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GENERAL FEATURES OF AGRICULTURE IN ZAMBIA

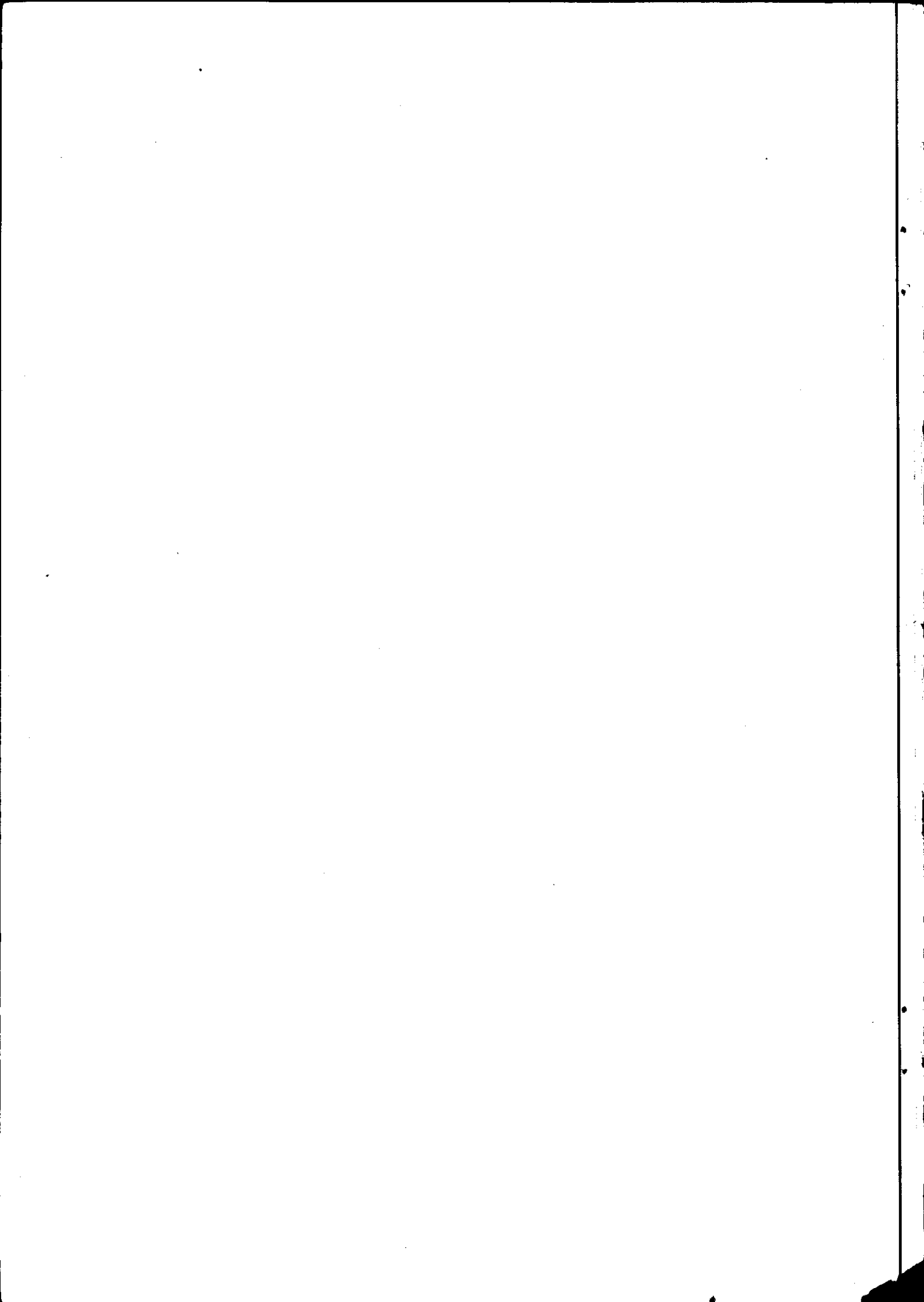
M.Sc. S. Azzali

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APPENDIX 1: Reviews of various classifications of farmers

1. INTRODUCTION

Zambian agriculture at independence, in October 1964, displayed two radically different patterns. Modern commercial farming for cash and export had been developed largely by European settlers, whereas subsistence farming was the main type of agriculture for the 70% of the African population.

1.1. Classification of farming types

Nowadays, different types of agriculture can be distinguished in Zambia according to income, to technical inputs, to farm size. The different classifications of farm types are given in Appendix 1 (after FOOD STRATEGY STUDY, 1981).

From the same publication we have chosen for this study the classification given by Jaeger, who classified the levels of farming as follows, where the zone are according to the agro-ecological zones of Zambia (Map 1).

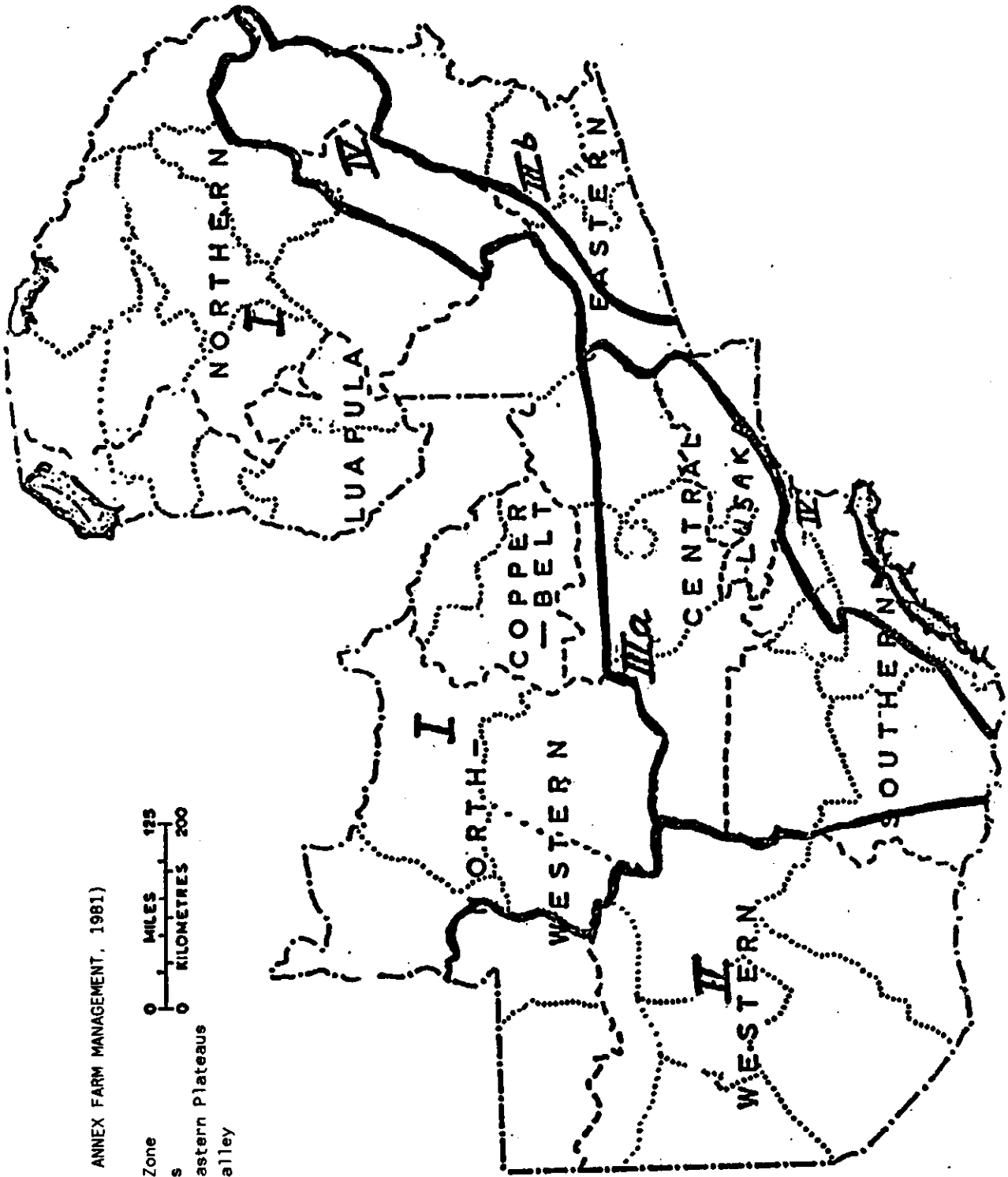
LEVEL 1 : Traditional subsistence households
size holding : not more than 5 ha, usually 1-2 ha as average
production : consumption crops, no cash crops
staple crops : zone 1 cassava, millets, sorghum (in Kasempa,
Chizera and Solwezi districts)
zone 2 cassava, maize and millet
zone 3 maize
zone 4 sorghum, millet and maize

LEVEL 2 : Small-scale emergent farmers
size holding : 1-10 ha
production : staple and cash crops
staple crops : see Level 1

M A P 1
AGRO-ECOLOGICAL ZONES
(after FOOD STRATEGY STUDY - ANNEX FARM MANAGEMENT, 1981)



- I Northern High Rainfall Zone
- II Western Semi-arid Plains
- III Central, Southern and Eastern Plateaus
- IV Luangwa, Zambezi Rift Valley



cash crops : zone 1 maize, rice, beans (wheat)
zone 2 maize, rice and some cotton
zone 3 maize, cotton (sunflower, groundnuts, wheat)
zone 4 cotton and maize

LEVEL 3 : Medium scale commercial farmers

size holding : 10-40 ha

staple crops : maize, small plots of cassava, sorghum in North-
Western province

cash crops : zone 1 maize, rice, wheat (Copperbelt)
zone 2 maize and rice
zone 3 maize, sunflower, wheat, cotton and groundnuts
zone 4 sunflower, cotton and maize

LEVEL 4 : Large scale commercial farmers

size holding : more than 40 ha

staple crops : none

cash crops : maize, wheat, sunflower, groundnuts and cotton (mainly
located in zone 3a)

CHAUDRI (1985) proposed an other farm size classification :

- a) commercial farmers: more than 20 ha
- b) emergent or small scale commercial farmers: between 5 and 20 ha
- c) peasant or traditional farmers: less than 5 ha

This study will describe the size and type of farms (Jaeger classification) for each Province and for each district. In particular, it will describe crop calendar and management technique of cultivated crops.

1.2. Definition of phenological stages by crops

From the agronomic informations collected through literature average crop calendars have been established for each district of Zambia provinces. In these crop calendars the phenological stages have been coded and defined as follows:

1. sowing
2. full ground cover
3. flowering
4. yield formation
5. harvesting

The occurrences of these five phenological stages represent the exhaustive informations for the preparation of an average crop calendar. However, it was seldom possible to find the whole set of informations for a specific crop and district. Consequently, only those stages and their occurrences, specifically found in the literature and concerning a crop cultivated in a specific district, were taken into account.

For this reason informations concerning some crop phenological stages are disuniform as it is shown in the thirty-three crop calendars prepared for this report.

1.3. Few remarks on measurement units used to quantify crop production

Crop production figures are taken into account in this report. Particularly, production records mainly for maize have been analysed and, when data were available, informations on other crop productions have been added. Crop production is mainly expressed in 'bags' which amount, expressed in Kg, changes according to crops.

Table 1 shows the correspondent values in Kg of measurement unit 'bag' used for different crops in Zambia.

No information regarding the humidity percentage of the seed production is mentioned.

In some other tables, however, metric ton is also used as measurement unit to express crop production.

Table 1. Measurement unit 'bag' expressed in Kg
for different crop cultivated in Zambia

Crop	Measurement unit	
	bag	kg
Maize	1	90
Paddy rice	1	80
Sunflower	1	50
Shelled groundnuts	1	80
Soybeans	1	90

2. NORTHERN PROVINCE

2.1. Climate pattern

SCHULTZ (1974) described the climatic pattern of Northern Province as follows : the temperatures are moderate tropical, frost is practically absent the annual rainfall exceeds 1000 mm which is higher than the minimum water requirements of plant/crops. The number of humid months can be 4, from December till March, or 6, from November to April. But from December to March, dry spells in excess of 5 days are rare. At least three (December-February) and up to five (November-March) months have less than 5 hours of sunshine per day. The climate is optimal for annual crops with a long growing season and resistant to rust and fungi. Perennial cassava is the major subsistence crop, with finger millet a good second.

Trees like fruit trees (citrus) and timber trees do well. The central part of northern region is the wettest region in Zambia. Annual rainfall exceeds 1200 mm, and 6 are the humid months. The growing season is the longest in the country and long enough to allow the cultivation of perennials like pineapples, coffee and tea.

2.2. Agricultural systems

The Northern province is 107,000 km² large excluding lakes and swamps.

Agriculture is mainly characterized by shifting cultivation or chitemene systems as it is shown in Map 2. A brief introduction and description of chitemene systems used in Northern Province will follow. SCHULTZ (1974) distinguished the chitemene systems by:

- ratio of cleared to cropped area
- shape and size of cleared area and of field
- period of cultivation (ratio of crop to fallow years)
- crop rotation
- staple crops

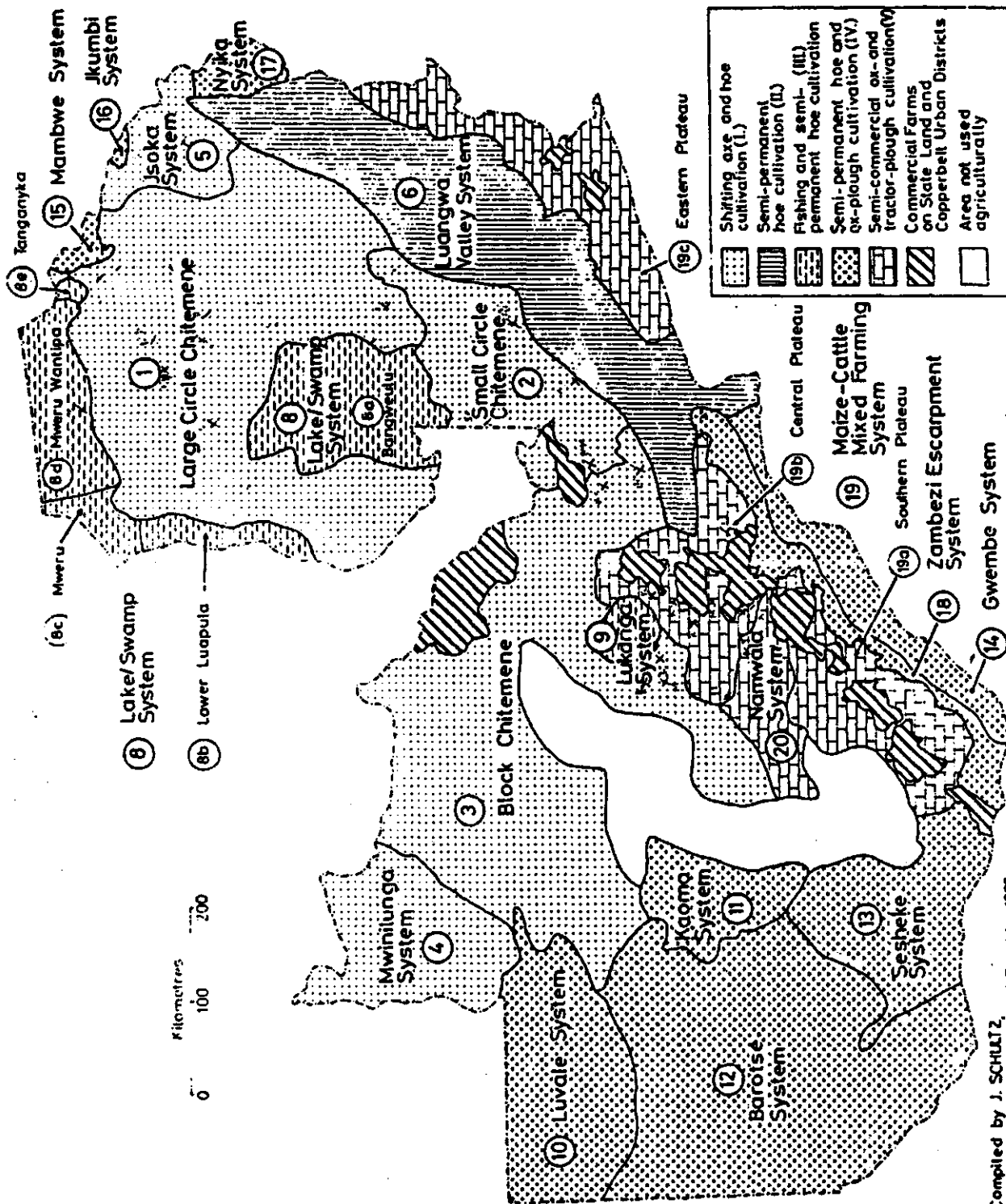
The first three of these features can be related to

- the period required for arboreal regeneration
- the available woodland suitable for chitemene.

Shifting cultivation in the Northern province affects about 50-100 Km². It is mainly practiced by the Bemba people which adopted the large circle chitemene system. According to WERGER (1978) the Bemba live in the northeastern plateau of Zambia (Luapula and Northern Provinces) and reside in small scattered villages of not more than 50 families.

