone with a very short to short
vs/s+s/vs and a short to very short cropping season

Good yield potential

1st rains, start norm. end of March: E. mat. foxtail or proso millet

2nd rains, start norm. end of Oct.: Dryland composite maize (~ 60 %), e. mat. sorghum like Serena or v. e. mat. like IS 8595 (70–80%), e. mat. bulrush millet (bird rejecting awned variety from I.C.R.I.S.A.T.)[5], e. mat. foxtail or proso millet (70–80 %); v. e. mat. bambarra groundnuts (70–80 % on sandy soils), v. e. mat. moth beans, v. e. mat. tepary beans (70–80 %), v. e. mat. cowpeas, black and green grams, chick peas (esp. on heavy black soils), v. e. mat. beans like Mwezi moja (higher places); v. e. mat. sunflower like Russian dwarf (70–80 %), e. mat. like Issanka (60–70 %), v. e. mat. rai (oilseed, 70–80 %); v. e. mat. pumpkins, e. mat. onions

Whole year, best planting time end of Oct.: Castor C–15, sisal, jojoba; buffalo gourds (light soils)[2] and Marama beans (light and medium soils)[3], Vigna lobatifolia[4], e.mat. cassava (on light soils)

Fair yield potential

1st rains: V. e. mat. tepary beans, v. e. mat. bambarra groundnuts, v. e. mat. cowpeas (40–50 %), v. e. mat. moth beans (50–60 %), green grams (40–50 %); v. e. mat. sunflower like Russian dwarf (40–50 %), rai (oilseed); v. e. mat. pumpkins

2nd rains: Katumani maize (if runoff is prevented nearly 60 %); dolichos beans, e. mat. beans like Canadian wonder or Mexican 142 (higher places); pigeon peas; cotton (on deep black soils), e. mat. groundnuts like Valencia, e. mat. soya beans; e. mat. sweet potatoes; cabbages, tomatoes

Whole year: Cassava (on medium soils)

Poor yield potential

1st rains: Sweet potatoes (to keep plant material with add. watering during dry season, good yields if well watered)

2nd rains: Cotton (on medium soils)

Pasture and forage

1.6–3 ha/LU on undestroyed nat. pasture; if degraded well improvable with Buffel grass (Cenchrus ciliaris) and grazing rotation; down to about 0.5 ha/LU with saltbush (Atriplex nummularia), Mesquite (Prosopis juliflora) and on good soils with horse tamarinds (Leucaena) as palatable shrubs and Makueni guinea grass (Panicum maximum), fodder legumes like moth bean vines (hay) and fodder sorghum (silage) as add. forage, esp. in dry seasons

LM 4 = Marginal Cotton Zone
vs+s/vs with a very short and a short to very short cropping season

(see Diagram Mwingi)

Good yield potential

2nd rains, start norm. end of Oct.: Dryland composite maize (~ 60 %), e. mat. sorghum like Serena or v. e. mat. like IS 8595 (70–80 %), e. mat. bulrush millet (bird rejecting awned variety), e. mat. foxtail or proso millet (70–80 %); v. e. mat. bambarra groundnuts (70–80 % on sandy soils), v. e. mat. moth beans, v. e. mat. tepary beans (70–80 %), v. e. mat. cowpeas, black and green grams, chick peas (esp. on heavy black soils), v. e. mat. beans like Mwezi moja (higher pl., 60–70 %); v. e. mat. sunflower like Russian dwarf 70–80 %), e. mat. like Issanka (60–70 %), v. e. mat. rai (oilseed 70–80 %); v. e. mat. pumpkins, e. mat. onions

Whole year, best planting time end of Oct.: Castor C–15, sisal, jojoba, buffalo gourds (light soils)[2] and Marama beans (light and medium soils)[3], Vigna lobatifolia[4], e. mat. cassava (on light soils)

Fair yield potential

1st rains, start b. of April: V. e. mat. foxtail millet; cowpeas for leaves, sweet potatoes near water to keep plant material (if well watered good yield pot.)

2nd rains: Katumani maize (if runoff is prevented nearly 60 %); dolichos beans, e.mat. beans like Canadian wonder or Mexican 142 (higher places), pigeon peas; cotton (on deep black soils), e. mat. groundnuts like Valencia, e. mat. soya beans; e. mat. sweet potatoes; cabbages, tomatoes

Whole year: Cassava (on medium soils)

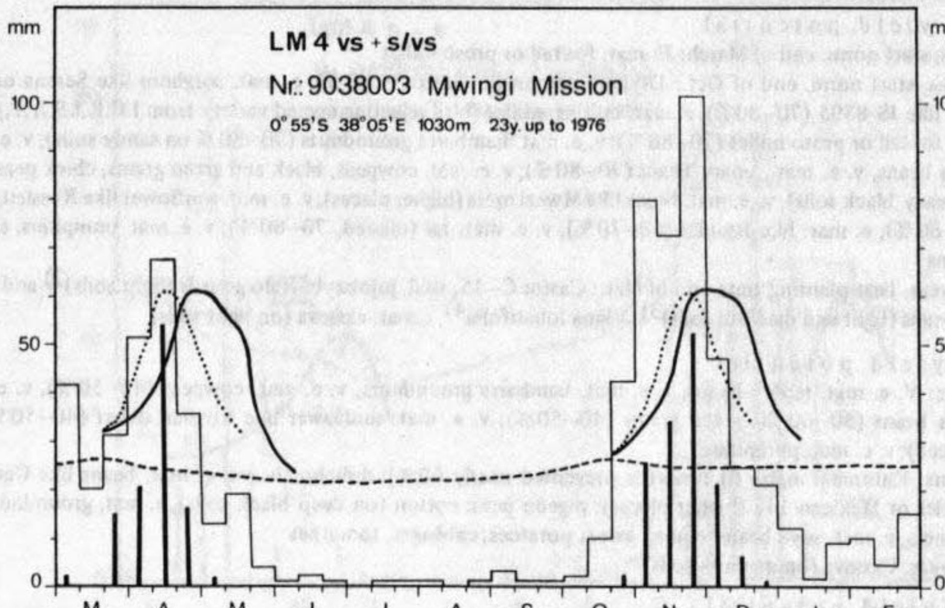
Poor yield potential

2nd rains: Cotton (on medium soils)

Whole year: Pawpaws

Pasture and forage

1.8–3.5 ha/LU on undestroyed nat. pasture; if degraded well improvable with Buffel grass (Cenchrus ciliaris) and grazing rotation; down to about 0.6 ha/LU with saltbush (Atriplex), Mesquite (Prosopis) and on good soils with horse tamarinds (Leucaena) as palatable shrubs, and legumes like moth bean vines (hay) and fodder sorghum (silage) as add. forage, esp. in dry seasons



Average rainfall per decade | rainfall surpassed in 6 out of 10 years
--- Approx. pot. evapotranspiration of a permanent crop (sisal)
— Approx. pot. evapotranspiration of dwarf sorghum
······ Approx. pot. evapotranspiration of very early mat. millets
190 Rainfall per indicated growing period, surpassed in 6 out of 10 years

LM 4 *Marginal Cotton Zone*
i+s/vs *with intermediate first rains[6]) and a short to very short cropping season (2nd rains)*

Good yield potential

2nd rains, start norm. end of Oct.: Dryland composite maize (~ 60 %), e. mat. sorghum like Serena or v. e. mat. like IS8595, e. mat. bulrush millet (bird rejecting awned variety), e. mat. foxtail or proso millet (70–80 %); v. e. mat. bambarra groundnuts, v. e. mat moth beans, v. e. mat. tepary beans (70–80 %), v. e. mat. cowpeas, black and green grams, chick peas (esp. on heavy black soils), v. e. mat. beans like Mwezi moja (higher places); v. e. mat sunflower like Russian dwarf (70–80 %), e. mat. like Issanka (60–70 %), v. e. mat. rai (oilseed 70–80 %); v. e. mat. pumpkins, e. mat. onions

Whole year, best planting time end of Oct.: Castor C–15, sisal, jojoba; buffalo gourds, Marama beans, Vigna lobatifolia, e. mat. cassava (on light soils)

Fair yield potential

2nd rains: Katumani maize (with prevented runoff nearly 60 %); dolichos beans, e. mat. beans like Canadian wonder or Mexican 142 (higher places), e. mat. sweet potatoes; cotton (on deep black soils), e. mat. groundnuts like Valencia, e. mat. soya beans; cabbages, tomatoes

Whole year, best planting time end of Oct.: Cassava (on medium soils)

Poor yield potential

1st rains, start norm. b. of April: V. e. mat. foxtail millet, cowpeas for leaves; sweet potatoes near water to keep plant material (if well watered good yield potential)

2nd rains: Cotton (on medium soils), pigeon peas

Pasture and forage

2–4 ha/LU on undestroyed nat. pasture; if degraded well improvable with buffel grass (Cenchrus ciliaris) and grazing rotation; down to about 0.65 ha/LU with saltbush (Atriplex), Mesquite (Prosopis) and on good soils with horse tamarinds (Leucaena) as palatable shrubs, fodder legumes like moth bean vines (hay) and fodder sorghum (silage) as add. forage, esp. in dry seasons

LM 5 = *Livestock–Millet Zone*

Runoff-catching methods are especially important for agriculture

LM 5 = *Livestock-Millet Zone*
vs+vs/s *with a very short and a very short to short cropping season*

Good yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail and hog millet; cowpeas for leaves
2nd rains, start end of Oct.: E. mat. foxtail and proso millet; v. e. mat. sunflower like Russian dwarf, v. e. mat. rai (oilseed)
Whole year: Buffalo gourds[2)], Marama beans[3)], Vigna lobatifolia[4)], Opuntia var. without prickles

Fair yield potential
1st rains: Nearly as LM5 vs+vs
2nd rains: Dryland comp. maize, e. mat. bulrush millet (50–60 %, awned variety recommended), v. e. mat. sorghum (50–60 %); v. e. mat. bambarra groundnuts, v. e. mat. tepary beans, v. e. mat. moth beans (50–60 %), v. e. mat. cowpeas, black and green grams, chick peas (on heavy black soils), v. e. mat. beans like Mwezi moja (higher places) (40–50 %); e. mat. sunflower like Issanka, e. mat. soya beans; v. e. mat. pumpkins, e. mat. onions
Whole year: Castor C–15, sisal, cassava, jojoba

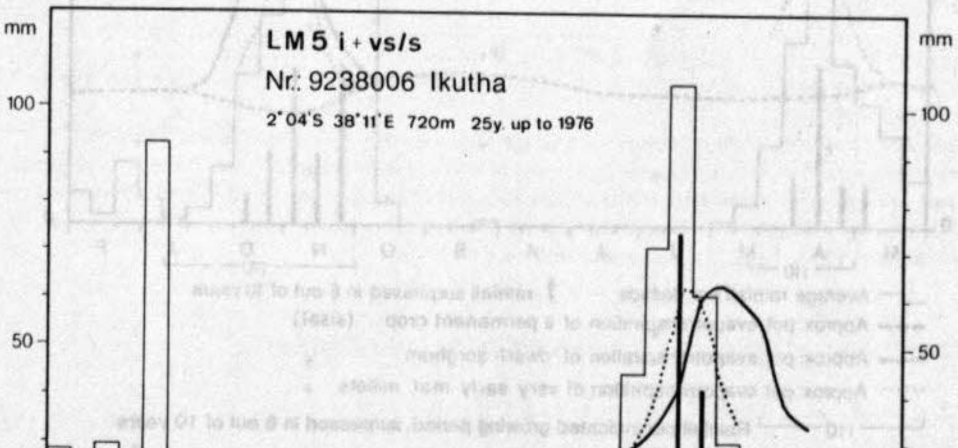
Pasture and forage
2.5–4,5 ha/LU on undestroyed nat. pasture[7)], if degraded well improvable with horsetail grass (Chloris roxburghiana) and grazing rotation; down to about 0.65 ha/LU with saltbush (Atriplex nummularia) and Mesquite (Prosopis juliflora), fodder legumes like moth bean vines (hay) and silage of fodder sorghum for the dry season

LM 5 = Livestock-Millet Zone
vs+vs with two very short cropping seasons

Good yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail and hog millet
2nd rains, start norm. end of Oct.: The same
Whole year: Buffalo gourds, Marama beans, Opuntia var. without prickles (fruit and vegetable, also fodder)

Fair yield potential
1st rains: E. mat. foxtail and proso millet, dwarf sorghum (~ 40 %); green grams, v. e. mat. moth beans, v. e. mat. tepary beans (40–50 %), v. e. mat. cowpeas (~ 40 %), chick peas (on h. bl. soils); dwarf sunflower, v. e. mat. bambarra groundnuts (on light soils); v. e. mat. pumpkins
2nd rains: The same but less risky (see Table 4)
Whole year: Sisal, castor, jojoba, Vigna lobatifolia

Pasture and forage
3–5 ha/LU on undestroyed nat. pasture, improvable like in LM 5 vs+vs/s



LM 5 = *Livestock-Millet Zone*
i+vs/s *with intermediate first rains*[6] *and a very short to short cropping season (2nd rains)*

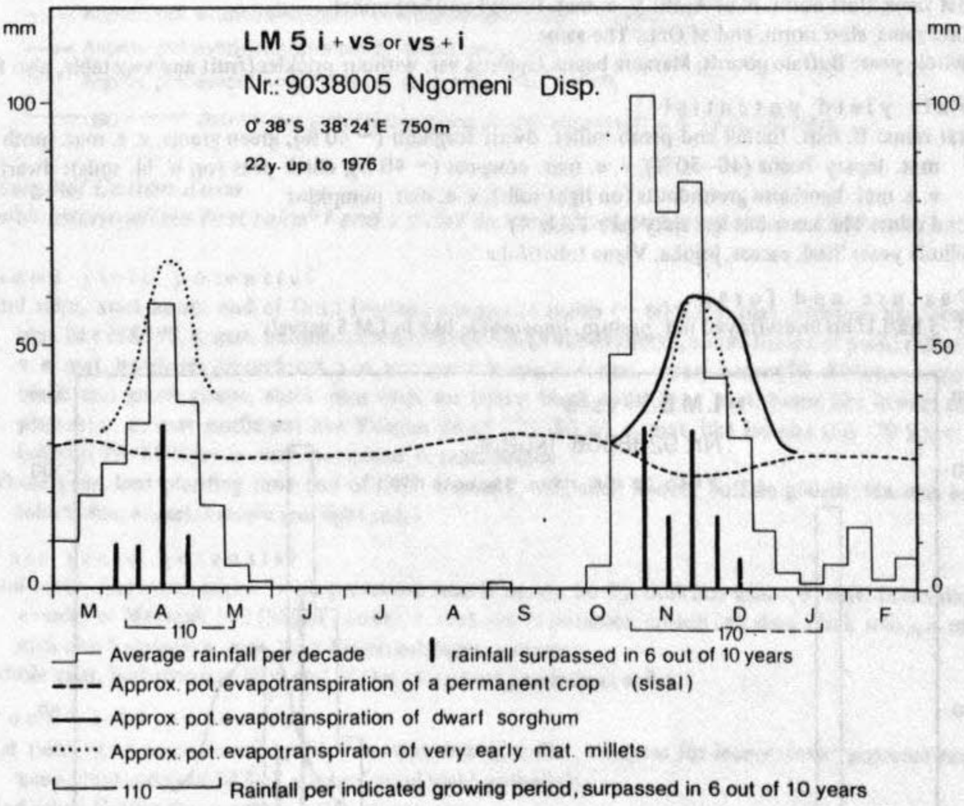
(see Diagram Ikutha)

Good yield potential
2nd rains, start end of Oct.: E.mat. foxtail and hog millet; dwarf sunflower, v.e.mat. rai (oilseed)
Whole year: Buffalo gourds (light soils)[2] and Marama beans (light and medium soils)[3]

Fair yield potential
2nd rains: Dryland comp. maize (~ 40 %), e. mat. proso millet (50–60 %), e. mat. bulrush millet (awned var.), v. e. mat. sorghum; v. e. mat. bambarra groundnuts, v. e. mat. tepary beans, v. e. mat. moth beans (50–60 %), v. e. mat. cowpeas (40–50 %), green grams, chick peas (on h. bl. soils); e. mat. sunflower like Issanka (~ 40 %), e. mat. soya beans (~ 40 %), v. e. mat. pumpkins, e. mat. onions
Whole year: Castor C–15, sisal, e. mat. cassava, jojoba

Poor yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail and hog millet
2nd rains: Katumani maize

Pasture and forage
3.5–5.5 ha/LU on undestroyed nat. pasture, if degraded well improvable with horsetail grass (Chloris roxburghiana) and grazing rotation; down to about 0.7 LU/ha with saltbush (Atriplex), Mesquite (Prosopis juliflora) and Algarrobo (Prosopis chilensis), moth bean vines (hay) and silage of fodder sorghum for dry seasons



LM 5 = *Livestock-Millet Zone*
vs+i or *with a very short cropping season and intermediate rains*
i+vs *or vice versa*

(see Diagram Ngomeni)

Good yield potential
1st or 2nd rains[8]: V. e. mat. foxtail and hog millet (~ 60 %)
Whole year: Buffalo gourds and Marama beans

Fair to poor yield potential
1st or 2nd rains[8]: Dwarf sorghum (40–50 %), e. mat. bulrush millet (awned var.); green grams (40–50 %), moth beans, v. e. mat. cowpeas (40–50 %), v. e. mat. bambarra groundnuts (sandy soils); dwarf sunflower, v. e. mat. pumpkins
Whole year: Sisal (40–50 %), castor

Risk of total crop failure see Table 4
Runoff-catching agriculture see Fig. 2 of Machakos District and Table 5

Pasture and forage
3.6–5.5 ha/LU on undestroyed short grass bushland with horsetail grass (Chloris roxburghiana) predominant; down to about 0.8 ha/LU with saltbush (Atriplex) as best palatable shrub, moth bean vines hay and fodder sorghum as silage for dry seasons

LM 5 = *Livestock-Millet Zone*
i+vs *with intermediate first rains[6]) and a very short cropping season (2nd rains)*

Potential as above but cropping chances in first rains very marginal, in second rains more reliable. Stocking rates roughly the same too but more fodder reserves necessary like palatable shrubs, silage of fodder sorghum, and hay of moth bean vines

KITUI DISTRICT

TABLE 4: DANGER OF FAMINE DUE TO CROP FAILURES IN THE LIVESTOCK-MILLET ZONE
with a very short cropping season and intermediate rains or vice versa = LM 5 vs + i or i + vs
Sample: Ngomeni, Kitui District
Crop combination: Sorghum, bulrush millet, cowpeas, green grams

Year	First Rains		Second Rains		Famine Year	
	partial	total	partial	total crop failure	bad	very bad
1947						
48						
49	+		+		+	
1950		+	+			+
51						
52						
53						
54	+			+		+
55		+				+
56	+					
57						
58						
59		+	+			+
1960		+		+		+
61	+		+a)		+	
62						
63						
64	+		+		+	
65		+		+		+
66						
67						
68						
69				+	+	
1970	+			+		+
71		+	+			+
72		+			+	
73	+		+		+	
74	+			+		+
75		+		+		+
76		+				+
77						
78						
79						
%age	24	27	21	21	18	33
of years	51 %		42 %		51 %	

a) Crop failure due to too much rain

Source: Detailed interview with the Assistant Chief Francis K. Ndoo, 26/8/79

LM 6 = Lower Midland Ranching Zone

LM 6 b r = Lower Midland Ranching Zone with bimodal rainfall

No rainfed agriculture economically possible except with runoff-catching techniques (see Fig. 2, Machakos D.) More than 4 ha/LU on short grass savanna, up to 12 ha/LU in bushland. Grazing rotation essential not to destroy grass cover and to control increase of useless bushes

KITUI DISTRICT

TABLE 5: DISTANCES FOR RUNOFF-CATCHING AGRICULTURE

FIRST RAINS (start normally end of March)

AEZ	Maize variety[a)]	Intercrop[b)]	Distance of ridged rows[c)]	Plant distance in row[c)]
UM 3–4	H 511	–	75 cm (2 1/2 feet)	30 cm (1 foot)
	Katumani comp. B.	Early mat. beans	75 cm "	30 cm "
UM 4	Katumani comp. B.	Very early mat. beans	83 cm (2 3/4 feet)	30 cm "
LM 4 s/vs + s	Katumani comp. B.	Dolichos beans	90 cm (3 feet)	30 cm "
vs/s+s/vs	Dryland comp.	Cowpeas	105 cm (3 1/2 feet)	30 cm "
vs+s/vs	Dryland comp. or dwarf sorghum	Black grams	125 cm (4 1/4 feet)	30 cm "
i+s/vs	Only suited for dwarf sorghum in 1st rains	–	120 cm (4 feet)	20 cm (2/3 foot)
LM 5				
vs+vs/s	Dryland comp. or dwarf sorghum	Green grams	125 cm (4 1/4 feet)	30 cm (1 foot)
vs+vs	Dryland comp. or dwarf sorghum	Green grams	125 cm "	36 cm (1 1/4 foot)
i+vs/s	Only suited for millet in 1st rains	–	Depends on kind of millet and var.[d)]	
vs+i or i+vs	Dryland comp. or dwarf sorghum	Green grams	150 cm (5 feet)	45 cm (1 1/2 foot)
i+vs	Only suited for millet in 1st rains	–	Depends on kind of millet and var.[e)]	
L 5				
vs+i or i+vs	Dryland comp. or dwarf sorghum	Chick peas (yellow gr.)	150 cm (5 feet)	45 cm "
i+vs	Only suited for millet in 1st rains	–	Depends on kind of millet and var.[e)]	

a) The seeds should be soaked in water 20 hours before planting.

b) If the April rains are below normal, the intercrops should be uprooted and used as a spinach. Complete mulching of unshaded interrows from mid May onward important.

c) Experimenting farmers should also try the next closer and wider spacing of the resp. AEZ to meet rainfall variability. In wet years the wide spaced plots give less yields but in dry years more than the normal spaced ones. This helps to avoid famine. Farmers in the wetter zones 3 and 4 should also have normal fields for higher yields in normal and wet years. Ridging ploughs are very helpful.

d) Bulrush millet (awned var.) 120 x 20 cm, v. e. mat. foxtail millet 45 x 10 cm

e) Bulrush millet (awned var.) 120 x 25 cm, v. e. mat. foxtail millet 60 x 10 cm

L = LOWLAND ZONES (here IL = INNER LOWLAND ZONES)

L 5 = Lowland Livestock–Millet Zone

L 5 vs+i or i+vs = Lowland Livestock-Millet Zone with a very short cropping season and intermediate rains or vice versa[8)]

Crops nearly the same as LM 5 vs+i or i+vs but ye-eb nut bushes (Somalia) included in good yield potential.
Stocking rate nearly equal, same fodder plants.
High risk of total crop failures (see Table 4)

L 5 i+vs = Lowland Livestock-Millet Zone with intermediate first rains and a very short cropping season (2nd rains)

Crops as LM 5 i+vs but also ye-eb nut bushes included.
Stocking rates a bit less, fodder reserves necessary

L 6 = L o w l a n d R a n c h i n g Z o n e

L 6 = Lowland Ranching Zone
b r with bimodal rainfall

Conditions as LM 6 but stocking rate more than 4.5 ha/LU. Game cropping and game ranching with eland, oryx, gerenuk, and others give higher production per ha than cattle and need no water for months during the dry seasons

1) Average yield may be only fair due to different rainfall reliability in UM 4 (see Map First Rains)

2) It produces seeds rich in protein, and after some seasons tubers. Bitter substances can be washed out. From Arizona cultivation in Africa still experimental

3) It produces beans and tubers, even in very dry years. From Kalahari, still experimental. For foot notes 3)–4) see Nat. Academy of Science: Tropical legumes. Washington 1979

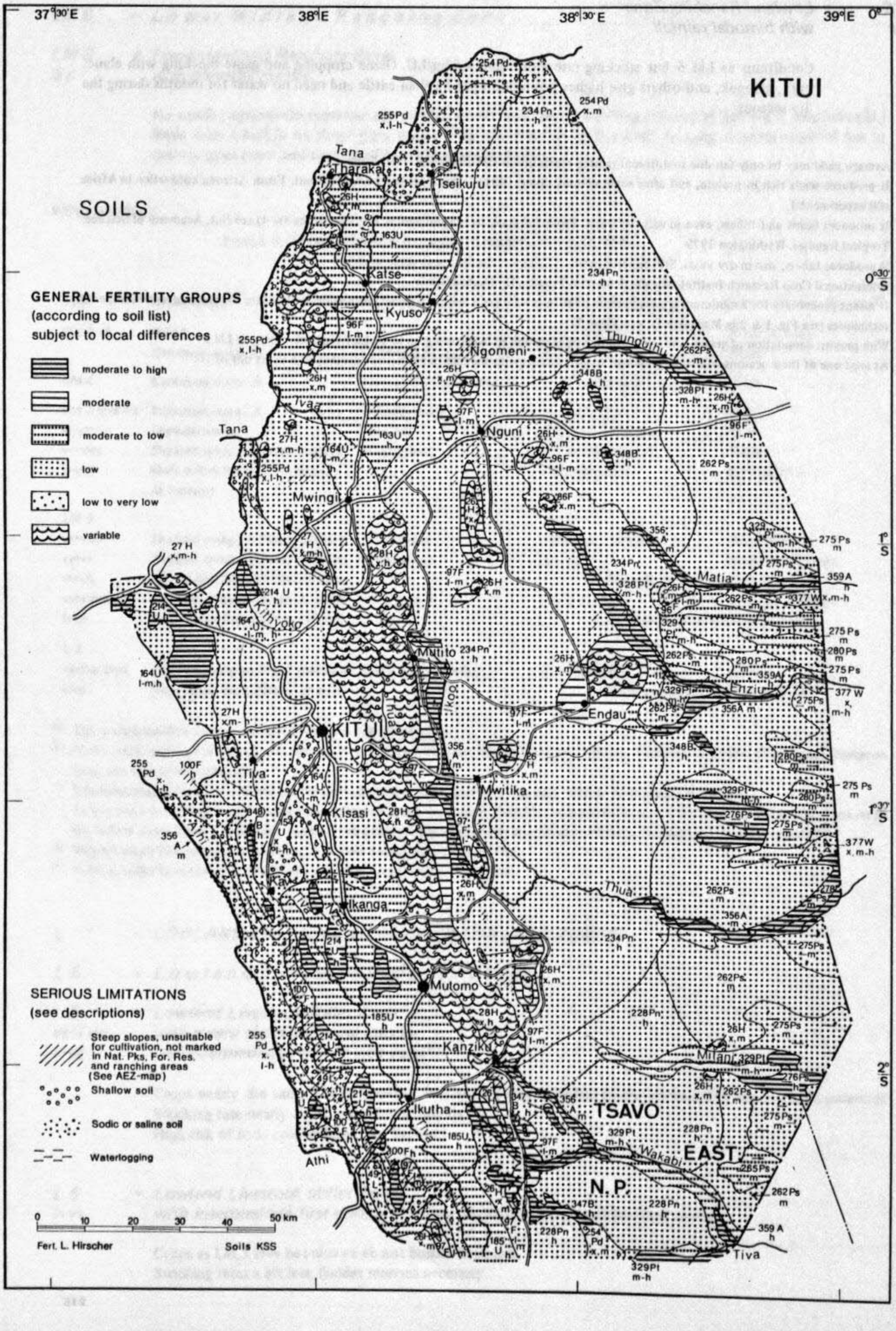
4) It produces tubers, also in dry years. Still experimental

5) International Crop Research Institute for the Semi-Arid Tropics, Hyderabad, India

6) It means probability for a minimum growing period of at least 45 days is less than 60 %. Cultivation is therefore too risky except with special techniques (see Fig. 1 & 2 in Machakos D. and Table 5).

7) With present denudation of grasses and spread of dry thickets due to overgrazing up to 10 ha/LU are necessary in LM 5

8) At least one of these seasons will be long enough to give success with the mentioned crops normally in 6 years out of 10.


37°30'E
38°E
38°30'E
39°E
0°
0°30' S
1° S
1°30' S
2° S
KITUI
SOILS
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
moderate to high
moderate
moderate to low
low
low to very low
variable
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (See AEZ-map)
Shallow soil
Sodic or saline soil
Waterlogging
0 10 20 30 40 50 km
Fert. L. Hirscher
Soils KSS
Tana
Tharaka
Tseikuru
Kaise
Kyuso
Ngomeni
Thunguthu
Nguni
Tiva
Mwingi
Kithyoko
Mutito
Endau
Enziu
Matia
KITUI
Tiva
Kisasi
Mwitika
Athi
Ikanga
Mutomo
Thua
Kanziku
Ikutha
Mitani
Wakabi
TSAVO
EAST
N. P.
Tiva
Athi

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

Apart from the Yatta Plateau and the range of hills in the central part of the district, the topography is undulating and gives way to plains toward the east. Various gneisses of the Basement System are the bedrock and are exposed in the hills east of Kitui and Mutomo, and northeast of Endau. The soils occur in wide zones running north/south, as determined by parent materials and climate; the latter becomes progressively drier to the east.

The soils of the hills (map unit 26 H) are usually shallow and stony. Occasionally they may be somewhat more fertile (unit 27 H) and occur with the former unit. On the associated foothills, the soils are of moderately low to high fertility (unit 97 F).

The uplands in the western part of the district carry soils characterised by an increase of clay with depth, unit 164 U of low fertility, 163 U and 185 U of low to moderate fertility. South of Kangondi there are some areas with soils of unit 214 U of moderate to high fertility.

The major part of the central district is a non-dissected sedimentary plain (units 228 Pn, 234 Pn). These soils have a low natural fertility. To the east they are associated with soils forming the so-called „red sand plain" (unit 262 Ps). They are of low fertility. Soils of the unit 275 Ps occur near the eastern district boundary. They have a hardpan and are of low natural fertility. These soils are often found together with soils of low to moderate fertility (unit 280 Ps).

Along the major water courses on the flat river terraces, soils of moderate to high fertility occur (unit 328 Pt). These soils are associated with those of unit 276 Ps which are of variable fertility.

Most of the soils in the plains are of low to moderately low fertility and show a sodic/salinity hazard. In some areas in the east of the district "badlands" are found with poor soils rich in sodium (unit 377 W).

SOILS ON HILLS AND MINOR SCARPS

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

26 H = somewhat excessively drained, shallow, reddish brown, friable, rocky or stony, sandy clay loam (eutric REGOSOLS; with Rock
x, m[1) Outcrops and calcic CAMBISOLS)

27 H = complex of excessively drained to well drained, shallow, dark red to brown, friable sandy clay loam to clay; in many places
x, m–h rocky, bouldery and stony 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)

28 H = somewhat excessively drained to well drained, shallow to moderately deep, dark reddish brown to brown, friable, rocky and
x, h stony, sandy clay to clay; in many places with acid humic topsoil (humic CAMBISOLS, lithic phase; with LITHOSOLS/REGOSOLS, chromic LUVISOLS, lithic phase and Rock Outcrops)

SOILS ON PLATEAUS AND HIGH-LEVEL STRUCTURAL PLAINS

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

49 L = well drained, shallow to very deep, dark red, friable clay; in many places rocky and bouldery (nito-rhodic FERRALSOLS and
x, h nito-chromic CAMBISOLS, lithic and/or bouldery phase)

SOILS ON FOOTSLOPES

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

86 F = imperfectly drained, moderately deep, dark reddish brown to dark greyish brown, friable to firm, strongly calcareous and often
x, m moderately saline and strongly sodic, stony clay loam; in many parts with boulder surface (calcic XEROSOLS, boulder-mantle and saline-sodic phase)

Soils developed on colluvium from undifferentiated Basement System rocks

96 F = well drained, very deep, yellowish red to dark reddish brown, friable, coarse loamy sand to sandy clay loam (chromic LUVISOLS;
l–m with rhodic FERRALSOLS and luvic/ferralic ARENOSOLS)

97 F = well drained, very deep, dark red, friable coarse loamy sand to sandy clay loam (rhodic FERRALSOLS; with ferralic ARENO-
l–m SOLS and ferralo-chromic LUVISOLS)

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

Soils developed on colluvium from various rocks

100 F = well drained, moderately deep to very deep, dark red to reddish brown, friable to firm, sandy clay to clay (chromic LUVISOLS;
h with rhodic FERRALSOLS)

SOILS ON PIEDMONT PLAINS

Soils developed on alluvium from undifferentiated Basement System

112 Y = well drained, very deep, dark red, friable, sandy clay to clay (ferralo-chromic LUVISOLS)
h

SOILS ON LOWER MIDDLE-LEVEL UPLANDS

Soils developed on quartzites

154 U x, l—m = complex of somewhat excessively drained to well drained, shallow to very deep, dark reddish brown to yellowish brown, loose to friable, loamy sand to sandy clay loam; in places rocky and stony (ferralic ARENOSOLS; with orthic FERRALSOLS, ACRISOLS a.o.; partly lithic and stony phase)

Soils developed on undifferentiated Basement System rocks

163 U h = well drained, moderately deep to deep, dark red to yellowish red, friable to firm, sandy clay to clay, often with topsoil of loamy sand (chromic LUVISOLS and ferralo-ferric/chromic/orthic LUVISOLS)

164 U l—m = well drained, moderately deep to very deep, dark reddish brown to dark yellowish brown, friable to firm, sandy clay to clay; in many places with topsoil of loamy sand to sandy loam (ferralo-chromic/orthic/ferric ACRISOLS; with LUVISOLS and FERRALSOLS)

SOILS ON LOWER-LEVEL UPLANDS

Soils developed on undifferentiated Basement System rocks

185 U h = association of: — well drained, moderately deep to deep, dark red to dark reddish brown, friable to firm, sandy clay to clay; on slopes (chromic LUVISOLS)
— well drained, very deep, light brown to strong brown, very friable clay; on flat interfluves (orthic and xanthic FERRALSOLS)

SOILS ON UPLAND-PLAIN TRANSITIONAL LANDS

Soils developed on gneisses rich in ferromagnesian minerals

214 U h = complex of well drained to imperfectly drained, shallow to very deep, dark red to black, friable to firm, cracking clay; in places sodic (pellic VERTISOLS, with verto-eutric NITOSOLS, verto-eutric PLANOSOLS and orthic SOLONETZ, partly lithic phase)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

Soils developed on Basement System rocks rich in ferromagnesian minerals

228 Pn h = well drained, deep to very deep, dusky red to dark red, friable sandy clay (rhodic FERRALSOLS)

Soils developed on undifferentiated Basement System rocks

234 Pn h = well drained, deep to very deep, dark red to strong brown, friable, sandy clay to clay (rhodic and orthic FERRALSOLS)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated Basement System rocks

254 Pd x, m = complex of well drained, shallow to moderately deep, dark red to yellowish brown, non to moderately calcareous, stony sandy clay loam, over petrocalcic material or quartz gravel (calcic CAMBISOLS, lithic or petrocalcic phase; with chromic LUVISOLS, petric phase)

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 HIGHER-LEVEL PLAINS

Soils developed on sheetwash and aeolian deposits from undifferentiated Basement System rocks

262 Ps m = well drained, deep to very deep, dark red to dusky red, friable, sandy loam to sandy clay loam, predominantly more acid (ferralo-chromic ACRISOLS; with ferralic ARENOSOLS and ferric LUVISOLS)

SOILS ON "SEALING LOAM" PLAINS

Soils developed on Plio-Pleistocene bay sediments (Marafa beds), (little or not remodelled; flat surface, dot pattern)

275 Ps m = imperfectly drained, moderately deep, brown, extremely firm, moderately calcareous, non-saline but moderately sodic clay loam (hardpan), with a thin topsoil of sealing sandy loam (luvo-orthic SOLONETZ)

276 Ps m = poorly drained, deep, dark grey, firm, moderately calcareous, slightly sodic clay, with soft surface (calcaric GLEYSOLS(?), sodic phase)

278 Ps m = imperfectly to poorly drained, deep, greyish brown, extremely firm, slightly calcareous, moderately sodic and moderately saline, slightly cracking clay, with a very thin topsoil of sandy clay loam (gleyic SOLONETZ, saline phase)

Soils developed on sheetwash sediments from Plio-Pleistocene bay sediments (Marafa beds)

280 Ps m = imperfectly drained, deep, brown, extremely firm, slightly calcareous, non saline but slightly sodic, clay loam (hardpan), abruptly underlying a thick topsoil of sealing sandy loam (gently sloping parallel drainage)(solodic PLANOSOLS)

SOILS ON SEDIMENTARY PLAINS OF UPPER RIVER TERRACES

Soils developed on sediments mainly from undifferentiated Basement System rocks

328 Pt m–h = well drained to moderately well drained, deep, dark brown, friable to firm, slightly calcareous, clay loam to clay (eutric CAMBISOLS)

329 Pt m–h = well drained, deep, dark reddish brown to reddish brown, friable, sandy clay loam to sandy clay, over pisocalcic material (calcic LUVISOLS, pisocalcic phase)

SOILS ON OLDER ALLUVIAL FANS

Soils developed on sediments mainly derived from bay sediments

331 Pf h = complex of well drained to imperfectly drained, very deep, reddish brown to grey, firm clay soils of varying calcareousness, salinity and sodicity, in many places with strongly sealing topsoil; with inclusions of well drained, very deep, brown, loose loamy sand (levee complex)(luvo-orthic SOLONETZ, saline phase; with solodic PLANOSOLS, saline phase, chromic VERTISOLS, saline-sodic phase and cambic ARENOSOLS)

SOILS ON BOTTOMLANDS

Soils developed on infill mainly from undifferentiated Basement System rocks

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)

348 B h = imperfectly drained, very deep, dark grey to dark brown, very firm, slightly to moderately calcareous, moderately sodic clay, with a saline deeper subsoil (chromic VERTISOLS, saline-sodic phase)

SOILS ON FLOODPLAINS

Soils developed on sediments mainly from crystalline Basement System rocks

356 A m = well drained to imperfectly drained, very deep, brown to dark brown, friable, slightly calcareous, micaceous, sandy loam to clay loam; in places with a saline-sodic deeper subsoil (eutric FLUVISOLS)

Soils developed on sediments from various sources (recent floodplains)

359 A h = imperfectly drained to poorly drained, very deep, dark reddish brown to dark greyish brown, firm to very firm, cracking clay; in many places mottled and with a calcareous, saline and sodic deeper subsoil (chromic VERTISOLS, saline-sodic phase)

SOILS ON BADLANDS

Soils developed on Plio-Pleistocene bay sediments (Marafa beds)

377 W x, m–h = excessively drained, brown, very firm, strongly sodic, gravelly clay loam to sandy clay of varying depth; strongly eroding and strongly sealed (SOLONETZ, 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: Explanatory Soil Map and Agro-climatic Zones Map of Kenya, Scale 1:1000.000. Rep. E 1, Nairobi 1982. See this map also for colours; symbols simplified here.

POPULATION AND LAND

According to the population Census of September 1979, 464,283 people live in Kitui District, 4,402 of whom (0.95 %) live in Kitui township and not more than 6,671 (1.44 %) in the 9 small trading centres (Table 6). Most are dependent on livestock and to a smaller extent on agriculture. The district is approximatively 2,938,000 ha in size, of which 658,500 ha belong to Tsavo East National Park, leaving 2,280,300 ha in all. Of this figure, 2,006,400 ha is so-called agricultural land, even though most of it in the eastern part of the district is suitable for ranching only and livestock is the mainstay of the population (Table 8).

Statistically, an average household of 5.33 people (Table 7) had 23.94 ha land at its disposal, i.e. per person 4.43 ha (Table 8). However, individual holdings differed considerably in size, e.g. Mutha location in the southeast is so dry (Inner Lowland Ranching Zone IL 6, 263,800 ha), that 193.44 ha were calculated per household (Table 8, footnote 3). On the other hand, in Changwithya location, 3.34 ha per person were still sufficient to do fairly well in the Zones UM 4 (Sunflower-Maize Zone, although here more pigeon peas are grown than sunflowers), LM 4 (Marginal Cotton Zone), and LM 5 (Livestock-Millet Zone).

In general, the higher parts of the country are much more densely populated and also agro-ecologically more suitable for crop cultivation. The lower parts are dryer and sparsely populated, and as the above examples indicate, much more land is necessary to support a household.

As maize cultivation is usually difficult here, it would be advisable to shift to other new cops with shorter growing periods which are more suited to the special conditions of the district. This is a semiarid and arid marginal area for agriculture, and any possibilities of improving the nutrition situation should be examinated carefully in view of the likelihood of famine.

KITUI DISTRICT

TABLE 6: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Mulango	12 401	14 597	26 998	4 948	315	85
Kisasi	10 031	12 172	22 203	4 388	254	87
Matinyani	10 606	12 764	23 370	3 933	220	106
Changwithya	14 010	14 492	28 502	5 764	127	222
Miambani	7 601	9 206	16 807	3 604	283	59
Nzambani	7 923	8 955	16 878	3 331	191	88
Yatta	9 150	10 372	19 522	3 806	695	28
Yatta B 2	2 347	2 040	4 387	1 247	445	9
Central Division	74 069	84 598	158 667	31 021	2 535	62
Mutito	4 418	5 154	9 572	2 046	281	34
Endau	3 706	4 279	7 985	1 468	2 535	3
Mui	4 458	5 338	9 796	1 889	384	25
Zombe	4 989	5 987	10 976	2 175	801	13
Nuu	5 152	6 184	11 336	2 265	774	14
Eastern Division	22 723	26 942	49 665	9 843	4 776	10
Ikanga/Mutomo	10 903	13 004	23 907	4 652	778	30
Ikutha	9 676	10 973	20 649	3 821	1 264	16
Kanziko	5 295	6 202	11 497	1 900	671	17
Voo	4 834	5 759	10 593	2 058	690	15
Mutha	3 400	3 811	7 211	1 556	3 185	2
Southern Division	34 108	39 749	73 857	13 987	6 590	11
Mutonguni	16 417	18 888	35 305	5 389	391	90
Migwani	15 937	18 814	34 751	6 101	660	52
Mwingi	14 062	15 547	29 609	5 613	783	37
Endui	4 701	5 514	10 215	1 826	410	24
Northern Division	51 117	58 763	109 880	18 929	2 245	48
Mvukoni	10 194	12 148	22 342	4 140	1 635	13
Katse	7 807	9 110	16 917	2 749	535	31
Tseikuru	4 847	5 781	10 628	1 774	557	19
Ngomeni	7 565	8 713	16 278	3 139	3 613	4
Tharaka	2 906	3 143	6 049	1 096	326	18
Far North Division	33 319	38 895	72 214	12 898	6 668	10
Kitui District	215 336	248 947	464 283	86 678	29 388	15

KITUI DISTRICT

TABLE 7: COMPOSITION OF HOUSEHOLD PER LOCATION AND DIVISION[a)]

LOCATION/DIVISION	No. of Households total	Farmers Family b) Adults >15 years	Children <15 years	Other Relatives	Non-Relatives	Persons per Households total b)
Location:						
Mulango	4938	2.88	1.50	0.85	0.24	5.44
Kisasi	4478	2.70	1.26	0.73	0.27	4.96
Matinyani	3918	3.04	1.69	0.99	0.24	5.96
Changwithya	5808	2.66	1.11	0.79	0.31	4.87
Miambani	3604	2.96	1.29	0.50	0.19	4.66
Nzambani	3318	2.75	1.35	0.65	0.31	5.06
Yatta	3799	2.74	1.29	0.89	0.22	5.14
Yatta 82	1290	2.00	0.59	0.44	0.37	3.40
Division: Central	31153	2.74	1.31	0.77	0.26	5.08
Location:						
Mutito	2041	2.50	1.03	0.80	0.34	4.68
Endau	1464	2.76	1.15	1.12	0.42	5.45
Mui	1886	2.70	1.21	1.00	0.28	5.19
Zombe	2171	2.70	1.07	0.96	0.31	5.04
Nuu	2264	2.72	1.17	0.74	0.37	5.00
Division: Eastern	9826	2.68	1.12	0.91	0.34	5.05
Location:						
Ikanga/Mutomo	4661	2.73	1.20	0.79	0.36	5.07
Ikutha	3809	2.91	1.34	0.78	0.38	5.40
Kanziko	1902	3.07	1.47	1.16	0.35	6.04
Voo	2054	2.91	1.12	0.81	0.31	5.16
Mutha	1557	2.59	0.90	0.68	0.46	4.63
Division: Southern	13982	2.85	1.22	0.83	0.37	5.26
Location:						
Mutonguni	5367	3.13	1.83	1.27	0.05	6.54
Migwani	6082	2.80	1.67	0.91	0.17	5.70
Mwingi	5607	2.84	1.43	0.64	0.37	5.28
Endui	1829	2.88	1.40	0.99	0.30	5.57
Division Northern	18885	2.97	1.61	0.94	0.28	5.80
Location:						
Mvukoni	4121	3.01	1.43	0.70	0.26	5.40
Katse	2749	3.02	1.53	1.24	0.36	6.15
Tseikuru	1771	3.12	1.45	1.04	0.38	5.99
Ngomeni	3156	2.94	1.23	0.56	0.36	5.09
Tharaka	1093	3.15	1.54	0.60	0.24	5.53
Division : Far North	12890	3.02	1.42	0.82	0.32	5.58
DISTRICT: KITUI	86737	2.85	1.36	0.84	0.30	5.33

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, include one and two persons per household as well

KITUI DISTRICT

TABLE 8: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON[1)]

Location/Division without townships	in '00 ha = sqkm: Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Non-agricultural land: Forest Res., lakes, swamps	Non-agricultural land: Others (roads, homesteads, rivers...)	Agricultural land	in '00 ha = sqkm: Area in agro-ecological zones AEZ: UM 3–4	UM 4	LM 3	LM 4	LM 5	IL 5	IL 6	in ha Agric. land per household	per person
Mulango	315			31	284				64	220			5.74	1.05
Kisasi	254	6		32	216				202	14			4.92	0.97
Matinyani	220			20	200		24		145	31			5.09	0.86
Changwithya	127	6		20	101		40		45	16			2.34	0.42
Miambani	283	69		20	194	2	22		170				5.38	1.15
Nzambani	191	75		15	101		9		92				3.03	0.60
Yatta	695	125		40	530					530			13.92	2.71
Yatta B 2	445	16		24	405[2)]				7	398			32.48	9.23[2)]
Central Division	2 530	297		202	2 031	2	95		725	1 209			6.89	1.32
Mutito	281	50	F. 20	14	197				15	182			10.73	2.23
Endau	2 535	41	F. 67	184	2 243[4)]			25	55	486	237	1 440	152.79	28.09[3)]
Mui	384	37		24	323				31	292			17.10	3.30
Zombe	801	30	F. 40	39	692				117	449		126	32.69	6.48
Nuu	774	32	F. 35	35	672					480	63	129	29.67	5.93
Eastern Division	4 775	190	162	296	4 127			25	218	1 889	300	1 695	43.10	8.49[3)]
Ikanga/Mutomo	778	19		52	707				300	407			16.39	3.13
Ikutha	1 264	188		50	1 026					1 026			26.85	4.97
Kanziko	671	38		23	610				5	605			32.11	5.31
Voo	690	6		57	627				108	491		28	30.47	5.92
Mutha	3 185	25		150	3 010[4)]					372		2 638	193.44	41.74[3)]
Southern Division	6 588	276		332	5 980				413	2 901		2 666	43.82	8.25[3)]
Mutonguni	391	13		34	344	42	116		114	72			6.50	1.00
Migwani	660	15		45	600	25	37		538				10.05	1.75
Mwingi	783	81		52	650				273	377			12.38	2.38
Endui	410	38		19	353				10	343			19.33	3.46
Northern Division	2 244	147		150	1 947	67	153		935	792			10.62	1.83
Mvukoni	1 695	44		105	1 486				157	845	63	421	35.89	6.65
Katse	535	81		34	420		27		83	261	49		15.48	2.51
Tseikuru	557			51	506					84	272	150	28.52	4.76
Ngomeni	3 613	38		290	3 285[4)]					1 183	38	2 064	108.77	20.97[3)]
Tharaka	326	30		14	282				2	216	64		25.73	4.66
Far North Division	6 666	193		494	5 979		27		242	2 589	486	2 635	47.10	8.37[3)]
Total rural area	22 803	1 103	162	1 474	20 064	69	275	25	2 533	9 380	786	6 996	23.94	4.43

1) For official land statistics see supplementary publication to FM-Handbook, Vol. III A : Agriculture Land Statistics
2) Including Vet. Dept. holding ground
3) Eastern parts not settled because of dryness
4) Most of it is only ranching land

AGRICULTURAL STATISTICS[1)]

The natural conditions of the district are suitable for ranching and subsistence farming only, given the present level of technology. An attempt has been made to grow coffee near Kitui town (AEZ UM 3–4). The Kitui ginnery has ginned fluctuating amounts of between 1,500 to 6,500 kg of seed cotton during the past five years which probably reflects the varying levels of productive rainfall during this period. It is estimated that roughly 1,000 ha of cotton is harvested p.a. producing 200–250 kg per ha; all other cotton planted does not receive any inputs and yields during the years of exceptional rainfall only.

1) At present, various scientific teams are engaged in dry land research and comprehensive information should be available towards the year 1985 at M.O.A. or FAO Office, Nairobi.

KITUI DISTRICT

TABLE 9a: COFFEE
AREA – PRODUCTION – YIELDS[a)]

Co-operatives

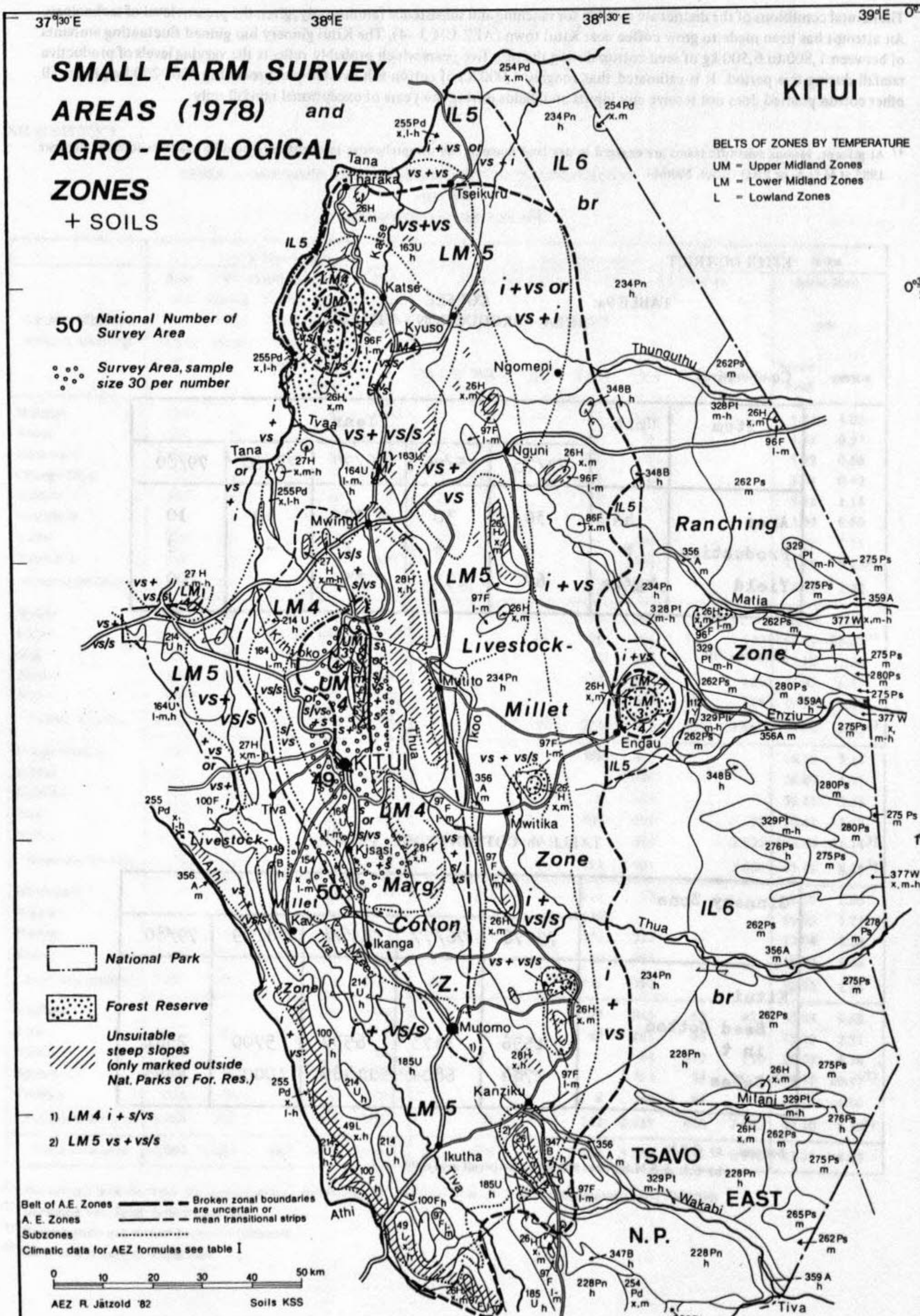
Item	Unit	Year				
		74/75	75/76	76/77	77/78	79/80
Area	ha	30	30	30	30	10
Production	t	2	4	1	-	2
Yield	kg/ha	67	133	33	-	200

Estates - Nil

TABLE 9b: COTTON PRODUCTION[b)]

Ginnery Zone	Year				
	75/76	76/77	77/78	78/79	79/80
Kitui					
Seed Cotton in t	1556	3878	6537	5700	2561
Bales	2784	6804	11469	10000	4493

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



SMALL FARM SURVEY AREAS (1978) and AGRO-ECOLOGICAL ZONES
+ SOILS
KITUI
37°30'E
38°E
38°30'E
39°E
BELTS OF ZONES BY TEMPERATURE
UM = Upper Midland Zones
LM = Lower Midland Zones
L = Lowland Zones
50 National Number of Survey Area
Survey Area, sample size 30 per number
National Park
Forest Reserve
Unsuitable steep slopes (only marked outside Nat. Parks or For. Res.)
1) LM 4 i + s/vs
2) LM 5 vs + vs/s
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
0 10 20 30 40 50 km
AEZ R. Jätzold '82
Soils KSS
Min. of Agr., German Agr. Team
Tana
Tharaka
Tseikuru
Katse
Kyuso
Ngomeni
Thunguthu
Nguni
Mwingi
Mutito
Ikoo
Thua
KITUI
49
50
Tiva
Kisasi
Kavi
Ikanga
Mutomo
Mwitika
Kanziku
Ikutha
Endau
Enzia
Matia
Milani
Athi
Wakabi
Tiva
IL 5
IL 6
br
LM 4
LM 5
UM 4
LM 3
Livestock-Millet Zone
Marg. Cotton Z.
Livestock-Millet Zone
Ranching Zone
TSAVO EAST N.P.

SMALL FARM SURVEY (SFS) 1)

Very low and unreliable rainfall, together with poor soils, make successful farming impossible, in more than 90 % of the district. With the SFS an attempt has been made to obtain some information about the organisation of smallholdings in this semi-arid and arid district. The results of the survey do not reflect the so-called average farm, but rather what the average farmer could achieve if he had the means and the initiative of his more prosperous colleagues who were included in the survey.

Besides the land shown in table 10 & 11, farmers use large tracts of communally owned land for grazing; the large range of crops planted reflects the desire of the farmer to spread the risk and earn a cash income, but it also indicates the absence of a proper extension advisory service. The yields harvested by the farmers are the results of a good season – complete crop failures have been excluded from the sample. The number of grazing LU (5.5 on these somewhat better farms) shows that the income of the average farmer from ranching is precious little (table 10 & 11). Even small declines and shifts in the annual rainfall pattern make famine relief necessary – the amount of food crops which sample farmers claimed they have at their disposal does not reflect reality. The average farmer may have less than 25 % of this amount. The widespread maize planting is due to the mistaken belief that maize developed at Katumani research station will grow and yield in semi-arid and arid regions. The yield figures shown in table 17 do not consider total crop failures and are also based on the assumption that the farmers are able to plant in time, i.e. are able to make use of the total vegetation period.

Mechanisation of field work to enable the farmers to make best use of the total vegetation period and extension advice which centres around farming recommendations for semi-arid and arid regions may help the farming population to produce the food they need during most years. A large increase in the amount of water channelled in to the Yatta furrow and intensive extension advice on horticultural crop production under irrigation may help to bring some income to the district. An overall improvement of the situation requires a perennial crop which produces good and reliable returns on agricultural labour under semi-arid resp. arid conditions.

1) At present, various scientific teams are engaged in dry land research and comprehensive information should be available towards the year 1985 at M.O.A. or FAO Office, Nairobi. See also annual publication FMHB Vol. III/A and III/B.

AEZ: UM (3–) 4 + LM 4

TABLE 10 a: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 49

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group		
		small	medium	large
Farm Size Total	ha	1.8	3.4	9.3
Land Use: Annual Crops[1] First Season Maize	ha	o.2	o.7	1.1
Beans	ha	o.1	o.5	1.o
Tobacco	ha	o.1	o.3	o.4
Maize & Beans	ha	o.3	o.2	o.7
Others	ha	o.2	o.2	o.1
Total	ha	o.9	1.9	3.3
Second Season[1] Maize	ha	o.1	o.7	1.1
Beans	ha	o.1	o.5	o.9
Maize & Beans	ha	o.3	o.2	o.7
Others	ha	o.2	o.1	o.1
Total	ha	o.7	1.5	2.8
Permanent Crops[1] Coffee	ha	-	o.2	o.2
	ha			
	ha			
	ha			
Portion of total	%		6 %	2 %
Grazing & Forage	ha	o.6	1.o	4.5
portion of total	%	33 %	39 %	48 %
Other Land Use	ha	o.3	o.3	1.3
Livestock on Farm:				
Cattle: local	LU	1.1	2.8	4.8
improved	LU	o.2	o.6	o.9
Sheep & Goats	LU	o.6	1.4	3.2
Total	LU	1.9	4.8	8.9

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group		
		small	medium	large
Farming Intensity:				
Cropping Intensity	-	o.9	1.1	o.7
Portion of improved cattle kept	%	15 %	18 %	16 %
Portion of Farmers owning a Plough	%	3o %	6o %	11o %
Labour on Farm:				
Family Adults	persons	3.1	2.1	2.o
Perm. Hired Labour	"	o.1	o.3	o.7
Children > 14 years	"	2.4	2.o	2.7
Persons living on Farm[2] -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.29	o.3	2.59
Children < 14 years	"	2.82	-	2.82
Subsistence Units	SU	3.98	o.3	4.28
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1378	19o4	
Beans	kg	4o6	553	
Cabbage	kg	13	1	
Sorghum	kg	6	8	
Cowpeas	kg	51	71	
	kg			
	kg			
	kg			

Other Crops cultivated: Cowpeas, Cabbage, Cotton, Onions, Tomatoes, Sorghum

1) Major crops only considered

2) Based on 1979 Census figures

TABLE 10 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group: small	medium	large
Farm Size Total	ha	1.7	3.8	9.3
Land Use: Annual Crops1) First Season				
Maize	ha	o.1	o.7	o.9
Beans	ha	o.1	o.1	o.4
Cotton	ha	o.1	o.1	o.7
Maize & Beans	ha	-	o.2	o.3
Others	ha	o.9	1.1	1.4
Total	ha	1.2	2.2	3.7
Second Season1)				
Maize	ha	o.1	o.6	1.o
Beans	ha	-	o.3	o.5
Maize & Beans	ha	o.2	o.1	o.2
Others	ha	o.2	o.7	1.o
Total	ha	o.5	1.7	2.7
Permanent Crops1)	ha			
	ha			
	ha			
	ha			
Portion of total	%			
Grazing & Forage	ha	o.3	1.2	4.4
portion of total	%	18 %	32 %	47 %
Other Land Use	ha	o.2	o.4	1.2
Livestock on Farm:				
Cattle: local	LU	2.9	5.8	3.1
improved	LU	-	-	-
Sheep & Goats	LU	o.4	1.2	2.o
Total	LU	3.3	7.o	5.1

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group: small	medium	large
Farming Intensity:				
Cropping Intensity	-	1.o	1.o	o.7
Portion of improved cattle kept	%	-	-	-
Portion of Farmers owning a Plough	%	3o %	12o %	12o %
Labour on Farm:				
Family Adults	persons	1.8	3.2	2.5
Perm. Hired Labour	"	o.2	o.6	o.3
Children > 14 years	"	o.8	2.4	2.3
Persons living on Farm2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.o5	o.33	2.38
Children < 14 years	"	2.67	-	2.67
Subsistence Units	SU	3.65	o.33	3.98
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1261	1742	
Beans	kg	263	358	
Sorghum	kg	44	59	
Millet	kg	197	265	
Cowpeas	kg	1o8	151	
	kg			
	kg			
	kg			

Other Crops cultivated: Maize & Sorghum, Sorghum, Cowpeas, Pigeon Peas, Sunflower, Tobacco, Maize & Cowpeas, Cassava

1) Major crops only considered

2) Based on 1979 Census figures

KITUI DISTRICT

AEZ: UM (3–) 4 + LM 4 **TABLE 11 a: ASSETS, LAND USE, FARMING INTENSITY, INPUTS** Survey Area 49

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	5.2	25.1	1.3	2.4	0.4	2.4
Avg. 1	5.2	27.9	1.9	2.4	1.4	3.0
Up. Qu.	6.6	22.0	2.0	3.0	1.0	4.0
Lo. Qu.	2.1	3.0	-	2.0	-	1.0

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	2.1	41	0.1	3	2.3	44	-	-	0.4	8	0.2	4
Avg. 1	2.1	32	0.4	6	2.3	34	0.4	6	1.3	19	0.2	3
Up. Qu.	2.8	61	-	2	3.4	55	-	-	0.4	11	0.2	8
Lo. Qu.	1.0	34	-	-	0.6	21	-	-	-	-	0.1	3
Total	64.0		4.4		68.4		0.4		11.6		6.4	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.6	1.0	2.4	10.7
Avg. 1			2.4	31.3
Up. Qu.	2.0	1.9	5.2	21.2
Lo. Qu.	1.5	0.4	1.2	-

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	41.4	0.5	0.2	0.3	-	-	-	0.4	-	1.5	-	-	0.1
Avg. 1	45.6	16.1	4.5	7.9	-	-	-	0.9	-	2.3	0.1	-	0.5
Up. Qu.	50.0	-	-	-	-	-	-	0.5	-	1.3	-	-	-
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

KITUI DISTRICT

TABLE 11 b: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

AEZ: LM 4 + 5

Survey Area 50

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	5.4	22.1	2.2	2.7	0.4	2.0
Avg. 1	5.4	23.6	2.8	2.7	1.5	2.8
Up. Qu.	6.2	32.0	3.0	3.0	1.0	4.0
Lo. Qu.	3.2	8.0	1.0	2.0	-	-

Land Use

Range	Annual ha	Crops %	Perm. ha	Crops %	Pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	2.6	47	-	-	2.2	41	-	-	0.3	6	0.3	6
Avg. 1	2.6	38	0.4	6	2.4	35	0.2	3	0.8	12	0.4	5
Up. Qu.	3.2	73	-	-	2.2	47	-	-	0.3	11	0.2	6
Lo. Qu.	1.6	41	-	-	0.6	16	-	-	-	-	0.1	2
Total	76.6		0.4		65.8		0.2		9.0		9.9	

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	1.0	2.5	-
Avg. 1			2.3	-
Up. Qu.	1.8	2.1	7.3	-
Lo. Qu.	1.2	0.6	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	36.8	1.7	-	-	-	-	-	0.2	-	1.5	-	-	-
Avg. 1	42.2	32.0	-	-	-	-	-	0.5	0.1	2.0	-	-	-
Up. Qu.	42.9	-	-	-	-	-	-	0.1	-	2.4	-	-	-
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

KITUI DISTRICT

AEZ: UM (3–) 4 + LM 4

TABLE 12 a: CROPPING PATTERN

Survey Area 49

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.6	1.3	1.60	0.00	18.8	28.0
Maize IPC	0.1	0.9	0.00	0.00	2.6	3.9
Sorghum	0.0	0.3	0.00	0.00	0.6	0.9
Beans	0.5	0.9	1.20	0.00	14.8	22.0
Beans IPC	0.1	3.2	0.00	0.00	3.2	4.8
Cowpeas	0.1	0.4	0.00	0.00	2.3	3.5
Pigeonpeas	0.1	0.5	0.00	0.00	1.9	2.9
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	0.1	0.00	0.00	0.1	0.2
Cotton	0.0	0.2	0.00	0.00	0.2	0.3
Tobacco	0.2	1.2	0.00	0.00	7.5	11.1
Maize & Beans	0.4	1.2	0.80	0.00	12.8	19.1
Maize & Others	0.0	0.4	0.00	0.00	1.2	1.8
Maize int.oth.	0.0	0.8	0.00	0.00	0.8	1.2
Total					67.2	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.6	1.3	1.20	0.00	18.0	33.6
Maize IPC	0.1	0.7	0.00	0.00	2.0	3.7
Beans	0.5	0.9	1.00	0.00	13.8	25.8
Beans IPC	0.1	1.4	0.00	0.00	2.8	5.2
Cowpeas	0.1	0.3	0.00	0.00	1.5	2.8
Pigeonpeas	0.0	0.4	0.00	0.00	0.4	0.7
Others	0.0	0.6	0.00	0.00	0.6	1.1
Maize & Beans	0.4	1.3	0.80	0.00	12.6	23.5
Maize & Others	0.0	0.5	0.00	0.00	1.0	1.9
Maize int.oth.	0.0	0.8	0.00	0.00	0.8	1.5
Total					53.5	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Coffee	0.0	0.1	0.04	0.00	0.6	100.0
Total					0.6	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

KITUI DISTRICT

TABLE 12b: CROPPING PATTERN

AEZ: LM 4 + 5

Survey Area 50

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.6	1.3	1.60	0.00	18.6	25.8
Sorghum	0.1	0.4	0.00	0.00	2.2	3.1
Bulrushmillet	0.2	0.6	0.60	0.00	6.8	9.4
Beans	0.2	0.6	0.40	0.00	6.8	9.4
Cowpeas	0.1	0.3	0.00	0.00	1.6	2.2
Pigeonpeas	0.0	0.4	0.00	0.00	0.8	1.1
Sunflower	0.0	0.4	0.00	0.00	0.8	1.1
Cotton	0.3	0.6	0.40	0.00	9.4	12.9
Tobacco	0.1	0.9	0.00	0.00	2.6	3.6
Cassava	0.0	0.2	0.00	0.00	0.2	0.3
Others	0.1	0.6	0.00	0.00	3.0	4.1
Maize & BulMlt	0.0	0.3	0.00	0.00	0.3	0.4
Maize & Sorgm	0.0	0.2	0.00	0.00	0.2	0.3
Maize & Beans	0.2	0.8	0.40	0.00	6.5	9.0
Maize & Cowps	0.1	1.0	0.00	0.00	2.0	2.8
Maize & Others	0.3	1.3	0.20	0.00	8.9	12.3
Maize int.oth.	0.0	1.2	0.00	0.00	1.2	1.7
Total					72.3	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.6	1.3	1.20	0.00	18.4	34.9
Maize IPC	0.0	0.4	0.00	0.00	0.4	0.8
Bulrushmillet	0.2	0.6	0.40	0.00	5.0	9.5
Beans	0.3	0.7	0.40	0.00	8.7	16.5
Cowpeas	0.1	0.2	0.12	0.00	1.7	3.3
Sunflower	0.0	0.4	0.00	0.00	0.8	1.5
Tobacco	0.0	0.8	0.00	0.00	0.8	1.5
Cassava	0.0	0.2	0.00	0.00	0.2	0.4
Others	0.1	0.6	0.00	0.00	3.4	6.5
Maize & Beans	0.2	0.8	0.12	0.00	5.5	10.5
Maize & Cowps	0.1	1.0	0.00	0.00	2.0	3.8
Maize & Others	0.2	1.5	0.00	0.00	5.8	11.0
Total					52.7	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Tea	0.1	1.3	0.00	0.00	2.6	76.5
Coconuts	0.0	0.8	0.00	0.00	0.8	23.5
Total					3.4	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

KITUI DISTRICT

TABLE 13 a: HERD COMPOSITION (GRAZING LIVESTOCK)

- in Head & Livestock Units -

AEZ: UM (3–) 4 + LM 4

Jan. '78, Survey Area 49

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	-	-	0.17				0.07			0.07
	Upper Qu.	-	-	-	-				-			-
1 - 2 years,	Average	0.03	-	-	0.10				0.07			0.07
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	-	-	0.23		0.27			0.45			0.45
	Upper Qu.	-	-	-		-			-			-
Subtotal(improved)	Total	4	-	7	8	8			17.6			17.6
	Average	0.13	-	0.23	0.27	0.27			0.59			0.59
	Upper Qu.	-	-	-	-	-			0.5			-
	Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =		38.9 % of total cattle,				Calves + Heifers =			100.0 % of dairy cows			
Unimproved Livestock:												
Under 1 year,	Average	0.40	0.03	-	0.60		0.67	4.23	0.70	-		0.70
	Upper Qu.	-	-	-	1		-	4	0.6	-		0.6
1 - 2 years,	Average	0.43	-	0.13	0.87				0.64			0.64
	Upper Qu.	-	-	-	1				0.5			0.5
Over 2 years,	Average	0.20	0.03	0.33		2.30	2.93	10.57	3.54	-	31.40	3.54
	Upper Qu.	-	-	2		3	-	6	0.7	-	11	0.7
Subtotal (unimp.)	Total	31	2	29	44	69	108	444	146.4	-	942	146.4
	Average	1.03	0.07	0.97	1.47	2.30	3.60	14.30	4.88	-	31.40	4.88
	Upper Qu.	1	-	2	2	3	-	10	5.6	-	25	5.6
	Lower Qu.	-	-	-	-	1	-	-	1.2	-	11	1.2
LU Male Cattle =		34.0 % of total cattle,				Calves + Heifers =			63.8 % of dairy cows			
LU Goats + Sheep =		37.7 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	35	2	36	52	77	108	444	164.0	-	942	164.0
	Average	1.17	0.07	1.20	1.73	2.57	3.60	14.80	5.47	-	31.40	5.47
	Upper Qu.	2	-	2	3	4	-	10	6.1	-	25	5.5
	Lower Qu.	-	-	-	-	1	-	-	1.5	-	11	1.2
LU Male Cattle =		34.3 % of total cattle,				Calves + Heifers =			67.5 % of dairy cows			
LU Goats + Sheep =		33.7 % of total Grazing Livestock Units										

Livestock Unit (LU) key: Improved Stock = Under 1 year 0.25 LU, 1–2 yrs 0.5 LU, Over 2 years 0.8 LU, cows 1 LU

Unimproved Stock = Under 1 year 0.20 LU, 1–2 yrs 0.45 LU, Over 2 years 0.65 LU, cows 0.65 LU

Goats/Sheep/Pigs = Under 1 year 0.10 LU, Over 1 year 0.15 LU

TABLE 13 b: **HERD COMPOSITION (GRAZING LIVESTOCK)**

- in Head & Livestock Units -

AEZ: LM 4 + 5

Feb. '78, Survey Area 50

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	2.40	-	-	0.67		0.23	3.33	0.97	-		0.97
Upper Qu.	1	-	-	1		-	5	0.9	-		0.9
1 - 2 years, Average	0.23	-	0.07	1.07				0.61			0.61
Upper Qu.	-	-	-	2				0.9			0.9
Over 2 years, Average	0.47	0.30	1.77		2.10	0.57	8.87	3.95	-	26.50	3.95
Upper Qu.	-	-	2		3	-	15	0.2	-	8	0.2
Subtotal (unimp.) Total	93	9	55	52	63	24	366	166.2	-	795	166.2
Average	3.10	0.30	1.83	1.73	2.10	0.80	12.20	5.54	-	26.50	5.54
Upper Qu.	2	-	2	3	3	-	21	9.0	-	30	9.0
Lower Qu.	-	-	-	-	-	-	3	2.6	-	8	2.6
LU Male Cattle =	53.3 % of total cattle,				Calves + Heifers =			82.5 % of dairy cows			
LU Goats + Sheep =	23.5 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	93	9	55	52	63	24	366	166.2	-	795	166.2
Average	3.10	0.30	1.83	1.73	2.10	0.80	12.20	5.54	-	26.50	5.54
Upper Qu.	2	-	2	3	3	-	21	9.0	-	30	9.0
Lower Qu.	-	-	-	-	-	-	3	2.6	-	8	2.6
LU Male Cattle =	53.3 % of total cattle,				Calves + Heifers =			82.5 % of dairy cows			
LU Goats + Sheep =	23.5 % 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

KITUI DISTRICT

TABLE 14a: INPUTS & YIELDS OF MAJOR CROPS

AEZ: UM (3–) 4 + LM 4

Survey Area 49

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.	60	-	2	-	1.00	2	-	1,283
	UpQu	100	-	-	-	1.25	3	-	1,575
	LoQu	-	-	-	-	-	-	-	675
Beans	Avg.	-	-	-	-	0.25	-	-	656
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	400
Cowpeas	Avg.	17	-	-	-	0.13	-	-	813
	UpQu	-	-	-	-	-	-	-	900
	LoQu	-	-	-	-	-	-	-	350
Maize & Beans									
Maize	Avg.	89	-	-	-	2.37	-	-	998
Beans	Avg.	-	-	-	-	-	-	-	415
Maize	UpQu	100	-	-	-	0.31	-	-	1,125
Beans	UpQu	-	-	-	-	-	-	-	563
Maize	LoQu	100	-	-	-	-	-	-	450
Beans	LoQu	-	-	-	-	-	-	-	200
Second Rains									
Maize	Avg.	59	-	2	-	0.40	3	3	1,096
	UpQu	100	-	-	-	0.75	6	6	1,125
	LoQu	-	-	-	-	-	-	-	540
Sorghum	Avg.	-	-	-	-	-	-	-	600
Beans	Avg.	-	-	-	-	0.27	-	-	572
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	250
Cowpeas	Avg.	-	-	-	-	0.15	-	-	882
	UpQu	-	-	-	-	-	-	-	1,075
	LoQu	-	-	-	-	-	-	-	600
Pigeonpeas	Avg.	-	-	-	-	-	-	-	2,167
Cotton	Avg.	100	-	-	-	-	-	-	500
Tobacco	Avg.	100	22	-	-	-	34	34	1,404
	UpQu	100	-	-	-	-	49	49	1,467
	LoQu	100	-	-	-	-	7	7	1,042
Perennial Crops									
Coffee	Avg.	-	27	-	-	2.08	5	8	793
	UpQu	-	-	-	-	-	-	-	556
	LoQu	-	-	-	-	-	-	-	-

KITUI DISTRICT

TABLE 14b: INPUTS & YIELDS OF MAJOR CROPS

AEZ: LM 4 + 5

Survey Area 50

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.	81	4	-	-	0.48	1	-	1,750
	UpQu	100	-	-	-	0.31	1	-	1,806
	LoQu	100	-	-	-	-	-	-	1,350
Bulrushmillet	Avg.	-	-	-	-	0.08	-	-	985
	UpQu	-	-	-	-	-	-	-	1,125
	LoQu	-	-	-	-	-	-	-	375
Beans	Avg.	-	-	-	-	-	1	-	661
	UpQu	-	-	-	-	-	-	-	900
	LoQu	-	-	-	-	-	-	-	450
Cowpeas	Avg.	14	-	-	-	-	2	-	463
	UpQu	-	-	-	-	-	2	-	500
	LoQu	-	-	-	-	-	-	-	200
Maize & Cowps									
Maize	Avg.	-	-	-	-	-	-	-	1,650
Cowps	Avg.	-	-	-	-	-	-	-	2,250
Second Rains									
Maize	Avg.	71	4	-	-	0.26	2	2	1,696
	UpQu	100	-	-	-	0.28	3	3	2,025
	LoQu	-	-	-	-	-	-	-	1,294
Sorghum	Avg.	-	-	-	-	-	-	-	1,233
	UpQu	-	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	200
Bulrushmillet	Avg.	-	-	-	-	-	-	-	731
	UpQu	-	-	-	-	-	-	-	1,200
	LoQu	-	-	-	-	-	-	-	350
Beans	Avg.	-	-	-	-	0.03	2	2	714
	UpQu	-	-	-	-	-	-	-	900
	LoQu	-	-	-	-	-	-	-	500
Cowpeas	Avg.	-	-	-	-	-	4	4	373
	UpQu	-	-	-	-	-	8	8	450
	LoQu	-	-	-	-	-	-	-	-
Pigeonpeas	Avg.	-	-	-	-	-	-	-	1,575
Cotton	Avg.	68	3	-	-	0.19	19	19	1,083
	UpQu	100	-	-	-	-	24	24	1,575
	LoQu	-	-	-	-	-	-	-	400
Cassava	Avg.	-	-	-	-	-	-	-	6,475
Perennial Crops									

KITUI DISTRICT

TABLE 15 a: DISPOSAL OF CROPS

AEZ: UM (3–) 4 + LM 5 — Survey Area 49

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	17,460	0	0	6,570	38	10,890	62
Maize & Beans	22,715	2,960	13	8,575	38	11,180	49
Maize & Others	1,130	0	0	0	0	1,130	100
Maize IPC	2,700	0	0	1,440	53	1,260	47
Maize int.oth.	680	0	0	350	51	330	49
Beans	7,960	0	0	4,295	54	3,665	46
Beans IPC	490	0	0	240	49	250	51
Cowpeas	1,550	0	0	740	48	810	52
Cabbage	500	0	0	300	60	200	40
Onions	135	0	0	110	81	25	19
Tomatoes	275	0	0	230	84	45	16
Second Rains							
Maize	19,350	0	0	9,450	49	9,900	51
Maize & Beans	22,060	1,980	9	7,885	36	12,195	55
Maize & Others	1,370	0	0	0	0	1,370	100
Maize IPC	1,800	0	0	675	38	1,125	63
Maize int.oth.	870	0	0	630	72	240	28
Beans	7,210	0	0	3,620	50	3,590	50
Sorghum	390	0	0	200	51	190	49
Cowpeas	1,260	0	0	550	44	710	56
Cotton	100	100	100	0	0	0	0
Tobacco	10,345	9,345	90	0	0	1,000	10
Cabbage	500	0	0	300	60	200	40
		Permanent Crops					
Nil							

