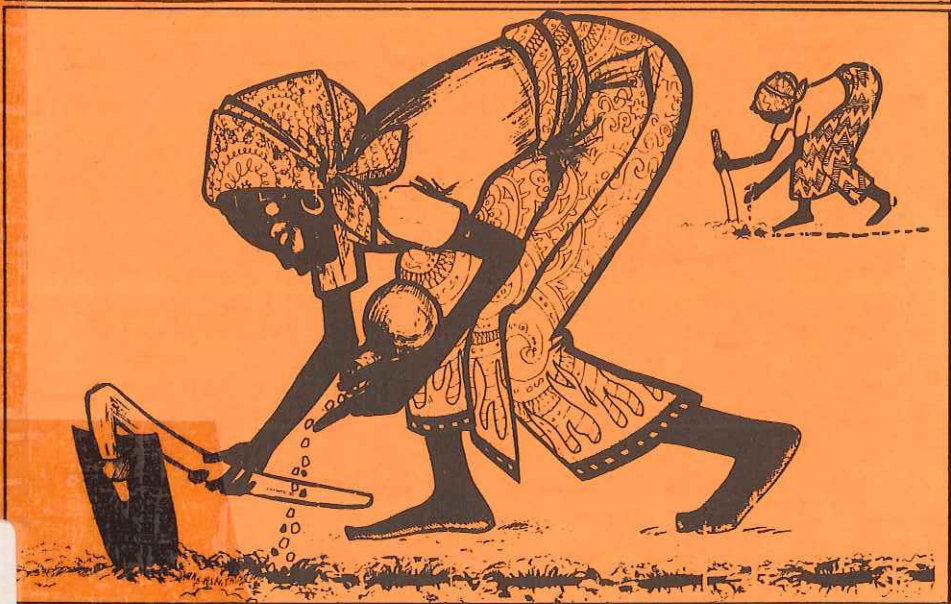
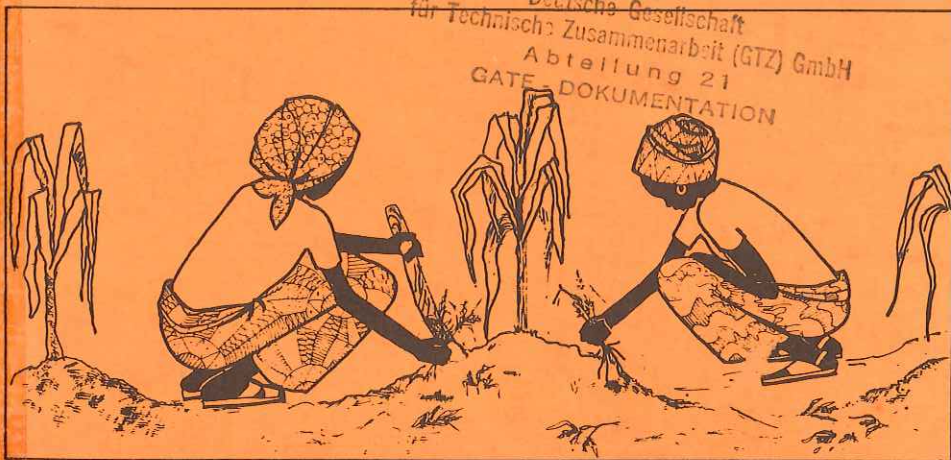


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PRIMARY SCHOOL AGRICULTURE Teacher's Manual Part Three

Farming Methods

Deutsche Gesellschaft
für Technische Zusammenarbeit (GTZ) GmbH
Abteilung 21
GATE DOKUMENTATION



PRIMARY SCHOOL AGRICULTURE

Teacher's Manual

Part One	Pedagogy
Part Two	Crops
Part Three	Farming Methods
Part Four	Crop Storage
Part Five	Land Tenure

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PRIMARY SCHOOL AGRICULTURE

Teacher's Manual

Part Three

Farming Methods

by Herbert Bergmann

Published in August 1980 by the
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Note to readers:

This documentation is based in part on research done by the Environmental Studies Section of IPAR-Buea in the years 1973 and 1974. The research approach has been documented elsewhere. Our text fairly often refers to types of communities which differ in important respects. These community types are:

(1) Isolated Rural Communities

They are inaccessible to vehicles and require one or several days of walking or long water transport, most of them are situated in the South-West Province.

(2) Remote Rural Communities

They are inaccessible to vehicles but are less than a day's walk away from motorable roads or places with basic service facilities.

(3) Marginal Rural Communities

They are either on poor roads which can be used only part of the year, or not far from main roads along footpaths; they have poorly developed cash crop farming, and marketing requires transport to a co-operative store elsewhere.

(4) Poorly Served Rural Communities

They are along roads with a firmly established cash crop agriculture but far away from government and non-government services.

(5) Well Served Rural Communities

They all lie on motorable roads and have rather good access to government and non-government services.

(6) Urban and Semi-Urban Areas

These are administrative centres and their immediate surroundings; they are on tarred roads or earth roads motorable throughout the year. Many of them have large markets or are in their immediate neighbourhood so that food crop farming becomes an income earning activity.

1. Objectives

Farming is an art which has developed slowly over centuries of human existence. It is based on very long experience and continuously adjusts to changing conditions. Every people, every group have their own way of going about farming, and individual farming women and men often have their own special skills. It is with these ways or methods of farming that the following section is concerned. Terms used in this connection are farming methods, farming techniques, and land-use systems to denote a whole combination of methods and techniques. One of the general aims of primary school agriculture is to prepare the way for improved farming in order to raise agricultural production or to reduce the work-load of the farming women and men. Teachers therefore need a fair knowledge of the most important techniques suitable for the different Cameroonian environments.

We shall start this section with some information about traditional farming methods in Cameroon. Significant agricultural progress may be possible by improving traditional farming methods. Progress might also require something entirely new, a break with tradition. In both cases, however, it is necessary to know what is happening at present and why things are as they are.

"Before any consideration can be given to possible developments on African smallholdings and the means by which these can be brought about, it must be determined what farmers are now doing, what factors govern their actions, and what pressures there are to change the pattern of agriculture that results."
(Cleave, J.H. 1974, p. 31)

There are several good reasons for carefully examining traditional farming methods:

- Traditional land-use systems are adjusted to local conditions in the best possible way under prevailing

circumstances since they are the outcome of centuries of learning.

- A lot of experience based on long observation and practice has accumulated which should be made available to as many people as possible.
- The inferiority of traditional agriculture is by no means established. There are sound reasons for mixed cropping, and there are local systems of crop rotation and crop sequences that have proved their value.
- Farming techniques are as much part of a people's culture as are its religion, its language, its history, and its arts.
- Therefore, traditional farming is embedded in a way of looking at the world and life in general. Ideas about cause and effect governing traditional farm operations will inevitably be applied to new, "modern" techniques. In order to take them into account it is necessary to know them. If, for example, people believe that fertility can be stolen from a farm by means of magic this might influence their outlook on organic and chemical fertilizers.

After this we shall briefly examine so-called modern or scientific agriculture which is still prescribed in current Rural Science syllabuses. The section will end with some information about recent developments in research in tropical agriculture. These developments seem to agree much more with traditional African agriculture than the approach to modernizing agriculture favoured so far.

A number of major objectives can be pursued in teaching about farming methods. The following list spells out a few of them. A summary table will show which parts of the section may be most useful in planning units with one

or several specific objectives.

- 1) Pupils will acquire basic knowledge and skills concerning farming techniques.
- 2) Pupils will systematically acquire basic knowledge about traditional farming techniques in their area and in other parts of Cameroon.
- 3) Pupils will develop pride in African tradition by discovering the advantages of traditional farming methods.
- 4) Pupils will be able to assess critically different farming methods.
- 5) Pupils will learn the logic and skill of observation and experimentation in an elementary form by comparing traditional and non-traditional methods of farming the same crop(s).
- 6) Pupils will develop at an elementary level the capacity to select farming methods adapted to local conditions.
- 7) By dealing with traditional agriculture and the body of knowledge and beliefs supporting it, schools will be able to document local knowledge about crops, farming techniques, soil and other related topics that up to now have only been handed down orally.
- 8) Teaching about farming methods may lead to links with the extension service and nearby agricultural research institutions. The school will receive up-to-date information on research findings and in turn will provide the extension service and research institutions with feedback on the local relevance of their proposals and findings.

The last two objectives are beyond the reach of the usual classroom but are intimately linked with generating new knowledge and making such knowledge available. Pursuing them will certainly enhance the effectiveness of classroom teaching and school farm work.

2. Traditional Agriculture

2.1. Traditional land-use systems - from shifting cultivation to degraded bush fallow

In Cameroon there are four types of traditional land-use system: shifting cultivation, rotational bush fallow, grass fallow, and continuous cultivation.

Shifting cultivation is a system where a few years of cultivation are followed by very long fallow periods. Fallowing is so long that trees and bushes can grow up again to form a secondary forest. In this way, fertility is completely restored to the soil after it has been farmed. But it means that fallow periods must be longer than ten years. Less than ten per cent of a community's land could therefore be farmed at any one time.

As fallow periods have become shorter, shifting cultivation has give way to rotational bush fallowing. Here, too, the time that the land lies fallow exceeds the time the land is under cultivation. Provided the fallowing period is long enough, bush fallowing also restores soil fertility:

"... when the time period between each cycle of cutting and burning was always in excess of seven years ... the Bush Fallow developed as a stable ecological system."
(Obi, J.K., and Tuley, P., 1973, p. 1)

"It can be seen that Bush Fallowing has many merits in the preservation of soil fertility. The soil is exposed for a minimum period of time by mixed cropping, the root system of the fallow is largely left intact, the fallow recovers quickly ..."
(Obi, J.K., and Tuley, P., 1973, p. 5)

"The stability of the system depends on the number of years that the land remains under fallow. NWOSU mentioned a 'basic rotation' with a fallow period of seven years:

1st year: yams, early maize and vegetable, cassava
2nd year: cassava followed by bush fallow
3rd - 9th year: bush fallow
(Lagemann, J., 1977, p. 9)

With further shortening of the fallow periods, the land-use system develops into a degraded bush fallow system. Fallow periods are too short to fully restore soil fertility.

When the fallow period is reduced to just one or two years, shrubs and bushes no longer grow again after farming but are replaced by spear grass. The bush fallow system turns into a grass fallow system. On the compounds, immediately surrounding the houses, there is continuous farming. The compound area is fertilized with a variety of materials, e.g. household refuse, animal droppings, grass and twigs for mulching. Fertility here is very high and is conscientiously maintained.