Vegetation is the only source of fertiliser which is transmitted to the soil via plant burning in form of ash. An ash-dependent system (chitemene) can support successfully traditional crop production. "Large circle" chitemene starts from the selection of the plot to be cleared. The plot is selected considering more the amount of wood available than the soil quality. At the end of the dry season clearance of bush and cutting of trees are performed. Only branches of trees are cutted leaving intact the trunk which allows a faster regeneration of woodland. Concentration of the brush and branches in large radial piles gives greater ash depth, reasonable crop yield and smaller area cleared (1.5 ha compared to 4-9 ha). Wood piles are burnt just before the first rains at the behest of the chief, which seems to know better about rain events. Ash provides nutriments to be washed down into the soil, burning clears from weeds. The ash garden and cleared plot may be cultivated for up to five years, though four seems to be usual. Finger millet (*Eleusine corocana*) is the Bemba staple and is

M A P 2
 FARMING REGIONS
 (after SCHULTZ, 1974)



Compiled by J. SCHULTZ,
 based on Land Use Map of Zambia, 1975

usually planted the first year and at least one of the following years.

SCHULTZ (1974) remarked that Bemba people use the land for 4-6 years, alternating or mixing the cultivation of finger millet, cassava groundnuts, beans, maize, sorghum etc. in the following way:

FIRST YEAR - in December finger millet is sown on the ash, in October cassava shoots are planted with the first rains

SECOND YEAR - groundnuts replace finger millet

THIRD YEAR - beans replace groundnuts; first harvest of cassava

FOURTH YEAR - last harvest cassava, followed by finger millet which finishes the rotation.

A family lays out a new chitemene field every year, so that all the crops in this cycle are being grown simultaneously.

Besides to the chitemene fields every family owns "gardens" or "village gardens" where they grow cassava, beans, sweet potatoes, maize, groundnuts, pumpkins, cucumber, tomatoes, etc. Grass turf is cut out with hoes and heaped upside down into small mounds 50 cm high and one to two meters long. Such compost plus other type of manure are used as fertilizer.

In some places village gardens are considerably large, where farmers are cultivating from three to four major crops:

-frequency of growth	:	cassava	87%	of all holding
		maize	74%	
		finger millet	65%	
		groundnuts	60%	
		beans	57%	
-land cultivated	:	cassava	0.08	ha
		maize	0.07	ha
		finger millet	0.05	ha
		beans	0.04	ha
		groundnuts	0.036	ha

(source: SCHULTZ, 1974).

PUZO (1978) added that chitemene is land intensive and cannot support dense rural populations. Infact, the amount of miombo required per person per year under chitemene is approximately 0.6 to 1.2 hectares. Assuming that trees regeneration needs 20-25 years, the total requirements of miombo under shifting cultivation is about 12-32 ha

per person (up to regeneration of forest): that means five persons per square kilometer on the average.

In the Mpika district of Northern province small-circle chitemene system is applied (described by TRAPNELL, 1953, as the southern chitemene system of the Lala and Bisa people), SCHULTZ (1974) and ALLAN, (1965) gave the most detailed description of the small chitemene system.

The felling is early started in the dry season from May to August. Trunks are cutted one meter from the ground and branches are spread on the soil to make them dry. After few weeks branches are collected and built into small stacks. Stackings have circular shapes of twenty-thirty feet in diameter, but also oval, pear shaped, striped and rings shapes are obtained.

Stacks are burned at the end of the dry season, but if it is done too early ash is blown away, if it is done too late, rain wets the brushes and they do not burn completely with a resulting loss of ash.

Finger millet sowing is done in December and the crop is harvested five months later. Usually the ash patches are used for a single crop and hardly the same spot is cultivated in the second year. Then a long period of regeneration follows.

SCHULTZ (1974) remarked a crop rotation example of the small circle chitemene system as :

FIRST YEAR - finger millet on the ash
SECOND YEAR - groundnuts
THIRD YEAR - field is left

An other type of agriculture in the Northern Province is the Isoka mixed large circle chitemene/cattle system (SCHULTZ, 1974).

Clearing and fields are the same as in large chitemene system, but type of crops is different. Cassava is only grown on 54% of holdings. The cultivation for maize is preferred to the other crops and maize is broadly sold in Malawi. Groundnuts, finger millet and beans are also cultivated. Half of the farmers keep cattle (20 animals for each).

The average number of major crops per holding approaches five and farm size is about 0.4 ha. It is the most advanced agriculture in north east Zambia. Inamwanga and Iwa tribes are traditionally cattle

owner and they take advantage of the grass plains of Chambeshi Flats (SCHULTZ, 1974).

2.3. Farm size distribution

In the Northern province 90% of the rural population is farming in traditional way. Large scale commercial farms are not present.

Table 2 shows type of farming and amount of rural population regarding the 1980 census in Northern province.

Table 2. Farming type distribution in Northern province (1980)
[FOOD STRATEGY STUDY, 1981 -Annex:Socio-regional framework]

Farming	N. Farms	Rural population
Medium scale commercial (10-40 ha)	90	800
Small scale commercial (1-10 ha)	7,400	55,500
Traditional farming	111,900	503,700
TOTAL	119,390	560,000

2.4. Maize production and yield forecasting

In the Northern province the marketable surplus of maize in 1982 was 648,590 bags (58,373 tons) which production was divided per districts as follows (Table 3).

Regarding 1983 and 1984 yield forecasting of maize, some actual and preliminary results are given in Table 4.

Table 3. Maize production in the districts of Northern province (bags) [ASTHANA et al, 1984]

	BAGS
Kasama	113,682
Mbala	173,693
Isoka	216,897
Chinsali	67,647
Mpika	38,226
Luwingu	24,352
Mporokoso	13,356
Kaputa	734

Table 4: Maize yield forecasting in Northern province (ANONYMOUS 1984)

Northern province	area (ha)	expected production (bags)	expected sales to official agency (bags)
1983-84 (p)	26,500	938,000	750,000
1982-83 (p)	40,100	1,400,000	1,201,000
1982-83 (a)	35,700	850,000	653,035

p=preliminary
a=actual

2.5. Crop phenology

From Map 3 (after VELDKAMP et al., 1984) different agroclimatic zones can be identified in the Northern province. Table 5 gives the agroclimatic zones for the districts of the Northern province.

Table 5. Agroclimatic zones in Northern province.

District	Zone Number	Length growing season	
		Mean value	70% probability
Kaputa	36	188-221 days	
Mbala	33	188-195 "	III dec. Nov. I dec. April (16 decades)
Kasama	29	173-195 "	II dec. Nov. III dec. March (16 dec.)
Mporokoso-Isoka- Chisali-small part Nakonde	28	173-180 "	
South Chisali	26	173-180 "	
Mpika North	29	173-195 "	III dec. Nov.
Mpika Central	26	173-180 "	III dec. March
Mpika Cent.West	24	166-180 "	(15 dec.)
Mpika South	2	141-166 "	
Lake Bangwellu	30	173-180 "	

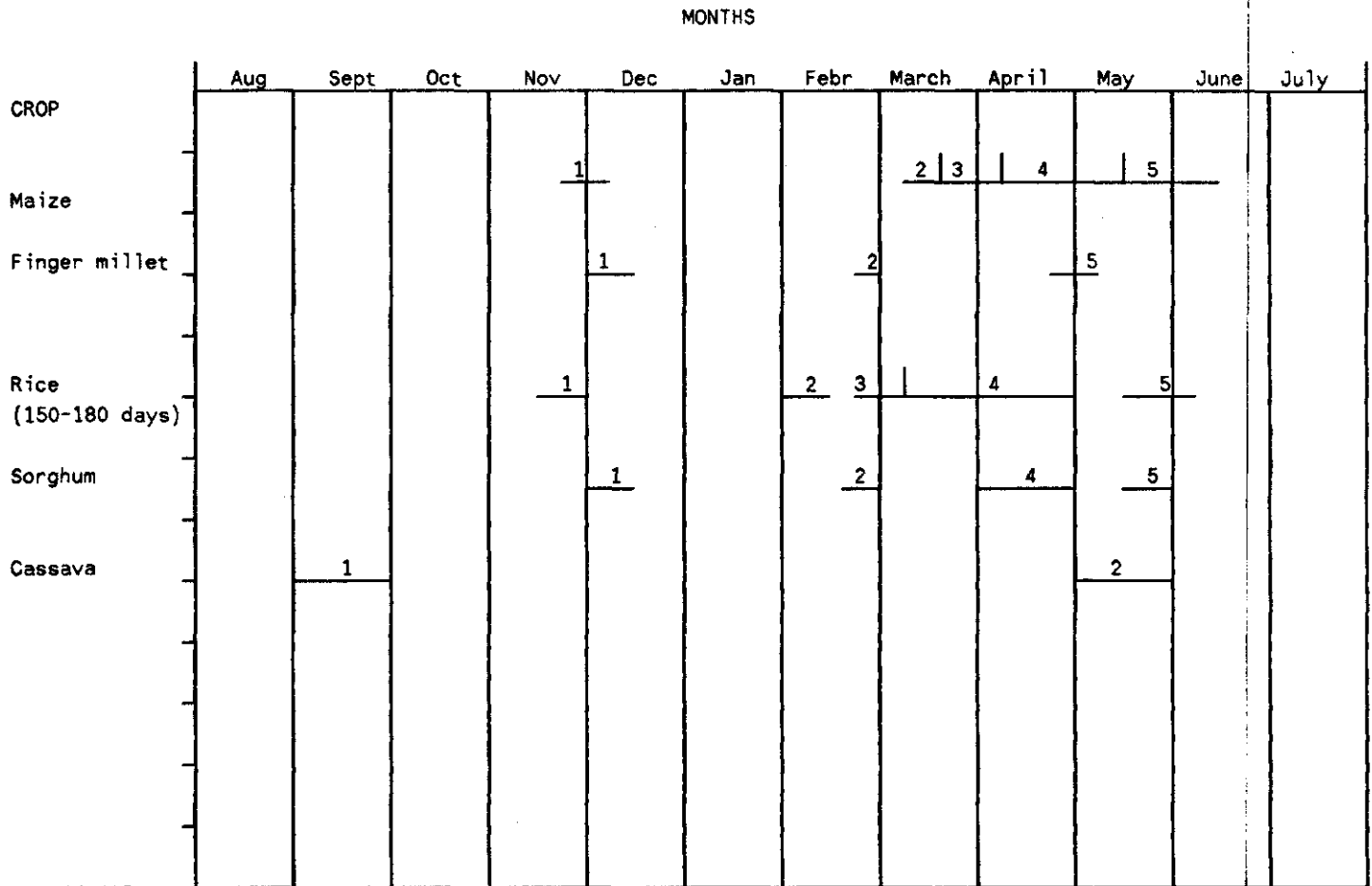
By stratification of Map 3 and Map 4, seven different crop calendars (one for each district) were prepared (Fig.1 to Fig.7).

Dates of occurrence of crop phenological stages shown in Fig.1-7 are estimated from crop growing patterns described by MANSFIELD et al (1974).

Length of the crop growing season has been calculated with the informations given by VELDKAMP et al (1984).

Fig. 1. AVERAGE CROP CALENDAR

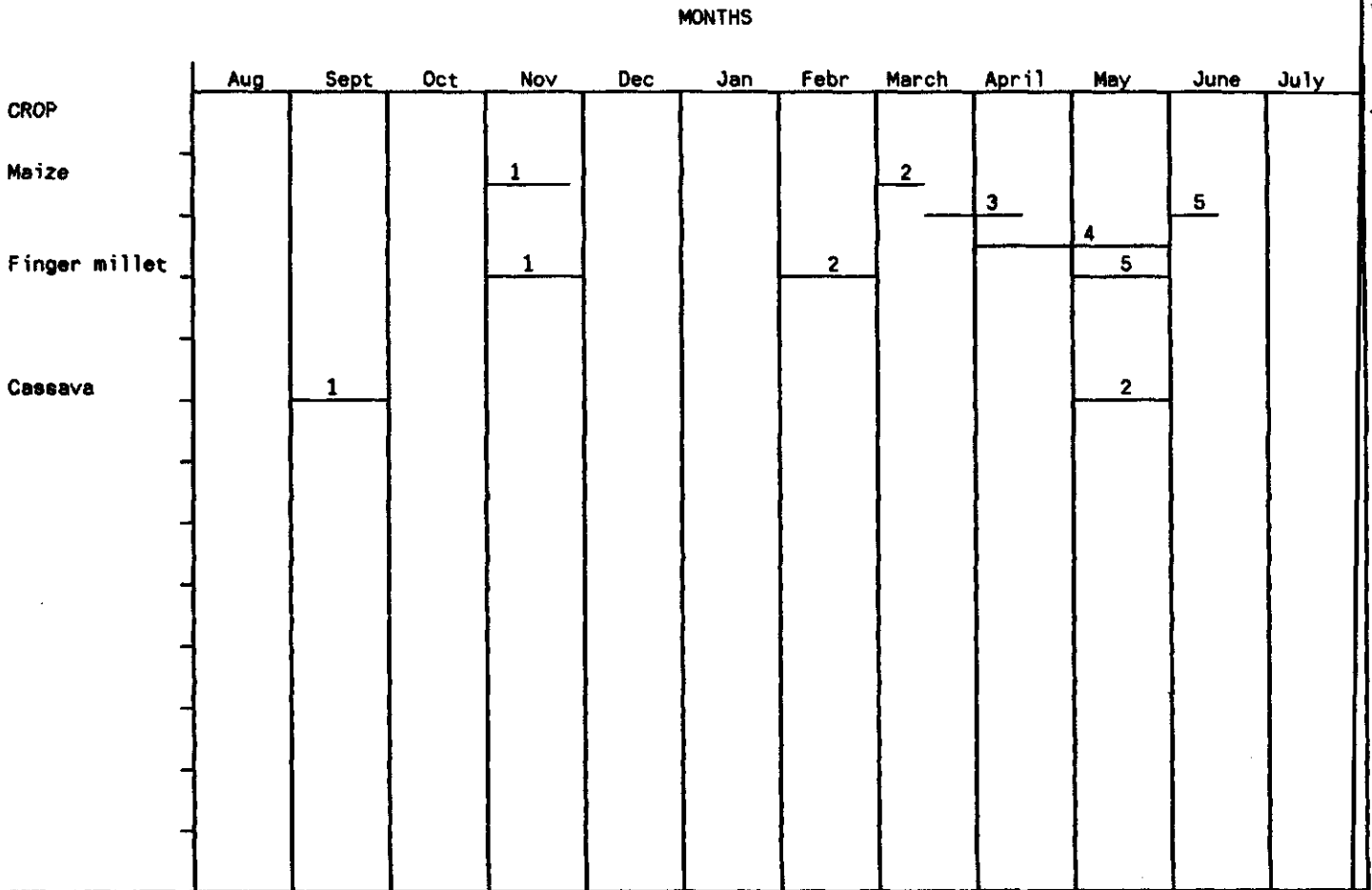
PROVINCE: Northern
DISTRICT: Mbala



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

Fig. 2. AVERAGE CROP CALENDAR

PROVINCE: Northern
 DISTRICT: Kaputa and Mpokoroso



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

Fig. 3. AVERAGE CROP CALENDAR

PROVINCE: Northern
DISTRICT: Isoka

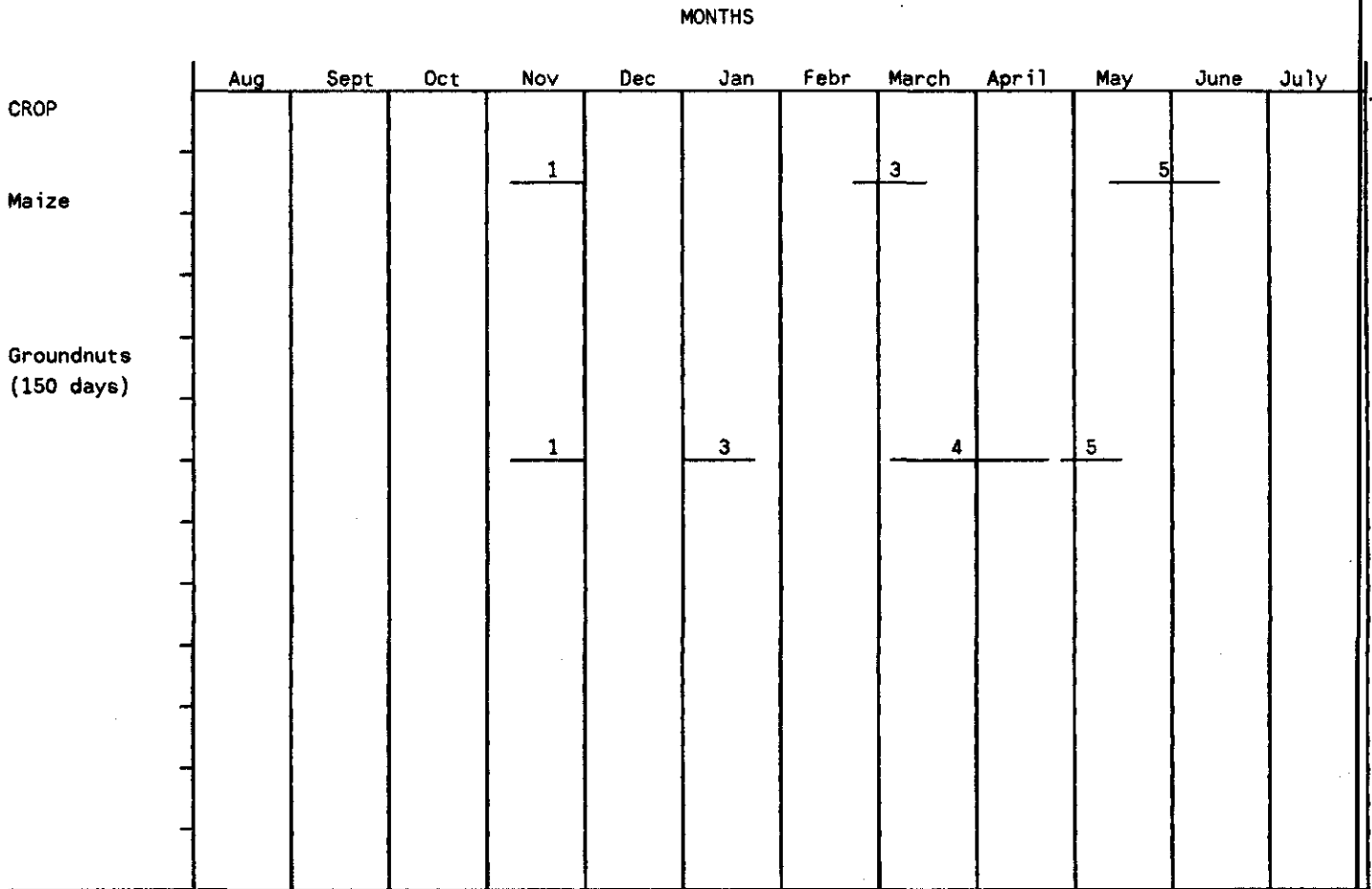
MONTHS

	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
CROP												
Maize				<u>1</u>			<u>3</u>				<u>5</u>	
Finger millet				<u>1</u>						<u>5</u>		
Velvet beans					<u>1</u>		<u>3</u>			<u>5</u>		
Beans					<u>1</u>		<u>3</u>		<u>5</u>			