KITUI DISTRICT

TABLE 15 b: DISPOSAL OF CROPS

AEZ: LM 4 + 5 — Survey Area 50

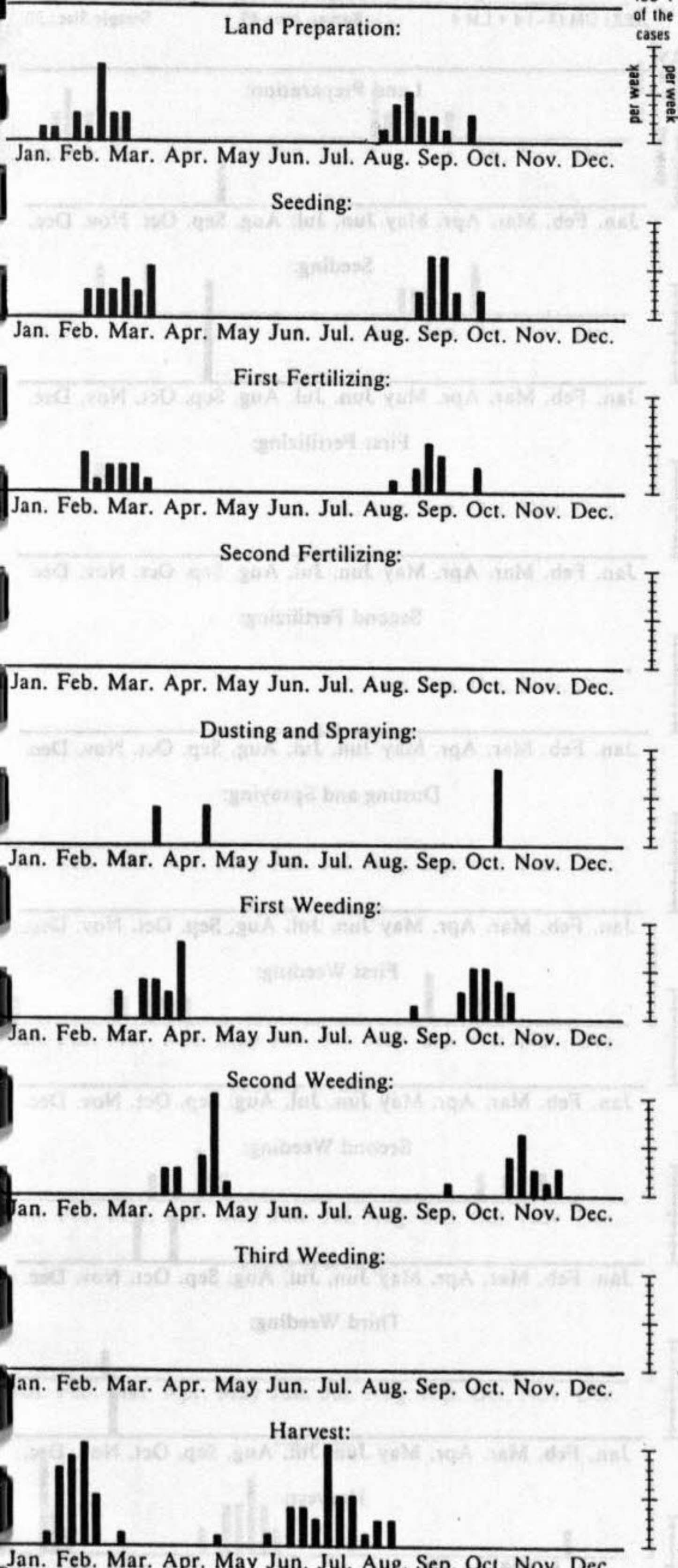
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	33,130	1,350		16,920	51	14,860	45
Maize & Beans	10,312	0	0	1,920	19	8,392	81
Maize & BulMlt	727	0	0	0	0	727	100
Maize & Sorgm	581	0	0	0	0	581	100
Maize & Cowps	6,240	0	0	240	4	6,000	96
Maize & Others	9,100	0	0	3,200	35	5,900	65
Maize int.oth.	2,650	0	0	1,350	51	1,300	49
Beans	4,020	0	0	2,060	51	1,960	49
Bulrushmillet	5,340	0	0	1,470	28	3,870	72
Cowpeas	815	0	0	160	20	655	80
Sunflower	450	450	100	0	0	0	0
Tobacco	150	150	100	0	0	0	0
Second Rains							
Maize	32,904	0	0	15,930	48	16,974	52
Maize & Beans	8,067	0	0	1,040	13	7,027	87
Maize & Cowps	4,490	0	0	160	4	4,330	96
Maize & Others	14,680	280	2	6,490	44	7,910	54
Maize IPC	540	0	0	0	0	540	100
Maize int.oth.	2,990	0	0	840	28	2,150	72
Beans	5,175	0	0	2,326	45	2,849	55
Bulrushmillet	2,890	0	0	1,010	35	1,880	65
Sorghum	1,870	0	0	680	36	1,190	64
Cowpeas	540	0	0	16	3	524	97
Sunflower	420	420	100	0	0	0	0
Cotton	10,730	10,530	98	0	0	200	2
Tobacco	2,260	760	34	0	0	1,500	66
		Permanent Crops					
Nil							

KITUI DISTRICT

TABLE 16 a: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 1 | Maize | Cases: 32[1)]

AEZ: UM(3–) 4 + LM4 | Survey Area 49 | Sample Size: 30



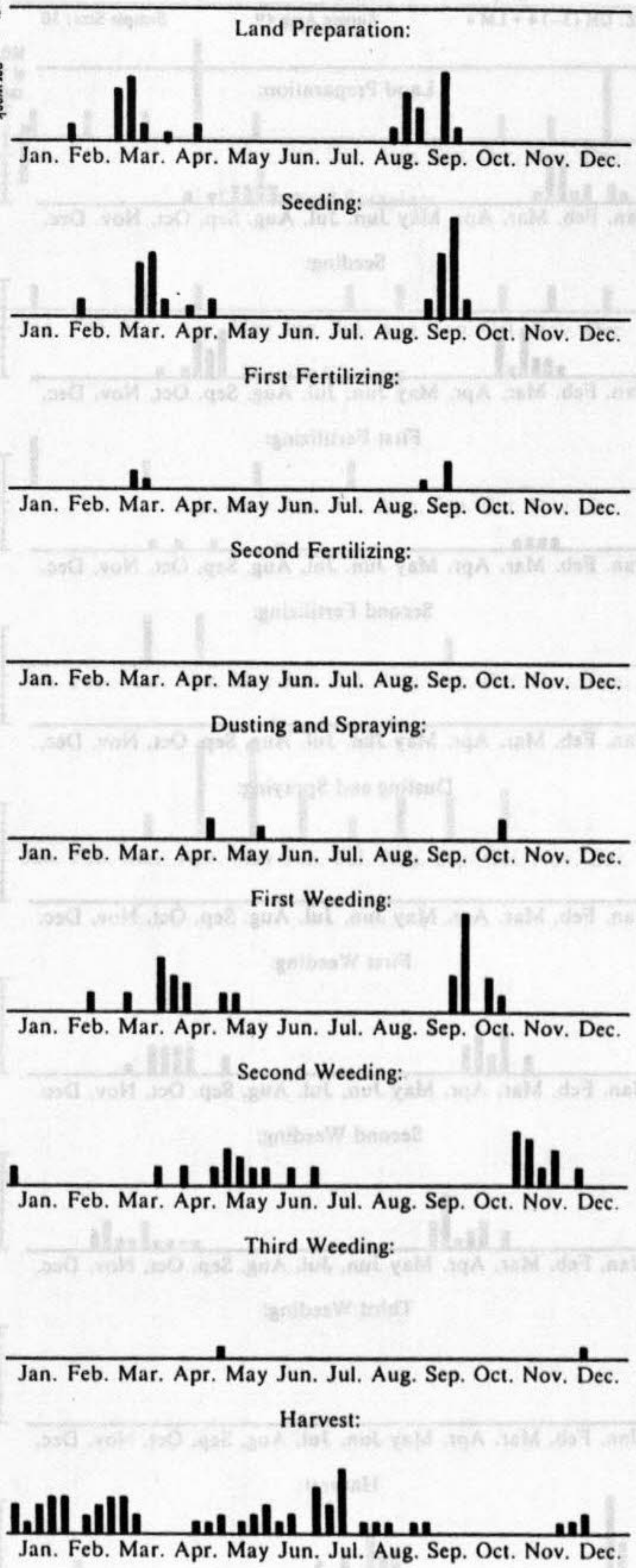
1) Maximum 30 per crop and season

KITUI DISTRICT

TABLE 16 b: **DISTRIBUTION OF FARMING ACTIVITIES**

Crop 2 | Maize & Beans | Cases: 42[1)]

AEZ: UM (3–) 4 + LM 4 | Survey Area 49 | Sample Size: 30



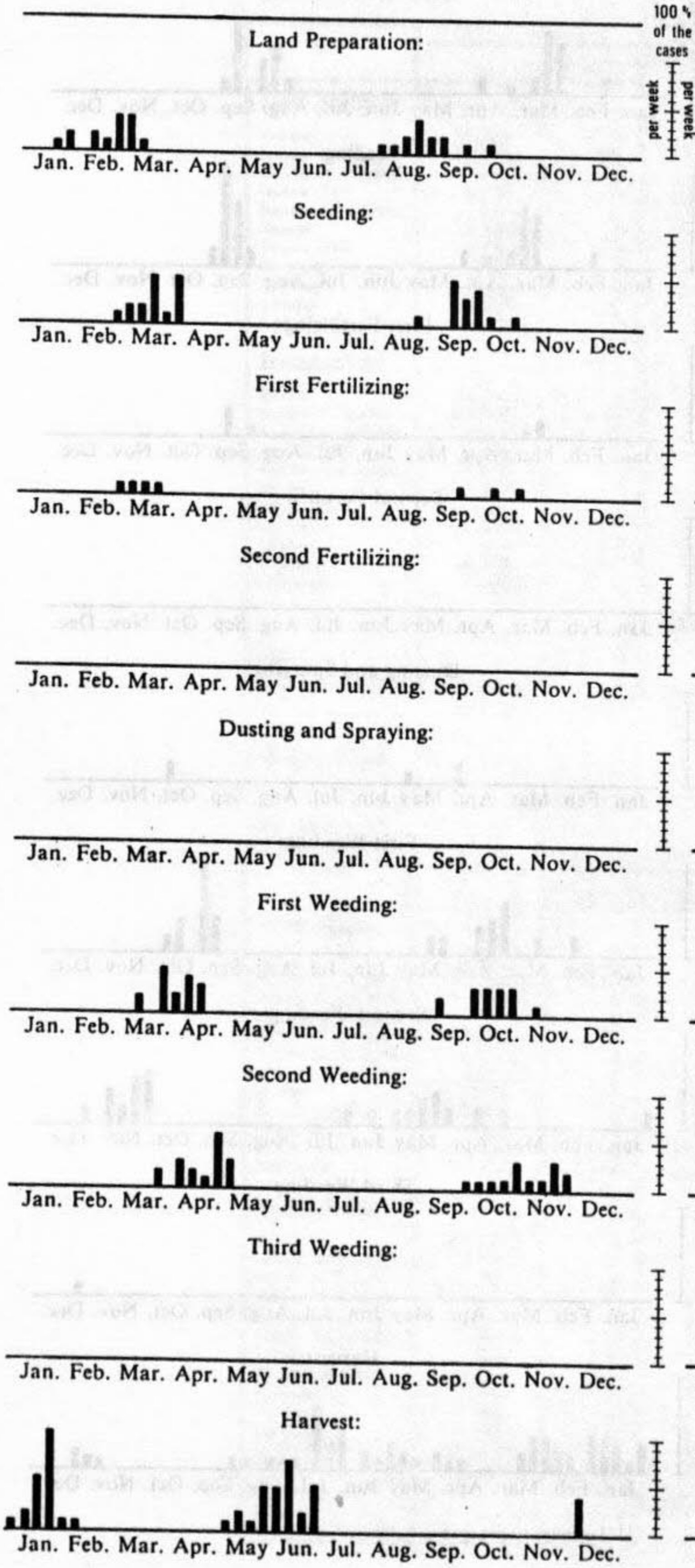
1) Maximum 30 per crop and season

KITUI DISTRICT

TABLE 16 c: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 32 1)

AEZ: UM (3–) 4 + LM 4 Survey Area 49 Sample Size: 30



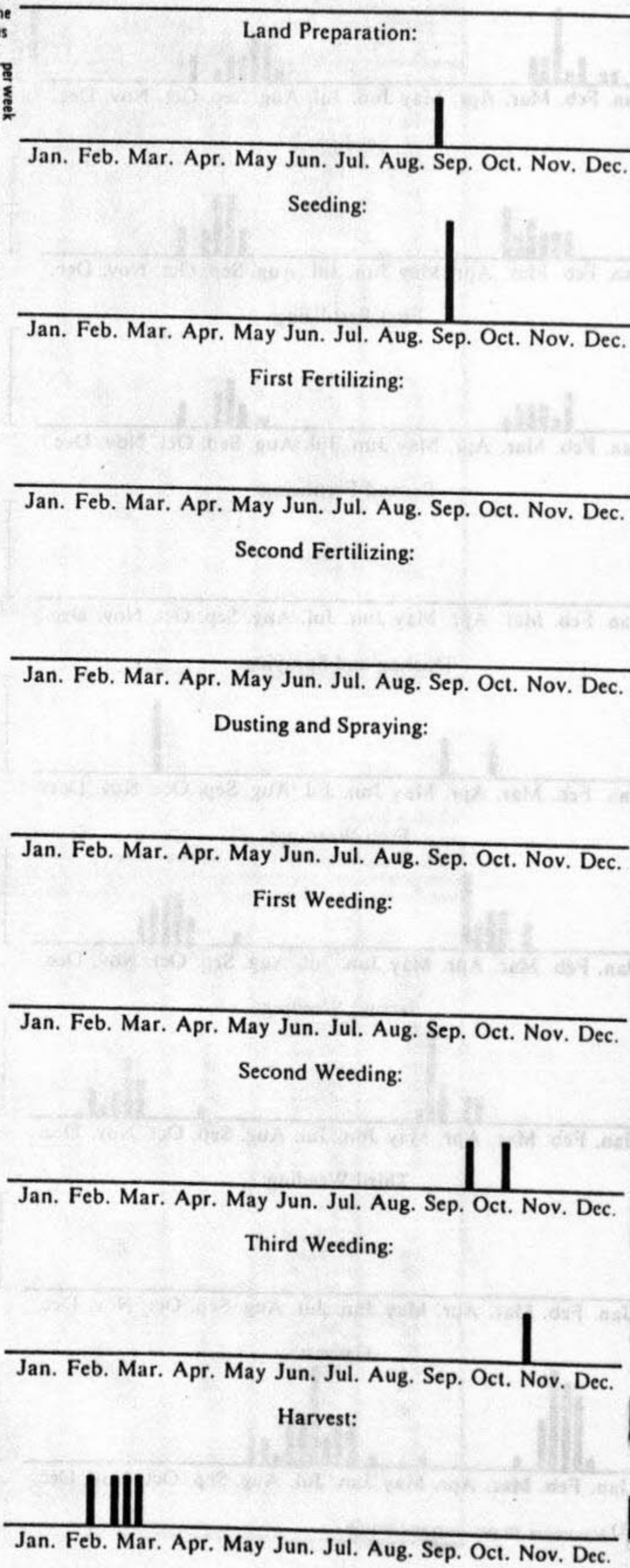
1) Maximum 30 per crop and season

KITUI DISTRICT

TABLE 16 d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 18 Sorghum Cases: 2

AEZ: UM (3–) 4 + LM 4 Survey Area 49 Sample Size: 30

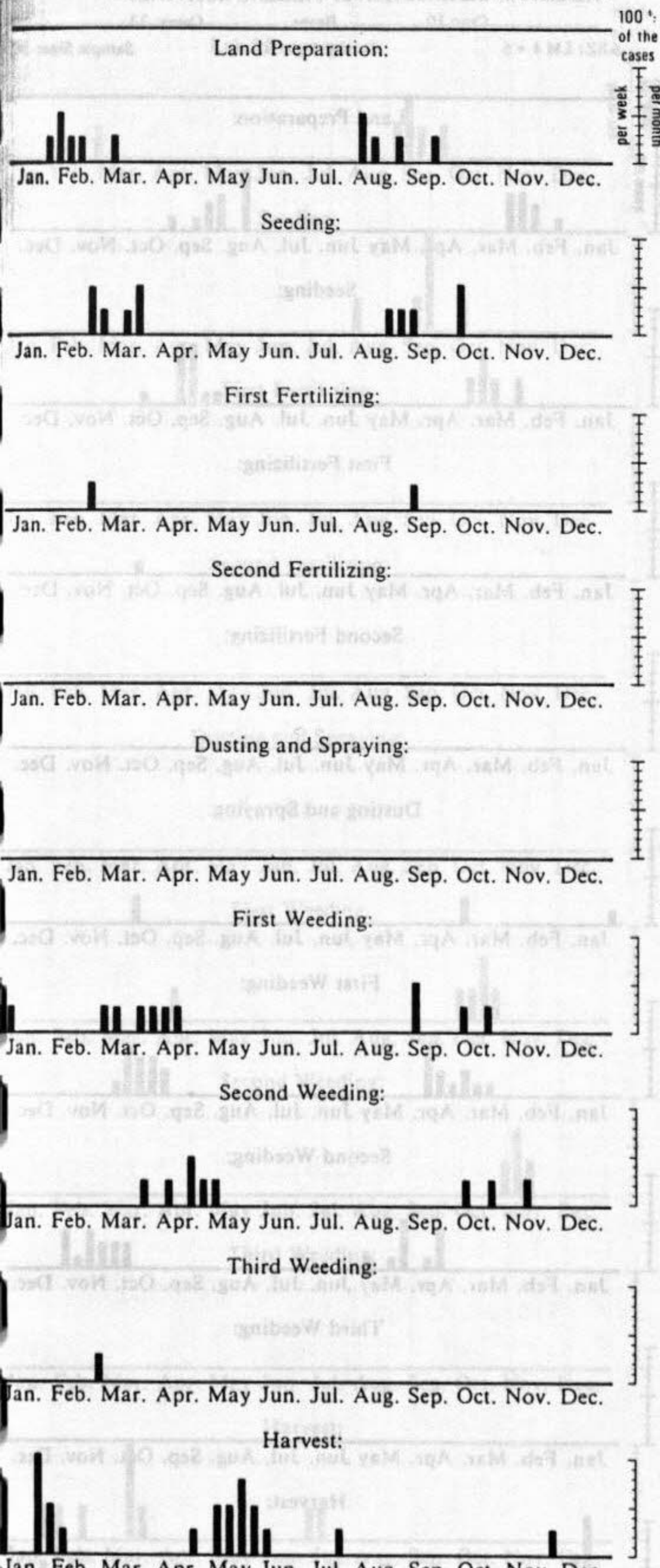


KITUI DISTRICT

TABLE 16 e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 20 Cowpeas Cases: 11

AEZ: UM (3–) 4 + LM 4 Survey Area 49 Sample Size: 30

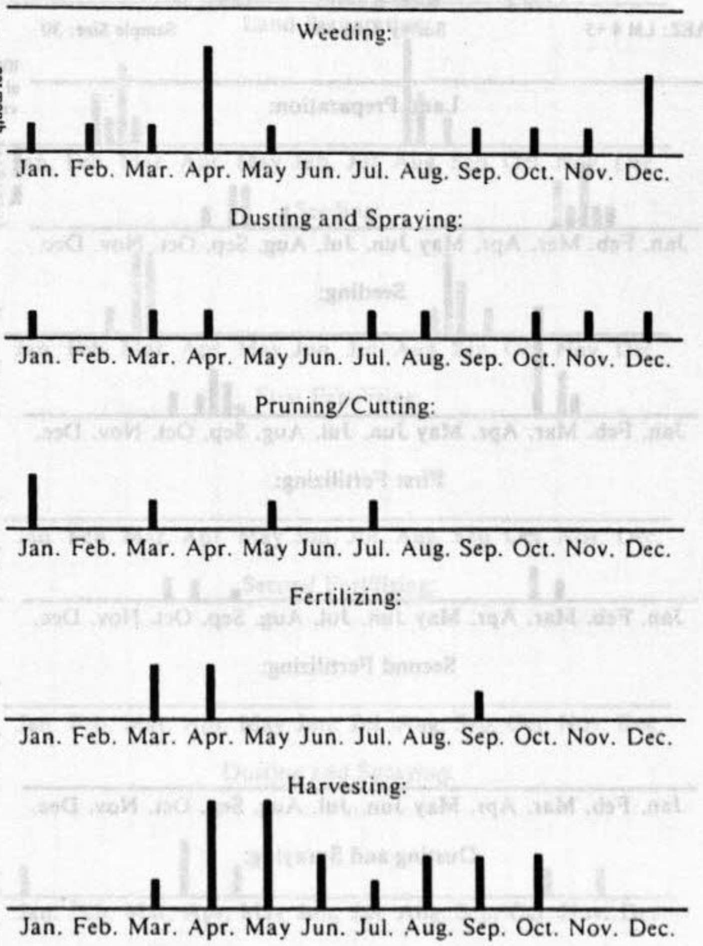


KITUI DISTRICT

TABLE 16 f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 6

AEZ: UM (3–) 4 + LM4 Survey Area 49 Sample Size: 30

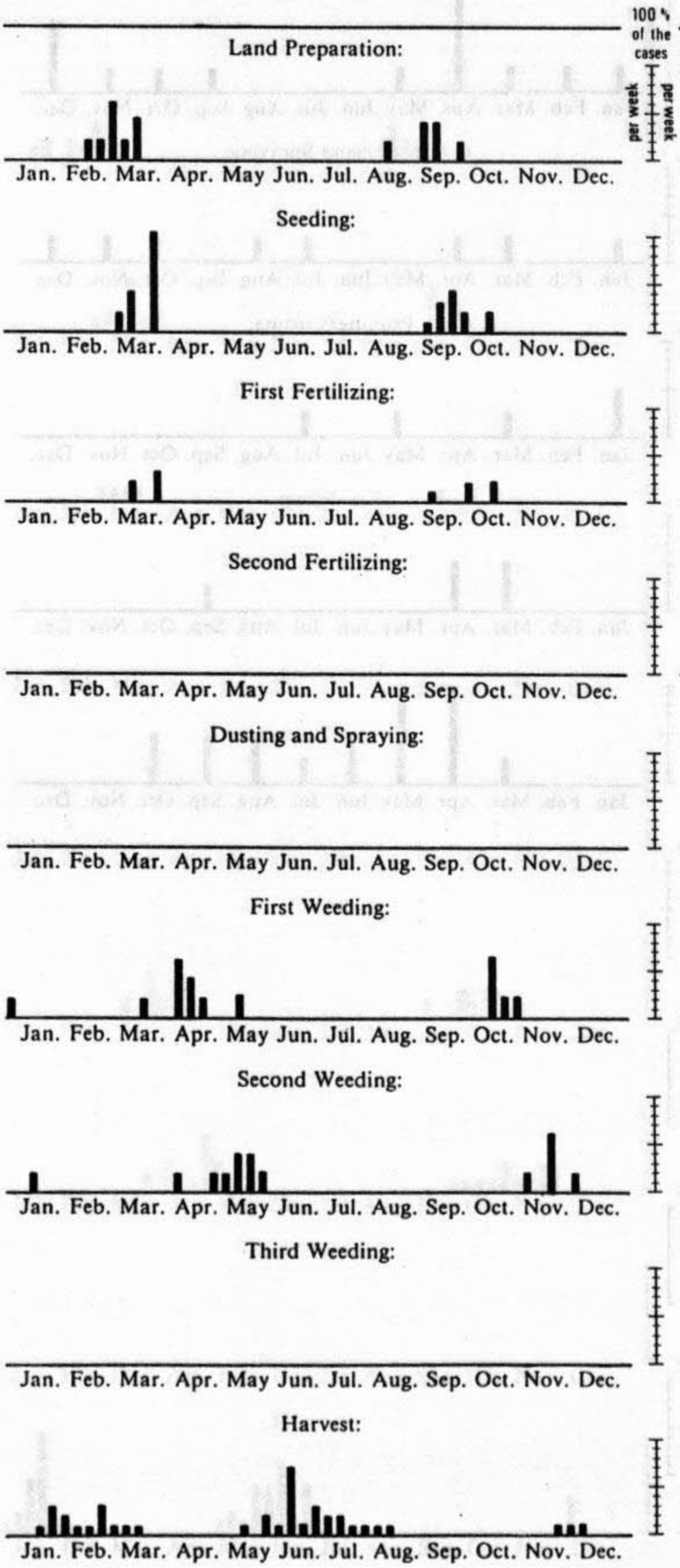


KITUI DISTRICT

TABLE 16g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 | Maize & Beans | Cases: 28

AEZ: LM 4 +5 | Survey Area 50 | Sample Size: 30

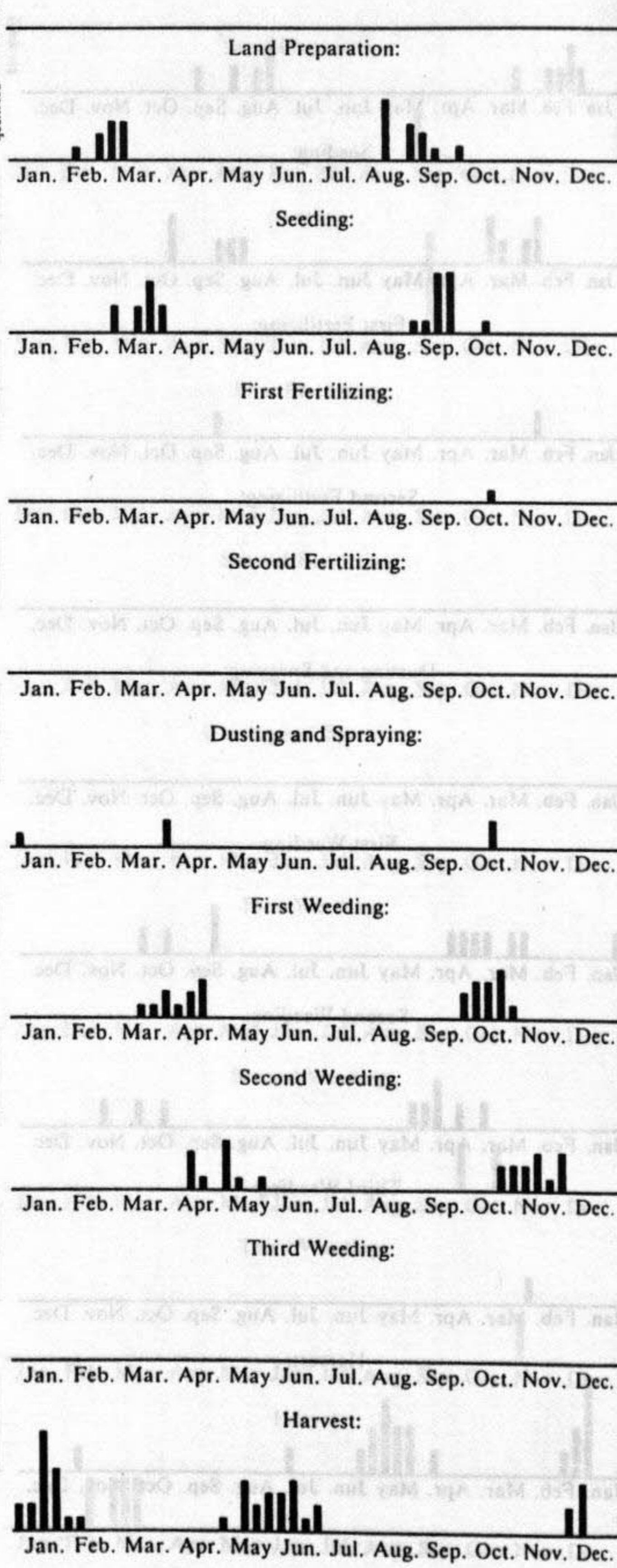


KITUI DISTRICT

TABLE 16h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 | Beans | Cases: 23

AEZ: LM 4 + 5 | Survey Area 50 | Sample Size: 30

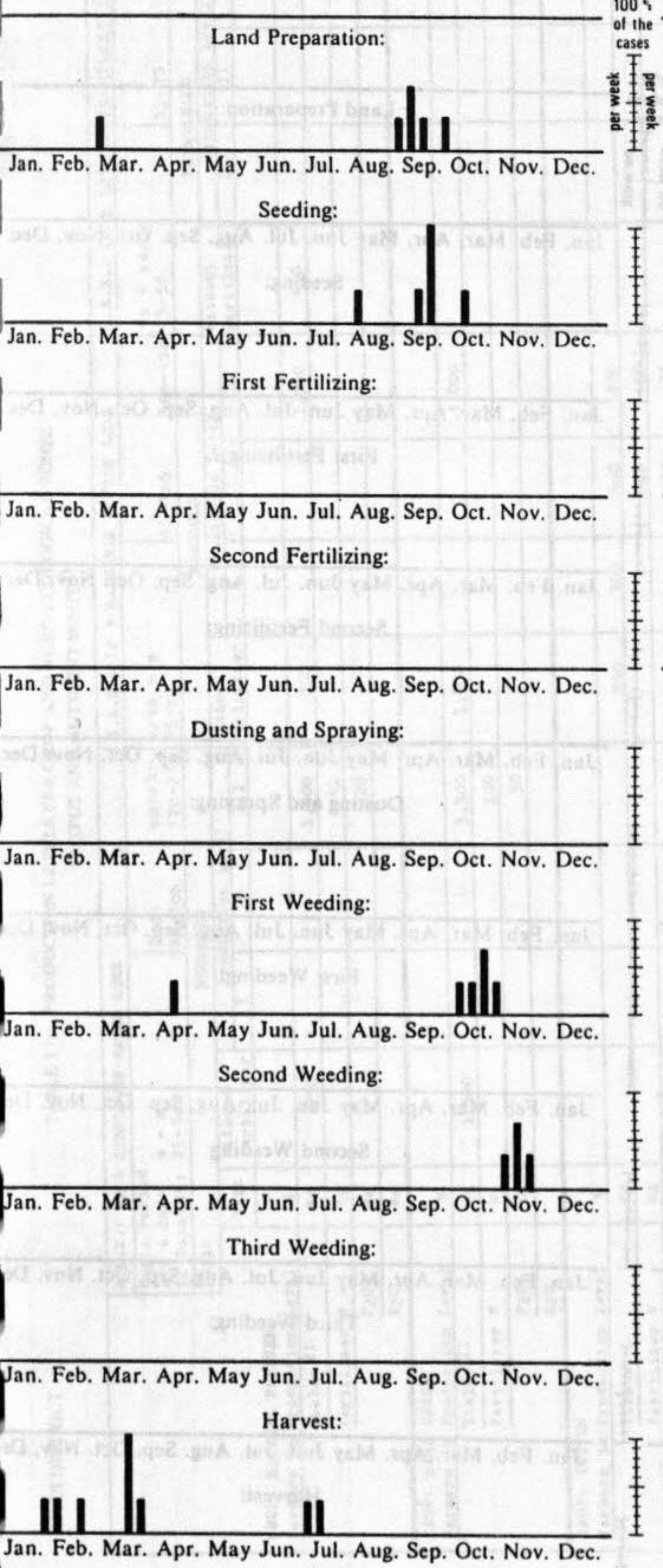


KITUI DISTRICT

TABLE 16 i: DISTRIBUTION OF FARMING ACTIVITIES

Crop 18 Sorghum Cases: 6

AEZ: LM 4 + 5 Survey Area 50 Sample Size: 30

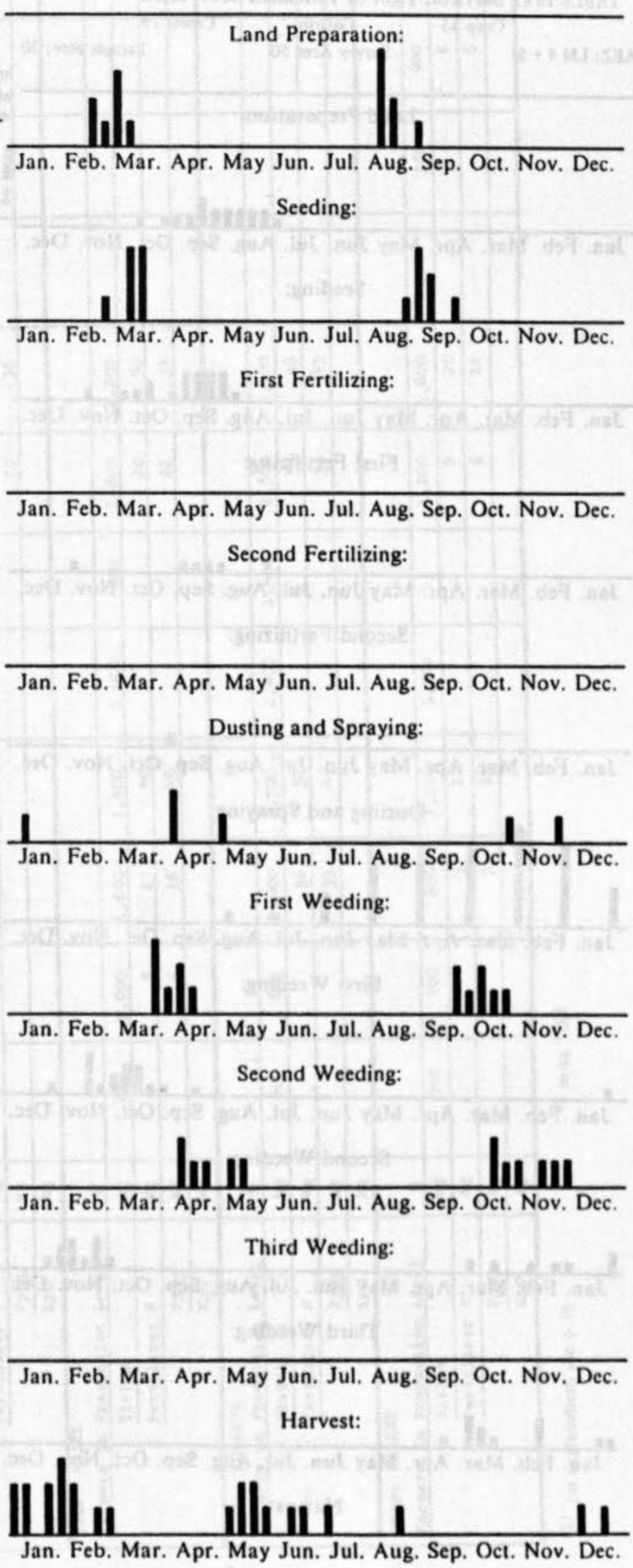


KITUI DISTRICT

TABLE 16 j: DISTRIBUTION OF FARMING ACTIVITIES

Crop 20 Cowpeas Cases: 14

AEZ: LM 4+ 5 Survey Area 50 Sample Size: 30

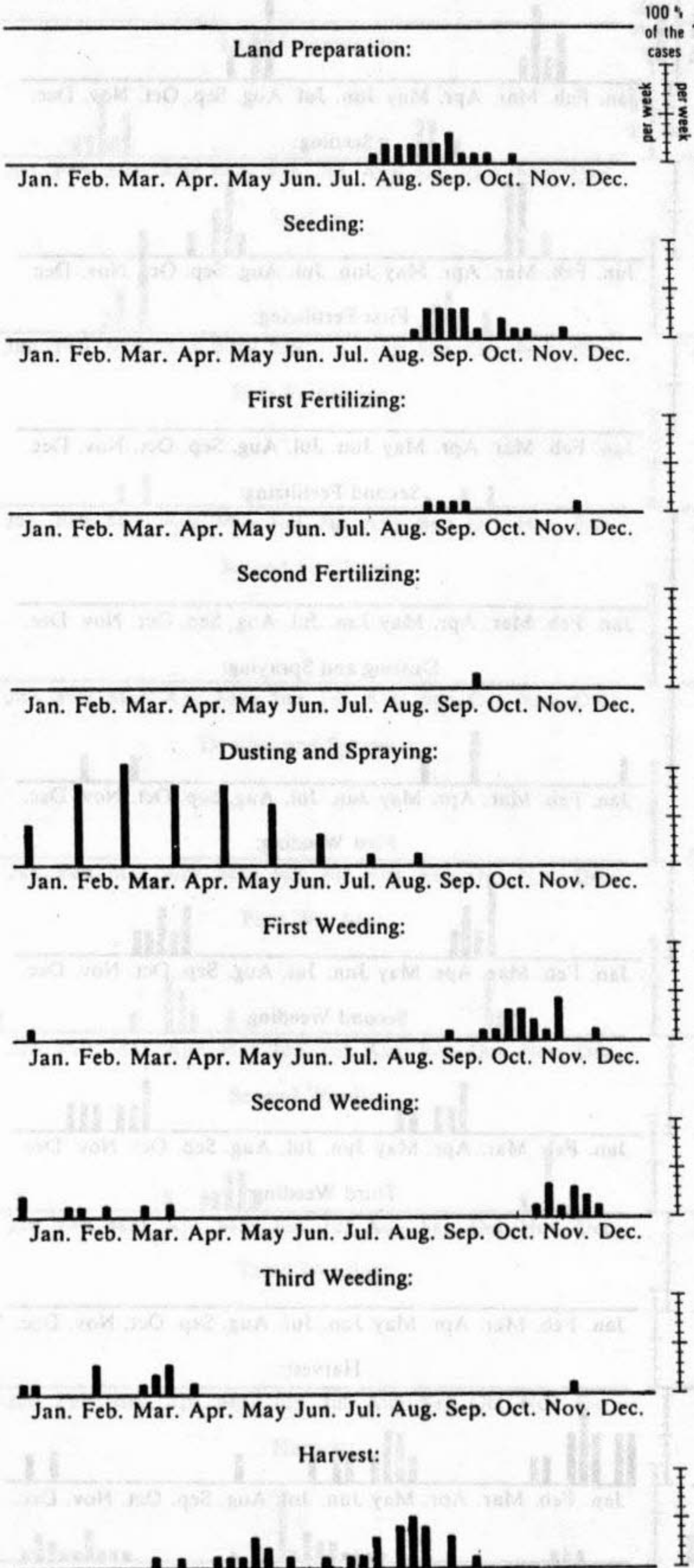


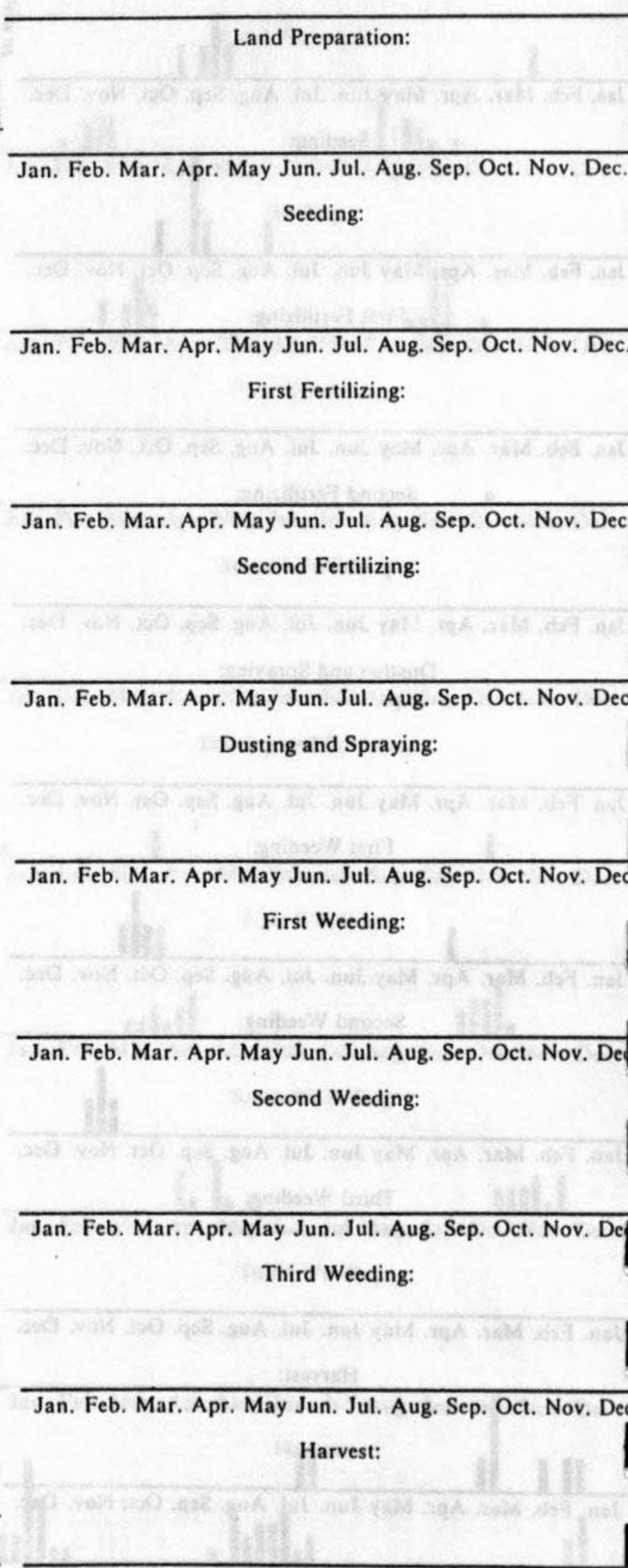
KITUI DISTRICT

TABLE 16 k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 35 Cotton Cases: 19

AEZ: LM 4 + 5 Survey Area 50 Sample Size: 30





KITUI DISTRICT

TABLE 17a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES OUTPUT AND NUTRIENT INPUT[1)]

		A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 LIVESTOCK-MILLET ZONE			
Vegt. Period 1st + 2nd: in Days, 1st:		s + s 85-105	2nd: 85-105	total: 170-210		s/vs + s 75-85		85-105	160-190	vs + vs/s 45-55		55-75	–
Soil:		REGOSOLS				REGOSOLS				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													
Farmers in Production Level	%												
Yields 2)	kg	750			1,500	750			1,500	450			900
Fertilizer N	kg				41								
P_2O_5	kg				20								
K_2O	kg												
CROP: BANA GRASS													
Farmers in Production Level	%												
Yields 2)	kg	1,500			3,300	1,500			3,000				
Fertilizer N	kg				100								
P_2O_5	kg				50								
K_2O													
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg					350	300	600	800				
Fertilizer N	kg							28	50				
P_2O_5	kg							20	36				
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	800	1,000	1,800	2,400	1,000	800	1,800	2,200				
Fertilizer N	kg		5	25	40			20	30				
P_2O_5	kg		6	28	45			22	34				
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	800	600	2,000	2,500	1,400	1,400	2,500	3,000				
Fertilizer N	kg			36	51			33	48				
P_2O_5	kg			33	47			30	43				
K_2O	kg												
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg	700	400	800	1,200	1,000		1,200	1,600	700	300	900	1,400
Fertilizer N	kg			5	18			8	20			8	22
P_2O_5	kg			5	16			6	16			6	18
K_2O	kg												

1) for explanations see p. 16

2) in kg TDN

KITUI DISTRICT

TABLE 17b: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES OUTPUT AND NUTRIENT INPUT

		A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE				A.E.Z.: LM 5 LIVESTOCK-MILLET ZONE			
		Vegt. Period 1st + 2nd: s + s in Days, 1st: 85-1o5		2nd: 85-1o5	total: 17o-21o	s/vs + s 75-85		85-1o5	16o-19o	vs + vs/s 45-55		55-75	—
		Soil: REGOSOLS				REGOSOLS				FERRALSOLS			
	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	300	600	800	600	400	700	1,000				
Fertilizer N	kg			5	14			5	10				
P_2O_5	kg			3	9			4	7				
K_2O	kg												
CROP: GRAMS													
Farmers in Production Level	%												
Yields	kg					750	400	900	1,200	600	300	600	700
Fertilizer N	kg							4	11				3
P_2O_5	kg							5	16				3
K_2O													
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	400		800	1,100	550		700	800				
Fertilizer N	kg			14	24			5	8				
P_2O_5	kg			20	34			7	12				
K_2O	kg												
CROP: GROUNDNUTS													
Farmers in Production Level	%												
Yields	kg					600		600	800				
Fertilizer N	kg								5				
P_2O_5	kg								6				
K_2O	kg												
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg					2,000	2,200	4,000	8,000				
Fertilizer N	kg						1	14	42				
P_2O_5	kg						1	14	42				
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	3,500	2,000	8,000	14,000	3.500	2,000	8,000	10,000				
Fertilizer N	kg			18	42			18	26				
P_2O_5	kg			32	75			32	46				
K_2O	kg												

COAST PROVINCE

TAITA-TAVETA DISTRICT

Contents | District page

NATURAL POTENTIAL

INTRODUCTION

Taita District is a dry area, unsuitable for agriculture except in higher rain catchment areas (Taita Hills) and their foothills, and in Taveta Division where rainfall increases near Kilimanjaro or irrigation possibilities exist. The highest elevations of the Taita Hills may be included in the Lower Highland Zone. The effect of the southeastern trade wind are visible from the end of the first rains to September: the mountains are covered by clouds formed by condensation of moisture in the rising air. There would be enough moisture for pyrethrum cultivation (LH 2) but this part is very steep and has shallow soils.

The main part of the Taita Hills belongs to the Upper Midlands, zone 2 is missing, and we have only a Marginal Coffee Zone there (UM 3). Some valley bottoms are wetter and are suitable for vegetables; the surplus finds a ready market in Mombasa. The next zones downwards, UM 4 and LM 4, are mainly dominated by steep slopes so there is not much space for maize, sunflower, or cotton.

In the foothill zone, it is normally too dry for maize, but there is some scope for very early maturing new sorghum and millet varieties. Sisal is an alternative, although it tends to be marginal with the average annual rainfall quickly dropping below 500 mm a few kilometers away from the mountains.

The other green, mountainous "islands" in the "sea" of uncultivable thornbush (L 6) are smaller and less elevated but locally important, like the Kasigau or Sagala Hills. The Tsavo National Park is excluded for cultivation purposes and therefore not mapped here, but it would be almost all zone L 6, useless for farmers (see also WIJNGARDEN, W. van, ed.: Reconnaisance Soil and Vegetation Survey of the Tsavo Area. Kenya Soil Survey R 7, Nairobi 1980).

TAITA-TAVETA 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.
9337081 900 m	Taveta, Ziwani Sisal Estate	31	Average	530	37	31	85	122	64	9	3	4	8	25	78	65
			60% rel.[1]	421	13	3	52	68	40	1	0	0	2	11	48	40
9338001 560 m	Voi, Met. Station	71	Av.	545	32	70	81	93	29	7	3	8	15	28	99	122
			60 %	446	11	4	51	65	13	0	0	2	4	14	59	81
9338003 1 460 m	Wundanyi D.C.'s Office, Boma	71	Av.	1 332	57	43	146	268	140	41	31	52	59	100	218	176
			60 %	1 218	23	19	94	202	116	18	17	28	34	75	175	151
9338004 465 m	Tsavo Railway Station	34	Av.	351	23	21	48	58	15	2	1	2	4	7	68	102
			60 %	291	0	0	9	40	2	0	0	0	0	0	45	62
9338005 1 675 m	Wesu Hospital	36	Av.	1 415	43	41	136	282	189	35	35	55	68	121	234	176
			60 %	1 131	12	10	57	239	157	0	29	24	4	65	226	97
9338006 1 143 m	Bura Cath. Mission	32	Av.	958	36	40	109	222	109	18	13	17	33	86	174	101
			60 %	898	12	33	92	227	51	4	4	3	1	33	138	59
9338007 1 095 m	Maktau Station	38	Av.	451	13	28	93	97	42	8	6	5	12	25	66	57
			60 %	364	0	12	63	57	27	0	0	0	0	3	57	21
9338017 650 m	Tsavo Mzima Springs	21	Av.	402	39	16	57	92	31	4	2	3	6	13	60	80
			60 %	298	7	4	13	38	11	0	0	0	0	2	45	46
9338018 610 m	Rukanga Kasigau Location	24	Av.	709	35	25	111	97	70	26	13	28	25	58	118	103
			60 %	597	26	11	74	67	37	2	2	6	20	14	80	73
9338020 517 m	Maungu Railway Station	12	Av.	384	28	19	68	48	24	10	2	4	11	36	60	75
			60 %	305	0	0	0	12	12	0	0	0	0	10	55	76

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

TAITA-TAVETA DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ 1)	Kind of records	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Years of rec.
9338022	Bachuma	CL	Mean max.	33.0	33.2	33.6	32.0	29.6	28.3	27.8	27.5	28.8	30.4	31.6	31.6	30.6	5
396 m	Range	6	Mean temp.	26.4	26.6	26.9	26.0	24.4	22.9	22.5	22.2	23.2	24.7	25.8	26.0	24.8	
	Research		Mean min.	19.8	20.1	20.3	20.0	19.2	17.5	17.2	17.0	17.6	18.9	20.0	20.3	19.0	
	Station		Abs. min.	16.7	11.0	17.0	18.0	16.5	14.0	13.5	14.0	14.0	15.5	17.5	13.0	11.0	
9337110	Taveta	LM	Mean. max.	31.9	32.7	32.1	30.2	27.8	26.9	26.8	27.4	29.9	31.3	31.6	31.4	30.0	5
770 m	Water	5	Mean temp.	22.3	24.0	24.4	23.8	21.5	20.6	20.0	20.2	21.7	22.7	23.0	23.0	22.3	
	Develop.	lp	Mean min.	12.6	15.2	16.7	17.4	15.2	14.3	13.3	13.0	13.5	14.1	14.3	14.6	14.5	
	Station		Abs. min.	5.5	5.0	6.0	11.5	8.0	7.0	5.5	4.5	5.0	3.0	5.0	6.5	3.0	
9338001	Voi	CL	Mean max.	31.7	33.1	33.3	31.7	29.8	29.0	27.9	27.9	29.1	30.9	31.3	30.7	30.5	32
560 m	Met. Stat.	5	Mean temp.	25.9	26.7	27.1	25.9	24.9	23.6	22.6	22.5	23.3	24.9	25.7	25.6	24.9	
		hp	Mean min.	20.2	20.3	20.9	20.2	20.0	18.3	17.4	17.2	17.6	18.9	20.1	20.5	19.3	
			Abs. min.	15.5	13.0	15.4	17.7	12.7	13.4	12.8	9.6	12.9	14.1	15.0	16.0	9.6	
9338005	Wesu	UM	Mean max.	23.1	24.4	24.2	22.3	20.1	18.9	17.9	18.1	19.6	21.6	22.5	22.1	21.2	15
1 675 m	Hospital	3	Mean temp.	18.3	18.8	18.6	17.6	16.1	14.6	13.7	13.7	14.5	16.0	17.1	17.5	16.4	
	(operating	hp	Mean min.	13.5	13.3	13.1	12.9	12.1	10.4	9.6	9.3	9.5	10.5	11.8	12.9	11.6	
	to 1955)		Abs. min.	8.3	7.8	7.2	6.7	6.1	5.0	4.4	3.9	4.4	6.1	6.1	7.8	3.9	

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

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

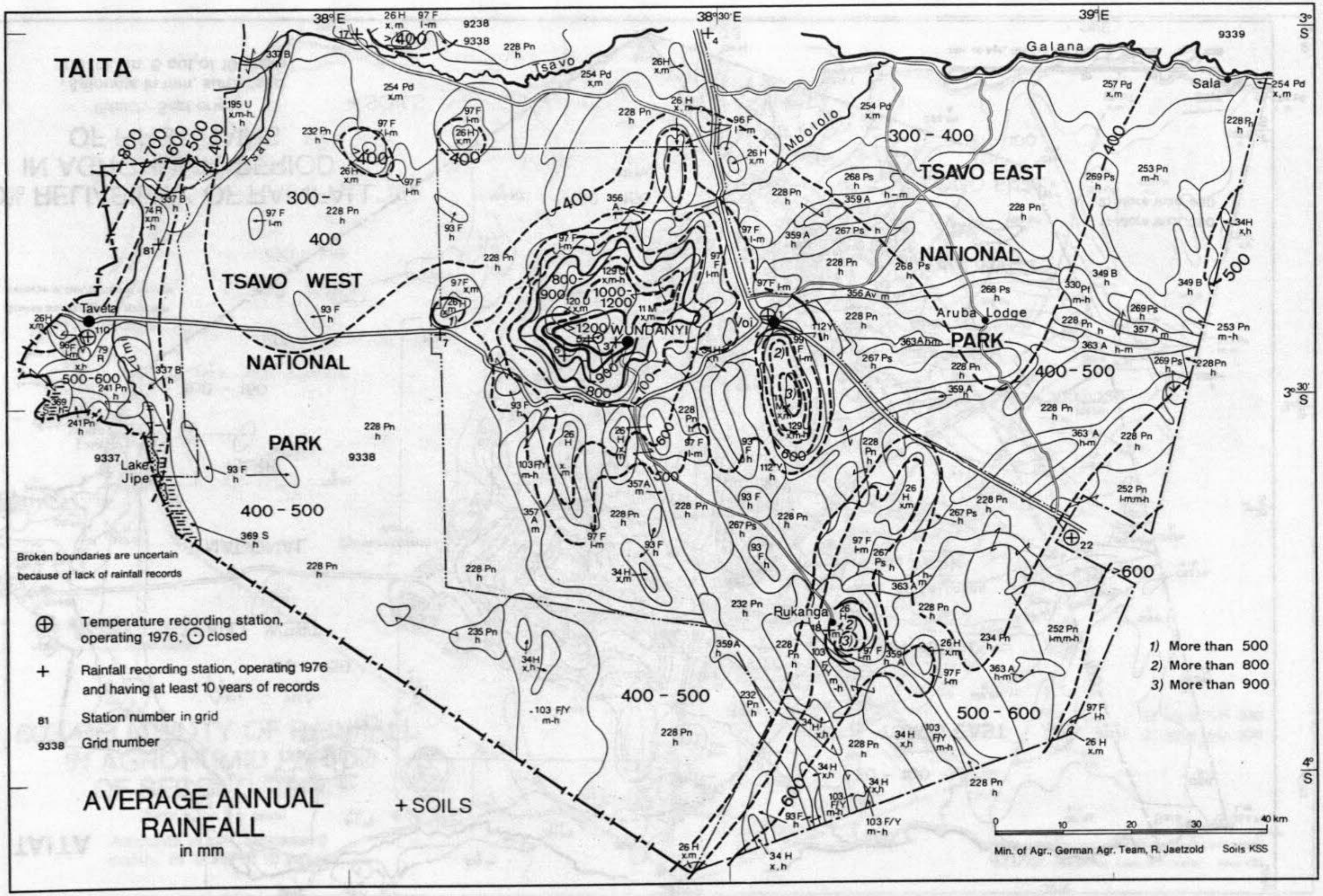
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall 1) 1st rains in mm	2nd rains in mm	60 % reliability of growing period 1st rains in days	2nd rains in days	Total 2) in days
LH 2 Wheat/Maize-Pyrethrum Zone	m + m/s				Very small				
UM 3 Marginal Coffee Zone	m/s + s/m	1 370–1 680	20.1–18.2	900–1 200	400–550	350–500	115–130	105–110	–
UM 4 Sunflower-Maize Zone	fs + s or s/vs	1 220–1 520	20.9–18.8	700– 900	250–400	270–400	85–115	85–105	–
LM 4 Marginal Cotton Zone	s/vs + vs/s	910–1 220	22.9–20.9	600– 800	190–360	180–300	75– 85	55– 75	–
	s/vs + s/vs				190–230	250–330	75– 85	75– 85	150–170 3)
LM 5 Lower Midland Livestock-Millet Zone	vs/s + vs	790– 980	23.5–22.4	550– 700	200–250	140–200	55– 75	45– 55	–
	vs/s + vs/s				Very small and unimportant				
	vs + i			480–620	140–200	120–150	45– 55	< 45	
LM 6 Lower Midland Ranching Zone	b r			No rainfed agriculture possible 4)					
L5 Lowland Livestock-Millet Zone	(vs) + (vs/s)	610– 790	24.6–23.5	550– 680	125–200	160–210	40– 55	50– 75	–
	(vs)+i or i+(vs)			520– 650	150–200	150–180	40– 50	40– 50	–
	(vs) + i			480– 600	140–190	120–150	40– 50	< 40	–
L 6 Lowland Ranching Zone	b r			No rainfed agriculture possible 4)					

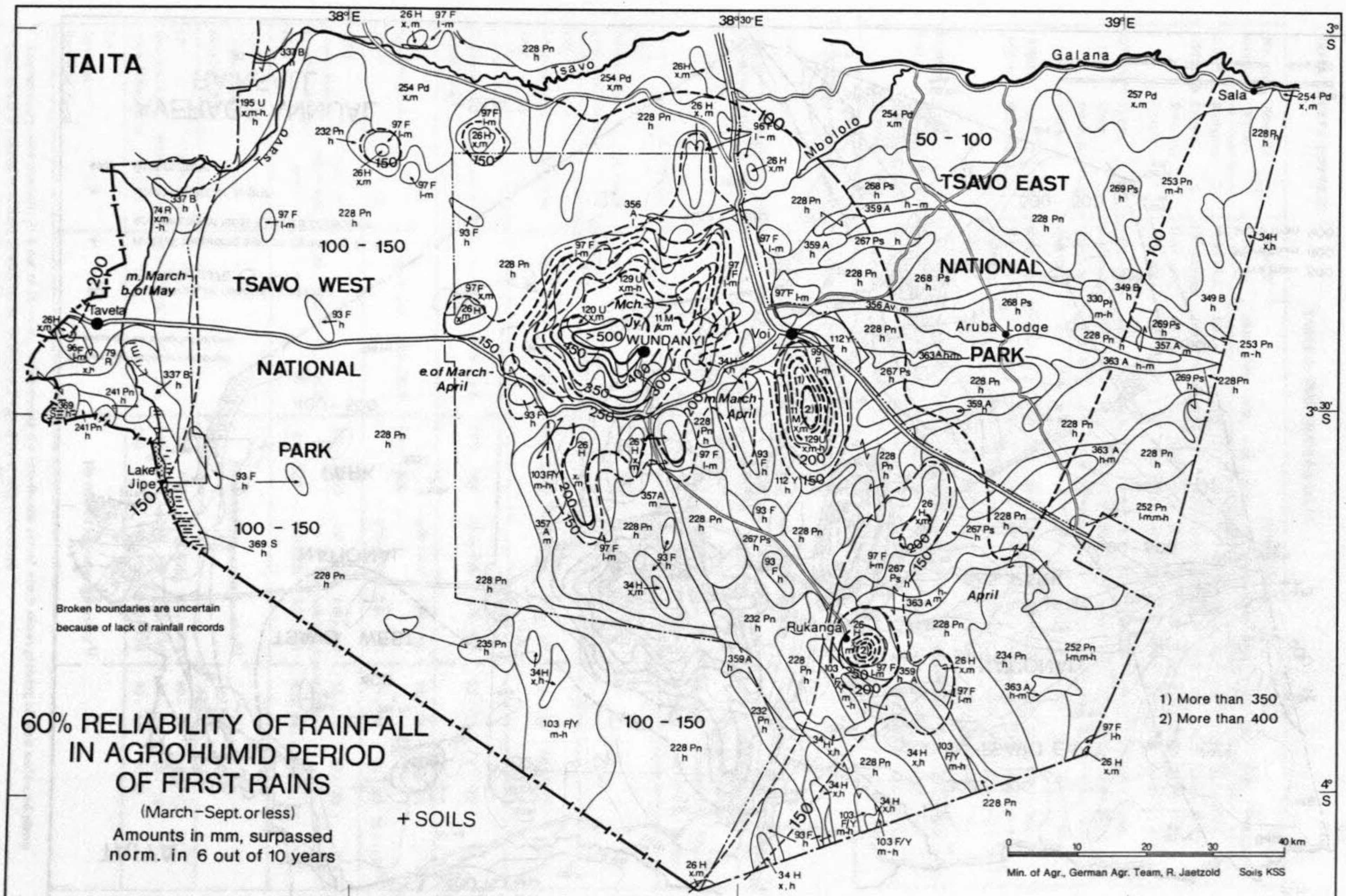
1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants

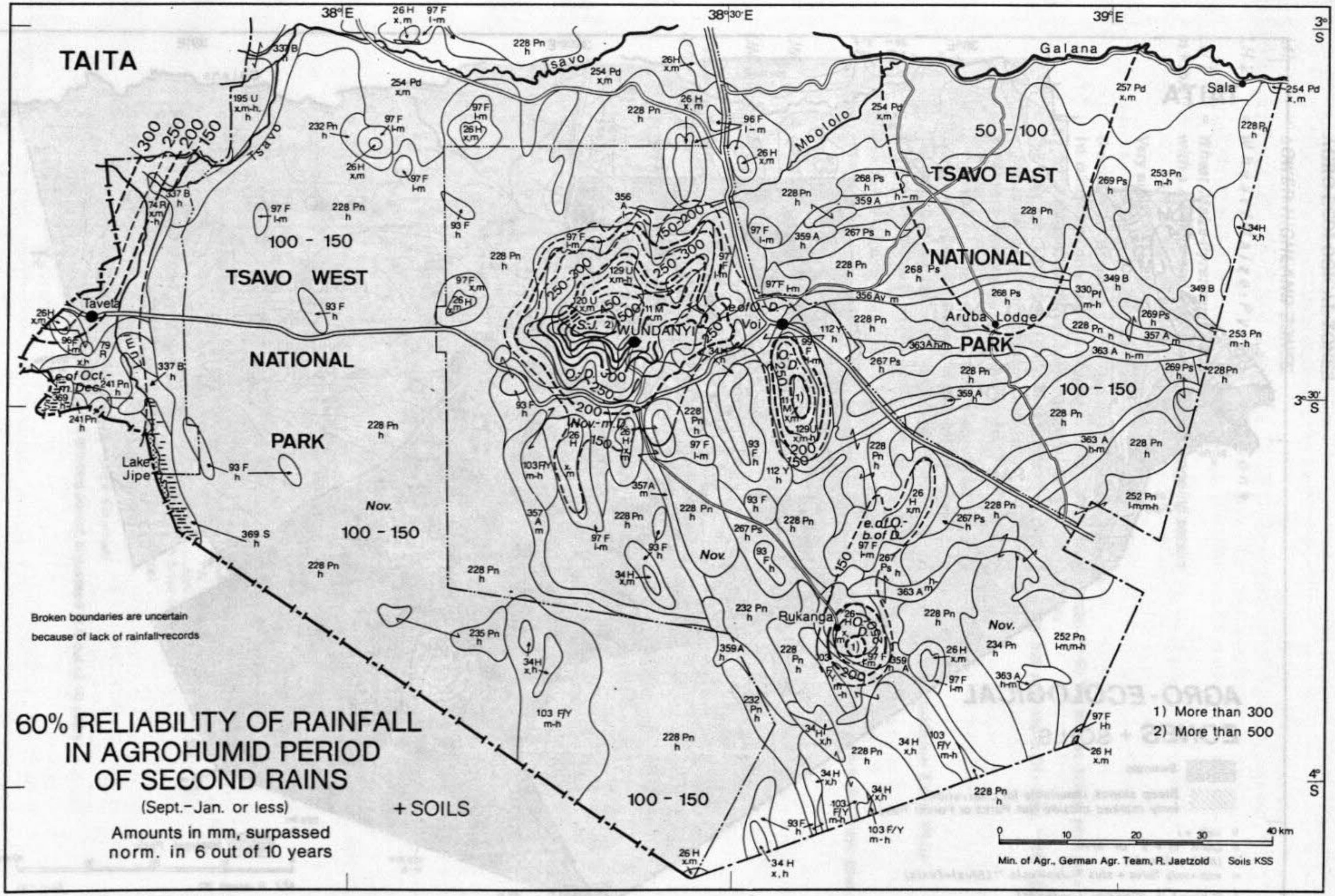
2) Only added if rainfall continues at least for survival (> 0.2 E_0) of most long term crops

3) From 2nd to 1st rains

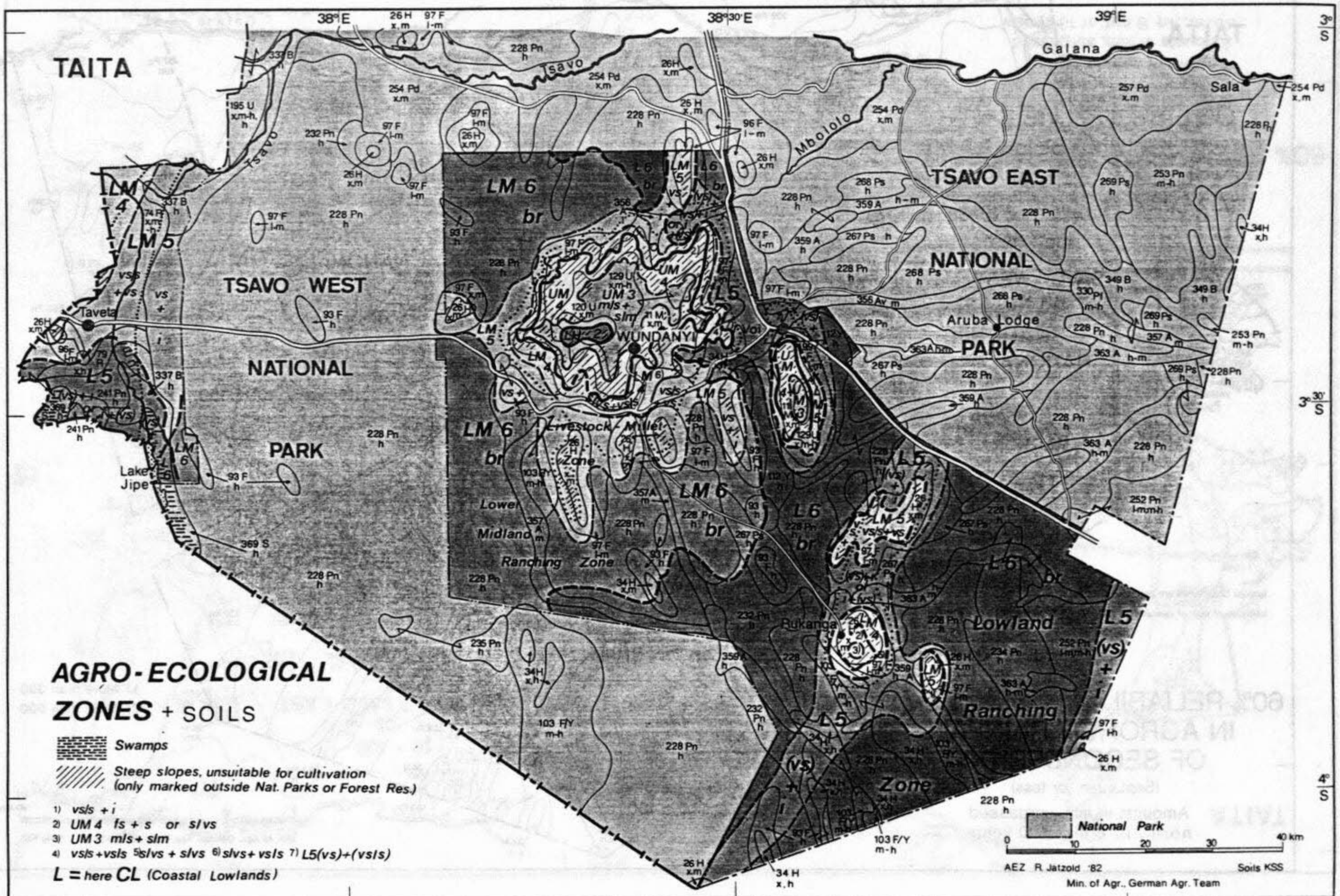
4) Except with runoff-catching techniques


TAITA
TSAVO WEST NATIONAL PARK
TSAVO EAST NATIONAL PARK
Taveta
Lake Jipe
Voi
WUNDANYI
Rukanga
Aruba Lodge
Sala
Galana
Tsavo
Mbololo
38°E
38°30'E
39°E
3° S
3°30' S
4° S
300 - 400
400 - 500
500 - 600
>600
Broken boundaries are uncertain because of lack of rainfall records
⊕ Temperature recording station, operating 1976, ⊙ closed
+ Rainfall recording station, operating 1976 and having at least 10 years of records
81 Station number in grid
9338 Grid number
1) More than 500
2) More than 800
3) More than 900
AVERAGE ANNUAL RAINFALL in mm
+ SOILS
0 10 20 30 40 km
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS


60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF FIRST RAINS
(March-Sept. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+ SOILS
TAITA
TSAVO WEST
NATIONAL
PARK
TSAVO EAST
NATIONAL
PARK
Taveta
Lake Jipe
WUNDANYI
Voi
Aruba Lodge
Rukanga
Sala
Galana
Tsavo
Mbololo
38°E
38°30'E
39°E
3° S
3° 30' S
4° S
50 - 100
100 - 150
100 - 150
100 - 150
100 - 150
m. March - b. of May
e. of March - April
m. March - April
April
Broken boundaries are uncertain
because of lack of rainfall records
1) More than 350
2) More than 400
0 10 20 30 40 km
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS



TAITA
60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF SECOND RAINS
(Sept.-Jan. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+ SOILS
Broken boundaries are uncertain
because of lack of rainfall-records
1) More than 300
2) More than 500
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS
TSAVO WEST
NATIONAL
PARK
TSAVO EAST
NATIONAL
PARK
Taveta
Lake Jipe
Wundanyi
Voi
Aruba Lodge
Rukanga
Sala
Tsavo
Galana
Mbololo
38°E
38°30'E
39°E
3°S
3°30'S
4°S
100 - 150
50 - 100
Nov.
0
10
20
30
40 km


TAITA
TSAVO WEST
NATIONAL
PARK
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Sala
Bukanga
Lake Jipe
Tsavo
Galana
Mbololo
38°E
38°30'E
39°E
3° S
3°30' S
4° S
Livestock-Millet Zone
Lower Midland Ranching Zone
Lowland Ranching Zone
AGRO-ECOLOGICAL
ZONES + SOILS
Swamps
Steep slopes, unsuitable for cultivation
(only marked outside Nat. Parks or Forest Res.)
1) vs/s + i
2) UM 4 fs + s or s/vs
3) UM 3 m/s + s/m
4) vs/s + vs/s 5) s/vs + s/vs 6) s/vs + vs/s 7) L5(vs)+(vs/s)
L = here CL (Coastal Lowlands)
National Park
0 10 20 30 40 km
AEZ R. Jatzold '82
Soils KSS
Min. of Agr., German Agr. Team

AGRO-ECOLOGICAL ZONES

LH = *LOWER HIGHLAND ZONES*

LH 2 = *W h e a t / M a i z e - P y r e t h r u m   Z o n e*

LH 2 = *Wheat/Maize-Pyrethrum Zone*
m + m/s[1)] *with a medium and a medium to short cropping season*

Very small

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. beg. of March: M. mat. wheat like Kenya Tembo (~ 60 %), m. mat. barley; peas, potatoes; cabbages, cauliflower, kales, carrots, beetroot, spinach, lettuces

2nd rains, start norm. end of Oct.: M. mat. wheat, m. mat. barley, very late mat. maize (N.–July, ~ 60 %); peas, potatoes; vegetables as above

Whole year: Black wattle, plums, passion fruit (lower 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: Finger millet; rapeseed, linseed; sweet potatoes

2nd rains: Late mat. maize (N.–June), finger millet; e. mat. beans, sweet potatoes; sunflower Kenya White

Whole year: Pyrethrum, tea (40–50 %)

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

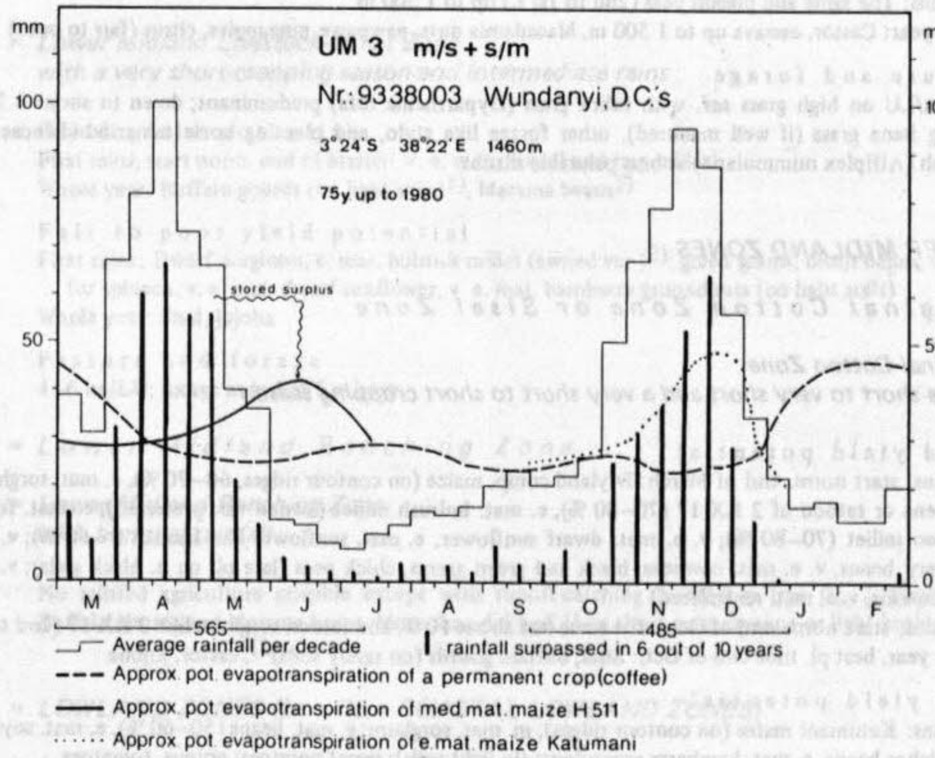
More than 1 ha/LU on sec. pasture (orig. montane forest), around 0.6 ha/LU on art. pasture of Kikuyu grass

UM = *UPPER MIDLAND ZONES*

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

UM 3 = *Marginal Coffee Zone*
m/s + s/m[1)] *with a medium to short and a short to medium cropping season*

(see Diagram Wundanyi)



Good yield potential

1st rains, start norm. beg. of March: E. mat. maize like Katumani comp. B, e. mat. sorghum like 2 KX 17 or Serena below 1 500 m; m. mat. sunflower like Hybrid S 301 A; onions, cabbages

2nd rains, start norm. end of Oct.: Serena and ratoon sorghum; e. mat. sunflower like HS 345 or below 1 500 m Issanka

Whole year: Pineapples (lower places), Macadamia nuts, castor, sisal

Fair yield potential

1st rains: M. mat. maize like H 512 (~ 40 %), finger millet; e. mat. beans, sweet potatoes; kales, tomatoes

2nd rains: L. mat. maize (O.–June), Katumani maize; e. mat. beans; cabbages, kales, tomatoes

Whole year: Arabica coffee (lower places poor, there add. irr. profitable), bananas, pawpaws, citrus, passion fruit

Pasture and forage

0.7–1.2 ha/LU on sec. high grass sav. with zebra grass (Hyparrhenia rufa) and star grass (Cynodon dactylon, on better soils), down to about 0.25 ha/LU feeding Napier and Bana grass (if well manured), maize stalks, fodder legumes like stylo, and planting horse tamarinds (Leucaena leucocephala)

UM 4 = *Sunflower-Maize Zone*

UM 4 s + s = *Sunflower-Maize Zone with two short cropping seasons*

Good yield potential

1st rains, start norm. end of March: E. mat. foxtail and proso millet (70–80 %), Katumani maize (good to fair), Dryland composite maize, v. e. mat. sorghum like IS 8595, Serena sorghum below 1 500 m; dwarf sunflower and Hybrid S 345; e. mat. cowpeas (below 1 500 m), v. e. mat. beans

2nd rains, start norm. end of Oct.: The same but Serena sorghum up to 1 800 m, ratoon sorghum like 2 KX 17 (N.–June/July)

Whole year: Sisal

Fair yield potential

1st rains: finger millet; e. mat. beans, bonavist beans (dolichos); sweet potatoes, tomatoes, onions

2nd rains: The same and pigeon peas (2nd to 1st r.) up to 1 500 m

Whole year: Castor, cassava up to 1 500 m, Macadamia nuts, pawpaws, pineapples, citrus (fair to poor)

Pasture and forage

1–2 ha/LU on high grass sav. with zebra grass (Hyparrhenia rufa) predominant; down to about 0.3 ha/LU feeding Bana grass (if well manured), other forage like stylo, and planting horse tamarind (Leucaena) and saltbush (Atriplex nummularia) as best palatable shrubs

LM = *LOWER MIDLAND ZONES*

LM 4 = *Marginal Cotton Zone or Sisal Zone*

LM 4 s/vs + vs/s = *Marginal Cotton Zone with a short to very short and a very short to short cropping season*

Good yield potential

1st rains, start norm. end of March: Dryland comp. maize (on contour ridges, 60–70 %), e. mat. sorghum like Serena or ratoon of 2 KX 17 (70–80 %), e. mat. bulrush millet (awned var. preferred), e. mat. foxtail or proso millet (70–80 %); v. e. mat. dwarf sunflower, e. mat. sunflower like Issanka (~ 60 %); v. e. mat. tepary beans, v. e. mat. cowpeas, black and green grams, chick peas (late pl. on h. black soils); v. e. mat. pumpkins, v. e. mat. rai (oilseed)

2nd rains, start norm. end of Oct.: The same less about 10 %, and ratoon sorghum like 2 KX 17 (2nd to 1st r.)

Whole year, best pl. time end of Oct.: Sisal, buffalo gourds (on sandy soils)[5], castor, jojoba

Fair yield potential

1st rains: Katumani maize (on contour ridges), m. mat. sorghum; e. mat. beans (50–60 %), e. mat. soya beans, dolichos beans, e. mat. bambarra groundnuts (in light soils); sweet potatoes; onions, tomatoes

2nd rains: The same and cotton bimodal var. (O.–Aug., on good soils, otherwise poor), pigeon peas (2nd to 1st r.)