"Compound farming is not a special land use system found only in Eastern Nigeria; it can be found world-wide in tropical regions where land scarcity has forced farmers to intensify production on small fields."
(Lagemann, J., 1977, p. 30)

"Compound farming is ... a type of land use which is of general importance in the humid tropics."
(Lagemann, J., 1977, p. 31)

In Cameroon, all four systems can be seen in operation. The average period of fallowing in a sample of 201 farm plots for which data on fallowing were available was four years. The fallowing table shows the frequency with which the different land-use systems occurred in a survey of the two anglophone provinces (compound farms excluded):

length of fallowing		land-use system
1 year	7.6%	grass fallow
2 years	28.8%	grass fallow
3 years	30.3%	degraded bush fallow
4 years	4.5%	degraded bush fallow
5 years	6.1%	degraded bush fallow
6 years	3.0%	degraded bush fallow
7-8 years	7.6%	bush fallow
9-10years	4.5%	bush fallow
more than 10 years	7.6%	shifting cultivation

The areas with long bush fallow shifting cultivation are remote areas with plenty of unoccupied land. By and large, periods of fallowing are tending to grow shorter whereas periods of continuous cropping remain the same or become even longer. If one compares the length of the farming period to the length of fallowing, the following picture emerges:

Fallow and farming periods compared	frequencies	
	absolute	%
the <u>fallow period</u> is two or more years <u>longer</u> than the <u>farming period</u>	33	25.4
the <u>fallow period</u> is one year <u>longer</u> than the <u>farming period</u>	16	12.3
the <u>fallow period</u> is as long as the <u>farming period</u>	20	15.4
the <u>fallow period</u> is one year <u>shorter</u> than the <u>farming period</u>	20	15.4
the <u>fallow period</u> is two or more years <u>shorter</u> than the <u>farming period</u>	41	31.5
	130	100.0

The length of the farming and the fallowing period is not left open to the choice of the local farmers but is the result of differences in local conditions. This is borne out by the way the length of the fallow period is affected by the general level of development of a community. The fallow period becomes increasingly shorter as one moves from isolated areas into urban or semi-urban communities.

At the time of the survey conducted by IPAR-Buea, food-crop farming in the South West Province was already much

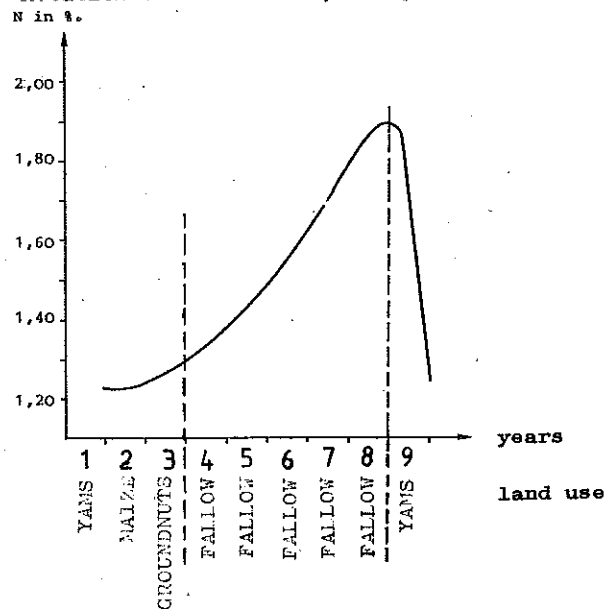
more market-oriented than in the North West Province. Consequently, fallowing periods were shorter in the South West than in the North West Province; this is true for nearly all zones with different levels of development and accessibility, as can be seen from the table below:

Average number of years of fallowing according to community type

Community type	South West Province	North West Province
isolated	3 - 4 years	3 years
remote	3 - 4 years	4 years
marginal	2 years	4 - 5 years
poorly served	2 - 3 years	3 years
well served	0 - 1 year	1 - 2 years
urban/semi-urban	1 - 2 years	1 year
Total per province	2 - 3 years	3 years

In order to understand clearly the importance of fallowing in traditional agriculture, let us look at the following graph. It takes the percentage of available nitrogen in the soil as an indicator of soil fertility. Three years of farming are followed by five years of fallowing. After the nitrogen content has reached its lowest level under maize cultivation in the second year, it increases after the cultivation of nitrogen fixing groundnuts. It rises steeply during the fallow period, but most of it is used up by yam farming in the first year after the fallow.

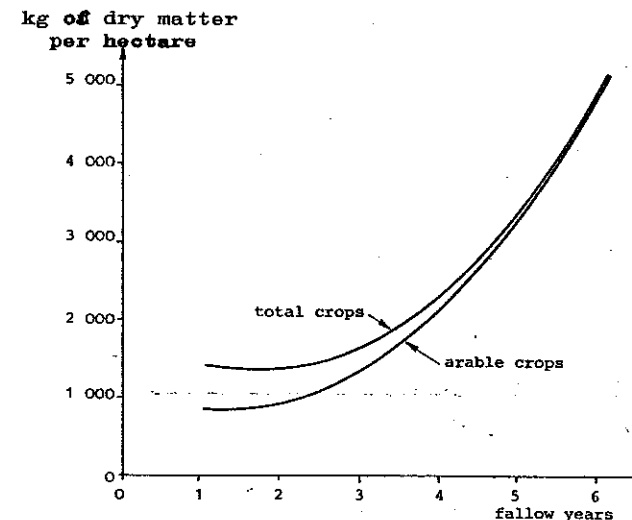
Development of Nitrogen in the Soil in the Traditional Rotation of the Baoulé, Ivory Coast



Source: adapted from Cadillon, M.: Evolution du sol sous une rotation Baoulée traditionnelle, IRAT, Bouaké, (undated),

How dramatically the length of the fallowing period can affect yields may again best be seen from a graph. It portrays the relation between yields as measured in dry matter per hectare and the number of years a plot is left fallow. It is taken from an area with light or sandy soils in Eastern Nigeria; the author of the study thinks, however, that the effect of lengthening the fallow period would be less pronounced in heavy or clay soils.

Relationship between Output of Crops and Length of Fallow Period Prior to Cultivation



Source: Lagemann, J., 1977, Fig. 15, p. 67

Further statistical analysis showed that 60 per cent of the increase or decrease in yields was most probably due to changes in the fallow periods.

Shortening fallow periods are a sure sign of pressure on land. As the fallow periods shorten, soil fertility is restored only imperfectly:

"The length of the fallow cycle depends upon the fertility of the soil and the availability of land. Where land is scarce the fallow cycle is short, and as population density increases fallow cycles ... become increasingly shorter. ... the abbreviated fallow cycles result in the steady depletion of soil fertility and a continuous decline in crop yields." (Smock and Smock, 1972, p. 73)

This means that schools and the agricultural extension service alike should stress the maintenance of soil fertility through fertilizers, manuring, and erosion control especially when they are operating in better developed and densely populated areas.

2.2. Traditional Farming Methods

Traditional farming is characterized by:

- the use of fire for clearing a new farm plot (slash-and-burn agriculture)
- superficial tillage by hand
- often planting on mounds or ridges
- mixed cropping using a number of carefully composed crop associations
- the lack of any inputs for fertilizing and crop protection on the fields away from the compound.

2.2.1. Clearing

Especially clearing by fire has been heavily attacked for destroying the soil. For a detailed analysis of what burning does to the soil, see the section on soil, especially the comparative analysis of three soil samples from a trial plot near Buea. Here, in less technical terms, are the advantages and disadvantages of burning:

"Burning of the bush has the following advantages:

- It kills most grasses and weeds, so that the first weeding needs to be done relatively late.
 - The alkaline ash raises the pH⁺ and availability of cations⁺ in the surface soil
 - Nutrients like P, K and Ca⁺ are made available in soluble form, which stimulates the growth of plants during the early growing period.
- On the other hand there are some disadvantages inherent in the system:
- The carbon, nitrogen and sulphur in the fallow and litter are lost in the burn (but not the amounts in the soil humus).
 - The fire damages trees like oil palms, raffia palms, etc.

⁺ For an explanation of technical terms see section on soil.

- There is a build-up of fire-tolerant, low-productive species.

Burning is, however, still an indispensable part of the system. Crops in bush fallow rotations depend on the pH⁺ effect of the burn, and in grass fallow systems the burning of the grass is still considered to be more advantageous than composting - in particular in terms of return on labour."

(Lagemann, J., p. 48/49)

- clearing in the forest zone

Burning of grass and undergrowth is very common, even more so the burning of the taller trees. In most cases, the dead trees are left standing on the farms, though sometimes the trees are allowed to continue growing as they are used for shade.

We may distinguish between the following systems of bush clearing in the forest zones:

- 60% of all farmers in the survey in the forest zones burned the grass and trees
- 17% of all farmers in the survey in the forest zones used grass and undergrowth as manure but burned the trees
- 23% of all farmers in the survey in the forest zones used grass and undergrowth as manure and felled rather than burned the trees

Burning is the only way of bush clearing in the isolated rural areas and it predominates in the remote and marginal rural communities. Among these communities is not a single one where it is not practised, but there may be some farmers who refrain from burning the grass.

In the poorly served rural communities, the pattern changes and you find farmers no longer burning the grass. This change becomes more pronounced in the well-served rural communities, and in the urban or semi-urban communities, only a few farmers seem to continue the practice of burning. Here, trees are more often felled

than burned, perhaps because of their relatively higher value as firewood and building material.

Farmers in the low-lying forest areas of the North West Province, all isolated or remote areas, do clearing by burning. The communities in the transitional zone between forest area and the grassland savannah, those that are not yet urban or semi-urban always burn grass and trees.

- clearing in the grassland area

In the grassland areas, we have identified four distinct methods of farm clearing.

- 40.4% of the farmers in the survey in the grassland zone burned grass and shrubs
- 16.3% of farmers in the survey in the grassland zone operated the nkara-system
- 18.3% of farmers in the survey in the grassland zone covered the grass with soil and thus used it as manure
- 25.0% of farmers in the survey in the grassland zone left the grass on top of the soil for manure

The nkara-system consists of cutting the grass down, covering it with soil to form a ridge, and then burning the grass. This keeps all the ash in the soil and makes a slow burning fire. It is on nkara ridges that egusi and Irish potatoes would be grown in the first year after clearing. There is a variant of nkara which consists of making ridges immediately after burning so that little of the ash is lost. But this is not as effective as the nkara system since the fire burns much faster, and the greater amount of smoke takes away more of the ash particles.

The nkara- system is especially common in the high altitude zones: throughout Bui Highlands, the neighbouring lower areas (Nkor, Lassin, Tabenken), the

Kom-highlands, the Baligham are, but also around Bamenda itself (Bafut, Bambili etc.). Although clearing by burning decreases as the level of development of a community improves, this tendency is weaker than in the forest zone and burning remains fairly common throughout. This may be due to the fact that, the nkara-system is a rather sophisticated approach to farm preparation.

Also, in most communities there is a wide range of practices. Good farm clearing without resorting to fire can be found even in remote and marginal communities.

Some areas of the South-West Province also use grassland methods of clearing, e.g. Fontem - Fotang area, which is a transitional zone and grassland savannah, some areas on the coastal strip where most forest trees have disappeared long since - Mudeka, Idenau - and communities where substantial food crop farming is going on in coffee and cocoa plantations like the area south of Tombel and around Nyassosso. Burning disappears as one moves from the isolated to the poorly-served rural and the urban or semi-urban communities.