1 Sowing
3 Flowering
5 Harvesting

Fig. 4. AVERAGE CROP CALENDAR

PROVINCE: Northern
DISTRICT: Kasama



- 1 Sowing
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

Fig. 5. AVERAGE CROP CALENDAR

PROVINCE: Northern
DISTRICT: Luwingu

MONTHS

	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
CROP												
Maize				1				3		5		
Rice				1			2	3	4		5	
Millet					1					5		
Groundnuts				1		3		4		5		
Beans				1			3		5			

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

Fig. 6. AVERAGE CROP CALENDAR

PROVINCE: Northern
DISTRICT: Chinsali

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize				1			3				5	
Millet				1						5		
Beans					1		3		5			
Groundnuts				1		3		4		5		

- 1 Sowing
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

Fig. 7. AVERAGE CROP CALENDAR

PROVINCE: Northern

DISTRICT: Mpika

MONTHS

	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
CROP												
Maize				<u>1</u>				<u>3</u>		<u>5</u>		
Millet					<u>1</u>					<u>5</u>		
Cassava		<u>1</u>								<u>2</u>		

1 Sowing

2 Full ground cover

3 Flowering

5 Harvesting

3. LUAPULA PROVINCE

3.1. Climate pattern

The climate of Luapula province can be described as: areas namely the shores of Lake Mweru and the shores of Lake Tanganyika are characterized by tropical hot and wet climate. The high temperature allows the growth of oilpalms, mangos, pawpaws and bananas. High potential crops are also paddy rice and cashew nuts.

The main staple crop is cassava; maize and groundnuts are also cultivated. The rest of the province is characterized by a climate pattern similar to that of the Northern province (after SCHULTZ, 1974).

3.2. Agricultural systems

The large chitemene system characterizes the indigenous agriculture (see description given in the Northern province).

A semi-permanent hoe cultivation is present where cassava is the predominant staple crop. Cassava needs little attention and the yields on the Chipya soils remain rather high even for many years.

Cassava cultivation remains on the same fields for about 10 years, farm size is the smallest of Zambia. Cassava harvest is continuously done after two-three years.

Next to cassava, maize is the second crop. Groundnuts are important in the areas of Bangwellu and lower Luapula valley.

3.3. Farm size distribution

Luapula province area is 50,560 km², from which 57% is classified as arable land (ASTHANA et al, 1984).

The 1980 population census counted 412,798 people, out of which 300,000 (1982) are subsistence farmers. Indeed, in Luapula province, 97% of the farms are classified as traditional. Table 6 gives the actual farm type distribution in Luapula province in 1980.

Table 6. Farming type distribution in Luapula province

	N. of farms	Rural population
Medium scale commercial (10-40ha)	50	500
small scale commercial (1-10 ha)	2,050	15,300
traditional farming	73,600	331,200
TOTAL	75,700	347,000

3.4. Maize production and yield forecasting

The total maize production in 1982 for Luapula Province was 50,213 bags (4,519 tons) divided for each district as follows:

	[bags]	[tons]	
Kawambwa	6,419	578	
Mansa	35,461	3,191	
Mnense	2,673	241	
Nchelenge	1,702	153	
Snafya	3,958	356	
Total	50,213	4,519	(ASTHANA et al, 1984.)

Actual and preliminary forecasts (ANONYMOUS, 1984) of maize production are given for Luapula province in 1983 and 1984 (Table 7).

Table 7. Maize yield forecasting in Luapula province

	Area [ha]	expected production [bags]	expected sales through off.agency [bags]
1983-1984 (p)	4,200	94,000	76,000
1982-1983 (p)	2,500	67,000	57,000
1982-1983 (a)	3,400	63,000	40,155

p=preliminary

a=actual

3.5. Crop phenology

From Map 3 description of agroclimatic zones is given for the principal districts of Luapula province in Table 8.

Table 8. Agroclimatic zones in Luapula province

District	Zone Number	Length growing season	
		mean value	70% probability
Lake Mweru	31	180-188 days	
Kaputa-Kawambwa	36	188-221 "	I dec. November II dec. April (19 dec.)
Samfya-Mwamfuli	30	173-180 "	III dec. Novemb. III dec. March (15 dec.)
Mansa	29	173-195 "	I dec. November III dec. March (16.5 dec.)
Mwense	25	173-180 "	

(source: VELDKAMP et al., 1984.)

Average crop calendars for the main crops cultivated in Luapula province were calculated from the informations provided by Map 3, by MANSFIELD et al. (1974) and by JAVAHERI (1976). Figs. 8-10 show the calculated crop calendars for each district.

Fig. 8. AVERAGE CROP CALENDAR

PROVINCE: Luapula
 DISTRICT: Nchelenge and Mansa

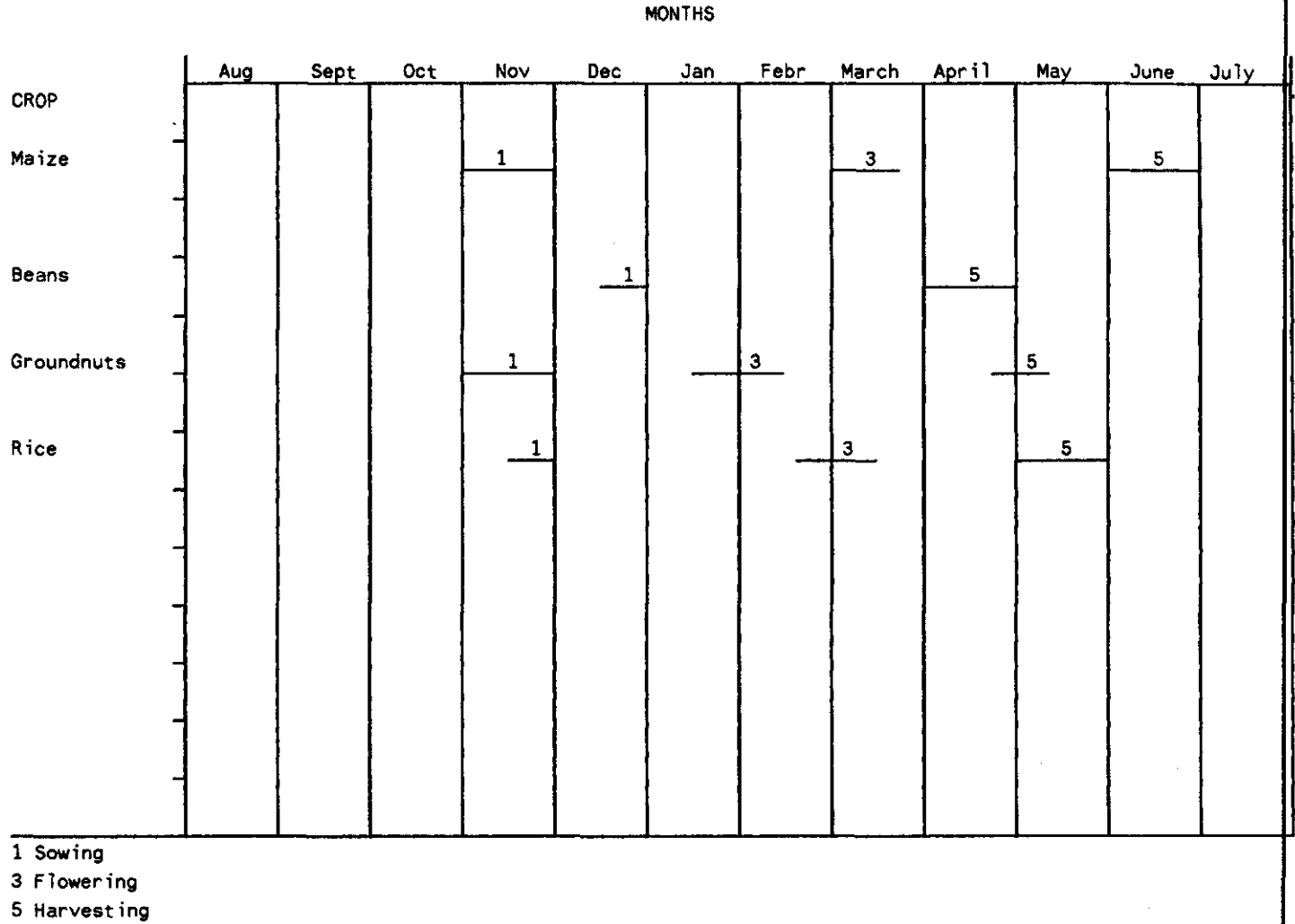


Fig. 9. AVERAGE CROP CALENDAR

PROVINCE: Luapula
DISTRICT: Kawambwa

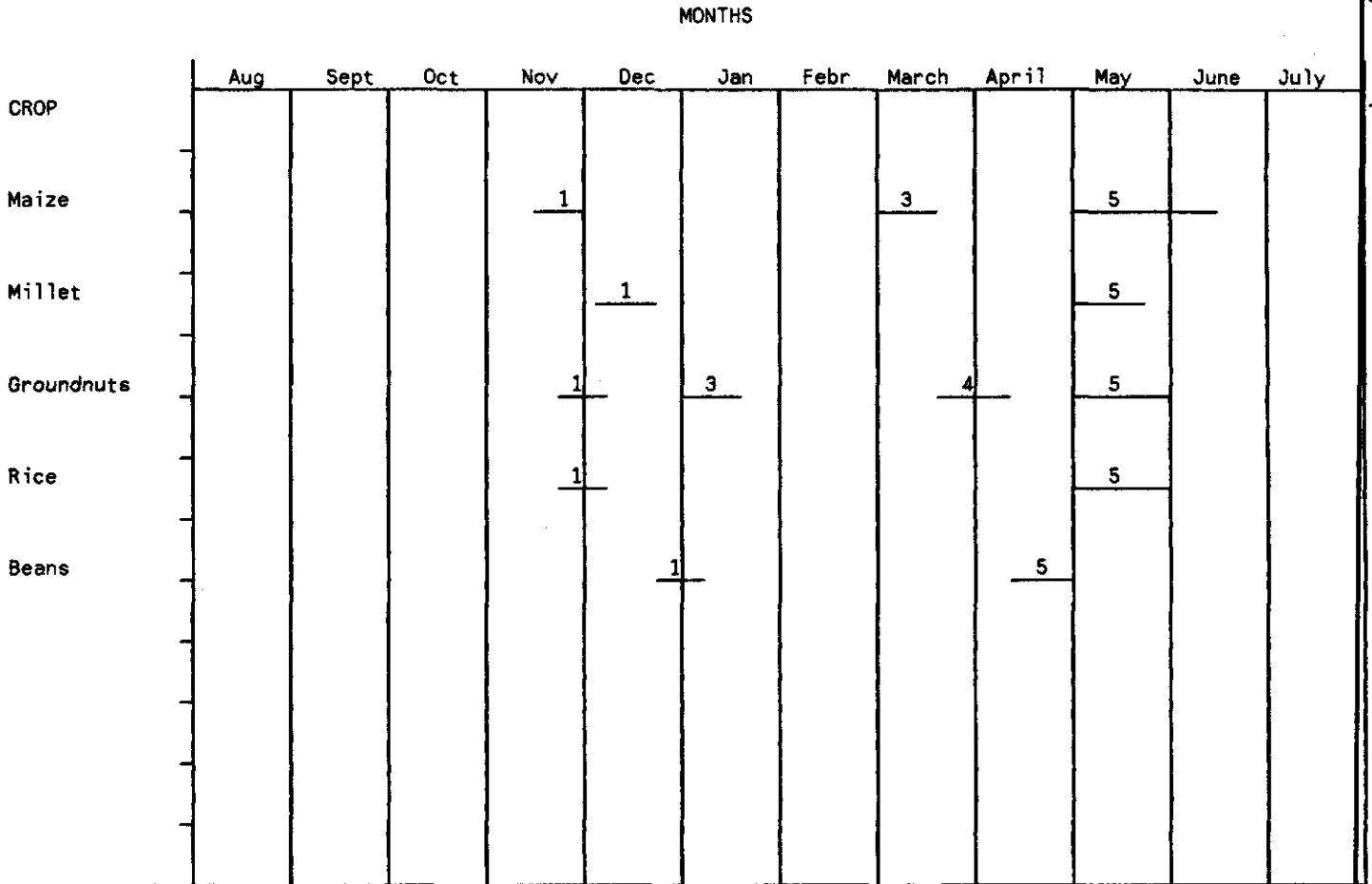
MONTHS

	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
CROP												
Cassava	1										2	
Rice				1				3			5	
Maize				1				3			5	

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 10. AVERAGE CROP CALENDAR

PROVINCE: Luapula
DISTRICT: Samfya



- 1 Sowing
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

4. EASTERN PROVINCE

4.1. Climatic pattern

The temperature is moderate tropical. The annual water balance is about 0. There are three or four humid to two-one sub-humid months. The total duration of humid and sub-humid months is not exceeding five months (from November till March). Because of high daily sunshine, annual crops having short growing period perform better (SCHULTZ, 1974).

4.2. Agricultural systems

The Eastern province is 31,080 km² large. The total population (1980) was 656,000 with a growth rate of 2.6%.

The Eastern Plateau region is the next region to develop commercially after Central and Lusaka province. Nsega, Ngomi and Chewa have holdings of 0.2 ha. Maize represents the main crop but 70% of the farmers grow groundnuts. In the region around Lundazi, 50% of the holdings cultivate beans and finger millet (SCHULTZ, 1974). The traditional agriculture of the Ngomi-Chewa people, Fort Jameson (later Chipata) is called "cultivated mounds" (ALLAN, 1965).

When a new garden is prepared from a well regenerated woodland, the land is slightly hoed over, the dried sods is later broken up with the hoe. In October the heaps, formed by sods covered by soil, are burnt. These small patches are called VIKUSE. Maize is planted together with cowpeas and pumpkins on the vikuse in November, before the main rains, and in December maize reaches 30-40 cm height.

Weeds are hoed down and placed in heaps forming a series of small mounds. Those mounds completed before the end of December are planted with groundnuts and the later ones with beans or sweet potatoes.

In the second year maize is planted on the mounds and in December weeds are heaped and buried into the soil forming mounds which are sown with groundnuts and beans or sweet potatoes. This rotation can keep on for 3 years (in poor soils) till 10 years (in rich soils) of continuous cultivation. Some chitemene is done only in order to supply finger millet for beer. Grazing is practised on dambo grassland.

Among the Tumbuka and neighbouring Chewa in the north of Eastern province, the first year garden crops are sown with finger millet on hoed land; beans, the main interplanted crop of the Tumbuka, is replaced southward by groundnuts.

In Petauke district Senga, Bisa, Kunda and Ambo practice the Luangwa system of cultivation (SCHULTZ, 1974). The traditional staple crops are maize and sorghum followed by finger millet and groundnuts. Maize is sown on the ash of burnt timber. Between the ash patches, crop is widely spaced to allow mound cultivation (weeding in December). Sorghum is planted in the lower lying areas of high temperature and uncertain rainfall in the second and subsequent years. On the average of holdings, 0.12 ha are cultivated with maize :

0.11 ha maize
 0.005 " sorghum
 0.005 " finger millet

Finger millet and groundnuts are dominant in the northern part of Luangwa valley. Sorghum is most widespread in the central part, where the majority of the farmers use up 50% of their land to cultivate sorghum. In the southern part of Luangwa valley (Lunsemfwa and Lukusashi valleys) maize is predominant.

Marketed maize comes from emergent and small scale farmers. Groundnuts and cotton productions have been replaced by maize (ASTHANA et al, 1984), as it is shown in table 9.

Table 9. Marketed volume of major crops in Eastern province [in tons]

	1980	1981	1982	1983
Maize	66,577	106,581	14,488	144,000
Groundnuts	1,455	913	585	na
Cotton	3,749	1,855	na	na
Sunflower	3,093	6,518	10,486	na
Burley tobacco	887	473	na	na

4.3. Farm size distribution

Traditional farming population is the 61% of the total rural population of the Eastern province, as it is shown in table 10 (FOOD STRATEGY STUDY, 1981).

Table 10. Farming type in Eastern province (1980)

	N. farms	Rural Population
Large scale commercial (more than 40 ha)	20	1,000
Medium scale commercial (10-40 ha)	3,100	29,500
Small scale commercial (1-10 ha)	27,000	202,700
Traditional farming	80,900	363,800
TOTAL	111,020	597,000

4.4. Maize production and yield forecasting

Production of maize was well spread all over Eastern province in 1982 and large amount of it was available for commercialization as it is shown in table 11.