Whole year: Macadamia nuts, cassava

Pasture and forage

1.5–3 ha/LU on mixed medium grass savanna with red oats grass (Themeda triandra) predominant; if degraded reseeding with buffel grass (Cenchrus ciliaris), and stocking rate further improvable by saltbush (Atriplex nummularia) and horse tamarind (Leucaena leucoc.) as palatable shrubs; add forage: Glycine, siratro, stylo, moth bean vines, pods of applering acacias (Ac. albida = Gao tree)

M 5 = L o w e r M i d l a n d L i v e s t o c k - M i l l e t Z o n e o r M a r g i n a l S i s a l Z o n e

Except some irrigation areas near Taveta

M 5 = Lower Midland Livestock-Millet Zone
/s + vs with a very short to short cropping season and a very short one

G o o d y i e l d p o t e n t i a l
1st rains, start norm. end of March: E. mat. foxtail and proso millet; v. e. mat. pumpkins
2nd rains, start norm. b. of Nov.: V. e. mat. foxtail and hog millet (on light soils)[5]
Whole year: Buffalo gourds (on light soils)[5], Marama beans[5], Opuntia var. without prickles (fruit and vegetable, also fodder)

F a i r y i e l d p o t e n t i a l
1st rains: Dryland comp. maize (~ 40 %)[2], e. mat. bulrush millet (awned variety recommended), dwarf sorghum; v. e. mat. tepary beans, black and green grams, v. e. mat. cowpeas, chick peas (late planted on h. bl. soils); dwarf sunflower, v. e. mat. bambarra groundnuts (on light soils), rai

F a i r t o p o o r y i e l d p o t e n t i a l
2nd rains: E. mat. bulrush millet, v. e. mat. dwarf sorghum; v. e. mat. moth beans, green grams, v. e. mat. cowpeas (40–50 %), chick peas (late planted on h. bl. soils), v. e. mat. bambarra groundnuts (light soils); v. e. mat. dwarf sunflower, v. e. mat. pumpkins
Whole year: Sisal, castor, jojoba

P a s t u r e a n d f o r a g e
3.5–5 ha/LU; down to about 0.8 LU/ha with buffel grass (Cenchrus ciliaris), silage of fodder sorghum, hay of moth bean vines, Mesquite (Prosopis chilensis) and saltbush (Atriplex numm.) for browsing, Gao trees (Acacia albida) for pods

LM 5 = Lower Midland Livestock-Millet Zone
s/s + vs/s with two very short to short cropping seasons

Potential almost as LM 5 vs/s + vs but in 2nd rains like in 1st rains

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

G o o d y i e l d p o t e n t i a l
First rains, start norm. end of March: V. e. mat. foxtail and hog millet
Whole year: Buffalo gourds (on light soils)[5], Marama beans[5]

F a i r t o p o o r y i e l d p o t e n t i a l
First rains: Dwarf sorghum, e. mat. bulrush millet (awned var.)[2]; green grams, moth beans, v. e. mat. cowpeas for spinach; v. e. mat. dwarf sunflower, v. e. mat. bambarra groundnuts (on light soils)
Whole year: Sisal, jojoba

P a s t u r e a n d f o r a g e
4–6 ha/LU; forage as in LM 5 vs/s+vs

LM 6 = L o w e r M i d l a n d R a n c h i n g Z o n e

LM 6 = Lower Midland Ranching Zone
r with bimodal rainfall

No rainfed agriculture possible except with runoff-catching techniques (see fig. 2, Machakos District) or Buffalo gourds and Marama beans. More than 4.5 ha/LU on short grass savanna or light bushland

L = LOWLAND ZONES (here CL = COASTAL LOWLAND ZONES)

L 5 = L o w l a n d L i v e s t o c k - M i l l e t Z o n e o r M a r g i n a l L o w e r S i s a l Z o n e

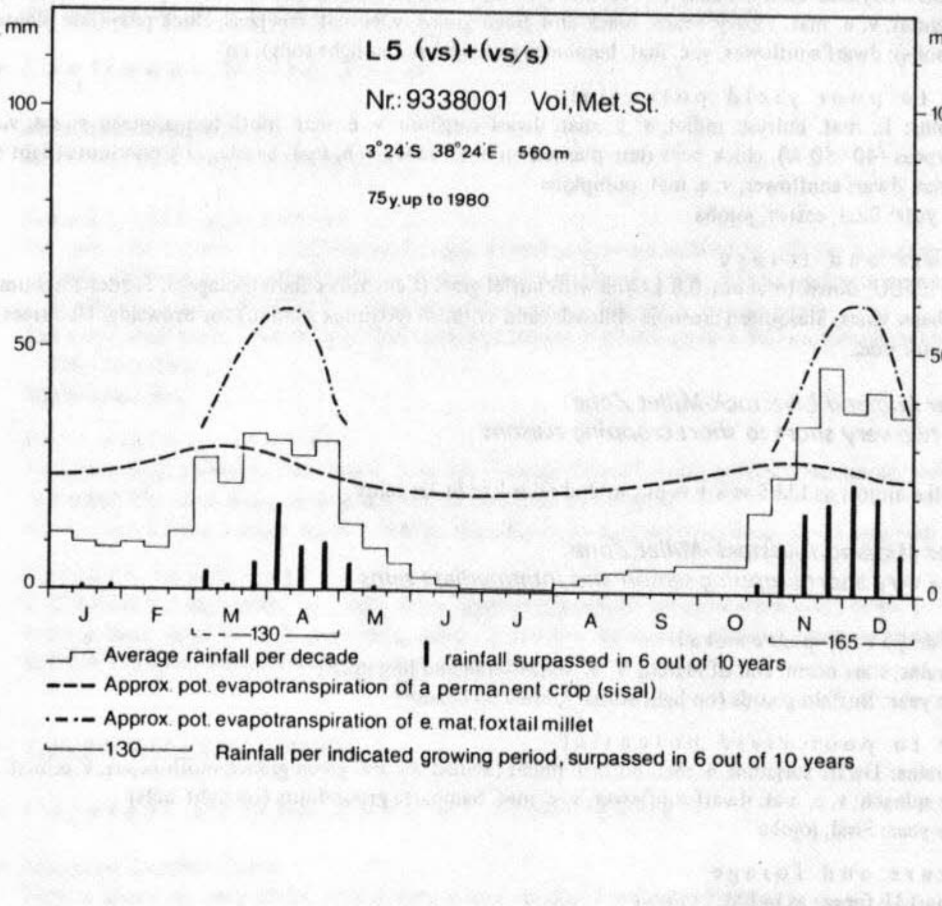
L 5 = Lowland Livestock-Millet Zone
(vs)+(vs/s) with a (weak) very short and a (weak) very short to short cropping season

(see Diagram Voi)

Good yield potential
1st rains, start end of March: V. e. mat. foxtail and hog millet
2nd rains, start norm. b. of Nov.: E. mat. proso millet like Serere I; moth beans; v. e. mat. pumpkins
Whole year: Buffalo gourds (on sandy soils)[5], Marama beans[5]

Fair yield potential
1st rains: E. mat. foxtail and proso millet; v. e. mat. cowpeas and green grams, v. e. mat. bambarra groundnuts (on light soils, fair to poor)
2nd rains: E. mat. bulrush millet, dwarf sorghum, e. mat. foxtail millet (nearly 60 %); black and green grams, moth beans, v. e. mat. cowpeas, chick peas (late pl. on h. bl. soils); rai (oilseed), dwarf sunflower (fair to poor), v. e. mat. bambarra groundnuts (on light soils)
Whole year: Sisal, castor, ye-eb nuts[6], Opuntia

Pasture and forage
Almost as in LM 5 vs/s + vs



L 5 (vs) + i or i + (vs) = ***Lowland Livestock-Millet Zone*** *with a (weak) very short cropping season and intermediate rains or vice versa[4)]*

Fair to poor yield potential
1st or 2nd rains[4)]: Dwarf sorghum, e. mat. bulrush millet; cowpeas (40–50 %), green and black grams, v. e. v. e. mat. bambarra groundnuts[3)]; dwarf sunflower
Whole year: Buffalo gourds (on light soils)[5)], Marama beans[5)], sisal, castor, ye-eb nuts[6)]

Poor yield potential
Whole year: Cassava

Pasture and forage
Small leaved bushland predominating, about 3–5 ha/LU; Gao trees on good soils for pods, Mesquite and saltbush on all places for add. browsing

5 = *Lowland Livestock-Millet Zone*
s) + i *with a (weak) very short cropping season and intermediate rains*

Fair to poor yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail millet (40–50 %), e. mat. bulrush millet; green grams
Whole year: Buffalo gourds (on light soils)[5], Marama beans[5], ye-eb nuts[6], sisal

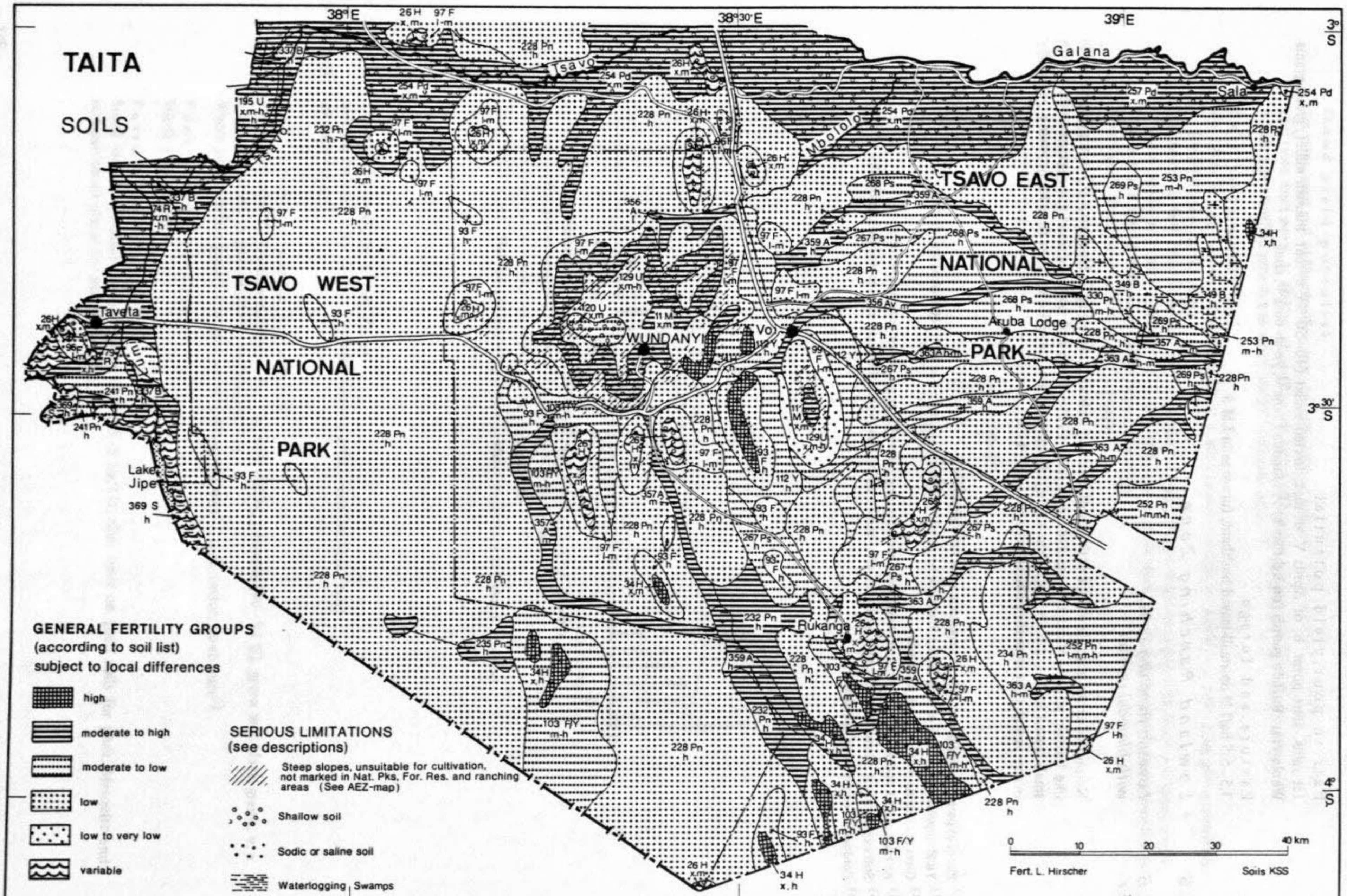
Pasture and forage
3.5–5.5 ha/LU on small-leaved bushland, forage as in LM 5

6 = *Lowland Ranching Zone*

6 = *Lowland Ranching Zone*
r *with bimodal rainfall*

No rainfed crops possible except with runoff-catching techniques (see Fig. 2, Machakos D.) or tough perennials like buffalo gourds, Marama beans and ye-eb nuts. Cattle, sheep and goats on short grass savanna mixed with small leaved bushland with more than 4.5 ha/LU; saltbush and Mesquite to plant for add. browsing (especially in dry years). Gao trees for pods on good (alluvial) soils

Places exposed to clouds may have intermediate rains July–September
Yield improvable and risk of crop failure lowerable by runoff-catching agriculture (see fig. 1, Machakos District)
Gives reasonable yields also on poor soils
At least one of the two rainy seasons will have a very short growing period for crops in 6 or more years out of 10
Still experimental. Plants produce edible seeds and, after some seasons, also tubers. Bitterness may be washed out in salty water
Cordeauxia edulis from Somalia


TAITA
SOILS
TSAVO WEST
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Rukanga
Aruba Lodge
Sala
Galana
Tsavo
Mbololo
38°E
38°30'E
39°E
3° S
3°30' S
4° S
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate to low
low
low to very low
variable
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (See AEZ-map)
Shallow soil
Sodic or saline soil
Waterlogging | Swamps
0 10 20 30 40 km
Fert. L. Hirscher
Soils KSS

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

The outstanding topographical feature of the district is the Taita Hills, which rise high above the rather featureless, non-dissected, erosional and sedimentary plains. In the western part of the district, some areas consist of volcanic foothills and lava flows. In the south, piedmont plains occur, while extensive bottomlands are found along the Voi river. The underlying geology consists mainly of undifferentiated Basement rocks.

The dominant soils on the Taita Hills are those of unit 11 M of moderate to high fertility. On the hills, soils of unit 26 H of variable fertility and 34 H of high fertility occur. Associated with the mountains are upland areas which carry soils of units 120 U and 129 U. Soils of unit 129 U have a low natural fertility but soils of unit 120 U with humic topsoils sometimes are richer in plant nutrients.

The foothills bordering the mountains and hills carry soils of units 93 F, 97 F, and 99 F of low natural fertility. On the piedmont plains, soils of unit 103 Y and 112 Y occur which are low to moderately fertile.

South of the Galana and Tsavo rivers, units 254 Pd and 257 Pd occur as a complex: both are moderately to highly fertile. Soils of unit 253 Pn also occur extensively, which developed over pisocalcic material and have low to moderate fertility. In the southwest, some areas of unit 235 Pn of moderate to high fertility are found. In the northwest, a small area is covered by soils of unit 232 Pn which are moderately to highly fertile and have a humic topsoil.

Soils of the bottomlands occur in the west (unit 337 B and 349 B). The soils of the alluvial plains are divided into three groups, viz.: 359 A, 363 A and 357 A. They all have a moderate to high fertility. Around Lake Jipe, swamp conditions are encountered (unit 369 S) with soils of variable fertility.

SOILS ON MOUNTAINS AND MAJOR SCARPS

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

11 M = well drained, moderately deep, reddish brown to brown, friable, stony sandy clay loam, with humic topsoil (humic CAMBI-
x, m[1] SOLS: with eutric REGOSOLS and Rock Outcrops)

SOILS ON HILLS AND MINOR SCARPS

Soils developed on undifferentiated Basement System rocks, predominantly gneisses

26 H = somewhat excessively drained, shallow, reddish brown, friable, rocky or stony, sandy clay loam (eutric REGOSOLS; with
x, m Rock Outcrops and calcic CAMBISOLS)

Soils developed on limestones and calcatic mudstones

34 H = somewhat excessively drained, shallow, dark grey, firm, moderately calcareous, stony clay
h (orthic RENDZINAS)

SOILS ON VOLCANIC FOOTRIDGES

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

74 R = well drained, shallow to very deep, dusky red to dark brown, friable, rocky, bouldery, stony or gravelly, silty clay loam to clay
x, m–h (nito-chromic CAMBISOLS and eutric CAMBISOLS, lithic and bouldery phase)

79 R = well drained, deep to extremely deep, dark reddish brown to dark brown, friable to firm clay; in places gravelly (eutric NITO-
x, h SOLS and nito-chromic CAMBISOLS; with chromo-luvic PHAEOZEMS)

SOILS ON FOOTSLOPES

Soils developed on colluvium from crystalline limestones

93 F = well drained, very deep, dark reddish brown, firm, slightly calcareous, slightly cracking clay, with a slightly to moderately
h sodic deeper subsoil (chromic LUVISOLS, sodic phase)

Soils developed on colluvium from undifferentiated Basement System rocks

96 F = well drained, very deep, yellowish red to dark reddish brown, friable, coarse loamy sand to sandy clay loam (chromic LUVI-
l–m SOLS; with rhodic FERRALSOLS and luvic/ferralic ARENOSOLS)

97 F = well drained, very deep, dark red, friable, coarse, loamy sand to sandy clay (rhodic FERRALSOLS; with ferralic ARENOSOLS
l–m and ferralo-chromic LUVISOLS)

99 F = complex of somewhat excessively drained to well drained, deep to very deep, dark red to brown, sandy loam to clay (ACRI-
l–m SOLS, undifferentiated; with ARENOSOLS)

SOILS ON FOOTSLOPES AND PIEDMONT PLAINS UNDIFFERENTIATED

Soils developed on colluvium and alluvium from crystalline limestones

103 F/Y = well drained, deep to very deep, dark brown, friable to firm, clay loam to sandy clay; in places calcareous (chromic LUVI-
m–h SOLS and haplic KASTANOZEMS)

SOILS ON PIEDMONT PLAINS

Soils developed on alluvium from undifferentiated Basement System rocks

112 Y = well drained, very deep, dark red, friable, sandy clay to clay
h (ferralo-chromic LUVISOLS)

SOILS ON UPPER-LEVEL UPLANDS

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

118 U = well drained, deep to very deep, dark reddish brown, friable and slightly smeary, silty clay loam, with thick humic topsoil
h (ando-luvic PHAEOZEMS)

Soils developed on undifferentiated Basement System rocks

120 U = complex of: - well drained, shallow, black to very dark brown, acid humic, very friable loam; in places rocky (RANKERS)
x, m - well drained, moderately deep, dark brown, friable clay loam, with a very thick acid humic topsoil (humic CAMBISOLS)

SOILS ON UPPER MIDDLE-LEVEL UPLANDS

Soils developed on undifferentiated Basement System rocks

129 U = well drained, moderately deep to very deep, dark red to reddish yellow, friable to firm, rocky sandy clay loam to clay
x, m–h (chromic ACRISOLS, rocky phase; with CAMBISOLS and FERRALSOLS)

SOILS ON UPLANDS, UNDIFFERENTIATED LEVELS

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

195 U = association of: - well drained, deep to very deep, dusky red to dark reddish brown, friable, stony clay loam to clay (chromic
x, m–h, h LUVISOLS; stony phase)
- imperfectly drained, deep to very deep, dark brown to very dark greyish brown, firm, calcareous, saline and sodic, stony, cracking clay (verto-luvic PHAEOZEMS, stony and saline-sodic phase)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

Soils developed on Basement System rocks rich in ferromagnesian minerals

228 Pn = well drained, deep to very deep, dusky red to dark red, friable sandy clay
h (rhodic FERRALSOLS)

Soils developed on crystalline or sedimentary limestones and gypsiferous rocks (Plio-Pleistocene Wajir-El Wak beds)

232 Pn = well drained, moderately deep, dark reddish brown, friable clay
h (chromic CAMBISOLS)

Soils developed on undifferentiated Basement System rocks

234 Pn = well drained, deep to very deep, dark red to strong brown, friable, sandy clay to clay (rhodic and orthic
h FERRALSOLS)

235 Pn = imperfectly drained, deep, black to very dark grey, very firm, slightly to moderately sodic, cracking clay (pellic VERTISOLS,
h sodic phase)

Soils developed on undifferentiated Basement System rocks with predominant volcanic ash influence

241 Pn = moderately well drained, very deep, dark reddish brown to dark brown, firm, strongly calcareous, slightly saline and
h moderately sodic, slightly cracking clay (vertic LUVISOLS, saline-sodic phase)

Soils developed on gritty sandstones

252 Pn = well drained, deep, strong brown to dark brown, firm, sandy clay loam to clay, with a topsoil of loamy sand to sandy loam
l–m, m–h (orthic LUVISOLS; with orthic ACRISOLS)

253 Pn = well drained, deep, red, firm, sandy clay loam to clay
m–h (chromic LUVISOLS)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated Basement System rocks

254 Pd = complex of well drained, shallow to moderately deep, dark red to yellowish brown, non to moderately calcareous, stony sandy
x, m clay loam, over petrocalcic material or quartz gravel (calcic CAMBISOLS, lithic or petrocalcic phase; with chromic LUVISOLS, petric phase)

Soils developed on undifferentiated sedimentary rocks

257 Pd = complex of well drained, shallow, dark reddish brown to strong brown, non to moderately calcareous, firm, gravelly and stony
x, m loam to sandy clay loam, partly over petrocalcic material (chromic CAMBISOLS to orthic LUVISOLS lithic or paralithic phase; with calcic CAMBISOLS, petrocalcic phase)

SOILS ON MIDDLE-LEVEL PLAINS "ENCLOSED PLAIN"

Soils developed on sediments from Basement System rocks rich in ferromagnesian minerals

267 Ps h = well drained, deep to very deep, red to dark red, friable to firm, sandy clay to clay, over pisocalcic material (on sheetwash and fluviatile sediments) (ferric LUVISOLS)

268 Ps h = well drained, very deep, dark reddish brown to dark red, friable to firm, sandy clay; in places moderately calcareous (on sheetwash and lacustrine sediments) (chromic LUVISOLS; with calcic LUVISOLS)

Soils developed on sheetwash sediments from Taru grits and coarse to fine-grained sandstones

269 Ps h = moderately well drained, deep, dark reddish brown, firm, slightly calcareous, sandy clay to clay, over pisocalcic material (calcic LUVISOLS, pisocalcic phase)

SOILS ON OLDER FANS

Soils developed on sediments mainly from undifferentiated Basement System rocks

330 Pf m–h = well drained, very deep, dark red to dark brown, firm, sandy clay loam to clay (LUVISOLS, undifferentiated)

SOILS ON BOTTOMLANDS

Soils developed on infill from undifferentiated volcanic rocks

337 B h = imperfectly drained, very deep, dark brown to dark grey, firm, slightly to moderately saline, moderately sodic, cracking clay; in many places calcareous (chromic and pellic VERTISOLS, saline-sodic phase)

Soils developed on infill mainly from undifferentiated Basement System rocks

349 B h = imperfectly drained to poorly drained, very deep, brown to dark brown, very firm, slightly calcareous, strongly sodic clay (orthic SOLONETZ)

SOILS ON FLOODPLAINS

Soils developed on sediments mainly from crystalline Basement System rocks

356 A m = well drained to imperfectly drained, very deep, brown to dark brown, friable, slightly calcareous, micaceous, sandy loam to clay loam; in places with a saline-sodic deeper subsoil (eutric FLUVISOLS)

Soils developed on sediments from various sources (recent floodplains)

257 A m = well drained to imperfectly drained, very deep, dark brown to yellowish brown, stratified, strongly calcareous, micaceous, predominantly loamy soils (calcaric FLUVISOLS)

359 A h = imperfectly drained to poorly drained, very deep, dark reddish brown to dark greyish brown, firm to very firm, cracking clay; in many places mottled and with a calcareous, saline and sodic deeper subsoil (chromic VERTISOLS, saline-sodic phase)

363 A m–h = moderately well drained, shallow to moderately deep, strongly calcareous, sandy clay to clay loam, over petrocalcic material (calcic CAMBISOLS, petrocalcic phase)

SOILS ON MISCELLANEOUS LAND TYPES, SWAMPS

369 S h = poorly drained to very poorly drained, very deep, dark greyish brown to dark olivine grey, firm to very firm, strongly calcareous, strongly saline and strongly sodic clay; in many places with fragipans at various depths (gleyic SOLONCHAKS, sodic phase and partly fragipan phase)

1) Soil texture-classes

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

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

POPULATION AND LAND

According to the population census of September 1979, 147, 597 people (Table 4) lived in the Taita Taveta District, a relatively large area; only those areas which are suitable for agriculture are densely populated. About 93.5 % of the population lives on a total of 584,200 ha agricultural or ranching land, with 6.5 % settled in Voi township (7,397 inhabitants) and in the two trading centres (together 2,201 people) of the district (Table 4).

The figure for the total rural area is not a good indication of actual conditions, as only 42.7 % (= 249,400 ha) of the agricultural land is more or less arable and only 2.7 % (= 15,800 ha), on the hills, is suitable for cultivation (apart from the irrigable areas near Taveta). Another 57.3 % (= 334,800 ha) of the usable land is assigned to LM 6 and L 6 (Lower Midland and Lowland Ranching Zone). In addition it should be noted that about 10,606 sq km are not included in the total rural area but belong to Tsavo West and Tsavo East National Park, so that all in all, Taita Taveta has a total of 16,945 sq km. The Tsavo National Park belongs mostly to zone L 6, which is useless for farming and therefore is not considered for cultivation purposes.

Statistically an average household of 4.75 people (Table 5) had 20.26 ha agricultural land i.e. 4.23 ha per person (Table 6). In Mbale, which is situated in the Taita Hills, only 4.80 ha agricultural land were available per household, 0.90 ha per person, but this green location has 1,900 ha (= 18.6 % of its agricultural land) in LH 2 (Wheat/Maize-Pyrethrum Zone) and 2,400 ha (= 23.5 % of its agricultural land) in UM 3 (Marginal Coffee Zone), so it should be able to cope with future population increase by more intensification, especially in vegetables.

TAITA-TAVETA DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Taveta	13 661	12 201	25 862	6 156	680	38
Taveta Division	13 661	12 201	25 862	6 156	680	38
Mbololo	12 501	11 444	23 945	5 560	10 825	2
Sagalla	3 634	4 087	7 721	1 654	674	11
Kasigau	3 132	3 082	6 214	1 150	2 186	2
Voi Division	19 267	18 613	37 880	8 364	13 686	2
Mbale	5 205	6 293	11 498	2 126	149	76
Weruga	12 167	13 597	25 764	4 957	552	46
Chawia	12 476	13 178	25 654	5 446	823	31
Bura	4 262	4 928	9 190	2 255	751	12
Mwanda	5 180	6 569	11 749	2 402	314	37
Wundanyi Division	39 290	44 565	83 855	17 186	2 590	32
Taita Taveta District	72 218	75 379	147 597	31 706	16 959	8

TAITA-TAVETA 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:						
Taveta	6153	2.56	0.91	0.36	0.36	4.19
Division: Taveta	6153	2.56	0.91	0.36	0.36	4.19
Location:						
Mbololo	5514	2.41	0.87	0.63	0.19	4.10
Sagalla	1659	2.56	1.24	0.73	0.13	4.65
Kasigau	1123	2.68	1.11	1.04	0.52	5.36
Division: Voi	8296	2.47	0.99	0.71	0.22	4.38
Location:						
Mbale	2123	2.74	1.52	0.95	0.20	5.41
Weruga	4939	2.73	1.42	0.86	0.14	5.15
Chawia	5437	2.57	1.17	0.71	0.26	4.71
Bura	2253	2.28	0.87	0.70	0.16	4.01
Nwanda	2403	2.60	1.24	0.92	0.13	4.89
Division: Wundanyi	17155	2.60	1.26	0.81	0.19	4.86
DISTRICT: TAITA TAVETA	31604	2.56	1.12	0.70	0.23	4.75

a) Source: Central Bureau of Statistics (CBS)

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

TAITA-TAVETA DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON[1)]

	in '00 ha = sqkm					in '00 ha = sqkm								in ha	
Location/Division without townships	Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Non-agricultural land: Forest Res., lakes, swamps	Non-agricultural land: Others (roads, home-steads, rivers...)	Agri-cultural land	Area in agro-ecological zones AEZ: LH 2	UM 3	UM 4	LM 4	LM 5	LM 6	L 5	L 6	Agric. land per house-hold	Agric. land per person
Taveta	680	6	F. 2 L. 8 Sw. 25	32	608				74	341	29	141	13	9.87	2.35
Taveta Division	680	6	35	34	626				74	341	29	169	13	10.17	2.42
Mbololo	204	15		9	180					17		129	34	6.63	1.30
Sagatta	674	45		13	616		10	5	38	38	49	106	370	37.20	7.90
Kasiqau	2 190	40	F. 2	43	2 105			2	45	59		591	1 408	183.03	33.88
Voi Division	3 068	100	2	65	2 901		10	7	83	114	49	826	1 812	107.00	20.93
Mbale	149	38		9	102	19	24	20	20	6			13	4.80	0.90
Weruga	552			25	472	14	52	22		79	271	34		9.50	1.80
Chawia	825	60		15	750		25		265	24	373		63	13.60	2.90
Bura	751	19		15	717			35		125	522		35	31.80	7.80
Mwanda	314	26		14	274	7	7	19		73	161		7	11.40	2.30
Wundanyi Division	2 591	198		78	2 315	40	108	96	285	307	1 327	34	118	14.20	3.10
Total rural Area	6 339	304	37	177	5 824	40	118	103	442	762	1 405	1 029	1 943	20.26	4.23

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

AGRICULTURAL STATISTICS[1)]

pproximately 450 ha of coffee is grown in the Wundanyi region, producing the uneconomic yield of about 180 kg/ha per ar. It is estimated that 1,000 ha of cotton is planted annually in the Taita area, of which probably one-third is irrigated; the gated cotton produces roughly 1,500 kg/ha, while on non-irrigated fields yields of 400–500 kg are achieved.

TAITA-TAVETA DISTRICT

TABLE 7: COFFEE
AREA – PRODUCTION – YIELDS[1)]

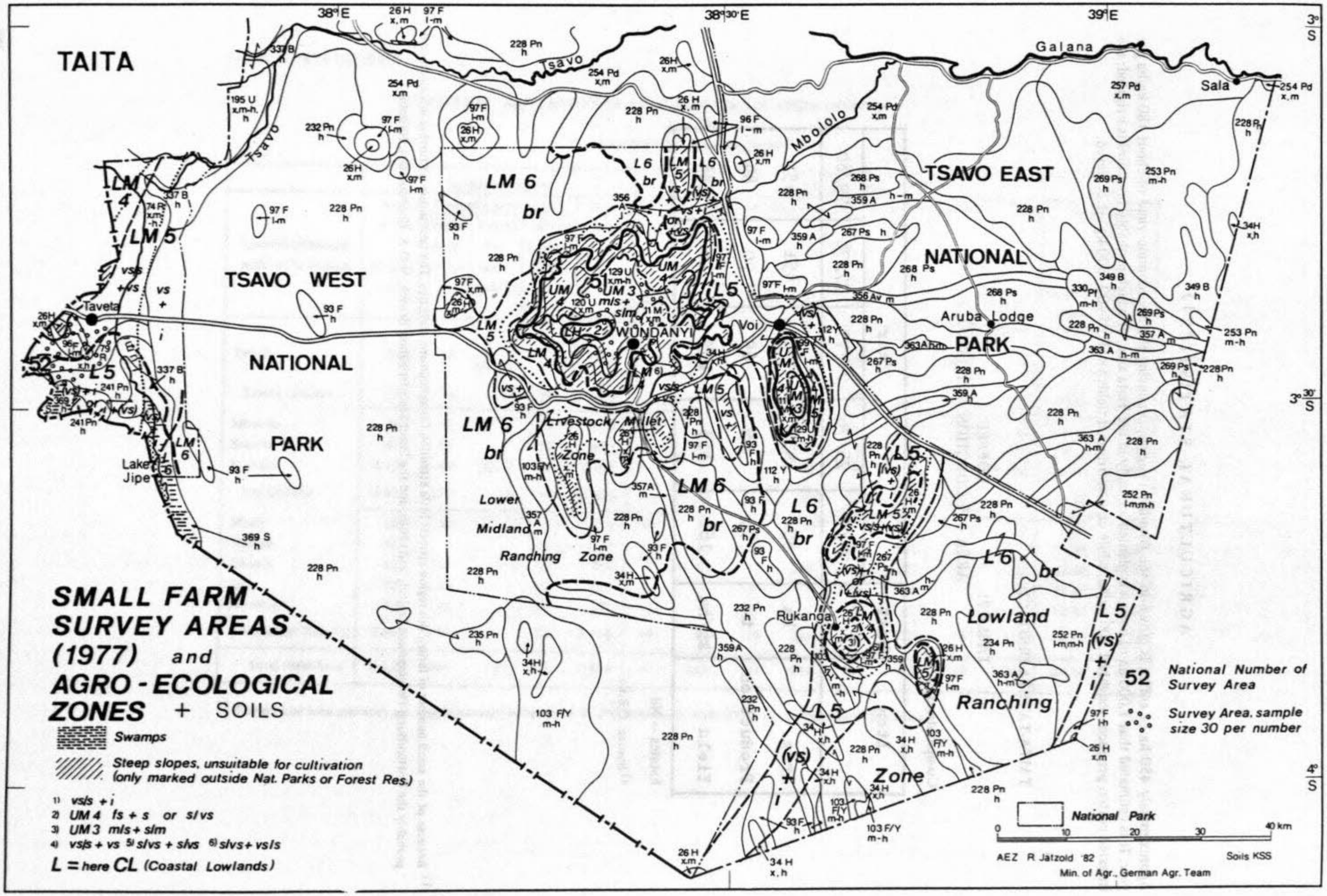
Co-operatives

Item	Unit	Year				
		74/75	75/76	76/77	77/78	79/80
Area	ha	451	451	451	451	451
Production	t	73	69	69	70	84
Yield	kg/ha	162	153	153	165 16	186

Estates – Nil

a) Source: C.B.K.

Because of the small number of farms, this region attracts little attention for agricultural statistics. The best source of further information is probably the Horticultural Development Project, Taita Hills, and the Small Scale Irrigation Branch, M.O.A. Headquarters, Nairobi.



SMALL FARM
SURVEY AREAS
(1977) and
AGRO - ECOLOGICAL
ZONES + SOILS
Swamps
Steep slopes, unsuitable for cultivation
(only marked outside Nat. Parks or Forest Res.)
1) vs/s + i
2) UM 4 fs + s or s/vs
3) UM 3 m/s + s/m
4) vs/s + vs 5) s/vs + s/vs 6) s/vs + vs/s
L = here CL (Coastal Lowlands)
52 National Number of Survey Area
Survey Area, sample size 30 per number
National Park
0 10 20 30 40 km
AEZ R. Jätzold '82
Soils KSS
Min. of Agr., German Agr. Team
TAITA
TSAVO WEST
NATIONAL
PARK
TSAVO EAST
NATIONAL
PARK
Taveta
Lake Jipe
Wundanyi
Voi
Rukanga
Aruba Lodge
Sala
Tsavo
Galana
Mbololo
38°E
38°30'E
39°E
3° S
3°30' S
4° S
LM 4
LM 5
LM 6
L 5
L 6
UM 3
UM 4
br
Livestock - Millet Zone
Lower Midland Ranching Zone
Lowland Ranching Zone

SMALL FARM SURVEY (SFS)[1)]

Large parts of the district are used for ranching or planted with sisal. Small-scale farming is developed in the Wundanyi and Taveta area only. Consequently the SFS was carried out in Taita Hills-Wundanyi (AEZ UM 3 (+4))and the Taveta (AEZ LM 4–5 + L 5 (+ irr.)) area only. It should be observed that most of the Taveta (sample) farmers practise supplementary irrigation.

The average farm sizes were 1.7 ha (UM 3 (+4)) and 2.3 ha (LM 4–5 + L 5 (+ irr.)). Both farm groups use 50 % of the land for annual crops, planted perennials on about 8 % of the land, while natural pasture makes up one-third of the farming area. The farmers plant 1.4 (UM 3+(4) and 1.2 crops (LM 4–5 + L 5 (+ irr.)) p.a. and keep between 6 and 7 LU per ha, but much of the stock is grazed on public land. Only the Taita Hills farmers kept some (20 %) improved stock and used considerable amounts of fertilizer, while the Taveta farmers practise plant protection in cotton (table 8 & 9). From the cropping pattern (table 10) it is clear that horticulture is the main source of income for the UM 3+(4) farmers, while cotton is the economic basis for the LM 4–5 + L 5 (+ irr.) farms. Both farming groups produce most of their staple food themselves. The proportion of male cattle to cattle kept was about 50 % and 30 % respectively (table 11). When assessing the yields, it is important to discount the effect of supplementary irrigation (table 12). The Taita Hills farmers had 12 % goats and sheep, the Taveta farmers 37 % among their grazing livestock units. The horticultural products are sold – throught boards or private traders – to Mombasa, while the staple food produced is consumed on the farms (UM 3+(4)). The LM 4–5 + L 5 (+ irr.) farmers sell their cotton to the board and consume the staple food they produce (table 13). The spread of farming activities such as land preparation and planting over of farming activities such as land preparation and planting over 6–8 months shows that most of the sample farmers irrigate their crop in both areas (graphs in table 14). The yield figures assessed in table 15 do not consider this (yield increasing) possibility.

Despite the small average farm size, Taita Hills farmers can make a good living from growing horticultural crops in future. Milk production based on heavily fertilized forage and zero grazing is recommended in order to improve soil fertility. Water storage dams for increased irrigation are essential for profitable horticultural production.

Taveta farmers will continue to depend on the availability of irrigation water. The rehabilitation and extension of the irrigation system with the aim of more economic water use, will provide a solid economic basis for the people of the region. Cotton growing and subsistence food production will remain the mainstay of the farmers. Special extension advice on economic water use, fertilizing and plant protection is welcomed by the farmers and should therefore show high economic and social returns.

1) Because of the small number of farms, this region attracts little attention for agricultural statistics. The best source of further information is probably the Horticultural Development Project, Taita Hills, and the Small Scale Irrigation Branch, M.O.A. Headquarters, Nairobi.

TAITA-TAVETA DISTRICT

AEZ: UM 3(+ 4)

TABLE 8 a: FARM ORAGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 51

Item	Unit	Farm Size & Land Use Livestock on Farm Farm Size Group small	medium	large
Farm Size Total	ha	1.o	2.o	3.1
Land Use: Annual Crops1) First Season				
Maize	ha	o.1	o.2	o.1
Beans	ha	o.1	o.3	o.2
Maize & Beans	ha	o.2	o.2	o.2
Vegetables		o.1	o.2	o.3
Cassava	ha	-	-	o.1
	ha			
Total	ha	o.5	o.9	o.9
Second Season1)				
Maize	ha	-	-	o.2
Beans	ha	o.1	o.1	o.1
Vegetables		-	o.1	o.2
Maize & Beans	ha	o.1	o.2	-
Total	ha	o.2	o.4	o.5
Permanent Crops1)				
Coffee	ha	o.1	o.1	o.1
	ha			
	ha			
	ha			
Portion of total	%	1o %	5 %	3 %
Grazing & Forage	ha	o.3	o.8	1.1
portion of total	%	3o %	4o %	35 %
Other Land Use	ha	o.1	o.2	1.o
Livestock on Farm:				
Cattle: local	LU	4.2	o.4	o.3
improved	LU	o.5	1.1	1.1
Sheep & Goats	LU	o.7	o.1	o.3
Total	LU	5.4	1.6	1.7

Item	Unit	Intensity, Labour/Persons on Farm Home Consumption Farm Size Group small	medium	large
Farming Intensity:				
Cropping Intensity	-	o.8	o.7	o.5
Portion of improved cattle kept	%	11 %	73 %	79 %
Portion of Farmers owning a Plough	%			
Labour on Farm:				
Family Adults	persons	2.2	2.8	2.2
Perm. Hired Labour	"	o.3	o.3	o.2
Children > 14 years	"	1.7	2.1	2.1
Persons living on Farm2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.o9	o.1	2.19
Children < 14 years	"	2.8o	-	2.8o
Subsistence Units	SU	3.77	o.1	3.87
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	146o	2o17	
Beans	kg	273	372	
English Potatoes	kg	35	1o	
Sweet Potatoes	kg	91	8	
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Maize & Sorghum, English potatoes, Cabbage, Onions, Tomatoes, Bananas, Pineapples

1) Major crops only considered

2) Based on 1979 Census figures

TAITA-TAVETA DISTRICT
AEZ: LM 4–5 + L 5 (+ irr.)

TABLE 8 b: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 52

Item	Unit	Farm Size & Land Use / Livestock on Farm / Farm Size Group: small	medium	large
Farm Size Total	ha	1.0	1.9	4.0
Land Use: Annual Crops 1) First Season				
Maize	ha	0.3	0.3	0.7
Beans	ha	-	-	0.2
Cotton	ha	0.2	0.6	0.7
Maize & Beans	ha	0.1	0.1	0.3
& Others	ha			
Total	ha	0.6	1.0	1.9
Second Season 1)				
Maize	ha	0.1	0.3	0.2
Beans	ha	0.1	-	0.4
Maize & Beans	ha	-	0.1	-
Total	ha	0.2	0.4	0.6
Permanent Crops 1)				
Bananas	ha	-	0.2	0.2
	ha			
	ha			
	ha			
Portion of total	%		11 %	5 %
Grazing & Forage	ha	0.2	0.5	1.2
portion of total	%	20 %	26 %	30 %
Other Land Use	ha	0.2	0.2	0.7
Livestock on Farm:				
Cattle: local	LU	1.1	2.6	5.0
improved	LU	-	-	-
Sheep & Goats	LU	0.7	1.4	3.0
Total	LU	1.8	4.0	8.0

Other Crops cultivated: Maize & Sorghum

Item	Unit	Intensity, Labour/Persons on Farm / Home Consumption / Farm Size Group: small	medium	large
Farming Intensity:				
Cropping Intensity	-	0.8	0.8	0.7
Portion of improved cattle kept	%			
Portion of Farmers owning a Plough	%			10 %
Labour on Farm:				
Family Adults	persons	1.8	2.4	2.2
Perm. Hired Labour	"	0.1	0.2	0.4
Children > 14 years	"	1.3	2.2	2.1
		Farmer's Family	Non-related Persons	Total
Persons living on Farm 2) -average household size-				
Adults > 14 years	persons	1.87	0.31	2.18
Children < 14 years	"	1.89	-	1.89
Subsistence Units	SU	3.00	0.31	3.31
		kg/year household	cal. person day	
Home Consumption of Major Food produced on Farm				
Maize	kg	1650	2279	
Beans	kg	101	138	
	kg			
	kg			
	kg			
	kg			
	kg			
	kg			

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

TAITA-TAVETA DISTRICT

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

AEZ: UM 3 (+ 4)

Survey Area 51

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	1.7	13.2	1.2	2.4	0.3	1.9
Avg. 1	1.7	14.6	1.8	2.4	1.1	3.1
Up. Qu.	2.4	7.0	2.0	3.0	-	3.0
Lo. Qu.	0.8	2.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	0.7	43	0.1	7	0.5	34	0.1	6	0.1	5	0.1	5
Avg. 1	0.7	28	0.2	9	0.6	25	0.4	19	0.4	15	0.1	4
Up. Qu.	0.8	57	0.2	9	0.8	50	-	-	-	-	0.1	7
Lo. Qu.	0.4	31	-	-	0.1	14	-	-	-	-	-	3
Total	20.2		3.2		15.8		2.7		2.5		2.6	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.4	2.1	5.7	22.2
Avg. 1			5.3	61.1
Up. Qu.	2.0	2.1	6.4	70.2
Lo. Qu.	1.0	0.6	0.6	-

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	40.0	5.0	2.0	10.1	0.5	0.6	-	0.4	-	1.5	-	0.7	0.7
Avg. 1	43.5	9.3	9.9	15.1	14.0	3.1	-	0.8	0.2	2.8	0.6	3.9	2.1
Up. Qu.	100.0	6.1	-	15.5	-	-	-	0.7	-	1.5	-	-	1.3
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

TAITA-TAVETA DISTRICT

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

AEZ: LM 4–5 + L 5 (+ irr.)

Survey Area 52

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	2.3	24.7	0.6	2.2	0.2	1.9
Avg. 1	2.3	28.5	1.3	2.2	1.2	3.6
Up. Qu.	3.0	24.0	1.0	2.0	-	2.0
Lo. Qu.	1.3	5.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	1.2	5.	0.2	9	0.6	27	-	-	0.2	9	0.1	4
Avg. 1	1.2	31	0.9	24	0.8	21	-	-	0.8	22	0.1	3
Up. Qu.	1.6	70	-	-	0.8	35	-	-	-	-	0.1	8
Lo. Qu.	0.6	40	-	-	0.1	5	-	-	-	-	-	1
Total	35.3		6.5		18.4		-		5.9		2.7	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate Farm Land LU/ha	Stocking Rate Pasture & Forage LU/ha	Improved Cattle % of total
Avg. 0	1.2	2.0	7.5	-
Avg. 1			6.5	-
Up. Qu.	1.5	2.5	8.0	-
Lo. Qu.	1.0	0.4	-	-

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	47.3	-	-	0.7	-	-	-	-	-	3.6	-	-	-
Avg. 1	53.2	-	-	38.3	-	-	-	-	-	4.2	-	-	-
Up. Qu.	75.0	-	-	-	-	-	-	-	-	5.8	-	-	-
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

TAITA-TAVETA DISTRICT

TABLE 10 a: CROPPING PATTERN

AEZ: UM 3 (+ 4) | Survey Area 51

First rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.1	0.6	0.00	0.00	3.8	17.9
Maize IPC	0.0	0.4	0.00	0.00	0.4	1.9
Beans	0.2	0.5	0.40	0.00	5.4	25.7
Bambara GNuts	0.0	0.0	0.00	0.00	0.0	0.2
Engl. Potatoes	0.0	0.1	0.00	0.00	0.2	0.8
Cabbage	0.1	0.2	0.12	0.00	2.1	9.8
Onions	0.0	0.0	0.00	0.00	0.1	0.4
Tomatoes	0.1	0.2	0.04	0.00	1.6	7.5
Cassava	0.0	0.4	0.00	0.00	0.8	3.8
Pineapples	0.0	0.1	0.00	0.00	0.1	0.4
Others	0.0	0.4	0.00	0.00	0.4	1.9
Maize & Sorgm	0.0	0.1	0.00	0.00	0.1	0.4
Maize & Beans	0.2	0.6	0.40	0.00	5.1	24.2
Maize & Others	0.0	0.3	0.00	0.00	1.1	5.3
Total					21.2	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.0	0.5	0.00	0.00	1.4	11.9
Beans	0.1	0.5	0.00	0.00	2.5	21.1
Engl. Potatoes	0.0	0.1	0.00	0.00	0.1	0.7
Cabbage	0.1	0.3	0.20	0.00	2.3	19.4
Tomatoes	0.0	0.1	0.00	0.00	0.6	4.8
Cassava	0.0	0.4	0.00	0.00	0.8	6.8
Pineapples	0.0	0.1	0.00	0.00	0.1	0.7
Maize & Beans	0.1	0.4	0.20	0.00	4.0	33.7
Maize & Others	0.0	0.1	0.00	0.00	0.1	1.0
Total					11.8	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Cookng Bananas	0.0	0.0	0.00	0.00	0.0	2.0
Coffee	0.1	0.2	0.12	0.00	2.0	98.0
Total					2.0	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

TAITA-TAVETA DISTRICT

AEZ: LM 4–5 + L 5 (+ irr.)

TABLE 10 b: CROPPING PATTERN

Survey Area 52

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.4	0.6	0.68	0.00	10.8	30.2
Maize IPC	0.0	0.8	0.00	0.00	0.8	2.2
Beans	0.1	0.4	0.00	0.00	1.8	5.2
Cotton	0.5	0.7	1.00	0.00	15.8	44.5
Sugarcane	0.0	0.2	0.00	0.00	0.4	1.1
Maize & Sorgm	0.0	0.4	0.00	0.00	0.4	1.1
Maize & Beans	0.1	0.3	0.00	0.00	1.9	5.4
Maize & Others	0.1	0.9	0.00	0.00	3.6	10.2
Total					35.6	100.0

Second Rains
Annual & Semipermanet Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.2	0.7	0.40	0.00	6.6	50.3
Maize IPC	0.0	0.8	0.00	0.00	0.8	6.1
Beans	0.1	0.9	0.00	0.00	4.3	32.8
Cotton	0.0	0.4	0.00	0.00	0.4	3.1
Sugarcane	0.0	0.2	0.00	0.00	0.4	3.1
Maize & Beans	0.0	0.3	0.00	0.00	0.6	4.6
Total					13.0	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Sweet Bananas	0.0	0.5	0.00	0.00	1.4	23.2
Cookng Bananas	0.2	1.0	0.00	0.00	4.8	76.8
Total					6.2	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

TABLE 11 a: HERD COMPOSITION (GRAZING LIVESTOCK)

– in Head & Livestock Units –

AEZ: UM 3 (+ 4)

Oct. 77, Survey Area 51

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	-	-	0.27				0.09			0.09
Upper Qu.	-	-	-	-				-			-
1 - 2 years, Average	-	0.03	-	0.13				0.08			0.08
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	-	-	-		0.60			0.60			0.60
Upper Qu.	-	-	-		1			1.0			1.0
Subtotal(improved) Total	3	1	-	12	18			23.3			23.3
Average	0.10	0.03	-	0.40	0.60			0.77			0.77
Upper Qu.	-	-	-	1	1			1.3			-
Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =	5.4 % of total cattle,				Calves + Heifers =			66.7 % of dairy cows			
Unimproved Livestock:											
Under 1 year, Average	5.70	-	-	0.17		0.40	2.17	1.43	0.10		1.44
Upper Qu.	-	-	-	-		1	-	0.1	-		0.1
1 - 2 years, Average	0.07	-	-	0.30				0.16			0.16
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	0.67	-	-		0.80	1.33	0.27	1.11	0.07	21.03	1.12
Upper Qu.	-	-	-		1	1	-	-	-	-	-
Subtotal (unimp.) Total	193	-	-	14	24	52	73	81.3	5	631	82.0
Average	6.43	-	-	0.47	0.80	1.73	2.43	2.71	0.17	21.03	2.73
Upper Qu.	-	-	-	1	1	2	-	1.4	-	11	1.7
Lower Qu.	-	-	-	-	-	-	-	-	-	-	-
LU Male Cattle =	70.0 % of total cattle,				Calves + Heifers =			58.3 % of dairy cows			
LU Goats + Sheep =	15.4 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	196	1	-	26	42	52	73	104.5	5	631	105.3
Average	6.53	0.03	-	0.87	1.40	1.73	2.43	3.48	0.17	21.03	3.51
Upper Qu.	1	-	-	1	2	2	-	2.2	-	11	1.7
Lower Qu.	-	-	-	-	-	-	-	0.9	-	-	-
LU Male Cattle =	53.6 % of total cattle,				Calves + Heifers =			61.9 % of dairy cows			
LU Goats + Sheep =	12.0 % 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

TAITA-TAVETA DISTRICT

TABLE 11 b: HERD COMPOSITION (GRAZING LIVESTOCK)

– in Head & Livestock Units –

AEZ: LM 4–5 + L 5 (+ irr.) Oct. '77, Survey Area 52

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	3.30	-	-	0.60		0.97	4.33	1.31	-		1.31
Upper Qu.	-	-	-	-		1	6	0.7	-		0.7
1 - 2 years, Average	0.17	0.07	-	1.33				0.70			0.70
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	0.17	-	0.07		1.97	2.07	9.63	2.60	-	9.37	2.60
Upper Qu.	-	-	-		2	3	12	0.1	-	5	0.1
Subtotal (unimp.) Total	109	2	2	58	59	91	419	138.5	-	281	138.5
Average	3.63	0.07	0.07	1.93	1.97	3.03	13.97	4.61	-	9.37	4.61
Upper Qu.	-	-	-	1	2	5	18	3.4	-	11	3.4
Lower Qu.	-	-	-	-	-	-	1	0.9	-	5	0.9
LU Male Cattle =	31.4 % of total cattle,				Calves + Heifers =			98.3 % of dairy cows			
LU Goats + Sheep =	36.8 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	109	2	2	58	59	91	419	138.5	-	281	138.5
Average	3.63	0.07	0.07	1.93	1.97	3.03	13.97	4.61	-	9.37	4.61
Upper Qu.	-	-	-	1	2	5	18	3.4	-	11	3.4
Lower Qu.	-	-	-	-	-	-	1	0.9	-	5	0.9
LU Male Cattle =	31.4 % of total cattle,				Calves + Heifers =			98.3 % of dairy cows			
LU Goats + Sheep =	36.8 % 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

TAITA-TAVETA DISTRICT

TABLE 12 a: INPUTS & YIELDS OF MAJOR CROPS

AEZ: UM 3 (+ 4)

Survey Area 51

Crop		Inputs: Improved Seeds %	Nutrients: N kg/ha	Nutrients: P_2O_5 kg/ha	Nutrients: K_2O kg/ha	Manure t/ha	Chemicals: Insec. kg/ha	Chemicals: Fungicide kg/ha	Yield kg/ha
First Rains									
Beans	Avg.	-	-	4	-	0.13	1	1	542
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	225
Engl. Potatoes	Avg.	-	521	7	104	-	-	33	3,000
Cabbage	Avg.	100	16	16	1	0.76	16	-	6,332
	UpQu	100	31	23	-	-	25	-	7,050
	LoQu	100	-	-	-	-	1	-	2,500
Tomatoes	Avg.	-	15	26	-	1.19	7	3	5,041
	UpQu	-	15	31	-	-	8	-	5,000
	LoQu	-	-	-	-	-	-	-	1,600
Second Rains									
Maize	Avg.	100	18	25	3	0.03	1	1	2,615
	UpQu	100	23	58	-	-	-	-	3,175
	LoQu	100	-	-	-	-	-	-	1,800
Engl. Potatoes	Avg.	50	31	8	6	5.00	3	3	23,125
Cabbage	Avg.	100	7	19	1	2.78	49	49	5,999
	UpQu	100	9	14	-	-	25	25	6,250
	LoQu	100	-	-	-	-	-	-	2,500
Onions	Avg.	-	-	-	-	6.88	-	-	1,500
Tomatoes	Avg.	-	21	37	-	2.15	17	27	5,938
	UpQu	-	26	35	-	0.25	17	40	6,250
	LoQu	-	-	-	-	-	-	-	2,000
Maize & Beans									
Maize	Avg.	64	1	14	-	0.59	-	-	1,739
Beans	Avg.	9	-	-	-	3.86	-	-	876
Maize	UpQu	100	-	34	-	0.75	-	-	3,375
Beans	UpQu	-	-	-	-	2.50	-	-	900
Maize	LoQu	-	-	-	-	-	-	-	400
Beans	LoQu	-	-	-	-	-	-	-	107
Perennial Crops									
Passionfruit	Avg.	-	-	-	-	-	-	-	7,500
Cookng Bananas	Avg.	-	-	-	-	-	-	-	4,500
Pineapples	Avg.	-	98	-	-	-	-	-	1,250
Coffee	Avg.	-	49	5	-	1.02	-	17	12,753
	UpQu	-	93	-	-	1.25	-	25	12,500
	LoQu	-	-	-	-	-	-	1	2,425

TAITA-TAVETA DISTRICT

TABLE 12 b: INPUTS & YIELDS OF MAJOR CROPS

AEZ: LM 4–5 + L 5 (+ irr.)

Survey Area 52

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.	27	-	-	-	-	2	-	3,221
	UpQu	100	-	-	-	-	-	-	2,700
	LoQu	-	-	-	-	-	-	-	1,125
Beans	Avg.	17	-	-	-	-	1	-	721
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	353
Cotton	Avg.	100	-	-	-	-	15	-	1,165
	UpQu	100	-	-	-	-	14	-	1,250
	LoQu	100	-	-	-	-	3	-	450
Second Rains									
Maize	Avg.	21	-	-	-	-	3	3	1,693
	UpQu	-	-	-	-	-	-	-	2,250
	LoQu	-	-	-	-	-	-	-	900
Beans	Avg.	-	-	38	-	-	5	5	567
Cotton	Avg.	100	-	-	-	-	40	40	675
Perennial Crops									
Sugarcane	Avg.	-	-	-	-	-	-	-	10,000
Sweet Bananas	Avg.	-	-	-	-	-	-	-	5,167
Cookng Bananas	Avg.	-	-	-	-	-	-	-	5,004
	UpQu	-	-	-	-	-	-	-	5,833
	LoQu	-	-	-	-	-	-	-	1,838

TAITA-TAVETA DISTRICT

TABLE 13 a: DISPOSAL OF CROPS

AEZ: UM 3 (+ 4)

Survey Area 51

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize & Beans	7,085	0	0	930	13	6,155	87
Maize & Others	2,120	800	38	0	0	1,320	62
Beans	3,735	0	0	282	8	3,453	92
Engl. Potatoes	360	0	0	180	50	180	50
Cabbage	12,486	10,866	87	1,060	8	560	4
Tomatoes	7,082	4,350	61	1,790	25	942	13
Second Rains							
Maize	12,970	1,920	15	450	3	10,600	82
Maize & Beans	15,890	0	0	3,630	23	12,260	77
Maize & Others	7,400	2,100	28	600	8	4,700	64
Maize IPC	900	0	0	0	0	900	100
Beans	140	0	0	0	0	140	100
Engl. Potatoes	2,600	0	0	1,990	77	610	23
Cabbage	11,490	6,740	59	3,300	29	1,450	13
Onions	120	120	100	0	0	0	0
Tomatoes	3,390	2,540	75	240	7	610	18
Permanent Crops							
Nil							

TAITA-TAVETA DISTRICT

TABLE 13 b: DISPOSAL OF CROPS

AEZ: LM 4–5 + L 5 (+ irr.)

Survey Area 52

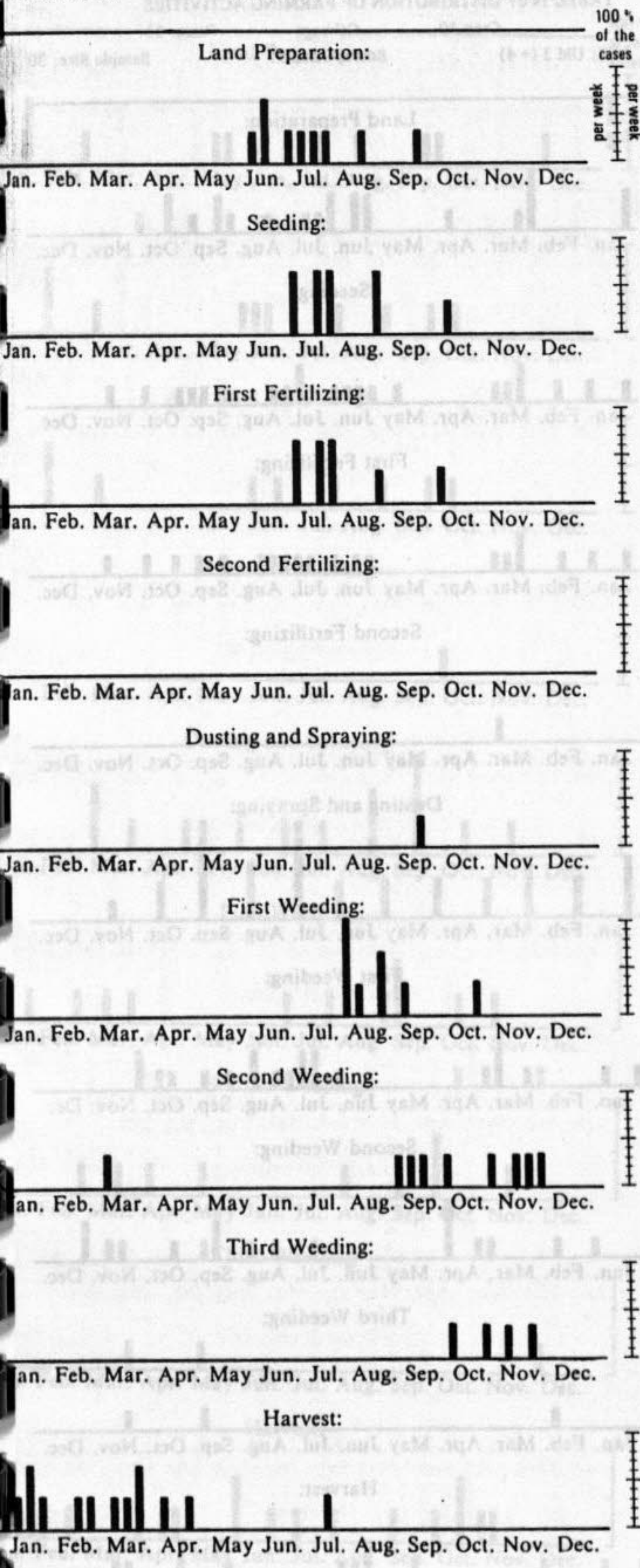
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	24,570	980	4	4,040	16	19,550	80
Maize & Beans	4,635	0	0	1,290	28	3,345	72
Maize & Sorgm	3,600	0	0	0	0	3,600	100
Maize & Others	7,120	2,130	30	0	0	4,990	70
Maize IPC	900	0	0	450	50	450	50
Beans	1,965	0	0	1,230	63	735	37
Cotton	24,503	24,503	100	0	0	0	0
Second Rains							
Maize	12,930	0	0	3,250	25	9,680	75
Maize & Beans	1,305	0	0	450	34	855	66
Maize IPC	720	0	0	310	43	410	57
Beans	720	0	0	80	11	640	89
Cotton	675	675	100	0	0	0	0
Permanent Crops							
Nil							

TAITA-TAVETA DISTRICT

TABLE 14 a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 9

AEZ: UM 3 (+ 4) Survey Area 51 Sample Size: 30

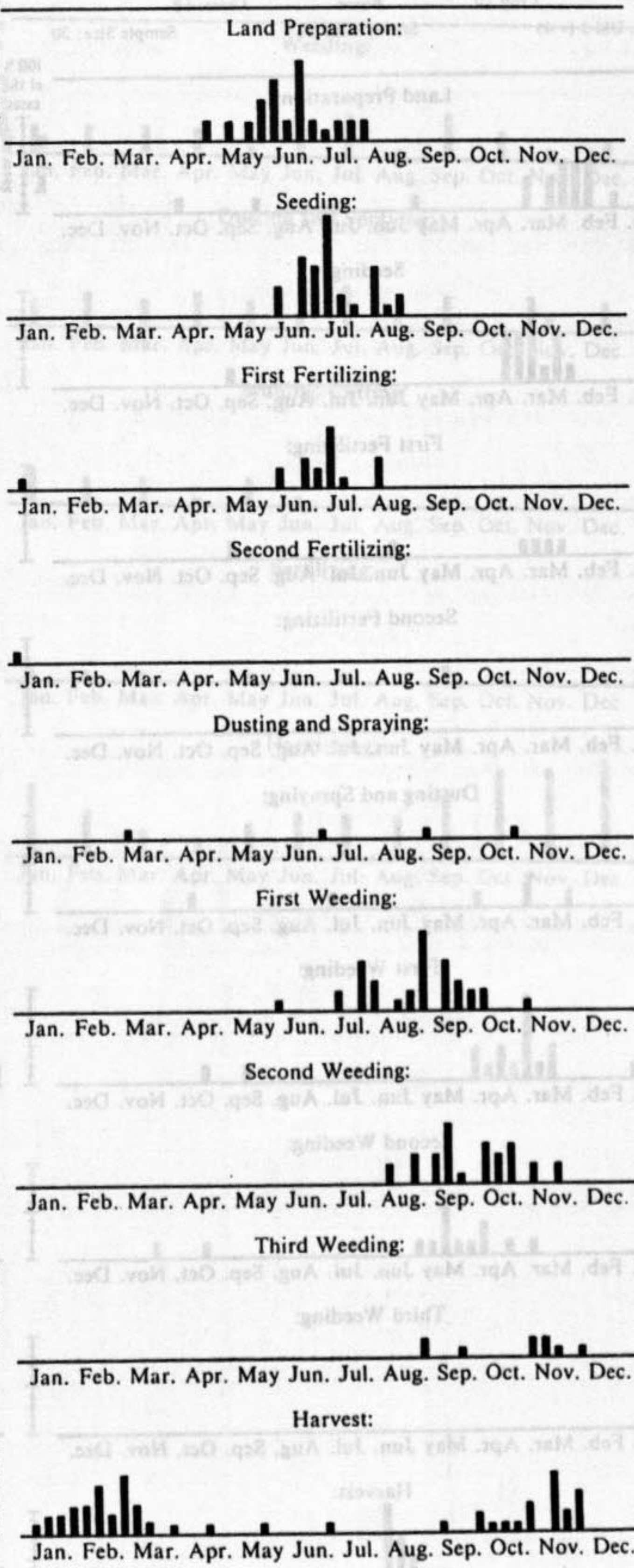


TAITA-TAVETA DISTRICT

TABLE 14 b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 35[1)]

AEZ: UM 3 (+ 4) Survey Area 51 Sample Size: 30



1) Maximum 30 per crop and season

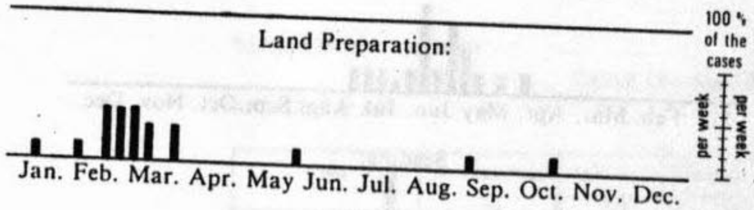
TAITA-TAVETA DISTRICT

TABLE 14 c: DISTRIBUTION OF FARMING ACTIVITIES

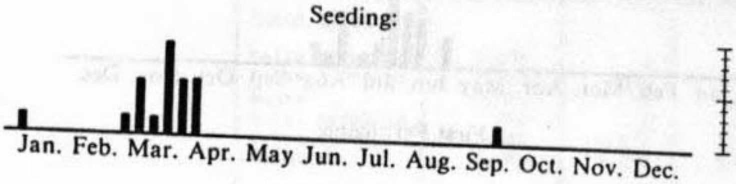
Crop 10 Beans Cases: 18

AEZ: UM 3 (+ 4) Survey Area 51 Sample Size: 30

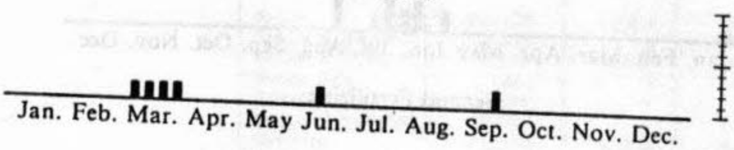
Land Preparation:



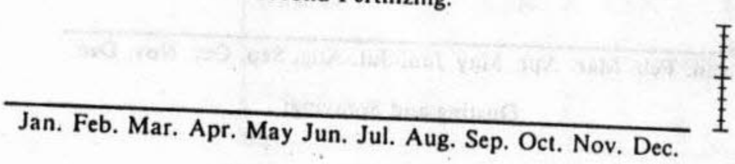
Seeding:



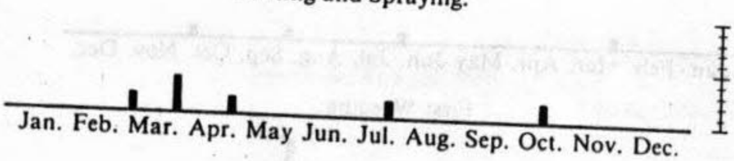
First Fertilizing:



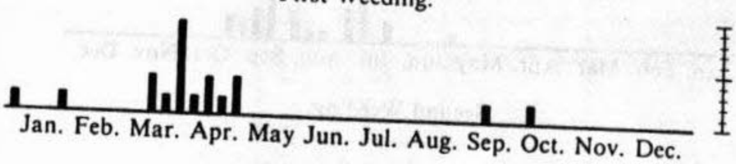
Second Fertilizing:



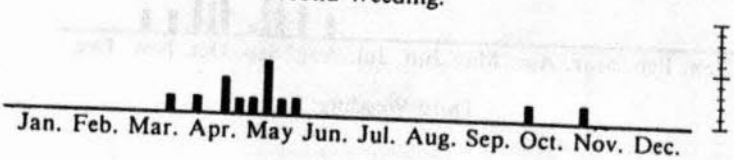
Dusting and Spraying:



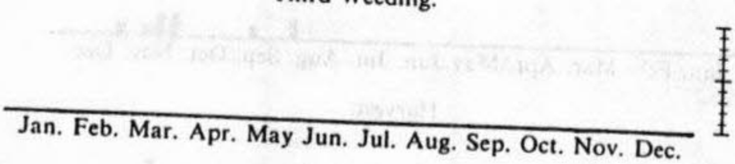
First Weeding:



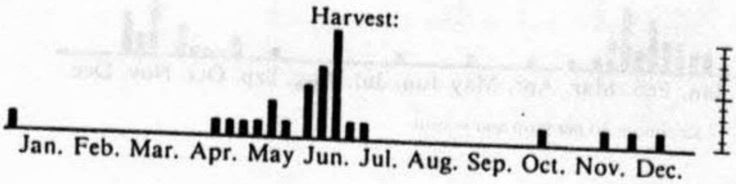
Second Weeding:



Third Weeding:



Harvest:



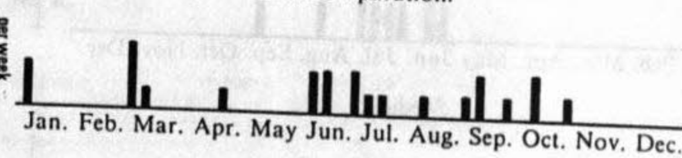
TAITA-TAVETA DISTRICT

TABLE 14 d: DISTRIBUTION OF FARMING ACTIVITIES

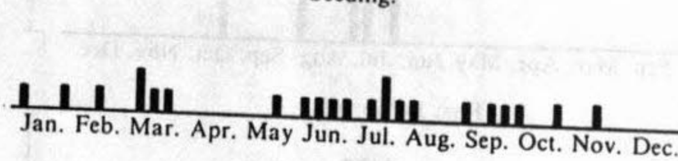
Crop 40 Cabbage Cases: 23

AEZ: UM 3 (+ 4) Survey Area 51 Sample Size: 30

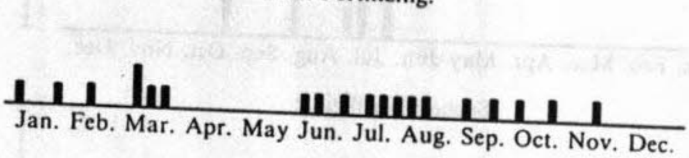
Land Preparation:



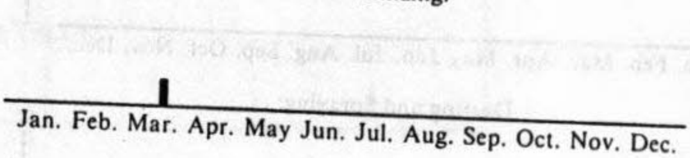
Seeding:



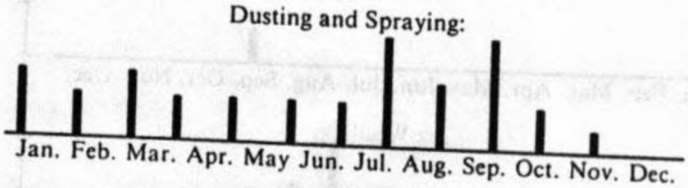
First Fertilizing:



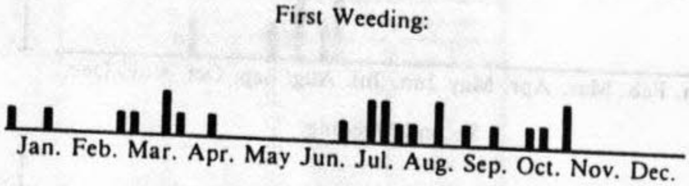
Second Fertilizing:



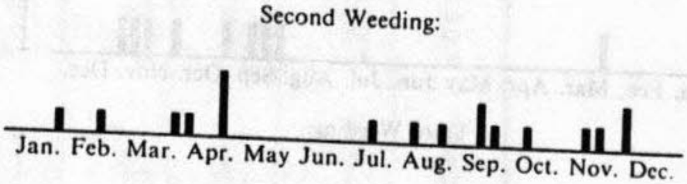
Dusting and Spraying:



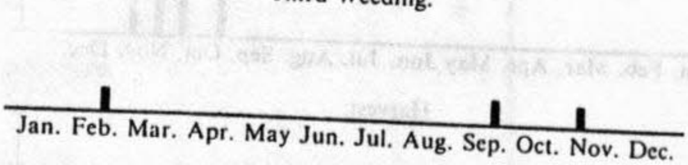
First Weeding:



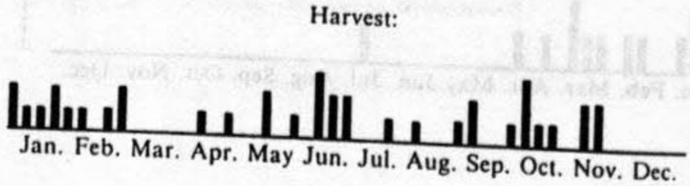
Second Weeding:



Third Weeding:



Harvest:

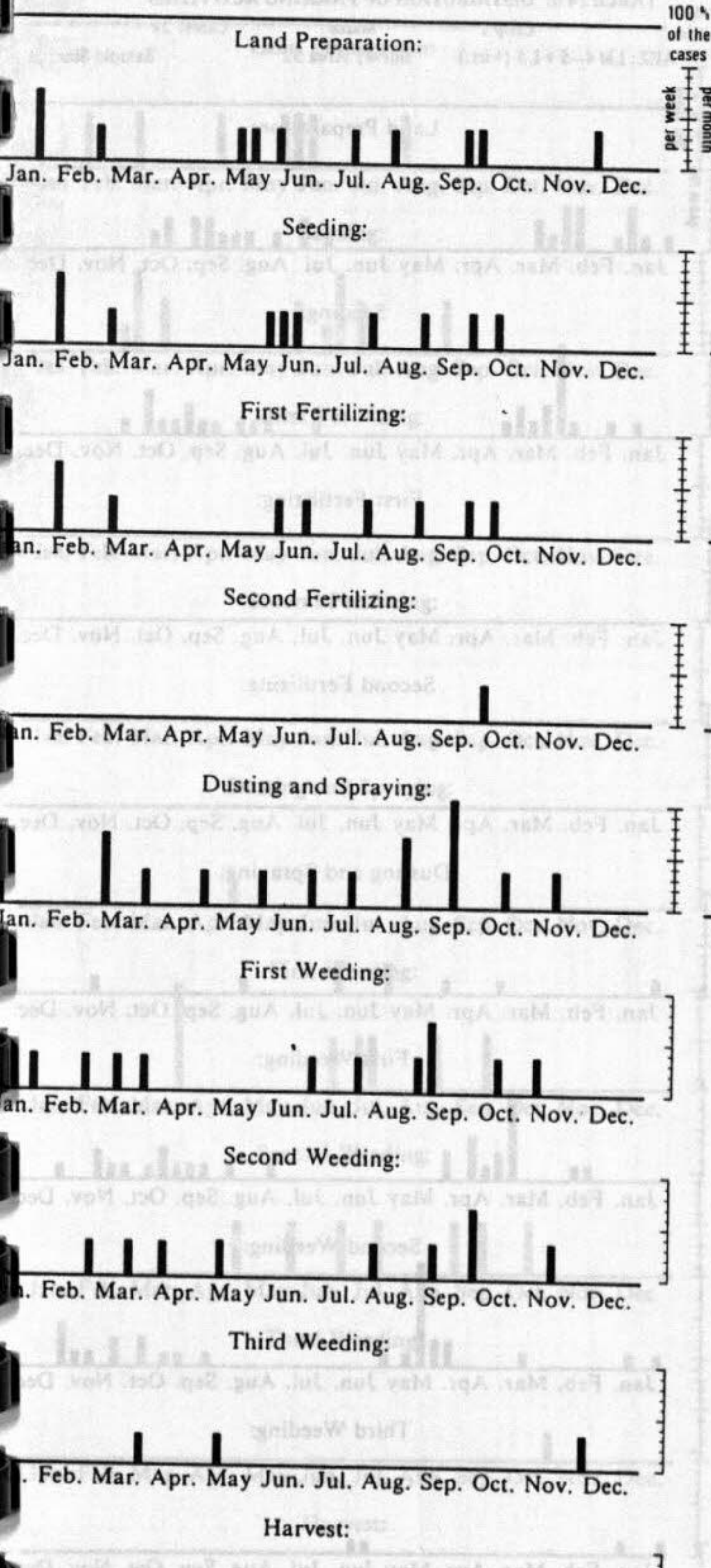


TAITA-TAVETA DISTRICT

TABLE 14 e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 44 Tomatoes Cases: 11

AEZ: UM 3 (+ 4) Survey Area 51 Sample Size: 30

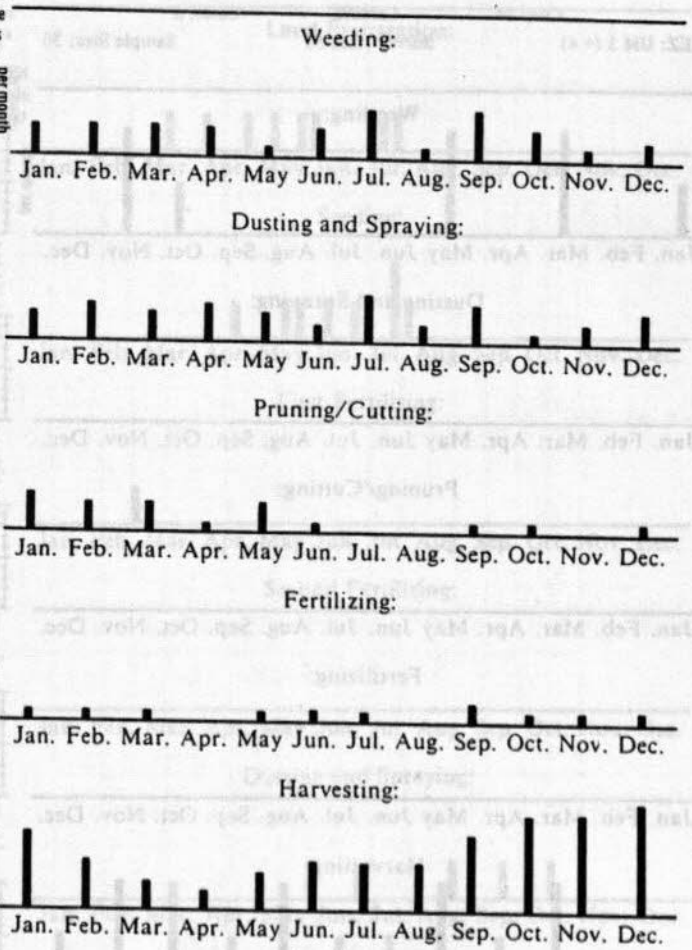


TAITA-TAVETA DISTRICT

TABLE 14 f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 51 Coffee Cases: 12

AEZ: UM 3 (+ 4) Survey Area 51 Sample Size: 30

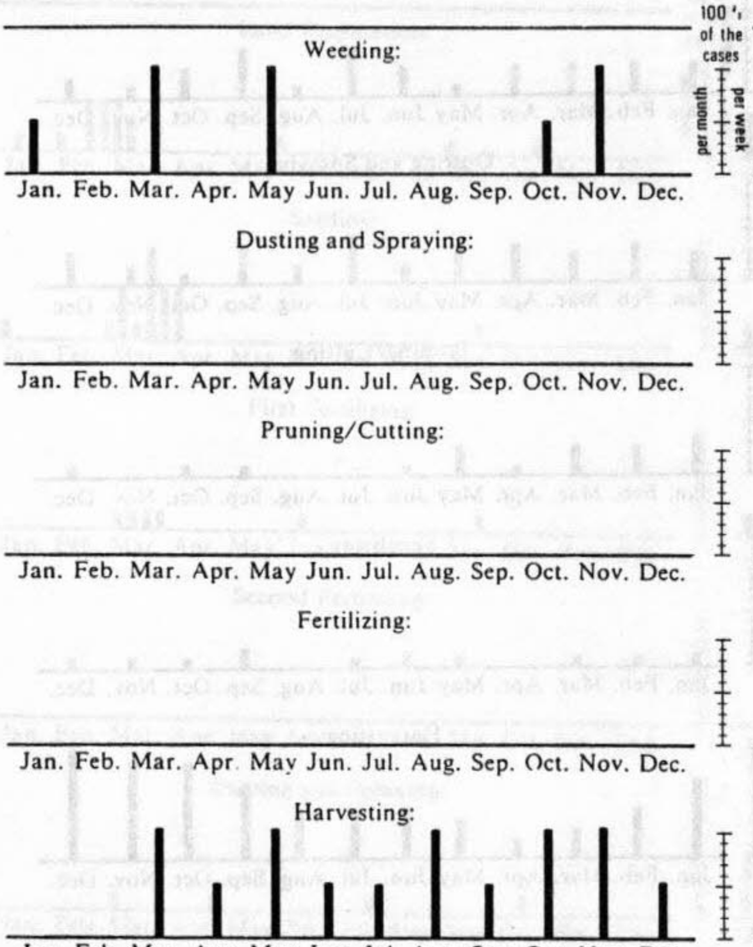


TAITA-TAVETA DISTRICT

TABLE 14 g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 64 Cassava Cases: 2