The incidence of burning in farm clearing

Community Type	<u>South West Province:</u> grass is		<u>North West Province:</u> grass is	
	burnt %	used for manure%	burnt%	used for manure%
isolated	88.9	11.1	100.0	-
remote	70.0	30.0	66.7	33.3
marginal	75.0	25.0	37.5	62.5
poorly served	28.6	71.4	69.2	30.8
well served	30.0	70.0	52.4	47.6
urban/semi-	27.3	72.7	53.3	46.7
Total	52.7	47.3	58.9	41.1

Farmers know that burning was strongly discouraged by the Department of Agriculture. They gave specific reasons why they continued it, or under what conditions they used fire for clearing:

- to kill off roots and stumps of trees and shrubs
- to grow groundnuts - they do very well immediately after burning (Nhiangse/Bakossi)
- to grow egusi (Shiy/Bui; Awing near Santa)
- to grow cocoyams (Baligham)

In most areas it will be necessary to work towards the elimination of burning as a means of farm clearance. But the situation is different in the two provinces. Whereas in the North-West Province, especially in the grassland savannah, nearly every community already has progressive farming women whom the teacher could cite and show as an example, he would face great difficulties in the isolated, remote, and marginal areas because the use of fire is universal there. On the other hand, in the easily accessible areas, in the South-West Province, his task would be easier and he could concentrate on explaining the reasons for the already established modern practices of bush clearing and farm preparation.

2.2.2. Tilling

In the overwhelming majority of cases tilling is done by hand. A short-handled hoe with a large blade is the universal tool for tilling. So far, only in the Wum area and in parts of the Ndop plain are ox-drawn ploughs used. But there are plans to extend this method of tilling to other parts of the North West Province where the slopes are gentle. Deep ploughing as done in Europe would be disastrous in tropical conditions since it would aggravate soil erosion. There are several traditional methods of tilling. The simplest one, practiced on fertile, well drained soil, is the simple scratching



of the surface with a cutlass, planting maize seeds and covering them at once with soil. Tilling and planting are done at the same time. According to the slope of the land, the farmers often make mounds or ridges when tilling. These ridges, mounds or beds often contain grass and the remains of the previous crops as manure. Initially, ridges were made down the slope of a hill. In this way, work was easier for the women who worked moving uphill. Contour ridging means a much more uncomfortable working position, the more so the steeper the slope. Yet, due to administrative pressure it has been adopted in most areas. The downward sloping ridges made erosion worse.

2.2.3. Timing - the Crop Calendar

The correct timing of farm operations is part of good farm management. Timing is particularly important with respect to planting, weeding, and, for some crops, harvesting.

The right planting time is a matter of great concern in traditional agriculture. It is so important that many ethnic communities in Cameroon follow a religious ritual in determining the right time for planting. After consulting an oracle, a dignitary, often a woman, sometimes the chief of the area, will announce the start of the planting season. In fact, since germination and healthy plant growth very much depend on the availability and distribution of rainfall, a good deal of familiarity with the local climate is needed in order to be able to choose the best time for planting.

Research findings on planting times can again be drawn from the study "Traditional African Farming Systems in Eastern Nigeria":

Time of planting is significantly related to the output on compounds as well as on outer fields in all three villages. (There is statistical evidence that)

supports farmers' experience that late planting reduces the yield of their crops. The data suggest that farmers who planted their crops later than others suffered a worse labour bottleneck during planting time ..."
(Lagemann, 1977, p. 70)

"... other things being equal - later planting reduces the aggregate production of arable crops".
(Lagemann, 1977, p. 73)

The effect of weeding on plant development also depends on good timing. In traditional agriculture, weeding may be done later than in modern agriculture, due to the effect of fire on weeds:

"... early weed growth after the burn was minimal, and as most farmers only weeded once, the one weeding gave superior results if performed later than very close to planting, when weed competition was minimal."
(Lagemann, 1977, p. 74)

Although this result was obtained from a study on maize farming, similar results have been obtained for arable crops in general. If weeding is carried out more than two months after planting, yields decrease in proportion to the length of the delay in weeding.

The importance of good timing in traditional agriculture can be seen in the fact that mutual help is most prominent when the time factor is important. The institutions of mutual help, e.g. the work groups of men and women, are organized for farm clearing and tilling - in order to get the farm ready in time - but also for planting and sometimes weeding.

Information about timing in Cameroonian traditional agriculture is summarized in the crop calendar. A crop calendar shows how farm work spreads throughout the year for each crop that is included. The crop calendar proposed here shows the major annual and perennial crops grown in the anglophone provinces of Cameroon. It is

subdivided into two calendars, one for the rain forest zone, and one for the savannah zone. For maize, a further subdivision has been made in the calendar for the grassland savannah. There is one calendar for areas with two yearly crops of maize - mostly in the transitional zones of Momo and Mezam Division -, and another calendar for areas with one maize crop per year. These are the highlands of Bui and Donga-Mantung Division.

The crop calendar does not show the "best" times for each activity, not even the best starting or finishing times. It shows the times as indicated by local farmers in their various communities. Therefore, there is quite a long time-span shown even for activities like planting that are done in rather a hurry. The two calendars represent the average for a zone. This average can conceal important local differences.

- reading the crop calendar

- For easy comparison, all farm work has been grouped into four main operations: soil preparation, planting, farm maintenance, and harvesting. Any teacher is free to break these operations down into their component parts. For example, soil preparation in maize farming may consist of cutting down grass, burning, tilling, and ridging.
- Taking the example of maize, this is the information contained in the crop calendar of the rain forest zone:
 - Farm preparation (clearing, tilling) starts in January and will be finished by the end of February.
 - Depending on the first rains, planting may be done between late February and early April, mostly around mid-March.
 - Farm care (weeding and thinning) starts in mid-April and may go on until the middle of June.
 - Harvesting depends on planting time and the length of

the life cycle of the varieties used. It starts as early as the beginning of June and may end only by the end of July.

- In areas with very early planting, tilling for a second maize crop has already started the beginning of July.
- Planting starts in August and ends by the end of September.
- Since the second crop is planted during rainy season, weed growth starts earlier. Therefore, weeding is done earlier after planting than is the case with dry season maize crop.
- Harvesting spreads over November and December, again due to differences in planting time.
- The crop calendars do not show a time for farm preparation for crops like beans, groundnuts, egusi and Irish potatoes. This is because most of the time they are inter-cropped with major staple food crops such as maize and yams. Therefore their time of farm preparation is the same as for the main staple food crop are combined with.
- For the annual crops, all the farming operations occur in a yearly cycle. For some staple foods - cassava, some varieties of yams, cocoyams and colocasia - this cycle is longer than one year but once it is finished, the whole sequence with all the operations will have to start afresh.
- The cycle is different with tree crops. Farm preparation is done only once during the lifetime of a coffee, cocoa, or oil-palm tree. The plot will have to be prepared for transplanting the seedlings. Once the tree farm is established, the annual activities are farm care - weeding, pruning, mulching, application of fertilizer -, and harvesting. Processing of the harvest - drying, fermentation, de-pulping, oil making, safe storage, transportation and marketing - are much more important than for the annual crops but are not shown on the calendar.

- using the crop calendar

a) selecting crops for school farm work

The crop calendar can be useful in selecting crops for the school farm. When checking the crop calendar against term time and holiday periods, four questions must be answered:

- Is there enough time for harvesting, drying, and storage - if not, what can be done to ensure that these operations are done in time, especially during the summer holidays?
- What important farm work tasks fall in holiday periods?
- Is the vegetative cycle of a given crop longer than 9 months (one academic year) or even longer than 12 months (this is the case when harvesting is shown in the same month or a few months later - mostly in the case of root and tuber crops) ?

If any such crops are grown, or if perennial food crops like pineapples are farmed, they should be farmed early enough for the class which planted them to harvest the whole crop. Thus, pineapples should be farmed as soon as a class starts farming, cassava, cocoyams and cococasia should be farmed in class 5, so that at least by the end of class 6 the crop can be harvested.

Annual food crops must be preferred since they limit farm planning to periods of one year. In the highlands of the North-West Province (Bui and Donga-Mantung Division), the maize harvest is so late that even maize might have to be left out. But this would be inconvenient because maize is the staple food in the area. Therefore, it is important that holiday arrangements be made and enforced. On the other hand, Irish potatoes can conveniently be grown as an early crop.

All the late crops with planting times from August

to October are ruled out because of the holidays. The only possible late crop is beans which could be planted in October, if the work involved in clearing the plot is not too great.

As the main planting season for plantains and bananas is the rainy season, schools have little interest in farming these crops. They could very well, however, establish coffee, cocoa, and oil palm nurseries which could be prepared in February and started in March. The seedlings could be sold at transplanting time, i.e. at the end of the third term.

b) lesson topics

- Finding out the crop calendar of the school community

Taking the appropriate crop calendar as a reference, the class can be asked to work out the calendar of farm operations for the crops to be farmed on the school farm. Groups of children can be asked to find out from their mothers the locally agreed timing for the various farm operations. This can then be checked against the information provided by the general crop calendar. As the year goes by, observations made on the school farm and on local farms will add precision to the first draft based on questions asked.

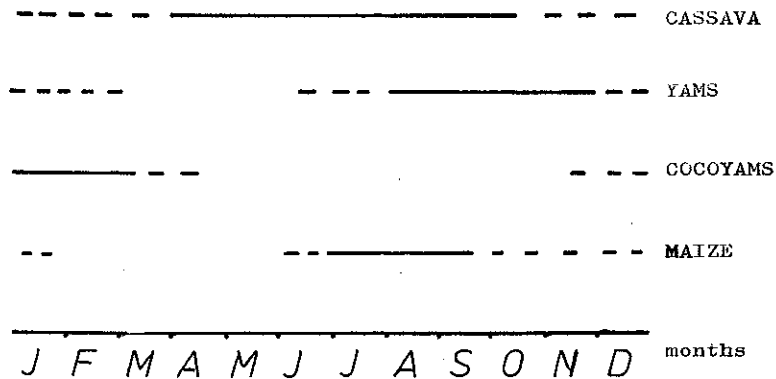
- Breaking the main farm operations down into their component parts

This is an exercise in further precision and might be useful in final year language teaching as well as in teaching on agriculture. In defining the different activities that make up farm preparation or farm care, one might refine the calendar for the crops selected.

- The crop calendar with its many crops and four activi-

ties shown at the same time will be too complicated for immediate use in classes four to six. A simplified version should therefore be prepared. This may be done by concentrating on one crop only or on the two or three crops being grown on the same plot, e.g. maize, beans, and okro. Simplification could also be achieved by concentrating on one activity, e.g. harvesting, for a number of important crops. This would show the availability of various crops throughout the year. An example from Nigeria is provided in the following figure.