Actual and preliminary yield forecasting (ANONYMOUS, 1984) of maize production were calculated for Eastern province in 1983 and 1984 (Table 12).

Table 11. Maize production and consumption (bags) in the districts of Eastern province [ASTHANA et al, 1984].

District	Consumption	Production	Balance
Chipata	585,715	871,205	+285,490
Chama	106,334	5,430	-100,904
Katete	288,470	350,888	+ 82,418
Lundazi	351,647	653,063	+301,416
Chadiza	137,320	225,530	+ 88,210
Petauke	465,455	664,042	+178,587
TOTAL	1,818,941	2,750,158	+935,217

Table 12. Maize yield forecasting in Eastern province

	Area [ha]	Expected production [bags]	Expected sales [bags]
1983-84(p)	210,000	2,969,000	1,698,000
1982-83(p)	225,000	3,252,000	1,748,000
1982-83(a)	221,000	3,096,000	1,599,544

p=preliminary

a=actual

4.5. Crop phenology

From Map 3 (VELDKAMP et al, 1984) the agroclimatic zones relating to the districts of Eastern province could be established (Table 13).

Average crop calendars for the main crops cultivated in Eastern province were calculated and show in Figs.11-14.

In Chama district, crop selection was done on the basis of the informations given by VAN SPENGEN, 1976.

Detailed informations given by COSTER, 1958, on crop calendars in

Table 13. Agroclimatic zones in Eastern province

District	Zone Number	Length of growing season	
		Mean Value	70% probability
Chama	2	141-166 days	
	17	166-175 "	
Lundazi	17	166-175 "	I decade December II dec. March (11 decades)
Chipata	20	166-173 "	I dec. December
	16	159-166 " (on the south)	II dec. March (11 decades)
Petauke	12	152-159 days	I dec. December
Katete			I dec. March
Chadiza			(10 decades)

Petauke and Katete districts were used for the preparation of the average crop calendar in those districts.

Moreover, as GRAY (1969) has remarked, Eastern province seems very suitable to groundnuts cultivation, which crop has represented the most common one till the expanding of corn cultivation.

Nowadays groundnuts are still cultivated and local varieties have been selected and ameliorated. Chalimba and Red Makulu represent late varieties which growing cycle is 150-160 days long, Natal Common is an early variety growing within 130 days. If groundnuts are sown between mid-November-beginning of December, the flowering peak of different varieties occurs following the following schedule:

- for Natal Common flowering is after 38 days from the planting
- for Makulu Red " " " 45 " " " "
- for Chalimbana " " " 50 " " " "

Information on sorghum phenology in Chama district and on cotton phenology in Petauke, Katete, Chadiza districts have been given respectively by RAO et al, 1984 and by KREUL, 1983.

Fig. 11. AVERAGE CROP CALENDAR

PROVINCE: Eastern

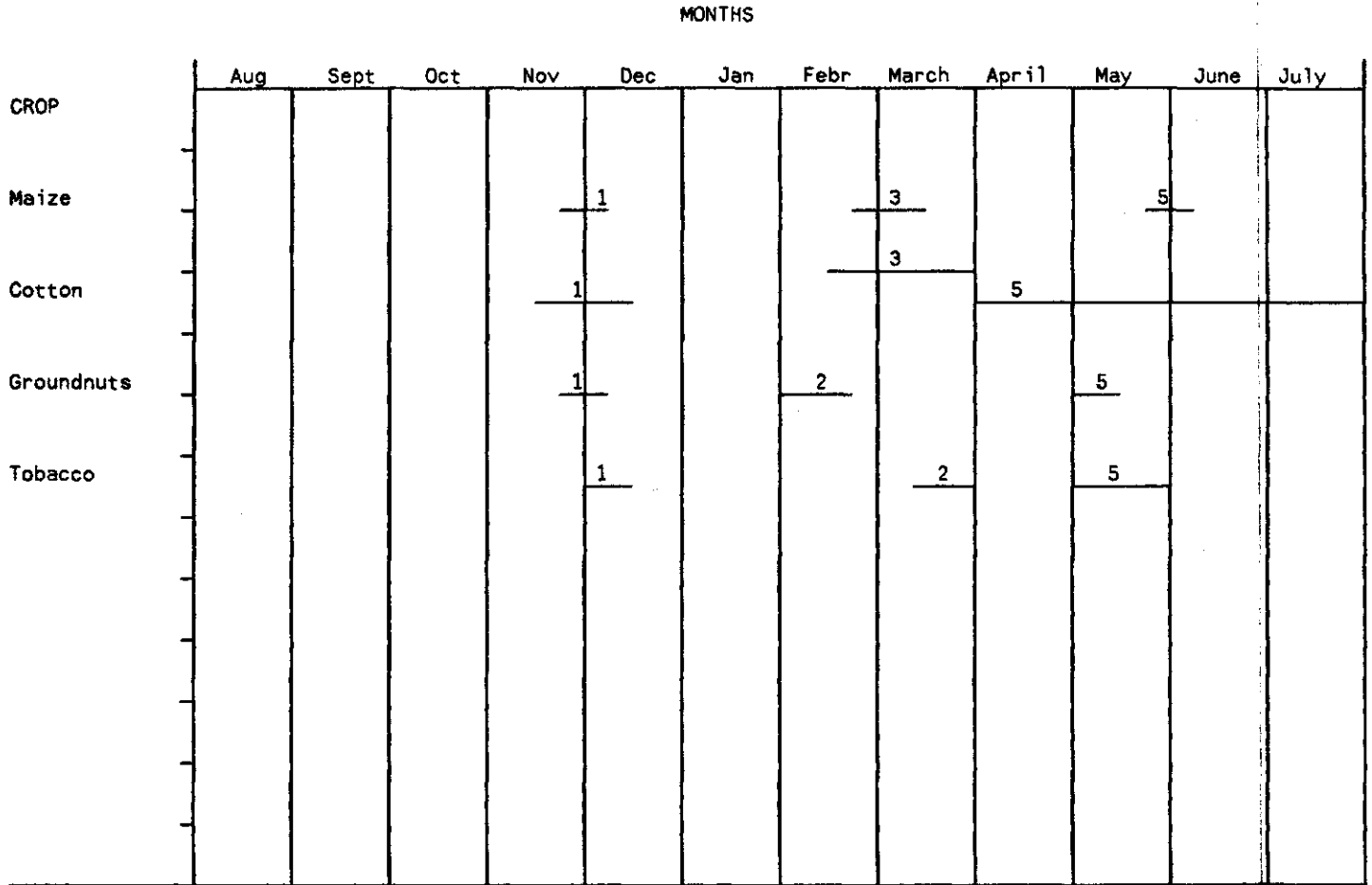
DISTRICT: Chama

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Sorghum					1*		3	5	1			
Finger millet					1			5				
Maize				1			3			5		
Rice					1		2	3	4		5	
Groundnuts				1			3			5		

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

Fig. 12. AVERAGE CROP CALENDAR

PROVINCE: Eastern
 DISTRICT: Lundazi,



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 13. AVERAGE CROP CALENDAR

PROVINCE: Eastern
DISTRICT: Chipata

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize					1			3		5		
Cotton				1			3	3	5			
Groundnuts				1			3			5		
Tobacco					1			2		5		
Grain legumes						1	2		5			

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 14. AVERAGE CROP CALENDAR

PROVINCE: Eastern
 DISTRICT: Petauke - Katete - Chadiza

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize					1			3		5		
Groundnuts					1		2			5		
Tobacco					1			2		5		
Legumes						1	3		5			
Soybeans					1		3			5		
Cotton				1				3		5		

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

5. CENTRAL PROVINCE

5.1. Climate pattern

SCHULTZ (1974) described it as follows: the Central plateau climate is characterized by three-four humid months and two sub-humid months. The rainfall amount is about 800-1000 mm. The growing season starts in November and ends in March, and those crops which are characterized by short growing season are more suitable for such environment.

5.2. Agricultural systems

A traditional type of agriculture is practiced by Lala people (ALLAN, 1965).

In Serenje district Lala population often cultivate six form of subsidiary gardens :

- 1) Second year ash circle. Small ash circles are planted in the second year of chitemene with ground beans, groundnuts or cowpeas.
- 2) Sorghum gardens. Subsidiary gardens are cut and prepared as chitemene gardens. Maize, sorghum and sweet potatoes are planted on the ash circles, instead of finger millet, and land between the circle is mounded. Mounds is sown with sorghum, intercropped with cowpeas, peanuts and cassava. Mounds practice is to ensure good soil fertility.
- 3) Maize and bean gardens: very small gardens made on the dambo margin sites.
- 4) Cassava gardens; they are located in dambo fringing woodland, on the dry upper slope.
Crop is planted on mounds and few plants of maize, sorghum and cowpeas may be added.
- 5) Seepage gardens. Maize and beans are grown on the seepage sites of dambos and by streamsides. Grass and turf are hoed in circular pattern and, after drying, are burnt in August. Maize is planted in the moist soil in August and reaped in December as green cobs. Beans are then planted as soon as the maize is harvested.

6) Livingstone potato beds. Long beds located on the upper flanks of dambos and planted with Livingstone potatoes.

The land use factor is related to the regeneration time necessary for trees to grow up; it depends also on the effects of fire in the late burning. Infact wise burning regime (early burning) allows for recovery of trees in 20 years. But incontrolled regime requires 30-40 years. In Serenje district trees recover after 22-25 years after shifting cultivation.

5.3. Farm size distribution

Even though traditional farming is still practiced, commercial farming in the Central province represents more than the 60% of the total farming. Table 14 shows such distribution (FOOD STRATEGY STUDY, 1981).

Table 14. Farming type in Central province

	Farms	Rural Population
Large scale commercial (more 40 ha)	300	15,200
Medium scale commercial (10-40 ha)	7,630	72,500
Small scale commercial (1-10 ha)	21,400	160,500
Traditional farming	18,400	82,800
TOTAL	47,730	331,000

5.4. Maize production and yield forecasting

Also in Central province maize represents the most important crop, which is commercialized in Western, Copperbelt, Luapula, Northern and Lusaka provinces. Kabwe district is the larger producer of maize and, in the same district, the number of commercial farms is the largest. Crop purchases data in Central province have been given for 1981 by ASTHANA et al, (1984):

Crops	1981
	[M/T]
Maize	162,240
Seed cotton	6,066
Sunflowers	5,235
Virginia tobacco	910
Shelled groundnuts	105

As regards maize, purchase figures are available (FAO, 1984) by district (Table 15).

Table 15. Purchase of maize in Central province in 1981-1982

District	(bags)
Serenje	65,221
Mkushi	644,555
Kabwe	664,466
Mumbwa	188,477
TOTAL	1,562,719

Production and sales forecasts for maize in the Central province (ANONYMOUS, 1984) are summarized in Table 16.

Table 16. Maize production and sales forecasts in Central province
(after ANONYMOUS, 1984)

	Area [ha]	Expected production [bags]	Expected sales [bags]
1983-84(p)	98,000	2,964,000	2,497,000
1982-83(p)	142,000	3,807,000	3,029,000
1982-83(a)	147,000	3,301,000	2,236,714

p=preliminary

a=actual

5.5. Crop phenology

From Map 3 (VELDKAMP et al., 1984), several agroclimatic zones can be discriminated in Central Province (Table 17).

Table 17. Agroclimatic zones in Central province

District	Zone Number	Length Growing Season	
		Mean Value	70% Probability
Mumbwa	15	159-166 days	I dec. December II dec. February (9 decades)
Mkushi(north)	24	173-180 "	
(south)		159-166 "	
Kabwe	15	159-166 "	I dec. December
(south)		110-120 "	II dec. March (10 decades)
Serenje	18	166-173 "	III dec. November II dec. March (11 decades)

Crop calendars are given for each district of Central province from Figs. 15-18. MOORE (1974) has given detailed informations on the cultivation of maize and sorghum in Mumbwa district.

Fig. 15. AVERAGE CROP CALENDAR

PROVINCE: Central
DISTRICT: Serenje

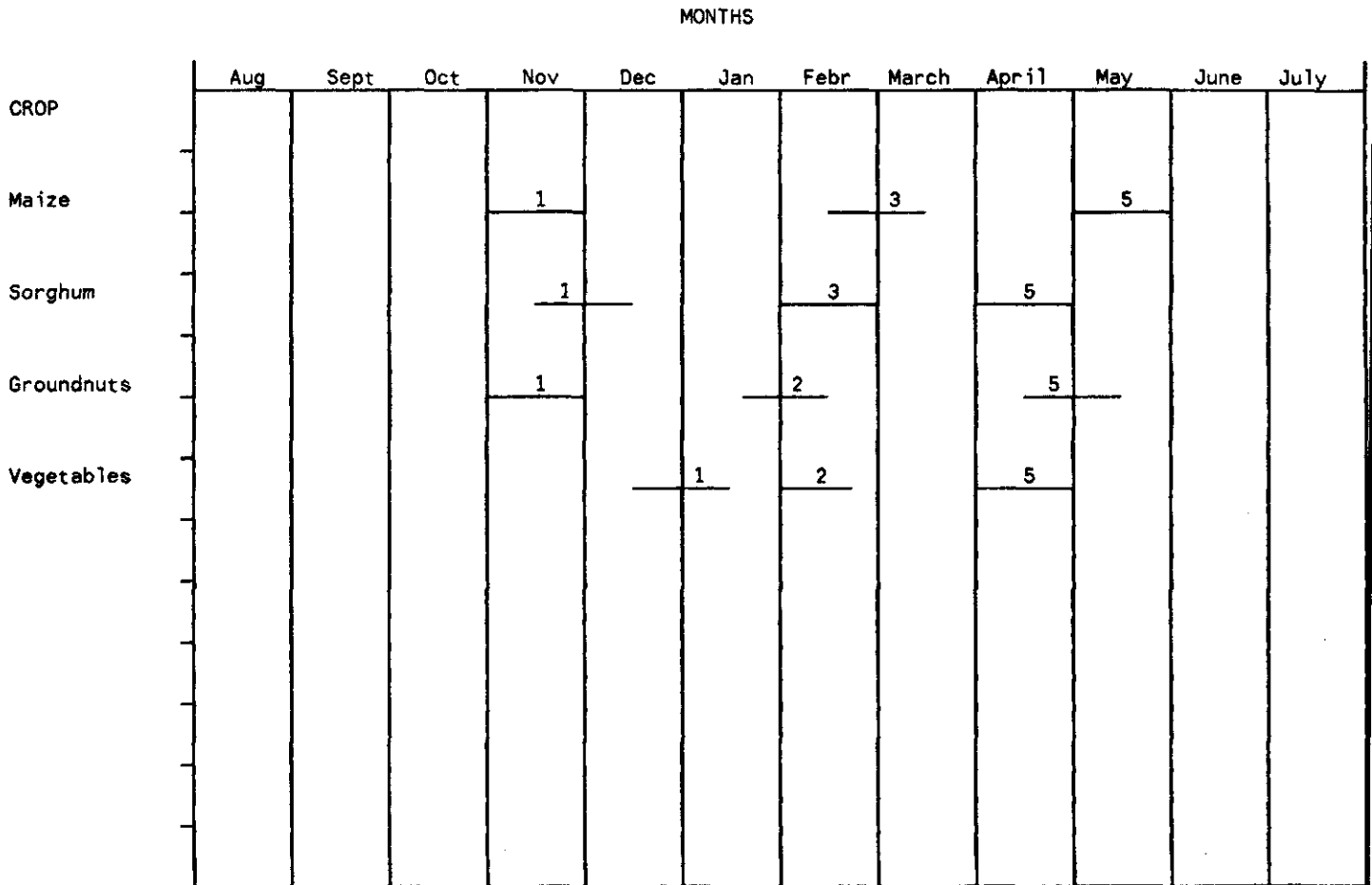
MONTHS

CROP	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize				1			3			5		
Cassava		1								2		
Beans					1	2			5			

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 16. AVERAGE CROP CALENDAR

PROVINCE: Central
 DISTRICT: Mkushi



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 17. AVERAGE CROP CALENDAR

PROVINCE: Central
DISTRICT: Kabwe

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize				1				3		5		
Sorghum				1			3		5			
Groundnuts				1			2			5		
Vegetables						1	2		5			

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 18. CENTRAL

PROVINCE: Central
 DISTRICT: Mumbwa

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize				1			3	4		5		
Sorghum				1			3			5		
Bullrush millet				1						5		
Groundnuts				1		2				5		
Vegetables						1	2		5			

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 4 Yield formation
- 5 Harvesting

6. LUSAKA PROVINCE

6.1. Climate pattern

Climatic pattern of Lusaka Province is very similar to the climate of Central Plateau (see for description climatic pattern of Central province).

6.2. Agricultural systems

No literature was founded about agricultural practices in Lusaka province.

6.3. Farm size distribution

The total area of Lusaka province is 21,900 km² with a population of 693,873 (1980 Population Census), the yearly growth rate of the population is 5.3%.

Distribution of the farming population in the province shows that 61% of the farmers are emergent ones and large scale commercial farmers are the 21% of the total, the 18% left over is divided between subsistence and medium/large scale commercial farmers (ASTHANA et al, 1984).

However, different figures are given from the report of "Food strategy study, 1981" related to the farming distribution (Table 18).

Table 18. Farming type in Lusaka Province (1980) [after FOOD STRATEGY STUDY, 1981 - annex : socio-regional framework]

	Farms	Rural Population
Large scale commercial (more than 40 ha)	90	4,300
Medium scale commercial (10-40 ha)	1,910	18,100
Small scale commercial (1-10 ha)	4,300	32,300
Traditional farming	13,400	60,300
TOTAL	19,700	115,000

6.4. Maize production and yield forecasting

Also in Lusaka province maize represents the most important cash crop as it is shown in table 19.