AEZ: UM 3 (+ 4) Survey Area 51 Sample Size: 30

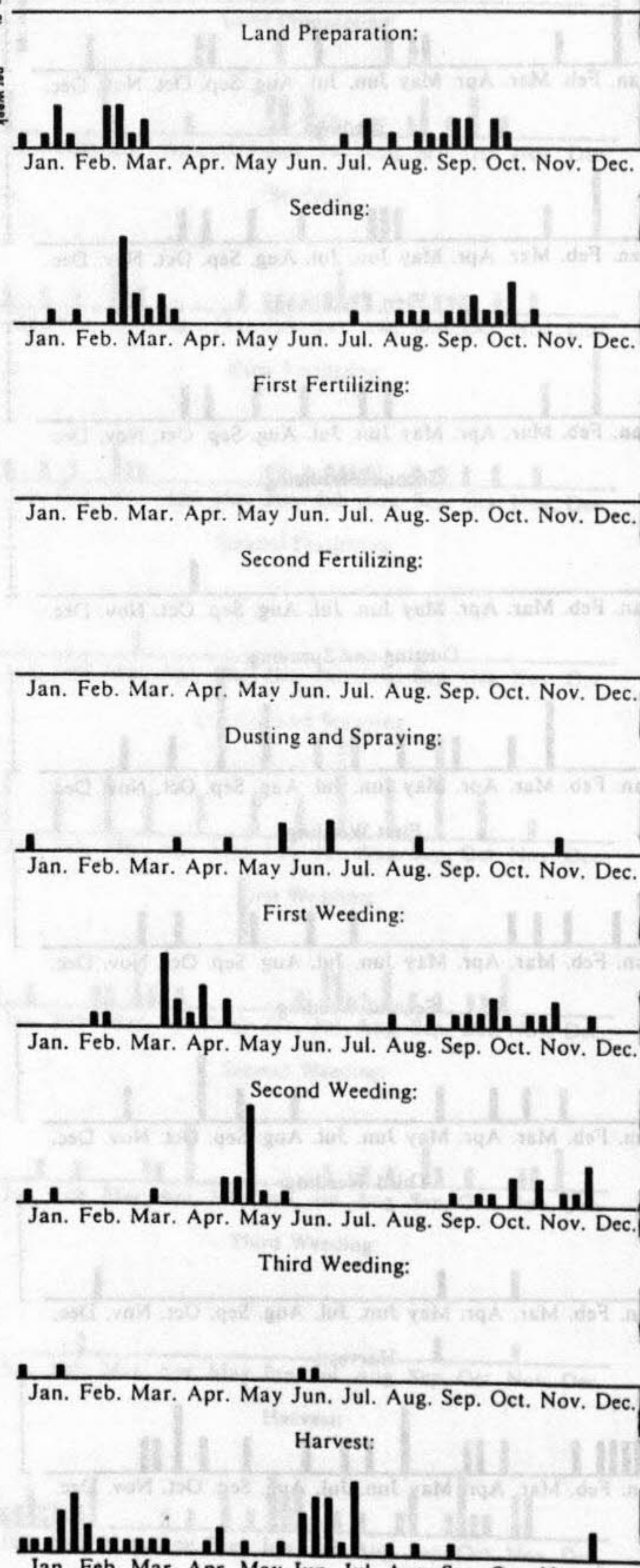


TAITA-TAVETA DISTRICT

TABLE 14 h: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 29

AEZ: LM 4–5 + L 5 (+ irr.) Survey Area 52 Sample Size: 30

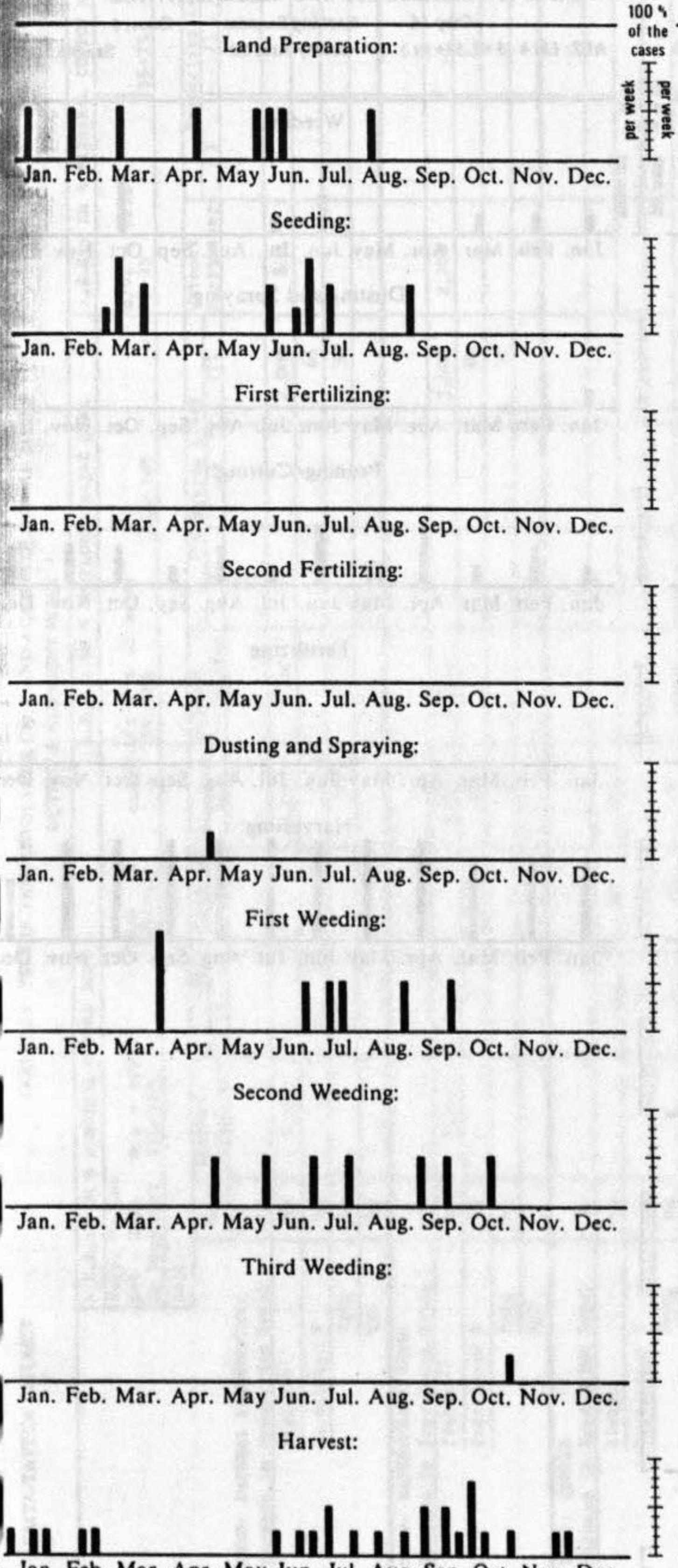


TAITA-TAVETA DISTRICT

TABLE 14 i: DISTRIBUTION OF FARMING ACTIVITIES

Crop 2 Maize & Beans Cases: 16

AEZ: LM 4–5 + L 5 (+ irr.) Survey Area 52 Sample Size: 30

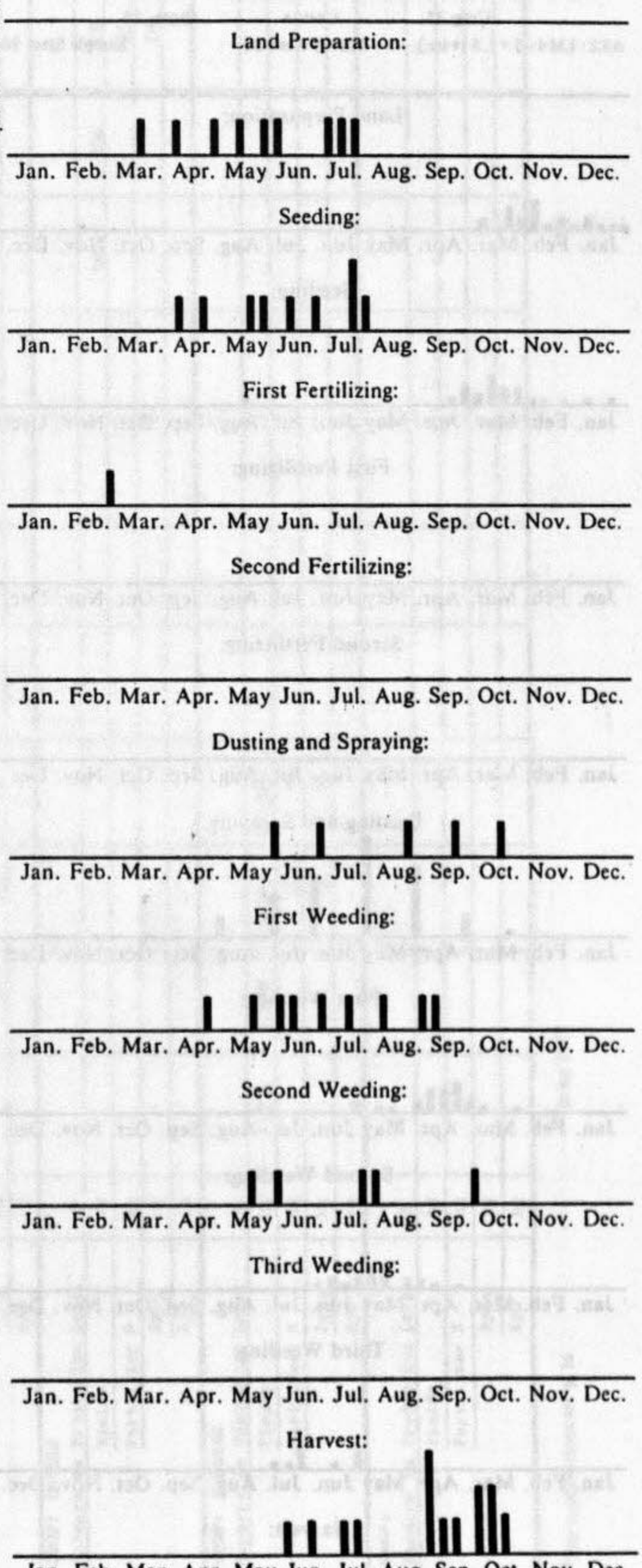


TAITA-TAVETA DISTRICT

TABLE 14 j: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 9

AEZ: LM 4–5 + L 5 (+ irr.) Survey Area 52 Sample Size: 30

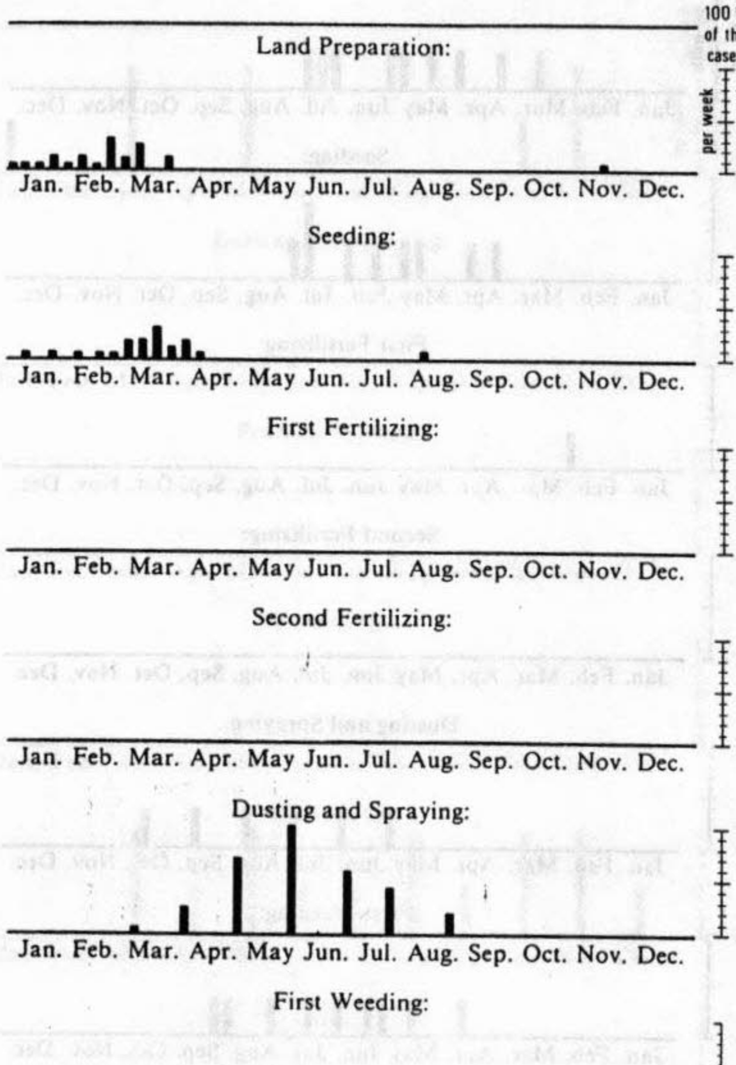


TAITA TAVETA DISTRICT

TABLE 14 k: DISTRIBUTION OF FARMING ACTIVITIES

Crop 35 Cotton Cases: 23

AEZ: LM 4–5 + L 5 (+ irr.) Survey Area 52 Sample Size: 30



TAITA-TAVETA DISTRICT

TABLE 14 l: DISTRIBUTION OF FARMING ACTIVITIES

Crop 56 Cooking Bananas Cases: 5

AEZ: LM 4–5 + L 5 (+ irr.) Survey Area 52 Sample Size: 3

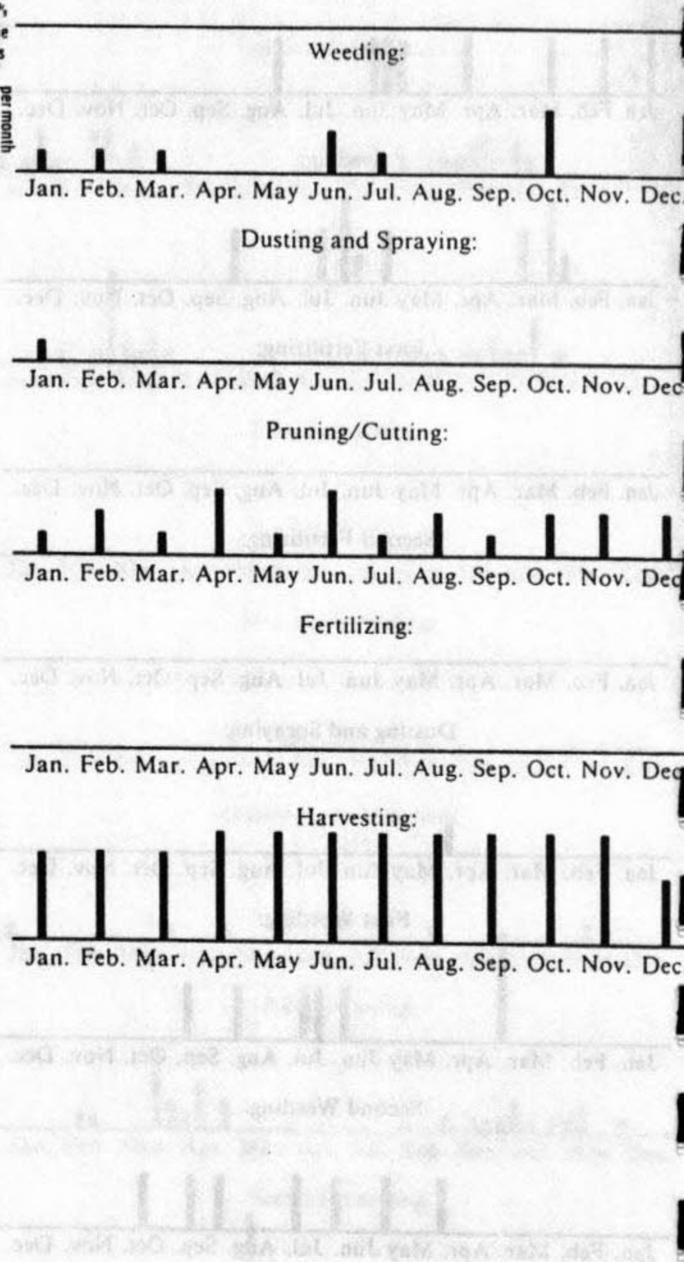


TABLE 15a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT & NUTRIENT INPUT[1]

		A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE			
Vegt. Period 1st + 2nd: in Days, 1st:		m/s + s/m 115-13o		2nd: 1o5-11o	total: —	fs + s or s/vs 85-115		85-1o5	—	s/vs + vs/s 75-85		55-75	—
Soil:													
	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 2)	kg	1,200			2,200	800			2,000	800			2,000
Fertilizer N	kg				55				66				66
P_2O_5	kg				27				33				33
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields 2)	kg	2,200			4,000	1,500			3,000	2,200			4,000
Fertilizer N	kg				100				83				100
P_2O_5	kg				50				42				50
K_2O	kg												
CROP: COFFEE													
Farmers in Production Level	%												
Yields	kg		300	500	700								
Fertilizer N	kg		30	50	70								
P_2O_5	kg		90	90	90								
K_2O	kg												
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg									300	300	600	800
Fertilizer N	kg											33	55
P_2O_5	kg											24	40
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	5,500	4,000	7,000	12,000								
Fertilizer N	kg			23	98								
P_2O_5	kg			11	46								
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

1) for explanations see p. 16

2) in kg TDN

TAITA-TAVETA DISTRICT

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

		A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE			
		Vegt. Period 1st + 2nd: in Days, 1st: m/s + s/m 115-13o		2nd: 1o5-11o	total: —	fs + s or s/vs 85-115		85-1o5	—	s/vs + vs/s 75-85		55-75	—
		Soil:											
	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	1,300	2,400	2,800	1,400	1,300	2,000	2,500	950	800	1,500	2,000
Fertilizer N	kg			20	30			15	28			14	26
P_2O_5	kg			22	34			17	31			15	29
K_2O	kg												
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg									1,400	1,100	2,000	2,800
Fertilizer N	kg											18	42
P_2O_5	kg											16	38
K_2O													
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg	1,200		1,000	1,500	900		800	1,400	1,000		800	1,500
Fertilizer N	kg				10				16				16
P_2O_5	kg				8				14				14
K_2O	kg												
CROP: MAIZE & BEANS													
Farmers in Production Level	%												
Yields	kg	1,600		2,400/300	2,800/400								
Fertilizer N	kg			34	49								
P_2O_5	kg			31	46								
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg					700	500	1,000	1,400	700	500	1,200	1,500
Fertilizer N	kg							14	34			30	48
P_2O_5	kg							11	25			18	28
K_2O	kg												
CROP: SUNFLOWER													
Farmers in Production Level	%												
Yields	kg	800	400	500	1,100	700	400	500	900	500		500	1,000
Fertilizer N	kg				10				7				17
P_2O_5	kg				15				10				25
K_2O	kg												

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

		A.E.Z.: UM 3 MARGINAL COFFEE ZONE				A.E.Z.: UM 4 SUNFLOWER-MAIZE ZONE				A.E.Z.: LM 4 MARGINAL COTTON ZONE			
		Vegt. Period 1st + 2nd: in Days, 1st: m/s + s/m 115-13o		2nd: 1o5-11o	total: —	fs + s or s/vs 85-115		85-1o5	—	s/vs + vs/s 75-85		55-75	—
		Soil:											
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg	3,000	3,500	15,000	25,000								
Fertilizer N	kg		4	84	154								
P_2O_5	kg		4	84	154								
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	5,000	3,000	8,000	16,000	4,000	3,000	7,000	14,000	3,500	3,000	7,000	10,000
Fertilizer N	kg			24	88			24	80			28	52
P_2O_5	kg			21	77			21	70			24	45
K_2O													
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg					4,000	3,500	6,000	8,000	3,000	3,800	6,000	9,000
Fertilizer N	kg							8	16		3	12	24
P_2O_5	kg							14	28		6	21	42
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												

KWALE DISTRICT

Contents District page

NATURAL POTENTIAL

INTRODUCTION

Kwale District is typical for the zonation of Coast Province: It is dominated by a zone of about 35 km from the sea to the hinterland, with over 800 mm p.a. rainfall usually, and suitable for conventional agriculture, here in Agro-Ecological Zones CL 2–4[1]. The reason is the braking effect of the trees on the air masses coming from the sea, especially on the SE trade wind [2]. The turbulence thus caused is re-enforced by the effects of the Shimba Hills. For this reason, the highest annual average rainfall (1,400 mm) is recorded southeast of the highest point of this ridge.

The air descends beyond the hills, but due to a continuing undulating impulse given to the air by the braking and updamming, the air rises again in a distance of 25 km. In rising up, the air cools and therefore loses moisture. Not as much as on the coast, of course, because the air has already lost a big part of its water content, but it could be used for some cultivation in the vast Ranching Zone L 6. Other waves are following to the west, therefore we see on the AEZ map strips of the Livestock-Millet Zone L 5 in L 6.

The wettest zone is the Lowland Sugar Cane Zone L 2. But it is here near its margins, therefore the cane producers have difficulties there. It thrives well only on good deep soils, which are limited[3]. On lighter soils it is similar to L 3.

The quality of the Coconut-Cassava Zone L 3 also depends very much on the soils. In the Shimba (Tsimba) Hills National Reserve, most soils are not suitable for these leading crops.

The Cashew-Cassava Zone L 4 suffers from a less concentrated rainfall (see Diagram Ndavaya). The first rains decrease rapidly from the coast to the hinterland, at a rate of about 100 mm per 3 km (see rainfall reliability map of first rains). They are followed by some intermediate rains in August which are good for simsim and cowpeas if relay planted in other crops at the end of the first rains.

The smaller second rains are insignificant on the coast, but increase slightly for about 15–20 km in to the hinterland[4]. Their reliablitiy in 6 out of 10 years during the real agro-humid period surpasses 150 mm only in a small strip (see Map 3). Kinango, 35 km inland, can rely only on 100 mm in this period, although the average from October to January is 290 mm. For the first rains the corresponding figures are 265 mm and 450 mm from March to July.

In the interior the rains become concentrated again but the amounts are so small and the agro-humid period so short that it is only sufficient for special crops like very early maturing dwarf sorghum or tough perennials like Marama beans in L 5.

1) CL = Coastal Lowlands. All areas in the coastal districts belong to CL, therefore, to simplify it in the maps, there is only written L.

2) The air masses are slowed down to 1/3 of their speed when they move over the tree-covered areas. The pursuing air which comes from the sea is banked up resulting in rainfall by cooling. Thus, it is necessary to have at least 30 % of the cultivated land planted with trees or, otherwise, the climate will become more arid.

3) Detailed soil distribution and land use recommendation, see D.O. MICHIEKA, J.J. VLEESHOUWER and B.J. van der POUW: Soils of the Kwale Area (quarter degree sheets 200, 201, 202). Kenya Soil Survey R 3, Nairobi 1978.

4) BRAUN, H.M.H.: Average monthly rainfall as a percentage of the annual rainfall in Kenya and Tanzania. Kenya Soil Survey M 14, Nairobi 1977, Fig. 3.

KWALE 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	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
9339006	Samburu Station	42	Average	616	26	24	57	82	88	26	22	29	41	62	85	75
279 m			60 % rel.[1)]	538	11	7	29	62	56	9	19	17	13	21	45	50
9439001	Kwale, Agric.	64	Av.	1 151	36	14	67	164	213	112	88	74	74	125	114	71
393 m	Department		60 %	1 025	16	1	46	100	188	75	69	45	36	66	44	55
9439003	Assoc. Sugar Works	43	Av.	1 426	23	18	78	271	359	155	121	82	61	84	103	71
15 m	Ltd.		60 %	1 116	6	2	32	206	211	135	115	44	24	20	40	31
9439004	Gazi, Kenya Sugar	54	Av.	1 349	23	24	70	256	347	150	100	86	68	79	89	58
46 m	Co. Ltd.		60 %	976	4	0	35	172	213	145	93	33	39	53	32	39
9439013	Vanga, Mudir's Office	40	Av.	1 109	36	19	86	193	294	38	79	67	51	86	98	62
12 m			60 %	989	8	0	48	165	153	30	69	55	23	51	85	47
9439014	Gazi, Mudir's Office	39	Av.	1 408	21	18	69	275	397	133	108	81	66	86	104	50
6 m			60 %	1 223	6	0	29	194	229	115	80	60	42	44	54	28
9439015	Mudir of Kinango	31	Av.	841	20	33	52	146	150	55	58	49	39	84	105	50
305 m			60 %	670	11	10	15	90	108	25	32	26	15	37	45	50
9439017	Msambweni, Tiwi	29	Av.	1 289	25	17	58	259	327	98	95	82	86	81	93	69
9 m	Disp.		60 %	1 004	6	0	19	129	221	93	64	43	25	42	33	33
9439021	Mombasa, Port Reitz	30	Av.	1 050	34	19	63	167	227	70	65	67	78	94	97	69
56 m	Aerodrome		60 %	915	8	2	15	82	177	61	44	40	24	56	47	33
9439027	Mwangulu	21	Av.	739	24	27	74	112	135	48	54	59	47	70	22	67
122 m			60 %	661	2	10	41	65	69	35	32	30	27	28	20	30
9439030	Muhaka	23	Av.	1 129	23	19	50	204	260	104	93	79	59	93	105	40
60 m			60 %	984	0	0	9	140	175	85	75	39	29	54	31	26
9439031	Simba Hills, Mrore	26	Av.	984	34	19	48	150	195	76	63	73	52	87	117	70
407 m	No. 1		60 %	839	3	6	18	79	155	54	53	43	22	37	21	41
9439038	Msambweni, Waa	22	Av.	1 069	24	15	42	191	266	107	79	62	60	80	99	45
31 m	Disp.		60 %	961	7	0	18	113	214	77	53	47	30	30	17	20
9439043	Simba Hills, Dev. Sch.	23	Av.	1 290	40	13	71	223	290	106	104	81	66	127	122	63
244 m			60 %	1 134	13	0	34	151	224	78	79	62	35	78	38	34
9439044	Gazi, Kikoneni	20	Av.	1 236	25	14	92	209	234	112	107	89	70	84	124	77
152 m			60 %	1 063	0	0	22	150	160	81	88	55	42	44	97	33
9439046	Vanga, Lunga Lunga	24	Av.	912	31	21	77	146	176	61	51	44	38	72	123	71
61 m	School		60 %	796	17	6	24	90	124	35	40	26	17	48	82	34

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

KWALE DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ[1]	Kind of records	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Years of rec.
				Temperature in °C													
9435021	Mombasa,	CL	Mean max.	32.1	32.4	32.7	31.2	29.2	28.5	27.7	28.0	28.9	29.7	30.6	31.6	30.2	24
57 m	Port Reitz	4	Mean temp.	27.6	28.0	28.4	27.5	25.9	24.8	24.0	24.1	24.8	25.8	26.8	27.4	26.3	
	Airport,	lp	Mean min.	23.2	23.6	24.2	23.8	22.6	21.2	20.3	20.3	20.8	22.0	23.0	23.3	22.4	
	Met. Station		Abs. min.	18.4	20.6	20.8	21.1	18.9	17.5	17.6	14.1	17.6	17.7	20.0	19.4	14.1	

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

KWALE DISTRICT

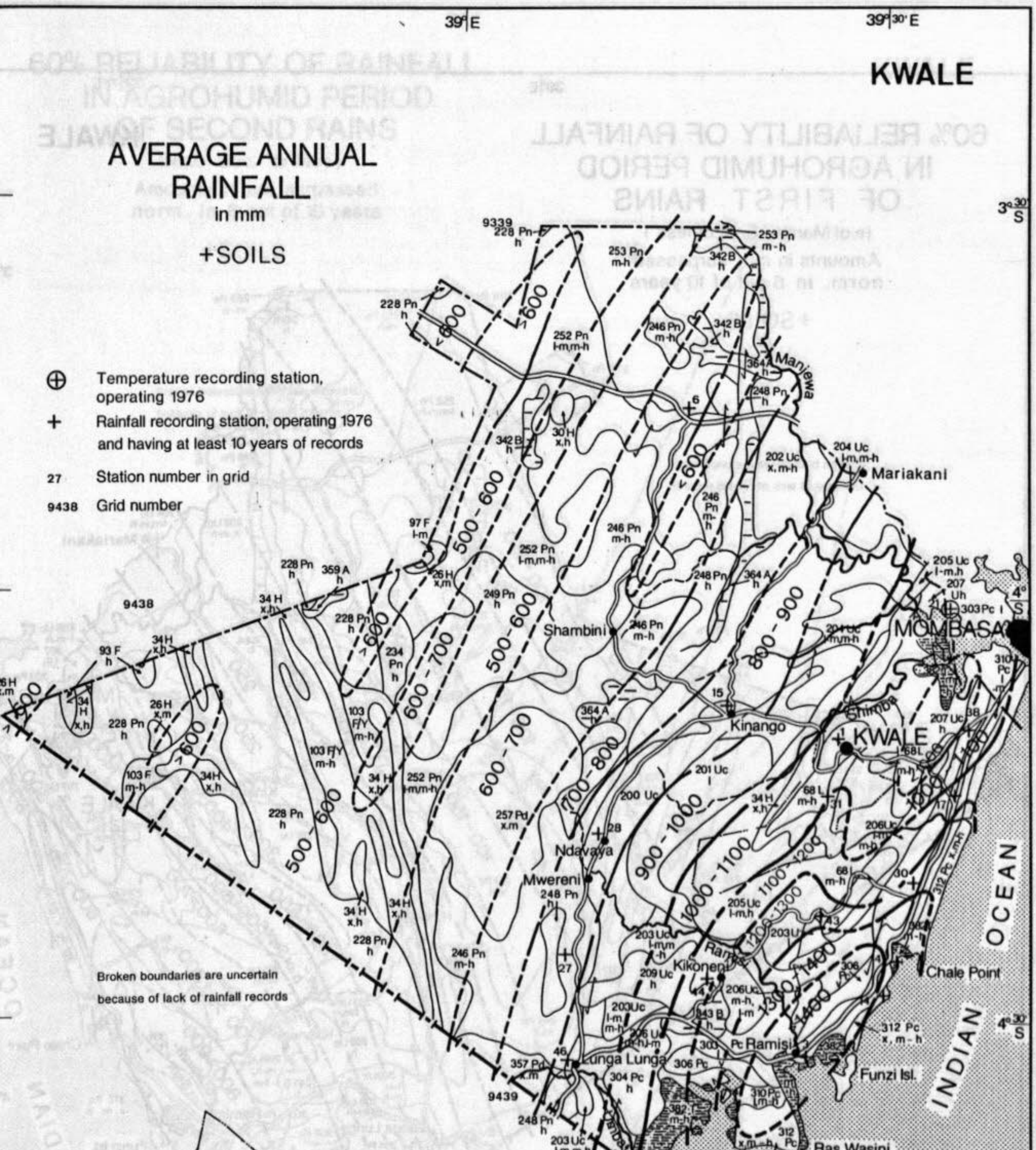
TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

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	60 % reliability of rainfall[1] 2nd rains in mm	60 % reliability of growing period 1st rains in days	60 % reliability of growing period 2nd rains in days	60 % reliability of growing period Total[2] in days[3]
L 2 (−3) Lowland Marginal Sugarcane Zone	l/m + i	1–60	26.6–26.3	1 200–>1 400	750–900	80–150	175–195	<45	–
L 3 Coconut-Cassava Zone	l/m i (vs/s)	1–450	26.6–24.0	1 050–1 250	600–750	170–200	175–195	55–75	210–270
	m/l i			1 000–1 350	500–800	100–180	155–175	<40	–
	m/l i (vs)			1 000–1 300	500–800	170–200	155–175	40–55	195–230
	m/l + i			1 000–1 300	500–800	100–160	155–175	<40	–
	m i (vs)			970–1 080	380–680	160–200	135–155	40–55	175–210
L 4 Cashewnut-Cassava Zone	m i	1–250	26.6–25.0	1 050–1 200	500–600	80–150	135–155	<40	–
	m i (vs/s)			980–1 050	400–500	170–200	135–155	55–75	190–230
	m i (vs)			980–1 020	400–450	170–180	135–155	40–55	175–210
	m + i			950–1 050	400–500	120–150	135–155	<40	–
	m/s i (vs)			900–1 000	320–400	140–190	115–135	40–55	155–190
	s/m i (vs)			850– 930	280–350	140–180	105–115	40–55	145–170
	s i (vs)			850– 900	230–280	140–170	85–105	40–55	125–160
L 5 Lowland Livestock-Millet Zone	s i (vs)	120–650	27.5–24.3	850– 900	230–280	140–170	85–105	40–55	125–160
	s/vs i (vs)			800– 850	210–270	130–160	75– 85	40–55	115–140
	vs/s + vs			750– 800	180–250	130–150	55– 75	40–55	–
	(vs/s) + (vs)			600– 780	180–210	125–140	55– 75	40–55	–
	(vs) + i or i + (vs)			650– 750	150–200	120–130	40–55	35–50	–
	(vs) + i			600– 700	150–200	50–120	40– 55	<40	–
L 6 Lowland Ranching Zone	b r	120–600	27.5–24.6	500– 600	100–150	50–120	30–40	20–30	–

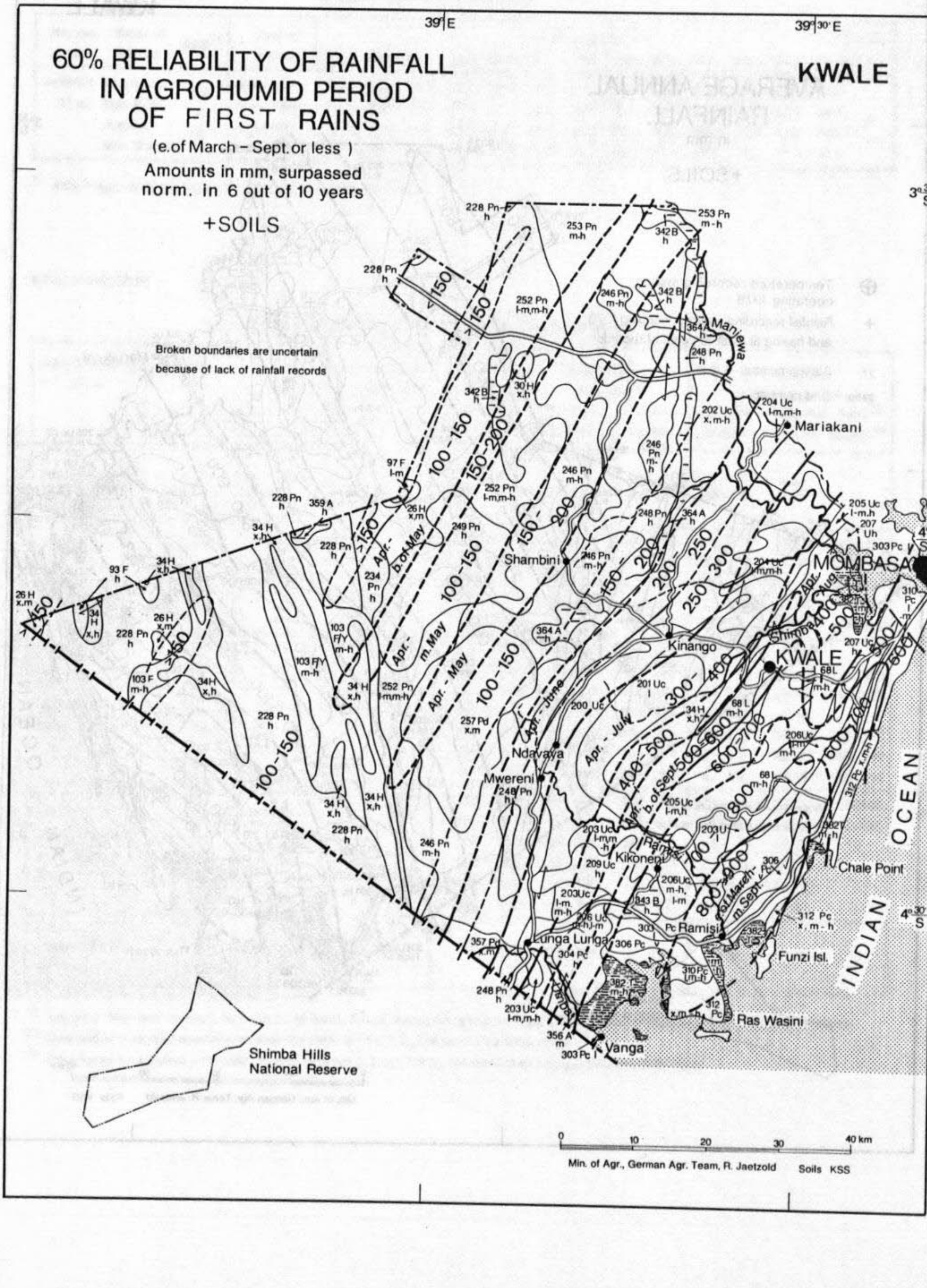
1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants

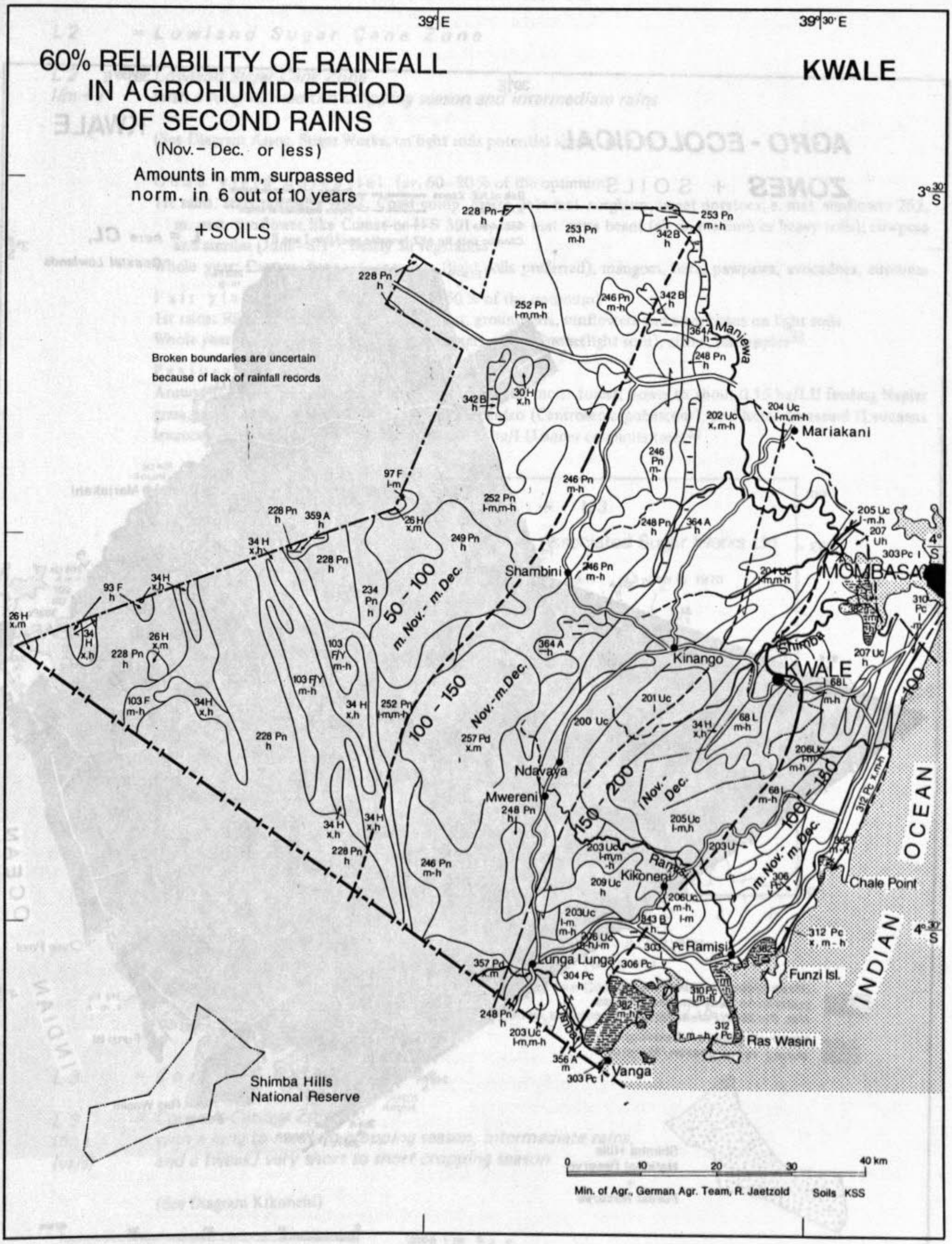
2) Only added if rainfall continues at least for survival (<0.2 E_o) of most long term crops

3) Interrupted by a period with water supply between 0.2 and 0.4 E_o for more than 50 days (intermediate rains)

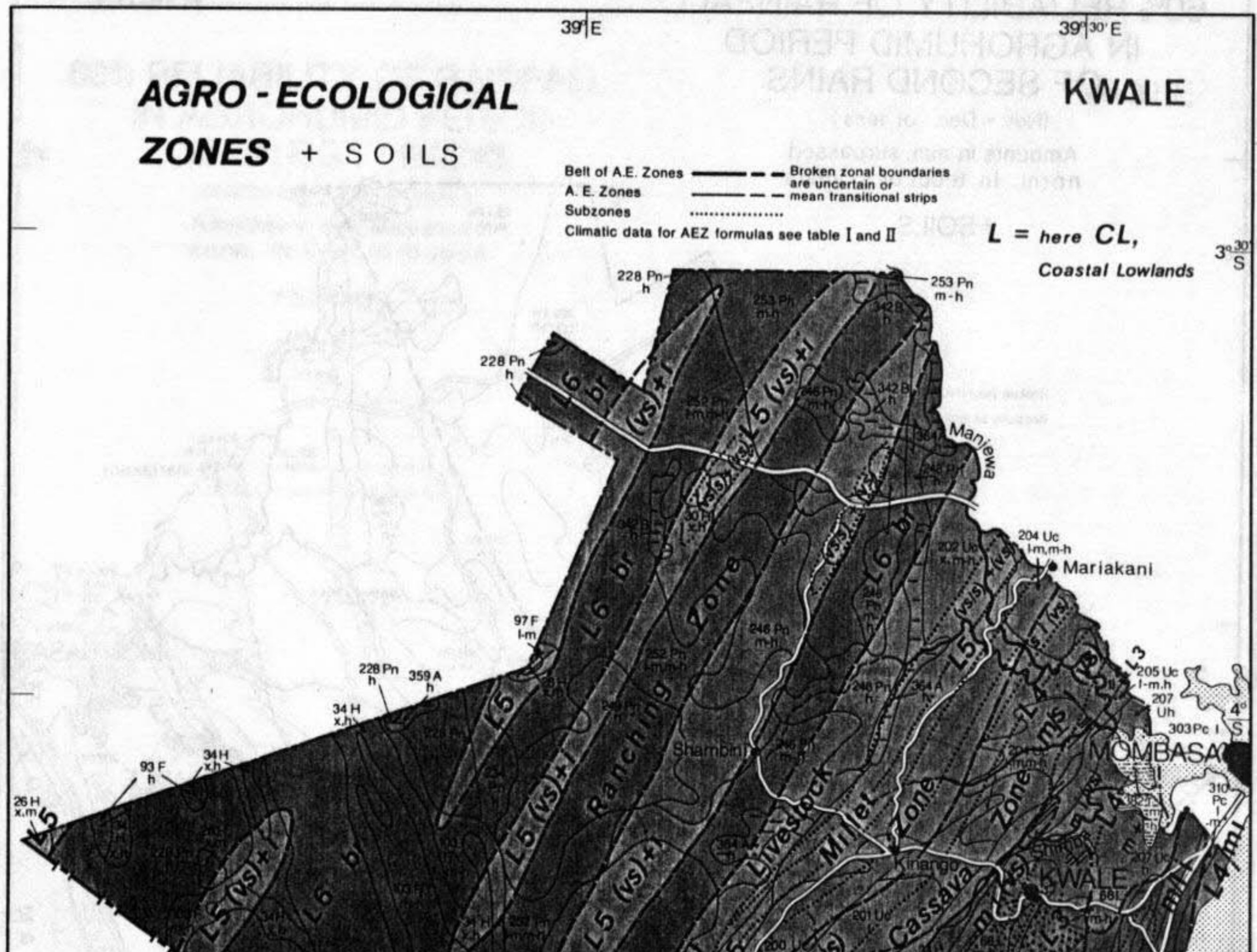


KWALE
AVERAGE ANNUAL RAINFALL in mm
+SOILS
39° E
39° 30' E
3° 30' S
4° S
4° 30' S
Temperature recording station, operating 1976
Rainfall recording station, operating 1976 and having at least 10 years of records
27 Station number in grid
9438 Grid number
Broken boundaries are uncertain because of lack of rainfall records
Shimba Hills National Reserve
Mariakani
Shambini
Kinango
KWALE
MOMBASA
Ndavaya
Mwereni
Kikoneni
Lunga Lunga
Ramisi
Vanga
Funzi Isl.
Ras Wasini
Chale Point
INDIAN OCEAN
9339
9439
500-600
600-700
700-800
800-900
900-1000
1000-1100
1100-1200
1300-1400
0 10 20 30 40 km
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS


60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF FIRST RAINS
(e.of March – Sept.or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
KWALE
39° E
39° 30' E
3° 30' S
4° S
4° 30' S
Broken boundaries are uncertain
because of lack of rainfall records
Manjewa
Mariakani
Shambini
Kinango
MOMBASA
KWALE
Shimba
Ndavaya
Mwereni
Kikoneni
Ramisi
Lunga Lunga
Vanga
Chale Point
Funzi Isl.
Ras Wasini
INDIAN
OCEAN
Shimba Hills
National Reserve
Apr. – b.of May
Apr. – m. May
Apr. – May
Apr. – June
Apr. – July
Apr. – b. of Sept
Apr. – Aug
m.March – m.Sept.
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS
0
10
20
30
40 km



60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF SECOND RAINS
(Nov.– Dec. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
KWALE
39°E
39°30'E
3°30'S
4°S
4°30'S
Broken boundaries are uncertain
because of lack of rainfall records
50 – 100
m. Nov.– m. Dec.
100 – 150
Nov.– m.Dec.
150 – 200
Nov.– Dec.
100 – 150
m. Nov.– m. Dec.
100
Mariakani
Shambini
Kinango
KWALE
MOMBASA
Ndavaya
Mwereni
Kikoneni
Ramisi
Lunga Lunga
Vanga
Chale Point
Funzi Isl.
Ras Wasini
Manjewa
Shimba
Ramisi
INDIAN OCEAN
Shimba Hills
National Reserve
0 10 20 30 40 km
Min. of Agr., German Agr. Team, R. Jaetzold
Soils KSS


AGRO - ECOLOGICAL
ZONES + SOILS
KWALE
39°E
39°30'E
3°30' S
4° S
4°30' S
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
L = here CL,
Coastal Lowlands
Livestock - Millet Zone
Ranching Zone
Cashewnut - Cassava Zone
Coconut - Cassava Zone
Mariakani
MOMBASA
KWALE
Kinango
Shambini
Ndavaya
Mwereni
Kikoneni
Lunga Lunga
Vanga
Chale Point
Funzi Isl.
Ras Wasini
INDIAN OCEAN
Steep slopes, unsuitable for cultivation (only marked outside Nat. Parks or Forest Res.)
Water-logging or flooding during rainy season / Mangrove
Shimba Hills National Reserve + Forest Reserve
1) L4 m i (vs/s)
0 10 20 30 40 km
Min. of Agr., German Agr. Team
AEZ R. Jätzold '83
Soils KSS

AGRO-ECOLOGICAL ZONES

L = *LOWLAND ZONES (COASTAL LOWLAND ZONES)*

L 2 = *Lowland Sugar Cane Zone*

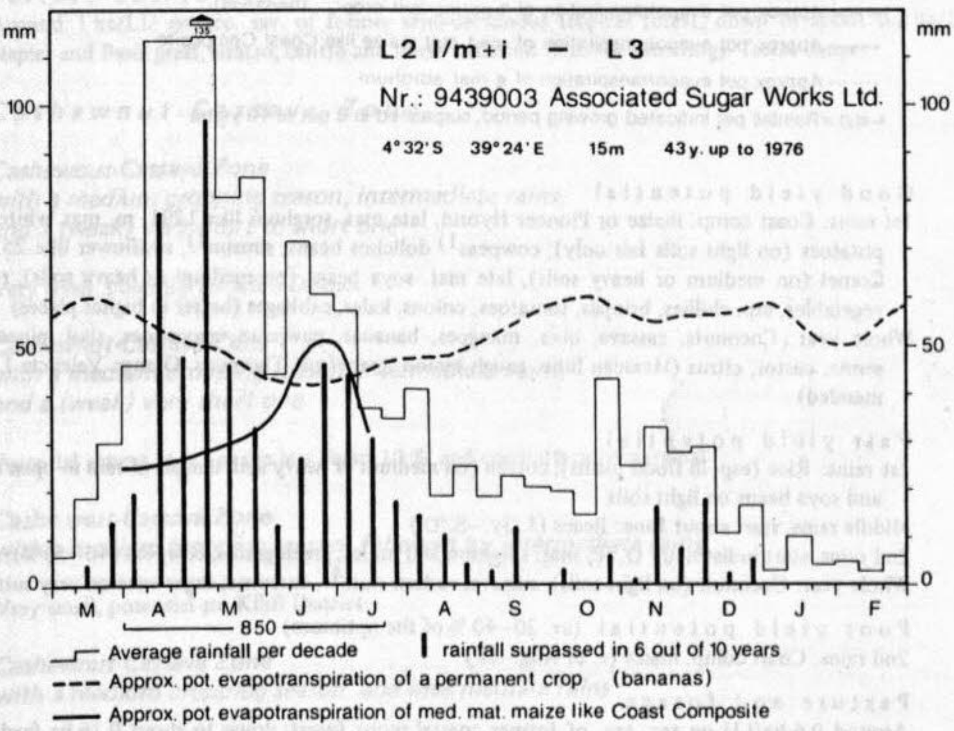
L 2 l/m + i = *Lowland Sugar Cane Zone with a long to medium cropping season and intermediate rains*

(See Diagram Assoc. Sugar Works, on light soils potential almost as L 3)

Good yield potential (av. 60–80 % of the optimum)
1st rains, start normally April: Coast comp. maize, late mat. sorghum; sweet potatoes; e. mat. sunflower 252, m. mat. sunflower like Comet or H S 301 A, late mat. soya beans (all on medium or heavy soils); cowpeas and simsim (June–S.)[1]; nearly all vegetables
Whole year: Cassava, bananas, coconuts (light soils preferred), mangoes, bixa, pawpaws, avocadoes, curcuma

Fair yield potential (av. 40–60 % of the optimum)
1st rains: Rice (esp. in flood plains); late mat. groundnuts, sunflowers and soya beans on light soils
Whole year: Sugar cane (on light soils marginal), cashew nuts (light soils), citrus, pineapples[3]

Pasture and forage
Around 0.5 ha/LU on sec. savanna of former coastal moist forest; down to about 0.15 ha/LU feeding Napier grass, siratro (Macroptilium atropurpureum), centro (Centrosema pubescens), and horse tamarind (Leucaena leucocephala); with Mimosa pudica down to 0.4 ha/LU under coconuts trees[2]

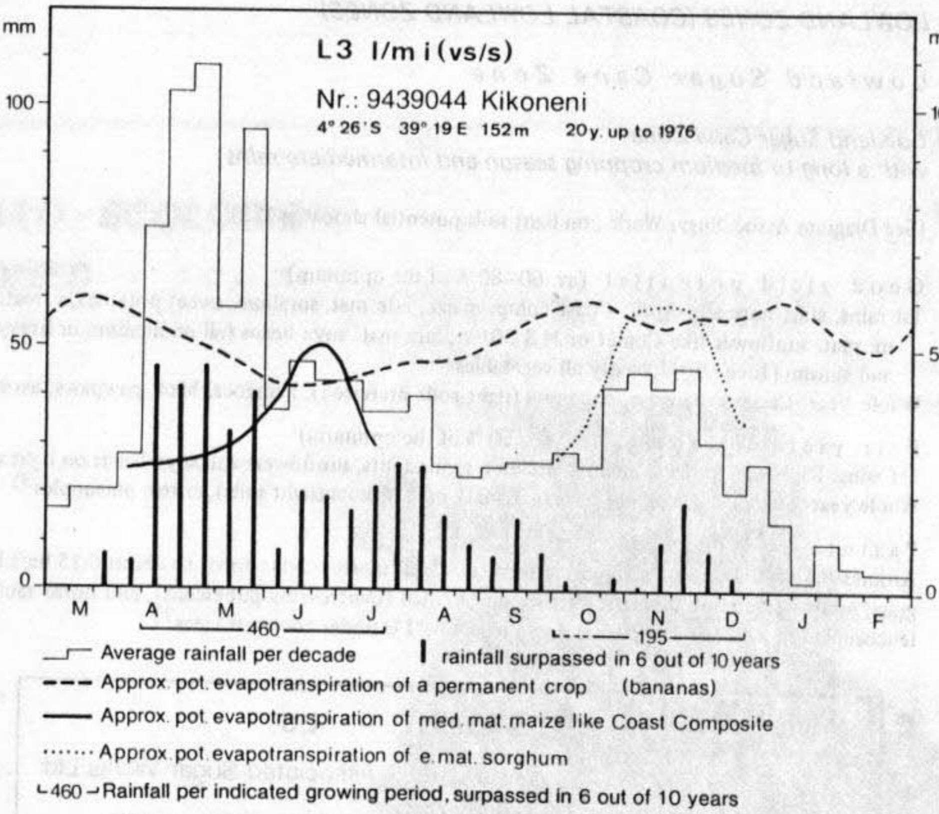


L 3 = *Coconut-Cassava Zone*

L 3 l/m i (vs/s) = *Coconut-Cassava Zone with a long to medium cropping season, intermediate rains, and a (weak) very short to short cropping season*

(See Diagram Kikoneni)

1) Crops for the intermediate rains, interplanted or relay-planted already at the end of the first rains
2) Ref.: Fox, J.W. and Cumberland, K.B. (1962): Western Samoa. Christchurch, New Zealand
3) No top qualities



Good yield potential

1st rains: Coast comp. maize or Pioneer Hybrid, late mat. sorghum like 1291, m. mat. white sorghum; sweet potatoes (on light soils fair only); cowpeas[1]) dolichos beans; simsim[1]), sunflower like 252, H S 301 A or Comet (on medium or heavy soils), late mat. soya beans (on medium or heavy soils), roselle; nearly all vegetables, esp. chillies, brinjals, tomatoes, onions, kales, cabbages (better in higher places)

Whole year: Coconuts, cassava, bixa, mangoes, bananas, pawpaws, avocadoes, sisal, pineapples[3]), guavas, senna, castor, citrus (Mexican lime, rough lemon, grapefruit Thomson, Orange Valencia Late most recommended)

Fair yield potential

1st rains: Rice (esp. in flood plains); cotton (on medium or heavy soil, danger of rain in open bolls), sunflower and soya beans on light soils

Middle rains, start about June: Beans (J./Jy.–S./O.)

2nd rains, start indistinctly O.: E. mat. sorghum and millet; green grams, cowpeas (40–50 %); sweet potatoes

Whole year: Coconuts (on light soils), cassava, cashew nuts[4]), curcuma; sugar cane on very suitable soils

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

2nd rains: Coast comp. maize (e. of Aug.–D.)

Pasture and forage

Around 0.6 ha/LU on sec. sav. of former coastal moist forest; down to about 0.16 ha feeding Napier grass, siratro, centro and horse tamarind (for browsing); Mimosa pudica under coconut trees

L 3 m/l i (vs) = *Coconut-Cassava Zone with a medium to long cropping season, intermediate rains, and a (weak) very short cropping season*

Almost the same potential as L 3 l/m i (vs/s) less about 10 % in yields and stocking rates

L

L 3 m/l i = *Coconut-Cassava Zone with a medium to long cropping season followed by intermediate rains*

Potential in first rains as above. No crop in second rains. Bananas var. Bocoboco and Dwarf Cavendish

4) Danger of spoiled nuts by second rains and fungus diseases

L 3 m/l + i = *Coconut-Cassava Zone with a medium to long cropping season and intermediate rains*

Potential in first rains as above but marginal for cowpeas and simsim. No crop in 2nd rains. Bananas var. Bocoboco

L 3 m i (vs) = *Coconut-Cassava Zone with a medium cropping season, intermeditate rains, and a (weak) very short cropping season*

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

1st rains: Coast comp. and Pioneer Hybrid maize, m. mat. white sorghum (70–80 %), m. mat. bulrush and finger millet; sweet potatoes; dolichos beans[1)], green grams[1)], m. mat. soya beans, sunflower like 252, roselle; m. mat. groundnuts and bambarra groundnuts[6)], nearly all vegetables (species see Lamu District), chillies

Whole year: Bixa, pawpaws, sisal, mangoes, cashew nuts[5)], West Indian avocadoes, guavas, senna, castor, cassava[5)]

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

1st rains: Rice; simsim[1)], cowpeas[1)] (both nearly 60 %), pigeon peas, cotton (on m. and h. soils, danger of rain in open bolls)

Whole year: Coconuts[5)], bananas, citrus, pineapples[3)], curcuma

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

2nd rains, start indistinctly around b. of Nov.: Green grams, e. mat. millets

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

Around 1 ha/LU on sec. sav. of former semi-deciduous tropical forest; down to about 0.2 ha/LU feeding Napier and Bana grass, siratro, centro and horse tamarind (also for browsing). Tsetse danger

L 4 = *C a s h e w n u t - C a s s a v a   Z o n e*

L 4 m i (vs/s) = *Cashewnut-Cassava Zone with a medium cropping season, intermediate rains, and a (weak) very short to short one*

Very small, potential see Kilifi District

L 4 m i (vs) = *Cashewnut-Cassava Zone with a medium cropping season, intermediate rains, and a (weak) very short one*

Potential almost as L 3 m i vs less about 10 %, and coconuts only marginal

L 4 m i = *Cashe vnut-Cassava Zone with a medium cropping season, followed by intermediate rains*

Very small, potential see Kilifi District

L 4 m + i = *Cashewnut-Cassava Zone with a medium cropping season and intermediate rains*

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

1st rains, start norm. indistinctly mid March: Pioneer Hybrid maize, m. mat. sorghum; dolichos beans, groundnuts, bambarra groundnuts[6)]; sweet potatoes; e. and m. mat. soya beans, e. mat. sunflower 252 or (on light soils) Issanka (~ 60 %); kales, chillies, onions, pumpkins, sweet pepper, okra, egg plants, Chinese cabbage, garlic, water melons, cucumbers

Whole year: Cassava, cashew nuts, sisal, castor, mangoes

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

1st rains: Coast comp. maize, rice in mbugas; sweet potatoes, cowpeas; cotton (on m. and h. soils), safflor (nearly 60 %) cabbage, tomatoes;

Whole year: Pawpaws, senna, bixa

5) Not on heavy soils

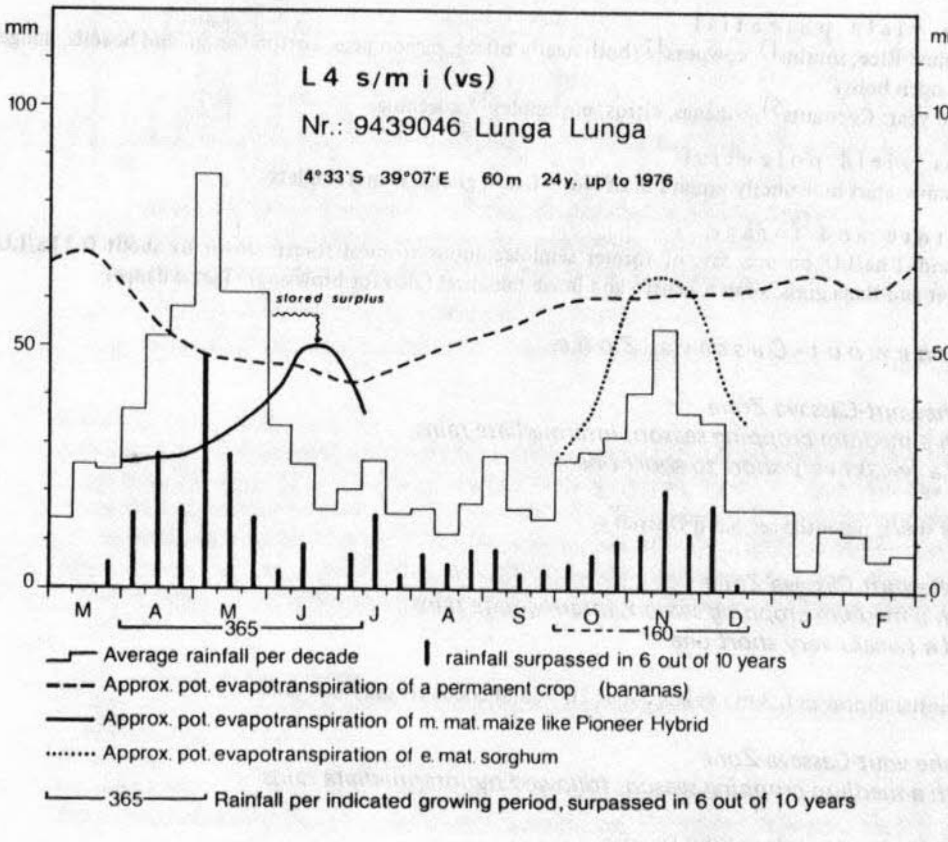
6) Reasonable yields also on poor soils

Poor yield potential
Whole year: Coconuts, bananas

Pasture and forage
More than 1.5 ha/LU on Coastal semi-deciduous forest-savanna mosaic; down to about 0.3 ha/LU feeding Napier and Bana grass, siratro, centro, and planting horse tamarind for browsing; sheep and goats esp. recommended, also in the following drier AEZs

L 4 m/s i (vs) = *Cashewnut-Cassava Zone with a medium to short cropping season, intermediate rains, and a (weak) very short one*

Almost the same as above less about 10 %; e. mat. soya beans and sunflower Issanka more suited than m. mat. varieties



L 4 s/m i (vs) = *Cashewnut-Cassava Zone with a short to medium cropping season, intermediate rains, and a (weak) very short one*

(See Diagram Lunga Lunga)

Good yield potential
1st rains, start norm. indistinctly end of March: E. mat. sorghum, e. mat. bulrush millet (awned variety); green grams, cowpeas
Whole year: Sisal, perennial castor

Fair yield potential
1st rains: Coast composite maize and Pioneer Hybrid; chick peas, black grams (50–60 %); e. mat. bambarra groundnuts, groundnuts, simsim, sweet potatoes; sunflower Issanka; e. mat. soya beans on h. and m. soils, kales, cabbage, onions, tomatoes, chillies
2nd rains, start norm. Oct.: E. mat. millets (~ 40 %); green grams (~ 40 %), chick peas (on h. bl. soils), cowpeas mainly for spinach
Whole year: E. mat. cassava like Kibandameno, stroke 27 and 156 (on light soils); cashew nuts, mangoes, pineapples

Poor yield potential
2nd rains: E. mat. dwarf sorghum

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

Around 2 ha/LU in woodland, more than 3 ha in thickets; partly danger of tsetse if not cleared enough; feeding Bana grass and planting horse tamarind for browsing down to about 0.4 ha/LU

L 4 = Cashewnut-Cassava Zone
s i with a short cropping season, intermediate rains,
(vs) and a (weak) very short one

Very small, potential see Kilifi District

L 5 = L o w l a n d   L i v e s t o c k - M i l l e t   Z o n e

L 5 = Lowland Livestock-Millet Zone
s i with a short cropping season, intermediate rains,
(vs) and a (weak) very short one

(See Diagram Ndavaya)

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

1st rains, start indistinctly b. of April: E. mat. sorghum (60–70 %), e. mat. bulrush millet (awned variety), green grams

Whole year: Buffalo gourds (on sandy soils)[7] and Marama beans[7], Opuntia var. without prickles

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

1st rains: Cowpeas, chick peas (late planted on heavy black soils), black grams, sweet potatoes; e. mat. bambarra groundnuts[6], sunflower Issanka, e. mat. soya beans

2nd rains start indist. e. of O.: Chick peas (on h. bl. soils); green grams (fair to poor); cowpeas for spinach

Whole year: E. mat. cassava like stroke 27 and 156 (40–50 %, on light soils), sisal, castor

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

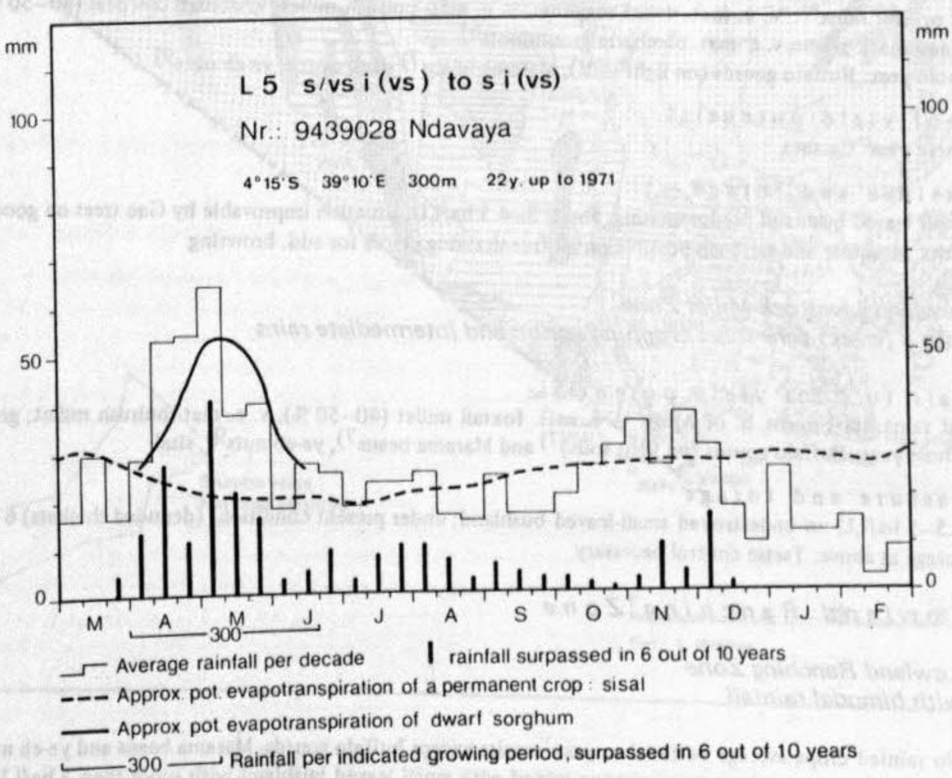
1st rains: Coast comp. maize

2nd rains: V. e. mat. dwarf sorghum, e. mat. bulrush millet; sweet potatoes (to keep plant material for next rains; better results in swampy places)

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

About 2–3 ha/LU on sclerophytic evergreen bushland; Gao tree pods (Acacia albida), Mauritius bean and moth bean vines as add. forage; Mesquite (Prosopis juliflora) and saltbush (Atriplex nummularia) to plant for browsing in overgrazed areas

7) Still experimental. Plants produce also tubers after some time (more than one year)



L 5 = *Lowland Livestock-Millet Zone*
s/vs i *with a short to very short cropping season, intermediate rains,*
(vs) *and a (weak) very short one*

Almost the same as above less about 5 % from yield expectations in 1st rains and from stocking rates

L 5 = *Lowland Livestock-Millet Zone*
vs/s i *with a very short to short cropping season, intermediate rains,*
(vs) *and a (weak) very short one*

Good yield potential
1st rains, start indistinctly around begin.of April: V. e. mat. dwarf sorghum (~ 60 %), e. mat. bulrush millet (awned var.); green grams; luffa gourds
Whole year: Buffalo gourds (on light soils)[7], Marama beans[7]

Fair yield potential
1st rains: Black grams, cowpeas, chick peas (late planted on h. bl. soils); v. e. mat. sunflower, e. mat. soya beans (40–50 %), e. mat. bambarra groundnuts

Poor yield potential
2nd rains, start indistinctly end of O.: V. e. mat. dwarf sorghum, e. mat. bulrush millet; green grams
Whole year: Sisal, castor, drought resistant cassava (fair to poor)

Pasture and forage
Almost the same as s i (vs) less about 10 %

L 5 = *Lowland Livestock-Millet Zone*
(vs/s) *with a (weak) very short to short cropping season*
+ (vs) *and a (weak) very short one*

Almost the same as above less about 10 % in first rains, dwarf sorghum only about 5 % less

L 5 = *Lowland Livestock-Millet Zone*
(vs) + i *with a (weak) very short cropping season and intermediate rains*
or i + (vs) *or vice versa*[8]

Fair to poor yield potential
1st or 2nd rains[8]: V. e. mat. dwarf sorghum, v. e. mat. bulrush millet; v. e. mat. cowpeas (40–50 %), green and black grams, v. e. mat. bambarra groundnuts[6]
Whole year: Buffalo gourds (on light soils), Marama beans[7] sisal, castor, ye-eb nuts[9]

Poor yield potential
Whole year: Cassava

Pasture and forage
Small leaved bushland predominating, about 3–4.5 ha/LU; situation improvable by Gao trees on good soils for fruits, Mesquite and saltbush possible on all free-draining places for add. browsing

L 5 = *Lowland Livestock-Millet Zone*
(vs) + i *with a (weak) very short cropping season and intermediate rains*

Fair to poor yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail millet (40–50 %), v. e. mat. bulrush millet; green grams
Whole year: Buffalo gourds (on light soils)[7] and Marama beans[7], ye-eb nuts[9], sisal

Pasture and forage
3.5–5 ha/LU on undestroyed small-leaved bushland; under present conditions (denuded thickets) 6–8 ha/LU; forage as above. Tsetse control necessary

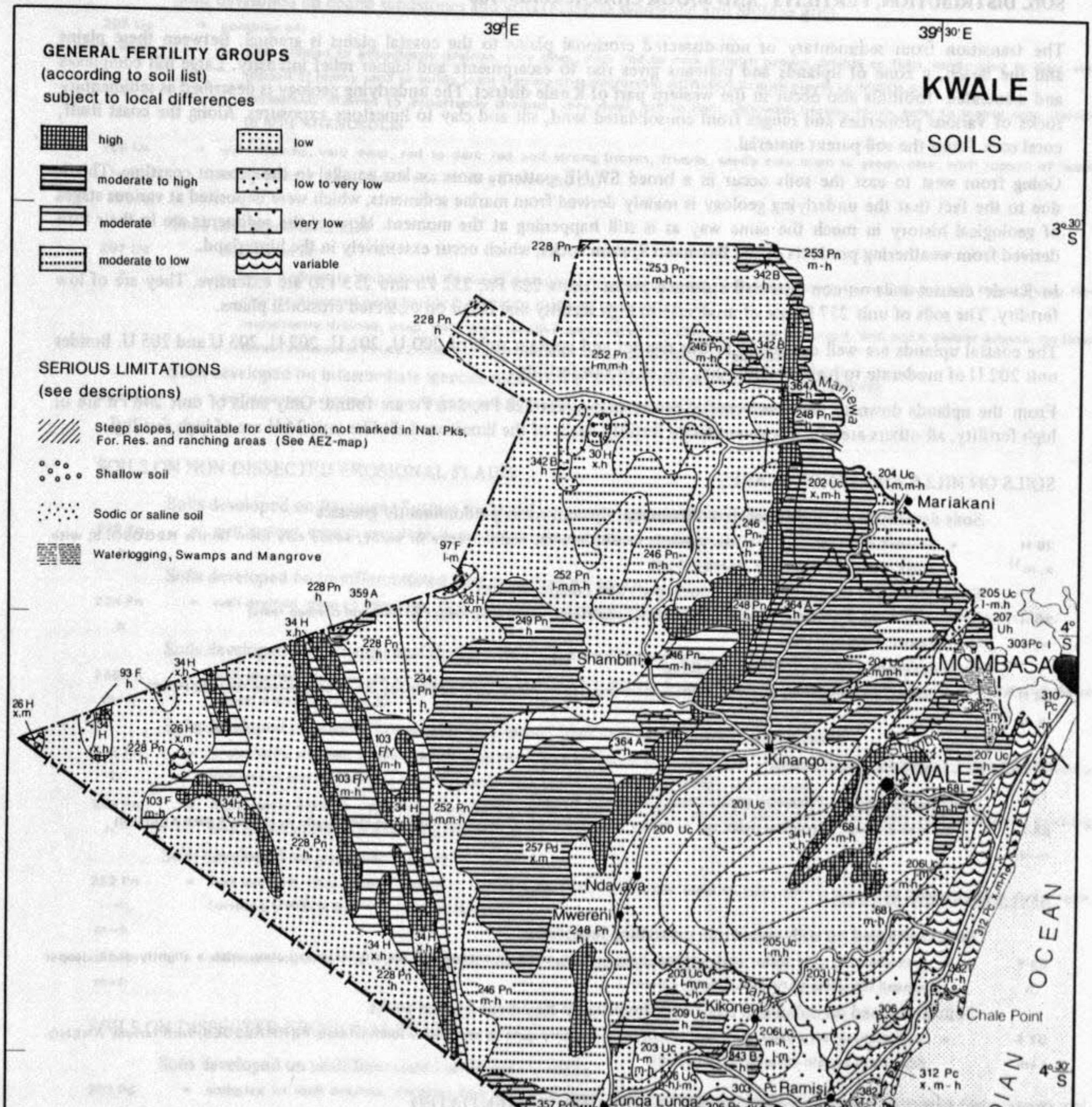
L 6 = *Lowland Ranching Zone*

L 6 = *Lowland Ranching Zone*
b r *with bimodal rainfall*

No rainfed crops average better than poor results except buffalo gourds, Marama beans and ye-eb nuts. Cattle, sheep and goats on short grass savanna mixed with small leaved bushland with more than 5 ha/LU, denuded thickets more than 8 ha/LU; saltbush and Mesquite to plant for add. browsing, especially in dry years. Gao trees (Acacia albida) for pods on good (alluvial) soils. Tsetse in places with evergreen thickets

8) At least one of the two rainy seasons will have a very short growing period for crops in 6 or more years out of 10

9) Cordeauxia edulis from Somalia


KWALE
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
SERIOUS LIMITATIONS
(see descriptions)
Steep slopes, unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas (See AEZ-map)
Shallow soil
Sodic or saline soil
Waterlogging, Swamps and Mangrove
39°E
39°30'E
3°30' S
4° S
4°30' S
Mariakani
MOMBASA
Shambini
Kinango
KWALE
Ndavaya
Mwereni
Kikoneni
Lunga Lunga
Ramisi
Vanga
Chale Point
Funzi Isl.
Ras Wasini
INDIAN OCEAN
Shimba Hills National Reserve
0 10 20 30 40 km
Fert. L. Hirscher
Soils KSS

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

The transition from sedimentary or non-dissected erosional plains to the coastal plains is gradual. Between these plains and the beach, a zone of uplands and plateaus gives rise to escarpments and higher relief intensity. Large hill complexes and associated foothills also occur in the western part of Kwale district. The underlying geology is described as sedimentary rocks of various properties and ranges from consolidated sand, silt and clay to limestone exposures. Along the coast itself, coral rock forms the soil parent material.

Going from west to east the soils occur in a broad SW-NE pattern, more or less parallel to the present coastline. This is due to the fact that the underlying geology is mainly derived from marine sediments, which were deposited at various stages of geological history in much the same way as is still happening at the moment. Most of the sediments are in their turn derived from weathering products of the Basement System rocks, which occur extensively in the hinterland.

In Kwale district soils on non-dissected erosional plains (units 228 Pn, 252 Pn and 253 Pn) are extensive. They are of low fertility. The soils of unit 257 Pd are of moderate to high fertility and occur on dissected erosional plains.

The coastal uplands are well developed in this district and contain soils of 200 U, 201 U, 202 U, 203 U and 205 U. Besides unit 202 U of moderate to high fertility, they are all of low fertility.

From the uplands down to the lower coastal plains, map units 228 Pn, 246 Pn are found. Only soils of unit 248 Pn are of high fertility, all others are of a low to moderate fertility. Soils of the limestone hills like unit 34 H are of high fertility.