Time Sequence of Harvest and Availability of
Major Annual Staples in Eastern Nigeria



--- minor harvest period or consumed from storage
 _____ major harvest period

Source: adapted from Lagemann, J., 1977, figure 6, p. 41

- Concentrating on harvesting periods would give an approach to market studies. Price fluctuation for different foodstuffs could be studied in terms of harvesting periods.
- Harvesting periods can equally well be used to discuss the changing composition of meals throughout the year in different regions. This can be done particularly well if from the crop calendar a calendar is derived which shows the availability of the main food crops throughout the year, and which adds the harvest times for the various fruits, and the main fishing and hunting seasons. This leads to a complete picture of the nutritional situation.
- In a social studies teaching unit on work organisation, the distribution of work loads for men and women in a typical forest area or grassland area farm household can be analysed.
- Similarly, one can also speculate about food requirements, taking into account how heavy the work load is at different times of the year.

These are only a few suggestions. We shall depend on the creativity and resilience of the teachers to make full use of the possibilities which the crop calendar offers.

2.2.4. Planting and Sowing

Work connected with planting and sowing differs very much according to the crops grown. We shall therefore make a few general observations about planting in traditional farming. Much of the detail will be left to the sections on particular crops.

- Selection and preparation of seed material

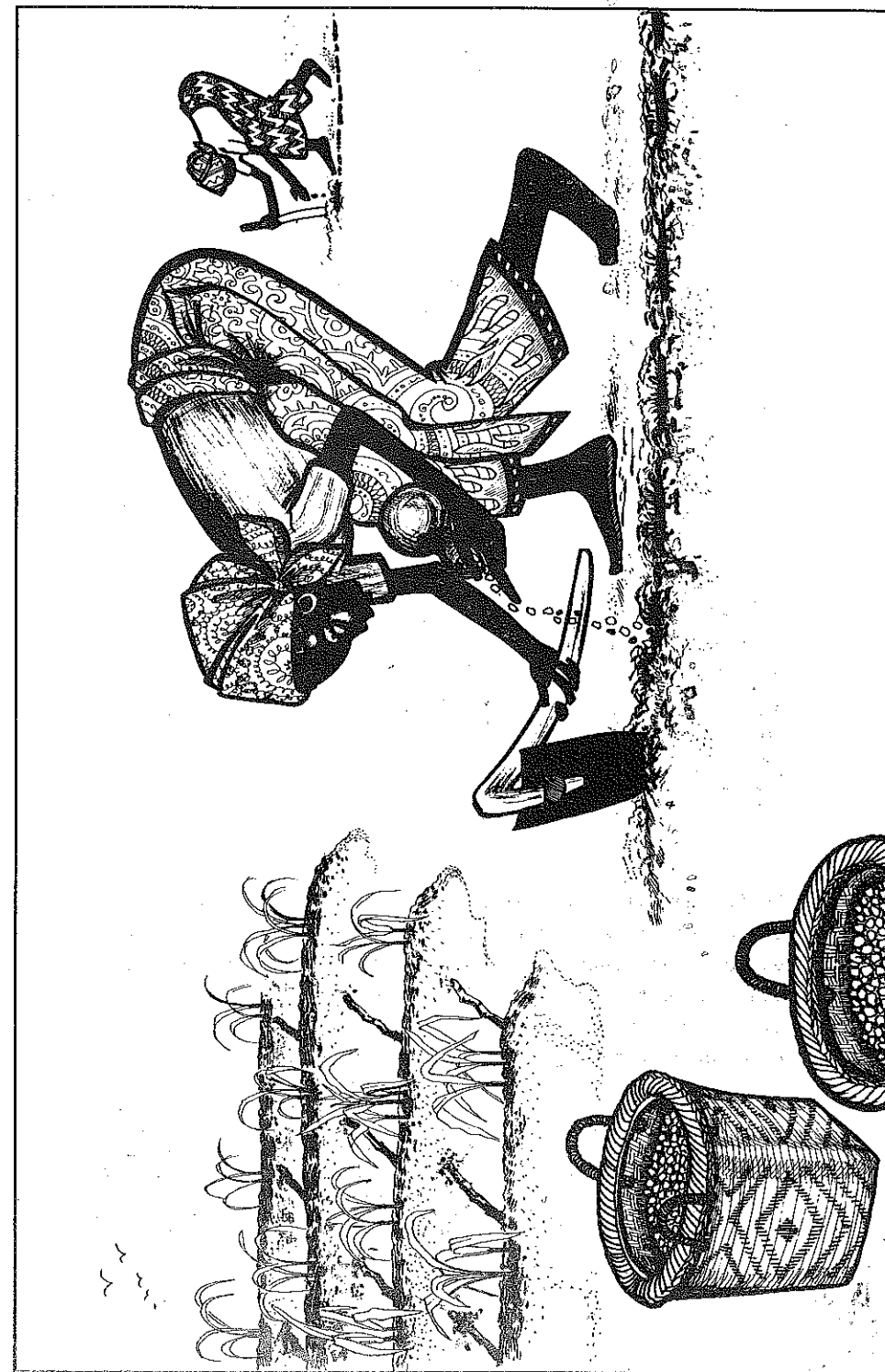
Selection of seeds, tubers, corms, suckers or cuttings as planting material always involves a lot of skill and careful observation. Each farming community has its set of rules in order to find out what will make the best planting material. Pupils could be asked to find out from their mothers and fathers how they organize suitable planting material and what signs they look for when they reject a plantain sucker or a groundnut seed for planting. There are also a number of techniques of safe storage and of preparation of seed material for planting. One such technique is pre-germination (maize and bean seeds, seed yams) which advances plant growth after planting. These techniques should be described and discussed in school.

- Actual planting

Crops are always planted by digging a hole and burying the seed material in the soil. Unlike in earlier European farming, cereals are not broadcast but the individual seed grains are planted one by one.

Some crops are planted together at the same time under the method of mixed cropping. Thus, maize and bean seeds or groundnut seeds may even be mixed in the same calabash used for planting. There are never less than three maize seeds, put in a stand often more, and the same number of bean or groundnut seeds. If cocoyam or colocasia are interplanted with maize, this is done when the maize has already germinated and the plants are well established. This has the advantage, among other things, that patches of ground can be used where the maize seeds failed to germinate.

Planting is not done in straight lines, nor according to precisely measured distances. Since neither animal drawn implements nor engine-powered machines are used



at any stage during farming, there is not really a need for straight lines. All that is required is that enough space is left for people to pass when they weed or harvest without damaging the crop,

On a mound farmed with maize, beans, and leaf vegetables according to traditional methods, the average distance between stands was roughly 40 cm, with a standard deviation⁺ of 15.7 cm. This certainly does not represent a strict standard of planting distances. But as can be seen from the table below, most stands are between 25 cm and 55 cm apart from each other:

Distance between stands (in cm)	frequency	
	absolute	in per cent
9 - 15	5	17.9
24 - 35	3	10.7
40 - 49	11	39.3
50 - 55	6	21.4
56 and above	3	10.7
	28	100.0

On the mounds, crop density is high and amounts to 6 - 7 stands per square meter. Making allowance for the paths between the mounds that use up quite a lot of land, this would amount to about 45,000 stands with at least two plants each per hectare. The study from Eastern Nigeria reports crop densities of 22,000 to 31,800 stands per

⁺The standard deviation is a statistic showing how individual observations differ or "deviate" from the average. Thus, if all the distances between stands fall in the range from 35 cm to 45 cm, standard deviation will be much smaller than if the distances range between 20 cm and 60cm

hectare on compound farms immediately surrounding the house, and between 12,000 and 40,000 stands on farms away from the compound (Lagemann, J., 1977, pp 36 and 45). Near Buea, on very fertile soil, the following densities were recorded, using the density square:

- 14,400 stands of maize per hectare in mixed cropping on the flat,
- 39,000 stands of maize and beans in mixed cropping on mounds,
- 12,000 stands of maize per hectare in mixed cropping on mounds.

Crop density varies a lot according to soil fertility, the crops grown, and the amount of preparatory work a farmer is willing to do. Well prepared soil will support a higher crop density than poorly tilled soil.

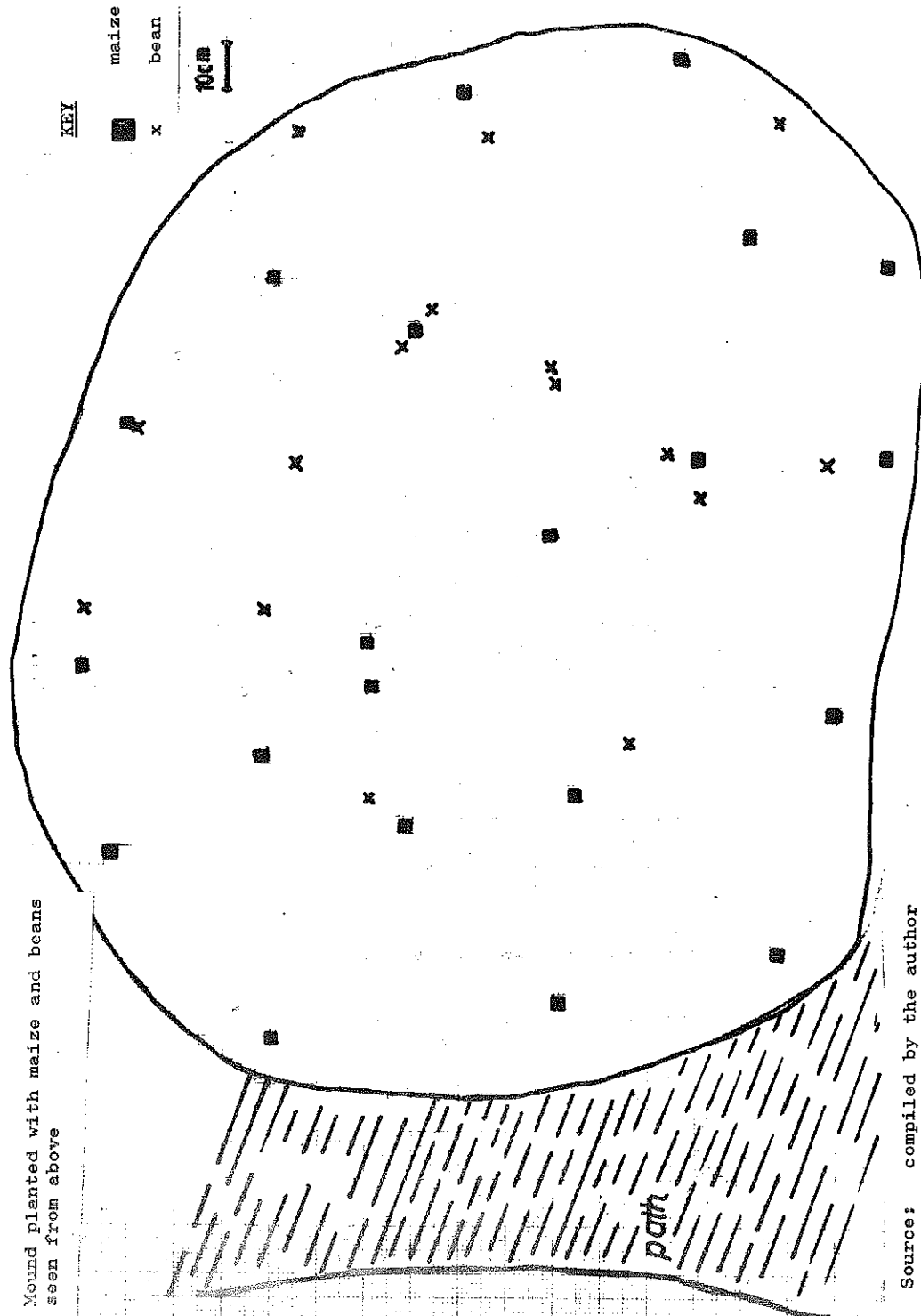
When ridges are formed, as is normally the case across the slopes of hills, more or less continuous contour lines are formed. Ridges are of rather uniform width, depending on the work habits of the woman building them. Near Buea, a traditional farm with eleven ridges was measured. These are the measurements:

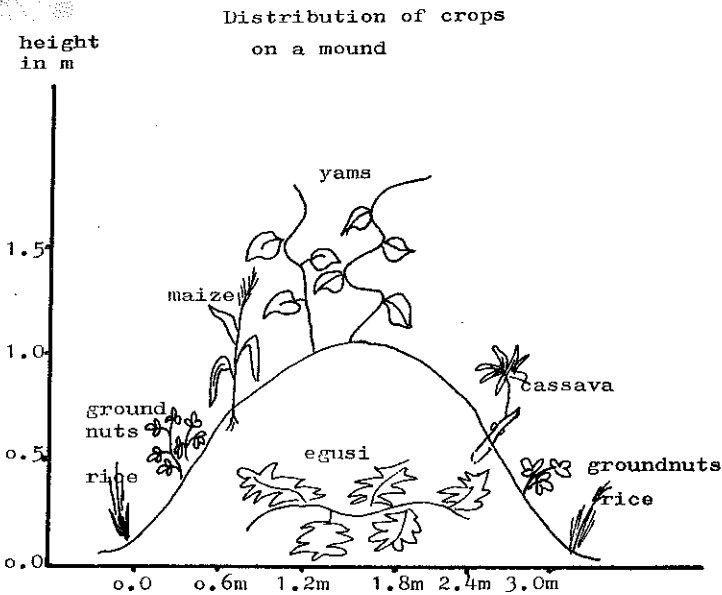
- length of ridges: uniformly 14.60 m due to pre-established straight boundaries
- widest ridge: 2.66 m
- narrowest ridge: 1.14 m
- average width of ridges: 1.66 m including all ridges
1.56 m excluding the widest ridge
- standard deviation of ridges: 0.38 m including all ridges
0.20 m excluding the widest ridge
- average width of furrows: 0.80 m
- standard deviation of furrows: 0.14 m
- highest ridge: 0.57 m (this is also the widest ridge)
- average height of ridges: 0.32 m all ridges included
0.29 m excluding the highest ridge
- standard deviation of height: 0.09 m all ridges included
0.05 m excluding the highest ridge

The widest and highest ridge was prepared for particular crops since grass was burnt in it using the nkara technique.

Planting on ridges is often done in staggered rows. For example, up to three rows of maize and beans or groundnuts or cowpeas may be planted on a ridge. Again, planting distances are not measured out by a yardstick, but they are not haphazard either. They follow rule-of-thumb knowledge about the best density on a given soil. If a school class went to measure the distances between stands of maize or cocoyams along one or two ridges planted according to traditional methods the children might be surprised by the degree of regularity they found.

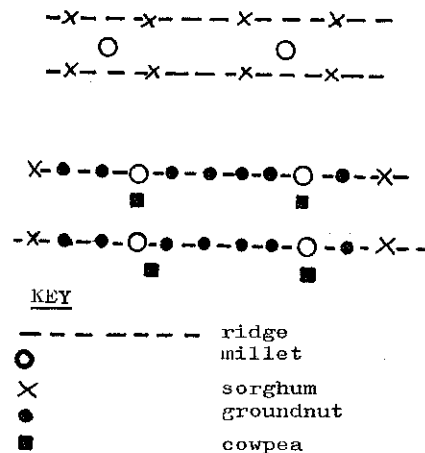
The illustrations in this section show how one might represent graphically the planting patterns used on mounds in traditional farming. Similar patterns may be used for ridges.





Source: adapted from Okigbo and Greenland, *Intercropping Systems in Tropical Africa*, in *Multiple Cropping*, p.74

Planting pattern in a Sahel region



Source: adapted from Okigbo and Greenland, *Intercropping Systems in Tropical Africa*, in: *Multiple Cropping*, p.84

2.2.5. Weeding

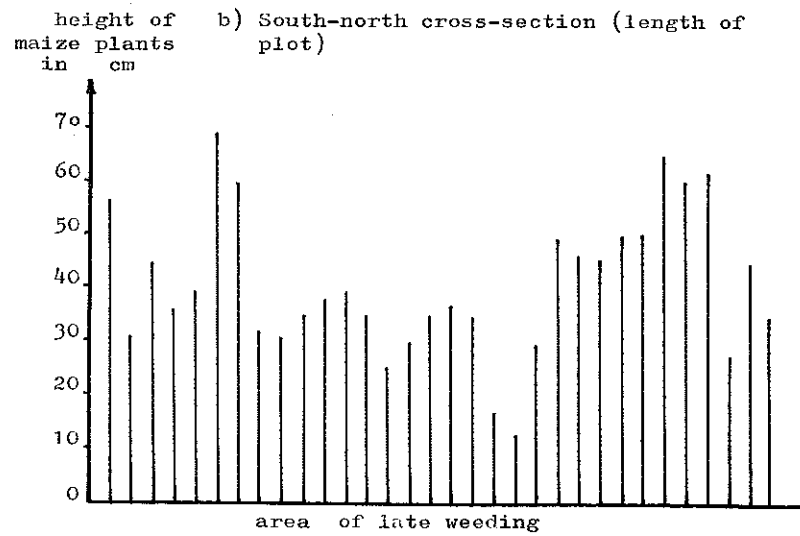
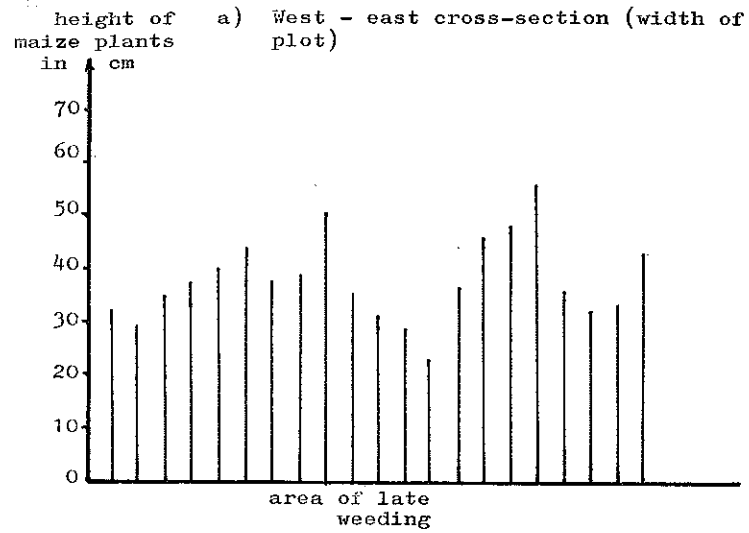
Weeding is a feature of nearly all farming. Exceptions are farms where crop associations are found which keep down most or all the weeds so that weeding becomes unnecessary. This is the case where pumpkins or various species of melons are grown as a secondary crop.

Weeding is usually done with a short-handled hoe. Weeds are left on the farm to wither - except those that would immediately start to grow again. As they decompose, they add nutrients to the top soil. If they are available in sufficient quantities they act as mulch, protecting the top soil against erosion and loss of water. Weeding is very demanding in terms of labour. If it is done too late it will cause serious damage to crop yields (see the section on timing of farm operations above).

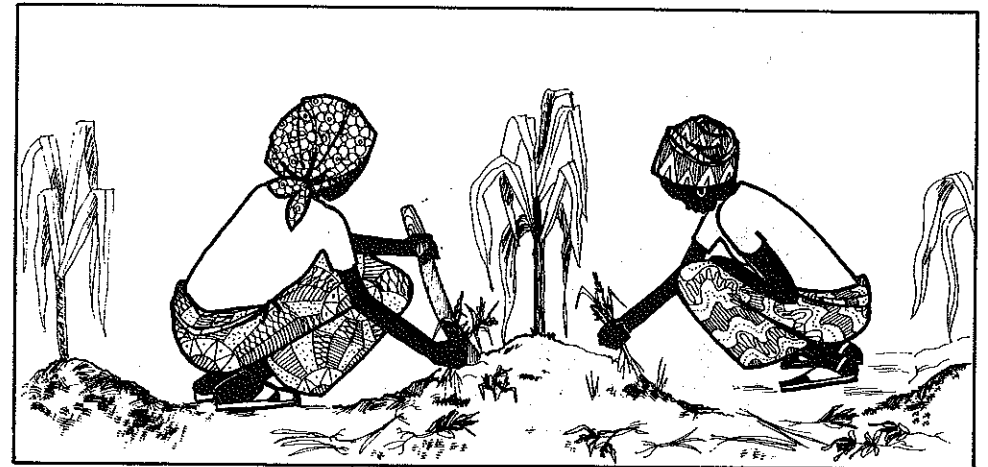
The following is an example of the effect of late weeding on maize growth:

On a local farm with maize and cocoyams the farming woman and her helpers had started weeding from the boundaries of her farm towards the centre. They had given up, however, before finishing the job, probably because they lacked sufficient cocoyam cormels which they were planting as they went along. Therefore, in the centre of the farm, weeds continued to grow for another two weeks. Subsequently, most of the maize plants in the central part of the farm were significantly shorter than the ones in the parts that had been weeded earlier. The measurements presented in the charts below were taken by doing two cross-sections through the centre of the farm at right angles, and measuring all the maize plants along these lines.

The effect of weeding on plant growth
(maize farm near Buea)



Source: compiled by the author



2.2.6. Manuring

Farms are usually not manured. As was mentioned above, soil fertility is restored by

- the fallow period,
- burning at the beginning of a new farming period.

The cultivated areas directly surrounding the houses are manured with all sorts of suitable materials, e.g.

- kitchen and household refuse,
- ashes,
- animal dung,
- waste from the processing of crops, e.g. coffee berry pulp.

Compost is hardly ever prepared. The often-quoted study on traditional African farming systems reports the following methods of manuring the compound farm:

- mulching: all kinds of smaller branches, twigs and leaves from trees and shrubs are used for mulching the compound. The yam mounds especially are covered with a thick layer of these materials;
- animal waste: dung, mainly from goats, is applied throughout the year to the crops. It is usually applied to individual plants;
- ashes: as with animal waste, ashes are distributed directly around the individual plants;
- composting: this practice is common in Owerre-Ebeiri (a village with a high population density, H.B.) where grasses from the fallow areas are collected and thrown together with household remains, into pits where the materials decay. The resulting rich soil is then applied to the crops;
- shifting of latrines: every year the latrines are shifted to another site within the compound. After a period of one cropping season the latrines are filled in, and bananas or plantains are planted, and so receive ample nutrients for many years. These manuring habits have not been developed to such a degree in the lower populated areas, ... the labour-intensive way of building up soil fertility is a result of the people's efforts to overcome the increasing food shortage which results from the high population density."