Table 19. Crop purchases in 1981 and 1982 (M/T) in Lusaka Province
(after ASTHANA et al, 1984)

	Maize	Wheat	Sunflower	Soyabeans
1981	29,195	2,796	1,841	171
1982	19,642	-	-	-

Maize production and sales forecasts for Lusaka province (ANONUMOUS, 1984) are given in Table 20.

Table 20. Maize yield and sales forecasts in Lusaka province

	Area [ha]	Expected production [bags]	Expected sales [bags]
1983-84(p)	20,300	424,000	250,000
1982-83(p)	24,700	736,000	455,000
1982-83(a)	25,000	495,000	217,417

a=actual

p=preliminary

6.5. Crop phenology

Description of the agroclimatic zones in which Lusaka Province (see Map 3) is divided is given in Table 21 (VELDKAMP et al, 1984):

Table 21. Agroclimatic zones in Lusaka province

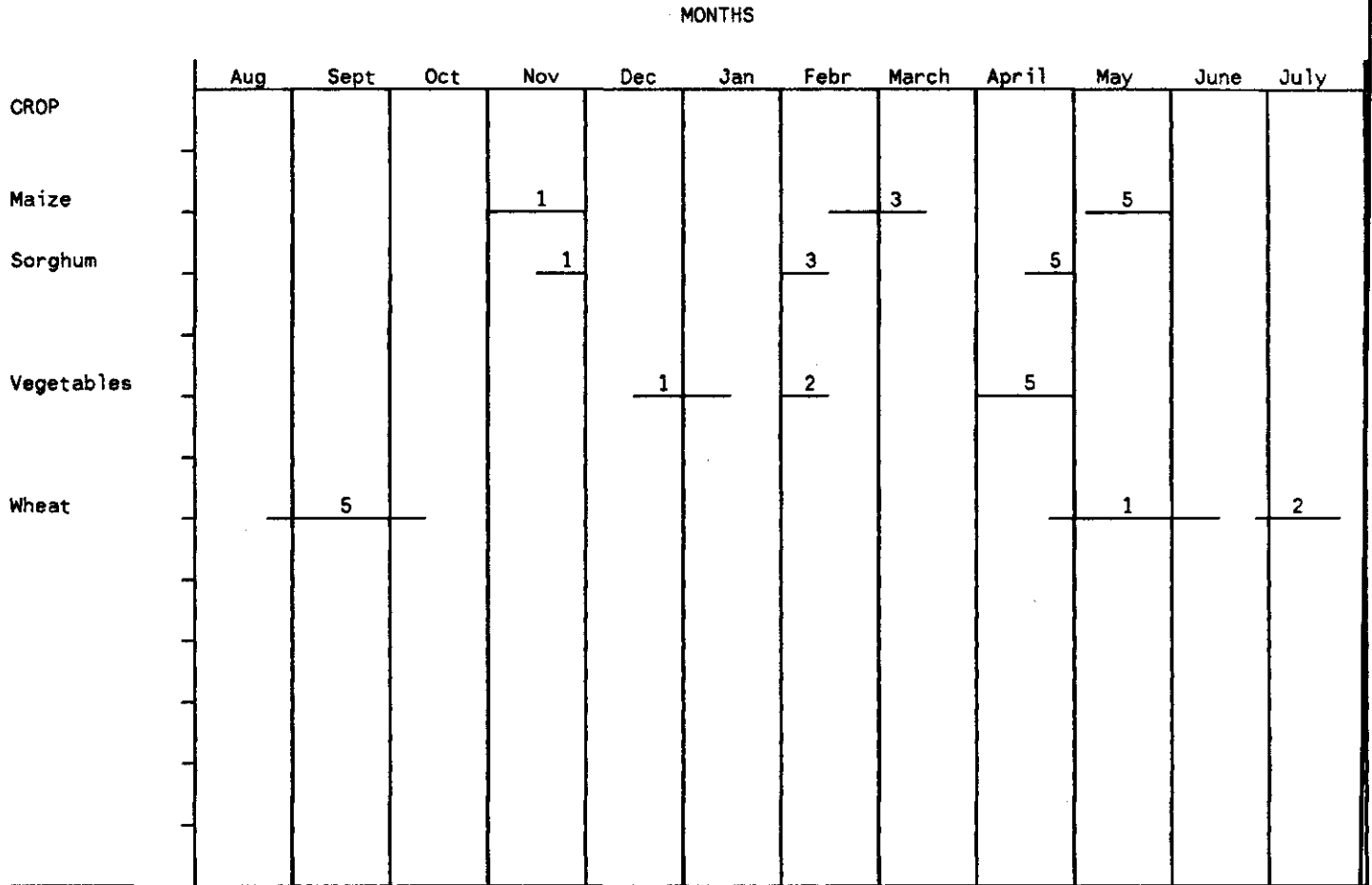
District	Zone Number	Length of the Growing Season	
		mean value	70% probability
Luangwa	2	141-166 days	
Runfusa	6	147-152 "	
Lusaka	10	152-159 "	I dec. December III dec. February (9 decades)

Average crop calendars for the main crops cultivated in Lusaka province were calculated (Figs. 19-20).

Information on wheat phenology in Lusaka province are given by MOONO, 1976. He remarked that wheat cycle under rainfed condition is 84 days long while 150 days long when wheat is irrigated.

Fig. 19. AVERAGE CROP CALENDAR

PROVINCE: Lusaka
DISTRICT: Lusaka



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 20. AVERAGE CROP CALENDAR

PROVINCE: Lusaka
 DISTRICT: Luangwa

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize				1			3			5		
Sorghum				1			3		5			
Wheat		5							1	1	1	2

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

7. COPPERBELT PROVINCE

7.1. Climate pattern

Climate according to SCHULTZ (1974), is very similar to the Northern province and to the northern part of North-Western province.

7.2. Agricultural systems

Copperbelt province is 31,330 km² large, where 52% of the land can be classified as arable land. Population Census in 1980 counted 1,248,888 people with a yearly rate of average growth of 3.9 %.

In the northern district of Copperbelt province mainly commercial farms and State lands are present, small scale irrigation project were also supported as it is shown in Chapula, Kalulushi district, (CLAESSENS, 1975); an example of vegetable calendar and scheme of crop rotation are given in Fig. 21.

In the southern part of the province Lamba people practice a type of block chitemene system, as it is described by ALLAN (1965). "Lamba people living in a more fertile soils (Copperbelt region which soils can perform three time bigger yield than the other considered regions) practice a different type of chitemene. Their garden consists of three parts: a) the fiteme or ash patches; b) the inkuule or hoed portion between the ash patches and c) the cisumbu or cut but uncultivated part which is rarely more than a quarter of the whole.

First year - fiteme is planted with maize, sorghum seed may be broadcast and underplanted with pumpkins and cucurbits.

Inkuule is cultivated with sorghum (main crop for Lamba people) mixed with maize and few groundnuts, groundbeans, sweet potatoes, and cassava. Maize and pumpkins are planted on ant-hills (higer fertility) and finger millet planted on the margins of the garden. Cucumbers of several types are underplanted in the inkuule.

Second year - the fiteme and the inkuule are planted with sorghum and little maize; in part of the cisumbu minor crops are cultivated. Finger millet may be cultivated on ash patches followed by groundbeans or groundnuts.

Third year - inkuule is often mounded to avoid weeds increase, the whole area cultivated in the second year is now cultivated with sorghum, and the rest of the cisumbu is cultivated with subsidiary crops.

Cropping is continued for 3-4 years on the weaker soils but for 8 years in more fertile ones.

In addition to the main gardens, Lamba have few fiteme for finger millet in the woodland far from the village. They look like small-circle chitemene gardens in which pumpkins and gourds are sown on the margins. Low soil fertility allows to sow grain crops only once, but during the second year groundnuts or groundbeans can be planted.

In the marginal grassland of dambos ridge gardens, which are long beds or ridges 4 feet wide, are cultivated with Livingstone potatoes which last for two years.

The fipoka is made by hoeing up the humic topsoil of fertile sandy-clay dambo soils which are used to cultivate cash crops as vegetable and maize for sale".

7.3. Farm size distribution

From the "FOOD STRATEGY STUDY, 1981" it is possible to quantify the importance of the traditional farming still preminent in Copperbelt province (Table 22).

Table 22. Farming type in Copperbelt province

	Farms	Rural Population
Medium scale commercial (10-40 ha)	490	4,700
Small scale commercial (1-10 ha)	2,000	14,900
Traditional farming	17,900	80,400
TOTAL	20,390	100,000

7.4. Maize production and yield forecasting

Copperbelt province produces mainly maize, wheat, sunflower, sorghum, soybeans, vegetables and fruits. However, maize production in 1982 was not enough to cover the total consumption, as it is shown in table 23.

Table 23. Maize production and consumption in the districts of Copperbelt province (bags) [ASTHANA et al, 1984].

District	Production	Consumption	Balance
Chililabombwe	-	113,661	-(113,661)
Chingola	-	268,762	-(268,762)
Kalulushi	-	114,450	-(114,450)
Kitwe (Chambeshi)	1,972	591,300	-(598,328)
Luanshya	14,899	242,098	-(227,199)
Mufulira	3,026	273,769	-(270,742)
Ndola (rural)	121,196	227,865	-(106,669)
Ndola (urban)	-	541,789	-(541,786)

Moreover, the forecasted maize production for the years 1983 and 1984 remained also rather low compared to consumption (Table 24) (ANONYMOUS, 1984).

Table 24. Maize yield and sales forecasts in Copperbelt province

	Area [ha]	Expected production [bags]	Expected sales [bags]
1983-84(p)	10,000	180,000	108,000
1982-83(p)	8,400	177,000	133,000
1982-83(a)	7,700	159,000	90,220

p=preliminary

a=actual

7.5. Crop phenology

Description of agroclimatic zones of the Copperbelt province is given in Table 25 (after VELDKAMP et al, 1984).

District	Zone number	Length of growing season	
		mean value	70% probability
Chililabombwe	34	188-204 days	
Mufilura			
Chingola			
Ndola (urban)			II decade Nov.
Kitwe			II decade March (15 decades)
Luanshya	24		
Ndola (rural)		166-180 days	

Average crop calendars of the main crops cultivated in Copperbelt province are shown in Figs. 22-24.

Fig. 22. AVERAGE CROP CALENDAR

PROVINCE: Copperbelt

DISTRICT: Chilibabombwe, Mufulira, Chingola

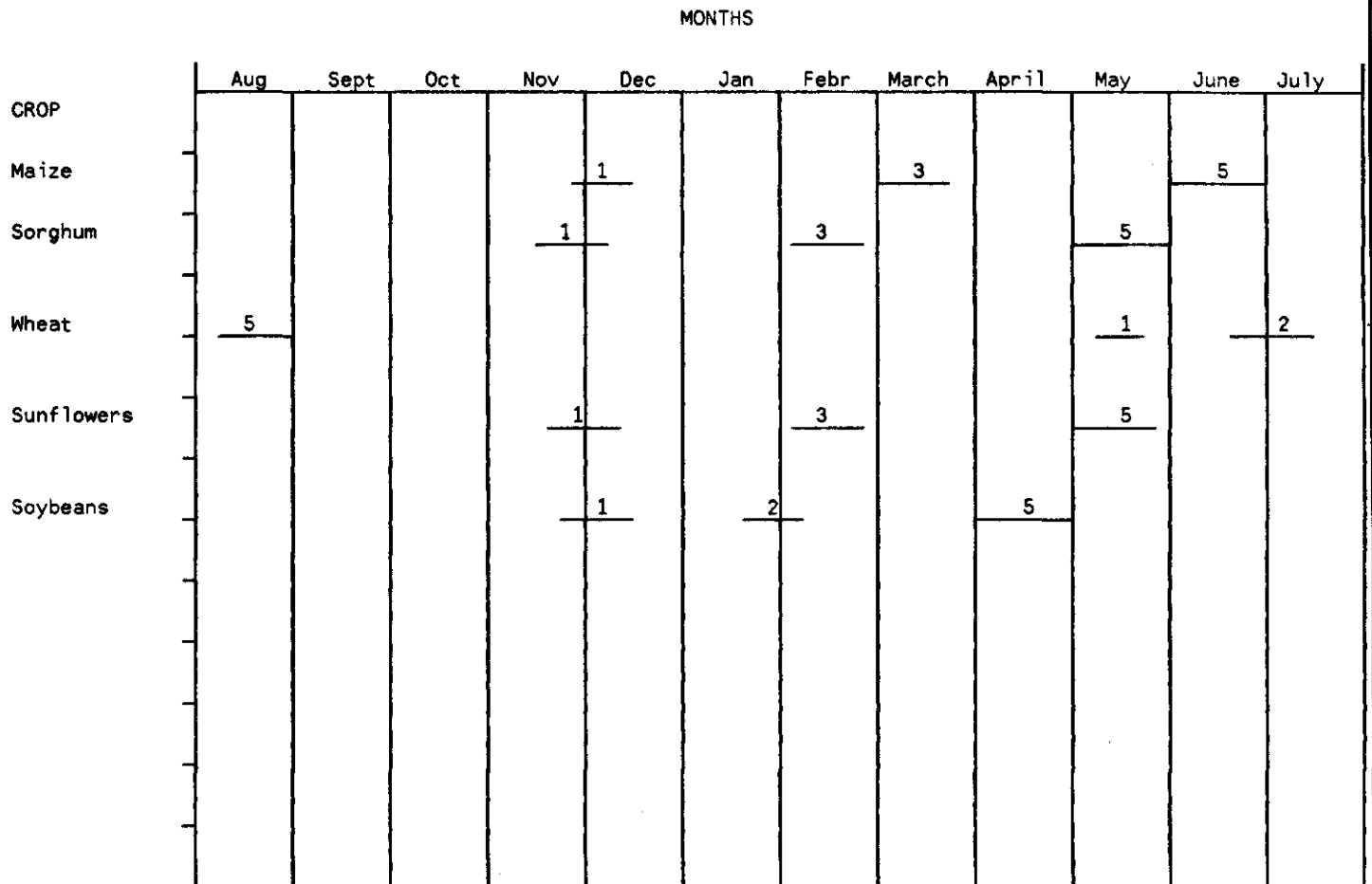
MONTHS

	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
CROP												
Maize				1				3			5	
Wheat	5									1		2
Soybeans				1				3		5		
Vegetables					1				5			
Sunflowers				1				3		5		

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 23. AVERAGE CROP CALENDAR

PROVINCE: Copperbelt
 DISTRICT: Ndola urban, Kitwe



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 24. AVERAGE CROP CALENDAR

PROVINCE: Copperbelt
 DISTRICT: Luanshya, Ndola rural

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize				1			3			5		
Sorghum				1			3			5		
Wheat	5									1		2
Soybeans				1		2			5			
Sunflowers				1		3			5			

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

8. NORTH WESTERN PROVINCE

8.1. Climate pattern

In the northern part of this province rainfall amount exceeds 1200 mm. per year and the humid months are six. It is the wettest province of Zambia. Rainfall affects the length of the growing season which is also the longest in the whole country. There cultivation of perennial crops is suggested.

In the central and southern part of North Western province rainfall exceeds 1000 mm per year and the humid months can be either four or six (December-March or November-April) (SCHULTZ, 1974).

8.2. Agricultural systems

Several types of traditional farmings are practiced by the different tribes living in the North-Western province.

Luvale, Luchazi and Chokwe people are living in Kabompo and Zambezi districts and they practice a type of agriculture called Luvale system (SCHULTZ, 1974). Main staple crop is cassava: 50-75% of the cultivated land around Kabompo is cultivated with this crop. Maize is the second important crop.

Cassava is grown on roughly rectangular clearings on flat ground and it is harvested the second year. Cassava is also replanted continuously over the entire field. If the soil becomes exhausted, field is left fallow or rotated with groundnuts or beans. Bulrush millet is grown on the woodlands. Near the village houses, gardens for vegetables and fruit trees are cultivated. Furthermore small fields (maximum size 0.04 ha) are cultivated on the edge of valley floors (SCHULTZ, 1974).

In Mwinilunga district a shifting/semi-permanent cultivation system is practised and called Mwinilunga system (SCHULTZ, 1974).

Transformation of woodlands into arable land is done according to the small chitemene method: formation of small patches of ash (burnt trees) and finger millet is planted. Ash patches are in irregular shape. Cassava roots are planted on small mounds which are made by hoeing. Cassava, the main staple crop, is harvested in the third or

fourth year. A second planting of cassava can follow. Cassava is grown on average 0.23 ha while maize and finger millet on 0.02 ha.

Crops in the holdings are so far distributed: 92% cassava, 4.9% maize, 2.4% finger millet (SCHULTZ, 1974).

Kaonde people live mainly in Solwezi and Kasempa districts and they practice mainly block chitemene system. This system consists mainly of slash and burn system where a huge proportion of cultivated land is cleared area in which a 3 years-rotation sequence is practiced. Fields are burnt in October, before the first rain and this type of burning is known as "late" and "hot" burning as opposed to the "early" and "cool" burning practiced between May-June (JAEGER, 1981). ALLAN (1965) remarked the beneficial effects of late and hot burning: "late burning means that the tree stumps are for the most part destroyed. The hot burning has a positive effect on organic decomposition and nitrate production, especially when it is followed by rainfall." After burning the field, parts of the plot having no ash are hoed and planted with sorghum. In stretches with a high ash content maize and pumpkins are planted, while sweet potatoes, yams and cassava are planted along the edges of the field in mounds. In the second and subsequent years, the field is used for sorghum whereby the fertile parts are planted with groundnuts and pumpkins. The main field is about 1-2 ha (JAEGER, 1981). Maize, sorghum and cassava represent the main crops, maize is present in the 91% of all the holdings while sorghum is cultivated by the 2/3 of the farmers. Traditionally holdings are growing sorghum in 0.09 ha, maize on 0.07 ha and cassava on 0.05 ha (SCHULTZ, 1974). Sorghum plots are used for 3-7 years.