SOILS ON HILLS AND MINOR SCARPS

Soils developed on undifferentiated Basement System rocks predominantly gneisses

26 H
x, m[1)] = somewhat excessively drained, shallow, reddish brown, friable, rocky or stony, sandy clay loam (eutric REGOSOLS; with Rock Outcrops and calcic CAMBISOLS)

Soils developed on Jurassic sandstones, grits and conglomerates

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

Soils developed on crystalline limestone

34 H
x, h = somewhat excessively drained, shallow, dark grey, firm, moderately calcareous, stony clay (orthic RENDZINAS)

SOILS ON COASTAL PLATEAUS

Soils developed on Pliocene sandstones (Magarini sands)

68 L
m–h = well drained, extremely deep, red to dusky red, very friable, sandy clay loam to clay (acric to rhodic FERRALSOLS)

SOILS ON FOOT SLOPES

Soils developed on colluvium from crystalline limestones

93 F
h = well drained, very deep, dark reddish brown, firm, slightly calcareous, slightly cracking clay, with a slightly sodic deeper subsoil (chromic LUVISOLS, sodic phase)

Soils developed on colluvium from undifferentiated Basement System rocks

97 F
l–m = well drained, very deep, dark red, friable, coarse loamy sand to sandy clay loam (rhodic FERRALSOLS; with ferralic ARENOSOLS and ferralo-chromic LUVISOLS)

SOILS ON FOOT SLOPES AND PIEDMONT PLAINS UNDIFFERENTIATED

Soils developed on colluvium and alluvium from crystalline limestones

103 F
m–h = well drained, deep to very deep, dark brown, friable to firm, clay loam to sandy clay; in places calcareous (chromic LUVISOLS and haplic KASTANOZEMS)

SOILS ON COASTAL UPLANDS

Soils developed on fine sandstones and siltstones (Mariakani sandstone and Upper Maji-ya-Chumvi beds)

200 Uc
l–m,
m–h = imperfectly drained, deep to very deep, yellowish brown, mottled, firm, fine sandy clay loam to clay, abruptly underlying 20–100 cm of fine sand to fine sandy loam; with sodic deeper subsoils (sodic PLANOSOLS)

201 Uc
l = well drained, deep to very deep, pinkish grey to brown, very friable, fine sand to loamy fine sand (albic to luvic ARENOSOLS)

202 Uc
x, m–h = well drained, shallow, dark brown to dark yellowish brown, fairly stony, fairly rocky, fine sandy clay loam to clay (eutric CAMBISOLS, lithic phase; with orthic LUVISOLS)

203 Uc
l–m,
m–h = well drained to imperfectly drained, deep, yellowish red to dark brown, friable, fine sandy clay loam to fine sandy clay, with a topsoil of loamy fine sand to fine sandy loam (orthic ACRISOLS)

204 Uc l–m, m–h = well drained, deep, dark brown to yellowish brown, firm, very fine sandy clay loam to clay, with topsoil of loamy very fine sand to very fine sandy loam; in places with abrupt transition and sodic deeper subsoil (orthic LUVISOLS; with sodic PLANOSOLS)

Soils developed on coarse sandstones and grits (Mazeras sandstone and Shimba grit)

205 Uc l–m, h = complex of:
– well drained to imperfectly drained, very deep, dark red to dark greyish brown, friable to firm, sandy clay to clay, with topsoil of loamy sand to sandy loam (ferralo-chromic/orthic ACRISOLS; with gleyic LUVISOLS)
– excessively drained to imperfectly drained, very deep, red to light yellowish brown, loose, sand to loamy sand (ferralic to luvic ARENOSOLS)

206 Uc l–m, m–h = well drained, very deep, red to dark red and strong brown, friable, sandy clay loam to sandy clay, with topsoil of loamy sand to sandy loam (rhodic and orthic FERRALSOLS)

Soils developed on shales

207 Uc h = association of:
– well drained to imperfectly drained, shallow to moderately deep, yellowish brown to very dark grey, firm to very firm clay; in dissected parts (eutric CAMBISOLS, partly lithic phase)
– imperfectly drained, deep, dark grey to olive grey, very firm clay, with humic topsoil, and sodic deeper subsoil; on interluves (verto-luvic PHAEZEMS, sodic phase; with vertic CAMBISOLS, sodic phase)

Soils developed on intermediate igneous rocks rich in ferromagnesian minerals (intrusives)

209 Uc h = well drained, extremely deep, dark red to yellowish red, friable clay (eutric NITOSOLS)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

Soils developed on Basement System rocks rich in ferromagnesian minerals

228 Pn h = well drained, deep to very deep, dusky red to dark red, friable sandy clay (rhodic FERRALSOLS)

Soils developed on undifferentiated Basement System rocks

234 Pn h = well drained, deep to very deep, dark red to strong brown, friable, sandy clay to clay (rhodic and orthic FERRALSOLS)

Soils developed on siltstones and shales (Lower Maji-ya-Chumvi beds), slightly dissected

246 Pn m–h = well drained, shallow, dark reddish brown to very dark brown, firm, fine sandy clay loam to clay (eutric CAMBISOLS, lithic phase; with LITHOSOLS)

Soils developed on shales (Lower Maji-ya-Chumvi beds and Taru carbonaceous shales)

248 Pn h = imperfectly drained, moderately deep to deep, dark greyish brown, very firm, cracking, fine sandy clay to clay; with a strongly calcareous and moderately sodic deeper subsoil (verto-luvic PHAEOZEMS, sodic phase)

249 Pn h = imperfectly drained, very deep, very dark grey to black, very firm, strongly calcareous, moderately saline and sodic, cracking clay (pellic VERTISOLS, saline-sodic phase)

Soils developed on gritty sandstones

252 Pn l–m, m–h = well drained, deep, strong brown to dark brown, firm, sandy clay loam to clay, with a topsoil of loamy sand to sandy loam (orthic LUVISOLS; with orthic ACRISOLS)

253 Pn m–h = well drained, deep, red, firm, sandy clay loam to clay (chromic LIVISOLS)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated sedimentary rocks

257 Pd x, m = complex of well drained, shallow, dark reddish brown to strong brown, non to moderately calcareous, firm, gravelly and strong loam to sandy clay loam, partly over petrocalcic material (chromic CAMBISOLS to orthic LUVISOLS, lithic or paralithic phase; with calcic CAMBISOLS, petrocalcic phase)

SOILS ON "SEALING LOAM" PLAIN

Soils developed on Plio-Pleistocene bay sediments (Marafa beds), (little or not remodelled; flat surface, dot pattern)

278 Ps m, h = imperfectly to poorly drained, deep, greyish brown, extemely firm, slightly calcareous, moderately sodic and moderatley saline, slightly cracking clay, with a very thin topsoil of sandy clay loam (gleyic SOLONETZ, saline phase)

SOILS ON COASTAL PLAINS

Soils developed on higher-level lagoonal deposits (Kilindini sands)

303 Pc l = excessively drained to well drained, very deep, reddish yellow to white, loose, sand to loamy sand (albic and ferralic ARENOSOLS)

304 Pc = imperfectly drained, deep to very deep, very dark greyish brown to olive brown, mottled, firm to very firm, sandy clay to clay; moderately calcareous and moderately saline/sodic throughout or in deeper subsoil (ortholuvic SOLONETZ and vertic LUVISOLS, saline-sodic phase)

Soils developed on lower-level lagoonal deposits (Kilindini sands)

306 Pc v = complex of very deep soils of varying drainage condition, colour, texture and salinity (albic ARENOSOLS, orthic FERRALSOLS, gleyic LUVISOLS, sodic PLANOSOLS, pellic VERTISOLS)

Soils developed on raised coral-reef limestone, with admixture of lagoonal deposits

310 Pc l, m–h = well drained, deep, dark red to reddish brown, friable, sandy clay loam to sandy clay, with topsoil of loamy sand (rhodic FERRALSOLS)

312 Pc x, m–h = well drained, shallow, dark brown to dark reddish brown, rocky, sandy clay loam to sandy clay (LITHOSOLS; with ferralic CAMBISOLS, lithic phase)

SOILS ON BOTTOMLANDS

Soils developed on infill from Taru sandstones

342 B h = imperfectly drained to poorly drained, very deep, dark brown to dark grey, firm to very firm, sodic clay, with a calcareous and saline deeper subsoil (luvo-orthic SOLONETZ)

Soils developed on infill from lagoonal deposits (Kilindini sands)

343 B h = imperfectly drained to poorly drained, very deep, light brownish grey to brown, mottled, firm to very firm, clay; in places sodic and cracking (higher-level depressions) (gleyic PHAEOZEMS; with verto-luvic PHAEOZEMS and pellic VERTISOLS, sodic phase)

SOILS ON FLOODPLAINS

Soils developed on sediments mainly from crystalline Basement System rocks

356 A m = well drained to imperfectly drained, very deep, brown to dark brown, friable, slightly calcareous, micaceous, sandy loam to clay loam; in places with a saline-sodic deeper subsoil (eutric FLUVISOLS)

Soils developed on sediments from various sources (recent floodplains)

357 A m = well drained to imperfectly drained, very deep, dark brown to yellowish brown, stratified, strongly calcareous, micaceous predominantly loamy soils (calcaric FLUVISOLS)

359 A h = imperfectly drained to poorly drained, very deep, dark reddish brown to dark greyish brown, firm to very firm, cracking clay; in many places mottled and with a calcareous, saline and sodic deeper subsoil (chromic VERTISOLS, saline-sodic phase)

364 A h = poorly drained, very deep, very dark grey, very firm, moderately calcareous, slightly saline and slightly to moderately sodic, cracking clay (pellic VERTISOLS, saline-sodic phase)

SOILS IN MANGROVE SWAMPS

382 T m–h = very poorly drained, very deep, olive to greenish grey, soft (unripe), excessively saline and moderately to strongly sodic, loam to clay, often with sulfidic material (thionic FLUVISOLS and gleyic SOLONCHAKS)

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. Expl. Soil Survey, Rep. E1, Nairobi 1982. See this map also for colours; symbols simplified here.

POPULATION AND LAND

According to the population census of September 1979, more than 288,000 people lived in the Kwale District on a total rural area of 794,200 ha, of which 731,300 ha (92 %) could be called agricultural land (Table 4 and 6). Only 4.41 % of the total population were not primarily dependent on agriculture and livestock (living in one township and 4 trading centres).

Statistically, 14.76 ha agricultural land were available per household, or 2.65 ha per person, which seems quite a lot. Unfortunately, these figures give a minimum of information as the average farm sizes in the Kwale District vary from 1.56 ha (Tiwi location in the Central Division, L 3) to 58.7 ha per household (Mwereni location in the Southern Division, L 4–6, see Table 6). This range is too wide to allow for any general interpretations of the actual conditions of the district as a whole.

Nevertheless it may be stated that population pressures are not yet critical in most parts of the district. However, in Tiwi location, the growing population will soon become a difficult problem, which might also be true of Waa location, although the figures (2.77 ha per household) do not yet indicate this because some old plantations are included.

In the coconut areas (L 3 near the coast) reasonable sizes are found in those regions which were recently settled, as the example of the Lukore location shows, 8.1 ha per household.

In the area L 4 where cashewnuts predominate, 7.11 ha per farm is relatively small, due to the increasing percentage of livestock which is needed to support the farm. This last mentioned fact has also to be taken into account in Mwereni location where 58.7 ha are needed per household, because here most of the economic activities are based on ranching.

KWALE DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Tsimba	6 794	6 807	13 601	2 435	156	86
Waa	4 596	4 453	9 049	1 627	53	169
Tiwi	5 221	5 076	10 297	1 854	32	315
Ng'ombeni	6 766	6 614	13 380	2 515	97	136
Central Division	23 377	22 950	46 327	8 431	340	135
Mkongani	5 536	5 710	11 246	1 941	185	60
Mwaluphamba	4 927	5 444	10 371	1 615	147	70
Lukore	2 353	2 381	4 734	741	66	70
Majimboni	1 502	1 397	2 899	545	54	52
Kubo Division	14 318	14 932	29 250	4 842	454	64
Kinango	7 119	8 013	15 132	2 539	292	51
Kilibole	7 639	9 110	16 749	3 145	222	75
Puma	5 669	6 198	11 867	1 700	945	12
Samburu North	7 041	7 761	14 802	2 465	1 086	13
Samburu South	6 915	7 880	14 795	2 374	716	20
Ndavaya	2 817	3 076	5 893	1 070	291	20
Mwavumbo	7 151	8 324	15 475	2 783	283	54
Hinterland Division	44 351	50 362	94 713	16 076	3 837	24
Msambweni	12 307	11 576	23 883	4 835	182	130
Pongwe/Kidimu	4 627	4 249	8 876	2 028	167	52
Vanga/Lunga Lunga	8 016	7 876	15 892	3 218	609	26
Mwereni	7 583	8 321	15 904	2 915	1 802	8
Diani	14 838	13 555	28 393	5 414	252	112
Kikoneni	12 329	12 796	25 125	4 502	317	79
Southern Division	59 700	58 373	118 073	22 912	3 331	35
Kwale District	141 746	146 617	288 363	52 261	8 257	34

KWALE DISTRICT

TABLE 5: COMPOSITION OF HOUSEHOLDS PER LOCATION AND DIVISION[a]

LOCATION/ DIVISION	No. of Households total	Farmers Family b) Adults >15 years	Children < 15 years	Other Relatives	Non-Relatives	Persons per Households total b)
Location:						
Tsimba	2407	3.03	1.19	1.07	0.29	5.58
Waa	1626	3.05	0.98	1.27	0.23	5.50
Tiwi	1842	2.93	1.02	1.36	0.21	5.52
Ng'ombeni	2508	2.86	0.94	1.28	0.22	5.29
Division: Central	8383	2.97	1.02	1.23	0.24	5.47
Location:						
Mkongani	1934	3.09	1.32	1.12	0.28	5.81
Mwaluphamba	1608	3.46	1.38	1.29	0.32	6.45
Lukore	743	3.04	1.37	1.57	0.39	6.37
Majimboni	540	2.75	1.07	1.09	0.45	5.37
Division: Kubo	4825	3.16	1.33	1.24	0.33	6.06
Location:						
Kinango	2533	3.18	1.34	1.10	0.30	5.91
Kilibole	3137	3.11	1.29	0.79	0.15	5.34
Puma	1699	3.62	1.64	1.34	0.37	6.96
Samburu North	2462	3.09	1.14	1.06	0.71	6.01
Samburu South	2378	3.33	1.36	1.00	0.52	6.22
Ndavaya	1067	3.01	1.30	0.85	0.36	5.52
Mwavumbo	2778	3.17	1.21	0.88	0.30	5.57
Division: Hinterland	16054	3.21	1.31	0.99	0.38	5.89
Location:						
Msambweni	4826	2.70	0.84	1.05	0.33	4.92
Pongwe/Kidimu	2026	2.57	0.59	0.94	0.29	4.38
Vanga/Lunga Lunga	3212	2.85	0.89	0.92	0.27	4.95
Mwereni	2937	3.23	1.29	0.51	0.38	5.41
Diani	5410	2.82	0.76	1.00	0.36	4.95
Division: Southern	22901	2.92	0.94	0.90	0.33	5.10
Location:						
Kikomeni	4490	3.21	1.30	0.78	0.31	5.59
DISTRICT: KWALE	52163	3.05	1.09	1.01	0.33	5.48

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, includc one and two persons per households as well

KWALE DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON[1)]

Location/Division without townships	Area total (in '00 ha = sqkm)	Non-agricultural land: Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads, rivers...)	Agri-cultural land	Area in agro-ecological zones (in '00 ha = sqkm) AEZ: L2 2)	L3	L4	L5	L6	Agric. land per household (in ha)	per person (in ha)
	Census 79											
Tsimba	149	24		11	114		91	23			6.07	1.00
Waa	53			8	45		34	11			2.77	0.50
Tiwi	32			3	29		27	2			1.56	0.28
Ng'ombeni	97			12	85		20	65			3.38	0.64
Central Division	331	24		34	273		172	101			3.47	0.62
Mkongani	185	8	F. 25	14	138		30	108			7.11	1.23
Mwaluphamba	147	4		13	130		22	98	10		8.05	1.25
Lukore	66			6	60		60				8.10	1.27
Majimboni	54			5	49		49				8.99	1.69
Kubo Division	452	12	25	38	377		161	206	10		7.79	1.29
Kinango	292	8	F. 17	18	249		4	176	69		11.70	1.85
Kilibole	222			18	204			119	85		6.49	1.22
Puma	945			45	900			26	414	460	52.94	7.58
Samburu North	1 086	2		51	1 033				418	615	46.47	7.52
Samburu South	716			34	682				318	364	28.73	4.61
Ndavaya	291			14	277			25	174	78	25.89	4.70
Mwavumbo	283			14	269			52	209	8	9.67	1.74
Hinterland Division	3 835	10	17	194	3 614		4	398	1 687	1 525	23.43	3.93
Msambweni	182		F. 6	23	153	88	65				4.12	0.86
Pongwe/Kidimu	167			16	151	77	74				7.45	1.70
Vanga/Lunga Lunga	604		F. 8	33	563		119	75	117	252	19.85	3.96
Mwereni	1 802			91	1 711		14	60	528	1 109	58.70	10.76
Diani	252		F. 8	32	212	42	170				3.92	0.75
Kikomeni	317	6	F. 27	25	259	28	174	57			5.75	1.03
Southern Division	3 324	6	49	220	3 049	235	616	192	645	1 361	14.24	2.76
Total rural area	7 942 3)	52	91 3)	486	7 313	235	953	897	2 342	2 886	14.76	2.65

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

2) All the Lowland Zones here are Coastal Lowland Zones (CL), if this further differentiation is wanted (see Table I)

3) Mangrove swamps are not included

AGRICULTURAL STATISTICS [1)]

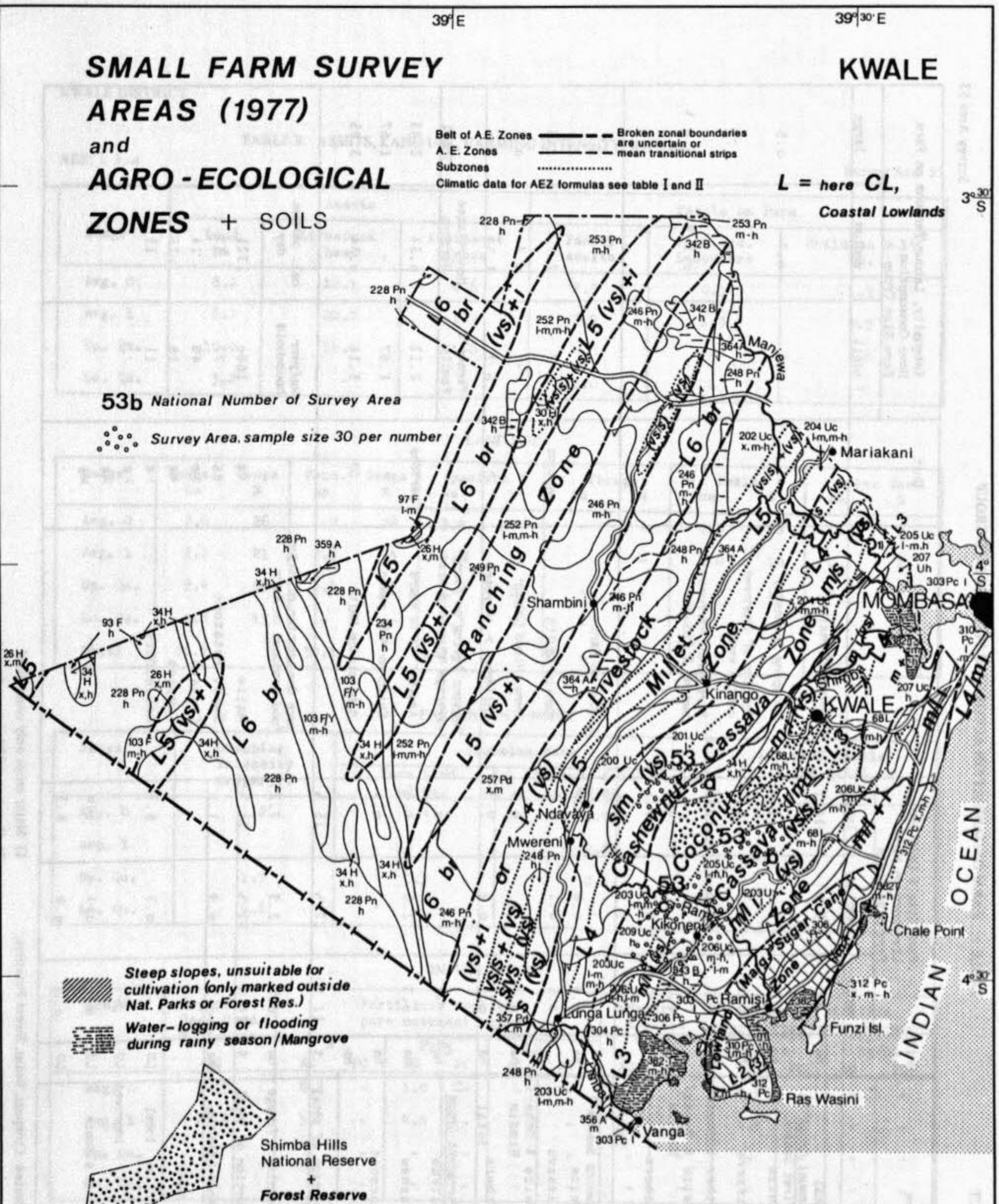
Large areas of the AEZ L 2–3–4 of this district are covered with various perennial crops, especially coconuts and cashew nut trees. Fairly reliable agricultural statistics are, however, not yet available. It is estimated that Kwale farmers plant cotton on roughly 800 ha, about 85 % of which is interplanted with maize or cassava. Cotton, properly cultivated, yields roughly 400 kg/ha, but the average yield here is, however, only 150–200 kg/ha. There is also a large sugar cane plantation in the southern part of the district, but the rather unsuitable ecological conditions make economic cane farming difficult.

SMALL FARM SURVEY (SFS) [1)]

The farming system of the Kwale district is very complex and therefore the results of the SFS can give a limited insight only. The survey was carried out in three areas: Kikoneni, Nkomba and Mkomgani. The farm sizes were fairly big – 8 ha. Roughly 1.2 crops are planted p.a. The low stocking rate is partly a result of livestock diseases (Trypanosomiasis); purchased inputs are practically unused (table 7 & 8). A large range of crops is grown of which the high proportion of cassava and sweet potatoes indicates the potential for these plants. Nearly half of the land is under tree crops (table 9). The herd compositions are influenced by livestock diseases (table 10). The yields harvested by the sample farmers indicate the somewhat better conditions of the Kwale district in comparison to the rest of the coastal area (table 11). Some food surplus is produced on the farms, and much cassava and sweet potatoes finds its way (via local traders) to Mombasa. There is potential for tree and root crops as well as for forage growing and milk production.

The information available is not sufficient to make any sound recommendations about farm development or to serve as a basis for comprehensive agricultural development proposals. The district should therefore be included in a comprehensive farm survey.

1) It is hoped that the results of a comprehensive farm survey will be available towards 1985/86, replacing this tentative information.


SMALL FARM SURVEY
AREAS (1977)
and
AGRO-ECOLOGICAL
ZONES + SOILS
KWALE
39° E
39° 30' E
3° 30' S
4° S
4° 30' S
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
L = here CL, Coastal Lowlands
53b National Number of Survey Area
Survey Area, sample size 30 per number
Steep slopes, unsuitable for cultivation (only marked outside Nat. Parks or Forest Res.)
Water-logging or flooding during rainy season / Mangrove
Shimba Hills National Reserve + Forest Reserve
Ranching Zone
Livestock Millet Zone
Cashewnut Cassava Zone
Coconut Cassava Zone
Sugar Cane Zone
Lowland
Mariakani
Mombasa
Shambini
Kinango
KWALE
Ndavaya
Mwereni
Kikoneni
Ramisi
Lunga Lunga
Vanga
Chale Point
Funzi Isl.
Ras Wasini
INDIAN OCEAN
1) L4 m i (vs/s)
0 10 20 30 40 km
AEZ R. Jätzold '83
Soils KSS

KWALE DISTRICT

AEZ: L 3–4

TABLE 7: FARM ORGANISATION ACCORDING TO FARM SIZE GROUP

Survey Area 53

Item	Unit	Farm Size & Land Use, Livestock on Farm, Farm Size Group: small	medium	large
Farm Size Total	ha	2.5	7.4	14.2
Land Use: Annual Crops[1] First Season				
Maize	ha	0.5	1.4	1.8
Cassava	ha	0.1	0.2	0.3
Other (Simsim)	ha	0.1	0.5	0.8
Maize & Beans/Simsim	ha	0.2	-	0.2
Others	ha	-	0.1	0.3
Total	ha	0.9	2.2	3.4
Second Season[1]				
Maize	ha	0.4	0.8	0.8
Cassava	ha	0.1	0.1	0.3
Maize & Others/Simsim	ha	0.2	-	0.3
Others Total	ha	0.7	0.9	9.6
Permanent Crops[1]				
Citrus	ha	-	-	0.7
Cashew	ha	0.3	2.0	1.0
Coconut	ha	-	-	0.4
	ha			
Portion of total	%	12 %	27 %	15 %
Grazing & Forage	ha	0.6	2.3	7.2
portion of total	%	24 %	31 %	51 %
Other Land Use	ha	0.7	0.9	1.5
Livestock on Farm:				
Cattle: local	LU	-	0.5	6.7
improved	LU	-	-	-
Sheep & Goats	LU	0.2	0.4	1.6
Total	LU	0.2	0.9	8.3

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	%	-	-	-
Portion of Farmers owning a Plough	%	-	0.1 %	0.8 %
Labour on Farm:				
Family Adults	persons	3.7	2.7	2.5
Perm. Hired Labour	"	-	0.4	0.5
Children > 14 years	"	0.2	1.3	3.0
Persons living on Farm[2] -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	2.11	0.34	2.45
Children < 14 years	"	1.67	-	1.67
Subsistence Units	SU	3.11	0.34	3.45
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	168o	2321	
Sweet Potatoes	kg	77	37	
Cassava	kg	49	24	
Cowpeas	kg	18	25	
Groundnuts	kg	11	15	
	kg			
	kg			
	kg			

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

1) Major crops only considered

2) Based on 1979 Census figures

KWALE DISTRICT

AEZ: L 3–4

TABLE 8: ASSETS, LAND USE, FARMING INTENSITY, INPUTS

Survey Area 53

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children > 14 No.
Avg. 0	8.2	12.1	0.6	2.9	0.3	1.5
Avg. 1	8.2	22.7	1.9	2.9	1.5	3.5
Up. Qu.	10.0	14.0	1.0	4.0	-	2.0
Lo. Qu.	3.2	-	-	2.0	-	-

LAND USE

Range	Annual ha	Crops %	Perm. ha	Crops %	pasture ha	%	Forage ha	%	Fallow ha	%	Other Use ha	%
Avg. 0	2.0	26	1.7	22	3.4	44	-	-	0.5	6	0.2	2
Avg. 1	2.2	21	2.5	24	4.3	42	-	-	1.0	10	0.2	2
Up. Qu.	2.4	43	2.4	31	5.4	55	-	-	0.8	15	0.2	2
Lo. Qu.	0.8	15	-	-	0.3	10	-	-	-	-	-	1
Total	60.7		52.1		102.2		-		14.7		4.6	

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	0.4	0.9	-
Avg. 1			0.8	-
Up. Qu.	1.7	0.3	0.4	-
Lo. Qu.	0.8	-	-	-

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	10.5	0.2	-	1.0	-	-	-	-	-	0.4	-	-	-
Avg. 1	28.6	5.2	-	4.0	-	-	-	-	-	1.5	-	-	-
Up. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-
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

KWALE DISTRICT

TABLE 9: CROPPING PATTERN

AEZ: L 3–4

Survey Area 53

First Rains
Annual & Semipermanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total Sample Area	
	ha	ha	ha	ha	ha	%
Maize	1.1	1.4	2.00	0.20	33.6	48.3
Maize IPC	0.1	1.1	0.00	0.00	4.4	6.3
Beans	0.1	0.5	0.00	0.00	1.6	2.3
Cowpeas	0.0	0.1	0.00	0.00	0.1	0.2
Sunflower	0.1	0.7	0.00	0.00	2.2	3.2
Cotton	0.0	0.4	0.00	0.00	1.2	1.7
Cassava	0.2	0.5	0.40	0.00	5.6	8.0
Sweet Potatoes	0.0	0.2	0.00	0.00	0.2	0.3
Sugarcane	0.0	0.6	0.00	0.00	0.6	0.8
Others	0.5	0.9	0.80	0.00	13.5	19.5
Maize & Beans	0.0	0.8	0.00	0.00	0.8	1.2
Maize & Cowps	0.0	0.5	0.00	0.00	0.9	1.3
Maize & Others	0.1	2.0	0.00	0.00	2.0	2.9
Total					69.4	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total Sample Area	
	ha	ha	ha	ha	ha	%
Maize	0.5	1.4	0.80	0.00	15.8	37.7
Maize IPC	0.1	1.4	0.00	0.00	2.8	6.7
Beans	0.1	0.5	0.00	0.00	2.0	4.8
Cowpeas	0.0	0.5	0.00	0.00	1.0	2.4
Bambara GNuts	0.0	0.6	0.00	0.00	0.6	1.4
Sunflower	0.0	1.0	0.00	0.00	1.0	2.4
Cassava	0.2	0.5	0.40	0.00	5.6	13.3
Sweet Potatoes	0.1	3.2	0.00	0.00	3.2	7.6
Sugarcane	0.0	0.6	0.00	0.00	0.6	1.3
Others	0.2	0.9	0.40	0.00	6.0	14.3
Maize & Beans	0.0	0.8	0.00	0.00	0.8	1.9
Maize & Others	0.1	1.3	0.00	0.00	2.6	6.2
Total					41.9	100.0

Permanent Crops

Crop	Average 0	Average 1	Upper Quartile	Lower Quartile	Total Sample Area	
	ha	ha	ha	ha	ha	%
Citrus	0.4	2.1	0.00	0.00	10.7	24.6
Cashew Nuts	0.8	1.8	1.40	0.00	22.9	52.8
Coconuts	0.3	2.0	0.00	0.00	9.8	22.6
Total					43.4	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

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

– in Head & Livestock Units –

AEZ: L 3–4

Oct. '77, Survey Area 53

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	0.67	0.13	-	0.77		0.43	1.43	0.50	-		0.50
	Upper Qu.	-	-	-	-		-	3	0.3	-		0.3
1 - 2 years,	Average	0.07	0.23	0.17	0.40				0.39			0.39
	Upper Qu.	-	-	-	-				-			-
Over 2 years,	Average	0.07	0.23	0.40		1.93	1.50	3.67	2.23	-	16.43	2.23
	Upper Qu.	-	-	-		-	2	5	-	-	4	-
Subtotal (unimp.)	Total	24	18	17	35	58	58	153	93.6	-	493	93.6
	Average	0.80	0.60	0.57	1.17	1.93	1.93	5.10	3.12	-	16.43	3.12
	Upper Qu.	-	-	-	-	-	3	9	2.1	-	22	2.1
	Lower Qu.	-	-	-	-	-	-	-	-	-	4	-
LU Male Cattle =		34.2 % of total cattle,				Calves + Heifers =			60.3% of dairy cows			
LU Goats + Sheep =		22.6 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock	Total	24	18	17	35	58	58	153	93.6	-	493	93.6
	Average	0.80	0.60	0.57	1.17	1.93	1.93	5.10	3.12	-	16.43	3.12
	Upper Qu.	-	-	-	-	-	3	9	2.1	-	22	2.1
	Lower Qu.	-	-	-	-	-	-	-	-	-	4	-
LU Male Cattle =		34.2 % of total cattle,				Calves + Heifers =			60.3% of dairy cows			
LU Goats + Sheep =		22.6 % 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

KWALE DISTRICT

AEZ: L 3–4

TABLE 11: INPUTS & YIELDS OF MAJOR CROPS

Survey Area 53

Crop		Inputs: Improved Seeds %	Nutrients: N kg/ha	Nutrients: P_2O_5 kg/ha	Nutrients: K_2O kg/ha	Nutrients: Manure t/ha	Chemicals: Insec. kg/ha	Chemicals: Fungicide kg/ha	Yield kg/ha
First Rains									
Maize	Avg.	9	1	11	-	0.01	1	-	1,762
	UpQu	-	-	12	-	-	-	-	2,700
	LoQu	-	-	-	-	-	-	-	788
Cowpeas	Avg.	-	-	-	-	-	-	-	3,592
Bambara GNuts	Avg.	-	-	-	-	-	-	-	533
Sunflower	Avg.	100	-	-	-	-	-	-	522
Cotton	Avg.	100	10	17	-	-	4	-	754
	UpQu	100	17	25	-	-	2	-	1,000
	LoQu	100	-	-	-	-	-	-	390
Cassava	Avg.	-	-	-	-	-	-	-	1,669
Second Rains									
Maize	Avg.	7	-	3	-	-	1	1	3,040
	UpQu	-	-	-	-	-	1	1	3,375
	LoQu	-	-	-	-	-	-	-	750
Beans	Avg.	-	-	-	-	-	-	-	294
Perennial Crops									
Cassava	Avg.	-	-	-	-	-	-	-	2,689
	UpQu	-	-	-	-	-	-	-	3,600
	LoQu	-	-	-	-	-	-	-	625
Citrus	Avg.	-	-	-	-	-	-	-	5,030
	UpQu	-	-	-	-	-	-	-	1,200
	LoQu	-	-	-	-	-	-	-	189
Cashew Nuts	Avg.	-	-	-	-	-	-	-	1,745
	UpQu	-	-	-	-	-	-	-	2,440
	LoQu	-	-	-	-	-	-	-	300
Coconuts	Avg.	-	-	-	-	-	-	-	1,590
	UpQu	-	-	-	-	-	-	-	1,333
	LoQu	-	-	-	-	-	-	-	-

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TABLE 12: DISPOSAL OF CROPS

AEZ: L 3–4

Survey Area 53

Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	52,660	18,000	34	6,090	12	28,570	54
Maize & Beans	870	450	52	0	0	420	48
Maize & Cowps	855	0	0	0	0	855	100
Maize IPC	2,700	0	0	810	30	1,890	70
Beans	498	0	0	60	12	438	88
Cowpeas	510	0	0	400	78	110	22
Bambara GNuts	320	0	0	0	0	320	100
Sweet Potatoes	12,300	0	0	10,000	81	2,300	19
Sunflower	1,183	1,183	100	0	0	0	0
Cotton	1,362	1,362	100	0	0	0	0
Second Rains							
Maize	47,200	17,110	36	450	1	29,640	63
Maize & Beans	630	270	43	0	0	360	57
Maize & Cowps	930	0	0	0	0	930	100
Maize & Others	160	160	100	0	0	0	0
Maize IPC	2,115	0	0	630	30	1,485	70
Beans	540	0	0	120	22	420	78
Cowpeas	80	0	0	0	0	80	100
Sunflower	375	375	100	0	0	0	0
Permanent Crops							
Coconuts	680	0	0	0	0	680	100
Cashew Nuts	1,810	0	0	1,760	97	50	3
Cassava	3,270	0	0	1,800	55	1,470	45
Citrus	4,960	0	0	1,000	20	3,960	80

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TABLE 13a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 37[1)]

AEZ: L 3–4 Survey Area 53 Sample Size: 30

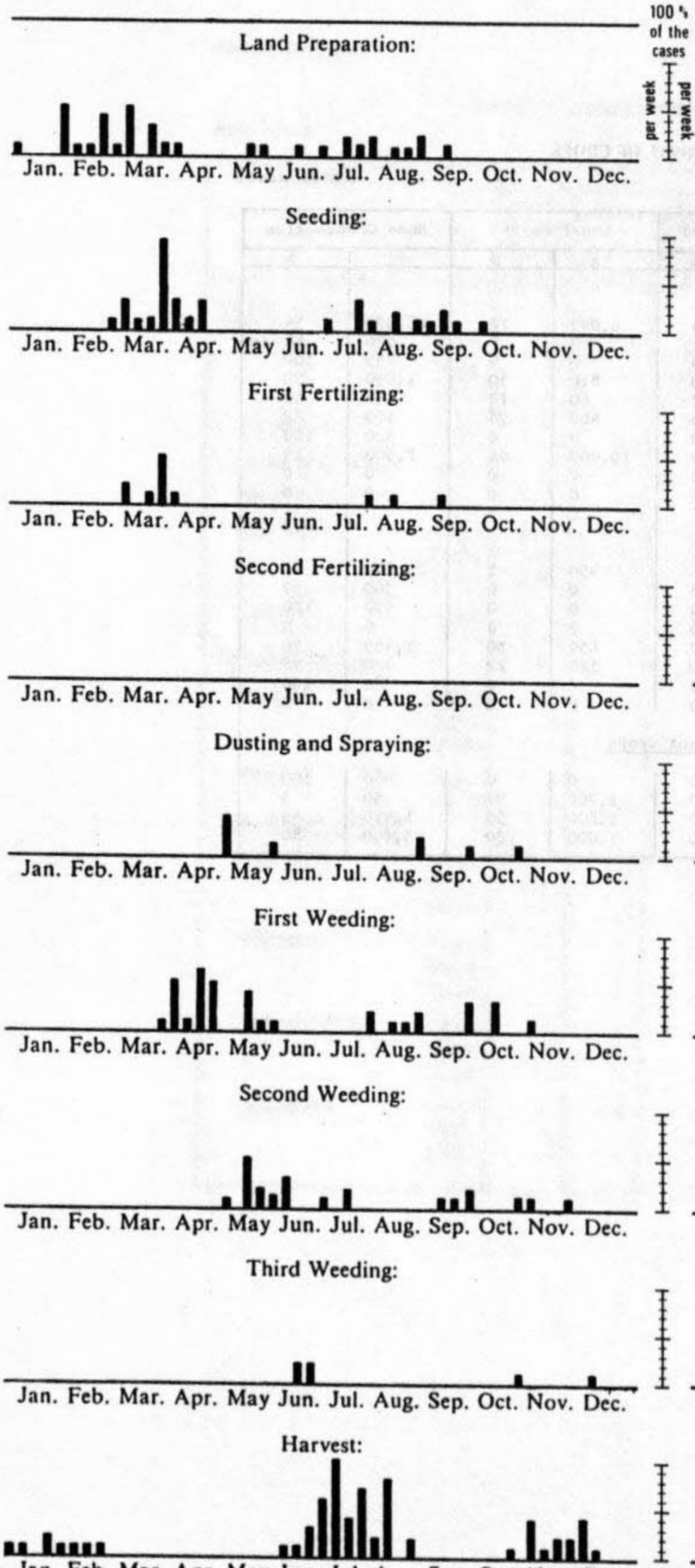

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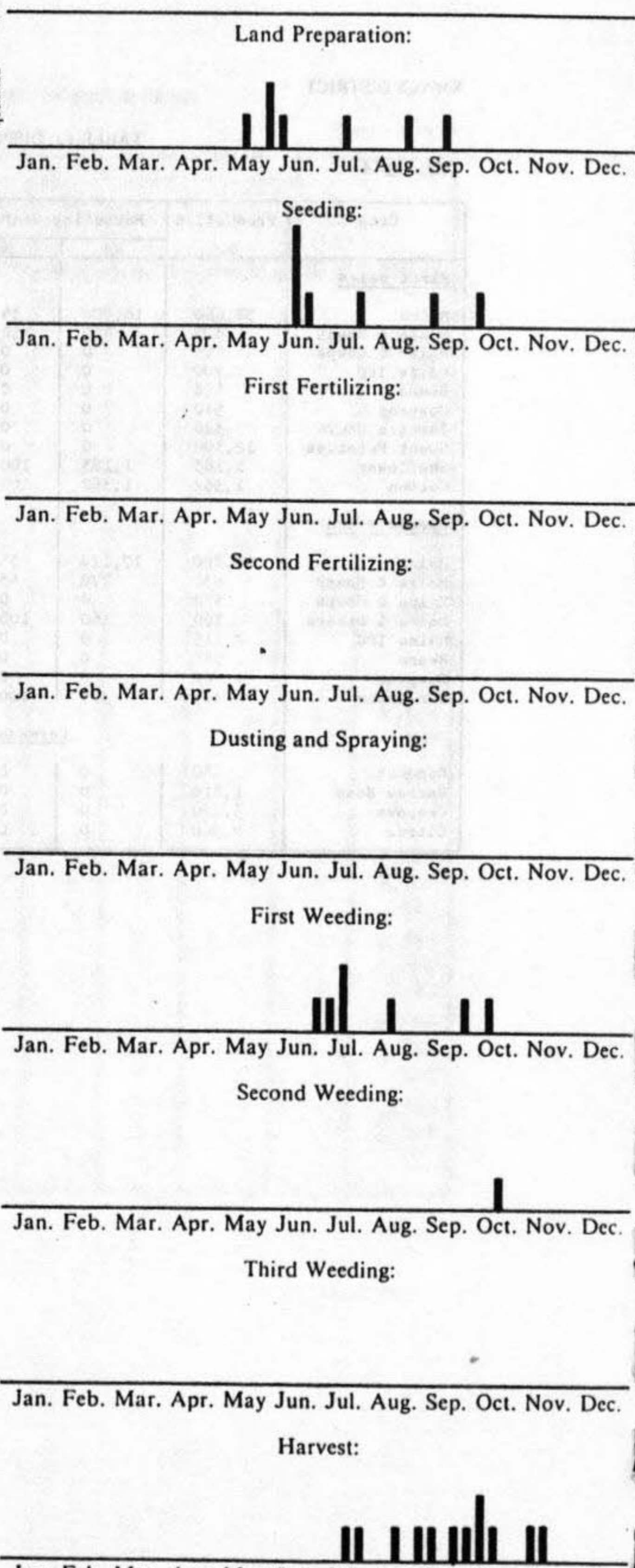
TABLE 13b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 10 Beans Cases: 7

AEZ: L 3–4 Survey Area 53 Sample Size: 30



1) Maximum 30 per crop and season

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TABLE 13c: DISTRIBUTION OF FARMING ACTIVITIES

Crop 20 Cowpeas Cases: 4

AEZ: L 3–4 Survey Area 53 Sample Size: 30

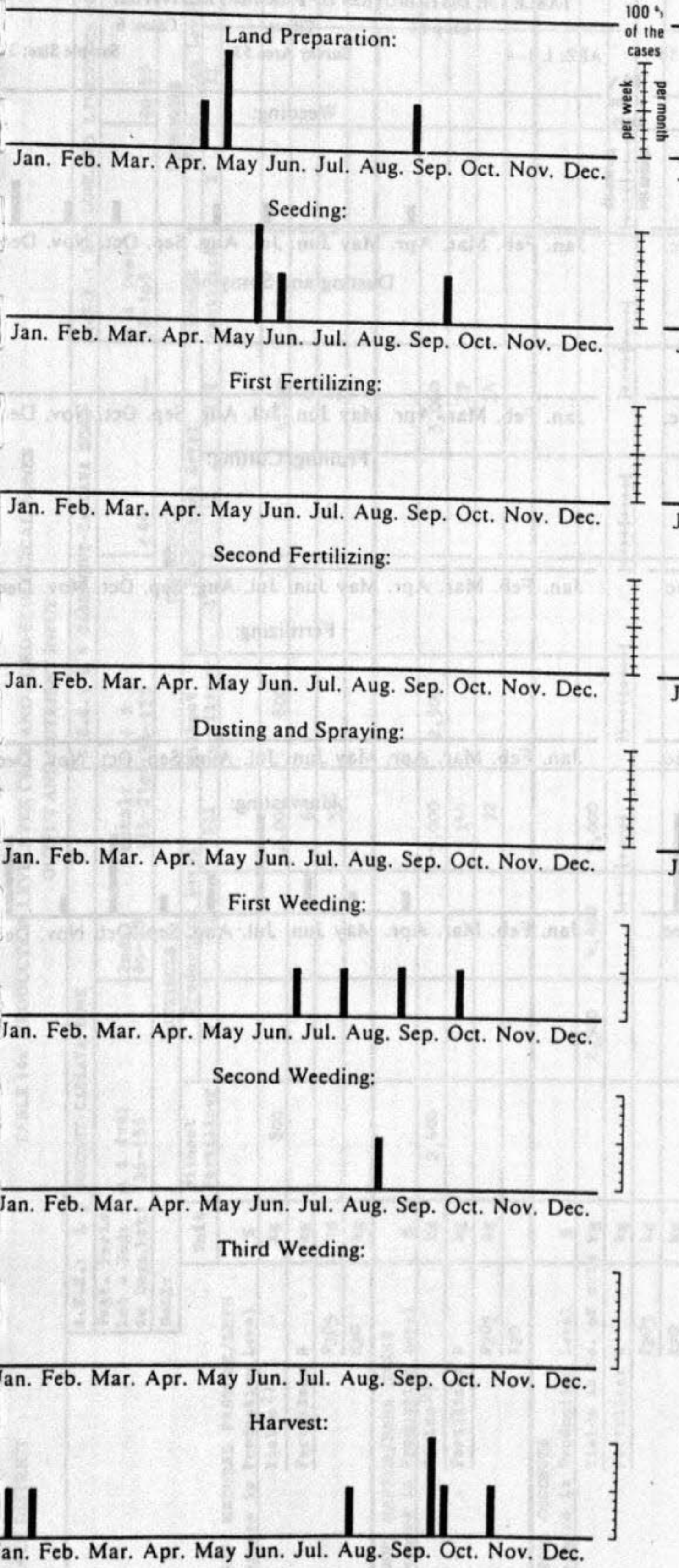

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TABLE 13d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 59 Coconuts Cases: 6

AEZ: L 3–4 Survey Area 53 Sample Size: 30

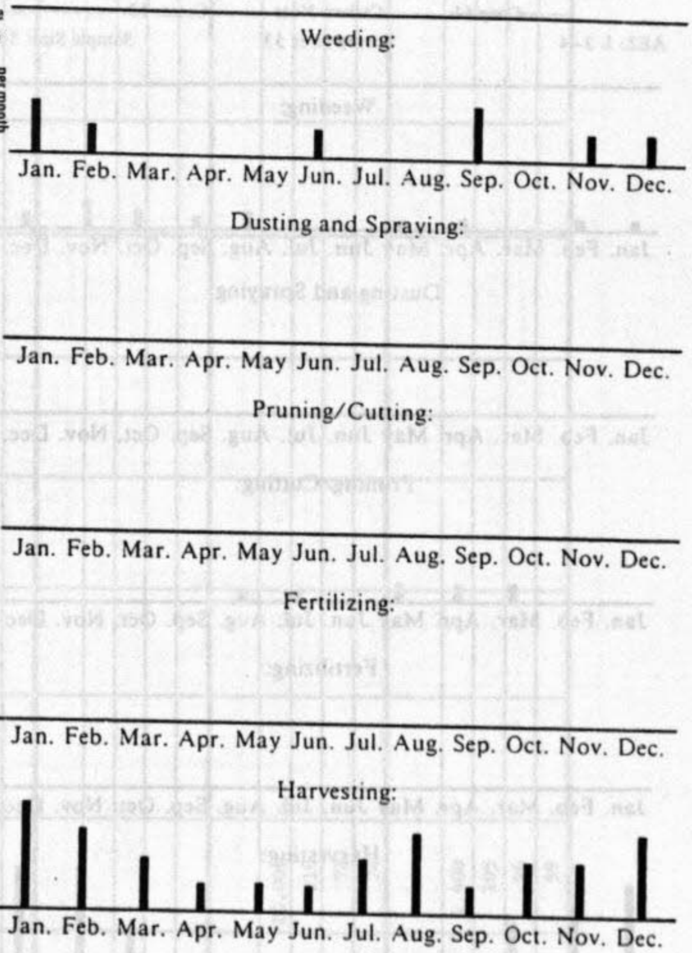

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TABLE 13e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 61 **Cashew Nuts** Cases: 13

AEZ: L 3–4 Survey Area 53 Sample Size: 30

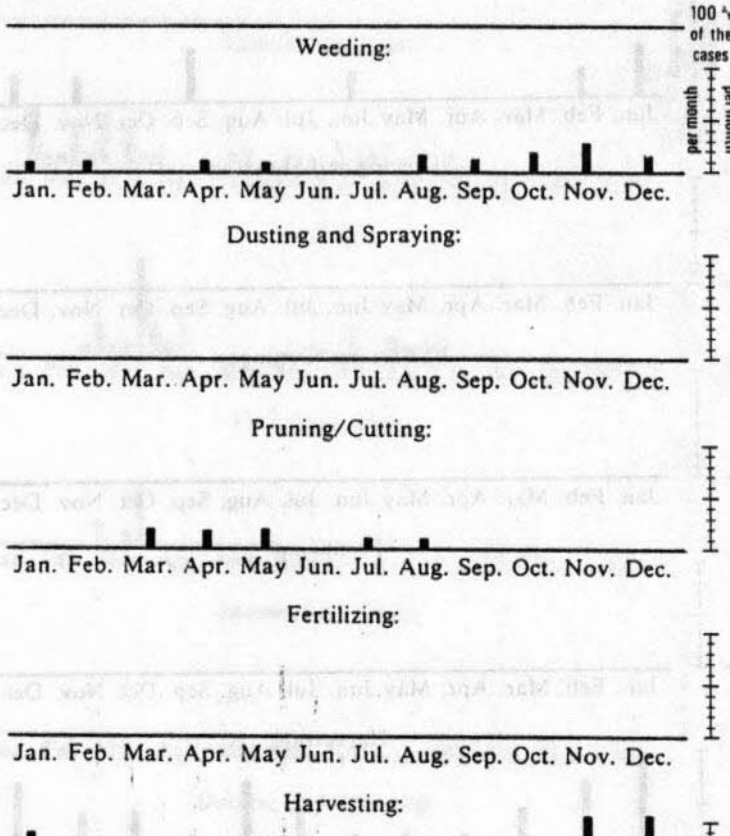

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TABLE 13f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 66 **Citrus** Cases: 6

AEZ: L 3–4 Survey Area 53 Sample Size: 30

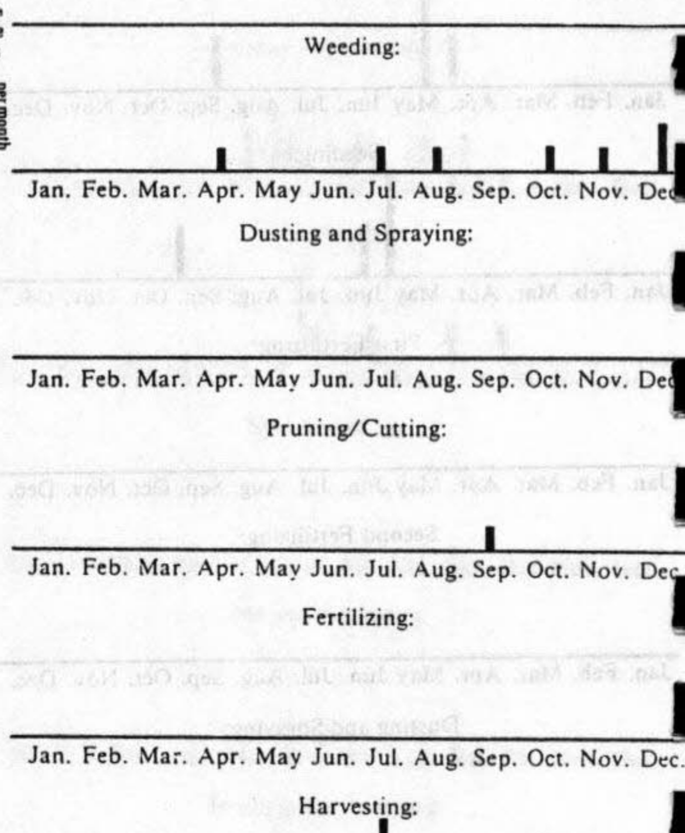

TABLE 14a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: m i (vs) in Days,1st: 135-155		2nd: 40-55	total: 175-210	m + i 135-155		< 40	—	s i (vs) 85-105		40-55	125-160
		Soil:	ACRISOLS			CAMBISOLS				LITHOSOLS			
	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 2)	kg	800			2,000	800			1,800	450			500
Fertilizer N	kg				66				55				
P_2O_5	kg				33				27				
K_2O	kg												
CROP: NAPIER/BANA GRASS													
Farmers in Production Level	%												
Yields 2)	kg	2,400			5,000	2,500			3,000				
Fertilizer N	kg				144				27				
P_2O_5	kg				72				14				
K_2O	kg												
CROP: COCONUTS													
Farmers in Production Level	%												
Yields in No. of nuts	~~kg~~		2,500	4,400	5,000								
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: CASHEWNUTS													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	6,000	4,000	8,000	20,000								
Fertilizer N	kg			36	216								
P_2O_5	kg			12	72								
K_2O	kg			12	72								
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg	450	450	900	1,400								
Fertilizer N	kg			49	105								
P_2O_5	kg			36	76								
K_2O	kg			28	59								

1) for explanations see p.16   2) in kg TDN

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

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
	Vegt. Period 1st + 2nd: in Days,1st:	m 1 (vs) 135-155		2nd: 4o-55	total: 175-21o	m + 1 135-155		<4o	—	s 1 (vs) 85-1o5		4o-55	125-16o
	Soil:	ACRISOLS				CAMBISOLS				LITHOSOLS			
		Without Fertilizer	Production Level			Without Fertilizer	Production Level			Without Fertilizer	Production Level		
	Unit		I	II	III		I	II	III		I	II	III
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	1,000	1,600	2,500	3,000	1,200	1,600	2,000	2,300				
Fertilizer N	kg		18	45	60		9	21	30				
P_2O_5	kg		15	35	50		7	17	24				
K_2O	kg		8	16	25		3	9	12				
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	2,400	1,600	2,800	3,400	2,200	-	-	3,000				
Fertilizer N	kg			16	40				32				
P_2O_5	kg			13	27				22				
K_2O				7	14				11				
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg					900	500	1,000	1,800	900	400	800	
Fertilizer N	kg							6	36				
P_2O_5	kg							6	24				
K_2O	kg							4	12				
CROP: COW PEAS													
Farmers in Production Level	%												
Yields	kg	400	400	700	1,000	400	400	700	1,000				
Fertilizer N	kg			12	24			12	24				
P_2O_5	kg			10	20			10	20				
K_2O	kg			10	20			10	20				
CROP: GRAMS													
Farmers in Production Level	%												
Yields	kg					400		600	800				
Fertilizer N	kg							8	16				
P_2O_5	kg							6	12				
K_2O	kg							6	12				
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

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

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: in Days, 1st: m 1 (vs) 135-155		2nd: 40-55	total: 175-210	m + 1 135-155		<40	—	s 1 (vs) 85-105		40-55	125-160
		Soil: ACRISOLS				CAMBISOLS				LITHOSOLS			
	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	600	450	800	1,000	800	450	800	1,000	700	450	700	
Fertilizer N	kg			6	8			-	8				
P_2O_5	kg			6	8			-	8				
K_2O	kg			6	8			-	8				
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	800		1,300	1,900	700		1,300	1,700	600		600	
Fertilizer N	kg			25	55			30	50			-	
P_2O_5	kg			19	42			23	38			-	
K_2O													
CROP: SIMSIM													
Farmers in Production Level	%												
Yields	kg	350	350	500	800	400	350	500	800				
Fertilizer N	kg				-			-	-				
P_2O_5	kg			13	38			8	33				
K_2O	kg			13	38			8	33				
CROP: GROUNDNUTS													
Farmers in Production Level	%												
Yields	kg	800	600	1,000	1,600								
Fertilizer N	kg			8	32								
P_2O_5	kg			6	26								
K_2O	kg			6	26								
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												

KWALE DISTRICT

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

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: m i (vs) in Days, 1st: 135-155		2nd: 4o-55	total: 175-21o	m + i 135-155		<4o	—	s i (vs) 85-1o5		4o-55	125-16o
		Soil: ACRISOLS				CAMBISOLS				LITHOSOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: SUKUMAWIKI													
Farmers in Production Level	%												
Yields	kg					3,000		8,000	22,000				
Fertilizer N	kg							40	152				
P_2O_5	kg							30	114				
K_2O								30	114				
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	6,000		12,000	10,000	5,000		8,000	12,000				
Fertilizer N	kg			46	96			30	70				
P_2O_5	kg			36	72			18	42				
K_2O	kg			36	72			18	42				
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg	4,500		12,000	18,000	4,000	3,000	12,000	16,000	3,500	3,000	7,000	10,000
Fertilizer N	kg			30	54			32	48			14	26
P_2O_5	kg			45	81			48	72			21	39
K_2O	kg			45	81			48	72			21	39
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												

KILIFI DISTRICT

Contents	District page

NATURAL POTENTIAL

INTRODUCTION

The average annual rainfall increases slightly from the coast, which has 900–1,000 mm, to more than 1,100 mm around Gede and east of Kaloleni. It seems that increased precipitation occurs due to the effects on air-masses from the sea of the tall forest of Gede and the coastal hills (see JAETZOLD, 1978, and GTZ, 1977).

There is less rain in the Kilifi depression, the Rare valley, and in the depression between the first range of the coastal hills and the second, larger one. In the rain shadow of this second range, the Kaloleni Hills, there is a sharp decrease in precipitation. In general, the rainfall tends to decrease quickly eastward from the maximum zone with a few exceptions on other hills or ridges like Mangea Hill (300–520 m), or on the Bamba Uplift (310 m). There is another decrease of precipitation north of Malindi which is difficult to explain. Perhaps the flatness of the area is one reason, or the turning of the SE-wind to a direction more parallel to the coast. Land use faces many problems there (see McGOWAN and Ass., 1977).

As regards rainfall and tree crops, only those areas with more than 1,050 mm a year are fairly well suited to coconuts although conditions are not optimal (ideally it should be around 1,500 mm). However, coconut palms can be seen from 700 mm average annual rainfall onward, although productivity may be considered worthwhile only when more than 850 mm occur. This depends also on the evaporation ratio and the danger of very dry periods (see map of Agro-Ecological Zones), because in the marginal areas many trees die after about 15 years in heavy drought periods. The damage done to the growing points of the palms by the rhinoceros beetle can be overcome only if enough moisture is available.

Mangoes are a slightly more demanding tree crop. Regular high quality fruit yield may not be possible below 950 or even 1,000 mm.

Roughly the same situation prevails with bananas, which ideally require more than 1,000 mm (see Map of Annual Rainfall). Citrus fruit also require more than 1,000 mm for good results, but top quality cannot be achieved due to high night temperatures (21–24°C). Pineapples also suffer from the high night temperatures (ACLAND 1975, p. 143). They may not develop enough acidity and become too big and mushy – the reason a plantation near Kilifi failed (Ngerenyi). In the interior towards Bamba, the nights get cooler (av. 20°C, cool season 18°C), the fruit taste better, and are more the right size because of less rain which is more evenly distributed. This is due to the fact that the long rains decrease from the coast inland, and the short rains increase to a certain extent up to a distance of about 30 km (see maps of seasonal rainfall).

This pattern affects less demanding crops like cashew nuts and cassava unfavourably (700–1,000 mm). The flowering period for cashew nuts is affected by these second rains, causing in wet years poor fruit setting or infestation which leads to low quality nuts. Cassava needs a distinct wet period to form big tubers.

If the second rains start early or continue more or less uninterrupted from the first rains, they often hit the open cotton bolls. For this and other reasons, no good cotton zone exists on the coast. For annual crops, this bimodal rainfall with two peaks can be very difficult, because neither peak is high enough (for instance, around Ganze). The following maps give more information on the problems and the possibilities.

The first rains ("Long Rains") start with a 60 % reliability towards the end of March. Near the coast they are heavy in April and May, and decrease gradually until October (see Diagrams) in most years without a distinctive end (Table 1). During the years 1946–76 the amount received in the agro-humid period at Kilifi-Kibarani was between 120 and 1,130 mm, so the average is not typical. It is better to consider the probability factor of how much is likely in 6 out of 10 years (see Diagram Kilifi and Map of First Rains).

The second rains ("Short Rains") start indistinctly towards the end of October, last until December or January but with no pronounced end, and variability is high. It is therefore difficult to give a figure for the reliability of rainfall in a well defined agro-humid period, and the map of second rains can be only a rough guide. The main problem is that in most areas they are insufficient for a maize crop. Tables for monthly rainfall expectation are published by BRAUN (1977).

References

ACLAND, J.D. (1979): East African Crops, 3rd ed., London

BRAUN, H.M.H. (1977): Seasonal and Monthly Rainfall Probability Tables for the East-Central, North-Western and Coast Region of Kenya. (= Miscellaneous Paper M 13), Kenya Soil Survey, Nairobi

GERMAN AGENCY FOR TECHNICAL COOPERATION (GTZ, 1977): Development of Settlement Schemes in the Coast Province of Kenya. Report, Department of Settlement, Nairobi

JAETZOLD, R. (1978): Possibilities of Agricultural Settlements in the Northern Coastal Area of Kenya. GeoJournal 2.3, p. 225–242

McGOWAN and Associates Pty. Ltd. (1977): Magarini Land Settlement Project, Kilifi District, Coast Province, Kenya. Report, Nairobi

KILIFI 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	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
					Monthly rainfall in mm											
9239000	Adu Location	11	Average	931	17	14	44	124	164	93	67	63	58	78	137	72
120 m			60 % rel.[1)]	656	0	4	3	93	137	48	31	31	22	24	53	20
9339004	Kilifi, D.O.	53	Av.	954	18	15	38	122	268	117	78	56	56	71	73	43
8 m			60 %	819	0	0	11	90	201	72	61	38	28	28	41	16
9339010	Marafa, Dispensary	38	Av.	887	14	24	51	100	184	86	74	53	63	77	80	83
61 m			60 %	792	2	1	17	53	118	76	55	27	21	13	59	65
9339012	Ganze, Dispensary	25	Av.	831	25	14	48	97	187	56	42	44	54	84	103	78
183 m			60 %	603	14	0	14	47	103	39	23	22	17	44	73	36
9339013	Chonyi	33	Av.	1 150	21	19	51	147	271	99	89	76	97	96	109	75
256 m			60 %	1 029	0	0	37	37	162	86	72	51	39	90	105	36
9339016	Bamba	18	Av.	677	10	15	53	104	137	29	27	31	46	74	78	74
244 m																
9339017	Mariakani Vet. St.	34	Av.	856	32	18	56	108	130	60	37	53	69	82	126	87
204 m			60 %	778	16	6	15	69	109	38	28	31	14	23	85	33
9339027	Baricho	24	Av.	724	33	18	58	98	91	44	30	27	47	77	113	89
67 m			60 %	650	11	3	39	88	77	35	21	15	10	20	56	76
9339030	Jibana Disp.	20	Av.	1 094	16	15	57	150	250	109	70	71	58	126	124	49
152 m			60 %	977	2	1	13	62	188	90	49	53	18	69	88	15
9339034	Chakama	16	Av.	539	42	16	41	97	27	31	26	18	45	34	169	54
91 m			60 %	481	19	0	24	87	25	21	13	8	9	16	80	52
9339038	Kaloleni, Boma	15	Av.	1 090	31	25	43	121	176	103	77	82	96	141	134	62
226 m			60 %	772	8	2	8	67	159	56	50	51	35	44	66	39
9339039	Ruruma, Chief's	14	Av.	1 058	27	21	70	123	167	91	27	72	99	137	153	71
171 m	Camp		60 %	860	0	0	7	25	120	65	25	35	40	32	60	31
9340000	Malindi, D.O.	78	Av.	1 050	9	7	34	158	336	163	90	56	53	64	51	29
3 m			60 %	905	0	0	10	112	245	113	71	37	25	26	29	11
9340001	Malindi, Gongoni	36	Av.	930	4	5	40	145	273	126	82	44	46	65	62	38
15 m	Fundisha Saltworks		60 %	795	0	0	12	103	194	91	63	25	23	27	30	15
9340005	Malindi, Water	22	Av.	1 087	14	8	49	174	243	163	96	57	64	84	89	46
46 m	Supply		60 %	940	2	0	19	132	172	115	78	38	29	43	49	26
9340006	Malindi, Kisima	17	Av.	1 049	6	9	42	188	255	162	91	74	55	65	76	26
15 m	Farm Ltd.															
9340007	Malindi, Gedde	19	Av.	1 211	18	12	54	187	273	171	113	69	80	80	105	51
91 m	Cotton Research St.															
9340009	Malindi, Met. Station	14	Av.	1 091	11	15	42	186	313	160	74	64	46	71	79	30
20 m																
9340010	Ganda	10	Av.	1 055	19	29	60	140	265	197	85	52	30	63	111	9
18 m																
9340011	Magarini	13	Av.	979	4	15	16	155	259	145	81	63	40	67	105	29
31 m																

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

KILIFI DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ[1]	Kind of records	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Years of rec.
				Temperature in °C													
9340009	Malindi	CL	Mean max.	30.5	31.1	32.1	31.0	28.8	27.9	27.4	27.4	28.4	29.5	30.5	30.8	29.6	
20 m	Airport,	3	Mean temp.	26.6	27.1	28.0	27.4	26.0	25.0	24.6	24.4	25.0	25.8	26.5	26.9	26.1	
	Met. Stat.	lp	Mean min.	22.8	23.1	24.0	23.9	23.2	22.2	21.8	21.5	21.6	22.2	22.6	23.1	22.7	8
			Abs. min.	18.8	17.0	21.1	16.6	20.6	18.4	18.0	16.7	17.6	17.6	19.6	20.4	16.6	
9435021	Mombasa,	CL	Mean max.	32.1	32.4	32.7	31.2	29.2	28.5	27.7	28.0	28.9	29.7	30.6	31.6	30.2	
57 m	Port Reitz	4	Mean temp.	27.6	28.0	28.4	27.5	25.9	24.8	24.0	24.1	24.8	25.8	26.8	27.4	26.3	
	Airport,	lp	Mean min.	23.2	23.6	24.2	23.8	22.6	21.1	20.3	20.3	20.8	22.0	23.0	23.3	22.4	24
	Met. Stat.[2]		Abs. min.	18.4	20.6	20.8	21.1	18.9	17.5	17.6	14.1	17.6	17.7	20.0	19.4	14.1	

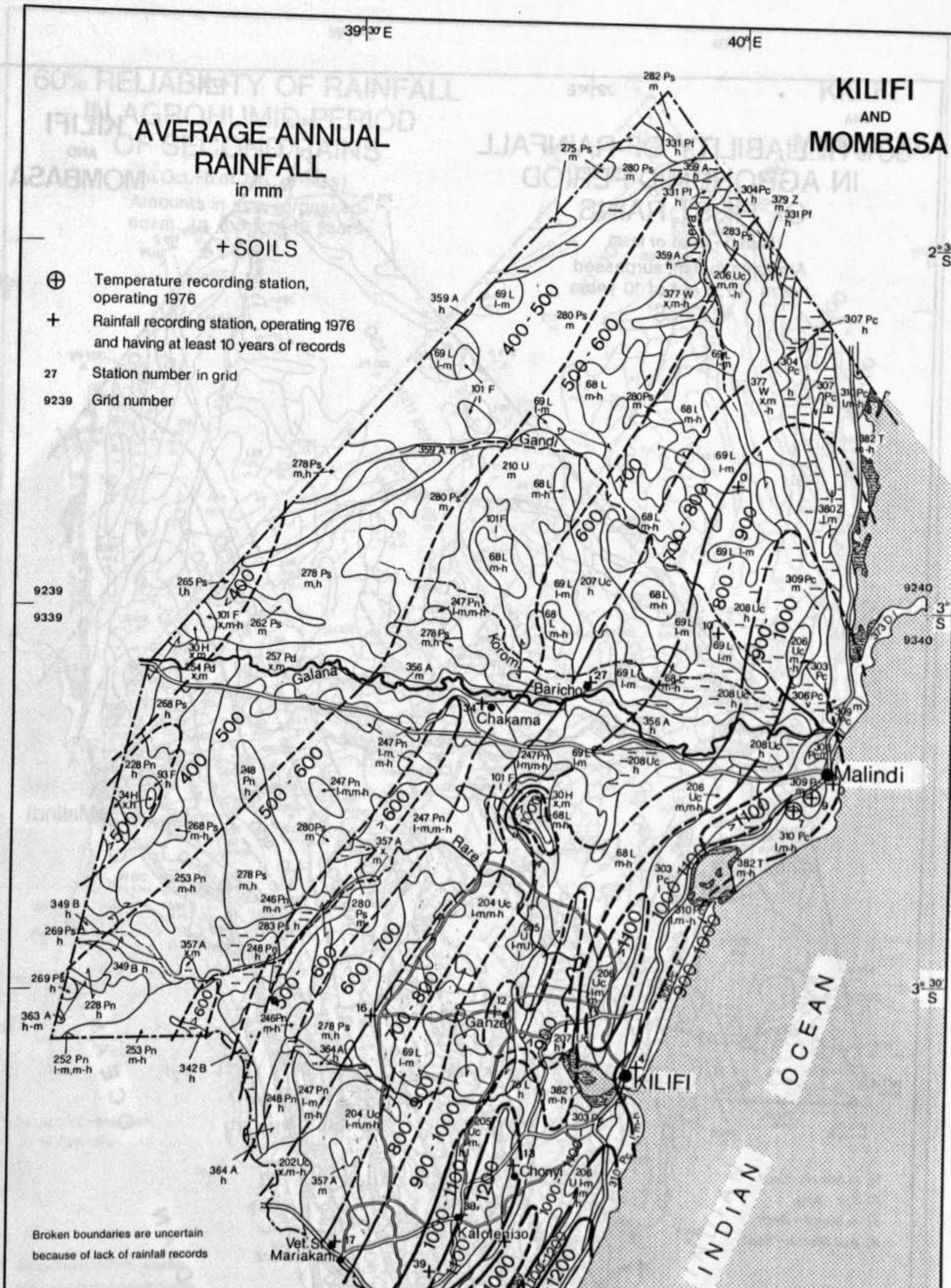
1) AEZ = Agro-ecological zone; lp = lower places within the zone
2) Mombasa District

KILIFI DISTRICT

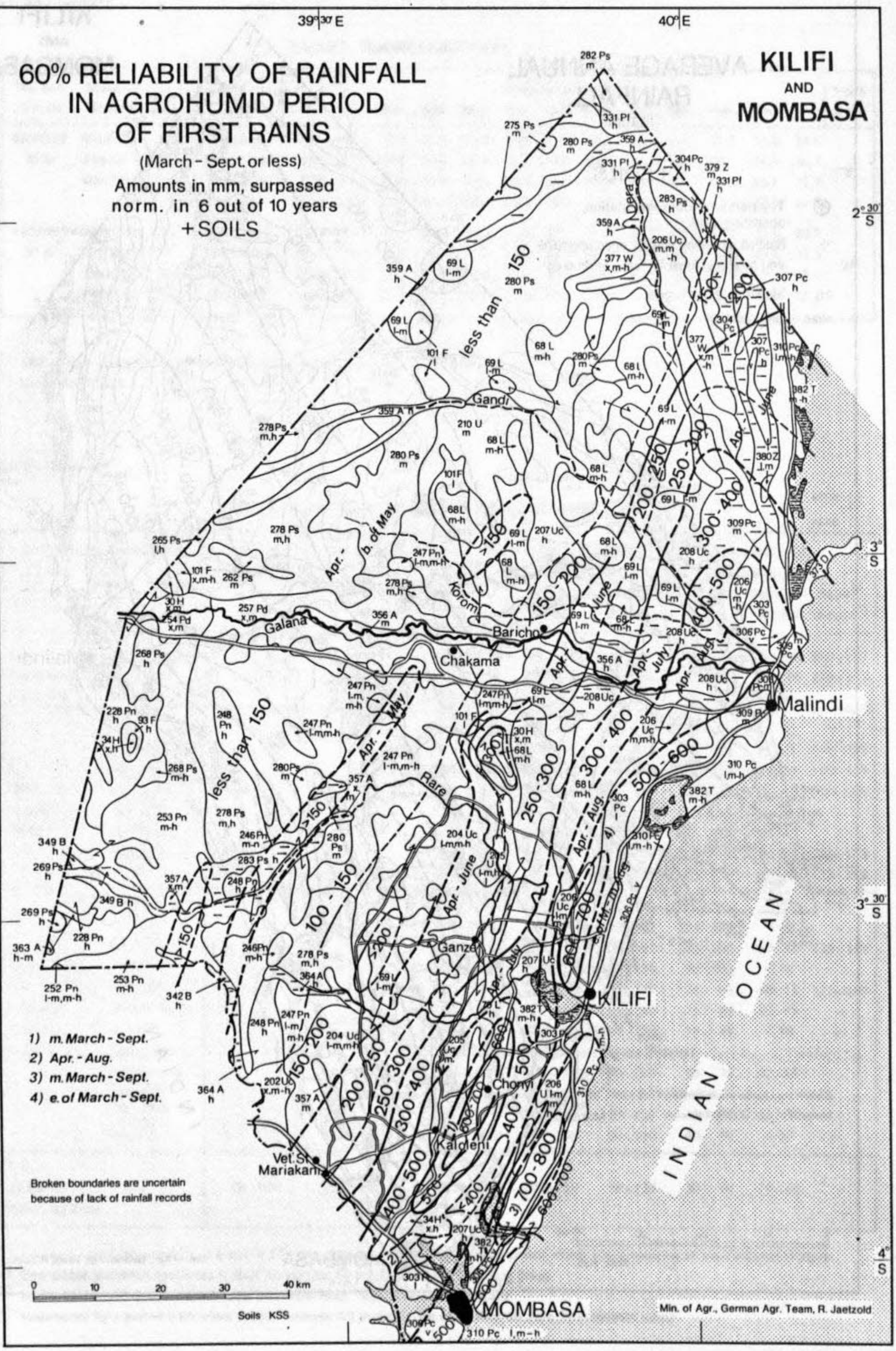
TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

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 in days	2nd rains in days	Total[2] in days[4]
L 3	m/l i s			1 100–1 200	480–700	200–250	155–175	85–105	240–280
Coconut-Cassava Zone	m i (s/vs)	1–450	26.6–24.0	1 000–1 150	400–650	170–220	135–155	75– 85	210–240
	m/l i[3]			1 050–1 230	400–800	50–130	155–175	<40	–
	m i[3]			850–1 100	320–600	50–130	135–155	<40	–
	m i (vs/s)			940–1 100	300–650	150–200	135–155	55–75	190–230
L 4	m i (vs)			900–1 100	320–620	90–200	135–155	40–55	175–210
Cashewnut-Cassava	m/s i (vs)	1–300	26.6–24.9	920–1 000	250–380	140–180	115–135	40–55	155–190
	m/s i[3]			850–1 000	300–500	50–140	115–135	<30	–
Zone	m/s + i			850–1 100	270–600	80–140	115–135	<40	–
	s/m i (vs)			780– 950	200–350	130–180	105–115	40–55	145–170
	s i (vs)			800– 950	200–350	150–180	85–105	40–55	125–160
	s/m i + i			820–1 000	220–500	50–160	105–105	<40	–
	s/m + i			800–1 000	220–500	60–160	105–115	<40	–
	s i (vs)			760– 880	220–320	150–180	85–105	40–55	125–160
	s i[3]			800– 900	250–350	50–130	85–105	<30	–
L 5	s/vs i (vs)			700– 880	170–270	150–170	75– 85	40–55	115–140
Lowland	(s/vs) + vs	1–300	26.6–24.9	700– 750	180–200	150–160	75– 85	40–55	–
Livestock-	s/vs i[3]			750– 820	220–260	100–130	75– 85	<30	–
Millet Zone	vs/s + (vs)			Small transitional strip (see Kwale District)					
	(vs/s) + (vs)			640– 820	150–220	130–160	55– 75	40–55	–
	(vs/s) i[3]			Small transitional strip (see Tana River District)					
	(vs) + i or i + (vs)			600– 760	120–200	130–150	40– 55	35–50	–
	(vs) + i			550– 750	150–200	80–130	40– 50	<40	–
L 6 Lowland Ranching Zone	b r	90–300	27.0–24.9	380– 700	100–150	50–130	30– 40	20–30	–

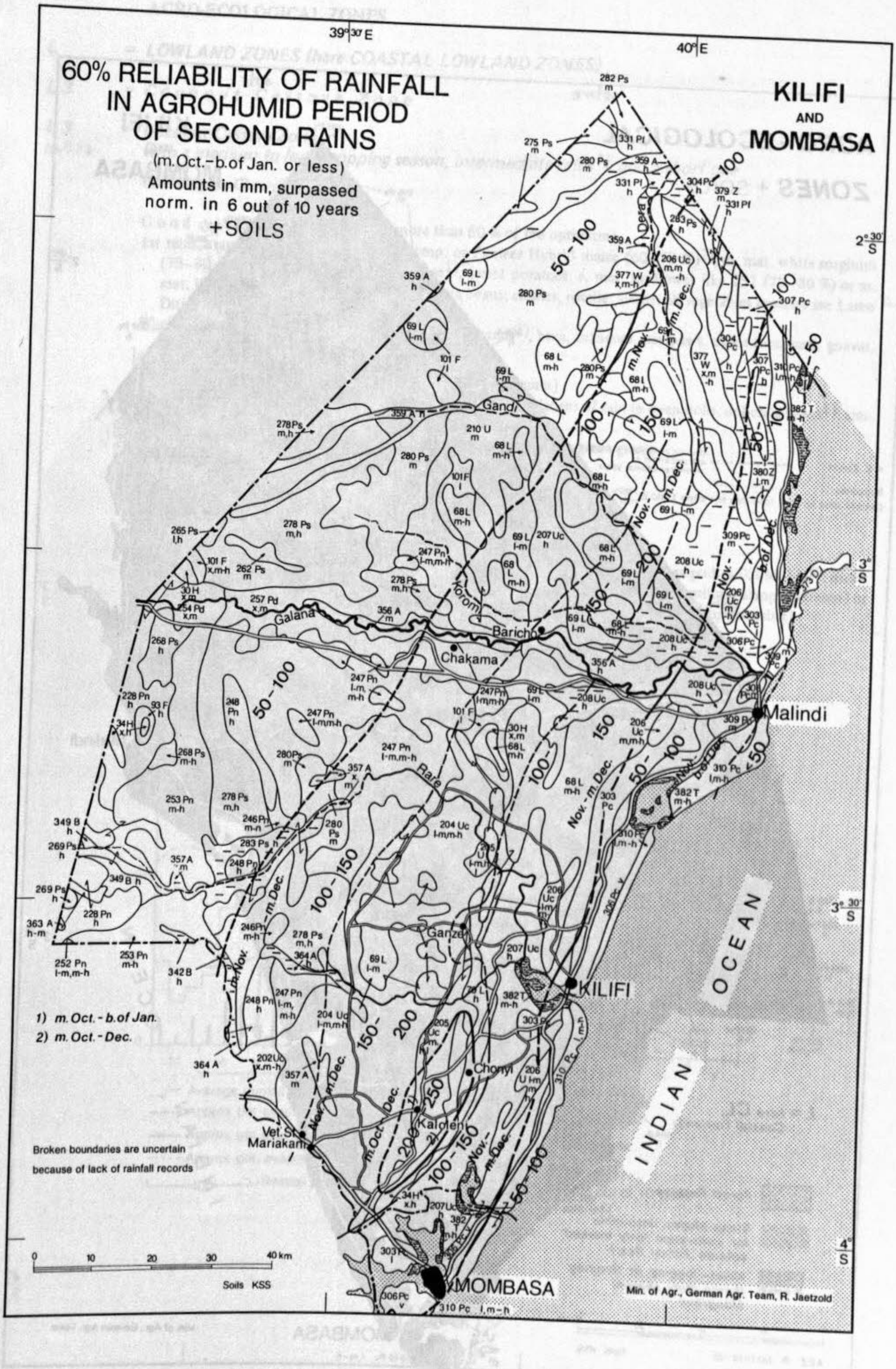
1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants
2) Only added if rainfall continues at least for survival (> 0.2 E_0) of most long term crops
3) Intermediate rains follow immediately after first rains. Second rains insignificant
4) Interrupted by a period with water supply between 0.2 and 0.E_0 for more than 50 days (intermediate rains)

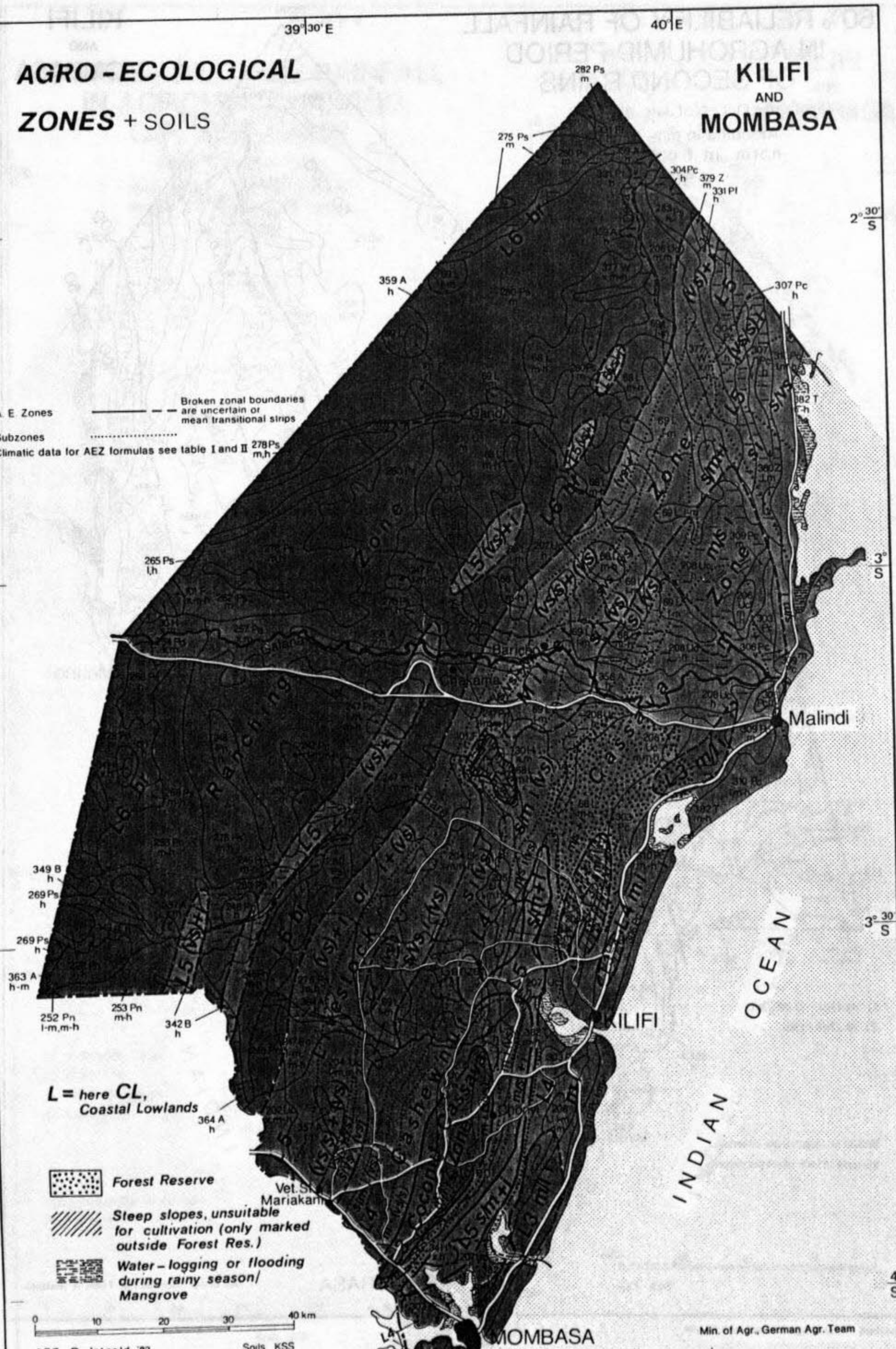


KILIFI AND MOMBASA
AVERAGE ANNUAL RAINFALL
in mm
+ SOILS
Temperature recording station, operating 1976
Rainfall recording station, operating 1976 and having at least 10 years of records
27 Station number in grid
9239 Grid number
Broken boundaries are uncertain because of lack of rainfall records
39°30' E
40° E
2° 30' S
3° S
3° 30' S
4° S
9239
9339
9240
9340
0 10 20 30 40 km
Soils: KSS
Min. of Agr., German Agr. Team, R. Jaetzold
Malindi
KILIFI
MOMBASA
Chakama
Baricho
Gandi
Ganze
Chonyi
Kaloleni
Mariakani
Vet. St.
Galana
Rare
Korom
INDIAN OCEAN
400-500
500-600
600-700
700-800
800-900
900-1000
1000-1100
1100
1200
<1000