(Lagemann, J., 1977, p. 39)

Where ridges are built, a certain form of green manuring is sometimes used: At the beginning of a new planting

season weeds, grasses and crop residues such as maize stalks are cut and gathered in the furrows. After this, neighbouring ridges are divided up and new ridges are built in the former furrows. Crops growing on the new ridges not only profit from the decaying plant material buried in the soil but also from nutrients that rain may have washed down from the former ridges.

2.2.7. Crops

A large number of crops are grown in traditional agriculture in Cameroon. We shall first provide some information about the frequency of the different crops in the two provinces, as shown in the IPAR-Buea survey. We shall then discuss mixed cropping as practised in Cameroon, crop sequences and rotations, and finally, cropping patterns according to various land-up zones.

This table shows the frequency of growing various crops in the two provinces. The main crops are emphasized.

Percentage of Communities Growing
the Respective Crops

C R O P	P R O V I N C E		T O T A L
	SOUTH WEST	NORTH WEST	
COFFEE	88.8	88.1	88.5
COCOA	69.4	11.9	38.4
OIL PALM	91.7	50.0	69.2
RAFFIA	38.9	78.6	60.3
YAMS	83.3	76.2	79.5
CASSAVA	91.7	90.5	91.1
COCOYAMS	94.4	95.2	94.8
COLOCASIA	47.2	30.9	38.4
MAIZE	86.1	100.0	93.6
BEANS	66.7	88.1	78.2
SWEET POTATOES	35.1	71.4	54.6
IRISH POTATOES	0.0	54.8	29.5
PLANTAINS	94.4	95.2	94.8
BANANAS	66.7	83.3	75.6
EGUSI	21.6	30.9	26.9
GROUNDNUTS	44.4	54.8	50.0
GUINEACORN	0.0	16.7	8.9
RICE	11.1	19.0	15.4
VEGETABLE	69.4	83.3	76.8
SUGAR CANE	8.3	26.2	17.9
FRUITS	50.0	54.8	52.6
KOLA	52.8	73.8	64.1
TOBACCO	0.0	2.4	1.3
N	36	42 ⁺	78

⁺ Because of geographic similarities, two communities in Fontem subdivision were counted as N.W.P. communities

- crop husbandry

Nearly all farming done by smallholders uses the system of mixed cropping. Various crops are grown together on the same farm. Single cropping is only practised in the case of tree crops, most frequently with oil palms. There are good reasons for mixed cropping:

- The risk of crop failure is spread over various crops. If one fails, the other may still yield a harvest.
- Heavy infestation with a pest attacking a particular crop is less likely, as the distance between plants of the same kind is larger than with single cropping.
- Work on one and the same piece of land is spread out over time. Harvesting and early crop can be an extra weeding operation for the later crops.
- Intercropping tree farms with food crops is an inducement for women to help weeding the coffee or cocoa farm or even do it all alone. As they weed the food crops under and between the trees they mulch the trees at the same time.
- In some areas, land is so scarce that heavy food farming becomes a necessity on coffee farms.

As one author on tropical agriculture puts it:

"By planting a succession of crops with varying planting times, rooting habits and maturities, the cultivator may make better use of his or her time, permit plants to tap the nutrients in various soil layers more effectively, distribute the risks due to vagaries of climate or incidence of pests and diseases, assure a more regular food supply and gradually, as the season progresses, cover the soil so well with vegetation that there is more effective protection against the effect of sun and rain and comparatively little need for the time-consuming job of weeding. Moreover, as long as only 'unimproved' varieties of crops are available or are used, the total yield from a given area may well be higher than when a single crop is planted in pure stand."
(de Wilde, J.C., et al., 1967, p. 20)

The study from Eastern Nigeria quoted several times already provides further insights into the effects of mixed



cropping. On compound plots, more than 40 species of useful plants were counted. These crops were planted very densely, coming close to bush or forest conditions which represent a stable system where soil fertility is continuously kept high. (Lagemann, J., 1977, p. 35) In the forest zones, trees and shrubs remain on the farms. "Most fields carry more trees and shrubs than commercial tree crop plantations." (Lagemann, J., 1977, p. 43) The reason suggested by the author for such a high plant density is that most of the plants are not vigorous because of the poor soil fertility. This seems to indicate that up to a certain extent the weakness of individual plants can be offset by an increasing number of plants. More important, he sees "... a deliberate effort by the farmers to maintain a dense vegetation in order to reduce leaching and erosion." (Lagemann, J., 1977, p. 43, emphasis mine). Continuous dense vegetation is also maintained by phased planting, i.e. planting at different times. A final conclusion is offered:

"The lower the fertility status, the greater the number of stands and species grown on a given piece of land. Phased planting and mixed cropping are apparently tools to counteract the yield-depressing effect of a decline in soil fertility."

(Lagemann, J., 1977, p. 46)

The following crop associations under the system of mixed cropping have been found to be typical in the anglophone provinces of Cameroon:

Crop Associations in tree crop farms

Most newly established tree crop farms are used for annual crops as long as the trees are small, have not yet formed a canopy, and do not yet yield. As the tree plantations mature and shade most of the farm, all food crops except plantains and bananas tend to disappear. But even in old established tree farms cases of inter-

cropping with annual food crops can still be found.

Coffee

Out of 207 farm plots growing coffee, 63.7% are pure coffee farms, with plantains and bananas as food crops in most cases. 6.3% combine another tree crop with coffee, mostly cocoa and occasionally oil palms. All these farms have plantains/bananas and cocoyams. The annual foodcrop most commonly found in coffee farms is cocoyams/colocasia (on 23.7% of all coffee farms), maize is much less common.

Cocoa

Of the surveyed cocoa farms, 42% are pure cocoa farms combining only bananas or plantains with the tree crop. The other farms all combine another tree crop with cocoa, most of the time oil palms which are dotted here and there on the farm plot and were probably left over when the farm was cleared. One third of the cocoa farms mix cocoa and coffee. Apart from plantains, food crops are rarely grown on cocoa farms, probably because the canopy, once formed, gives a heavier shade than on coffee farms. Intercropping with annual food crops is restricted to cocoyams/colocasia (25% of cocoa farms).

Oil palm

38.5% of the oil palm plots seen were pure palm farms. This low percentage is due to the fact that most of the time, oil palms are not planted but are exploited as they grow wild. People arrive at relatively pure oil palm plots by allowing wild palm seedlings to grow while cutting down other shoots. They may even transplant wild seedlings found elsewhere to their plot. These plots then contain trees of different ages; no attention has been paid to spacing, and usually, as the trees grow

very high, there is enough light to allow the farming of food crops. Oil palm growing as practised by the plantations (CDC, PAMOL) is spreading slowly among smallholders. Palms are often dotted about on coffee farms (another 38.5% of the plots with oil palms). Food crops grown with oil palms are plantains/banana, cocoyams/colocasia, and cassava.

Crop associations on food crop farms

Food crops are rarely farmed as single crops, the only notable exception being cassava with its heavy demand on soil nutrients.

Cassava

Apart from being planted as a single crop, cassava is farmed together with cocoyams, and sometimes with cocoyams and maize. Only very rarely is cassava combined with yams (on 17% of all cassava farms). Equally rare are plantains/bananas found on cassava farms.

Yams

Yams are equally often combined with maize and with cocoyams, but the joint farming of all three crops is very rare.

Colocasia

The association of colocasia with plantains/bananas which is common on coffee and oil palm farms is also found on pure foodcrop farms. This association may be extended by yams, or maize and/or groundnuts. Occasionally, colocasia go together with other tuber or root crops, but they are intercropped with yams rather than with cassava.

Maize

Maize is never grown as a single crop. The association of maize with cocoyams or with plantains/bananas is very common, but all three crops rarely occur

Crop Sequence and Crop Rotations

The crop rotations taught on the school farms are copied neither by the school leavers nor by the adult population nor even by the teachers on their private farms. Does this mean that one should abandon the teaching of crop rotation in school farm work as being ineffective? The findings presented below show that the local farmers, at least in some areas, practise definite crop sequences in a system of mixed cropping. In some cases, these sequences come close to real rotations because of the short periods of fallowing (one to two years) between the period of farming. It would seem as if the school farm rotations have been rejected because they insist on single cropping. We describe below the different crop sequences encountered during our survey, and indicate where they have been found. It will have to be established through experimentation by the agricultural research stations and by the teachers in charge of school farms which of these are viable or can be made viable, and which ones will have to be discouraged.

Crop Sequences on Tree Crop Farms

As already mentioned, it is common practice to grow food crops on newly established coffee or cocoa farms. On coffee farms, mostly colocasia are farmed during the first three to four years until the coffee starts bearing. Occasionally, maize is added.

Observed: On the slopes of Mt. Cameroon (Biyuku/Buea, Ekona, Munyenge)
 in the Rumpi hills (Lokando)
 in the Ndian-Mundenba area (Beoko, Esoki, Bima)

Similar patterns can be observed in the North-West

Province. More elaborate sequences of food crops with young coffee are:

year	crops					Inokum, Manyu Division
1	coffee,	colocasia,	maize,	beans,	groundnuts,	vegetables
2	coffee,	colocasia,	-	-	-	-
3	coffee,	-	-	-	-	-

year	crops			Mbepji, Donga Mantung D.
1	coffee	groundnuts		
2	coffee	-	maize	
3-5	coffee	-	maize	
6	coffee	-	-	

Newly established cocoa farms may be left for one or two years without food crops before cocoyams and/or maize are grown between the young trees. From the fourth or fifth year onwards, food crops are no longer grown systematically on cocoa farms.

(Munyenge, Bombanda near Kumba, Ekenge on the Kumba-Mamfe road)

A more complicated sequence has been observed in Ekenge:

year	crops					
1	cocoa	plantains	colocasia	cassava	maize	beans
2	cocoa	-	-	cassava	maize	beans
3-5	cocoa	-	-	cassava	maize	beans
6	cocoa	-	-	-	-	-

Intercropping on oil palm farms depends on the height of the palms and the shade they give. As a farmer in Anyake, Momo Division observed, bush clearing under oil

palms ensures big bunches. But in order to benefit fully from the work of clearing, maize is grown under high palms.