The streamside gardens, situated along streams and dambos are mainly present in the east side of Kasempa District. The so-called "pre-rain gardens" are planted on the end of the dry season (August-September) and harvested during the rainy season, after the "hunger months" (January-February). Maize is the main crop there cultivated, but other crops as vegetables, pumpkins and beans are in small quantity cultivated.

These gardens are cultivated for 3-6 years and having a size from 0.1 to 0.5 ha. JAEGER (1981) has written a very detailed report on the settlement pattern in Kasempa district giving also accurate informations on calendar seasonal activities very useful to compile an average crop calendar.

8.3. Farm size distribution

The total area of North Western province is 125,800 km² where only the 10% is cropped area (JAEGER, 1981). The 1980 population census counted 340,000 people having an annual growth rate equal to 2.4%; 264,000 people are farmers practicing mainly subsistence farming (Table 26).

Table 26 . Farming type in North Western province
(after FOOD STRATEGY STUDY, 1981]

	Farms	Rural Population
Medium scale commercial (10-40 ha)	80	800
Small scale commercial (1-10 ha)	2,900	21,900
Traditional farming	53,600	241,300
TOTAL	56,580	264,000

8.4. Maize production and yield forecasting

Staple crops as cassava and finger millet are very important in the whole North Western province, while the area cultivated with marketable crops is rising (Table 27).

Table 27 . Crop purchases (bags) for the period 1981-1982 in the North Western province (after ASTHANA et al, 1984)

	1981	1982
maize	41,540	49,686
sunflower	101	139
paddy rice	90	109
ground nuts	21	13
soybeans	2	4

The same source gives the maize purchase for each district in 1982:

District	Marketable production [bags]
Zambezi	4,358
Kabompo	11,296
Chizera	4,710
Solwezi	15,181
Mwinilunga	6,472
Kasempa	7,669
TOTAL	49,686

Maize production forecast for the years 1983 and 1984 are given in Table 28 (after ANONYMOUS, 1984) for the entire North Western province.

Table 28. Maize production forecast in North Western province

	Area [ha]	Expected production [bags]	Expected sales [bags]
1983-84 (p)	3,700	81,000	59,000
1982-83 (p)	3,200	78,000	62,000
1982-83 (a)	4,800	95,000	51,263

Maize requirements exceeds production in each district of the province as it is shown in Table 29 for the year 1982 (ASTHANA et al, 1984).

Table 29. Estimated consumption requirements in 1982 in North Western province

District	Population	Total bags consumption	Production Marketed/Retained Bags * 36%	Balance
Chizera	13,369	13,302	4,710 2,649	- 5,943
Kabompo	42,565	45,416	11,296 6,354	-27,766
Kasempa	31,288	34,229	7,669 4,314	-22,246
Mwinilunga	70,837	70,483	6,472 3,640	-60,371
Solwezi	102,238	112,768	15,181 8,539	-89,048
Zambezi	57,711	62,097	4,358 2,451	-55,288

8.5. Crop phenology

Table 30 gives the mean duration of the growing season in the same districts of the North Western province.

Table 30. Agroclimatic zones in North Western province

Districts	Zone Number	Length Growing Season	
		Mean Value	70% Probability
Zambezi Kabompo	32	180-195 days	I dec. November- III dec. March (15 decades)
Mwinilunga	35	204-212 "	I dec. November III dec. March
Solwezi	34	188-204 "	I dec. November III dec. March (15 decades)
Kasempa (south)	19	166-173 "	II dec. November II dec. March (13 decades)

Average crop calendars of the main crops cultivated in the North Western province are shown in Figs. 25-27.

Fig. 25. AVERAGE CROP CALENDAR

PROVINCE: North-Western
DISTRICT: Mwinilunga

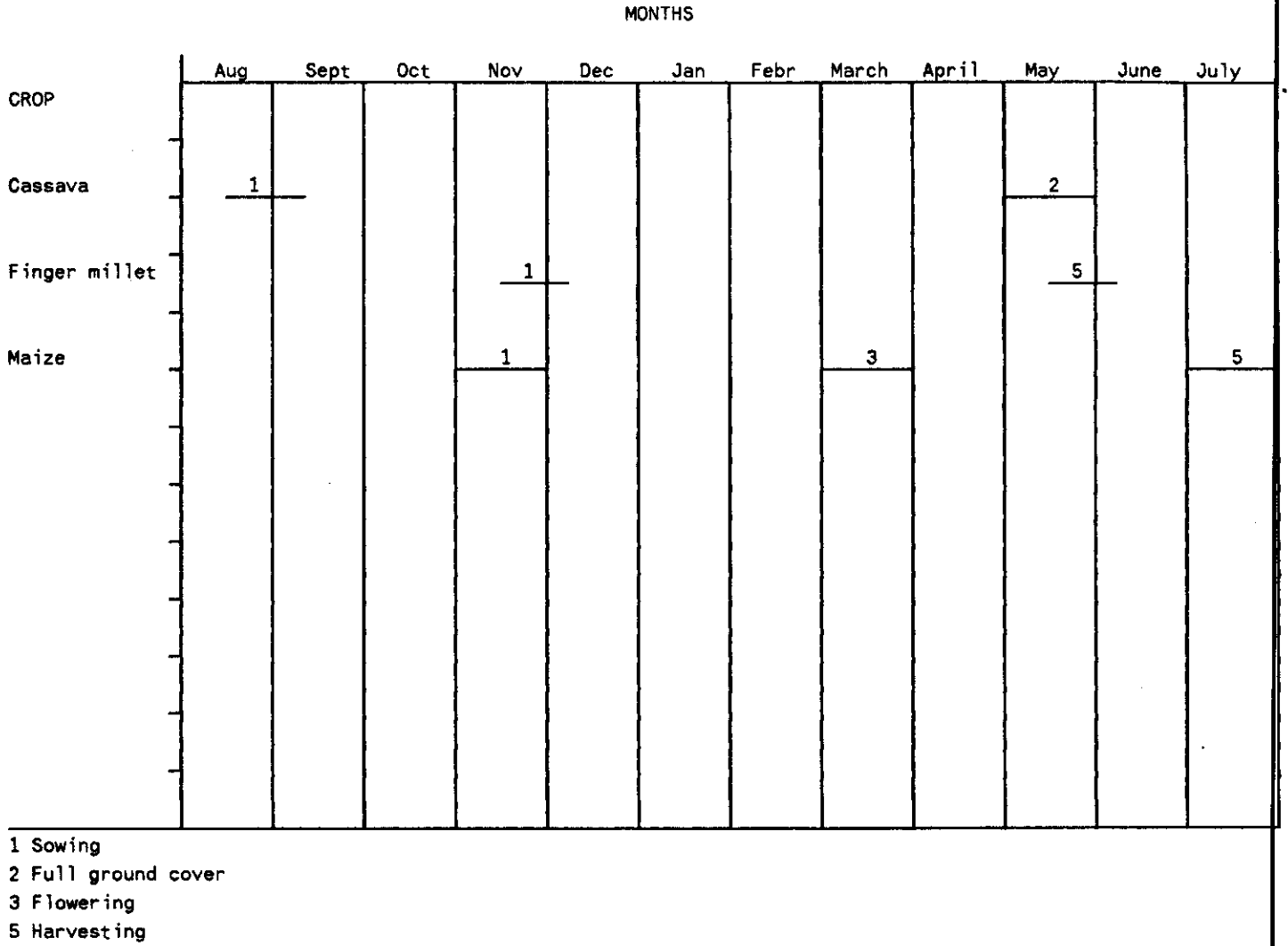


Fig. 26. AVERAGE CROP CALENDAR

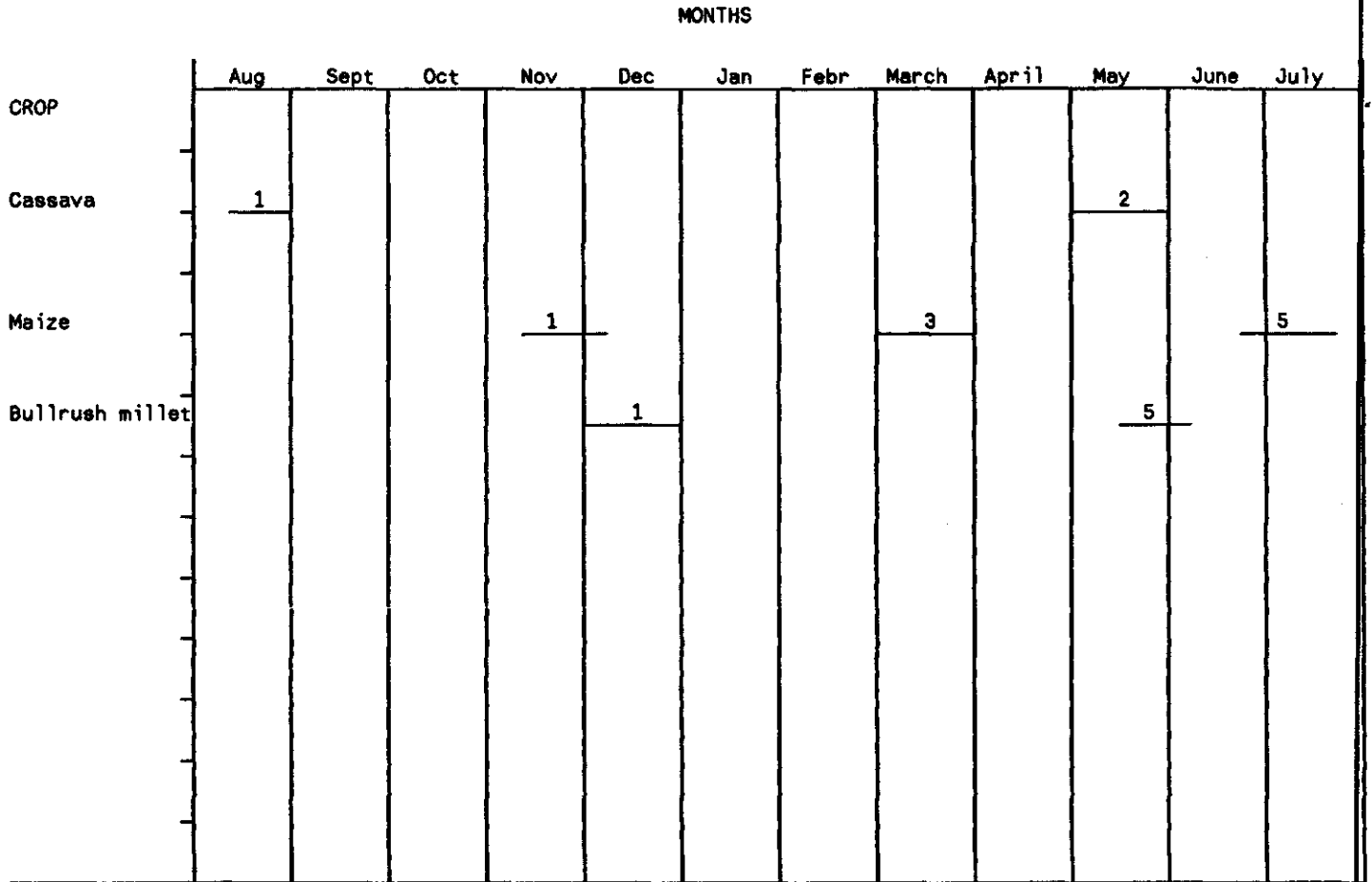
PROVINCE: North Western
 DISTRICT: Kasempa - Solwezi

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize in dambo		1			3		5					
in field				1				3			5	
Groundnuts				1			2					
Beans in dambo		1		2			5					
Sorghum					1			3			5	
Cassava					1							

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 27. AVERAGE CROP CALENDAR

PROVINCE: North-Western
DISTRICT: Zambezi and Kabompo



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

9. WESTERN PROVINCE

9.1. Climate pattern

Climate pattern of the Western province is rather similar to the Eastern province (already described), only the southern part of the Western province (Senanga and Sesheke districts) has the following characteristics: annual rainfall of 800 mm distributed in 120-130 days. Wet season consists of three humid months and one sub-humid. Mean growing season lasts about four months from December till March (SCHULTZ, 1974).

9.2. Agricultural systems

In the Western province many traditional agricultural systems are present because of the complexity of the environment.

Barotse system is present in Lukulu, Kalabo, Senanga and Mongu districts. It consists of an extensive use of the flood plains, unregularly flooded year after year. Maize and cattle grazing are the main agricultural resources. The cultivated sandy areas, mainly with cassava, need a period of rest, while the lands in the alluvial plains can be continuously cultivated with maize. Average holdings are 0.22 ha large. Seasonal migration is common in order to purchase the best pasture for cattle. Infact, after the flood occurred, cattle are driven in June on the plains where the pasture is sufficient through all the dry season. Cattle are driven back to the woodlands when the plains are flooded again in December/January. In order to describe the cultivation management in the Barotse system we will follow the description given by SCHULTZ, 1974. Fig. 28 shows the location in the environment pattern of the different types of cultivation. The following description applies to such type of cultivations.

SITAPA/plural LITAPA - fertile clay deposits, these depressions dry only in June, then grass is immediately burnt and the soil is ploughed for maize seeding. However it is a risky cultivation because water level drop very rapidly during the dry season. Maize ripening depends on the first rain in October. Floods occur again in January-February.

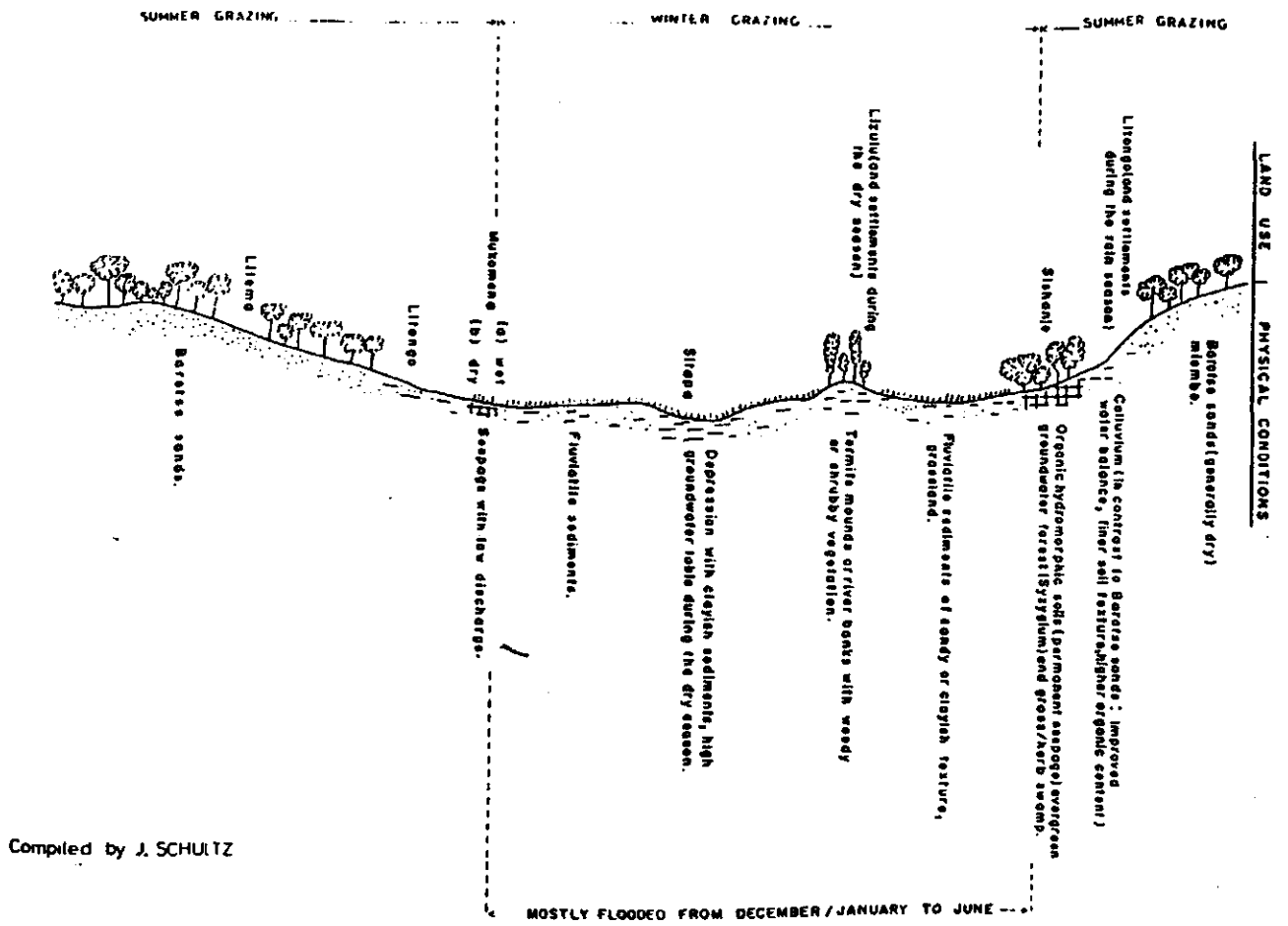


Fig. 28. Associations of landscape units with different types of cultivations in the Barotse system (after SCHULTZ, 1974)

LIZULU/plural MAZULU - clay soil on mounds. They are the safest sites on the Barotse Plain. Maize is the main crop which is seeded in December. Maize cultivation is uninterrupted thanks to the cattle manure use. On more sandy soils, LIZULU, sorghum is the dominant crop.