60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF FIRST RAINS
(March - Sept. or less)
Amounts in mm, surpassed norm. in 6 out of 10 years
+SOILS
KILIFI AND MOMBASA
39°30' E
40° E
2° 30' S
3° S
3° 30' S
4° S
1) m. March - Sept.
2) Apr. - Aug.
3) m. March - Sept.
4) e. of March - Sept.
Broken boundaries are uncertain because of lack of rainfall records
Soils KSS
Min. of Agr., German Agr. Team, R. Jaetzold
0 10 20 30 40 km
INDIAN OCEAN
Malindi
KILIFI
MOMBASA
Galana
Gandi
Baricho
Chakama
Ganze
Chonyi
Kaloleni
Vet. St. Mariakani
Rare
Korom
less than 150


60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF SECOND RAINS
(m.Oct.-b.of Jan. or less)
Amounts in mm, surpassed norm. in 6 out of 10 years
+SOILS
KILIFI AND MOMBASA
39°30' E
40°E
2°30' S
3° S
3°30' S
4° S
Galana
Gandi
Korom
Rare
Baricho
Chakama
Malindi
Ganze
KILIFI
Chonyi
Kaloleni
Vet.St. Mariakani
MOMBASA
INDIAN OCEAN
1) m.Oct. - b.of Jan.
2) m.Oct. - Dec.
Broken boundaries are uncertain because of lack of rainfall records
0 10 20 30 40 km
Soils KSS
Min. of Agr., German Agr. Team, R. Jaetzold


AGRO-ECOLOGICAL ZONES + SOILS
KILIFI AND MOMBASA
39°30'E
40°E
2°30' S
3° S
3°30' S
4° S
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
Climatic data for AEZ formulas see table I and II
L = here CL, Coastal Lowlands
Forest Reserve
Steep slopes, unsuitable for cultivation (only marked outside Forest Res.)
Water-logging or flooding during rainy season/ Mangrove
0 10 20 30 40 km
AEZ R. Jatzold '83
Soils KSS
Min. of Agr., German Agr. Team
Malindi
KILIFI
MOMBASA
INDIAN OCEAN
Mariakani
Ranching Zone
Cashew nut - Cassava Zone
Livestock
Coconut - Cassava Zone
282 Ps m
275 Ps m
304 Pc h
379 Z m
331 Pl h
307 Pc h
359 A h
382 T l-h
265 Ps l,h
349 B h
269 Ps h
269 Ps h
363 A h-m
252 Pn l-m,m-h
253 Pn m-h
342 B h
364 A h
310 Pc l,m-h

AGRO-ECOLOGICAL ZONES

L = *LOWLAND ZONES (here COASTAL LOWLAND ZONES)*

L 3 = *Coconut-Cassava Zone*

L 3 m/l i s = *Coconut-Cassava Zone with a medium to long cropping season, intermediate rains*[1]*, and a short one*

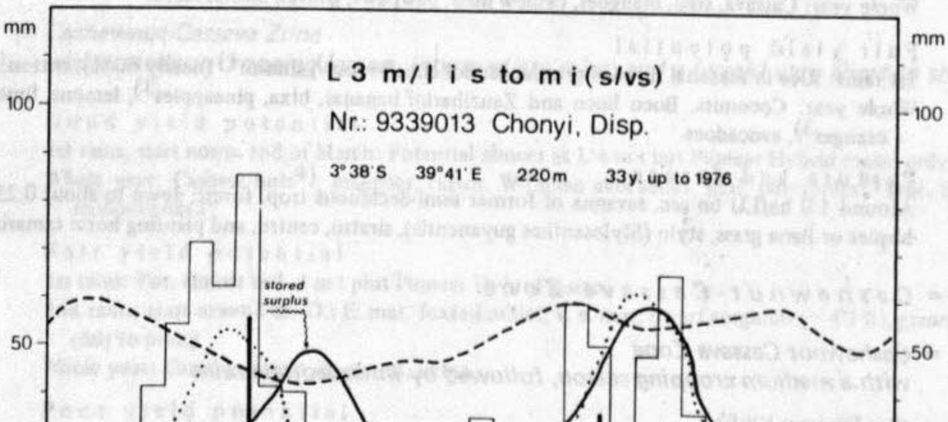
(See Diagram Chonyi)

Good yield potential (av. more than 60 % of the optimum)
1st rains, start norm. mid April: Coast comp. or Pioneer Hybrid maize (60–70 %)[2], m. mat. white sorghum (70–80 %), late mat. sorghum[2]; cowpeas[1], sweet potatoes; e. mat. sunflower like 252 (70–80 %) or m. mat. like H S 301 A a. o. var.[2], m. mat. soya beans; chillies, roselle; almost all vegetables (species see Lamu District)
Whole year: Coconuts (~ 60 %, on light soils), bananas[2], bixa, mangoes, pawpaws, avocadoes, sisal, guavas, senna, castor

Fair yield potential (av. 40–60 % of the optimum)
1st rains: Rice in seasonal flooded grasslands; cotton with danger of rain in open bolls, dolichos beans[1], simsim[1]
2nd rains, start norm. mid Oct.: M. mat. sorghum; sweet potatoes; green grams
Whole year: Cassava, citrus[3], pineapples[3], cashew nuts[4], curcuma

Poor yield potential (av. 20–40 % of the optimum)
2nd rains: Coast comp. maize

Pasture and forage
Nearly no grassland. Grazing under coconut trees around 0.7 ha/LU, with Mimosa pudica 0.4 ha/LU[5]; down to about 0.15 ha/LU feeding Napier or Bana grass and legumes like siratro (Macroptilium atropurpureum) or centro (Centrosema pubescens), and planting horse tamarind (Leucaena leucocephala, for browsing)



L 3 *m i (s/vs)* = *Coconut-Cassava Zone with a medium cropping season, intermediate rains, and a (weak) short to very short one*

Good yield potential

1st rains, start norm. mid April: M. mat. white sorghum; cowpeas[1)], sweet potatoes; m. mat. soya beans, sunflower 252, roselle, m. mat. bambarra groundnuts[6)7)], nearly all vegetables

Whole year: Mangoes, sisal, West Indian avocadoes, bixa, pawpaws, guavas, senna, castor, cassava (~ 60 %), pineapples[3)]

Fair yield potential

1st rains: Coast comp. maize Pioneer Hybrid maize, rice in seasonal flooded grasslands; simsim[1)] (nearly 60 %), dolichos beans[1)], late mat. groundnuts[6)]; cotton (with danger of rain in open bolls)

2nd rains, start norm. mid O.: Sweet potatoes, green grams, simsim, e. mat. groundnuts[6)]

Whole year: Coconuts[6)], bananas, citrus, cashew nuts (50–60 %)[4)6)]

Poor yield potential

2nd rains: Coast comp. maize

Pasture and forage

Around 0.8 ha/LU on sec. savanna of former semi-deciduous tropical forest; down to about 0.2 ha/LU feeding Napier or Bana grass, siratro, centro, and planting horse tamarind (for browsing)

L 3 *m/l i* = *Coconut-Cassava Zone with a medium to long cropping season and intermediate rains*

Good yield potential

1st rains, start norm. end of March: Coast comp. and Pioneer Hybrid maize (60–70 %), m. mat. white sorghum; sweet potatoes, cowpeas[1)] (~ 60 %), m. mat. soya beans, m. mat sunflower like H S 301 A; chillies, roselle; onions, okra, egg plants, aubergines, sweet pepper, kales, garlic, Chinese cabbage, brinjals, tomatoes, water and sweet melons, cucumbers, pumpkins, zucchini, mchicha

Whole year: Cassava, sisal, mangoes, cashew nuts, pawpaws, guavas, senna, castor

Fair yield potential

1st rains: Rice in seasonal flooded grasslands; dolichos beans[1)], simsim[1)] (nearly 60 %); cotton; cabbages

Whole year: Coconuts, Boco boco and Zanzibarini bananas, bixa, pineapples[3)], lemons, limes, grapefruit[3)], oranges[3)], avocadoes

Pasture and forage

Around 1.0 ha/LU on sec. savanna of former semi-deciduous trop. forest; down to about 0.25 ha/LU feeding Napier or Bana grass, stylo (Stylosanthes guyanensis), siratro, centro, and planting horse tamarind

L 4 = *Cashewnut-Cassava Zone*

L 4 *m i* = *Cashewnut-Cassava Zone with a medium cropping season, followed by intermeditate rains*

(See Diagram Kilifi)

Good yield potential

1st rains, start norm. end of March/b. of April: Coast composite and Pioneer Hybrid maize (~ 60 %), m. mat. sorghum; sweet potatoes; e. and m. mat. sunflower like 252 or (on light soils) Issanka, guar[14)], kenaf; brinjals, kales, onions, okra, aubergines, sweet pepper, egg plants, chillies, Chinese cabbage, water and sweet melons, cucumbers, pumpkins, zucchini, mchicha

Whole year: Cashew nuts, cassava, sisal, mangoes, castor

Fair yield potential

1st rains: Coast comp. maize (50–60 %), rice in semi-permanent swamps; cowpeas[1)], simsim[1)]; cotton, groundnuts (on light soils); tomatoes, garlic, cabbage

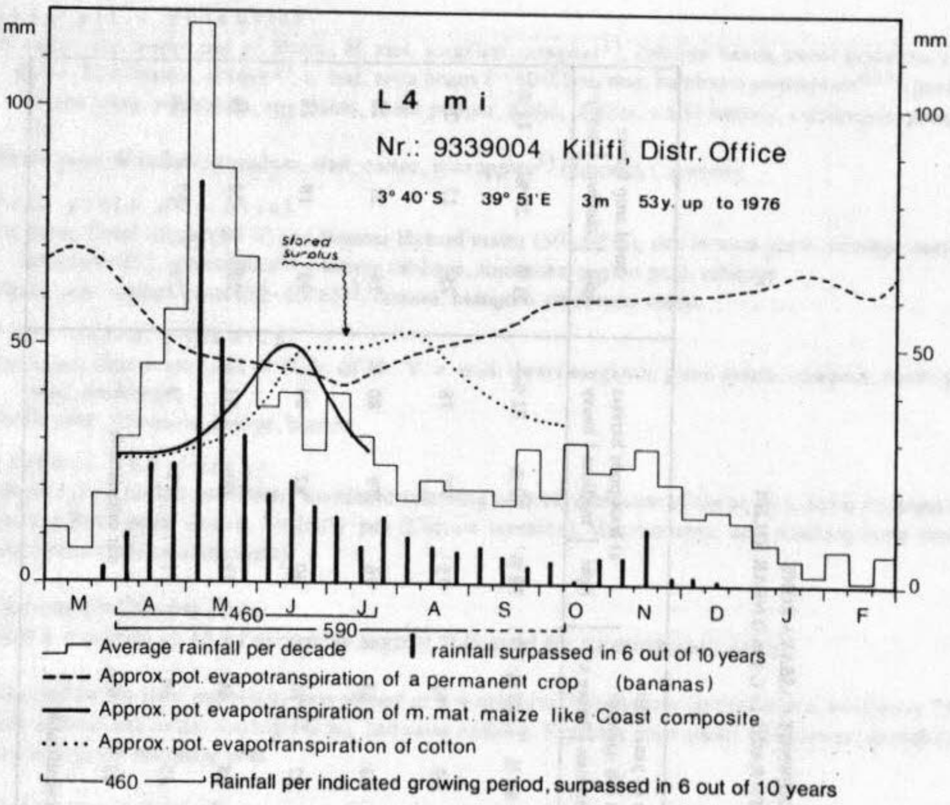
Whole year: Pawpaws (50–60 %), senna, bixa

Poor yield potential

Whole year: Coconuts, bananas

Pasture and forage

Around 1.5 ha/LU on nat. pasture in coastal semi-deciduous forest-savanna mosaic; down to about 0.28 ha/LU feeding Napier and Bana grass, siratro, centro and planting horse tamarind



L 4 m i (vs/s) = *Cashewnut-Cassava Zone with a medium cropping season, intermediate rains, and a (weak) very short to short one*

Good yield potential

1st rains, start norm. end of March: Potential almost as L 4 m i but Pioneer Hybrid maize only fair

Whole year: Cashew nuts[4]), mangoes, castor, W-Indian avocadoes, sisal, pineapples[3]) (var. Smooth Cayenne recommended)

Fair yield potential

1st rains: Pot. almost as L 4 m i plus Pioneer Hybrid maize

2nd rains, start around m. O.: E. mat. foxtail millet, v. e. mat. dwarf sorghum (~ 40 %); green grams, cowpeas (fair to poor)

Whole year: Cassava, pawpaws, guavas, senna

Poor yield potential

2nd rains: Dryland comp. maize; v. e. mat. sunflower, e. mat. soya beans: sweet potatoes[9])

Whole year: Coconuts, bananas, citrus

Pasture and forage

About 1–1.5 ha/LU; down to about 0.2 ha/LU feeding Napier and Bana grass, siratro, centro, and planting horse tamarind

L 4 m i (vs) = *Cashewnut-Cassava Zone with a medium cropping season, intermediate rains, and a (weak) very short one*

Very small, potential 1st rain almost as L 4 m i + (vs/s) but better for cotton (50–60 %), 2nd rains e. mat. foxtail millet, v. e. mat. dwarf sorghum, green grams, and cowpeas poor

L 4 m + i = *Cashewnut-Cassava Zone with a medium cropping season and intermediate rains*

Very small, potential see Kwale District

KILIFI DISTRICT

TABLE 4: CULTIVATION CHANCES AND RISKS IN THE CASHEWNUT-CASSAVA ZONE WITH A MEDIUM CROPPING SEASON AND INTERMEDIATE RAINS (= L 4 m i) NEAR KILIFI

Long rains, planting time begin of April

Crop variety or fodder plant	Veg. cycle in days (average)	Percentage of years with very good harvest			at least good harvest			at least fair harvest			at least poor harvest			total crop failure		
		on light	medium	heavy s.	light	medium	heavy s.	light	medium	heavy s.	light	medium	heavy s.	light	medium	heavy s.
Pioneer Hybrid maize	105	40 %	45 %	49 %	51 %	55 %	58 %	63 %	65 %	67 %	79 %	80 %	82 %	21 %	20 %	18 %
Coast Comp. maize	120	34	35	38	43	47	49	58	60	62	75	77	78	25	23	22
Sunflower 252 = Kensun	110	36	41	46	46	53	55	60	63	65	76	79	80	24	21	20
Early mat. soya beans	85	43	50	55	52	58	62	65	67	70	80	82	84	20	18	16
Medium mat. soya beans	120	37	42	45	48	53	56	61	65	66	78	80	81	22	20	19
Cotton	150	30	32	34	39	43	44	53	55	56	71	73	74	29	27	26
Napier and Bana grass	perennial	35	40	45	45	50	55	60	63	65	not calculatable					
Bananas	perennial	15	20	25	25	30	35	not calculatable								

L 4 = *Cashewnut-Cassava Zone*
m/s i (vs) *with a medium to short cropping season, intermediate rains, and a (weak) very short one*

Good yield potential
1st rains, start norm. end of March: M. mat. sorghum; cowpeas[1], dolichos beans, sweet potatoes; e. mat. sunflower like Issanka, simsim[1], e. mat. soya beans (~60 %), m. mat. bambarra groundnuts[6)7)], guar[14]; kales, onions, okra, aubergines, egg plants, sweet pepper, garlic, chillies, water melons, cucumbers, pumpkins, brinjals
Whole year: W-Indian avocadoes, sisal, castor, pineapples[3] (Smooth Cayenne)

Fair yield potential
1st rains: Coast comp. (50 %) and Pioneer Hybrid maize (50–60 %), rice in semi-perm. swamps; cotton, safflor, sunflower 252, groundnuts[6]; Chinese cabbage, tomatoes, pigeon peas, cabbage
Whole year: Cashew nuts (50–60 %)[4], cassava, mangoes, pawpaws, senna

Poor yield potential
2nd rains, start norm. end of O./b. of N.: V. e. mat. dwarf sorghum; green grams, cowpeas, sweet potatoes[9]; dwarf sunflower
Whole year: Coconuts, orange, lemons

Pasture and forage
About 1.5–2 ha/LU on cleared woodland (clearing necessary because of tsetse fly); down to about 0.3 ha/LU feeding Bana grass, centro, butterfly pea (Clitoria ternatea), Macrotyloma, and planting horse tamarind and saltbush (Atriplex nummularia)

L 4 = *Cashewnut-Cassava Zone*
m/s i *with a medium to short cropping season followed by intermediate rains*

Potential in 1st rains and whole year almost as L 4 m/s i (vs) but Pioneer Hybrid maize, sunflower 252, cashew nuts and cassava better (nearly 60 %), 2nd rains nothing. Stocking rates about 10 % lower; drought stress may be too high for butterfly peas

L 4 = *Cashewnut-Cassava Zone*
m/s + i *with a medium to short cropping season and intermediate rains*

Potential almost as L 4 m/s i but cowpeas and simsim planted towards the end of 1st rains average only poor yields

L 4 = *Cashewnut-Cassava Zone*
s/m i (vs) *with a short to medium cropping season, intermediate rains, and a (weak) very short one*

Good yield potential
1st rains, start indistinctly b. of April: E. mat. sorghum, e. mat. bulrush millet (awned variety); green grams, cowpeas[1] and simsim[1] (both good to fair yields)
Whole year: Perennial castor, sisal

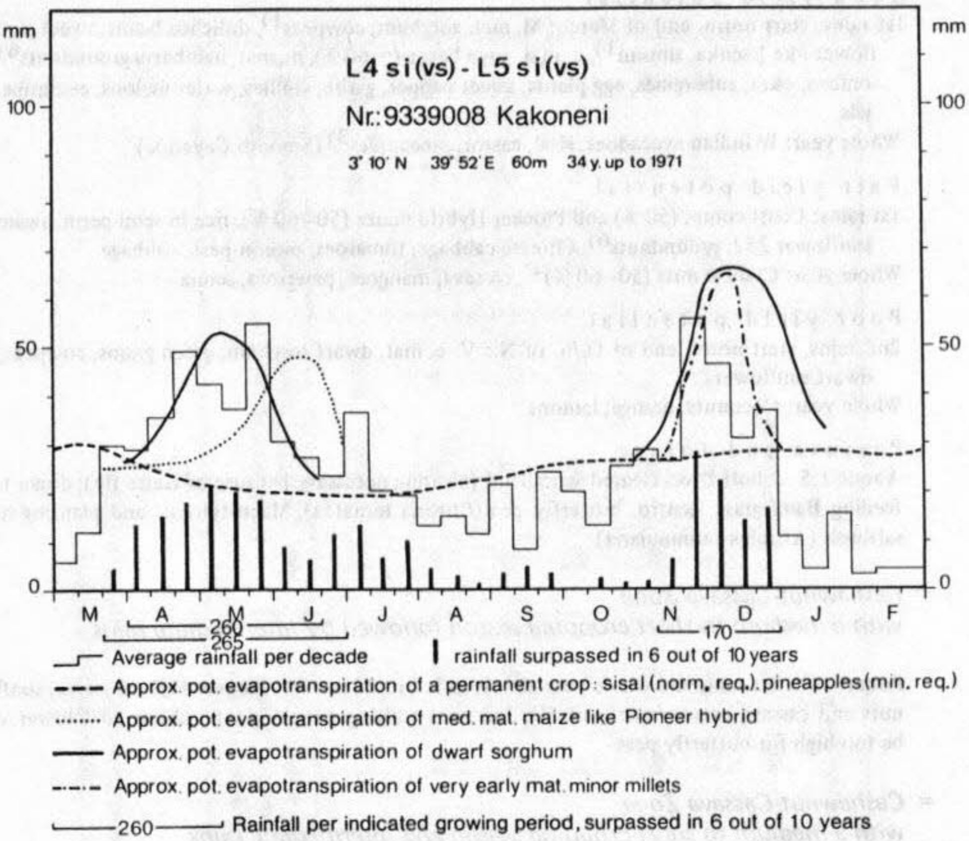
Fair yield potential
1st rains: Pioneer Hybrid maize; black grams; e. mat. bambarra groundnuts, groundnuts; sweet potatoes; sunflower Issanka, e. mat. soya beans (on h. and m. soils); kales, cabbage, onions, tomatoes, chillies, brinjals, okra, green and red sweet pepper (Yolo wonder, Bullnose), aubergines, garlic, water melons, cucumbers, pumpkins
2nd rains, start indistinctly Oct.: V. e. mat. dwarf sorghum, e. mat. millets (both grain crops have fair to poor average yields); green grams (~ 40 %), chick peas (on h. soils), cowpeas for spinach
Whole year: E. mat. cassava like stroke 27 and 156, cashew nuts, mangoes, pineapples[3]

Pasture and forage
Around 2 ha/LU on woodland (partly tsetse if not cleared enough); feeding Bana grass, centro, butterfly pea, and planting horse tamrind for browsing down to about 0.3 ha/LU

L 4 = *Cashewnut-Cassava Zone*
s i (vs) *with a short cropping season, intermediate rains, and a (weak) very short one*

(See Diagram Kakoneni)

Good yield potential
1st rains, start norm. m. April: E. mat. sorghum, e. mat. bulrush millet (awned var.); cowpeas[1], green grams, simsim (J./Jy.–A./S.,~ 60 %), e. mat. sunflower like Issanka; e. mat. soya beans on h. and m. soils; chillies (Long Red Cayenne)
Whole year: Mangoes, castor, sisal (~ 60 %)



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

1st rains: Coast composite or local maize, finger millet; dolichos beans; sweet potatoes; groundnuts and bambarra groundnuts; kales, onions, tomatoes, red and green pepper, cabbage, brinjals, okra

2nd rains, start indistinctly m. Oct.: E. mat. foxtail millet; green grams and simsim (fair to poor), cowpeas for spinach

Whole year: Cashewnuts, drought resistant cassava (like Kibandameno, stroke 27 or 156), pawpaws, pineapples[3)]

S o m e m a r g i n a l c r o p s w i t h p o o r y i e l d p o t e n t i a l

2nd rains: Coast comp. maize, local maize, sweet potatoes[9)]

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

More than 2 ha/LU on woodland; feeding Bana grass and legumes like siratro down to about 0.35 ha/LU (m. soils on free draining land) and planting horse tamarinds (also on mbuga edges). Tsetse flies near rivers or thickets

L 5 = *L o w l a n d L i v e s t o c k - M i l l e t Z o n e*

L 5 s/m i + i = *Lowland Livestock-Millet Zone with a short to medium cropping season, intermediate rains, and a 2nd season with interm. rains*

Small, potential almost as L 4 m/s i less about 10 %, but cashew nuts marginal

L 5 s/m + i = *Lowland Livestock-Millet Zone with a short to medium cropping season, and a second season with intermediate rains*

Small areas, potential almost as L 4 m/s + i less about 10 %, but cashew nuts very marginal, cowpeas and simsim (planted towards the end of 1st rains) too

L 5 s i (vs) = *Lowland Livestock-Millet Zone with a short cropping season, intermediate rains, and a (weak) very short one*

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

1st rains, start around b. of April: E. mat sorghum (60–70 %), e. mat bulrush millet (awned variety); green grams; luffa gourds

Whole year: Buffalo gourds (on sandy soils)[10)], Marama beans[10)], Opuntia var. without prickles (fruit and vegetable, also fodder)

L 5 (s/vs) + (vs) = *Lowland Livestock-Millet Zone with a (weak) short to very short cropping season and a (weak) very short one*

(See Diagram Baricho)

Good yield potential
Whole year, best planting time mid April: Buffalo gourds (on sandy soils)[10], Marama beans[10]

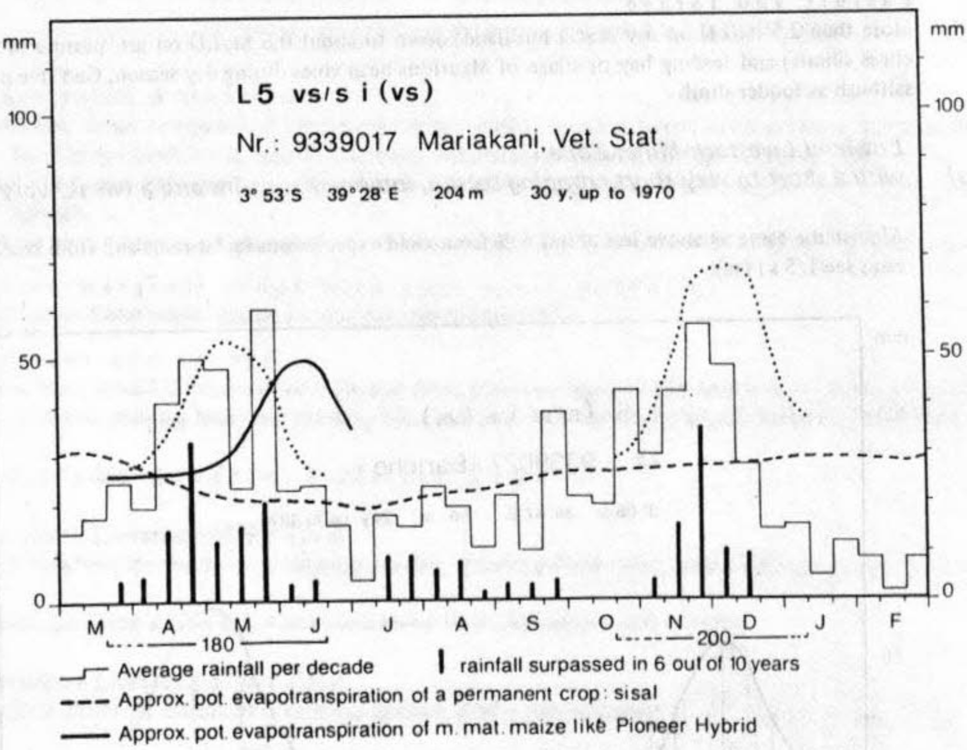
Fair yield potential
1st rains, start norm. b. of April: E. mat. dwarf sorghum (50–60 %), e. mat. bulrush millet (awned var.); chick peas (on h. soils), cowpeas, green and black grams (May–Aug.), e. mat. bambarra groundnuts; e. mat. sunflower like Issanka, e. mat. soya beans, onions
2nd rains, start norm. end of Oct.: Cowpeas for spinach, green grams
Whole year: Sisal, drought resistant cassava like stroke 27 or 156 (fair to poor), castor

Poor yield potential
1st rains: E. mat. maize like Coast composite
2nd rains: E. mat. bulrush millet (awned var.), v. e. mat. dwarf sorghum (half plant pop. density recommended)
Whole year: Mangoes

Pasture and forage
Around 4 ha/LU on sclerophytic evergreen bushland (partly tsetse infested), around 2 ha/LU in mbugas; down to about 0.6 ha/LU on Buffel grass pastures and feeding vines of Mauritius or Marama beans, and planting saltbush and Mesquite as fodder shrubs

L 5 s/vs i = *Lowland Livestock-Millet Zone with a short to very short cropping season followed by intermediate rains*

Potential almost as L 5 s i less about 5–10 % in yields and 10–20 % in stocking rates



L 5 vs/s i (vs) = *Lowland Livestock-Millet Zone with a very short to short cropping season, intermediate rains, and a (weak) very short one*

(See Diagram Mariakani)

Good yield potential
1st rains, start indistinctly around b. of April: E. mat dwarf sorghum (good to fair), e. mat. bulrush millet (awned var., ~ 60 %); luffa gourds
Whole year: Buffalo gourds (on light soils)[10], Marama beans[10]

Fair yield potential
1st rains: Black and green grams, cowpeas, chick peas (late planted on h. bl. soils); e. mat. sunflower, e. mat. soya beans, e. mat. bambarra groundnuts
Whole year: Sisal, drought resistant cassava (fair to poor), castor

Poor yield potential
2nd rains, start norm. end of O.: V. e. mat. dwarf sorghum, e. mat. bulrush millet; green grams

Pasture and forage
Almost as s i (vs) less about 10 %

L 5 = Lowland Livestock-Millet Zone
(vs/s)+(vs) with a (weak) very short to short cropping season and a (weak) very short one

Potential almost the same as above less about 10 % in first rains, sorghum only 5 %

L 5 = Lowland Livestock-Millet Zone
(vs/s) i with a (weak) very short to short cropping season followed by intermediate rains

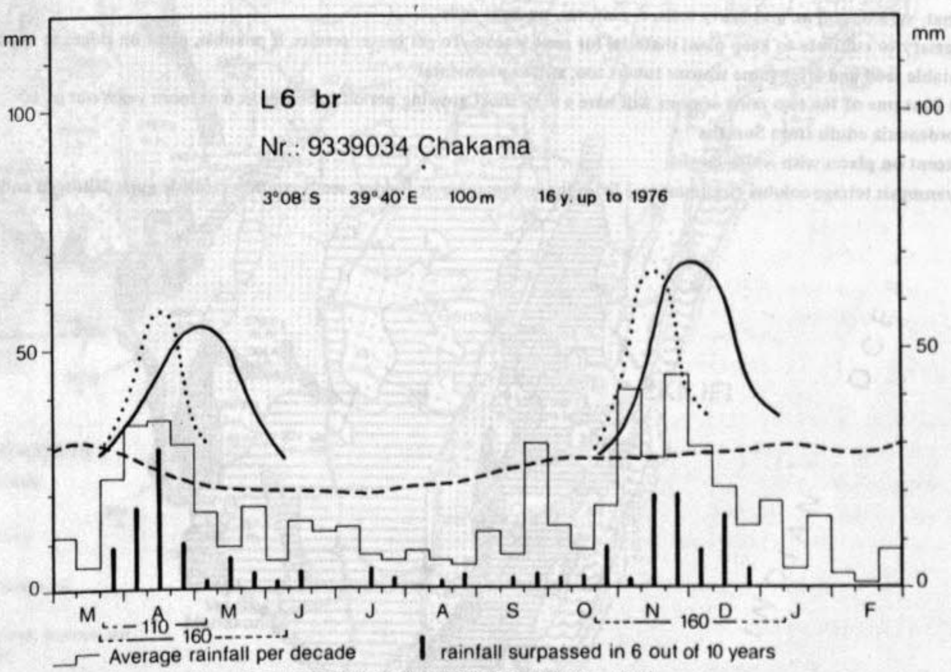
Small and unimportant. Potential see Tana District

L 5 = Lowland Livestock-Millet Zone
(vs) + i with a (weak) very short cropping season and intermediate rains
or i + (vs) or vice versa[11]

Fair to poor yield potential
1st or 2nd rains[10]: V. e. mat. dwarf sorghum, v. e. mat. foxtail millet, e. mat. bulrush millet; cowpeas, green and black grams, v. e. mat. bambarra groundnuts; dwarf sunflower
Whole year: Buffalo gourds (on light soils)[10], Marama beans[10], sisal, castor, ye-eb nuts[12]

Poor yield potential
Whole year: Cassava

Pasture and forage
Small-leaved bushland predominating, about 3–4 ha/LU; stocking rates better if there are planted Gao trees on good soils for pods, Mesquite and saltbush on most places[13] for add. browsing



L 5 = *Lowland Livestock-Millet Zone*
(vs) + i *with a (weak) very short cropping season and intermediate rains*

Fair to poor yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail millet (40–50 %)
Whole year: Buffalo gourds (on light soils)[10], Marama beans[10], ye-eb nuts, sisal

Poor yield potential
1st rains: E. mat. bulrush millet, v. e. mat. dwarf sorghum; green grams

Pasture and forage
3–5 ha/LU on small-leaved bushland; situation improvable by Gao trees on good soils for pods, Mesquite and saltbush possible to plant on all free-draining places for add. browsing

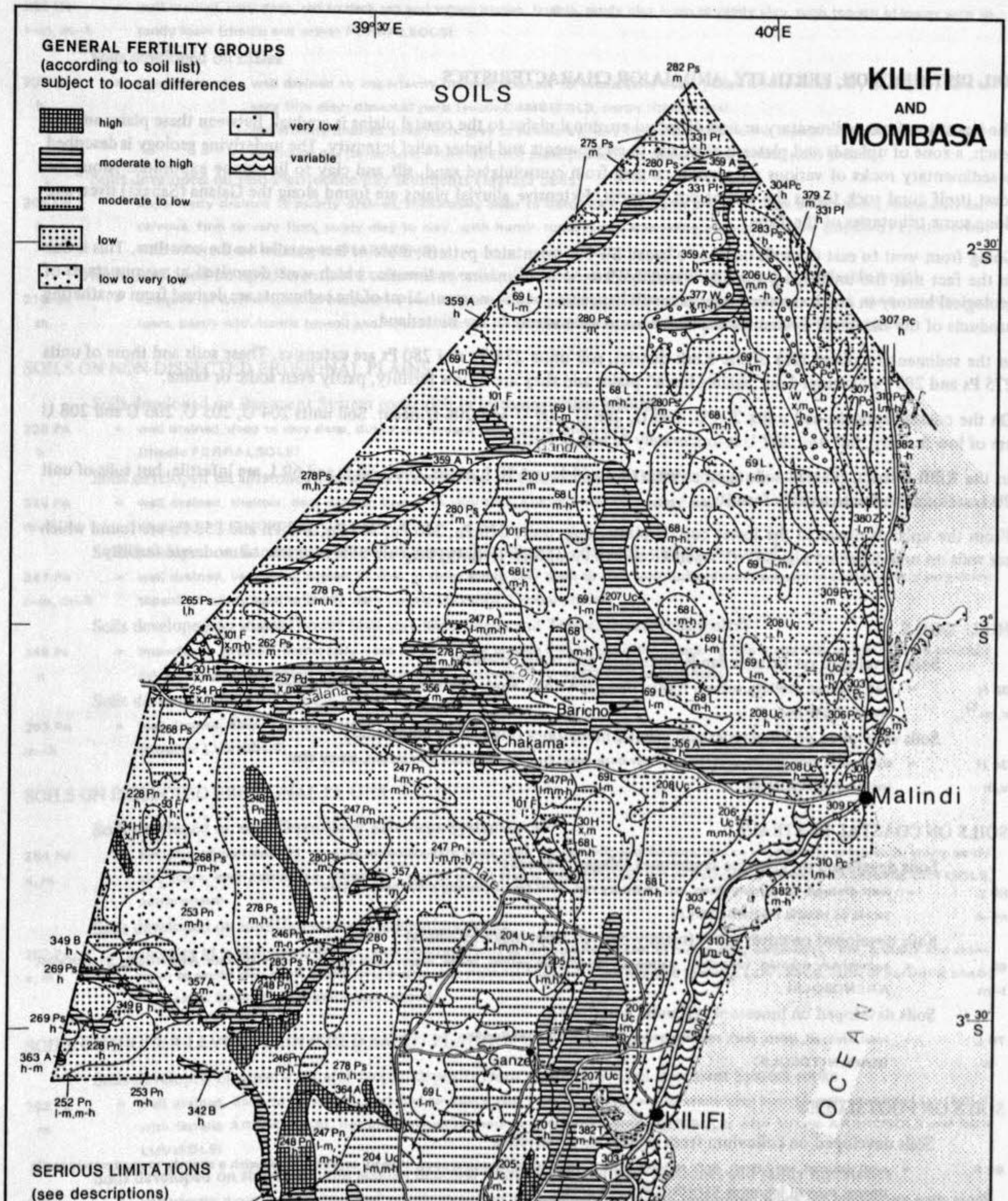
L 6 = *Lowland Ranching Zone*

L 6 = *Lowland Ranching Zone*
b r *with bimodal rainfall*

(See Diagram Chakama)

No rainfed crops average better than poor results except buffalo gourds, Marama beans and ye-eb nuts. Cattle, sheep and goats on undestroyed short grass savanna mixed with small leaved bushland need more than 5 ha/LU; saltbush and Mesquite to plant for add. browsing, especially in dry years. Gao trees (Acacia albida) for pods on good (alluvial) soils

1) Crops in the intermediate rain are interplanted or relay-planted already at the end of the first rains
2) Only fair results on light soils
3) No top qualities
4) Danger of spoiled nuts by second rains
5) Ref.: FOX, J.W. and CUMBERLAND, K.B. (1962): Western Samoa. Christchurch, New Zealand
6) Not on heavy soils
7) Gives reasonable yields also on poor soils
8) M. mat. varieties on m. and heavy soils, e. mat. var. on light soils
9) Necessary to cultivate to keep plant material for next season. To get better results, if possible, plant on ridges in swampy places
10) Eatable seed and after some seasons tubers too, still experimental
11) At least one of the two rainy seasons will have a very short growing period for crops in 6 or more years out of 10
12) Cordeauxia edulis from Somalia
13) Except on places with water-logging
14) Cyamopsis tetragonolobia (leguminosae) from India; vegetable or fodder, seeds contain valuable gum. Nitrogen collector


KILIFI
AND
MOMBASA
SOILS
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
high
moderate to high
moderate to low
low
low to very low
very low
variable
SERIOUS LIMITATIONS
(see descriptions)
Shallow soil
Sodic or saline soil
Waterlogging, Swamps and Mangrove
39°30' E
40° E
2°30' S
3° S
3°30' S
4° S
Malindi
Baricho
Chakama
Galana
Ganze
KILIFI
Chonyi
Kaloleni
Mariakani
MOMBASA
INDIAN OCEAN
0
10
20
30
40 km
Soils KSS
Fert. L. Hirscher

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

The transition from sedimentary or non-dissected erosional plains to the coastal plains is gradual. Between these plains and the beach, a zone of uplands and plateaus gives rise to escarpments and higher relief intensity. The underlying geology is described as sedimentary rocks of various properties, ranging from consolidated sand, silt and clay to limestone exposures. Along the coast itself coral rock forms the soil parent material. Extensive alluvial plains are found along the Galana (Sabaki) river, and along some tributaries of the Tana.

Going from west to east the soils occur in a broad SW-NE orientated pattern, more or less parallel to the coastline. This is due to the fact that the underlying geology is mainly derived from marine sediments, which were deposited at various stages of geological history in much the same way as is still happening at the moment. Most of the sediments are derived from weathering products of the Basement System rocks, which occur extensively in the hinterland.

In the sedimentary plains (Ps) of the Kilifi district, soil units 278 Ps and 280 Ps are extensive. These soils and those of units 275 Ps and 283 Ps developed on "sealing loam" plains and they are of low fertility, partly even sodic or saline.

On the coastal uplands, soil units 204 U, 205 U, 206 U, 207 U and 208 U occur. Soil units 204 U, 205 U, 206 U and 208 U are of low fertility, but unit 207 U is moderately to highly fertile.

In the Kilifi district, plateau soils such as units 68 L, 69 L and 70 L occur. Units 68 L and 69 L are infertile, but soils of unit 70 L are of a moderate to high fertility.

From the uplands down to the lower coastal plains, map units 228 Pn, 246 Pn, 247 Pn, 248 Pn and 253 Pn are found which are soils on non-dissected plains (Pn). Apart from 248 Pn of high fertility, they are of low or low to moderate fertility.

HILL SOILS

Soils developed on Jurassic sandstones, grits and conglomerates

30 H = well drained, shallow, brown, friable, rocky and stony, sandy clay loam (on hills and plateau rests)
x, m[1] (eutric REGOSOLS)

Soils developed on limestones and calcitic mudstones (crystalline limestones)

34 H = somewhat excessively drained, shallow dark grey, firm, moderately calcareous, stony clay
x, h (orthic RENDZINAS)

SOILS ON COASTAL PLATEAUS

Soils developed on Pliocene sandstones (Magarini sands)

68 L = well drained, extremely deep, red to dusky red, very friable, sandy clay loam to clay
m–h (acric to rhodic FERRALSOLS)

Soils developed on cover sands (mainly derived from Magarini sands)

69 L = excessively drained, very deep, yellowish red to pale yellow, loose, loamy sand to sandy loam (ferralic ARENOSOLS; with albic
l–m ARENOSOLS)

Soils developed on limestones (Kambe limestone)

70 L = well drained, deep, dark reddish brown, friable, fine sandy clay
h (eutric NITOSOLS)

SOILS ON FOOTSLOPES

Soils developed on colluvium from crystalline limestones

93 F = well drained, very deep, dark reddish brown, firm, slightly calcareous, slightly cracking clay, with a slightly to moderately sodic
h deeper subsoil (chromic LUVISOLS, sodic phase)

Soils developed on colluvium from sandstones, grits and conglomerates (Taru, Mazeras)

101 F = excessively drained, very deep, reddish yellow, loose, sand to loamy sand (luvic ARENOSOLS; with ferralic and albic ARENO-
l SOLS)

SOILS ON COASTAL UPLANDS

Soils developed on fine sandstones and siltstones (Mariakani sandstone and Upper Maji-ya-Chumvi beds)

204 Uc = well drained, deep, dark brown to yellowish brown, firm, very fine sandy clay loam to clay, with topsoil of loamy very fine
l, m, h sand to very fine sandy loam; in places with abrupt transition and sodic deeper subsoil (orthic LUVISOLS; with solodic PLA-
NOSOLS)

202 Uc = well drained, shallow, dark brown to dark yellowish brown, fairly stony, fairly rocky, fine sandy clay loam to clay (eutric
x, m–h CAMBISOLS, lithic phase; with orthic LUVISOLS)

Soils developed on coarse sandstones and grits (Mazeras sandstone and Shimba grit)

205 Uc = complex of: - well drained to imperfectly drained, very deep, dark red to dark greyish brown, friable to firm, sandy clay to
l, m, h clay, with topsoil of loamy sand to sandy loam (ferralo-chromic/orthic ACRISOLS; with gleyic LUVISOLS)
- excessively drained to imperfectly drained, very deep, red to light yellowish brown, loose, sand to loamy sand
(ferralic to luvic ARENOSOLS)

206 Uc l–m, m–h = well drained, very deep, red to dark red and strong brown, friable, sandy clay loam to sandy clay, with topsoil of loamy sand to sandy loam (rhodic and orthic FERRALSOLS)

Soils developed on shales

207 Uc h = association of: - well drained to imperfectly drained, shallow to moderately deep, yellowish brown to very dark grey, firm to very firm clay: dissected parts (eutric CAMBISOLS, partly lithic phase)
- imperfectly drained, deep, dark grey to olive grey, very firm clay, with humic topsoil and sodic deeper subsoil; or interfluves (verto-luvic PHAEOZEMS, sodic phase; with vertic CAMBISOLS, sodic phase)

Soils developed on Plio-Pleistocene bay sediments (Marafa beds)

208 Uc h = imperfectly drained to poorly drained, moderately deep to deep, dark yellowish brown to light olive brown, moderately calcareous, firm to very firm, sandy clay to clay, with humic topsoil; in places saline and sodic (mollic SOLONETZ; with orthic RENDZINAS and verto-luvic PHAEOZEMS)

Soils developed on undifferentiated sedimentary rocks (Mazeras and Mariakani sandstones and Marafa beds)

210 Uc m = complex of well drained to moderately well drained, moderately deep, reddish brown, friable to very firm, sandy loam to clay loam; partly with humic topsoil and/or sodic subsoil (undifferentiated LUVISOLS; with verto-luvic PHAEOZEMS)

SOILS ON NON-DISSECTED EROSIONAL PLAINS

Soils developed on Basement System rocks rich in ferromagnesian minerals

228 Pn h = well drained, deep to very deep, dusky red to dark red, friable sandy clay (rhodic FERRALSOLS)

Soils developed on siltstones and shales (Lower Maji-ya-Chumvi beds), slightly dissected

246 Pn m–h = well drained, shallow, dark reddish brown to very dark brown, firm, fine sandy clay loam to clay (eutric CAMBISOLS, lithic phase; with LITHOSOLS)

Soils developed on fine sandstones and siltstones (Mariakani sandstone), slightly dissected

247 Pn l–m, m–h = well drained, very deep, brown, friable to firm, sandy clay loam to clay, with sodic deeper subsoil; in places with a very thick topsoil of loamy sand to sandy loam (orthic LUVISOLS, sodic phase)

Soils developed on shales (Lower Maji-ya-Chumvi beds and Taru carbonaceous shales)

248 Ps h = imperfectly drained, moderately deep to deep, dark greyish brown, very firm, cracking fine sandy clay to clay; with a strongly calcareous and moderately sodic deeper subsoil (verto-luvic PHAEOZEMS, sodic phase)

Soils developed on gritty sandstones

253 Pn m–h = well drained, deep, red, firm, sandy clay loam to clay (chromic LUVISOLS)

SOILS ON DISSECTED EROSIONAL PLAINS

Soils developed on undifferentiated Basement System rocks

254 Pd x, m = complex of well drained, shallow to moderately deep, dark red to yellowish brown, non to moderately calcareous, stony sandy clay loam, over petrocalcic material or quartz gravel (calcic CAMBISOLS, lith or petrocalcic phase; with chromic LUVISOLS, petric phase)

Soils developed on undifferentiated sedimentary rocks

257 Pd x, m = complex of well drained, shallow, dark reddish brown to strong brown, non to moderately calcareous, firm, gravelly and stony loam to sandy clay loam, partly over petrocalcic material (chromic CAMBISOLS to orthic LUVISOLS, lithic or paralithic phase; with calcic CAMBISOLS, petrocalcic phase)

SOILS ON HIGHER-LEVEL PLAIN ("RED SAND" PLAIN)

Soils developed on sheetwash and aeolian deposits from undifferentiated Basement System rocks

262 Ps m = well drained, deep to very deep, dark red to dusky red, friable, sandy loam to sandy clay loam (ferralo-chromic LUVISOLS; with ferralic ARENOSOLS), but predominantly more acid ferralochromic ACRISOLS; with ferralic ARENOSOLS and ferric LUVISOLS)

Soils developed on sheetwash and aeolian deposits from fine sandstones, siltstones and sandy limestones

265 Ps l, h = imperfectly drained, very deep, red to reddish brown, firm, slightly calcareous, moderately saline and moderately sodic sandy clay, abruptly underlying a topsoil of loamy sand (mainly on sediments from Mariakani sandstone?) (solodic PLANOSOLS and luvo-orthic SOLONETZ, saline phase)

SOILS ON MIDDLE-LEVEL PLAINS, "ENCLOSED" PLAINS

Soils developed on sediments from Basement System rocks rich in ferromagnesian minerals

268 Ps m–h = well drained, very deep, dark reddish brown to dark red, friable to firm sandy clay; in places moderately calcareous (on sheetwash and lacustrine sediments) (chromic LUVISOLS; with calcic LUVISOLS)

Soils developed on sheetwash sediments from Taru grits and coarse to fine-grained sandstone

269 Ps h = moderately well drained, deep, dark reddish brown, firm, slightly calcareous, sandy clay to clay, over pisocalcic material (calcic LUVISOLS, pisocalcic phase)

SOILS ON "SEALING LOAM" PLAIN

Soils developed on Plio-Pleistocene bay sediments (Marafa beds), (little or not remodelled; flat surface, dot pattern)

275 Ps m = imperfectly drained, moderately deep, brown, extremely firm, moderately calcareous, non-saline but moderately sodic clay loam (hardpan), with a thin topsoil of sealing sandy loam (luvo-orthic SOLONETZ)

278 Ps m, h = imperfectly to poorly drained, deep, greyish brown, extremely firm, slightly calcareous, moderately sodic and moderately saline, slightly cracking clay, with a very thin topsoil of sandy clay loam (gleyic SOLONETZ, saline phase)

Soils developed on sheetwash sediments from Plio-Pleistocene bay sediments (Marafa beds)

280 Ps m = imperfectly drained, deep, brown, extremely firm, slightly calcareous, non saline but slightly sodic, clay loam (hardpan), abruptly underlying a thick topsoil of sealing sandy loam (gently sloping parallel drainage) (solodic PLANOSOLS)

Soils developed on remodelled Plio-Pleistocene bay sediments (Marafa beds)

282 Ps m = imperfectly drained, deep, brown, very firm, moderately calcareous, moderately saline and moderately sodic clay loam (hardpan), with a thin topsoil of strongly sealing sandy clay loam (luvo-orthic SOLONETZ, saline phase)

283 Ps h = imperfectly drained to poorly drained, very deep, dark greyish brown, very firm, slightly calcareous, moderately to strongly saline and predominantly strongly sodic clay (hardpan); in places strongly calcareous and/or gypsic (orthic SOLONETZ, saline phase and gypsic/calcic phase)

SOILS ON COASTAL PLAINS

Soils developed on higher-level lagoonal deposits (Kilindini sands)

303 Pc l = excessively drained to well drained, very deep, reddish yellow to white, loose, sand to loamy sand (albic and ferralic ARENOSOLS)

304 Pc h = imperfectly drained, deep to very deep, very dark greyish brown to olive brown, mottled, firm to very firm, sandy clay to clay; moderately calcareous and moderately saline/sodic throughout or in deeper subsoil (ortho-luvic SOLONETZ and vertic LUVISOLS, saline-sodic phase)

Soils developed on lower-level lagoonal deposits (Kilindini sands)

306 Pc v = complex of very deep soils of varying drainage condition, colour, consistence, texture and salinity (albic ARENOSOLS, orthic FERRALSOLS, gleyic LUVISOLS, solodic PLANOSOLS, pellic VERTISOLS)

307 Pc h = imperfectly to poorly drained, very deep, grey to brown, mottled, very firm clay (hardpan) slightly calcareous and strongly saline and sodic throughout or in deeper subsoil (gleyic SOLONETZ; with gleyic or verto-luvic PHAEOZEMS, saline-sodic phase)

Soils developed on acolian deposits (remarked) (lagoonal deposits)

309 Pc m = well drained, very deep, yellowish red, very friable, fine sandy loam to fine sandy clay loam (orthic FERRALSOLS)

Soils developed on raised-coral-reef limestone, with admixture of lagoonal deposits

310 Pc l, m–h = well drained, deep, dark red to reddish brown, friable, sandy clay loam to sandy clay, with a topsoil of loamy sand (rhodic FERRALSOLS)

312 Pc x, m–h = well drained, shallow, dark brown to dark reddish brown, rocky, sandy clay loam to sandy clay (LITHOSOLS; with ferralic CAMBISOLS, lithic phase)

SOILS ON OLDER FANS

Soils developed on sediments mainly derived from bay sediments

331 Pf l = complex of well drained to imperfectly drained, very deep, reddish brown to grey, firm clay soils of varying calcareousness, salinity and sodicity, in many places with strongly scaling topsoil; with inclusions of well drained, very deep, brown, loose loamy sand (levee complex) (luvo-orthic SOLONETZ, saline phase, chromic VERTISOLS, saline-sodic phase and cambic ARENOSOLS)

SOILS ON BOTTOM LANDS

Soils developed on infill from Taru sandstones

342 B h = imperfectly drained to poorly drained, very deep, dark brown to dark grey, firm to very firm, sodic clay, with a calcareous and saline deeper subsoil (luvo-orthic SOLONCHAKS)

Soils developed on infill mainly from undifferentiated Basement System rocks

349 B h = imperfectly drained to poorly drained, very deep, brown to dark brown, very firm, slightly calcareous, strongly sodic clay (orthic SOLONETZ)

SOILS ON FLOODPLAINS

Soils developed on sediments mainly from crystalline Basement System rocks

356 A m = well drained to imperfectly drained, very deep, brown to dark brown, friable, slightly calcareous, micaceous, sandy loam to clay loam; in places with a saline-sodic deeper subsoil (eutric FLUVISOLS)

Soils developed on sediments from various sources (recent floodplains)

357 A x, m = well drained to imperfectly drained, very deep, dark brown to yellowish brown, stratified, strongly calcareous, micaceous, predominantly loamy soils (calcaric FLUVISOLS)

359 A h	=	imperfectly drained to poorly drained, very deep, dark reddish brown to dark greyish brown, firm to very firm, cracking clay; in many places mottled and with a calcareous, saline and sodic deeper subsoil (chromic VERTISOLS, saline-sodic phase)
364 A h	=	poorly drained, very deep, very dark grey, very firm, moderately calcareous, slightly saline and slightly to moderately sodic, cracking clay (pellic VERTISOLS, saline-sodic phase)

DUNES

373 D l	=	excessively drained, very deep, brown to pale brown, loose, sand to loamy sand (cambic ARENOSOLS)

SOILS ON BADLANDS

Badlands developed on Plio-Pleistocene bay sediments (Marafa beds)

377 W x, m–h	=	excessively drained, brown, very firm, strongly sodic, gravelly clay loam to sandy clay of varying depth; strongly eroding and strongly sealed (SOLONETZ, undifferentiated)

SOILS ON COASTAL BEACH RIDGES

Soils developed on older coastal beach ridges

379 Z m	=	well drained, very deep, red, very friable, sandy clay loam (rhodic FERRALSOLS)

Soils developed on younger coastal beach ridges often covering coral rock

380 Z l, m	=	moderately well drained, very deep, dark brown to reddish brown, firm to very firm, often moderately sodic, sandy clay loam, underlying a thick topsoil of friable loamy sand, in places shallow over coral rock (ferralo-chromic/orthic ACRISOLS, sodic phase; with solodic PLANOSOLS)

MANGROVE SWAMPS

382 T m–h	=	very poorly drained, very deep, olive to greenish grey, soft (unripe), excessively saline and moderately to strongly sodic, loam to clay, often with sulfidic material (thionic FLUVISOLS and gleyic solonchaks)

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. Expl. Soil Survey Rep. E1, Nairobi 1982. See this map also for colours; symbols simplified here.

POPULATION AND LAND

At the time of the population census in September 1979, 430,986 people (Table 5) lived in Kilifi District, which is the most densely populated district of the coast. As only 9.17 % of the total population lived in the 3 townships and 4 trading centres (altogether 39,509 people), more than 90 % of the population depended mainly on agriculture and livestock.

Of a total rural area of 1,196,400 ha (Table 7) 426,200 ha have to be subtracted, as they belong to the Galana Game Scheme and a few Forest Reserves (818 sq km), so that all in all 711,300 ha remain as agricultural land (= 59.45 % of the total rural area, Table 7). The statistics show that 10.43 ha (Table 7) were available per average household of 5.59 people (Table 6), i.e. 1.81 ha per person. This average is not very significant because in Kilifi the agro-ecological zonation ranges from L 3 (Coconut-Cassava Zone) to L 6 (Lowland Ranching Zone). The most densely populated zones, L 3 and L 4, form the smaller part of the district (254,100 ha = 35.7 % of the total agricultural land). About 40–50 km inland towards the west/northwest, zone L 6 begins.

With regard to the various locations, it should be mentioned that the situation in the Jibana location (Southern Division) is most critical. Although nearly 70 % of the agricultural land there is allotted to L 5 (Lowland Livestock-Millet Zone), only 1.87 ha is available per household (Table 7); in L 5, at least 5.0 ha are needed for livestock per family. The situation in Rabai location is also critical (1.72 ha per household) where only about 25 % of the agricultural land can be distributed to L 3 (Coconut-Cassava Zone). Nearly the same density is true for Mtwapa location (1.91 ha per household), although here 77 % of the agricultural land belongs to zone L 3.

In order to give any advice for the future, it has to be said that e.g. a settlement may be possible in the Adu location (in 1979, statistically available – 140.88 ha per household, mainly L 5 and L 6), but unfortunately mostly worse subzones of L 5 occur here. For this reason the above-mentioned step can only be realised if new varieties of crops, plus dry farming and runoff-catching techniques are introduced. Successful farming is impossible at the presently available level of technology.

KILIFI DISTRICT

TABLE 5: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Kaloleni	9 002	10 919	19 921	2 384	111	178
Kayagungo	10 001	12 561	22 562	2 409	277	81
Mariakani	8 816	9 784	18 600	3 216	203	91
Chonyi South	6 979	8 488	15 467	2 542	96	159
Chonyi North	6 966	8 350	15 316	2 111	106	143
Rabai	9 924	11 063	20 987	3 432	72	290
Ruruma	8 765	10 319	19 084	2 470	84	226
Kambe/Ribe	4 864	5 320	10 184	1 592	69	146
Jibana	4 510	4 913	9 423	1 552	35	262
Southern Division	69 827	81 717	151 544	21 708	1 057	143
Bamba	11 800	14 307	26 107	5 724	1 724	15
Kauma	4 523	5 046	9 569	867	171	55
Ganze	4 824	6 026	10 850	1 668	217	49
Vitengeni	5 739	6 609	12 348	2 608	637	19
Sokoke	3 047	3 516	6 563	877	166	39
Northern Division	29 933	35 504	65 437	1 744	2 917	22
Tezo Roka	17 027	18 934	35 961	7 442	284	126
Mavueni Makaungu	6 811	6 994	13 805	2 947	125	110
Junju	6 404	6 349	12 753	2 896	119	107
Mtwapa	8 324	8 215	16 539	3 411	79	207
Central Division	41 575	43 349	84 924	18 404	615	138
Chakama	1 666	1 233	2 899	667	2 985	0
Magarini	15 838	17 316	33 154	6 258	532	62
Jilore/Madunguni	4 621	4 845	9 466	1 975	282	33
Gede	8 604	8 533	17 137	2 700	102	167
Bungale/Baricho	2 453	2 301	4 754	922	557	8
Ganda	23 161	22 213	45 374	9 349	167	270
Garashi	3 574	4 154	7 728	1 389	174	44
Adu	1 757	1 941	3 698	685	2 468	1
Marafa	2 351	2 520	4 871	940	143	34
Malindi Division	64 025	65 056	129 081	24 885	7 414	17
Kilifi District	205 360	225 626	430 986	76 741	12 414	34

KILIFI DISTRICT

TABLE 6: 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:						
Kaloleni	2372	3.58	1.39	2.85	0.52	8.30
Kayagungo	2406	3.79	1.42	3.76	0.41	9.38
Mariakani	3208	3.05	0.97	1.26	0.51	5.78
Chonyi South	2548	3.46	1.57	0.60	0.43	6.07
Chonyi North	2115	3.59	1.72	1.49	0.44	7.24
Rabai	3428	3.29	1.17	1.48	0.23	6.12
Ruruma	2467	3.64	1.37	2.53	0.20	7.73
Kambe/Ribe	1589	3.38	1.35	1.33	0.31	6.41
Jibana	1544	3.12	1.73	0.92	0.33	6.10
Division: Southern	21677	3.44	1.35	1.81	0.38	6.98
Location:						
Bamba	5705	2.87	0.89	0.62	0.19	4.57
Kauma	860	3.84	1.62	4.66	0.92	11.04
Ganze	1670	3.55	1.25	1.51	0.19	6.50
Vitengeni	2690	3.01	1.04	0.32	0.24	4.59
Sokoke	878	3.17	1.17	2.08	1.05	7.47
Division: Northern	11722	3.09	1.07	1.09	0.32	5.57
Location:						
Tezo Roka	7405	2.73	0.91	0.78	0.36	4.77
Kilifi Township	1699	1.86	0.43	0.51	0.47	3.32
Mavueni Takaungu	2945	2.64	0.78	0.85	0.39	4.66
Junju	2901	2.64	0.85	0.52	0.39	4.40
Mtwapa	3401	2.80	0.87	0.70	0.42	4.79
Division: Central	18351	2.64	0.83	0.71	0.39	4.56
Location:						
Chakama	666	2.67	0.49	0.44	0.74	4.35
Magarini	6247	3.21	1.07	0.78	0.25	5.36
Jilore/Madunguni	1980	2.79	0.77	0.92	0.30	4.78
Gede	2676	3.29	1.15	1.34	0.52	6.31
Bungale/Baricho	922	3.25	0.92	0.83	0.16	5.16
Gada	9283	2.77	0.76	0.88	0.37	4.78
Garashi	1388	3.31	0.99	0.87	0.36	5.53
Adu	688	3.31	1.29	0.44	0.33	5.37
Maraga	946	3.18	1.08	0.64	0.25	5.15
Division: Malindi	24796	3.02	0.91	0.87	0.34	5.15
DISTRICT: KILIFI	76546	3.05	1.05	1.13	0.36	5.59

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, include one and two persons per household as well.

KILIFI DISTRICT

TABLE 7: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON 1)

Location/Division without townships	in '00 ha = sqkm: Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, homesteads, rivers...)	Agricultural land	in '00 ha = sqkm: Area in agro-ecological zones AEZ: L 3	L 3–4	L 4	L 5	L 6 2)	in ha: Agric. land per household	per person
Kaloleni	111			13	98	58		40			4.11	0.49
Kayafungo	277			14	263	5		169	89		10.92	1.17
Mariakani	203			18	185			14	133	38	4.88	0.84
Chonyi South Chonyi North	202	24		21	157	38		102	17		3.37	0.51
Rabai	72	3		10	59	14		45			1.72	0.28
Rumuma	84	6		11	67	29		29	9		2.71	0.35
Rambe/Ribe	69	4		8	57	16		21	20		3.58	0.56
Jibana	35	3		3	29			9	20		1.87	0.31
Southern Division	1 035	40		98	915	160		429	288	38	4.22	0.60
Bamba	1 724		252 3)	70	1 402			54	482	866	24.49	5.37
Kauma	171	15		11	145	12		106	27		16.72	1.52
Ganze	217			15	202			160	42		12.11	1.86
Vitengeni	637	18		6	613	18		192	283	120	23.50	4.96
Sokoke	166	10		2	154				81	73	17.56	2.35
Northern Division	2 915	43	252 3)	104	2 516	30		512	915	1 059	21.42	3.84
Tezo Roka	284	3		41	240		53	179	8		3.22	0.67
Mavueni Takaungu	125			16	109	100		9			3.70	0.79
Junju	119	1		14	104	42		51	11		4.11	0.93
Mtwapa	79			14	65	50		10	5		1.91	0.39
Central Division	607	4		85	518	192	53	249	24		3.10	0.66
Chakama	2 985		2555 3)	23	407				89	318	61.02	14.09
Magarini	532	8		42	482			343	139		7.70	1.45
Jilore/Madunguni	282			17	265			122	143		13.41	2.80
Gede	102			15	87	32		55			3.22	0.51
Bungale/Baricho	557			26	531				344	187	57.59	11.17
Ganda	146			18	128	29		99			2.93	0.58
Garashi	174			8	166			118	48		11.95	2.15
Adu	2 468		1455 3)	48	965			27	626	312	140.88	26.10
Marafa	143			10	133			91	42		14.15	2.73
Malindi Division	7 389	8	4010 3)	207	3 164	61		855	1 431	817	16.49	3.10
Total rural area	11 964 5)	95	4262 4)	494	7 113	443	53	2 045	2 658	1914	10.43	1.81

1) For official land statistics see supplementary publication to FMHB, Vol. III A: Agriculture Land Statistics

2) All the Lowland Zones here are "Coastal Lowland Zones" (CL), if this further differentiation is wanted (see Table I)

3) Belong to Galana Game Scheme

4) Arabuko Sokoke Forest and other small Forest Reserves (total 818 sqkm) are not included. Ar. Sok. Forest has very poor soils mainly

5) Magrove swamps are not included

AGRICULTURAL STATISTICS[1)]

The two major cash crops of the district are **coconuts** and **cashew nuts.** There are however no reliable statistics for the area planted with these tree crops and the amounts produced. The ginnery at Malindi gins annually about 1,500 t of **seed cotton** – the cotton research station (Kibos) estimates that within the Malindi-Kilifi area approximately 2,800 ha of cotton is planted annually, yielding roughly 150 kg/ha, thus two-thirds of the cotton ginned originates from outside the district and roughly 500 t are produced within it. There are a number of large estates in the district producing sisal, nuts, meat and milk.

KILIFI DISTRICT

TABLE 8: **COTTON PRODUCTION[a)]**

Ginnery Zone	Year				
	75/76	76/77	77/78	78/79	79/80
Malindi					
Seed Cotton in t	1327	3945	1672	1310	1332
Bales	2329	6922	2935	2299	2337

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

SMALL FARM SURVEY (SFS)[1)]

More than two-thirds of the district is unsuitable for economic small-scale farming because of poor soils and an unsuitable climate. The ecological conditions in the coastal region differ considerably form those of the rest of the country and so does its farming system. A production technique totally different from that of the Highlands has been developed by the family farms of the district. In addition, this farming system is heavily influenced by a rather complicated land ownershipland lease system, i.e. unlike the Highland system, the farmers do not often own the land they cultivate. It is impossible to disentangle the complexity of this farming system and the lives of the farming community in a country-wide survey like the SFS. The quality of the results of the survey must be judged with this in mind.

The SFS was carried out near Kaloleni (AEZ L 3 + 4) and between Marikebuni and Shauri Moyo (AEZ L 3 + 4). The results of the exercise have been compiled in the (SFS) tables and it is hoped that they provide some initial insight into the farming structure of the district. The farmers use 6.5 ha of land, of which about 2 ha were used for annual crops and 2 ha were planted with perennial crops, the rest of the land area was used for grazing.[2)] (Almost all land is cultivated manually, but since field preparation is usually limited to making planting holes, a two ha annual crop area can well be managed by one family). The farmers plant roughly 1.3 crops but often practise a relay planting system which requires less manual work. There are still large off-farm grazing areas, thus the stocking rate does not reflect the actual carrying capacity, which is probably in the region of 0.5 LU/ha. Practically no purchased inputs were used on the farms (table 9 & 10). The cropping pattern (table 11) reflects the subsistence farming character of the land use – the cash required is mainly obtained from the sale of tree crop products (cashew and/or coconuts). Livestock is kept exclusively for meat production and milk supply is for the farmers' household only (table 12). The yields (which the farmer claimed to harvest) are probably somewhat too optimistic (table 13). The staple food crops harvested are consumed on the farm or within the region, including Mombasa town all cotton and cashew nuts production is sold. The farming activities (graphs table 15) do not reflect the very complex relay planting and intercropping system, but merely show when the particular work is done. The data basis for the output and nutrient input table was also comparatively small and some bold interpolations were necessary to get some indication of possible outputs. The possible outputs are limited by poor soils and low rainfall; the fertilizers required to achieve fairly acceptable yields make production expensive (table 16).

A comprehensive farm survey is required in order to obtain sufficient information on the socio-economic situation of farming in the district. Only with this knowledge on hand can a strategy for development be compiled and implemented. A major problem is the low labour productivity in farming.

1) It is hoped that the results of a comprehensive farm survey will be available towards 1985/86; meanwhile some information can be obtained from the Mtwapa research station and the DAO.

2) For holding sizes, see also table 7


SMALL FARM SURVEY AREAS (1977) and AGRO-ECOLOGICAL ZONES + SOILS
KILIFI AND MOMBASA
39°30'E
40°E
2°30'S
3°S
3°30'S
4°S
54b National Number of Survey Area
Survey Area, sample size 30 per number
A. E. Zones
Broken zonal boundaries are uncertain or mean transitional strips
Subzones
Climatic data for AEZ formulas see table I and II
L = here CL, Coastal Lowlands
Forest Reserve
Steep slopes, unsuitable for cultivation (only marked outside Forest Res.)
Water-logging or flooding during rainy season/ Mangrove
0 10 20 30 40 km
AEZ R. Jätzold '83
Soils KSS
Min. of Agr., German Agr. Team
Ranching Zone
Livestock or Millet Zone
Cashew nut-Cassava Zone
Coconut-Cassava Zone
Cassava-Millet Zone
INDIAN OCEAN
Malindi
KILIFI
MOMBASA
Gandi
Galana
Chakama
Baricho
Ganze
Chonyi
Kaloleni
Mariakani
Rare
Korom
Dera

KILIFI DISTRICT

AEZ: L 3 + 4

TABLE 9: FARM ORGANIZATION ACCORDING TO FARM SIZE GROUP

Survey Area 54

Item	Unit	Farm Size & Land Use, Livestock on Farm, Farm Size Group: small	medium	large
Farm Size Total	ha	2.6	5.6	28.1
Land Use: Annual Crops 1) First Season				
Maize	ha	o.4	o.9	o.7
Maize & Cowpeas	ha	o.3	o.3	o.2
Cotton	ha	o.1	o.1	o.1
Cassava	ha	-	o.3	o.2
Others	ha	o.6	o.3	o.7
Total	ha	1.4	1.9	1.9
Second Season 1) Maize	ha	o.2	-	o.4
Cowpeas	ha	o.6	o.2	o.3
Cassava	ha	-	o.3	o.4
Others	ha	o.2	o.3	o.5
Total	ha	1.o	o.8	1.6
Permanent Crops 1) Cashewnuts	ha	o.3	1.8	1.3
Coconuts	ha	-	o.1	o.7
	ha			
	ha			
Portion of total	%	12 %	34 %	7 %
Grazing & Forage	ha	o.6	1.1	17.8
portion of total	%	23 %	2o %	63 %
Other Land Use	ha	o.3	o.7	6.4
Livestock on Farm:				
Cattle: local	LU	2.8	2.5	4.5
improved	LU	-	-	o.4
Sheep & Goats	LU	1.2	1.9	2.6
Total	LU	4.o	4.4	7.5

Item	Unit	Intensity, Labour/Persons on Farm, Home Consumption, Farm Size Group: small	medium	large
Farming Intensity:				
Cropping Intensity	-	1.o	o.8	o.2
Portion of improved cattle kept	%	-	-	18 %
Portion of Farmers owning a Plough	%	-	3o %	-
Labour on Farm:				
Family Adults	persons	2.8	3.8	5.o
Perm. Hired Labour	"	-	o.1	-
Children > 14 years	"	1.5	2.3	-
Persons living on Farm 2) -average household size-		Farmer's Family	Non-related Persons	Total
Adults > 14 years	persons	4.82	o.52	5.34
Children < 14 years	"	2.95	-	2.95
Subsistence Units	SU	6.59	o.52	7.11
Home Consumption of Major Food produced on Farm		kg/year household	cal. person day	
Maize	kg	1365	1885	
Beans	kg	13	18	
Cassava	kg	69	34	
Cowpeas	kg	189	265	
	kg			
	kg			
	kg			
	kg			

Other Crops cultivated: Tomatoes, Tobacco

1) Major crops only considered

2) Based on 1979 Census figures

KILIFI DISTRICT

AEZ: L 3 + 4

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

Survey Area 54

Range	Assets			People on Farm		
	Land ha	Livestock head	Equipment pieces	Family Adults	Perm.Hrd. Labourers	Children >14 No.
Avg. 0	6.5	21.8	0.3	3.6	0.1	2.0
Avg. 1	6.5	28.7	2.5	3.7	1.0	3.4
Up. Qu.	6.2	45.0	-	4.0	-	3.0
Lo. Qu.	4.0	2.0	-	2.0	-	-

Land Use

Range	Annual Crops ha	Annual Crops %	Perm. Crops ha	Perm. Crops %	Pasture ha	Pasture %	Forage ha	Forage %	Fallow ha	Fallow %	Other Use ha	Other Use %
Avg. 0	1.8	34	1.7	32	1.5	27	-	-	0.3	5	0.1	2
Avg. 1	1.8	27	2.0	30	1.9	29	0.1	2	0.7	11	0.1	2
Up. Qu.	2.4	46	2.2	35	1.5	39	-	-	0.4	12	0.1	2
Lo. Qu.	0.6	13	0.5	12	0.1	-	-	-	-	-	-	-
Total	52.6		49.8		42.6		0.1		7.4		2.7	

Farming Intensity

Range	Cropping Intensity crops/yr.	Stocking Rate		Improved Cattle % of total
		Farm Land LU/ha	Pasture & Forage LU/ha	
Avg. 0	1.3	0.7	3.0	0.6
Avg. 1			2.7	6.7
Up. Qu.	1.9	1.0	2.8	-
Lo. Qu.	1.0	-	-	-

Inputs Applied

Range	Improved Seed 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	31.0	0.1	-	0.1	-	-	-	-	-	0.5	-	-	-
Avg. 1	53.7	0.5	-	0.5	-	-	-	0.1	-	3.4	-	-	-
Up. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-
Lo. Qu.	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: Avg. 0 = average of all sample farms
Avg. 1 = average of 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

KILIFI DISTRICT

AEZ: L 3 + 4

TABLE 11: CROPPING PATTERN

Survey Area 54

First Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.7	1.4	1.00	0.00	21.1	32.3
Maize IPC	0.1	1.1	0.00	0.00	2.1	3.2
Cowpeas	0.1	0.7	0.00	0.00	2.0	3.1
Cotton	0.1	0.7	0.00	0.00	4.2	6.4
Tobacco	0.0	0.0	0.00	0.00	0.0	0.1
Cassava	0.2	0.7	0.40	0.00	7.2	11.0
Others	0.4	0.9	0.40	0.00	10.4	15.8
Maize & Cowps	0.2	1.3	0.00	0.00	6.3	9.6
Maize & Others	0.4	1.5	0.52	0.00	12.1	18.5
Total					65.4	100.0

Second Rains
Annual & Semipermanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Maize	0.3	1.2	0.20	0.00	9.3	27.2
Cowpeas	0.2	1.4	0.00	0.00	5.4	15.8
Tomatoes	0.0	0.4	0.00	0.00	0.8	2.5
Cassava	0.2	0.7	0.40	0.00	7.2	21.1
Others	0.3	0.9	0.12	0.00	8.2	23.9
Maize & Beans	0.1	2.0	0.00	0.00	2.0	5.9
Maize & Others	0.0	1.2	0.00	0.00	1.2	3.5
Total					34.1	100.0

Permanent Crops

Crop	Average 0 ha	Average 1 ha	Upper Quartile ha	Lower Quartile ha	Total Sample Area ha	Total Sample Area %
Citrus	0.0	0.2	0.00	0.00	0.2	0.5
Cashew Nuts	0.6	1.1	1.20	0.00	18.3	49.6
Coconuts	0.6	1.7	0.40	0.00	18.4	49.8
Total					36.9	100.0

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

KILIFI DISTRICT

TABLE 12: HERD COMPOSITION (GRAZING LIVESTOCK)
– in Head & Livestock Units –

AEZ: L 3 + 4

Oct. '77, Survey Area 54

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	0.03	-	-		-			0.03			0.03
Upper Qu.	-	-	-		-			-			-
Subtotal(improved) Total	1	-	-	-	-			0.8			0.8
Average	0.03	-	-	-	-			0.03			0.03
Upper Qu.	-	-	-	-	-			-			-
Lower Qu.	-	-	-	-	-			-			-
LU Male Cattle =	100.0 % of total cattle,				Calves + Heifers =			0.0 % of dairy cows			
Unimproved Livestock:											
Under 1 year, Average	0.17	-	-	0.45		0.66	4.66	0.66	-		0.66
Upper Qu.	-	-	-	-		-	6	0.6	-		0.6
1 - 2 years, Average	-	-	-	0.72				0.33			0.33
Upper Qu.	-	-	-	-				-			-
Over 2 years, Average	0.21	0.03	-		3.17	1.31	11.14	3.46	-	23.79	3.46
Upper Qu.	-	-	-		1	-	17	-	-	10	-
Subtotal (unimp.) Total	11	1	-	34	92	57	458	128.9	-	690	128.9
Average	0.38	0.03	-	1.17	3.17	1.97	15.79	4.44	-	23.79	4.44
Upper Qu.	-	-	-	-	1	-	20	5.5	-	27	5.5
Lower Qu.	-	-	-	-	-	-	-	0.2	-	10	0.2
LU Male Cattle =	7.2 % of total cattle,				Calves + Heifers =			37.0 % of dairy cows			
LU Goats + Sheep =	40.0 % of total Grazing Livestock Units										
Improved + Unimproved Grazing L/Stock Total	12	1	-	34	92	57	458	129.7	-	690	129.7
Average	0.41	0.03	-	1.17	3.17	1.97	15.79	4.47	-	23.79	4.47
Upper Qu.	-	-	-	-	1	-	20	5.0	-	27	5.5
Lower Qu.	-	-	-	-	-	-	-	0.2	-	10	0.2
LU Male Cattle =	8.1 % of total cattle,				Calves + Heifers =			37.0 % of dairy cows			
LU Goats + Sheep =	39.7 % 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

KILIFI DISTRICT

AEZ: L 3 + 4

TABLE 13: INPUTS & YIELDS OF MAJOR CROPS

Survey Area 54

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.	13	-	-	-	0.02	-	-	1,887
	UpQu	-	-	-	-	-	-	-	2,813
	LoQu	-	-	-	-	-	-	-	1,125
Cowpeas	Avg.	-	-	-	-	-	-	-	893
	UpQu	-	-	-	-	-	-	-	800
	LoQu	-	-	-	-	-	-	-	338
Cotton	Avg.	67	-	-	-	-	7	-	851
	UpQu	100	-	-	-	-	-	-	1,000
	LoQu	-	-	-	-	-	-	-	188
Cassava	Avg.	-	-	-	-	-	-	-	1,283
Maize & Cowps									
Maize	Avg.	-	-	-	-	-	-	-	2,604
Cowps	Avg.	-	-	-	-	-	-	-	339
Maize	UpQu	-	-	-	-	-	-	-	3,375
Cowps	UpQu	-	-	-	-	-	-	-	600
Maize	LoQu	-	-	-	-	-	-	-	1,125
Cowps	LoQu	-	-	-	-	-	-	-	80
Second Rains									
Maize	Avg.	11	-	-	-	0.04	1	1	1,408
	UpQu	-	-	-	-	-	-	-	1,575
	LoQu	-	-	-	-	-	-	-	-
Others	Avg.	-	-	-	-	-	-	-	625
	UpQu	-	-	-	-	-	-	-	1,017
	LoQu	-	-	-	-	-	-	-	125
Perennial Crops									
Cassava	Avg.	-	-	-	-	-	-	-	7,862
	UpQu	-	-	-	-	-	-	-	8,750
	LoQu	-	-	-	-	-	-	-	1,438
Cashew Nuts	Avg.	-	-	-	-	-	-	-	582
	UpQu	-	-	-	-	-	-	-	975
	LoQu	-	-	-	-	-	-	-	150
Coconuts	Avg.	-	-	-	-	-	-	-	2,068
	UpQu	-	-	-	-	-	-	-	2,500
	LoQu	-	-	-	-	-	-	-	179