In other regions, palm seedlings, which grow naturally on food crop farms, would be allowed to continue growing until they make food crop farming unprofitable. (Kunku, Akwaya Subdivision)

The following food crop sequences have been observed:

1) year	crops						Kajifu, Manyu Division
1	oil palm	cocoyams	plantains	water yams	yams		
2	oil palm	-	-	-	-	-	cassava
3	oil palm	-	-	-	-	-	cassava
4	oil palm	-	-	-	-	-	-

2) year	crops					Widihum, Momo Division
1	oil palm	plantains	cocoyams	colocasia	pepper	vegetables

Crop Sequences in Food Crop Farming

Sequences starting with yams

There are short sequences covering two years of farming and one or two years of fallowing, in which yams are grown only during the first year. A very simple one was found near Ndian, in Ikassa. It is a sequence of monocropping:

1) year	crops		Ikassa, Ndian Division
1	yams		
2	-	cassava	
3	f a l l o w		

Sequences with the usual mixed cropping are:

2) year	crops			Sabes Agong/Manyu Division
1	yams	plantains	colocasia	
2	-	-	colocasia	maize groundnut
3-4	f a l l o w			

3) year	crops			Njunye/Bangem Subdivision
1	yams	plantains	maize	colocasia
2	-	plantains	maize	- cassava
3	-	plantains	-	-

4) year	crops			Tugi/Momo Division
1	yams	maize	beans	groundnuts
2	-	maize	beans	-
3-5	f a l l o w			

Then there are the sequences in which yams are grown throughout, again mostly for only two years.

5) year	crops					Njunye and Kombone/Meme D.
1	yams	plantains	maize	colocasia	beans	groundnuts sw.yams
2	yams	plantains	maize	colocasia	beans	groundnuts sw.yams
3	cassava	sweet	potatoes			
	f a l l o w					

6) year	crops			Bambalang, Mezam Division
1	yams	calabash	egusi	
2	yams	calabash	egusi	maize groundnuts
3	yams	calabash	-	maize groundnuts
4-10	yams	-	-	maize groundnuts
11-12	f a l l o w			

Similar sequences can be observed with sweet yams.

7) year	crops		Bamali/Ndop Mezam Division	
1	sweet yams	maize	groundnuts	
2-5	-	maize	groundnuts	
6-7	f a l l o w			

8) pattern 3 has been observed with sweet yams instead of yams in Great Soppo (Buea), but sweet yams cultivation went on for two years, and after that, cassava was farmed for four more years before a long fallow of about 6 to 10 years.

9) year	crops		Kombone, Meme Division		
1	sweet yams	colocasia	plantains	vegetable	
2	sweet yams	colocasia	plantains	vegetable	cassava
3	sweet yams	colocasia	plantains	vegetable	cassava
			beans	groundnuts	

Sequences starting with cocoyams but without maize

1) year	crops		Nhiangse/Tombel, Meme Division	
1-2	cocoyams			
3	-	maize	groundnuts	
4-10	f a l l o w			

2) year	crops		Baligham, Mezam Division	
1	cocoyams			
2	-	maize	beans	
3-4	f a l l o w			

3) year	crops		Foreke Bellua/Fontem Manyu D.		
1	cocoyams	plantains			
2	-	plantains	maize	beans	groundnuts
3-5	f a l l o w				

4) year	crops		Sabes Agong/Manyu Division		
1	cocoyams	plantains	colocasia		
2	-	plantains	-	maize	groundnuts yams
3-5	f a l l o w				

5) year	crops		Awing Bambuluwe/Mezam		
1	colocasia	egusi	vegetables		
2-5	-	-	-	maize	beans
6-8	f a l l o w				

6) year	crops		Bamali/Ndop, Mezam Division		
1	cocoyams	sweet potatoes			
2-3	cocoyams		-		
4-5	f a l l o w				

When the farming of a plot starts off with colocasia, most of the time this crop is only grown for one year and is replaced or interplanted by a cereal and one or several leguminous plants in the next year.

Sequences starting with colocasia and with maize

1) year	crops		Ande/Nkambe, Donga Mantung D.		
1	colocasia	maize	beans	egusi	
2-3	colocasia	maize	-	-	
4-20	f a l l o w				

2) year	crops		Nhiangse/Tombel, Meme Division		
1	colocasia	cassava	maize		
2-3	colocasia	cassava	-		
4-6	f a l l o w				

3) year	crops		Mbebele/Bafut, Mezam Division	
1	colocasia	maize		
2	colocasia	-		
3-4	f a l l o w			
5	-	-	yams	beans
6-7	f a l l o w			

4) year	crops		Baligham, Mezam Division	
1	cocoyams	maize	groundnuts	
2	cocoyams	maize	groundnuts	beans
3	-	maize	groundnuts	beans
4-6	f a l l o w			

5) year	crops		Njunye/Bangem S.D. Meme Division			
1	colocasia	maize	groundnuts	beans	vegetables	egusi
2-5	-	maize	groundnuts	beans	vegetables	egusi
		cassava				
6-14	f a l l o w					

As can be seen above, when farming starts with colocasia and maize, most of the time colocasia are farmed throughout or at least through the major part of the farming period.

Sequences starting with maize but without tuber or root crops

1) year	crops		Tugi/Momo Division	
1	maize	beans		
2	-	-	yams	
3	-	beans	-	
4	-	-	-	cassava cocoyams
5-7	f a l l o w			

2) year	crops		Baligham, Mezam Division	
1	maize	groundnuts		
2-3	-	-	cassava	
4	f a l l o w			

3) year	crops		Kajifu/Manyu Division	
1	maize	plantains		
2	-	plantains	cassava	
3-9	f a l l o w			

Whereas these sequences incorporate a tuber or root crop later, mostly cassava, there are others with equally short farming periods which leave out such crops altogether:

4) year	crops		Mumfung/Menchum Division	
1	maize			
2	-	okro	guineacorn	
3-16	f a l l o w			

5) year	crops		Mmen and Kom area, Menchum D.	
1	maize			
2	beans			
3	tephrosia	as fallow crop		

There are, finally, instances where maize is grown all through the farming period of the sequence:

6) year	crops		Soppo/Buea, Fako Division	
1	maize	plantains		
2	maize	plantains	cocoyams	
3-5	f a l l o w			

7) year	crops		Chup/Nkambe, Menchum Division	
1	maize	groundnuts	vegetable	
2	maize	-	-	beans
3	maize	-	-	cocoyams

8) year	crops		Kitongwang/Oku, Bui Division	
1	maize	groundnuts		
2	maize	-	sweet yams	
3-4	maize	groundnuts	sweet yams	beans
5-7	f a l l o w			

9) year	crops	Shiy/Jakiri, Bui Division
1	maize	- egusi
2-10	maize	beans -
11-16	f a l l o w	

Sequences starting with cassava

1) year	crops
1-2	cassava
3	- beans
4	- maize cocoyams
5-6	f a l l o w
7	cassava
8	- yams

2) year	crops	Okoromanjang/Menchum Division
1-2	cassava	
3-4	-	cocoyams
5		maize
6-7	f a l l o w	
8		maize groundnuts

3) year	crops	Mbamsong, Bui Division
1	cassava	maize
2-7	cassava	-
8-9	f a l l o w	

4) year	crops	Shiy, Bui Division
1-2	cassava	maize
3-5	cassava	-
6-10	f a l l o w	

Sequences starting with Irish potatoes

Irish potatoes are one of the few food crops introduced by the colonial powers. Being a tuber crop, it has been

completely incorporated into traditional farming. Irish potatoes are grown in a variety of crop sequences. In one type of sequence, they are grown in the first year of a sequence of variable length.

1) year	crops	Baligham
1	Irish potatoes	
2	-	maize beans
3-4	f a l l o w	

2) year	crops	Awing
1	Irish potatoes	maize cocoyams pumpkins
2	-	maize cocoyams - beans
3	-	maize - - beans
4-5	f a l l o w	

3) year	crops	Shiy, Bui Division
1	Irish potatoes	maize beans egusi
2	-	maize - - cassava
3-5	-	maize beans - cassava
6-7	f a l l o w	

In another type of sequence, Irish potatoes are grown through half or more of the sequence.

4) year	crops	Potang, Manyu Division
1	Irish potatoes	cabbage
2	Irish potatoes	cabbage
3	-	- beans maize
4	-	- beans maize
5-6	f a l l o w	

5) year	crops	Meluf, Bui Division
1-3	Irish potatoes	maize cabbage carrots
4-5	-	maize cabbage carrots
6-8	f a l l o w	

6) year	crops				Mbamsong, Bui Division
1	Irish potatoes	maize	cocoyams	beans	
2	-	maize	cocoyams	beans	
3	Irish potatoes	maize	cocoyams	beans	
4	-	maize	cocoyams	beans	
5-6	f a l l o w				

There are sequences in which Irish potatoes are grown throughout, whereas other crops are added or dropped from the cropping pattern. The sequences covering more than four years of continuous farming always have maize associated throughout, and most of the time beans. The short sequence in Banjong brings in maize and beans only in the second year of the rotation:

7) year	crops				Banjong, Bui Division
1	Irish potatoes	colocasia	vegetables		
2	Irish potatoes	colocasia	vegetables	maize beans	cabbage
3-4	f a l l o w				

8) year	crops				Vekovi, Bui Division
1	Irish potatoes	maize	beans		
2	Irish potatoes	maize	-	cassava	
3	Irish potatoes	maize	beans	-	
4-5	Irish potatoes	maize	-	cassava	
6-8	f a l l o w				

9) year	crops						Vekovi, Bui Division
1	Irish potatoes	maize	beans				
2	Irish potatoes	maize	beans	cassava	egusi		
3	Irish potatoes	maize	beans	cassava	-		
4-10	Irish potatoes	maize	beans	-	-		
11-20	f a l l o w						

10) year	crops					Mbamsong, Bui Division
1	Irish potatoes	maize	-	colocasia	huckleberry	
2-10	Irish potatoes	maize	beans	-	-	
11-12	f a l l o w					

11) year	crops				Dzeng, Bui Division
1	Irish potatoes	maize	beans		
2-5	Irish potatoes	maize	beans	cocoyams	
6-10	f a l l o w				

Sequences starting with upland rice

1) year	crops		Ngale/Akwaya, Manyu Division
1	rice	cassava	
2	-	cassava	
3	-	cassava	
4-16	f a l l o w		

2) year	crops		Ngale/Akwaya, Manyu Division
1	yams		
2	rice		
3-12	f a l l o w		

3) year	crops			Banade/Esimbi, Menchum Division
1	rice			
2	-	maize	groundnuts	
3-4	f a l l o w			
5	-	-	groundnuts	
6	f a l l o w			

Other sequences

1) year	crops				Okoromanjang/Menchum Division
1	sweet potatoes				
2	-	groundnuts			
3-9	-	-	sw.yams, water yams,	colocasia	plantains
10-20	f a l l o w				

2) year	crops	Ngusi/Tombel S.D., Meme D.
1	beans	groundnuts
2	-	groundnuts
3-10	-	cocoyams
11-13	f a l l o w	

3) year	crops	Mbepji/Donga Mantung Division
1	groundnuts	
2-3	-	colocasia
4-5	f a l l o w	

The cropping sequences and rotations shown above have been restricted to the main crops. Vegetables and minor crops have been left out. Here is a crop sequence from Wum and Weh, Menchum Division, which shows all the crops grown on the farm plots:

year	crops
1	maize, colocasia, cassava, spotted beans, sweet potatoes, calabash egusi, pumpkin, melons, okro, garden eggs, huckleberry,
2	maize, colocasia, cassava, cowpeas, yams (very rare)
3	maize - - - groundnuts
4	cowpeas

Source: H. Simon, W.A.D.A. Survey 1975, unpublished

Notes: Information on crop association and sequences obtained as an average from 5 women. Only three out of the five women had farms in the 3rd and 4th year.