SISHANJO/plural LINSHANJO - soil is classified as Barotse peat. Originated by permanent seepage in the groundwater forest. Soils have to be drained to be cultivated. Groundwater level is controlled by a dense, almost rectangular channel system (unique method in Zambia). Maize is dominant crop but also vegetables play an important role. Planting starts in June and continues till September-October. Fields are continuously cultivated. Water table level in the fields should not drop more than 50 cm below the surface.

MUKOMENA - edges of the flood plains equivalent to the LINSHANJO. There is no permanent seepage and they have a higher sand content. Sub-soil is used for agriculture. Ditches 60cm. deep are dug in irregular rows, grass is heaped under the subsoil forming compost. There is a one meter difference between the bottom of ditches and the top of the ridges. The result is a richer mixture of soil and ridges are not flooded. Drainage network consists of ditches. The most important crop there is cassava. After 3 year new ridges are made. In some more fertile MUKOMENA (moister and richer in peat) two crops are grown each year: sweet potatoes from February till July and maize from August till December.

LITONGO/plural MATONGO - clay and fine sand soil with some humus content. Cultivation is done during the rainy season where dominant crop is maize. Other cultivated crops : bullrush millet, groundnuts cassava, fruit trees. This area is very suitable for settlement.

LITEMA/plural MATEMA - regosols soils having Barotse sands. Natural fertility is high but it has been destroyed by population increase. 75% of farmers is living on such MATEMA. Cultivated crops are mainly cassava and millet. Originally fields were cultivated for 5 years, having a long fallow period. Nowadays cultivation period is shorter.

Table 31. Agricultural systems, present land use and soil types in Western province (after VERBOOM et al., 1970)

Geomorphological unit	Soil type	Agricultural system (Tropnell and Clothier, 1957)	Crops	Duration of cultivation (years)	Duration (years) and type of fallow	Local name
Mankoya Terrace	I(a) Upland Sedentary Soils	Southern Plateau System; shifting cultivation	Maize, beans, pumpkins	4 - 5	10 - 20 Rush fallow	-
	I(b) Upland Mixed Sedentary and Shrotze Sand Soils	Shifting cultivation intermediate between Southern Plateau and Central Kalahari Systems; Southern Kalahari System in Sesheke District	Maize, groundnuts, sorghum, cassava	3 - 4	20 Rush fallow with summer grazing	-
	I(d) Valley Alluvium (Dambos)	Southern Plateau System; wetland grazing and some gardens	Some early maize, sweet potatoes on mounds	5 - 6	8 Grass fallow	-
Mangu-Kalabo Terrace	II(a) Lake-dune Barotse Sands	Central Kalahari System; shifting cultivation Southern Kalahari System in Sesheke District	Finger millet, bulrush millet, cassava, cattle	2 - 3	25 Rush fallow and upland grazing	Litomo
	II(b) Lake Basin Alluvial Soils	Central Kalahari System; shifting cultivation	Root crops	3	8 Grass fallow	Mukomona
	II(c) Humic Soils (i) Dry Litongo (ii) Wet Litongo (iii) Sishanjo	Central Kalahari System; Semi-permanent cultivation on the Dry Litongo with manuring, and on the Wet Litongo and Sishanjo on mounds	Fruit trees, vegetables, cassava, maize, beans, root crops, early maize	Semi-permanent	Grass fallow with winter grazing	(i) Dry Litongo (ii) Wet Litongo (iii) Sishanjo
	II(d) Recent Alluvium in Abandoned Watercourses	Central Kalahari System; semi permanent cultivation	Early maize, sorghum, pumpkin, cattle	Semi-permanent	Grass fallow with winter grazing	Sitape
Bilosi Terrace	III(a) Humic Soils (i) Dry Litongo (ii) Wet Litongo (iii) Sishanjo	Central Kalahari System; semi-permanent cultivation on the Dry Litongo with cattle manuring, and on Wet Litongo and Sishanjo on mounds	(i) Fruit trees, vegetables, grains, root crops (ii) Maize, beans, root crops (iii) Early maize, sweet potatoes, Cattle	Semi-permanent	Grass fallow with late winter grazing	(i) Dry Litongo (ii) Wet Litongo (iii) Sishanjo
	III(b) Flood Plain Sandy Alluvium	Central Kalahari System; mound cultivation and mid-winter grazing	Root crops Cattle	3	8 Grass fallow with mid-winter grazing	Seana or Dry Plain Litongo, Mukomona if cultivated (mounds)
	III(c) River Levee Alluvium	Central Kalahari System; hoe cultivation with cattle manuring	Mixed crops cattle	Semi-permanent	Early flood grazing and fodder trees	Lisulu
	III(d) Recent Alluvium in Abandoned Watercourses	Sitape (cultivated), hood or ploughed Mhalape (grassland) Lutunda (riverbank)	Cattle, early maize, sorghum, pumpkins, maize	Semi-permanent		Sitape Mhalape Lutunda

VERBOOM et al. (1970) in Table 31 have summarized the agricultural systems in the Western province.

In the southern part of the Western province Toka and Totela people practice Sesheke system which consists of cultivation on the valley terraces, where the better soils are located. There mainly maize and sorghum (100:60) are grown, and the proportion of cultivated area can vary between 25 and 50%.

9.3. Farm size distribution

The total population of Western province was recorded by the 1980 population Census as being 488,000 of which 425,000 are rural people. Traditional farming represented the most diffuse agricultural pattern till 1980 as it is shown by Table 32.

Table 32. Farming type in Western province (after FOOD STRATEGY STUDY, 1981)

	Farms	Rural Population
Small scale commercial (1-10 ha)	5,450	40,800
Traditional farming	85,400	384,200
TOTAL	90,850	425,000

9.4. Maize production and yield forecasting

In 1982 3,438 tons of maize and 454 tons of rice were purchased by the Western province cooperative union while the marketed maize per district was:

District	Tons
Kaoma	333.6
Mongu	5.6
Kalabo	-
Senenga	9.45
Sesheke	77.67

(source: ASTHANA et al, 1984)

Maize yield forecasts for 1983 and 1984 are shown in table 33.

Table 33. Maize yield forecasts in Western province (after ANONYMOUS, 1984).

	Area [ha]	Expected production [bags]	Expected sales [bags]
1983-84 (p)	13,300	172,000	83,000
1982-83 (p)	21,900	209,000	74,000
1982-83 (a)	12,100	132,000	50,618

p=preliminary

a=actual

9.5. Crop phenology

From Map 3 (VELDKAMP et al., 1984) different agroclimatic zones can be indicated for Western province and they are listed in Table 34.

With the data applying to the agroclimatic zones and to phenology of the main crops cultivated in Western province, crop calendars were calculated for each district of Western province (Figs. 29-33).

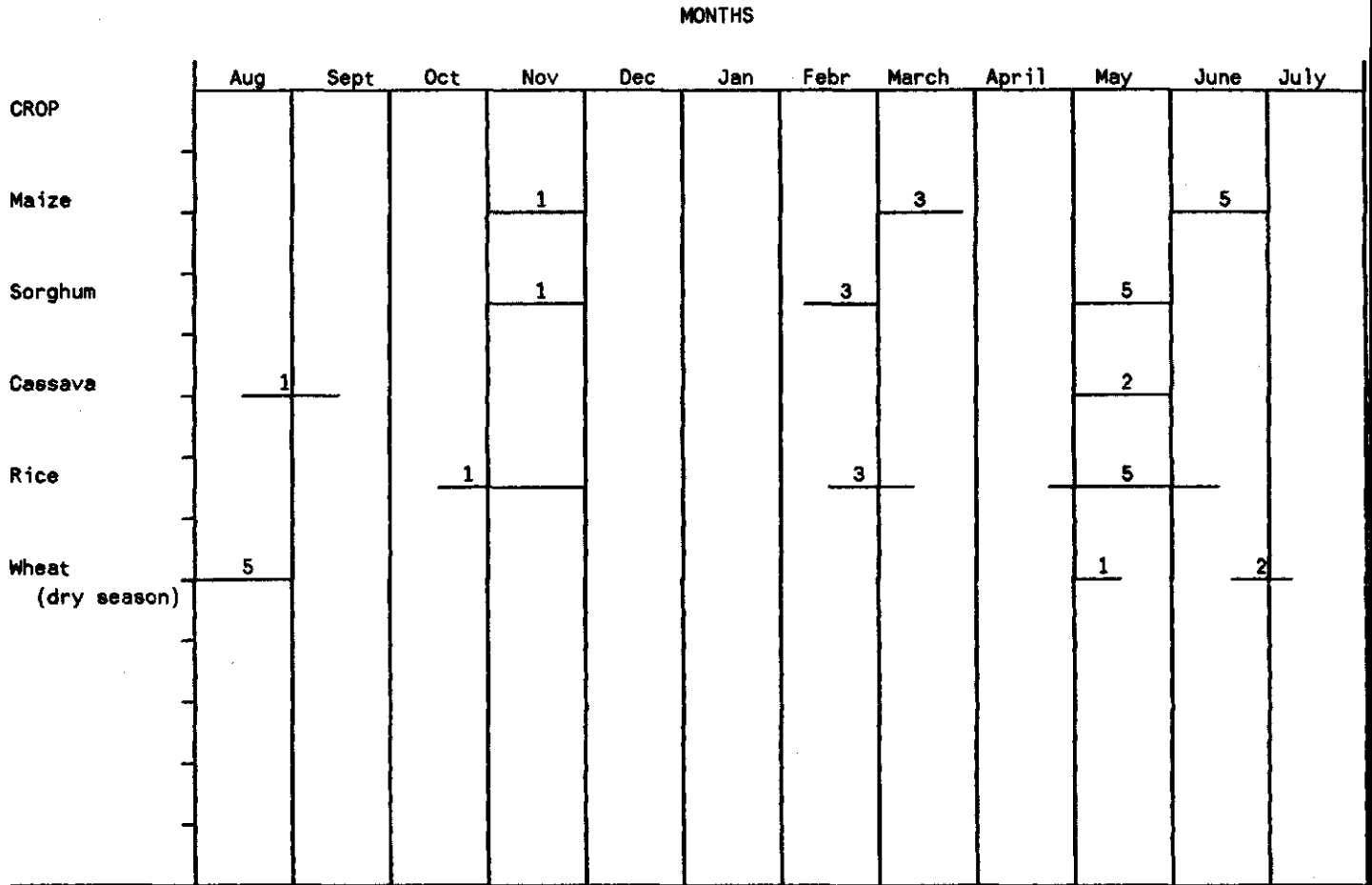
Informations on the crop phenology in Mongu district have been given by Rice resuscitation project, 1981.

Table 34. Agroclimatic zones of Western province

District	Zone Number	Length Growing Season	
		Mean Value	70% Probability
Lukulu	21	166-180 days	
Kalabo	22	166-180 "	
Mongu	13	159-166 "	I dec. December II dec. March (11 decades)
Senanga	7	152-159 "	
Sesheke	4	147-152 "	I dec. December II dec. February (8 decades)
Kaoma	13/15	156-166 "	I dec. December I dec. March (10 decades)

Fig. 29. AVERAGE CROP CALENDAR

PROVINCE: Western
 DISTRICT: Kalabo-Lukulu



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 30. AVERAGE CROP CALENDAR

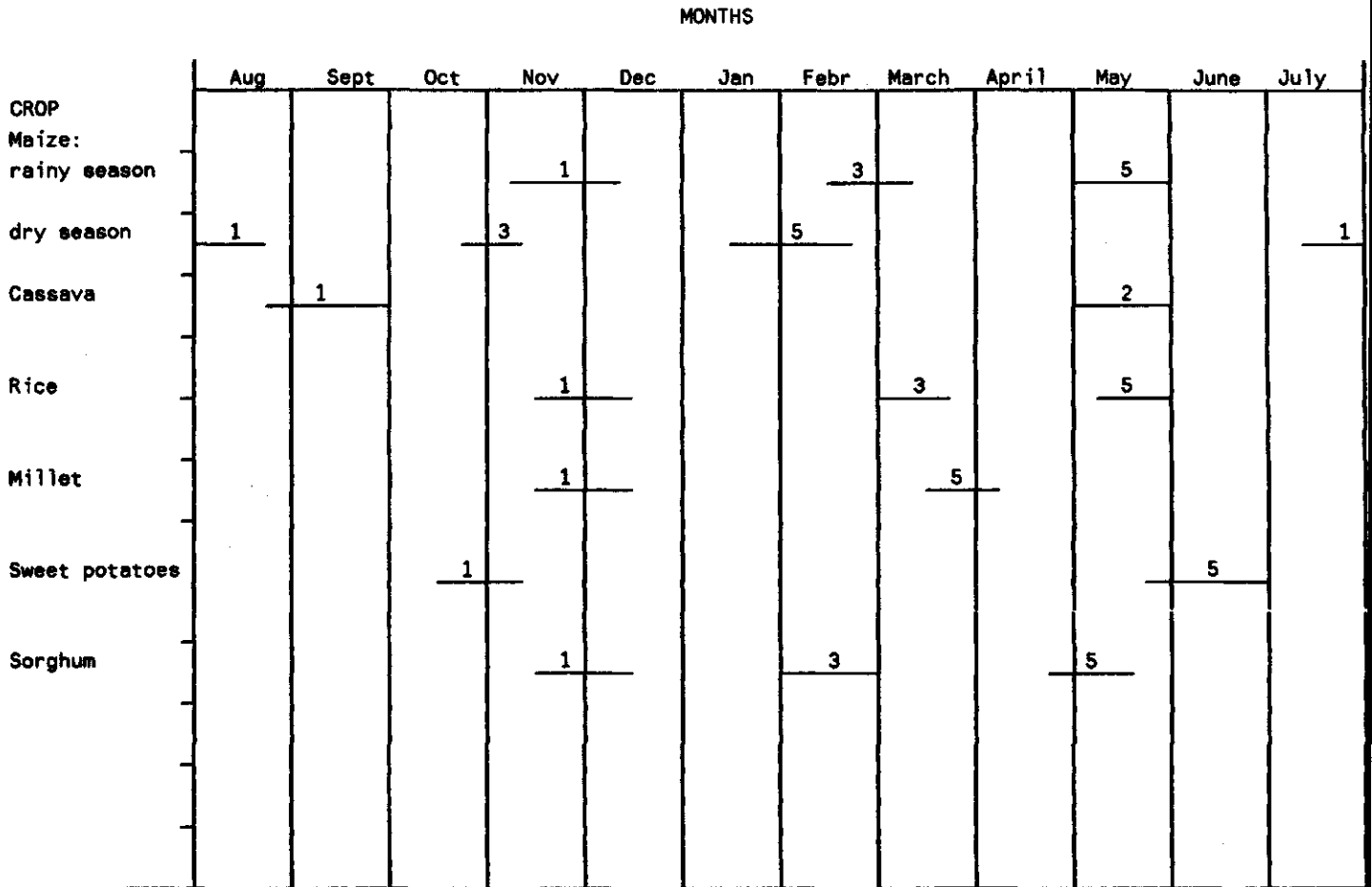
PROVINCE: Western
 DISTRICT: Kaoma

CROP	MONTHS											
	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
Maize				1				3		5		
Cassava	1									2		
Groundnuts					1		3			5		
Beans						1	2		5			
Sorghum				1			3			5		
Bul.millet				1						5		

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 31. AVERAGE CROP CALENDAR

PROVINCE: Western
DISTRICT: Mongu



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 32. AVERAGE CROP CALENDAR

PROVINCE: Western
DISTRICT: Senanga

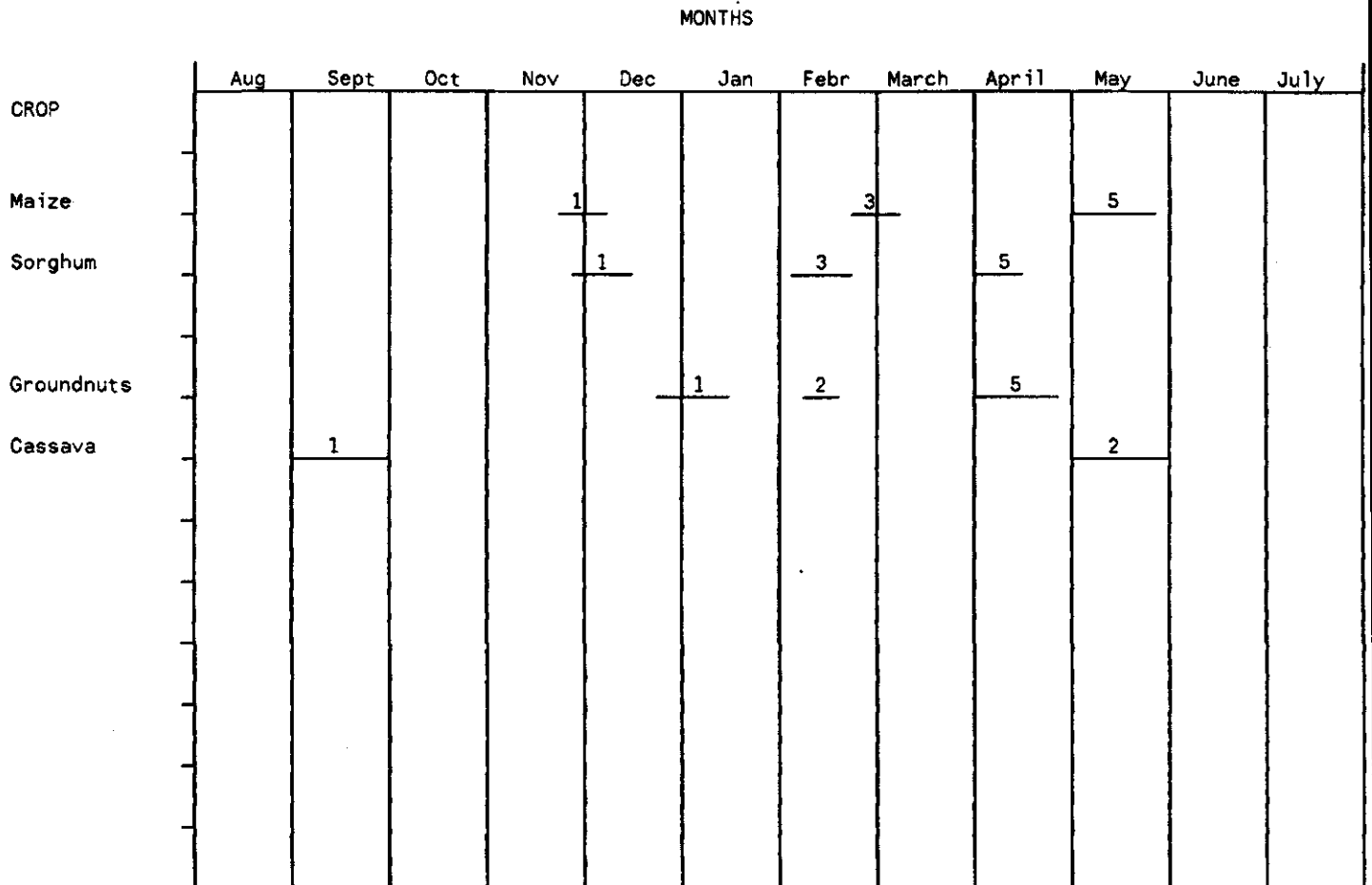
MONTHS

	Aug	Sept	Oct	Nov	Dec	Jan	Febr	March	April	May	June	July
CROP												
Maize				1			3			5		
Cassava	1									2		

- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

Fig. 33. AVERAGE CROP CALENDAR

PROVINCE: Western
 DISTRICT: Sesheke



- 1 Sowing
- 2 Full ground cover
- 3 Flowering
- 5 Harvesting

10. SOUTHERN PROVINCE

10.1. Climate pattern

The tropical hot and dry region covers the valley of middle Zambezi (Gwembe) and Luangwa where annual rainfall is less than 800 mm. Under rainfed farming drought resistant crops are more suitable for this environment. Duration of rainy season is on average 130-150 days (SCHULTZ, 1974).