KILIFI DISTRICT

AEZ: L 3 + 4

TABLE 14: DISPOSAL OF CROPS

Survey Area 54

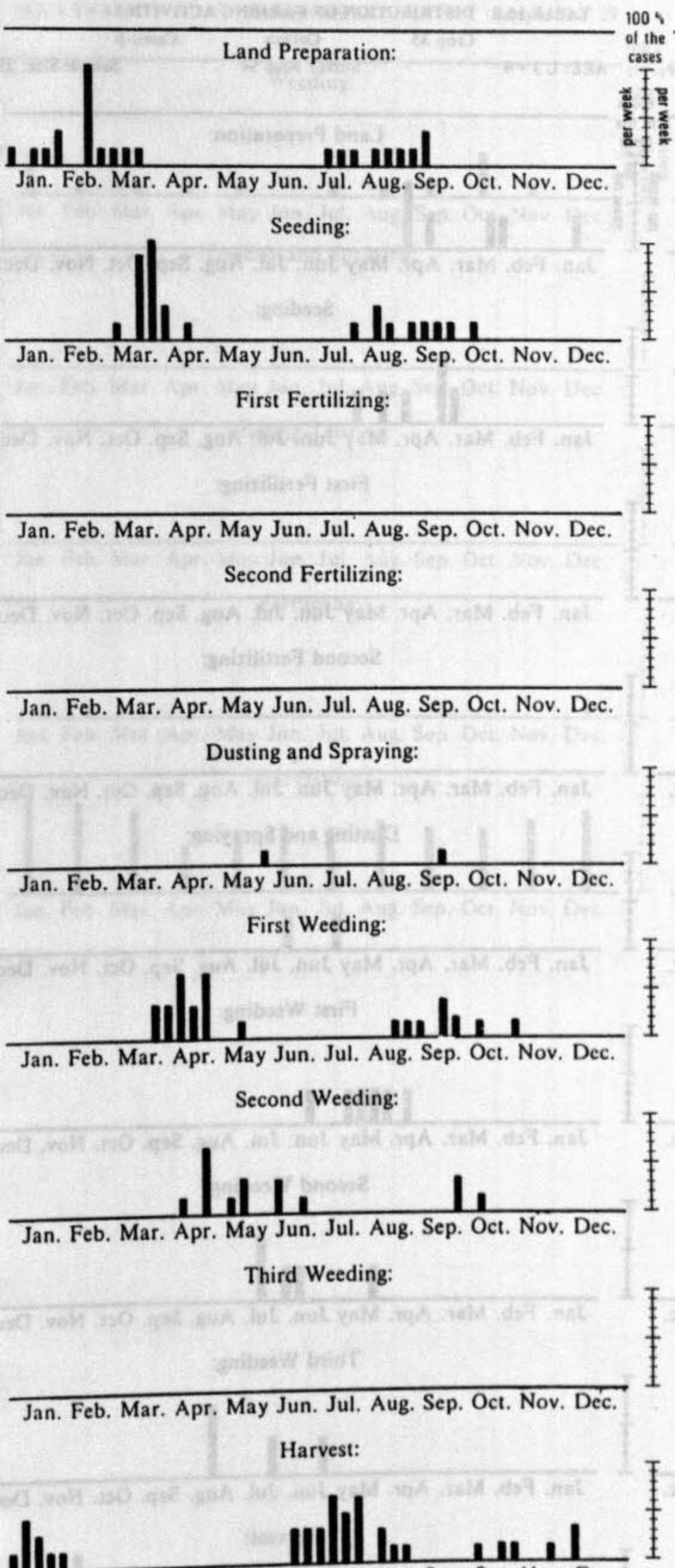
Crop	Production	Marketing Board		Local Market		Home Consumption	
	kg	kg	%	kg	%	kg	%
First Rains							
Maize	33,990	0	0	13,300	39	20,690	61
Maize & Cowps	18,130	400	2	0	0	17,730	98
Maize & Others	17,405	1,655	10	3,920	23	11,830	68
Maize IPC	2,240	0	0	0	0	2,240	100
Cowpeas	1,800	1,000	56	200	11	600	33
Cotton	2,750	2,750	100	0	0	0	0
Second Rains							
Maize	14,975	0	0	5,780	39	9,195	61
Maize & Beans	2,040	0	0	160	8	1,880	92
Maize & Others	2,080	0	0	0	0	2,080	100
Cowpeas	2,720	400	15	800	29	1,520	56
Tobacco	100	0	0	0	0	100	100
Tomatoes	432	0	0	432	100	0	0
			Permanent Crops				
Macademia Nuts	40	0	0	0	0	40	100
Cassava	2,080	0	0	0	0	2,080	100
Citrus	3,000	0	0	28,000	933	-25,000	-833

KILIFI DISTRICT

TABLE 15 a: DISTRIBUTION OF FARMING ACTIVITIES

Crop 1 Maize Cases: 24

AEZ: L 3 + 4 Survey Area 54 Sample Size: 29

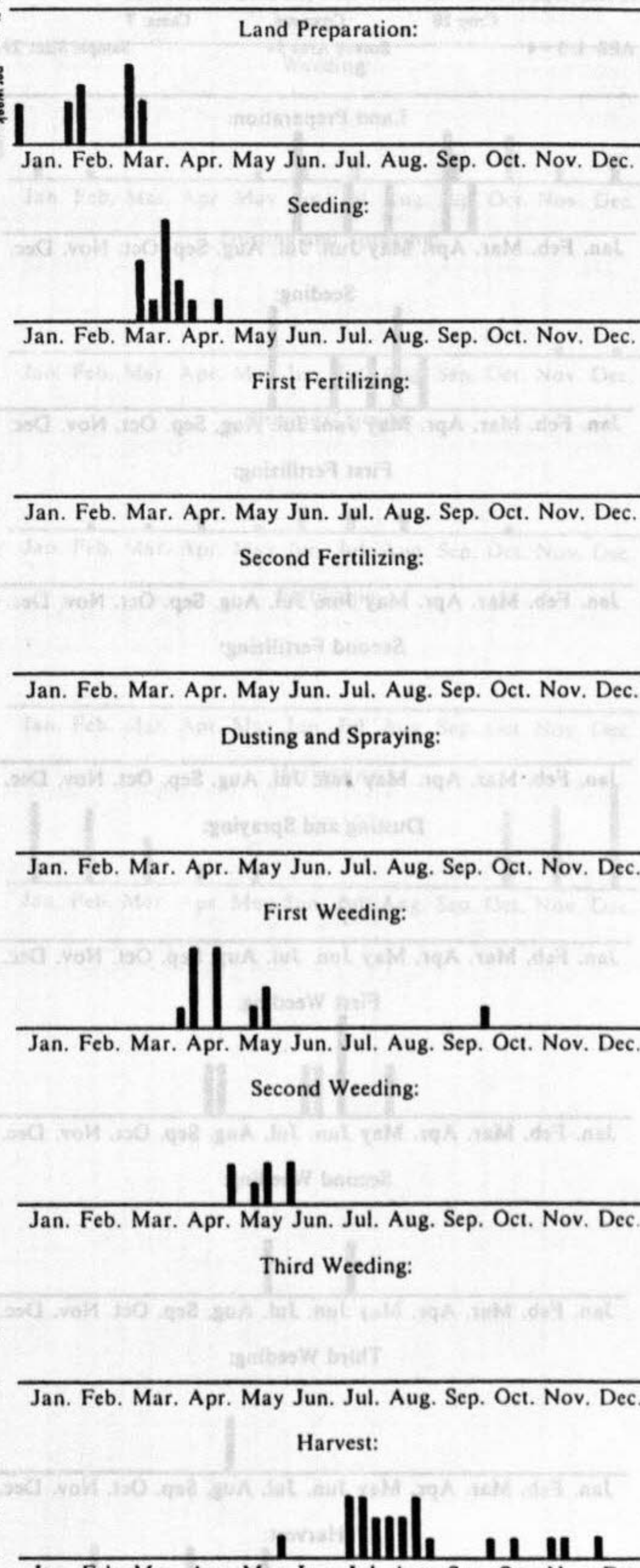


KILIFI DISTRICT

TABLE 15 b: DISTRIBUTION OF FARMING ACTIVITIES

Crop 6 Maize & cowpeas Cases: 13

AEZ: L 3 + 4 Survey Area 54 Sample Size: 29

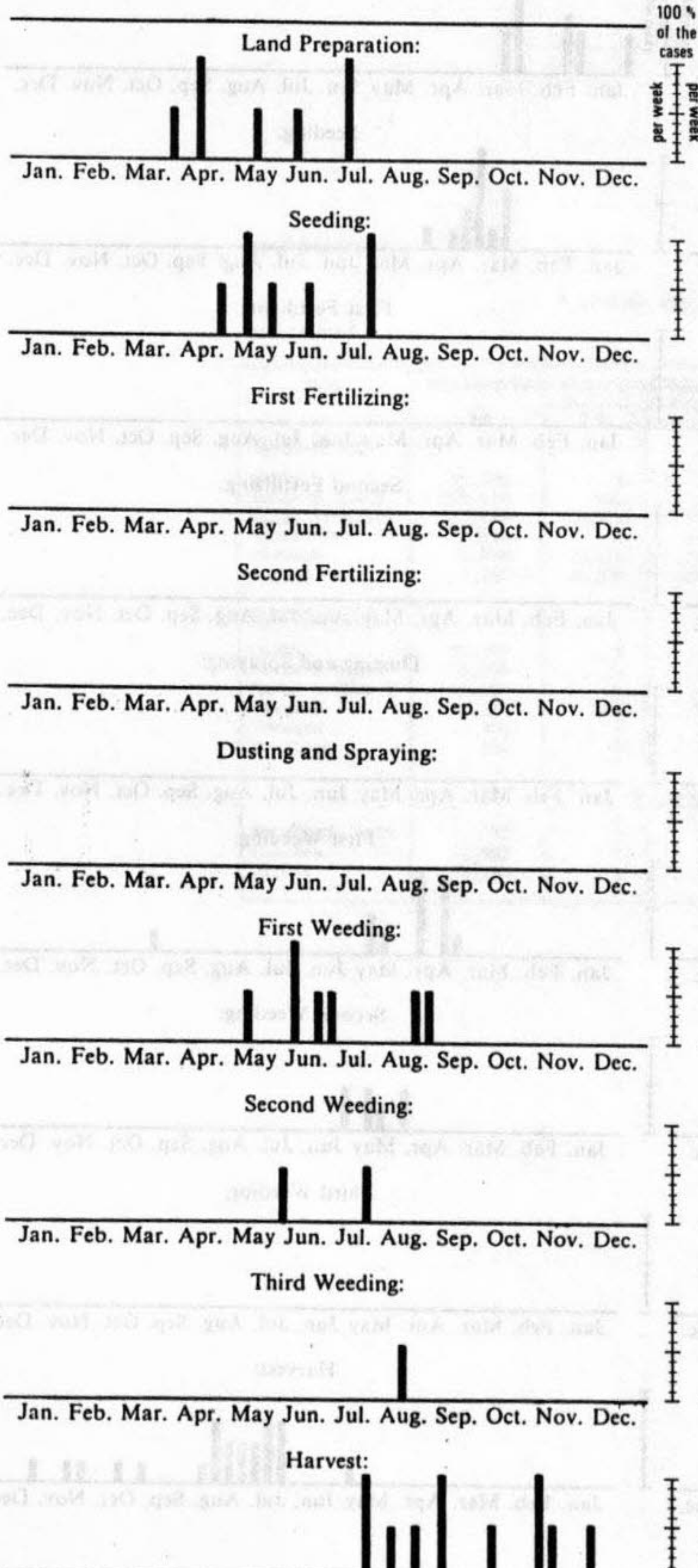


KILIFI DISTRICT

TABLE 15 c: DISTRIBUTION OF FARMING ACTIVITIES

Crop 20 Cowpeas Cases: 7

AEZ: L 3 + 4 Survey Area 54 Sample Size: 29

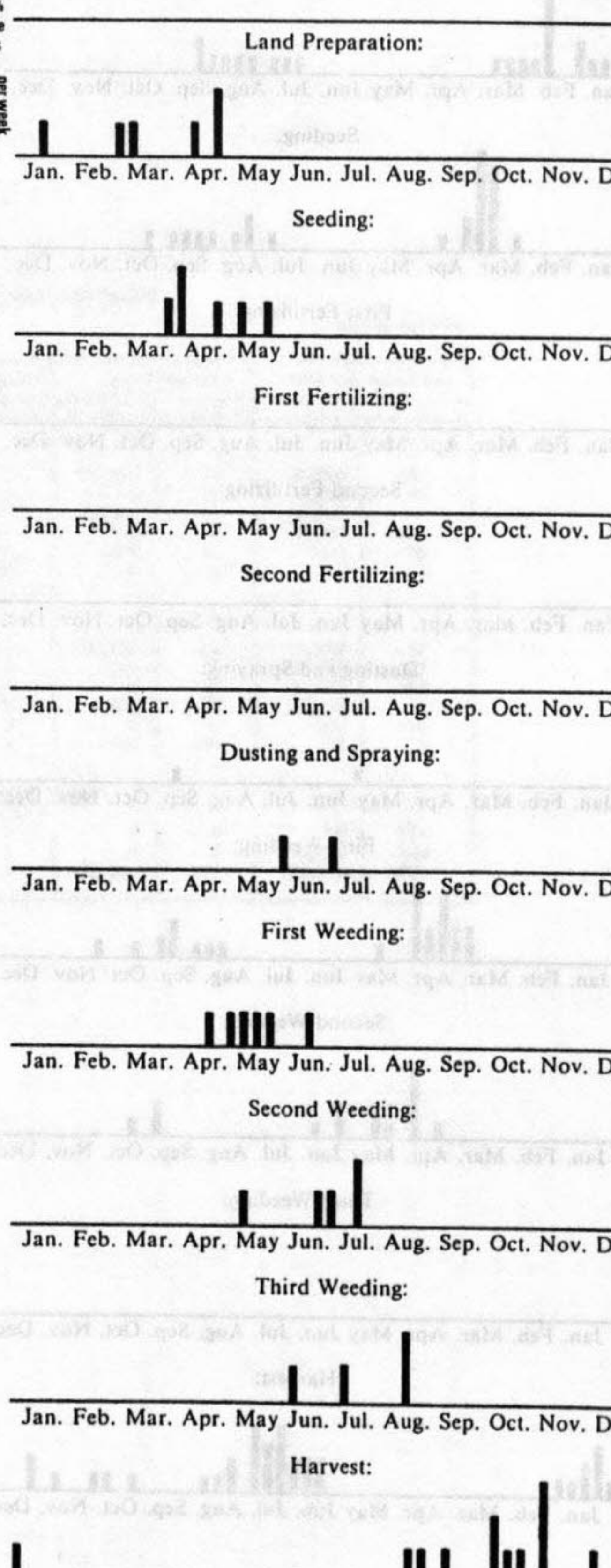


KILIFI DISTRICT

TABLE 15 d: DISTRIBUTION OF FARMING ACTIVITIES

Crop 35 Cotton Cases: 6

AEZ: L 3 + 4 Survey Area 54 Sample Size

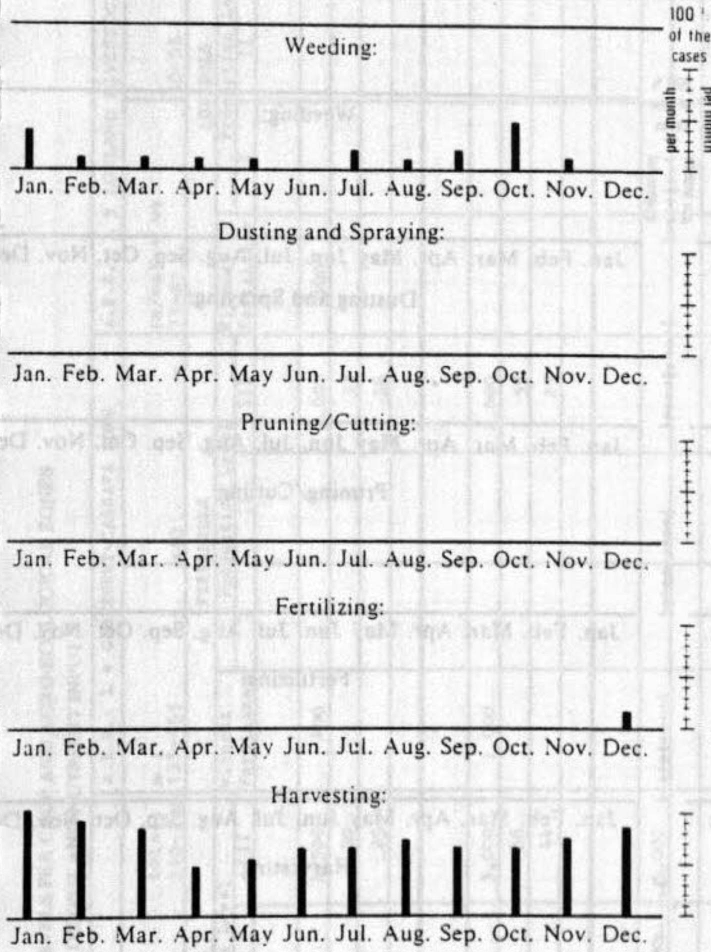


KILIFI DISTRICT

TABLE 15 e: DISTRIBUTION OF FARMING ACTIVITIES

Crop 59 Coconuts Cases: 13

AEZ: L 3 + 4 Survey Area 54 Sample Size: 29

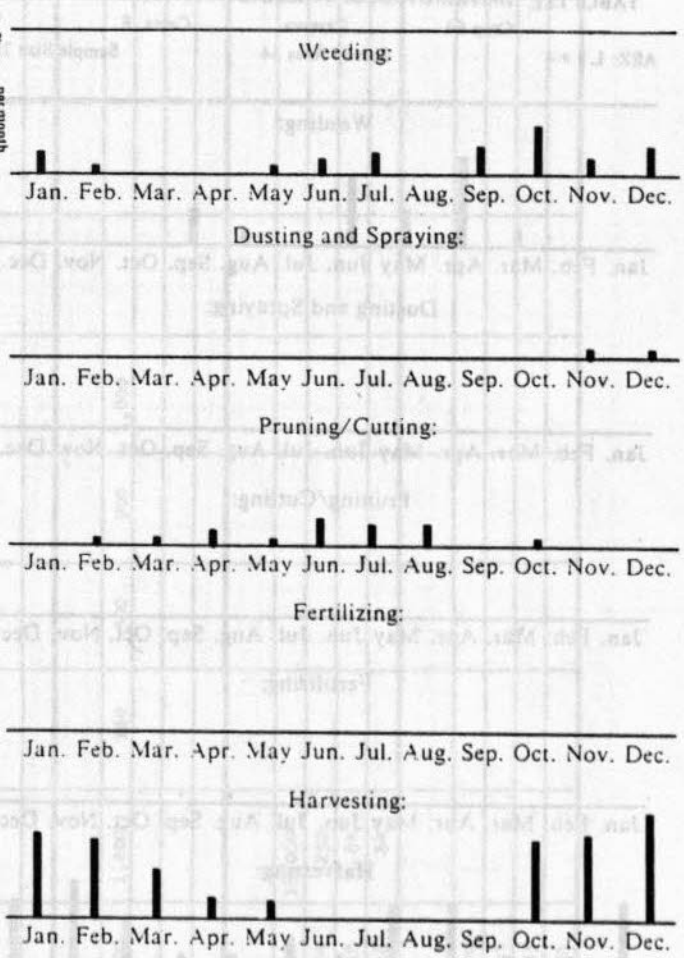


KILIFI DISTRICT

TABLE 15 f: DISTRIBUTION OF FARMING ACTIVITIES

Crop 61 Cashew Nuts Cases: 18

AEZ: L 3 + 4 Survey Area 54 Sample Size: 29

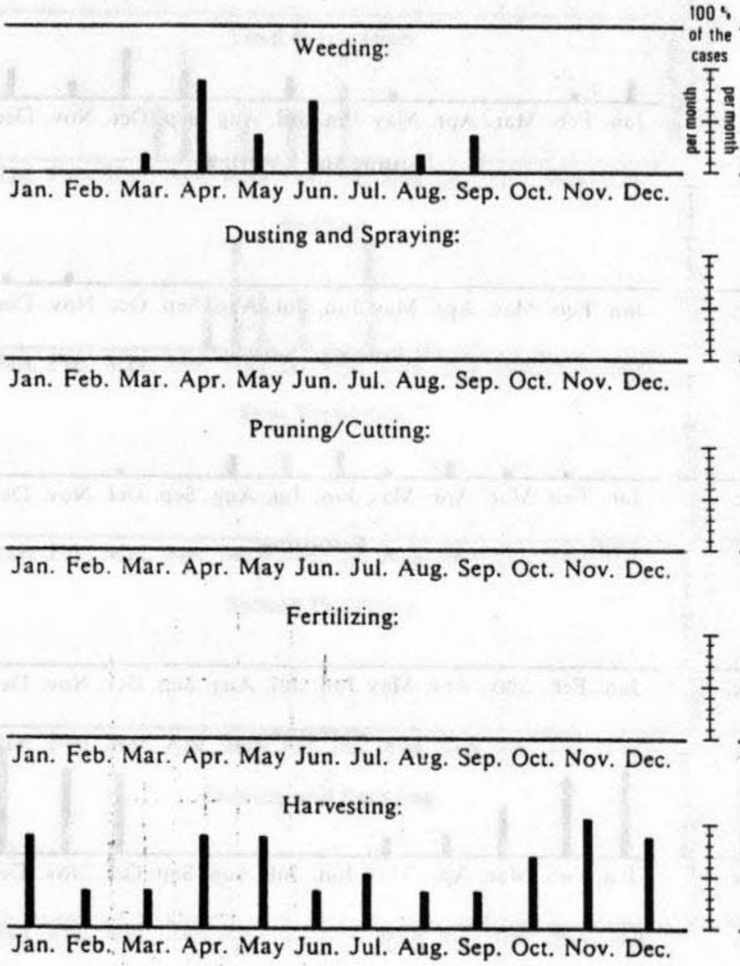


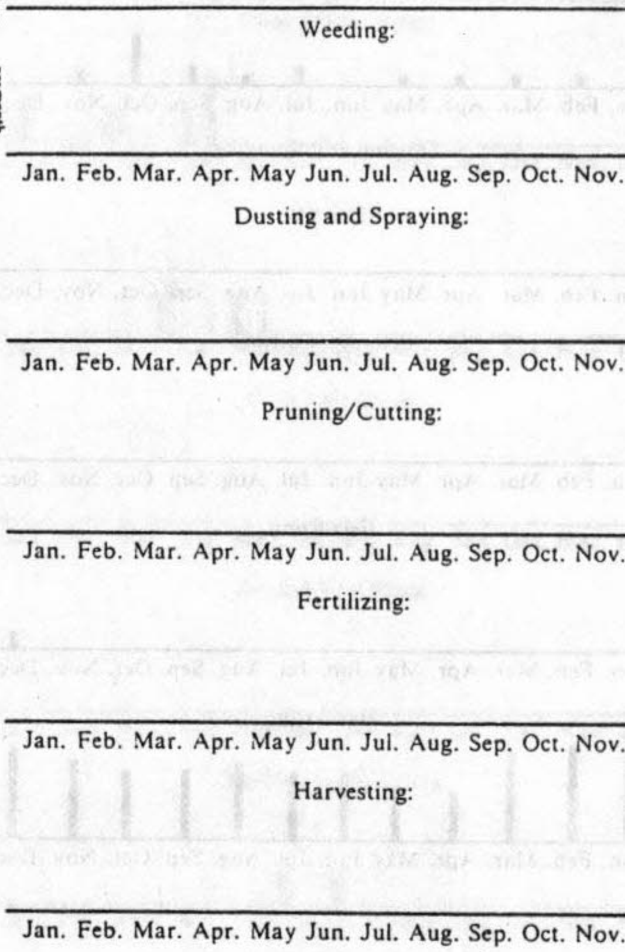
KILIFI DISTRICT

TABLE 15 g: DISTRIBUTION OF FARMING ACTIVITIES

Crop 64 Cassava Cases: 8

AEZ: L 3 + 4 Survey Area 54 Sample Size 29





KILIFI DISTRICT

TABLE 16a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT[1)]

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
Vegt. Period 1st + 2nd: in Days, 1st:		m i (s/vs) 135-155		2nd: 75-85	total: 210-240	m i 135-155		<40	—	(s/vs) + vs 75-85		40-55	—
Soil:		FERRALSOLS				FERRALSOLS				LUVISOLS			
	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 2)	kg	600			1,500	400			1,000	300			500
Fertilizer N	kg				50				33				-
P_2O_5	kg				25				16				-
K_2O	kg												
CROP: NAPIER/BANA-GRASS													
Farmers in Production Level	%												
Yields 2)	kg	1,400			3,000	1,000			2,000				
Fertilizer N	kg				88				55				
P_2O_5	kg				44				27				
K_2O													
CROP: COCONUTS													
Farmers in Production Level	%												
Yields in No. of nuts	kg		2,500	4,400	5,000								
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: CASHEWNUTS													
Farmers in Production Level	%												
Yields	kg	180	400	700	1,200	180	300	900	1,000				
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	4,000	4,000	7,000	18,000								
Fertilizer N	kg			54	252								
P_2O_5	kg			18	84								
K_2O	kg			18	84								
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg	300	400	700									
Fertilizer N	kg		11	44									
P_2O_5	kg		8	33									
K_2O	kg		6	26									

1) for explanations see p. 16 2) in kg TDN

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

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
Vegt. Period 1st + 2nd: in Days, 1st:		m i (s/vs) 135-155		2nd: 75-85	total: 210-240	m i 135-155		<40	—	(s/vs) + vs 75-85		40-55	—
Soil:		FERRALSOLS				FERRALSOLS				LUVISOLS			
	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	%		210										
Yields	kg	1,100		2,000	2,200	1,000		1,800	2,000				
Fertilizer N	kg			27	33			24	30				
P_2O_5	kg			22	26			20	24				
K_2O	kg			11	13			10	12				
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	1,600	1,200	2,500	3,000	1,400	1,200	2,000	2,800				
Fertilizer N	kg			34	54			24	54				
P_2O_5	kg			24	38			17	38				
K_2O				12	18			7	12				
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg	700	500	800	1,500	700	450	800	1,400	800	300	600	800
Fertilizer N	kg			15	30			5	26				
P_2O_5	kg			25	23			5	20				
K_2O	kg												
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: GRAMS													
Farmers in Production Level	%												
Yields	kg					400		600	800	400	500	600	-
Fertilizer N	kg							8	16			8	
P_2O_5	kg							6	12			6	
K_2O	kg							6	12			6	
CROP: MAIZE & COWPEAS													
Farmers in Production Level	%												
Yields	kg	1,100		2,000/200	2,200/300								
Fertilizer N	kg			37	47								
P_2O_5	kg			29	37								
K_2O	kg												

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

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: m i (s/vs) in Days,1st: 135-155		2nd: 75-85	total: 210-240	m i 135-155		<40	-	(s/vs) + vs 75-85		40-55	-
		Soil: FERRALSOLS				FERRALSOLS				LUVISOLS			
	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	500	375	600	1,000	500	300	600	800	400	300	500	600
Fertilizer N	kg				17			4	10			4	7
P_2O_5	kg				17			4	10			4	7
K_2O	kg				17			4	10			4	7
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	600		1,200	1,800	550		900	1,500	550		500	700
Fertilizer N	kg			30	60			18	48				8
P_2O_5	kg			23	46			13	36				6
K_2O				23	46			13	36				6
CROP: SIMSIM													
Farmers in Production Level	%												
Yields	kg	400	280	400	600								
Fertilizer N	kg			-	-								
P_2O_5	kg			-	17								
K_2O	kg			-	17								
CROP: GROUNDNUTS													
Farmers in Production Level	%												
Yields	kg	800	600	1,000	1,700								
Fertilizer N	kg			6	29								
P_2O_5	kg			5	24								
K_2O	kg			5	24								
CROP: COW PEAS													
Farmers in Production Level	%												
Yields	kg	400	400	700	800								
Fertilizer N	kg			12	20								
P_2O_5	kg			10	13								
K_2O	kg			10	13								
CROP: PIGEON PEAS													
Farmers in Production Level	%												
Yields	kg	400	400	700	1,000								
Fertilizer N	kg			15	30								
P_2O_5	kg			10	20								
K_2O	kg			10	20								

KILIFI DISTRICT

TABLE 16d: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES

OUTPUT & NUTRIENT INPUT

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: m i (s/vs) in Days, 1st: 135-155		2nd: 75-85	total: 210-240	m i 135-155		<40	—	(s/vs) + vs 75-85		40-55	-
		Soil: FERRALSOLS				FERRALSOLS				LUVISOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: SUKUMAWIKI													
Farmers in Production Level	%												
Yields	kg					2,500		6,000	16,000				
Fertilizer N	kg							28	54				
P_2O_5	kg							21	96				
K_2O	kg												
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	3,500		8,000	16,000	3,500		5,000	9,000				
Fertilizer N	kg			36	100			15	55				
P_2O_5	kg			27	75			9	33				
K_2O													
CROP: CASSAVA													
Farmers in Production Level	%												
Yields/year	kg	3,500	2,800	10,000	14,000	3,000	2,800	10,000	12,000	3,000	2,500	6,000	9,000
Fertilizer N	kg			26	4			28	36			12	24
P_2O_5	kg			39	63			42	54			18	36
K_2O	kg			39	63			42	54			18	36
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												

SOUTH-EASTERN TANA RIVER DISTRICT

Contents

NATURAL POTENTIAL

INTRODUCTION

Tana River District is almost all Ranching Zone L 6, except for the moist or irrigable areas near the river and a higher rainfall area near the coast in the southeast, adjoining Lamu District. There the average annual rainfall is more than 1,000 mm and a Coconut-Cassava Zone L 3 occurs. Within this zone, however, large stretches of soil are not suitable for these crops due to seasonal flooding or waterlogging (see Soil Map). The same is true for the Cashewnut-Cassava Zone L 4 and partly for L 5. In this Livestock-Millet Zone there is the problem of unconcentrated and unreliable rains (see Diagram Ngao).

On the other hand, there is some potential in the Tana valley and delta which is not shown by this climatic zonation: crops like maize and bananas are grown with soil moisture, and rice is also cultivated in some places. In future there may be irrigation and water regulation projects [1].

1) See the Reports of the Kenya Soil Survey and the special land suitability maps for large-scale irrigated rice of the KSS.

SOUTH-EASTERN TANA RIVER 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.
9240000	Kipini, District	67	Av.	947	23	8	41	140	298	123	66	36	33	37	58	84
3 m	Office		60 % rel.[1]	804	2	0	12	84	227	85	42	23	17	10	27	63
9240004	Ngao Methodist	19	Av.	705	15	9	25	95	108	67	44	41	102	73	85	40
15 m	Mission		60 %	569	0	1	5	60	81	59	25	23	21	23	42	20
9240012	Kurawa, Vet. Station	10	Av.	575	3	5	21	80	123	75	46	26	54	36	74	33
5 m			60 %	494	0	0	0	44	121	82	44	18	38	12	14	0

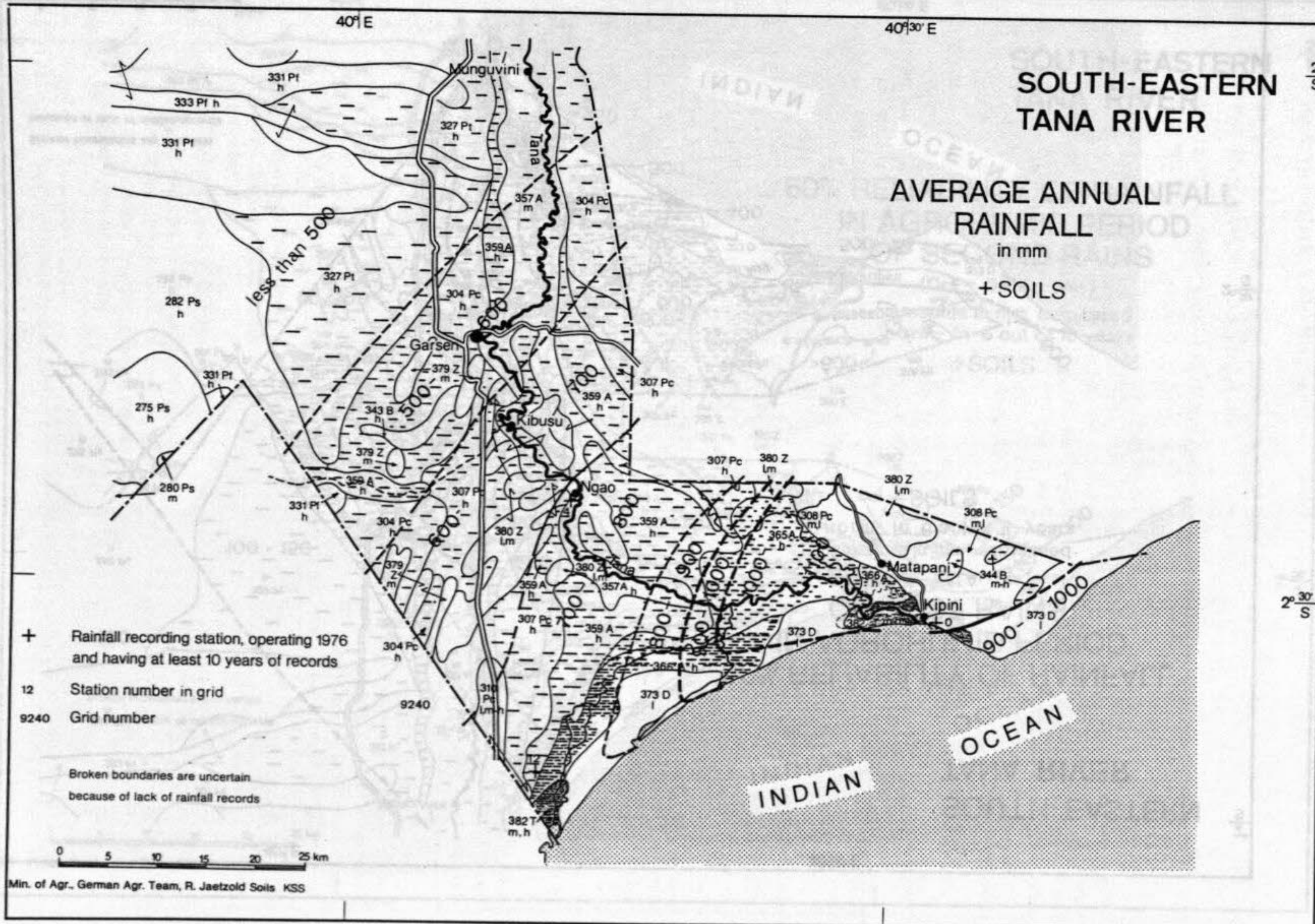
1) These figures of rainfall reliability should be exceeded normally in 6 out of 10 years.

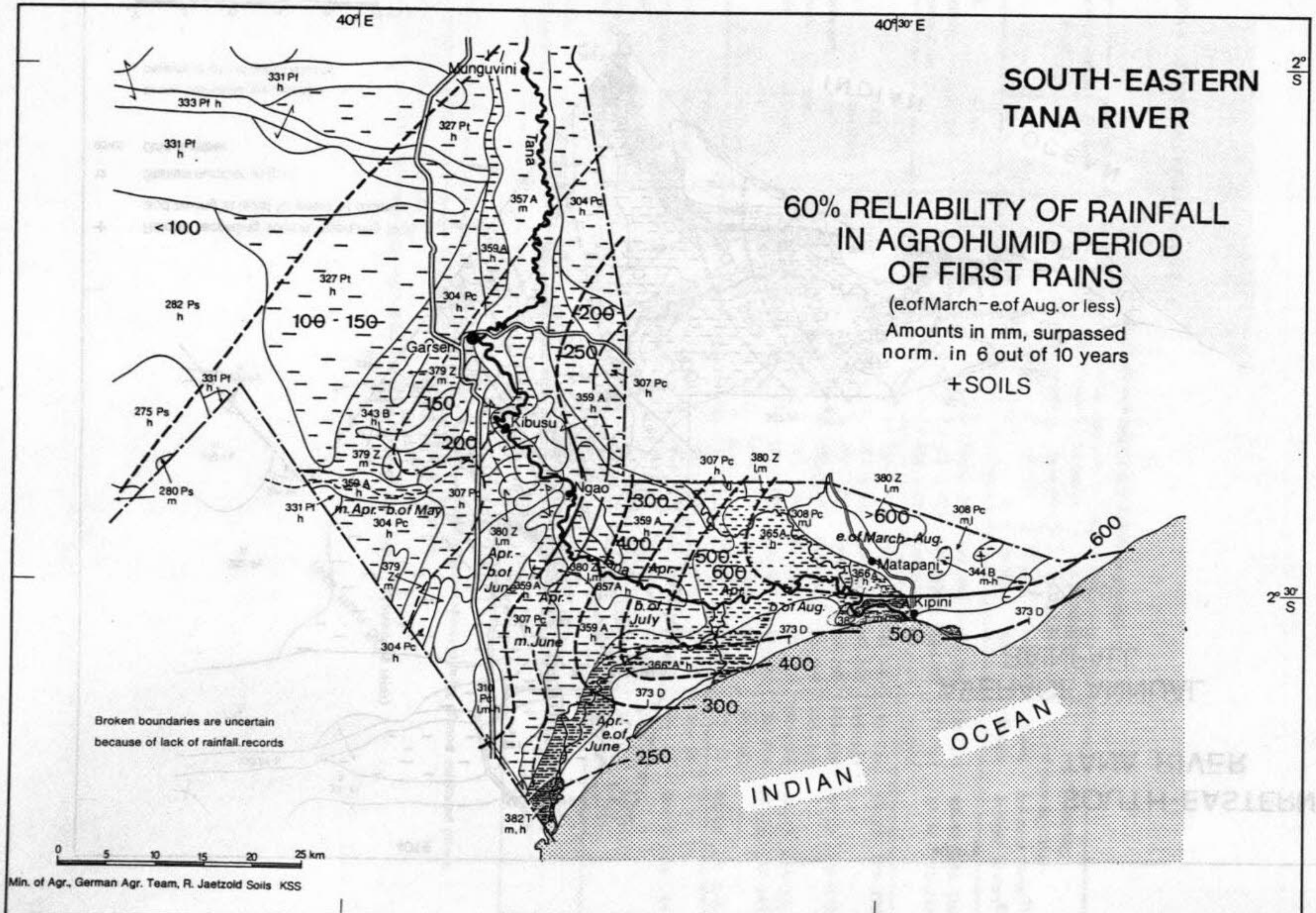
SOUTH-EASTERN TANA RIVER DISTRICT

TABLE 2: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

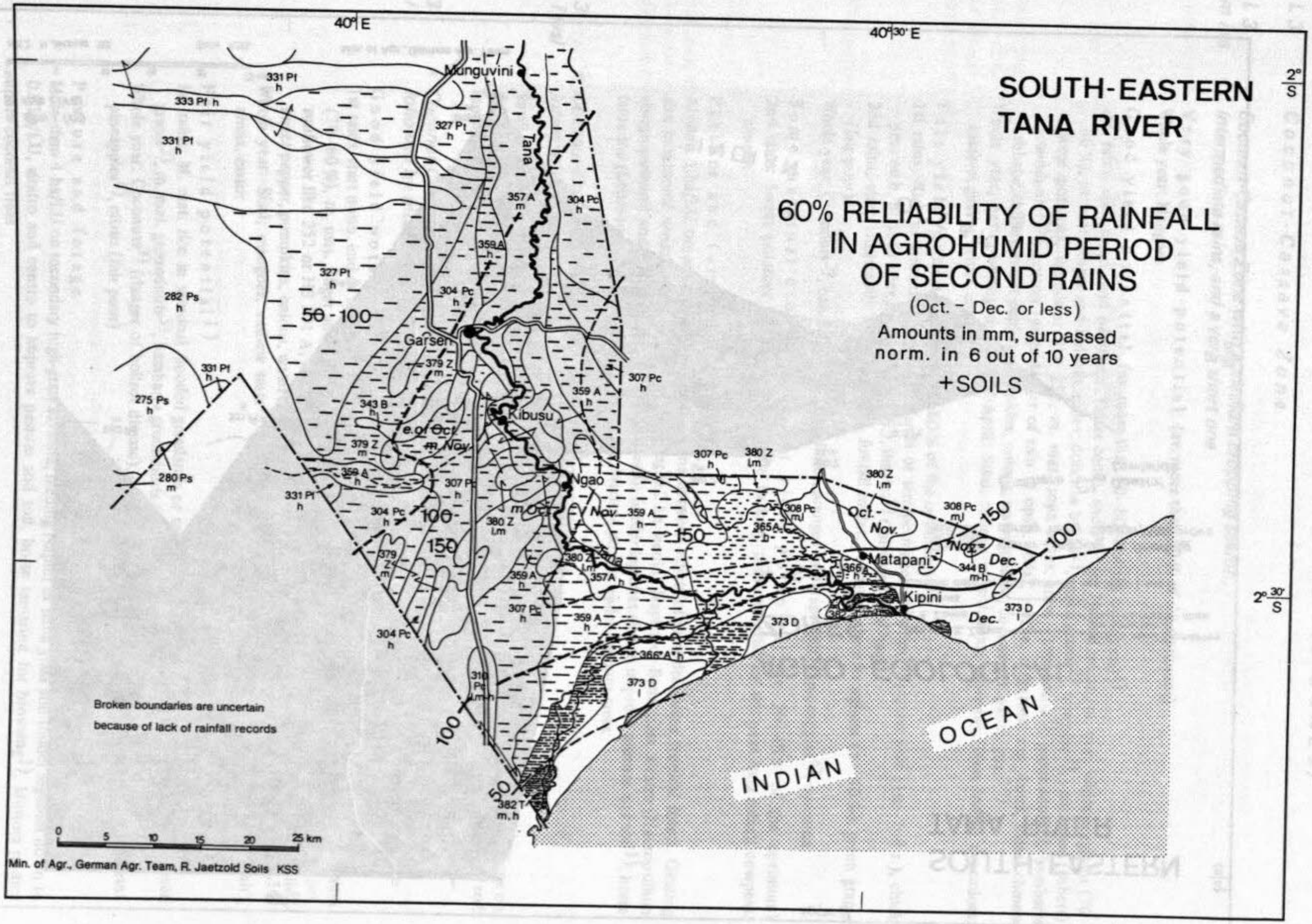
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1] 1st rains in mm	2nd rains in mm	60 % reliability of growing period 1st rains in days	2nd rains in days	Total[2] in days[4]
L 3 Coconut-Cassava Zone	m i vs	3–10	26.6–26.5	1 050–1 100	630–660	150–160	135–155	40–55	175–210
	m i (vs)			1 000–1 070	580–630	110–160	135–155	40–55	175–210
	m i			1 000–1 050	550–620	80–130	135–155	–	–
L 4 Cashewnut-Cassava Zone	m/s i (vs)	1–50	26.7–26.3	950–1 030	560–620	100–160	115–135	40–55	155–190
	m/s i			950–1 030	520–600	50–110	115–135	–	–
	s/m i (vs)			980–1 020	540–610	110–160	105–115	40–55	145–170
	s/m i			880–1 020	500–560	50–110	105–115	–	–
	s/m			900– 950	400–520	50– 80	105–115	40–55	145–170
	s i (vs)			820–1 000	500–600	90–160	85–105	40–55	125–160
	s i			800–1 010	440–500	50– 90	85–105	–	–
	s/vs i (vs)			800– 880	440–540	90–160	75– 85	40–55	115–140
L 5 Lowland Livestock-Millet Zone	s/vs i	1–60	27.0[3]–26.3	740– 900	220–450	50– 90	75– 85	–	–
	vs/s i (vs)			690– 800	180–500	90–160	55– 75	40–55	95–130
	(vs/s) i			690– 790	180–430	70–110	55– 75	–	–
	(vs/s) i + vs			580– 740	180–300	110–160	55– 75	40–50	–
	(vs) + i			520– 690	150–180	80–140	40– 55	<40	–
L 6 Lowland Ranching Zone	b r	20–100	28.0[3]–16.1	420– 640	60–150	50–120	30– 40	20–30	–

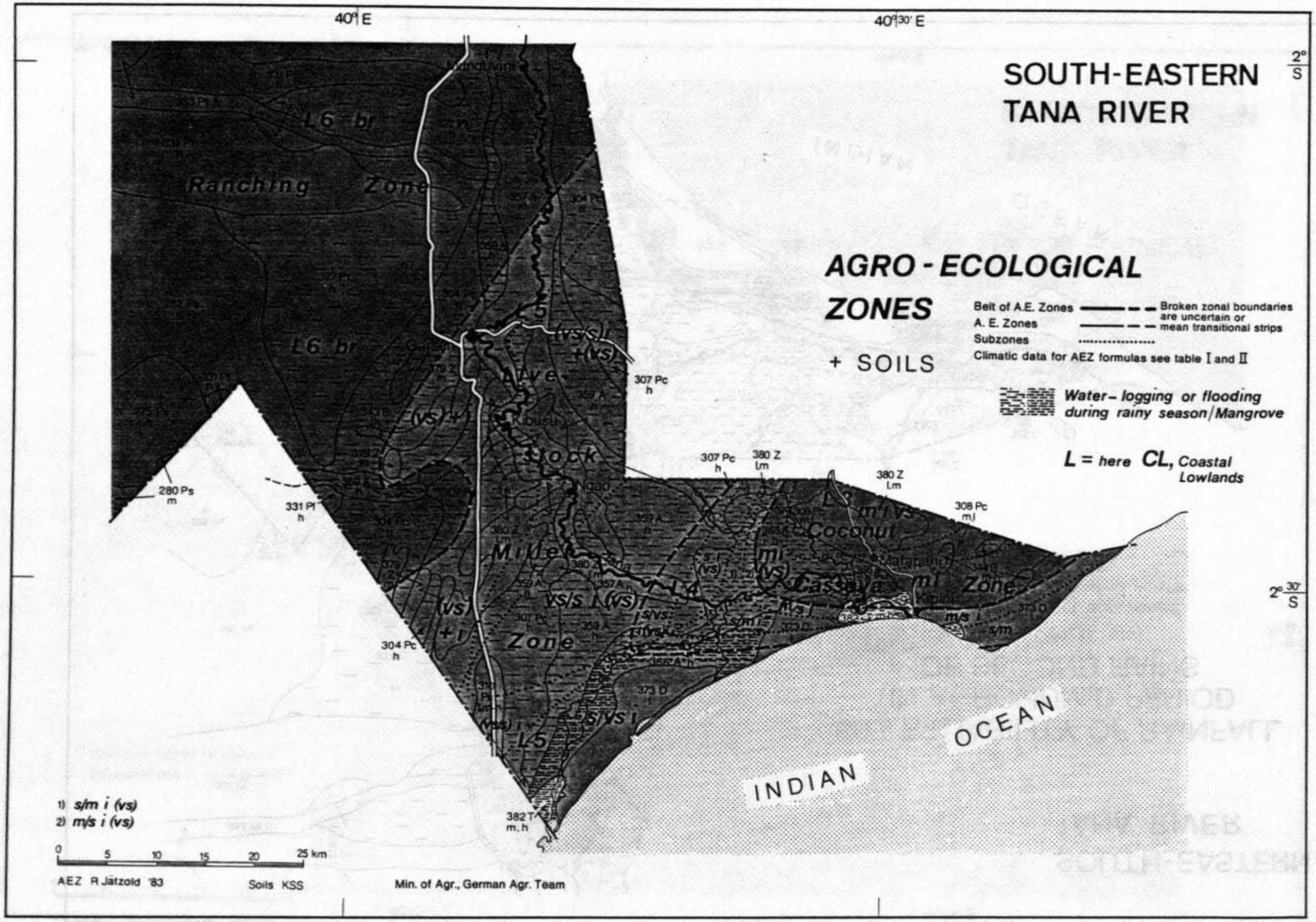
1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants.
2) Only added if rainfall continues at least for survival ($> 0.2\ E_o$) of most long term crops
3) Higher temperatures in the hinterland
4) Interrupted by a period with water supply between 0.2 and 0.4 E_o for more than 50 days (intermediate rains)


SOUTH-EASTERN
TANA RIVER
AVERAGE ANNUAL
RAINFALL
in mm
+ SOILS
40° E
40°30' E
2° S
2°30' S
Munguvini
Tana
Garsen
Kibusu
Ngao
Matapani
Kipini
INDIAN
OCEAN
less than 500
500
600
700
800
900
1000
+ Rainfall recording station, operating 1976 and having at least 10 years of records
12 Station number in grid
9240 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



SOUTH-EASTERN
TANA RIVER
60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF FIRST RAINS
(e.of March – e.of Aug. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
40° E
40°30' E
2° S
2° 30' S
Munguvini
Tana
Garsen
Kibusu
Ngao
Matapani
Kipini
INDIAN
OCEAN
<100
100 - 150
150
200
250
300
400
500
600
>600
e.of March – Aug.
m. Apr. – b.of May
Apr. – b.of June
Apr.
m. June
b.of July
b.of Aug.
Apr. – e.of June
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


SOUTH-EASTERN
TANA RIVER
60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF SECOND RAINS
(Oct. - Dec. or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+SOILS
40° E
40°30' E
2° S
2°30' S
Munguvini
Tana
Garsen
Kibusu
Ngao
Matapani
Kipini
INDIAN
OCEAN
50 - 100
100
150
>150
50
e. of Oct.
m. Nov.
Oct. -
Nov.
Dec.
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


SOUTH-EASTERN
TANA RIVER
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
Water - logging or flooding during rainy season / Mangrove
L = here CL, Coastal Lowlands
40° E
40°30' E
2° S
2°30' S
Ranching Zone
L6 - bi
L6 bi
Stock
Millet
Zone
L4
L5
Coconut
Cassava
Zone
INDIAN
OCEAN
280 Ps m
331 Pl h
304 Pc h
307 Pc h
380 Z Lm
308 Pc m,l
382 T m, h
1) s/m i (vs)
2) m/s i (vs)
0 5 10 15 20 25 km
AEZ R Jätzold '83
Soils KSS
Min. of Agr., German Agr. Team

AGRO-ECOLOGICAL ZONES

L = LOWLAND ZONES (COASTAL LOWLAND ZONES)

L 3 = Coconut-Cassava Zone

L 3 m i vs = Coconut-Cassava Zone with a medium cropping season, intermediate rains, and a very short one

Very good yield potential (av. more than 80 % of the optimum)
Whole year: Mangoes

Good yield potential (av. more than 60–80 % of the optimum)1)
1st. rains. start norm. end of March: Coast comp. and Pioneer Hybrid maize, m. mat. white sorghum (70–80 %), m. mat. finger and bulrush millet; dolichos beans2), green grams2), cowpeas2), yam beans (tubers), sweet potatoes, sunflower like 252, m. mat. soya beans, trop. Lima beans7), groundnuts3), bambarra groundnuts3)6); cotton (with danger of rain in open bolls), roselle; tomatoes, egg plants, kales, chinese cabbage, chillies, sweet pepper, pumpkins, onions, water melons, cucumbers, garlic, guar10)
Whole year, best planting time b. of April: Sisal; cashew nuts3), bixa, pawpaws, West Indian avocadoes; cassava; guavas, senna, castor

Fair yield potential (av. 40–60 % of the optimum)1)
1st rains: Rice in seasonal flooded grasslands or semipermanent swamps5); pigeon peas (1st–2nd r.), chick peas on h. bl. soils after flooding (July–S.); simsim2) (fair-good); cabbage
2nd rains, start indistinctly m. O.: E. mat. foxtail millet, v. e. mat. dwarf sorghum (~ 40 %); green grams (fair-poor)
Whole year: Coconuts3), bananas, lemons and limes, oranges and grapefruit4), pineapples4), curcuma

Some marginal crops with poor yield potential (av. 20–40 % of the optimum)
2nd rains: Sweet potatoes (necessary to cultivate to keep plant material for the next long rains); cowpeas; simsim

Pasture and forage
Around 1 ha/LU on secondary high-grass savanna between relicts of semi-deciduous tropical forest. Grazing also in seasonal waterlogged areas; down to about 0.2 ha feeding Napier or Bana grass, siratro (Macroptilium atropurpureum) and centro (Centrosema pubescens); fodder legumes also to improve pasture and soil1); horse tamarind (Leucaena leucocephala)1) for browsing Mimosa pudica under coconut trees

L 3 m i (vs) = Coconut-Cassava Zone with a medium cropping season, intermediate rains, and a (weak) very short one

Small, potential almost the same as L 3 m i vs but no reliable cultivation in 2nd rains. Special conditions on the banks of Tana River for fruit trees, rice, and dry season cultivation of maize and chick peas with soil moisture in delta flood plains

L 3 m i = Coconut-Cassava Zone with a medium cropping season followed by intermediate rains

Good yield potential1)
1st rains, start norm. end of March: Coast comp. and Pioneer Hybrid maize (60–70 %); m. mat white sorghum (70–80 %), m. mat. finger and bulrush millet; cowpeas (~ 60 %)2), yam beans (tubers), sweet potatoes, sunflower like 252 or HS 301 A; m. mat. soya beans tomatoes, egg plants, kales, Chinese cabbage, chillies, sweet pepper, pumpkins, onions, water melons, cucumbers, garlic, okra, roselle, trop. Lima beans7), guar10)
Whole year: Sisal; mangoes, cashew nuts3), pawpaws, West Indian avocadoes, cassava3); bixa (good-fair), senna, castor

Fair yield potential1)
1st rains: M. mat. rice in seasonal flooded grasslands or semi-permanent swamps5); dolichos beans2), green grams2), m. mat. groundnuts3), bambarra groundnuts (Apr.–Aug.)3)6); simsim2), cotton, cabbage
Whole year: Coconuts3) (danger of bollrot disease), drought resistant bananas like Bocoboco and Zanzibarini pineapples4), citrus (fair poor)

Pasture and forage
More than 1 ha/LU on secondary high-grass savanna; feeding Napier or Bana grass and fodder legumes down to 0.2 ha/LU, siratro and centro to improve pasture and soil, horse tamarind for browsing1), Mimosa pudica under coconut trees

L 4 = *Cashewnut-Cassava Zone*

L 4 m/s i (vs) = *Cashewnut-Cassava Zone with a medium to short cropping season, intermediate rains, and a (weak) very short one*

Very small and transitional. Potential in first rains as L 4 m/s i but Lima and yam beans only fair in second rains almost as L 4 s/m i (vs)

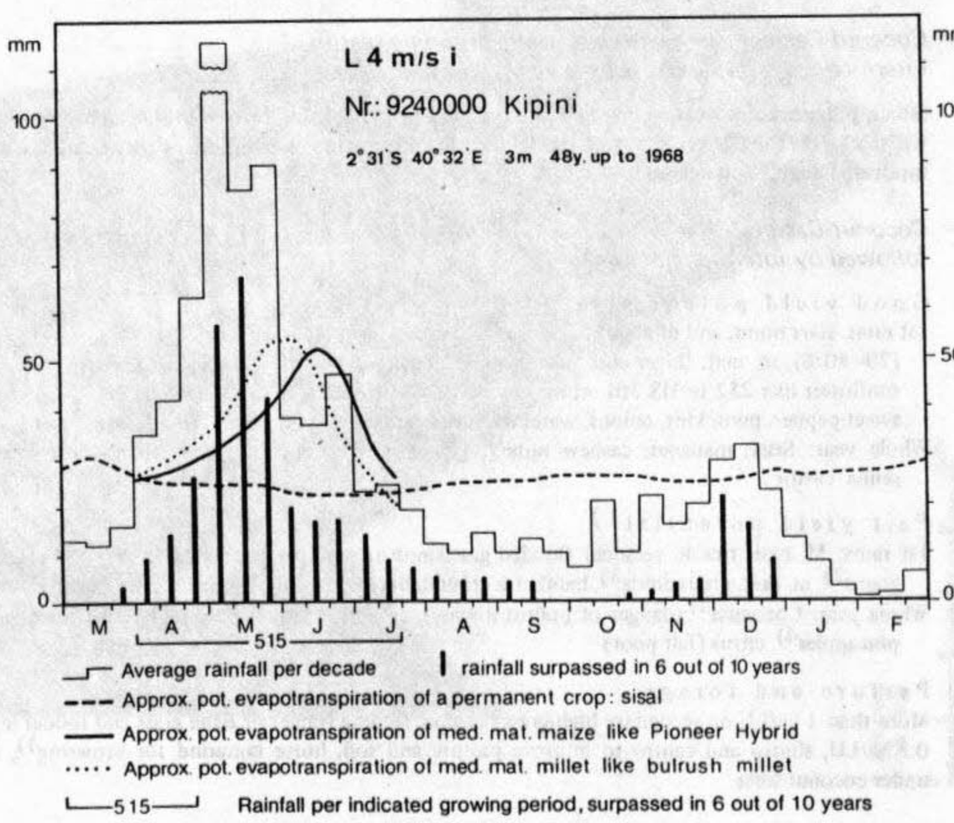
L 4 m/s i = *Cashewnut-Cassava Zone with a medium to short cropping season followed by intermediate rains*
(See Diagram Kipini)

Good yield potential[1)]
1st rains, start norm. end of March: Coast comp. and Pioneer Hybrid maize, m. mat. sorghum, m. mat. bulrush and finger millet; cowpeas (~ 60 %)[2)], dolichos beans; groundnuts[3)], bambarra groundnuts[3)6)] (Apr.–Aug.); e. mat. trop. Lima beans[7)], yam beans (tubers) sweet potatoes; m. mat. sunflower like 252; m. mat. soya beans on h. and m. soils, e. mat. soya beans on light soils; kales, onions, pumpkins, chillies, sweet pepper, okra, egg plants, Chinese cabbage, garlic, water melons, cucumbers, guar[10)]
Whole year: Cashew nuts[3)], cassava[3)]; sisal, mangoes

Fair yield potential[1)]
1st rains: E. mat. rice[5)] in semiperm. swamps; green grams (May/Je.–Aug./S.) and simsim[2)]; cotton, safflor; cabbages, tomatoes
Whole year: Pawpaws, senna, bixa

Some marginal crops with poor yield potential
Whole year: Bananas, coconuts

Pasture and forage
More than 1.5 ha/LU on secondary high-grass savanna; down to about 0.3 ha/LU feeding Bana grass, centro, siratro and Stylosanthes hamata (legumes also to improve pasture and soil), and planting horse tamarind for browsing. Dry forest patches on free draining land, doum palm savanna on lower places; tsetse flies near forest



L 4 s/m i (vs) = *Cashewnut-Cassava Zone with a short to medium cropping season, intermediate rains, and a (weak) very short one*

Very small transitional strip. Potential in 1st rains almost as L 4 s/m i; 2nd rains v. e. mat. foxtail millet and green grams fair to poor

L 4 s/m i = *Cashewnut-Cassava Zone with a short to medium cropping season followed by intermediate rains*

Potential almost as L 4 m/s i but Pioneer Hybrid maize, finger millet, sunflower 252, soya beans and cashew nuts only about 60 %, cowpeas[2] only fair .

L 4 s/m = *Cashewnut-Cassava Zone with a short to medium cropping season*

Potential almost as L 4 m/s i but cowpeas and simsim planted towards the end of 1st rains give only poor yields

L 4 s i (vs) = *Cashewnut-Cassava Zone with a short cropping season, intermediate rains, and a (weak) very short one*

Small and varying soils, potential see Lamu District

L 4 s i = *Cashewnut-Cassava Zone with a short cropping season followed by intermediate rains*

Very small, climatic potential see Lamu District, but local flooding and soils in Tana River Delta must be observed

L 4 s/sv i (vs) = *Cashewnut-Cassava Zone with a short to very short cropping season, intermediate rains, and a (weak) very short one*

Potential almost as L 4 s i (vs) but 1st rains start normally b. of April; soya beans only fair

L 5 = *Livestock-Millet Zone*

L 5 s/vs i = *Livestock-Millet Zone with a short to very short cropping season followed by intermediate rains*

Good yield potential
1st rains, start normally mid April: E. mat. sorghum (~ 60 %), e. mat. bulrush millet (awned var.,~ 60 %)[1], chick peas (late planted on h. bl. soils)
Whole year: Buffalo gourds (on light soils)[8], Marama beans[8]

Fair yield potential[1]
1st rains: Cowpeas and grams (May–Aug.); e. mat. sunflower, e. mat. groundnuts[3]; e. mat. bambarra groundnuts[3)6], e. mat. soya beans; onions
Whole year: Drought resistant cassava (~ 40 %), castor

Poor yield potential
1st rains: E. mat. local maize

Pasture and forage
More than 3 ha/LU on dry acacia bushland; down to about 0.5 ha/LU on art. pasture of buffel grass (Cenchrus ciliaris), feeding hay or silage of Mauritius and moth beans during dry season, and planting fodder shrubs like saltbush (Atriplex nummularia)

L 5 vs/s i (vs) = *Livestock-Millet Zone with a very short to short cropping season, intermediate rains, and a (weak) very short one*

Good yield potential[1]
1st rains, start norm. April: E. mat. foxtail millet; green grams; luffa gourds, water melons
Whole year: Buffalo gourds (on light soils)[8] and Marama beans[8]

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

1st rains: E. mat. bulrush millet (awned var.)[1], v. e. mat. sorghum (both grain crops fair-good); chick peas (late planted on h. bl. soils), cowpeas[1], blackgrams[1], e. mat. bambarra groundnuts[1]; v. e. mat. dwarf sunflower[1], simsim (May–Aug.)[1]

2nd rains, start norm. end of Oct.: Cowpeas for leaves, green grams (fair-poor)

Whole year: Sisal[1], castor[1], drought resistant cassava (fair-poor)[1], jojoba

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

2.5–4 ha/LU on sclerophytic evergreen bushland (partly tsetse infested), around 2 ha/LU on seasonally flooded grassland; down to about 0.5 ha/LU on art. pasture of buffel grass, feeding leaves of legumes like Mauritius or Marama beans, and planting fodder shrubs like saltbush or trees like Gao tree (Acacia albida, on good soils)

L 5 (vs/s) i = *Lowland Livestock-Millet Zone with a (weak) very short cropping season followed by intermediate rains*

Very small and unimportant

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

Whole year: Buffalo gourds (on light soils)[8] and Marama beans[8]

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

1st rains, start around b. of April: E. mat. dwarf sorghum, e. mat. bulrush millet (awned var.) green grams, luffa gourds

Whole year: Sisal

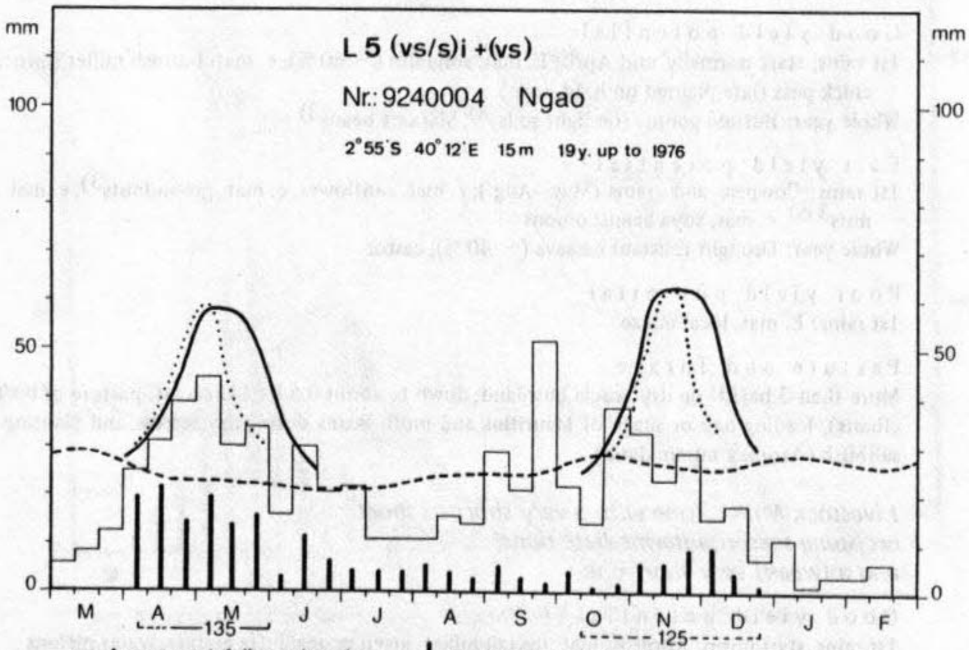
P a s t u r e   a n d   f o r a g e

Almost as L 5 vs/s i (vs) but stocking rates about 20 % lower

L 5 (vs/s) i + (vs) = *Livestock-Millet Zone with a (weak) very short to short cropping season, intermediate rains, and a (weak) very short one*

(See Diagram Ngao)

Almost as L 5 vs/s i (vs) but good potential there is only fair here; stocking rates about 10 % lower



L 5 = *Lowland Livestock-Millet Zone with a (weak)*
(vs) + i *very short cropping season and intermediate rains*

Fair to poor yield potential
1st rains, start norm. b. of April: V. e. mat. foxtail millet (40–50 %), v. e. mat. bulrush millet; green grams
Whole year: Buffalo gourds (on light soils)[8], Marama beans[8], ye-eb nuts[9], sisal

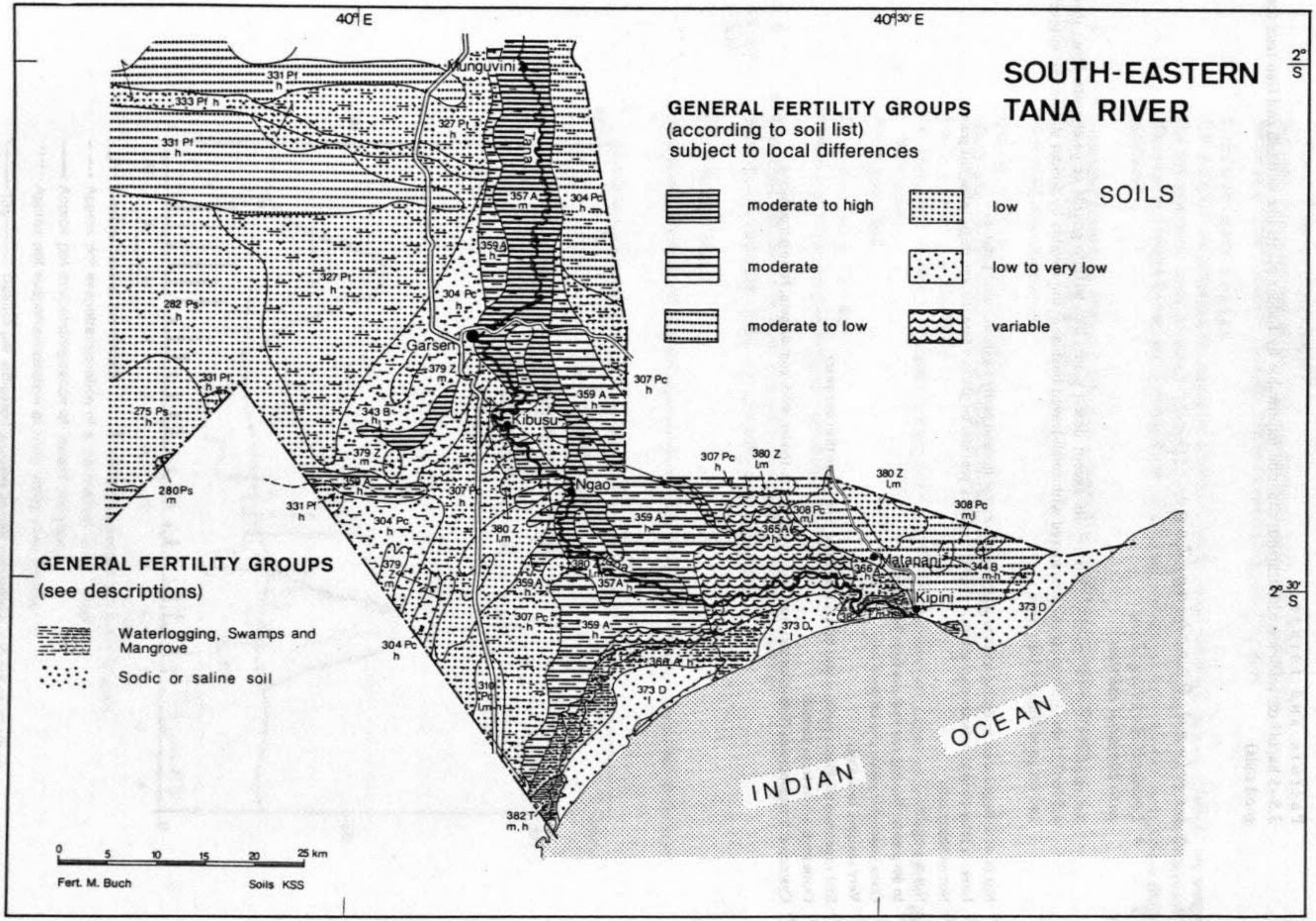
Pasture and forage
3.5–5 ha/LU on small-leaved bushland; situation improvable by fodder plants like saltbush and Gao trees (on good soils)

L 6 = *Lowland Ranching Zone*

L 6 = *Lowland Ranching Zone*
b r *with bimodal rainfall*

No rainfed crops for good or fair results except desert plants like buffalo gourds or ye-eb nuts. More than 4.5 ha/LU on short grass savanna mixed with small-leaved bushland; improvable by fodder shrubs like saltbush and on good soils by Gao trees

1) Not in waterlogged areas or during times of waterlogging, except rice and partly sorghum, sweet potatoes
2) Inter- or relay-planted in maize during June, cowpeas and chick peas also on places where the waterlogging has just gone
3) Not on heavy soils
4) Not top quality
5) In deep water floating rice varieties from Bangladesh
6) Gives reasonable yields also on poor soils
7) Very sensitive to salinity
8) Still experimental. Plants produce also tubers after some time (more than one year)
9) Cordeauxia edulis from Somalia
10) Cyamopsis tetragonolobia (Leguminosae) from India; vegetable or fodder, seeds contain gum; Nitrogen collector


SOUTH-EASTERN TANA RIVER
SOILS
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
moderate to high
moderate
moderate to low
low
low to very low
variable
GENERAL FERTILITY GROUPS
(see descriptions)
Waterlogging, Swamps and Mangrove
Sodic or saline soil
INDIAN OCEAN
40° E
40°30' E
2° S
2°30' S
Munguvini
Tana
Garsen
Kibusu
Ngao
Matanani
Kipini
0 5 10 15 20 25 km
Fert. M. Buch
Soils KSS

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

The extensive "grey-clay" plain of Garissa district merges gradually into the coastal plains of the Lamu district. Relief differences are small but important for soil water conditions. On both sides of the Tana river fertile alluvial plains occur which give way to the deltaic environment encountered west of Kipini. The main problems for land use there are water regulation and irrigation.

Along the coast, dunes are found, backed by swamps or floodplains; then a belt of older and younger coastal beach ridges occupy one zone of the district in an east-west direction. The northern and northwestern part of the district consists of sedimentary plains of upper river terraces and of large alluvial fans.

Marine (non)-consolidated sediments are the parent rock for most of the coastal plains (Pc). In the southern part of the district soils of unit 307 Pc of low fertility occur. Sometimes they are also associated with less fertile soils of unit 304 Pc.

Soils of units 379 Z and 380 Z of low fertility are encountered on slightly higher topography, as they are found on former coastal beach ridges, and often orientated in a SW-NE direction. Soils of unit 373 D, developed on dunes and of low fertility, are found along the coast.

Lower topographical positions on the plains are typical bottomlands (B), like soils of units 343 B of high fertility and 344 B of low to moderate fertility. Alluvial soils (A) of the Tana river floodplains are shown in map units 357 A, 359 A, 365 A, 366 A, 368 A and 369 A. In general, they are of a moderate to high fertility.

SOILS ON "SEALING LOAM" PLAINS

Soils developed on Plio-Pleistocene bay sediments (Marafa beds), (little or not remodelled; flat surface, dot pattern)

275 Ps = imperfectly drained, moderately deep, brown, extremely firm, moderately calcareous, non-saline but moderately sodic clay
h[1)] loam (hardpan), with a thin topsoil of sealing sandy loam (luvo-orthic SOLONETZ)

SOILS ON LOWER-LEVEL PLAINS ("GREY CLAY" PLAINS)

Soils developed on remodelled Plio-Pleistocene bay sediments (Marafa beds)

282 Ps = imperfectly drained, deep, brown, very firm, moderately calcareous, moderately saline and moderately sodic clay loam (hard-
h pan), with a thin topsoil of strongly sealing sandy clay loam (luvo-orthic SOLONETZ, saline phase)

283 Ps = imperfectly drained to poorly drained, very deep, dark greyish brown, very firm, slightly calcareous, moderately to strongly
h saline and predominantly strongly sodic clay (hardpan); in places strongly calcareous and/or gypsic (orthic SOLONETZ, saline phase and gypsic/calcic phase)

SOILS ON COASTAL PLAINS

Soils developed on higher-level lagoonal deposits (Kilindini sands)

304 Pc = imperfectly drained, deep to very deep, very dark greyish brown to olive brown, mottled, firm to very firm, sandy clay to clay;
h moderately calcareous and moderately saline/sodic throughout or in deeper subsoil (ortho-luvic SOLONETZ and vertic LUVISOLS, saline-sodic phase)

Soils developed on lower-level lagoonal deposits (Kilindini sands)

307 Pc = imperfectly to poorly drained, very deep, grey to brown, mottled, very firm clay (hardpan), slightly calcareous and strongly
h saline and sodic throughout or in deeper subsoil (gleyic SOLONETZ; with gleyic or verto-luvic PHAEOZEMS, saline-sodic phase)

308 Pc = moderately well drained, very deep, yellowish brown to greyish brown, mottled, very firm, sandy loam to sandy clay loam,
m, l with a very thick (60–100 cm) topsoil of light brownish grey to yellow, friable loamy sand; with inclusions of many small bottomlands of soil unit 344 B m–h gleyic to albic LUVISOLS, sodic phase; with ferralo-chromic LUVISOLS, dystric or solodic PLANOSOLS and cambic ARENOSOLS

Soils developed on raised-coral-reef limestone, with admixture of lagoonal deposits

310 Pc = well drained, deep, dark red to reddish brown, friable, sandy clay loam to sandy clay, with topsoil of loamy sand (rhodic
l, m–h (FERRALSOLS)

SOILS ON SEDIMENTARY PLAINS OF UPPER RIVER TERRACES

Soils developed on sediments mainly from Plio-Pleistocene bay sediments

327 Pt = moderately well drained to imperfectly drained, very deep, dark reddish brown to dark brown, firm, moderately calcareous,
h moderately saline and moderately to strongly sodic, slightly cracking clay (orthic SOLONETZ, saline phase)

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 developed on sediments mainly from undifferentiated Basement System rocks

329 Pt h = well drained, deep, dark reddish brown to reddish brown, friable, sandy clay loam to sandy clay, over pisocalcic material (calcic LUVISOLS, pisocalcic phase)

SOILS ON SEDIMENTARY PLAINS OF LARGE ALLUVIAL OLDER FANS

Soils developed on sediments mainly derived from bay sediments

331 Pf h = complex of well drained to imperfectly drained, very deep, reddish brown to grey, firm clay soils of varying calcareousness, salinity and sodicity, in many places with strongly sealing topsoil; with inclusions of well drained, very deep, brown, loose loamy sand (levee complex) luvo-orthic SOLONETZ, saline phase; with solodic PLANOSOLS, saline phase, chromic VERTISOLS, saline-sodic phase and cambic ARENOSOLS)

SOILS ON SEDIMENTARY PLAINS OF LARGE ALLUVIAL YOUNGER FANS

Soils developed on sediments mainly derived from bay sediments

333 Pf h = moderately well drained, very deep, dark reddish brown to dark brown, firm, moderately calcareous, moderately to strongly saline and strongly sodic, sandy clay to clay (levee complex) (orthic SOLONETZ, saline phase; with orthic SOLONSCHAKS, sodic phase)

SOILS ON BOTTOMLANDS

Soils developed on infill from lagoonal deposits (Kilindini sands)

343 Pf h = imperfectly drained to poorly drained, very deep, light brownish grey to brown, mottled, firm to very firm, clay; in places sodic and cracking (higher-level depressions) (gleyic PHAEOZEMS; with verto-luvic PHAEOZEMS and pellic VERTISOLS, sodic phase)

344 B m–h = poorly drained, very deep, greyish brown, mottled, very firm clay (hardpan), abruptly underlying a topsoil of friable humic sandy clay loam (lower-level depressions) (humic PLANOSOLS)

SOILS ON FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

357 A m = well drained to imperfectly drained, very deep, dark brown to yellowish brown, stratified, strongly calcareous, micaceous, predominantly loamy soils (calcaric FLUVISOLS)

359 A h = imperfectly drained to poorly drained, very deep, dark reddish brown to dark greyish brown, firm to very firm, cracking clay; in many places mottled and with a calcareous, saline and sodic deeper subsoil (chromic VERTISOLS, saline-sodic phase)

365 A h = poorly drained, deep, very dark grey, mottled, firm clay, with a sulfidic deeper subsoil (mollic GLEYSOLS, thionic phase)

366 A h = very poorly drained, deep, dark grey, soft (unripe) strongly saline and strongly sulfidic, clay (thionic LUVISOLS)

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 REED SWAMPS

369 A h = poorly drained to very poorly drained, very deep, dark greyish brown to dark olive grey, firm to very firm, strongly calcareous, strongly saline and strongly sodic clay; in many places with fragipans at various depths (gleyic SOLONCHAKS, sodic phase and partly fragipan phase)

SOILS ON DUNES

373 D l = excessively drained, very deep, brown to pale brown, loose, sand to loamy sand (cambic ARENOSOLS)

SOILS ON COASTAL BEACH RIDGES

Soils developed on older coastal beach ridges

379 Z m = well drained, very deep, red, very friable, sandy clay loam (rhodic FERRALSOLS)

Soils developed on younger coastal beach ridges often covering coral rock

380 Z l, m = moderately well drained, very deep, dark brown to reddish brown, firm to very firm, often moderately sodic, sandy clay loam, underlying a thick topsoil of friable loamy sand, in places shallow over coral rock (ferralo-chromic/orthic ACRISOLS, sodic phase; with solodic PLANOSOLS)

SOILS IN MANGROVE SWAMPS

382 T m–h = very poorly drained, very deep, olive to greenish grey, soft (unripe), excessively saline and moderately to strongly sodic, loam to clay, often with sulfidic material (thionic FLUVISOLS and gleyic SOLONCHAKS)

Soil discription from Kenya Soil Survey:
Exploratory Soil Map and Agro-climatic Zone Map of Kenya, scale 1 : 1.000.000. Expl. Soil Survey Rep. E1, Nairobi 1982. See this map also for colours; symbols simplified here.

POPULATION AND LAND

At the time of the last population Census in September 1979, 31,891 people (Table 3) were living in the south-eastern part of the Tana River District. As nearly the whole district is covered by Ranching Zone L 6, we only deal with the South-East, where L 3 (Coconut-Cassava Zone), L 4 (Cashewnut-Cassava Zone) and L 5 (Lowland Livestock-Millet Zone) occur.

As only 1,007 people (= 3.2 % of the total population, Table 3) were registered in the Garsen trading centre, nearly 97 % of the total population depended on agriculture and livestock for a living. These people lived on a total rural area of 918,700 ha (Table 5) of which 855,000 ha (= 93 % of the total rural area, Table 5) may be called agricultural land (including ranching land).

Statistically 158.51 ha were available for an average household of 5.67 people and 27.68 ha per person (Table 4,5). However in the Ndera location (only L 6) statistically 60.82 ha were available per household, which indicates that this area is already quite densely populated if ranching is the only possibility. However, more ranching is still possible in the Bilisa location (Table 5), but only if the people are able to solve the problem of water-supply during the dry periods. Further possibilities to improve the agricultural situation are given in the cultivatable areas in the Chara location, where 68 % of the agricultural land belong to Zone L 3 and L 4 (together 40,500 ha, Table 5); statistically 40.84 ha were available per household, although here soil and flooding problems occur. These problems can be partly solved by blood regulation, and further space for settlement can be created by irrigation.

SOUTH-EASTERN TANA RIVER DISTRICT

TABLE 3: POPULATION PER LOCATION AND DIVISION[1)]
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Mbalambala	1 930	1 851	3 781	652	1 787	2
Saka	1 971	1 916	3 887	666	3 705	1
Madogo	4 983	4 900	9 883	1 996	2 672	3
Naninghi	2 857	2 774	5 631	1 079	3 240	1
Bura	2 329	2 136	4 465	1 192	1 995	2
Northern Division	14 070	13 577	27 647	5 585	13 399	2
Wayu	4 034	3 694	7 728	1 256	11 129	0
Milalulu	2 809	2 870	5 679	1 093	479	11
Zubaki	5 820	5 655	11 475	2 295	367	31
Ndura	1 786	1 965	3 751	667	282	13
Kinakomba	1 070	1 106	2 176	411	184	11
Gwano	972	1 082	2 054	324	208	9
Central Division	16 491	16 372	32 863	6 046	12 649	2
Bilisa	4 181	3 967	8 148	1 484	6 678	1
Ndera	1 426	1 530	2 956	490	313	9
Salama	2 550	2 578	5 128	875	467	10
Ngao	3 961	3 990	7 951	1 302	949	8
Chara	3 968	3 740	7 708	1 457	782	9
Southern Division	16 086	15 805	31 891	5 608	9 189	3
Tana River District	46 647	45 754	92 401	17 239	38 694	2

1) Locations and division of the whole Tana River District. The south-eastern part is represented by the Southern Division.