10.2. Agricultural systems

In the Zambezi valley, Valley Tonga people practice a diversified agriculture. Because of the loss of the former settlements caused by the Zambezi dam construction (1957-58), Valley Tonga lost the winter gardens made on the river banks. The narrow zones along the river of fertile deposits are almost permanently cultivated, elsewhere cultivation rotates and shifts more often. Ploughing with oxes is very common. Sorghum is cultivated throughout the area and the second crop is maize (in the north) or bullrush millet (in the south). The main cash crop is cotton (SCHULTZ, 1974).

On the Zambezi escarpment and in the Southern Plateau, Tonga people cultivate their land on commercial basis. Fields are following the contour lines of the Eastern and Southern Plateau, having a rectangular shape of 2-5 ha large and plough is used (SCHULTZ, 1974).

Maize is the main cash crop and groundnuts is a subsidiary crop on 60% of the holdings (SCHULTZ, 1974).

The rotation of cultivations by Tonga consists of:

- 1) maize with application of farmyard manure
- 2) sunnehemp or velvet beans as green manure
- 3) maize with application of chemical fertilizer (sulphate of ammonia and superphosphate)
- 4) leguminous crop, generally groundnuts or velvet beans for seed or cowpeas (ALLAN, 1965).

10.3. Farm size distribution

Area of Southern province is 85,230 km² with a population of 686,000 according to the 1980 Population Census. 83% of this population is classified as rural which mainly consists of emergent farmers as Table 35 shows.

Table 35. Farming type in Southern province
(after FOOD STRATEGY STUDY, 1981)

	Farms	Rural Population
Large scale commercial (more than 40 ha)	320	16,000
Medium scale commercial (10-40 ha)	8,000	76,000
Small scale commercial (1-10 ha)	49,900	374,100
Traditional farming	7,500	33,900
TOTAL	65,720	500,000

10.4. Maize production and yield forecasting

Principal staple and cash crops are: maize, sorghum, millet, groundnuts, sunflower, beans, cotton, tobacco, soybeans and wheat. The Southern province produces 35% of the country marketed maize which, in 1981, consisted of 273,496 tons (ASTHANA et al, 1984). The distribution in the districts of maize production and consumption is given in table 36.

Table 36. Maize production and consumption number of bags in the districts of Southern province

District	Total population	Total consumption (1982)	Marketed production (1980-1981)	Total estimated production* (1980-1981)	Balance bags	M/T
Choma	139,775	377,705	851,133	1,105,368	+727,663	+65,490
Kalomo	107,384	297,776	872,385	1,132,967	+835,191	+75,167
Gwembe	24,473	68,521	4,019	5,219	- 63,302	- 5,697
Livingstone	77,115	167,340	27,809	36,116	-131,224	-11,810
Mazabuka	123,363	322,249	644,658	837,218	+514,969	+46,347
Monze	117,626	323,785	418,230	543,156	+219,371	+19,743
Namwala	61,581	171,177	220,611	286,508	+115,331	+10,380
Siavonga	27,100	76,227	-	-	- 76,227	- 6,860
Sinazongwe	48,611	130,890	-	-	-130,890	-11,780

*Total estimated production include 25% of maize retained at farm level

Maize yield forecasts were made for the years 1983 and 1984 as Table 37 shows.

Table 37. Maize yield forecasting in the Southern province (after ANONYMOUS, 1984).

	Area [ha]	Expected production [bags]	Expected sales [bags]
1983-84(p)	82,000	1,701,000	1,192,000
1982-83(p)	73,000	1,919,000	1,348,000
1982-83(a)	80,000	1,808,000	962,823

p=preliminary

a=actual

10.5. Crop phenology

Agroclimatic zones of Southern province are selected from Map 3 (VELDKAMP et al., 1984) and described in Table 38.

Table 38. Agroclimatic zones in Southern province

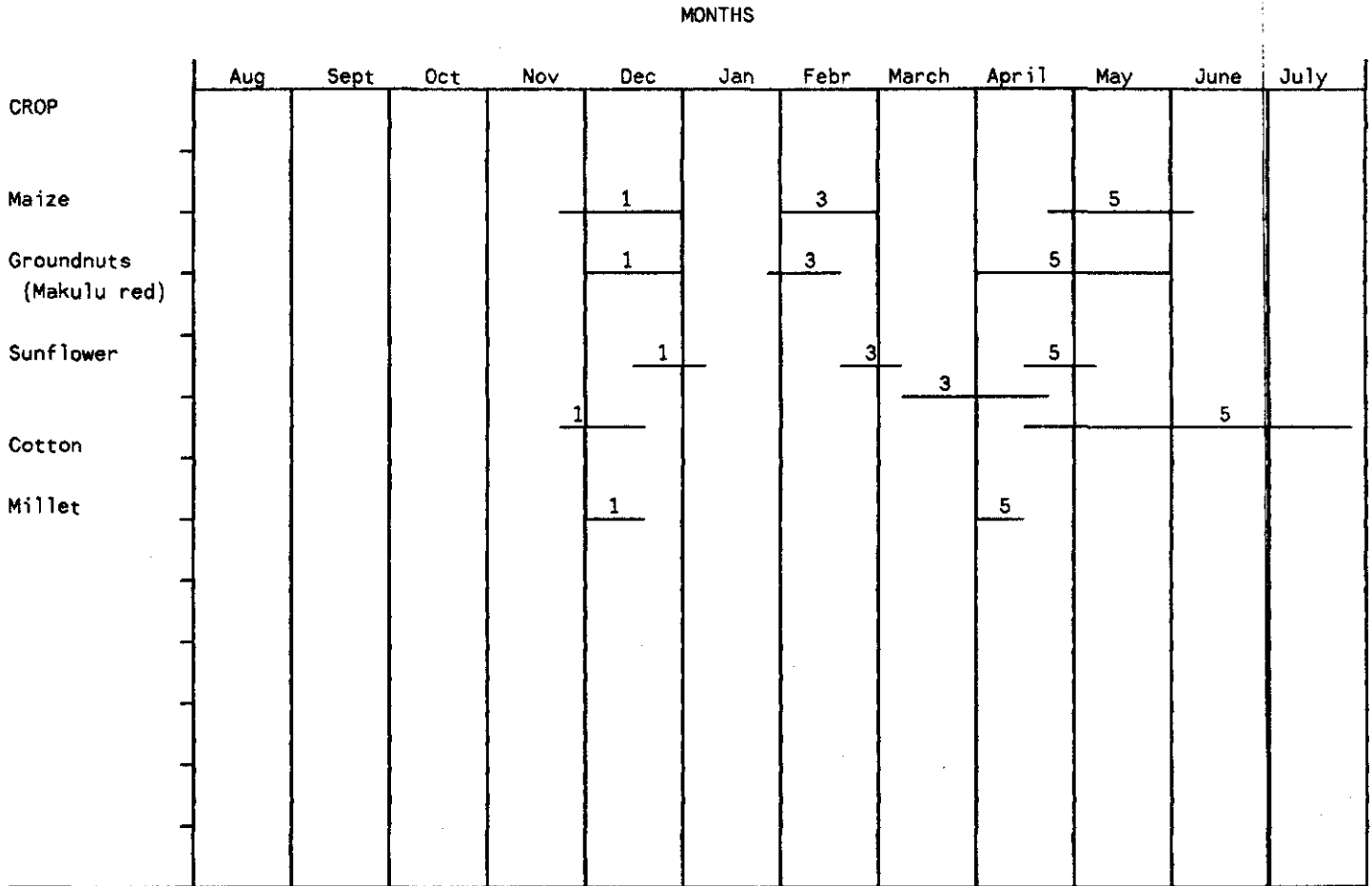
Districts	Zone Number	Length of Growing Season	
		Mean Value	70% Probability
Maamba Gwembe Chirundu	1	135-147 days	
Choma Monze Makabuka Kalomo	4	147-152 "	I dec. December III dec. February (9 decades)

Crop calendars of the main crops cultivated in each districts of Southern Province are shown in Figs. 34 and 35. Informations on maize and groundnut phenologies in Fig. 34 have been given respectively by KINSEY, 1979 and by HONISH, 1974. Rice phenology informations in Fig. 35 were given after QASEM, 1984.

Fig. 34. AVERAGE CROP CALENDAR

PROVINCE: Southern

DISTRICT: Choma, Monze, Mazabuka, Kalomo



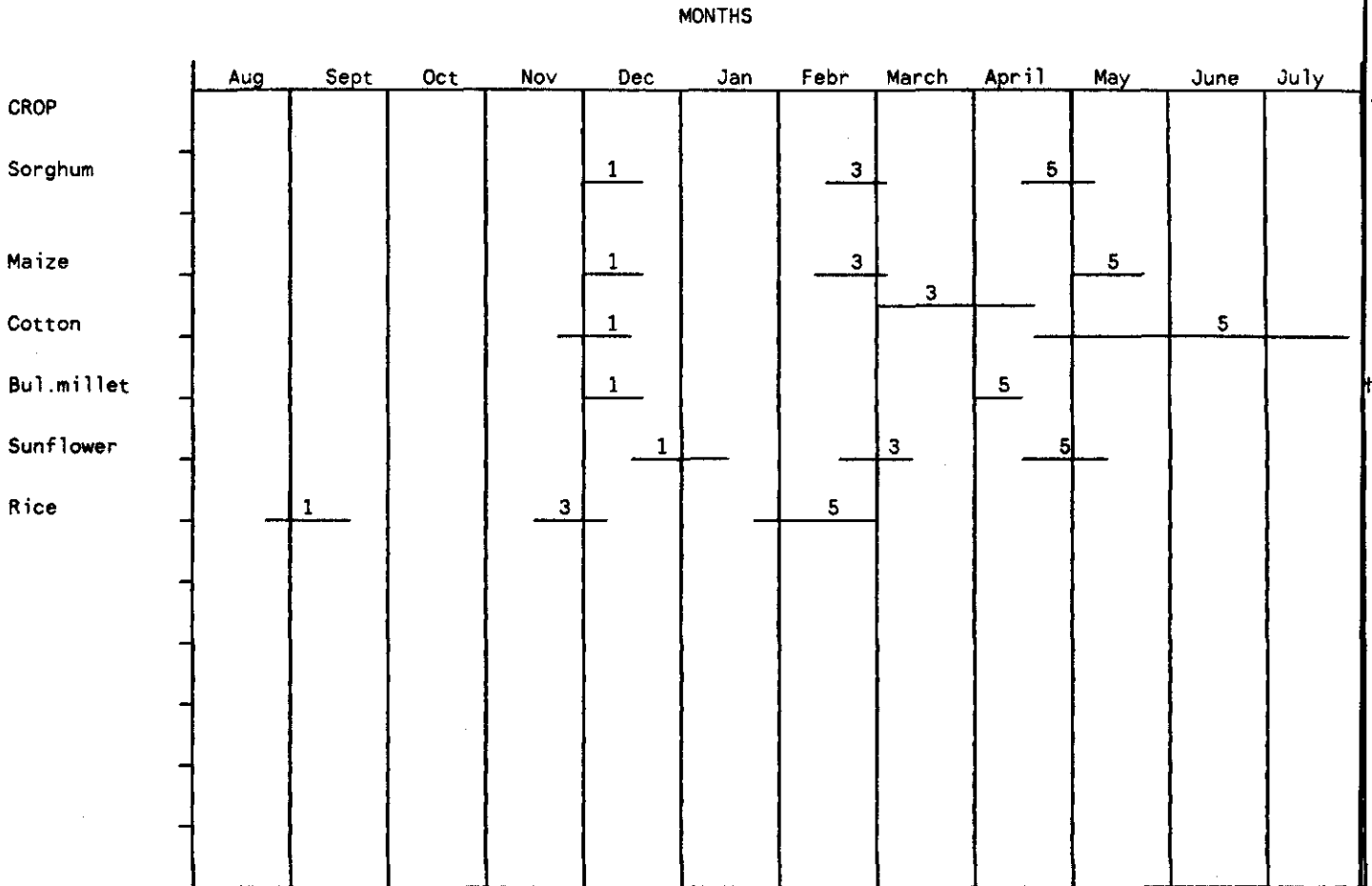
1 Sowing

3 Flowering

5 Harvesting

Fig. 35. AVERAGE CROP CALENDAR

PROVINCE: Southern
 DISTRICT: Maamba, Gwembe, Chirundu



1 Sowing
 3 Flowering
 5 Harvesting

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APPENDIX 1.

REVIEW OF VARIOUS CLASSIFICATIONS OF FARMERS

(after FOOD STRATEGY STUDY, 1981 -

ANNEX SOCIO-REGIONAL FRAMEWORK).

REVIEW OF VARIOUS CLASSIFICATIONS OF FARMERS

MAWD, Planning Unit, Statistics Section, Crop forecast report 1979/80.

- Large scale commercial farmers, income > K 21.000
- Medium-scale commercial farmers K 4.200 - 21.000
- Small-scale commercial farmers K 1.400 - 4.200
- Unclassified farmers - income not know but
land under crop > 5 hec

MAWD, Adaptive Research Planning Team 1980

(appendix II)

- Large-scale commercial 40 hec. inputs tractor ownership
purchased
- Medium-scale emergent 10-40 hec. " oxen/tractor owners/hire
- Small-scale emergent 0.25-5 hec. " oxen- (or tractor)hire
- Traditional 0.25-5 hec. no inputs purchased hand cultivation

FAO, Central Policy paper, 1976:

- Large-scale commercial farmers
- Emergent farmers (becoming medium or large-scale commercial farmers)
 - middle size emerging farmers
 - organized small-scale farmers
 - improved village farmers
- Traditional subsistence oriented smallholders

FAO/World Bank, Southern Province, 1980:

Average cropped Area

- Large scale commercial farmers 100 hec.
- Emergent and small-scale commercial farmers 30 hec.
- Ox-cultivation 3 hec.
- Hired oxcultivation 1.2 hec.
- Hand cultivators 0.8 hec.

FAO/SIDA Eastern province

- Commercial 40 hec.
- Medium scale commercial 10-40 hec.
- Emergent 2-10 hec.
- Subsistence (< 5 acres) 2 hec.

TNDP, 1980 (p. 151)

- Large scale commercial farmers
(including parastatals)
- Emergent farmers (Classification
criteria are not given)
 - (i) Improved village farmers
 - (ii) Organised smallholder schemes
 - (iii) Emergent middle farmers
- Traditional farmers

CIMMYT

- Large-scale commercial farmers 40 hec.
- Emergent commercial farmers 10-40 hec.
- Traditional Recommendation Domains
TDR 1 to 6 Traditional farming systems

Integrated rural development programme (Chinsali/Mubanga Area):

- Improved farmers 4.8 hec.
- Emergent farmers 2.6 hec.
- Traditional farmers 1.75 hec.
- Subsistence farmers 1.3 hec.

CSO (Proposed, June 1981)

- | | Cropped Areas | Cashturnover |
|--|---------------|-------------------|
| - Traditional Farmers | < 5 hec. | < K 1000 |
| - Small-scale commercial farmers | 5-20 hec. | K 1,000 - 20,000 |
| - Medium-scale commercial farmers
(and/or broilers)
(Dairy, Breeding cows) | 20-50 hec. | K 10,000 - 35,000 |
| - Large-scale commercial farmers
(and/or broilers)
(Dairy, Breeding cows) | > 50 hec. | > K 35,000 |