SOUTH-EASTERN TANA RIVER DISTRICT

TABLE 4: 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:						
Mbalambala	651	3.33	1.42	0.73	0.33	5.81
Saka	665	3.56	1.57	0.46	0.26	5.85
Madogo	2000	3.60	0.51	0.48	0.35	4.94
Nanighi	1082	3.09	1.30	0.54	0.27	5.20
Bura	1192	2.39	0.69	0.46	0.20	3.74
Division: Northern	5590	2.98	1.16	0.51	0.29	4.95
Location:						
Wayu	1268	3.46	1.63	0.52	0.44	6.05
Milalulu	1089	3.33	1.08	0.59	0.22	5.21
Zubaki	2267	2.92	0.97	0.68	0.36	4.93
Ndura	669	3.77	1.35	0.61	0.17	5.61
Kinakomba	409	3.40	1.18	0.52	0.22	5.32
Gwano	322	3.43	1.51	0.89	0.56	6.38
Division: Central	6024	3.24	1.20	0.62	0.33	5.40
Location:						
Bilisa	1473	3.08	1.31	0.81	0.32	5.52
Ndera	489	3.46	1.40	1.07	0.11	6.04
Salama	870	3.33	1.51	0.91	0.14	5.89
Ngao	1317	3.19	1.31	1.21	0.32	6.04
Chara	1456	2.93	1.05	0.99	0.24	5.21
Division: Southern	5605	3.13	1.29	0.99	0.25	5.67
DISTRICT: TANA RIVER	17219	3.12	1.22	0.71	0.29	5.34

a) Source: Central Bureau of Statistics (CBS). Locations and Divisions of the whole Tana River District. The south-eastern part is represented by the Southern Division.

b) Average figures, include one and two persons per households as well

TABLE 5: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON[1)]

Location/Division without townships	in '00 ha = sqkm					in '00 ha = sqkm				in ha	
	Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Forest Res., lakes, swamps	Others (roads, home-steads, rivers...)	Agri-cultural land	Area in agro-ecological zones AEZ: L 3	L 4	L 5	L 6	Agric. land per house-hold	person
Bilisa	6 676		30	288	6 358			80	6 278	602.08	103.65
Ndera	313			15	298				298[2)]	60.82	10.08
Salama	467			22	445			105	340[2)]	50.86	8.68
Ngao	949		50	45	854		13	595	246[2)]	65.59	10.74
Chara	782		140	47	595	280	125	190[2)]		40.84	7.72
Southern Division	9 187[3)]		220[3)]	417	8 550	280	138	970	7 162[2)]	158.51	27.68

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

2) Special cultivation possibilities exist near river banks and irrigation is possible with flood control

3) Mangrove swamps are not included

AGRICULTURAL STATISTICS [1)]

There are no reliable statistics for the area planted with the major cash crops coconuts, cashew nuts, and cotton. The ginnery in Hola is situated outside the south-eastern part of the Tana River District.

1) It is hoped that the results of a comprehensive farm survey will be available towards 1985/86, replacing this tentative information.

TANA RIVER DISTRICT

TABLE 6: COTTON PRODUCTION[a)]

Ginnery Zone	Year				
	75/76	76/77	77/78	78/79	79/80
Hola					
Seed Cotton in t	-	-	1430	1391	1257
Bales	-	-	2510	2441	2206

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

NO SMALL FARM SURVEY

LAMU DISTRICT

Contents **District page**

NATURAL POTENTIAL

INTRODUCTION

It is difficult to define the climatic potential accurately because there are very few rainfall recording stations. The amount of rainfall in the first rains decreases from a coastal strip of about 10 km wide to the hinterland at a rate of about 100 mm per 5 km. The second rains increase from the coast for the first 10 km, and then drop again. The intermediate rains between both seasons (very important for relay-planted crops like simsim and cowpeas) are also most frequent a few kilometers inland from the coast. For these reasons the highest average annual rainfall above 1,000 mm occurs about 5–20 km inland, interrupted by Mkunumbi Bay. From the climatic point of view, this high rainfall zone includes the Coconut-Cassava Zone L 3, but the soils are often not suitable for those leading crops. They are in many places waterlogging or, near Hindi, too heavy. Slow growth of coconuts increases the danger of pests and diseases (esp. rhinoceros beetle and bollrot disease).

The Cashewnut-Cassava Zone L 4 extends around AEZ L 3. Towards the hinterland, the rainfall in dry years is often not concentrated enough for cassava to encourage the formation of big tubers. The rainfall distribution also becomes less suitable for cashewnuts: the small rains fall during the flowering period and in wet years cause poor fruit setting and infestations of black spots on the nuts. Northwards this danger lessens but there is also a general decrease in rainfall in this direction. The actual boundary of L 4 is very difficult to define because apart from Kiunga on the coast there is no rainfall station there. The AEZ map gives an optimistic view, the agro-climatic map (see back cover of Vol. IIA) a pessimistic one. The real extension is important for settlement prospects[1)] in this sparsely populated area.

The Agro-Ecological Zone L 5 should be left for ranching land (like L 6) until technologies are available which allow a sufficient return from agriculture.

1) For a sample, see the pre-feasibility study of the Seminar fuer Landwirtschaftliche Entwicklung: The Hindi-Magogoni Settlement Scheme in Lamu District. Berlin 1978.

LAMU 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	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
9141000 8 m	Kiunga	23	Average	560	0	0	8	89	169	95	65	18	35	53	17	11
9240001 9 m	Lamu Met. Station	67	Av.	960	6	3	23	136	338	200	70	40	41	39	36	28
			60 % rel.[1)]	892	0	0	0	85	248	115	57	29	16	11	6	8
9240003 3 m	Witu Plantations	44	Av.	1 095	26	9	36	129	291	150	82	52	65	58	96	99
			60 %	862	1	0	12	80	246	105	63	33	29	20	67	66
9241000 8 m	Faza	45	Av.	863	5	2	16	122	276	162	81	45	45	42	45	24
			60 %	785	0	0	0	72	205	89	60	31	19	12	8	6
9241002 8 m	Siyu	10	Av.	961	0	0	35	160	293	159	64	34	66	81	46	23

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

LAMU DISTRICT

TABLE 2: TEMPERATURE DATA

No. and altitude	Name of Station	AEZ[1)]	Kind of records	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Year	Years of rec.
9240001	Lamu Met.	L 4	Mean max.	30.6	31.2	32.1	30.7	28.8	28.0	27.3	27.5	28.0	29.1	30.4	30.8	29.5	
9 m	Station	lp	Mean temp.	27.4	27.9	28.8	27.9	26.5	25.6	25.1	25.2	25.6	26.6	27.4	27.6	26.8	10
			Mean min.	24.3	24.7	25.6	25.2	24.3	23.4	22.9	23.0	23.3	24.1	24.4	24.5	24.1	
			Abs. min.	20.7	20.9	21.7	21.1	20.4	20.0	19.5	20.4	20.2	20.8	20.6	21.5	19.5	

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

LAMU DISTRICT

TABLE 3: CLIMATE IN THE AGRO-ECOLOGICAL ZONES

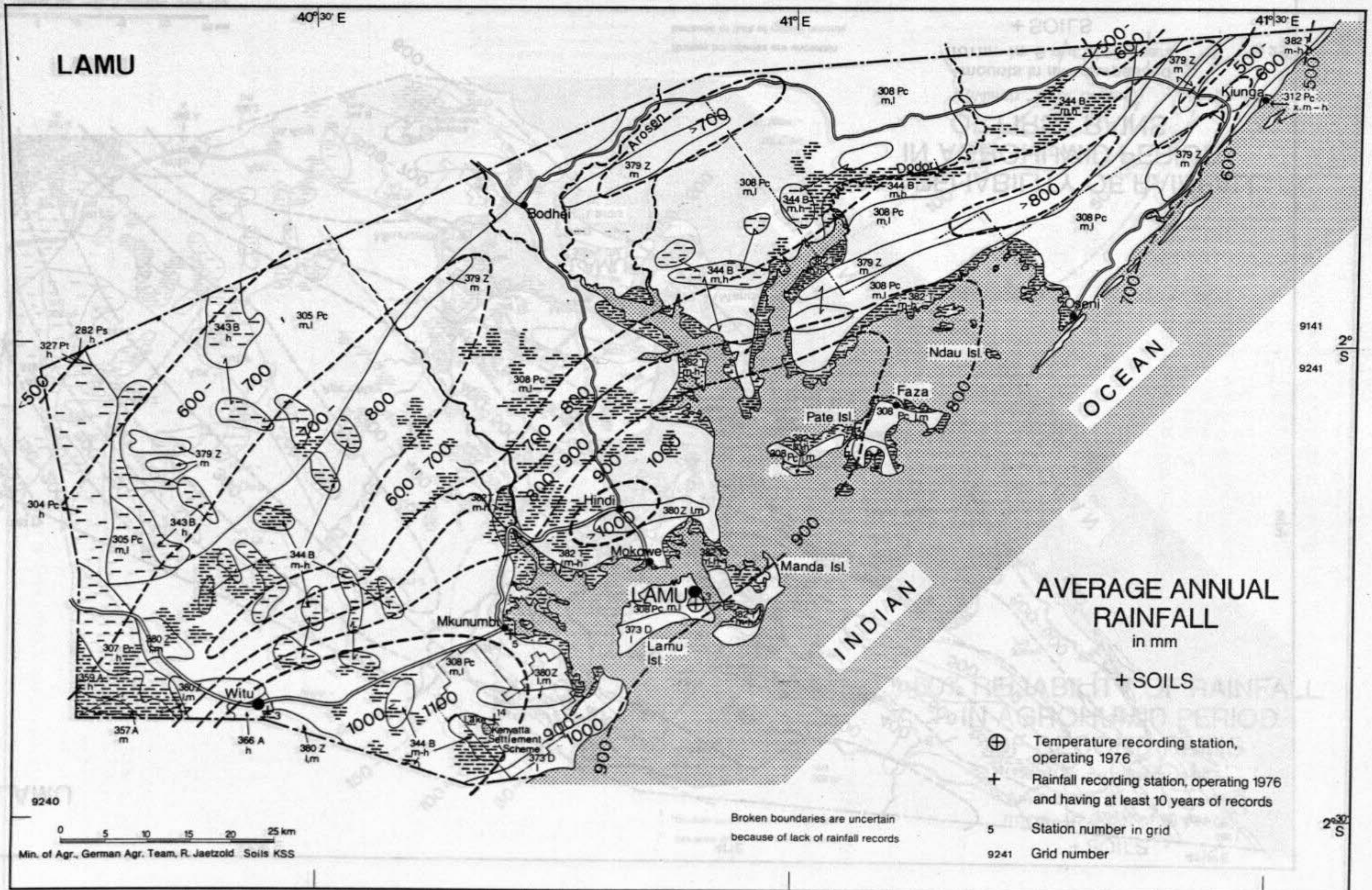
Agro-Ecological Zone	Subzone	Altitude in m	Annual mean temperature in °C	Annual av. rainfall in mm	60 % reliability of rainfall[1)] 1st rains in mm	2nd rains in mm	60 % reliability of growing period 1st rains in days	2nd rains in days	Total[2)] in days[3)]
L 3[4)]	m i vs			1 000–1 100	600–700	150–200	135–155	40–55	175–210
Coconut-	m i (vs)	1–80	27.0–26.5	980–1 100	600–700	130–180	135–155	40–50	175–205
Cassava Zone	m i			950–1 050	600–700	80–130	135–155	<40	–
	m/s i (vs)			Very small and transitional					
	m/s i			750– 980	550–630	120–150	115–135	<30	–
	m/s i + i			900–1 000	550–650	70–120	115–135	<40	–
L 4[4)]	s/m i			650– 950	500–600	40–130	105–115	–	–
Cashewnut-	s/m i (vs)	1–100	27.0–26.4	Very small, transitional strip					
Cassava	s/m			880– 920	580–620	<50	105–115	–	–
Zone	s i (vs)			680– 900	450–550	130–180	85–105	40–50	125–155
	s i			700– 800	400–530	50–130	85–105	–	–
	s			800– 850	500–550	<50	85–105	–	–
	s/vs i (vs)			680– 850	350–450	100–180	75– 85	40–50	105–135
	(s/vs) 1 + (vs)			580– 680	200–350	150–180	75– 80	40–50	–
L 5[4)]	s/vs i			500– 600	280–400	<50	75– 85	–	–
Lowland	vs/s i (vs)			620– 750	350–400	150–200	55– 75	40–50	95–125
Livestock-	(vs/s) i + (vs)	1–70	27.0–26.6	550– 650	170–250	130–160	55– 70	40–50	–
Millet Zone	vs/s			480– 520	180–280	<50	55– 75	–	–
	(vs) + i			550– 580	130–180	100–130	40– 55	<40	–
L 6[4)]									
Lowland	b r	60–70	27.0–26.9	<550	<130	<100	<40	<30	–
Ranching Zone									

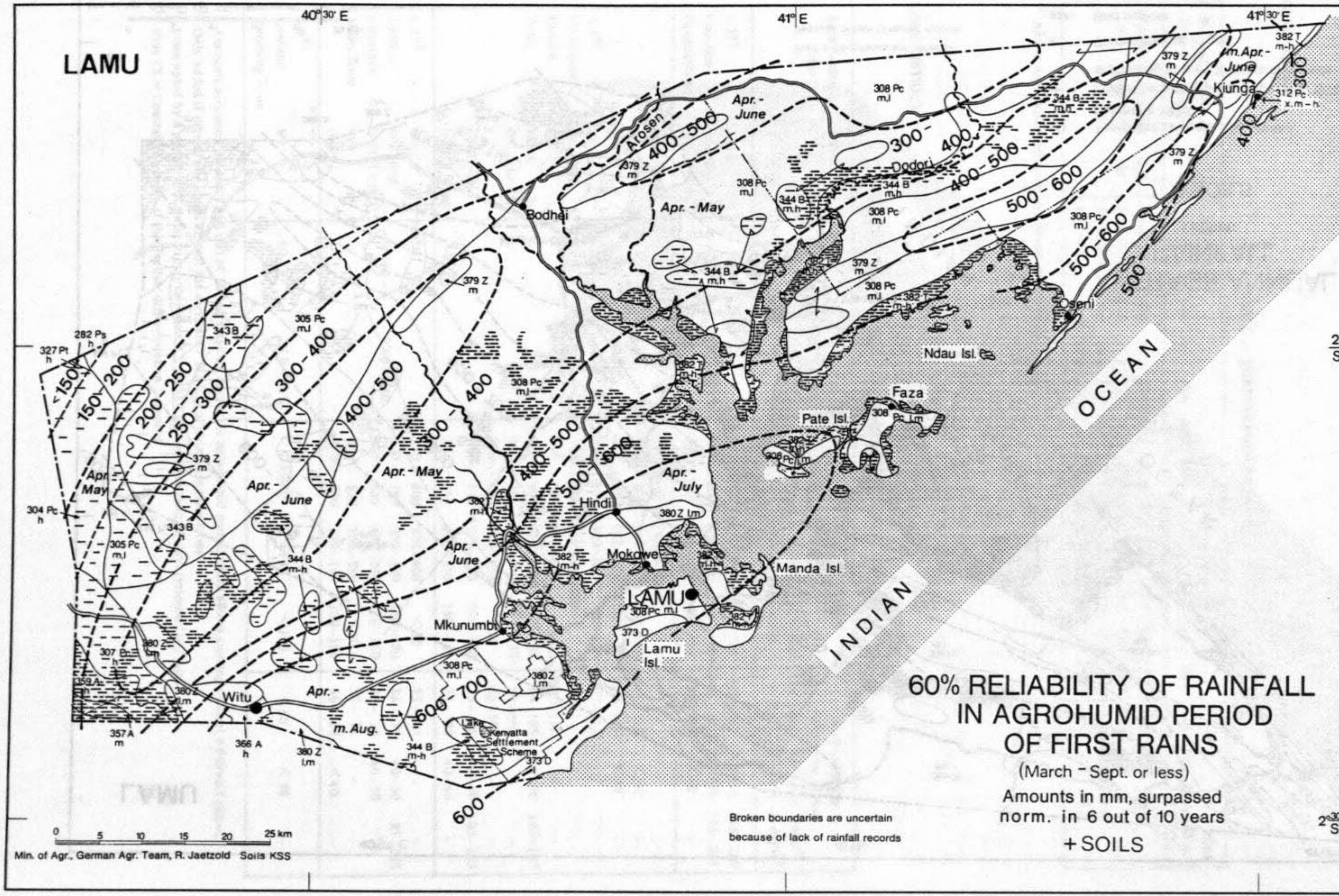
1) Amounts surpassed normally in 6 out of 10 years, falling during the agro-humid period which allows growing of most cultivated plants.

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

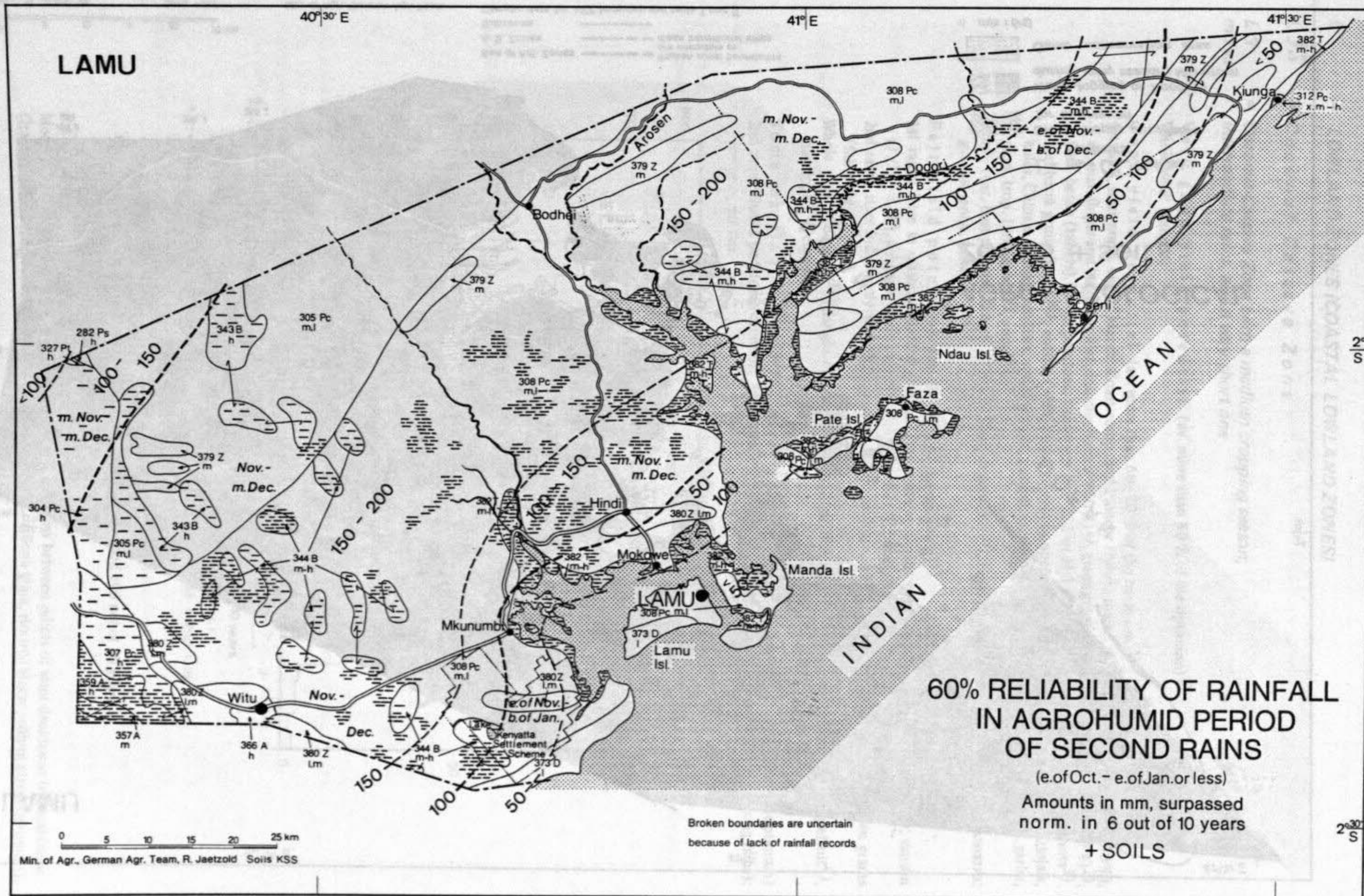
3) Interrupted by a period with water supply between 0.2 and 0.4 E_o for more than 50 days (intermediate rains)

4) Here CL = Coastal Lowlands, if this further differentiation is wanted.

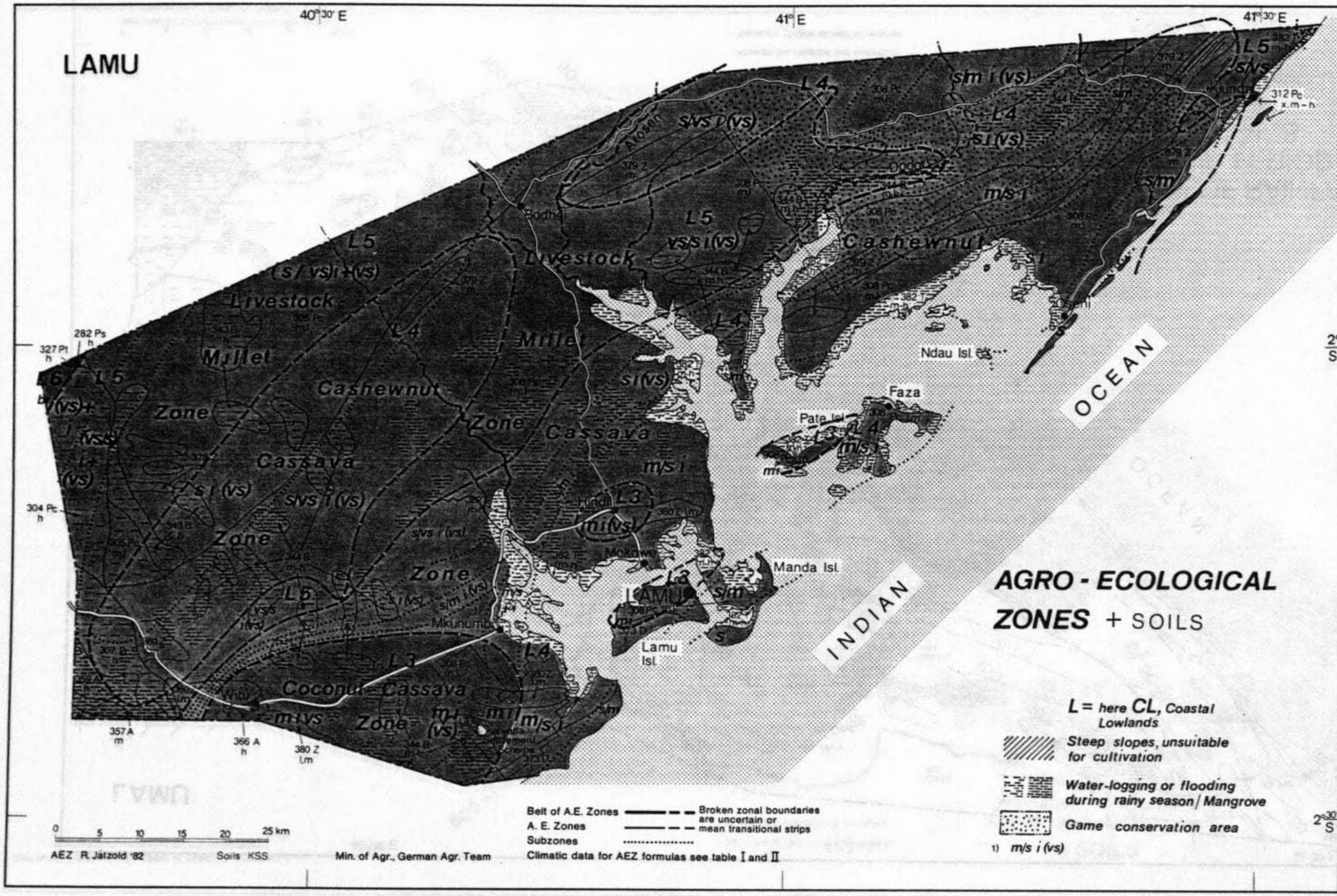

LAMU
AVERAGE ANNUAL
RAINFALL
in mm
+ SOILS
Temperature recording station, operating 1976
Rainfall recording station, operating 1976 and having at least 10 years of records
5 Station number in grid
9241 Grid number
Broken boundaries are uncertain
because of lack of rainfall records
INDIAN
OCEAN
Kiunga
Dodori
Bodhei
Arosen
Oseni
Ndau Isl.
Faza
Pate Isl.
Manda Isl.
Hindi
Mokowe
LAMU
Lamu Isl.
Mkunumbi
Witu
Kenyatta Settlement Scheme
40°30' E
41° E
41°30' E
2° S
2°30' S
9141
9241
9240
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS



LAMU
60% RELIABILITY OF RAINFALL IN AGROHUMID PERIOD OF FIRST RAINS
(March - Sept. or less)
Amounts in mm, surpassed norm. in 6 out of 10 years
+ SOILS
Broken boundaries are uncertain because of lack of rainfall records
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS
40°30' E
41° E
41°30' E
2° S
2°30' S
INDIAN
OCEAN
Kiunga
Dodori
Oseni
Bodhei
Arosen
Hindi
Mokowe
Mkunumbi
Witu
LAMU
Lamu Isl.
Manda Isl.
Pate Isl.
Faza
Ndau Isl.
Lake Kenyatta Settlement Scheme
Apr. - June
Apr. - May
Apr. - July
m. Apr. - June
Apr. - m. Aug.
<150
150 - 200
200 - 250
250 - 300
300 - 400
400 - 500
500 - 600
600 - 700
300
400
500
600



LAMU
40°30' E
41° E
41°30' E
2° S
2°30' S
60% RELIABILITY OF RAINFALL
IN AGROHUMID PERIOD
OF SECOND RAINS
(e.of Oct.– e.of Jan.or less)
Amounts in mm, surpassed
norm. in 6 out of 10 years
+ SOILS
Broken boundaries are uncertain
because of lack of rainfall records
0 5 10 15 20 25 km
Min. of Agr., German Agr. Team, R. Jaetzold Soils KSS
INDIAN
OCEAN
Kiunga
Dodori
Bodhei
Arosen
Hindi
Mokowe
Mkunumbi
Witu
LAMU
Lamu Isl.
Manda Isl.
Pate Isl.
Faza
Ndau Isl.
Oseni
Kenyatta Settlement Scheme
m. Nov. - m. Dec.
e. of Nov. - b. of Dec.
Nov. - m. Dec.
Nov. - Dec.
e. of Nov. - b. of Jan.
150 - 200
100 - 150
50 - 100
<50
<100
305 Pc m,l
308 Pc m,l
344 B m-h
343 B h
379 Z m
380 Z l,m
382 T m-h
312 Pc x,m-h
282 Ps h
327 Pt h
304 Pc h
307 B h
357 A m
366 A h
373 D l


LAMU
AGRO - ECOLOGICAL
ZONES + SOILS
40°30' E
41° E
41°30' E
2° S
2°30' S
INDIAN
OCEAN
Livestock
Millet
Cashewnut
Cassava
Zone
Coconut
Cassava
Zone
L5
L4
L3
L6
Bodhei
Mokowe
Mkunumbi
Witu
Faza
Pate Isl.
Manda Isl.
Lamu Isl.
LAMU
Ndau Isl.
Kiunga
312 Pc
x.m - h
282 Ps
h
327 Pt
h
304 Pc
h
357 A
m
366 A
h
380 Z
l,m
L = here CL, Coastal Lowlands
Steep slopes, unsuitable for cultivation
Water-logging or flooding during rainy season / Mangrove
Game conservation area
1) m/s i (vs)
Belt of A.E. Zones
A. E. Zones
Subzones
Broken zonal boundaries are uncertain or mean transitional strips
0 5 10 15 20 25 km
AEZ R. Jätzold '82
Soils KSS
Min. of Agr., German Agr. Team
Climatic data for AEZ formulas see table I and II

AGRO-ECOLOGICAL ZONES

L = *LOWLAND ZONES (COASTAL LOWLAND ZONES)*

L 3 = *Coconut-Cassava Zone*

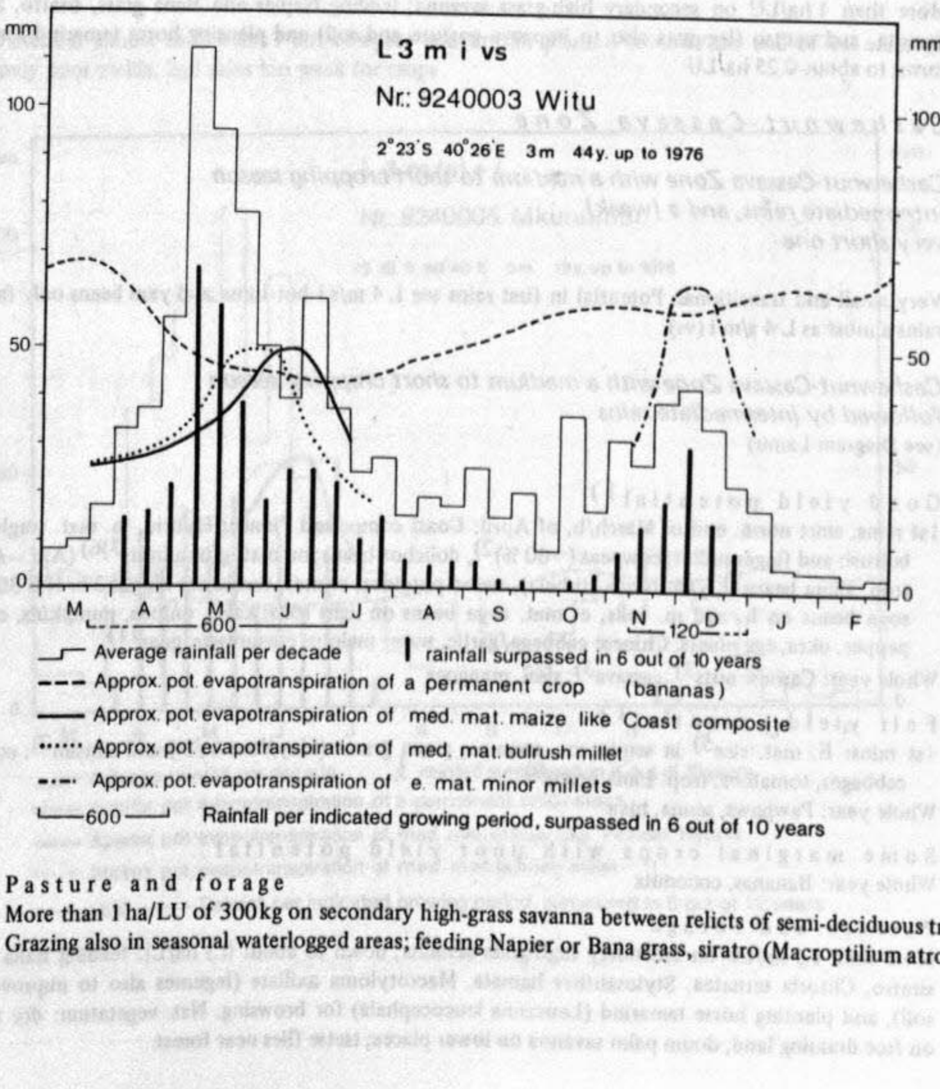
L 3 m i vs = *Coconut-Cassava Zone with a medium cropping season, intermediate rains, and a very short one*

Very good yield potential (av. more than 80 % of the optimum)[1)]
Whole year: Mangoes

Good yield potential (av. more than 60–80 % of the optimum)[1)]
1st rains, start norm. end of March: Coast comp. and Pioneer Hybrid maize, m. mat. finger and bulrush millet; dolichos beans (~60 %)[2)], green grams (60–70 %)[2)], cowpeas (60–70 %)[2)], yam beans (tubers), sweet potatoes; sunflower like 252 or H S 301 A, m. mat. soya beans, groundnuts[3)], bambarra groundnuts[3)6)]; cotton (with danger of rain in open bolls), roselle; tomatoes, egg plants, brinjals, kales, Chinese cabbage, chillies, sweet pepper, pumpkins, onions, sweet and water melons, cucumbers, garlic, okra, trop. Lima beans[9)], guar[11)]
Whole year, best planting time b. of April: Sisal; cashew nuts[3)], bixa, pawpaws, West Indian avocadoes; cassava; guavas, senna, castor

Fair yield potential (av. 40–60 % of the optimum)[1)]
1st rains: Rice in seasonal flooded grasslands or semi-permanent swamps[5)]; pigeon peas (1st-2nd r.); simsim (J./Jy.–S.O.); cabbage, chick peas on h. bl. soils after flooding (July–S.)
2nd rains, start indistinctly mid Oct.: E. mat. foxtail millet, v. e. mat. dwarf sorghum (~40 %); green grams (fair-poor)
Whole year: Coconuts[3)] (danger of bollrot disease), bananas, lemons and limes, oranges and grapefruit[4)], pineapples[4)], curcuma

Some marginal crops with poor yield potential (av. 20–40 % of the optimum)
2nd rains: Sweet potatoes (necessary to continue from 1st r. to keep plant material for the next long rains); cowpeas; simsim



Pasture and forage
More than 1 ha/LU of 300 kg on secondary high-grass savanna between relicts of semi-deciduous tropical forest. Grazing also in seasonal waterlogged areas; feeding Napier or Bana grass, siratro (Macroptilium atropurpureum),

centro (Centrosema pubescens, also to improve pasture and soil)[1] and planting horse tamarind (Leucaena leucocephala)[1] for browsing down to 0.2 ha/LU; Mimosa pudica under coconut trees

L 3 m i (vs) = *Coconut-Cassava Zone with a medium cropping season, intermediate rains, and a (weak) very short one*

Potential almost as L 3 m i vs but no reliable cultivation in the 2nd rains because they are too short, weak and erratic (risk of crop failure more than 50 %). Lemons and limes fair, other citrus marginal; bananas esp. var. Boco-boco and Zanzibarini[1]. Partly heavy soils (red loam on old coral reefs), good for maize, less suitable there for groundnuts, bambarra grdn., cashew nuts and coconuts

L 3 m i = *Coconut-Cassava Zone with a medium cropping season followed by intermediate rains*

Good yield potential[1]

1st rains, start norm. end of March: Coast comp. and Pioneer Hybrid maize (60–70 %), m. mat. white sorghum (70–80 %), m. mat. finger and bulrush millet; cowpeas (~60 %)[2], yam beans (tubers), sweet potatoes; sunflower like 252 or H S 301 A; m. mat. soya beans; tomatoes, egg plants, kales, Chinese cabbage, chillies, sweet pepper, pumpkins, onions, water melons, cucumbers, garlic, okra, roselle, trop. Lima beans[9], guar[11]

2nd rains insignificant

Whole year: Sisal; mangoes, cashew nuts[3], pawpaws, West Indian avocadoes, cassava[3]; bixa (good to fair), senna, castor

Fair yield potential[1]

1st rains: M. mat. rice in seasonal flooded grasslands or semi-permanent swamps[5]; dolichos beans, green grams[2], groundnuts[3], bambarra groundnuts (Apr.–Aug.)[3][6], simsim[2]; cotton; cabbage

Whole year: Coconuts[3] (danger of bollrot disease), drought resistant bananas like Bocoboco and Zanzibarini, pineapples[4], lemons, and limes, oranges and grapefruit (fair to poor)

Pasture and forage

More than 1 ha/LU on secondary high-grass savanna; feeding Napier and Bana grass, siratro, Stylosanthes hamata, and centro (legumes also to improve pasture and soil) and planting horse tamarind for browsing[1] down to about 0.25 ha/LU

L 4 = *Cashewnut-Cassava Zone*

L 4 m/s i (vs) = *Cashewnut-Cassava Zone with a medium to short cropping season intermediate rains, and a (weak) very short one*

Very small and transitional. Potential in first rains see L 4 m/s i but Lima and yam beans only fair, in second rains almost as L 4 s/m i (vs)

L 4 m/s i = *Cashewnut-Cassava Zone with a medium to short cropping season followed by intermediate rains*
(see Diagram Lamu)

Good yield potential[1]

1st rains, start norm. end of March/b. of April: Coast comp. and Pioneer Hybrid, m. mat. sorghum, m. mat. bulrush and finger millet; cowpeas (~60 %)[2], dolichos beans; m. mat. groundnuts[3][6] (Apr.–Aug.); e. mat. trop. Lima beans[9], yam beans (tubers), sweet potatoes; e. mat. sunflower like 252 or H S 301 A, m. mat. soya beans on h. and m. soils, e. mat. soya beans on light soils; kales, onions, pumpkins, chillies, sweet pepper, okra, egg plants, Chinese cabbage, garlic, water melons, cucumbers, guar[11]

Whole year: Cashew nuts[3], cassava[3]; sisal, mangoes

Fair yield potential[1]

1st rains: E. mat. rice[5] in semiperm. swamps; green grams (May/Je.–A./S.) and simsim[2]; cotton, safflor; cabbages, tomatoes; trop. Lima beans[9]

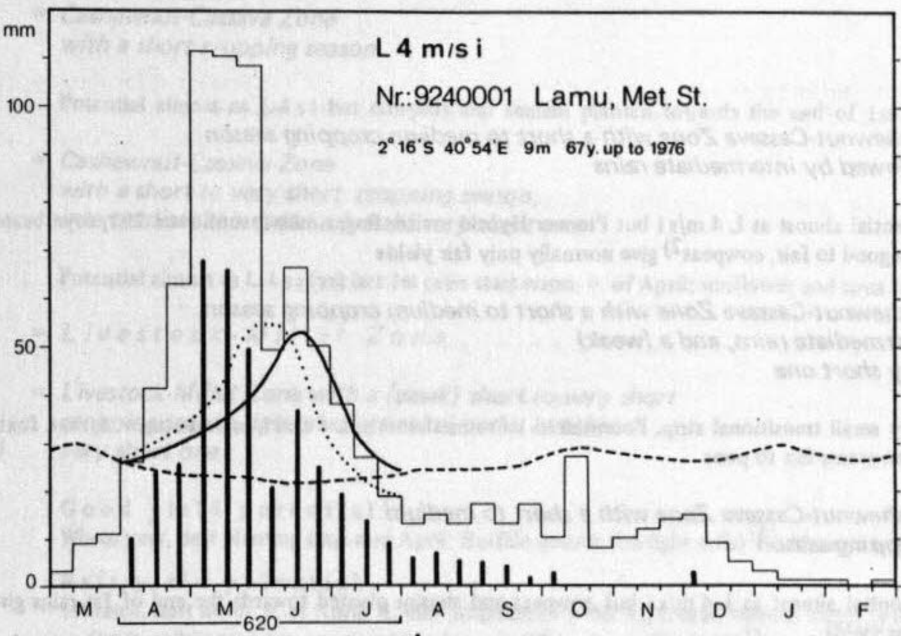
Whole year: Pawpaws, senna, bixa

Some marginal crops with poor yield potential

Whole year: Bananas, coconuts

Pasture and forage

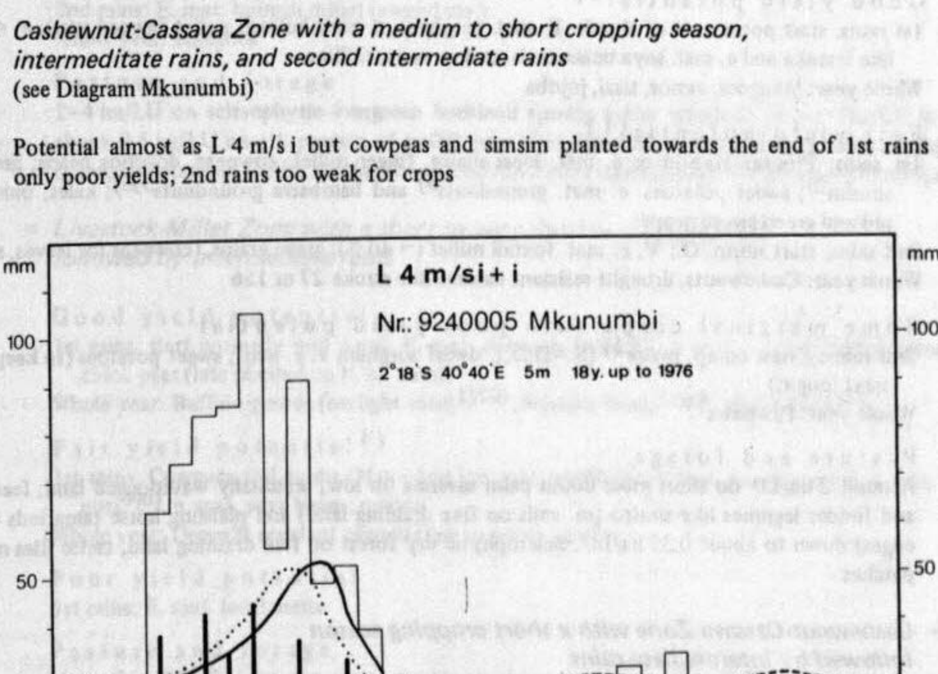
More than 1.5 ha/LU on secondary high-grass savanna; down to about 0.3 ha/LU feeding Bana grass, centro, siratro, Clitoria ternatea, Stylosanthes hamata, Macrotyloma axillare (legumes also to improve pasture and soil), and planting horse tamarind (Leucaena leucocephala) for browsing. Nat. vegetation: dry forest patches on free draining land, doum palm savanna on lower places; tsetse flies near forest



Average rainfall per decade — rainfall surpassed in 6 out of 10 years
— — — Approx. pot. evapotranspiration of a permanent crop: sisal
—— Approx. pot. evapotranspiration of med. mat. maize like Pioneer Hybrid
······ Approx. pot. evapotranspiration of med. mat. bulrush millet
—620— Rainfall per indicated growing period, surpassed in 6 out of 10 years

L 4 m/si + i = *Cashewnut-Cassava Zone with a medium to short cropping season, intermeditate rains, and second intermediate rains*
(see Diagram Mkunumbi)

Potential almost as L 4 m/s i but cowpeas and simsim planted towards the end of 1st rains give normally only poor yields; 2nd rains too weak for crops



Average rainfall per decade — rainfall surpassed in 6 out of 10 years
— — — Approx. pot. evapotranspiration of a permanent crop: sisal
—— Approx. pot. evapotranspiration of med. mat. maize like Pioneer Hybrid
······ Approx. pot. evapotranspiration of med. mat. bulrush millet
—610— Rainfall per indicated growing period, surpassed in 6 out of 10 years

L 4 s/m i = ***Cashewnut-Cassava Zone with a short to medium cropping season followed by intermediate rains***

Potential almost as L 4 m/s i but Pioneer Hybrid maize, finger millet, sunflower 252, soya beans and cashew nuts good to fair, cowpeas[2] give normally only fair yields

L 4 s/m i (vs) = ***Cashewnut-Cassava Zone with a short to medium cropping season, intermediate rains, and a (weak) very short one***

Very small transitional strip. Potential in 1st rains almost as L 4 s/m i, in 2nd rains v. e. mat. foxtail millet and green grams fair to poor

L 4 s/m = ***Cashewnut-Cassava Zone with a short to medium cropping season***

Potential almost as L 4 m/s i but cowpeas and simsim planted towards the end of 1st rains give norm. only poor yields

L 4 s i (vs) = ***Cashewnut-Cassava Zone with a short cropping season, intermediate rains, and a (weak) very short one***

Good yield potential[1)]

1st rains, start norm. end of March: E. mat. sorghum, e. mat. bulrush millet (awned var.); e. mat. sunflower like Issanka and e. mat. soya beans on h. and m. soils; chillies

Whole year: Mangoes, castor, sisal, jojoba

Fair yield potential[1)]

1st rains: Pioneer Hybrid or e. mat. local maize, finger millet; cowpeas, dolichos beans, green grams and simsim[2)]; sweet potatoes; e. mat. groundnuts[3)] and bambarra groundnuts[3)6)]; kales, onions, tomatoes, red and green sweet pepper

2nd rains, start norm. O.: V. e. mat. foxtail millet (~ 40 %); green grams, (cowpeas for leaves, simsim (~40 %)

Whole year: Cashewnuts, drought resistant cassava like stroke 27 or 156

Some marginal crops with poor yield potential

2nd rains: Coast comp. maize[1)] (S.–D./J.), dwarf sorghum v. e. mat.; sweet potatoes (to keep plant mat. for next long r.)

Whole year: Pawpaws[1)]

Pasture and forage

Around 2 ha/LU on short grass doum palm savanna on low, seasonally waterlogged land; feeding Bana grass and fodder legumes like siratro (m. soils on free draining land) and planting horse tamarinds (also on mbuga edges) down to about 0.35 ha/LU. Sclerophytic dry forest on free draining land, tsetse flies near these forest patches

L 4 s i = ***Cashewnut-Cassava Zone with a short cropping season followed by intermediate rains***

Good yield potential[1)]

1st rains, start norm. end of March: E. mat. sorghum, e. mat. (awned) bulrush millet; e. mat. sunflower like Issanka or Hybrid S 345, e. mat. soya beans (on h. and m. soils)

Whole year, best planting time b. of April: Buffalo gourds (on light soils)

Fair yield potential[1)]

1st rains: E. mat. maize like Pioneer Hybrid or local varieties, finger millet; cowpeas, dolichos beans, green grams and simsim (e. of May–e. of Aug.); e. mat. groundnuts[3)] and bambarra groundnuts[3)6)]; onions, tomatoes, chillies

Whole year: Cassava, cashewnuts, mangoes, sisal, castor, jojoba

Pasture and forage

Around 2.5 ha/LU on bushland with acacias, about 2 ha on short grass doum palm savanna in mbugas; horse tamarinds to plant on mbuga edges, saltbush (Atriplex nummularia) on higher land for browsing

L 4 s = *Cashewnut-Cassava Zone with a short cropping season*

Potential almost as L 4 s i but cowpeas and simsim planted towards the end of 1st rains only poor yields

L 4 s/vs i (vs) = *Cashewnut-Cassava Zone with a short to very short cropping season, intermediate rains, and a (weak) very short one*

Potential almost as L 4 s i (vs) but 1st rains start norm. b. of April; sunflower and soya beans only fair

L 5 = *Livestock-Millet Zone*

L 5 (s/vs) i + (vs) = *Livestock-Millet Zone with a (weak) short to very short cropping season, intermediate rains, and a (weak) very short one*

Good yield potential[1)]
Whole year, best planting time mid April: Buffalo gourds (on light soils)[10)], Marama beans[10)]

Fair yield potential
1st rains, start norm. b. of April: E. mat. sorghum (50–60 %), e. mat. bulrush millet (awned var.)[1)]; chick peas (on h. soils), cowpeas, green and black grams (May–Aug., 50–60 %)[1)]; e. mat. bambarra groundnuts[1)3)6)]; e. mat. sunflower like Issanka[1)], e. mat. soya beans[1)], e. mat. onions[1)]
2nd rains, start norm. end of Oct.: Cowpeas for leaves, green grams[1)]
Whole year: Sisal (50–60 %)[1)], castor[1)], drought resistant cassava[1)], jojoba

Poor yield potential
1st rains: E. mat. maize
2nd rains: E. mat. bulrush millet (awned var.)
Whole year: Mangoes

Pasture and forage
2–4 ha/LU on sclerophytic evergreen bushland (partly tsetse infested), about 2 ha/LU in mbugas; down to about 0.5 ha/LU on art. pasture of buffel grass (Cenchrus ciliaris) and feeding vines of Mauritius or Marama beans, and planting fodder shrubs like saltbush (Atriplex nummularia) and Mesquite (Prosopis spec.)

L 5 s/vs i = *Livestock-Millet Zone with a short to very short cropping season followed by intermediate rains*

Good yield potential
1st rains, start normally mid April: E. mat. sorghum (~60 %), e. mat. bulrush millet (awned var., ~60 %)[1)]; chick peas (late planted on h. bl. soils)
Whole year: Buffalo gourds (on light soils)[1)10)], Marama beans[1)10)], physic nut[1)7)]

Fair yield potential[1)]
1st rains: Cowpeas and grams (May–Aug.); e. mat. sunflower, e. mat. groundnuts[3)], e. mat. bambarra groundnuts[3)6)], e. mat. soya beans; onions
Whole year: Drought resistant cassava (fair to poor), castor

Poor yield potential
1st rains: E. mat. local maize

Pasture and forage
More than 3 ha/LU on dry acacia bushland; down to about 0.6 ha/LU on art. pasture of buffel grass and feeding hay or silage of Mauritius and moth bean vines during dry season, and planting fodder shrubs like saltbush and Gao trees on good soils (Acacia albida) for pods

L 5 vs/s i + (vs) = *Livestock-Millet Zone with a very short to short cropping season, intermediate rains, and a (weak) very short one*

Good yield potential[1)]
1st rains, start norm. April: E. mat. foxtail millet, luffa gourds and e. mat. water melons (from West-Africa)
Whole year: Buffalo gourds (on light soils)[10)], Marama beans[10)]

Fair yield potential

1st rains: E. mat. bulrush millet[1], v. e. mat. dwarf sorghum; chick peas (late pl. on h. bl. soils), cowpeas[1], green and black grams[1], v. e. mat. bambarra groundnuts[1]; v. e. mat. dwarf sunflower[1], simsim (May–Aug.)[1]

2nd rains, start norm. end of Oct.: Cowpeas for leaves, green grams (fair to poor)

Whole year: Sisal[1], castor[1], drought resistant cassava (fair to poor)[1], jojoba

Pasture and forage

Almost the same as L 5 (s/vs) i (vs)

L 5 (vs/s) i (vs) = *Livestock-Millet Zone with a (weak) very short to short cropping season, intermediate rains, and a (weak) very short one*

Potential almost as L 5 vs/s i (vs) but good potential there is only fair here; stocking rates about 10 % lower

L 5 vs/s = *Livestock-Millet Zone with a very short to short cropping season*

Good yield potential[1]

1st rains, start norm. mid April: Luffa gourds and v. e. mat. water melons (from West Africa), foxtail millet (mid May–e. of June)

Whole year: Buffalo gourds (on light soils)[10], Marama beans,[10] physic nut[7], ye-eb nuts[8]

Fair yield potential[1]

1st rains: E. mat. bulrush millet, dwarf sorghum; cowpeas, green and black grams, chick peas (late planted on h. bl. soils), v. e. mat. bambarra groundnuts[3)6)]; e. mat. soya beans (fair to poor), v. e. mat. dwarf sunflower

Pasture and forage

More than 4 ha/LU on acacia bushland, around 2 ha/LU on improved pasture with Buffel grass, saltbush and Gao trees

L 5 (vs) +i = *Lowland Livestock-Millet Zone with a (weak) very short cropping season and intermediate rains*

Fair yield potential[1]

1st rains, start norm. b. of April: V. e. mat. foxtail millet (40–50 %)

Whole year: Buffalo gourds (on light soils)[10], Marama beans[10], ye-eb nuts[8], sisal

Poor yield potential

1st rains: E. mat. bulrush millet, v. e. mat. dwarf sorghum; green grams

Pasture and forage

3–5 ha/LU on small-leaved bushland; situation improvable by fodder plants as in L 5 vs/s and by Opuntia spec.

L 6 = *Lowland Ranching Zone*

L 6 b r = *Lowland Ranching Zone with bimodal rainfall*

No rainfed crops for good or fair results except desert plants like buffalo gourds or ye-eb nuts.

More than 5 ha/LU on short grass savanna mixed with small-leaved bushland; improvable by fodder shrubs like saltbush and on good soils by Gao trees

1) Not in waterlogged areas or during times of waterlogging, except rice and partly sorghum, sweet potatoes

2) Relay-planted in maize during June/Jy., cowpeas and chick peas also on places where the waterlogging has just gone; cowpeas var. ER 7 and Vita 3 highest yields of peas; for leaves plant already in April.

3) Not on heavy soils

4) Not top quality

5) In deep water: floating rice varieties from Bangladesh

6) Gives reasonable yields also on poor soils

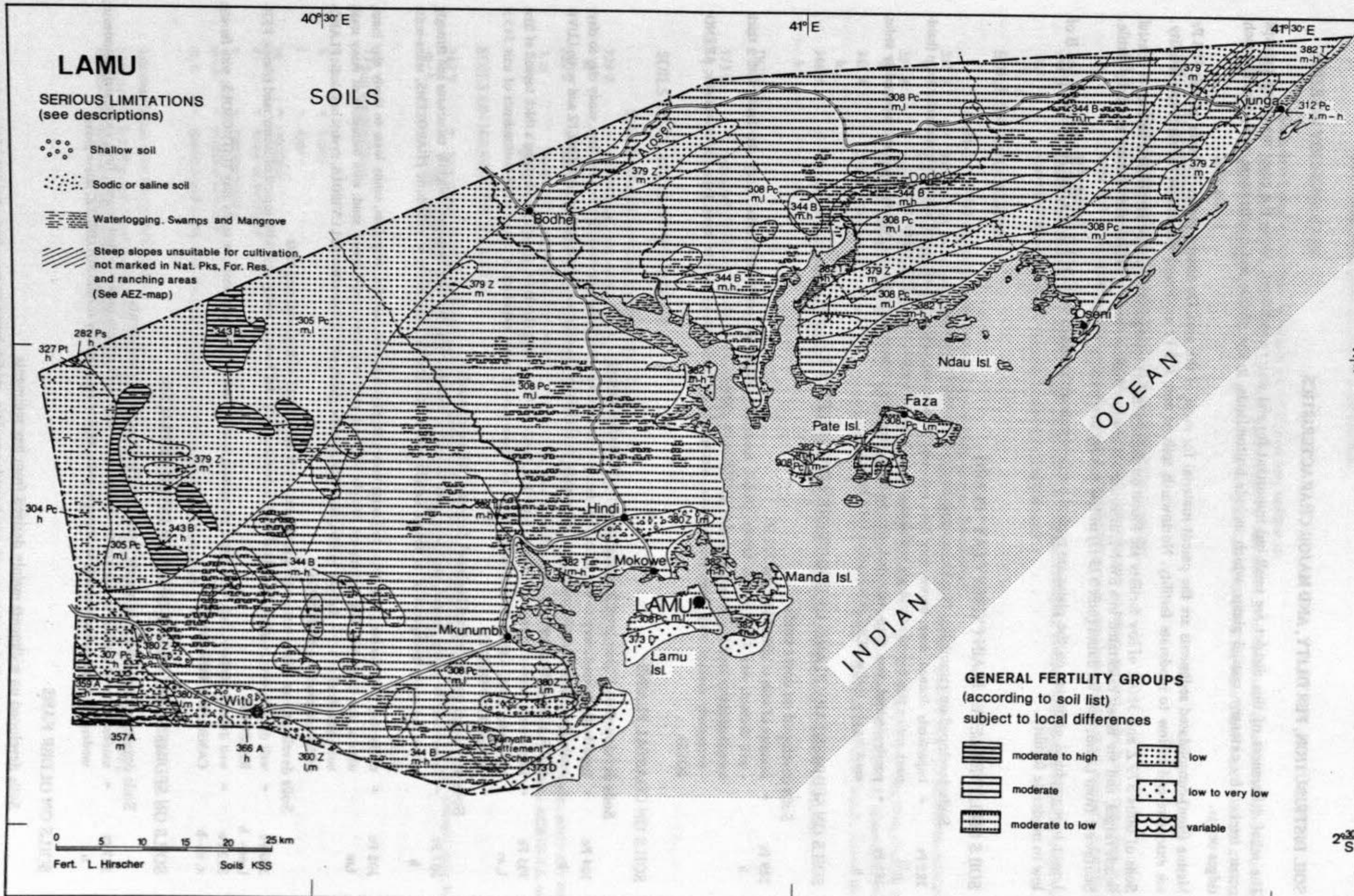
7) Jatropha cucas; shrub for hedging, gives medical or technical oil from seeds and blue colour or tannin from bark. Origin: NE-Brasil

8) Cordeauxia edulis from Somalia

9) Very sensitive to salinity

10) Still experimental. Plants produce edible seeds and, after some seasons, also tubers. Bitterness may be washed out in salty water

11) Cyamopsis tetragonolobia (Leguminosae) from India; vegetable or fodder, seeds contain gum; N collector


LAMU
SOILS
SERIOUS LIMITATIONS
(see descriptions)
Shallow soil
Sodic or saline soil
Waterlogging, Swamps and Mangrove
Steep slopes unsuitable for cultivation, not marked in Nat. Pks, For. Res. and ranching areas
(See AEZ-map)
40°30' E
41° E
41°30' E
2° S
2°30' S
INDIAN
OCEAN
Bodhe
Hindi
Mokowe
Mkunumbi
Witu
LAMU
Lamu Isl.
Manda Isl.
Pate Isl.
Faza
Ndau Isl.
Kiunga
GENERAL FERTILITY GROUPS
(according to soil list)
subject to local differences
moderate to high
moderate
moderate to low
low
low to very low
variable
0 5 10 15 20 25 km
Fert. L. Hirscher
Soils KSS

SOIL DISTRIBUTION, FERTILITY, AND MAJOR CHARACTERISTICS

The relief differences of this district are small but important for soil water conditions. Along the coast mangrove swamps occur, backed by extensive coastal plains, which include bottomlands. In the middle and northeastern part, coastal beach ridges occur.

Marine (non)-consolidated sediments are the parent material for most of the area. On coastal plains (Pc) soils of unit 308 Pc are extensive and of low to moderate fertility. Northwards soils of unit 305 Pc are found which have the same low fertility.

Soils of units 379 Z and 380 Z of low fertility are found on slightly higher topography, as they are formed on former coastal beach ridges, and are often orientated in a SW-NE direction. If not too shallow, some soils on coral rock are relatively fertile. Southwest from Lamu, soils on dunes (unit 373 D) of low to very low fertility occur.

Lower topographical positions on the plains are typical bottomlands with soils of units 343 B of a high fertility and 344 B of low to moderate fertility.

SOILS ON LOWER-LEVEL PLAIN ("GREY CLAY" PLAIN)

Soils developed on remodelled Plio-Pleistocene bay sediments (Marafa beds)

282 Ps h[1)] = imperfectly drained, deep, brown, very firm, moderately calcareous, moderately saline and moderately sodic clay loam (hardpan), with a thin topsoil of strongly sealing sandy clay loam (luvo-orthic SOLONETZ, saline phase)

285 Ps h = poorly drained, very deep, very dark grey to black, very firm, slightly calcareous, moderately saline and moderately sodic, cracking clay (pellic VERTISOLS, saline-sodic phase)

SOILS ON SEDIMENTARY PLAINS OF UNDIFFERENTIATED LEVELS

Soils developed on cover sands

289 Ps h = complex of soils of units 288 P and 372 D:
- well drained, very deep, reddish brown, friable, moderately calcareous, moderately sodic, sandy clay loam, with a thick topsoil of loamy sand (calcic to chromic LUVISOLS, sodic phase)
- excessively drained, very deep, brown, loose, moderately calcareous, loamy sand to sandy loam (calcaro-cambic ARENOSOLS)

SOILS ON COASTAL PLAINS

Soils developed on higher-level lagoonal deposits (Kilindini sands)

304 Pc h = imperfectly drained, deep to very deep, very dark greyish brown to olive brown, mottled, firm to very firm, sandy clay to clay; moderately calcareous and moderately saline/sodic throughout or in deeper subsoil (ortho-luvic SOLONETZ and vertic LUVISOLS, saline-sodic phase)

305 Pc l, m = imperfectly drained, very deep, brown, very firm, sandy loam to sandy clay loam, abruptly underlying a thick topsoil of friable loamy sand; slightly to moderately sodic in deeper subsoil; with inclusions of many small bottomlands of unit 343 B (solodic PLANOSOLS)

Soils developed on lower-level lagoonal deposits (Kilindini sands)

307 Pc h = imperfectly to poorly drained, very deep, grey to brown, mottled, very firm clay (hardpan), slightly calcareous and strongly saline and sodic throughout or in deeper subsoil (gleyic SOLONETZ; with gleyic or verto-luvic PHAEOZEMS, saline-sodic phase)

308 Pc l,m = moderately well drained, very deep, yellowish brown to greyish brown, mottled, very firm, sandy loam to sandy clay loam, with a very thick (60–100 cm) topsoil of light brownish grey to yellow, friable loamy sand; with inclusions of many small bottomlands of unit 344 B gleyic to albic LUVISOLS, sodic phase; with ferralo-chromic LUVISOLS, dystric or solodic PLANOSOLS and cambic ARENOSOLS)

Soils developed on raised-coral-reef limestone, with admixture of lagoonal deposits

310 Pc l, m – h = well drained, deep, dark red to reddish brown, friable, sandy clay loam to sandy clay, with topsoil of loamy sand (rhodic FERRALSOLS)

312 Pc x, m–h = well drained, shallow, dark brown to dark reddish brown, rocky, sandy clay loam to sandy clay (LITHOSOLS; with ferralic CAMBISOLS, lithic phase)

SOILS ON SEDIMENTARY PLAINS OF UPPER RIVER TERRACES

Soils developed on sediments mainly from Plio-Pleistocene bay sediments

327 Pt h = moderately well drained to imperfectly drained, very deep, dark reddish brown to dark brown, firm, moderately calcareous, moderately saline and moderately to strongly sodic, slightly cracking clay (orthic SOLONETZ, saline phase)

SOILS ON OLDER FANS

Soils developed on sediments mainly derived from bay sediments

331 Pf l, h = complex of well drained to imperfectly drained, very deep, reddish brown to grey, firm, clay soils of varying calcareousness, salinity and sodicity, in many places with strongly sealing topsoil; with inclusions of well drained, very deep, brown, loose loamy sand (levee complex) (luvo-orthic SOLONETZ, saline phase; with solodic PLANOSOLS, saline phase, chromic VERTISOLS, saline-sodic phase and cambic ARENOSOLS)

SOILS ON YOUNGER FANS

Soils developed on sediments mainly derived from bay sediments

333 Pf h = moderately well drained, very deep, dark reddish brown to dark brown, firm, moderately calcareous, moderately to strongly saline and strongly sodic, sandy clay to clay (levee complex) (orthic SOLONETZ, saline phase; with orthic SOLONCHAKS, sodic phase)

SOILS ON BOTTOMLANDS

Soils developed on infill from lagoonal deposits (Kilindini sands)

343 B h = imperfectly drained to poorly drained, very deep, light brownish grey to brown, mottled, firm to very firm, clay; in places sodic and cracking (higher-level depressions) (gleyic PHAEOZEMS; with verto-luvic PHAEOZEMS and pellic VERTISOLS, sodic phase)

344 B m, h = poorly drained, very deep, greyish brown, mottled, very firm clay (hardpan), abruptly underlying a topsoil of friable humic sandy clay loam (lower-level depressions) (humic PLANOSOLS)

SOILS ON FLOODPLAINS

Soils developed on sediments from various sources (recent floodplains)

357 A m = well drained to imperfectly drained, very deep, dark brown to yellowish brown, stratified, strongly calcareous, micaceous, predominantly loamy soils (calcaric FLUVISOLS)

359 A h = imperfectly drained to poorly drained, very deep, dark reddish brown to dark greyish brown, firm to very firm, cracking clay; in many places mottled and with a calcareous, saline and sodic deeper subsoil (chromic VERTISOLS, saline-sodic phase)

365 A h = poorly drained, deep, very dark grey, mottled, firm clay, with a sulfidic deeper subsoil (mollic GLEYSOLS, thionic phase)

366 A h = very poorly drained, deep, dark grey, soft (unripe) strongly saline and strongly sulfidic, clay (thionic LUVISOLS)

DUNES

373 D l = excessively drained, very deep, brown to pale brown, loose, sand to loamy sand (cambic ARENOSOLS)

SOILS ON COASTAL BEACH RIDGES

Soils developed on older coastal beach ridges

379 Z m = well drained, very deep, red, very friable, sandy clay loam (rhodic FERRALSOLS)

380 Z l, m = moderately well drained, very deep, dark brown to reddish brown, firm to very firm, often moderately sodic, sandy clay loam, underlying a thick topsoil of friable loamy sand, in places shallow over coral rock (ferralo-chromic/orthic ACRISOLS, sodic phase; with solodic PLANOSOLS)

SOILS ON MANGROVE SWAMPS

382 T m–h = very poorly drained, very deep, olive to greenish grey, soft (unripe), excessively saline and moderately to strongly sodic, loam to clay, often with sulfidic material (thionic FLUVISOLS and gleyic SOLONCHAKS)

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. Expl. Soil Surv. Rep. E1, Nairobi 1982.
See this map also for colours; symbols simplified here.

POPULATION AND LAND

According to the population census of September 1979, 42,299 people lived in Lamu District. Of this figure 8,374 people (= 19.84 % of the total population, Table 4) were registered in Lamu township. Most of the population, including some towns-people, depend on the 551,700 ha agricultural land for a living (= 84,88 % of the total rural area, Table 6). In other words, 79.59 ha agricultural land were available for an average household of 4.83 people, i.e. 16.27 ha per person (Table 6). As regards the agricultural land, it should be noted that zone L 4 (337,600 ha = 61.2 % of the agricultural land) and zone L 5 (160,600 ha = 29.1 % of the agricultural land) predominate (Table 6).

Only the two islands, Lamu (Central Division) and Pate (Faza Division), are relatively densely populated, although seen from the statistics, they also seem sparsely populated. However, the statistical land area includes parts of the mainland and unsuitable land like sand dunes. On the other hand, many of the 8,400 people living in Lamu township possess coconut plots outside, so the amount of agricultural land per person is in reality far lower than in Table 6 (see footnote 4 there).

Kiunga Division is very sparsely populated, with 421.48 ha agricultural land (Table 6) available for an average household of 4.32 people (Table 5). Here 83.2 % of the agricultural land (Table 6) was assigned to L 4 (Cashewnut-Cassava Zone) and another 16.8 % to L 5 (Lowland Livestock-Millet Zone). This is only an estimated value, as there is only one rainfall station and, strictly speaking, most of the area of L 4 belongs to the worse subzones of this main zone and also has poor soils (see Soil Map).

Nevertheless, it may be said that with cashewnuts and other crops (see AEZ potentials) the present agricultural situation is capable of considerable improvement. In addition to this, as Lamu District is still sparsely populated, several further settlements may be feasible in addition to the Hindi-Magogoni and Lake Kenyatta Settlement Schemes.

LAMU DISTRICT

TABLE 4: POPULATION PER LOCATION AND DIVISION
CENSUS 1979

Location/Division	Male	Female	Total	Number of households	Square kilometers	Density
Witu	1 751	1 598	3 349	672	1 232	2
Witu Division	1 751	1 598	3 349	672	1 232	2
Mkunumbi	6 223	5 547	11 770	2 684	1 429	8
Mpeketoni Division	6 223	5 547	11 770	2 684	1 429	8
Lamu Central	3 006	2 450	5 456	1 249	1 250	4
Lamu Township	4 166	4 228	8 394	1 749	1 399	6
Central Division	7 172	6 678	13 850	2 998	1 256	11
Kiunga	866	768	1 634	377	2 018	1
Kiunga Division	866	768	1 634	377	2 018	1
Faza	4 138	4 571	8 709	1 373	330	26
Siu	1 483	1 504	2 987	577	241	12
Faza Division	5 621	6 075	11 696	1 950	571	20
Lamu District	21 633	20 666	42 299	8 681	6 506	6

LAMU 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:						
Witu	665	2.78	0.87	0.85	0.48	4.97
Division: Witu	665	2.78	0.87	0.85	0.48	4.97
Location:						
Nkunumbi	2669	2.63	1.17	0.45	0.16	4.40
Division: Mpeketoni	2669	2.63	1.17	0.45	0.16	4.40
Location:						
Lamu Central	1241	2.45	0.57	0.91	0.24	4.18
Lamu Township	1747	2.39	0.61	1.37	0.32	4.69
Division: Central	2988	2.41	0.57	1.18	0.29	4.48
Location:						
Kiunga	378	2.55	0.6o	1.04	0.13	4.32
Division: Kiunga	378	2.55	0.60	1.04	0.13	4.32
Location:						
Faza	1376	2.78	1.06	2.17	0.33	6.33
Siu	573	2.95	0.77	0.95	0.54	5.21
Division: Faza	1949	2.83	0.97	1.81	0.39	6.00
DISTRICT: LAMU	8649	2.62	0.86	1.06	0.28	4.83

a) Source: Central Bureau of Statistics (CBS)

b) Average figures, include one and two persons per household as well.

LAMU DISTRICT

TABLE 6: AEZ-LAND AREA AVAILABLE PER LOCATION, DIVISION AND PER HOUSEHOLD AND PERSON[1)]

Location/Division without townships	in '00 ha = sqkm: Area total Census 79	Non-agricultural land: Unsuit. steep slopes	Non-agricultural land: Forest Res., lakes, swamps	Non-agricultural land: Others (roads, homesteads, rivers...)	Agricultural land	in '00 ha = sqkm: Area in agro-ecological zones AEZ: L3	L4	L5	L6	in ha: Agric. land per household	Agric. land per person
Witu	1 232		170	22	1 040	94	405	517	24	154.76	31.05
Witu Division	1 232		170	22	1 040	94	405	517	24	154.76	31.05
Mkunumbi	1 429		92	28	1 309	235	828	246		48.77	11.12
Mpeketoni Division	1 429		92	28	1 309	235	828	246		48.77	11.12
Lamu Central	1 250		180	24	1 046	39	553	454		83.75	19.17 [4)]
Central Division	1 250		180	24	1 046	39	553	454		83.75	19.17
Kiunga	2 018	30	330 [3)]	69	1 589		1 322	267		421.48	97.24
Kiunga Division	2 018	30	330 [3)]	69	1 589		1 322	267		421.48	97.24
Faza	330			16	314	143	171			22.87	3.61
Siu	241			22	219		97	122		37.95	7.33
Faza Division	571			38	533	143	268	122		30.41	5.47
Total rural area	6 500 [2)]	30	837 [3)]	181	5 517	511	3 376	1 606	24	79.59	16.27

1) For official land statistics see supplemetary publication to FM-Hanbook, Vol. III A : Agriculture Land Statistics

2) Mangrove swamps are not included

3) Included are 265 sqkm National Reserve

4) Lamu Central Location includes Lamu Island (except of Lamu township), Manda Island and 1 140 sqkm on the mainland. On Lamu Island 0.75 ha agric. land per person, including Lamu town 0.28 ha/person.

AGRICULTURAL STATISTICS[1)]

Little or nothing has been recorded about farming activities in the Lamu district. Often extremely poor soils and a largely unsuitable climate make successful farming difficult or impossible. Because of its limited importance, no smallscale farm survey was carried out within the district. Two types of small-scale farming are practised: (a) Settlements which are of very recent origin, have been created with a lot of financial and technical support. These farms are of very uniform structure, and fairly comprehensive information about them should be available at the Department of Settlements. (b) Traditional farming developed during the past 200–300 years; these farmers practise a highly adapted and skilled land use system. However, no Government aid has as yet been given to these farmers, and they have little connection with the cash economy. There is a possibility that the fairly good land now cultivated by these farmers may be turned into a settlement project and the life of the farmers will be reorganised accordingly, which will not necessarily mean an improvement in the quality of their life.

The settlement farmers receive much support through on-going projects and are not in need of further assistance. The traditional farmers need assistance in input supplies and marketing, some improvement of the roads in their area, and extension advice on the use of purchased inputs.

1) More detailed information can be obtained from the District Settlement Officer and the DAO

LAMU DISTRICT

TABLE 7: COTTON PRODUCTION a)

Ginnery Zone	Year				
	75/76	76/77	77/78	78/79	79/80
Lamu					
Seed Cotton in t	2579	104	149	226	259
Bales	4525	183	262	398	455

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

NO SMALL FARM SURVEY

LAMU DISTRICT

TABLE 8a: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT[1)]

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z			
		Vegt. Period 1st + 2nd: m i vs in Days, 1st: 135-155		2nd: 40-55	total: 175-210	m/s i 115-135		<30	—	(s/vs) i + (vs) 75-80		40-50	—
		Soil: LUVISOLS				LUVISOLS				PLANOSOLS			
	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 2)	kg	1,000			2,100	750			1,500	300			600
Fertilizer N	kg				61				41				-
P_2O_5	kg				30				20				-
K_2O	kg												
CROP: BANA GRASS													
Farmers in Production Level	%												
Yields 2)	kg	2,000			4,500	1,500			3,000				
Fertilizer N	kg				138				83				
P_2O_5	kg				69				42				
K_2O													
CROP: COCONUTS			FERRALSOLS										
Farmers in Production Level	%												
Yields in No. of Nuts	kg		2,000	4,000	5,000								
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: COTTON													
Farmers in Production Level	%												
Yields	kg	350	450	1,200	1,600								
Fertilizer N	kg		11	93	137								
P_2O_5	kg		8	68	100								
K_2O	kg												
CROP: BANANAS													
Farmers in Production Level	%												
Yields	kg	4,000	4,000	7,000	18,000								
Fertilizer N	kg			54	252								
P_2O_5	kg			18	84								
K_2O	kg												
CROP: MAIZE													
Farmers in Production Level	%												
Yields	kg	1,300	1,400	2,200	2,800	1,300		2,000	2,300				
Fertilizer N	kg		3	27	45			21	30				
P_2O_5	kg		2	22	36			17	24				
K_2O	kg												

1) For explanations see p. 16 2) in kg TDN

TABLE 8 b: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES

OUTPUT AND NUTRIENT INPUT

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: m i vs in Days, 1st: 135-155		2nd: 40-55	total: 175-210	m/s i 115-135		< 30	—	(s/vs) i + (vs) 75-80		40-50	—
		Soil: LUVISOLS				LUVISOLS				PLANOSOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: SORGHUM													
Farmers in Production Level	%												
Yields	kg	1,800	1,200	2,800	3,200	1,600	1,200	2,000	2,800				
Fertilizer N	kg			39	54			15	47				
P_2O_5	kg			28	38			12	33				
K_2O	kg												
CROP: MILLET													
Farmers in Production Level	%												
Yields	kg					900		900	1,600	800		600	900
Fertilizer N	kg								22				5
P_2O_5	kg								20				5
K_2O													
CROP: MAIZE & COW PEAS													
Farmers in Production Level	%												
Yields	kg	1,300	1,400/200	2,200/300	2,800/300								
Fertilizer N	kg		13	41	59								
P_2O_5	kg		9	33	47								
K_2O	kg												
CROP: BEANS													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												
CROP: GRAMS													
Farmers in Production Level	%												
Yields	kg					400	400	600	1,000	300		500	700
Fertilizer N	kg							8	24			8	16
P_2O_5	kg							6	18			6	12
K_2O	kg							-	-			6	12
CROP: CASHEW NUTS			FERRALSOLS				FERRALSOLS						
Farmers in Production Level	%												
Yields	kg	800		800	2,000	800		800	2,000				
Fertilizer N	kg												
P_2O_5	kg												
K_2O	kg												

TABLE 8 c: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: m i vs in Days,1st: 135-155		2nd: 40-55	total: 175-210	m/s i 115-135		<30	—	(s/vs) i + (vs) 75-80		40-50	—
		Soil: LUVISOLS				LUVISOLS				PLANOSOLS			
	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	650		650	900	500	500	650	900	500			700
Fertilizer N	kg				10			6	16				8
P_2O_5	kg				11			6	17				8
K_2O	kg												8
CROP: SOYA BEANS													
Farmers in Production Level	%												
Yields	kg	700		1,200	1,800	600		1,000	1,600	600		500	700
Fertilizer N	kg			25	55			20	50				5
P_2O_5	kg			19	42			15	38				4
K_2O													4
CROP: GROUNDNUTS													
Farmers in Production Level	%												
Yields	kg	900	800	1,000	1,700	800	650	1,000	1,000	600		500	800
Fertilizer N	kg			3	26			6	6				6
P_2O_5	kg			3	22			5	5				5
K_2O	kg												5
CROP: COWPEAS													
Farmers in Production Level	%												
Yields	kg	400	400	700	1,000								
Fertilizer N	kg			15	30								
P_2O_5	kg			10	20								
K_2O	kg												
CROP: SIMSIM													
Farmers in Production Level	%												
Yields	kg	400	320	600	700								
Fertilizer N	kg			-	-								
P_2O_5	kg			16	25								
K_2O	kg			-	-								
CROP:													
Farmers in Production Level	%												
Yields	kg												
Fertilizer N	kg												
P_2O_5	kg												

TABLE 8 d: PRODUCTION LEVELS PER CROP AND AGRO-ECOLOGICAL ZONES
OUTPUT AND NUTRIENT INPUT

		A.E.Z.: L 3 COCONUT-CASSAVA ZONE				A.E.Z.: L 4 CASHEWNUT-CASSAVA ZONE				A.E.Z.: L 5 LOWLAND LIVESTOCK-MILLET Z.			
		Vegt. Period 1st + 2nd: m i vs in Days,1st: 135-155		2nd: 40-55	total: 175-210	m/s i 115-135		<30	—	(s/vs) i + (vs) 75-80		40-50	—
		Soil: LUVISOLS				LUVISOLS				PLANOSOLS			
	Unit	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III	Without Fertilizer	Production Level I	II	III
CROP: CABBAGE													
Farmers in Production Level	%												
Yields	kg					2,500		6,000	22,000				
Fertilizer N	kg							28	156				
P_2O_5	kg							21	117				
K_2O	kg							11	58				
CROP: SWEET POTATOES													
Farmers in Production Level	%												
Yields	kg	4,500		10,000	18,000	3,000		5,000	9,000				
Fertilizer N	kg			44	108			20	60				
P_2O_5	kg			33	81			12	36				
K_2O				16	40			6	18				
CROP: CASSAVA													
Farmers in Production Level	%												
Yields	kg	4,000	4,000	8,000	16,000	3,000	3,000	10,000	14,000	3,000	2,000	5,000	9,000
Fertilizer N	kg			16	48			28	44			8	24
P_2O_5	kg			24	72			42	66			12	36
K_2O	kg			24	72			42	66			12	36
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												

Farmers Undertaking Soil Conservation Individually in Evurore Area

Table Showing Soil Conservation Work Completed by Individual Farmers up to September 1986

Area	Total no. of farmers	S.C. work to date FJ (m)	SB (m)	CD (m)	TL (m)	Gr (m)	GC (m)	Comments
1 Kamuthigo	37	2 400	2 700	200	3 500	720	500	Ciamithu sub-catchment
2 Kambungu	25	1 500	1 200	180	2 400	200		" "
3 Njura/Njaranga	18	1 200	1 800	250	2 000	300	200	" "
4 Kigwambiti	12	700	1 280	200	1 800	200	300	" "
5 Kathuri	10	900	700		1 200	600		Part time farmers
6 Karuri	8	1 300	400	150	1 600	200	1 800	" " "
7 Kamiigua	8	1 200	500	110	2 500	190		" " "
8 Kamutu	7	1 000			1 400	200	1 160	" " "
9 Kabuguri/Gaceci	5		250		900			" " "
10 Karangare	4	400			700			" " "
11 Kamwaa	3	600	150		500	200		" " "
10 Kyenri	?	?	?	?	?	?	?	" " "
Totals	137	11 200	8 980	1 090	18 500	2 810	3 960	

Ciamithu sub-catchment was the first area in which the SWCP got involved in soil conservation.
Part time farmers - farmers who have jobs which take them away from their farms for much of the time.

FJ - length of fanya juu terraces constructed
SB - length of stone bunds constructed
CD - length of cutoff drains constructed
TL - length of trash lines constructed
Gr - length of terraces planted with grass
GC - length of gullies controlled