In the fourth year, groundnuts may be grown instead of cowpeas. If the land is infertile, fallowing starts already in the 4th year.

(adapted from WADA, a Programme of establishing a training centre for draught cattle, Wum 1975, p. 9a)

General remarks on crop sequences

The information presented above is based on interviews with men on their farms. Since, most of the time, they do little of the work on food crop farms, their information may not have been very reliable. Teachers are invited to examine critically the crop associations and sequences for mistakes. They will find it fairly easy to work out these associations and sequences in their own area. Pupils and their mothers will be very helpful in this respect. With these reservations in mind, what conclusions can be drawn from our observations?

- 1) Some crops are definitely more likely to start a crop sequence and be left out later - usually after one or two years - than to be introduced into a farm plot which has already been used for some years. These crops are:

- yams
- egusi
- Irish potatoes
- cocoyams
- colocasia
- rice.

- 2) Some crops clearly are more likely to be introduced later to a farm plot. These are

- cassava
- beans
- guineacorn

Cassava especially is usually introduced towards the end of a sequence when the soil has already been exhausted by the previous crops.

- 3) Maize and beans may start a crop sequence or may

just as well be introduced later. In fact there are many cases where they are farmed throughout the time of farming one and the same piece of land.

- 4) Changes in the cropping pattern of a particular plot, i.e. dropping one crop and/or growing another crop, are most likely to occur in the second year of cultivation (dropping occurs in the second year in 70% of all cases, adding a new crop in the second year in 85% of all cases).

Usually, no additional crops are introduced after the third year of continuous farming. On the other hand crops may be left out, and thus the range of crops grown on a plot is reduced till the end of the sequence is reached and the farm plot is fallowed.

- Cropping Patterns

By cropping patterns we mean typical combinations of crops in particular areas. Cropping patterns are not the same as crop associations. Crop associations are crops grown together at the same time on one and the same piece of land. Cropping patterns represent the typical set of crops in a given area, whether grown in crop associations or not. The following examples will make this clear:

- 1) Suppose that in a given area in Europe wheat, potatoes, and sugar beet are grown as single crops. There are no crop associations, but the cropping pattern will be "wheat - potatoes - sugar beet".
- 2) Suppose that in a rain forest area in tropical Africa, all women grow maize and beans as one crop association, and yams and egusi melon as another one. Here are two typical crop associations with two crops each, but the cropping pattern will be "maize - beans - yams - egusi".
- 3) In another area, all farming women mix four crops on all of their farms: cassava, groundnuts, okro, and maize. Only in this case will crop associations and cropping patterns be the same.

The range of crops grown in an area, i.e. that area's cropping pattern, is certainly determined by ecological factors like climate and soil fertility. But the cultural habits of the people living there also matter, as well as the availability of new crops. The cropping patterns described below have emerged from the research carried out by IPAR-Buea. They are the result of a deliberate effort to group data which show an overwhelming variety. Others might have arrived

at different patterns. All the ten cropping patterns are presented here for the benefit of the teacher. But he would be ill advised to try to teach all of them to his pupils, and the same is true for the crop associations. The idea is to get away from cramming huge amounts of facts into pupil's heads. Documenting all the cropping patterns (and crop associations and crop sequences/rotations) serves the following purposes:

- 1) They make the teacher aware of the enormous variety of agricultural practices and traditions in Cameroon.
- 2) They make teachers curious to see which pattern best suits the place where he is teaching, and in what respect local cropping patterns differ from the ones described for his area.
- 3) In their teaching, teachers might usefully start with the local cropping pattern, deal with its component crops, establish reasons why they are grown in the area, and contrast it with one or two very different cropping patterns found elsewhere. The observed differences will help to stimulate the pupils' curiosity and motivation for learning.

There are a limited number of cropping patterns in the anglophone provinces. They are defined by a group of food crops which can be found virtually everywhere: - cassava, cocoyams, maize, and plantains/bananas -, and a number of further crops, tree crops as well as annual or biennial food crops. Within each cropping pattern, people regard a limited number of crops as their main food and cash crops. The patterns are labelled according to the geographical areas where they occur. We make a rough distinction between the rain forest zone of low altitude, the coast line area, the transition zone, the zones of high altitude (e.g. Bui Highlands

and the area around Santa), the isolated lowlands north of Nkambe, and the Esimbi-Akwaya region, finally the swamp areas (the Ndop plain, the Mbo-Nso plain etc.) The term "transition zone" is borrowed from F.E. Ngende, Geography of West Cameroon, Victoria, 1966, and J.A. Ngwa, An Outline Geography of the Federal Republic of Cameroon, London 1967, p. 95. Ngwa equates it with the Guinea Savannah vegetation type and refers to the regions which are intermediate between the equatorial rain forest and the savannah, and which lie between 600 and 900 m altitude.

The cropping patterns of the low altitude rain forest zone

a) Forest zone pattern I

Crops	Cocoa	Raffia Palm	Oil Palm	Coffee	Plantains	Bananas	Cassava	Cocoyams	Colocasia	Maize	Beans	Yams	Sweet Potatoes	Irish Potatoes	Green Vegetables	Rice	Groundnuts	Egusi	Guineacorn	Kolanuts
	M																			

M

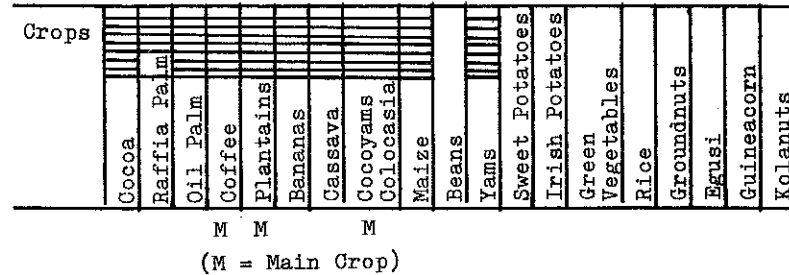
(M = Main Crop)

The tree crops are cocoa, robusta coffee, and oil palms. The most important tree crop is cocoa. Oil palms are mostly those which grow wild, although smallholder plantations are springing up around Mbonge, Mamfe, and along the Kumba-Mamfe road.

In addition to the common food crops, yams and green vegetables are grown nearly everywhere. Beans are less common. The staple foods are plantains and cocoyams.

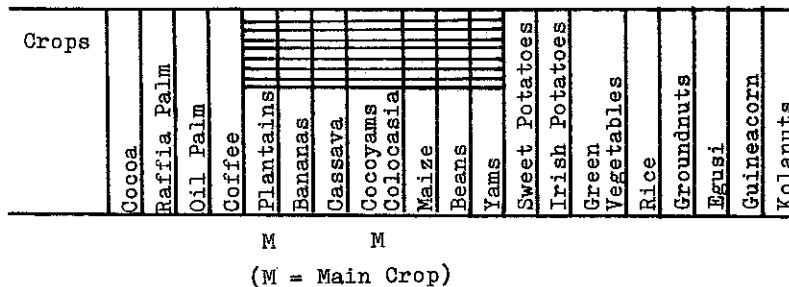
This pattern is much in evidence around Kumba, in the Rumpi Hills, in the Bakossi trough, along the Kumba-Mamfe road, and in the Cross river basin west of Mamfe.

b) Forest zone pattern II



The tree crops are as in the preceding pattern, but the emphasis shifts markedly from cocoa to coffee. Raffia palms are exploited for palm wine. Yams are grown as additional food crops with plantains and cocoyam/colocasia still being the main food crops. This pattern is found in areas bordering on raffia palm growing zones (Akwa in "Mamfe Overside", Anyake) or in places with a heavy concentration of immigrants from the grassland who are used to raffia wine rather than to palm wine (Ekona, Muyuka, Bekora, Ikassa), and finally in the Ejagham area.

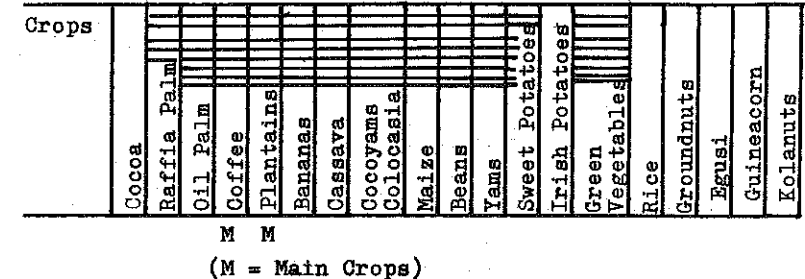
c) cropping pattern along the coast



Most of the land along the coast from the Mungo river westwards to Idenau belongs to the Cameroon Development Corporation (C.D.C.) and is covered by large plantations of oil palms and rubber. The plantations are interspersed, however, with villages inhabited by fishermen. Farming is essentially food crop farming. Cassava is grown for garri-making. Garri is sold to the fishermen. Raffia palms are tapped for wine. Some Bakweri villages on the slope of Mount Cameroon also follow this pattern although they are gradually taking to coffee farming.

The cropping patterns of the transition zone

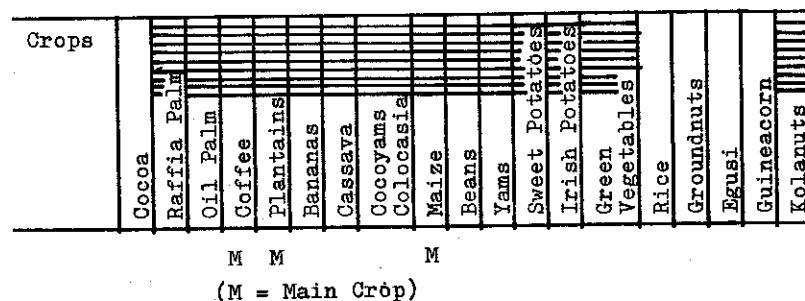
d) Transition zone pattern I



The tree crops here are coffee and oil palms. The raffia palm is used for wine tapping. The main cash earner is coffee. Kola trees are also common. Food crops include yams, beans, green vegetables and sweet potatoes. Groundnuts are often grown in addition. While the main staple food is still the plantain, maize is gaining in importance and is mentioned as the main food crop as often as cocoyams.

This pattern is common around Mount Cameroon, the Western border of the South West Province - the slopes of Mount Kupe and the Manenguba heights, and in the mountains and valleys west of the line from Bangem to Melong. It is found in the transition zone between forest and savannah, e.g. in Kunku and Bantakpa (Mamfe Overside), and Widikum. In these areas, robusta coffee is grown. In places like Bali-Nyonga, Mankin, Bafut, in the areas north of Oshie, and from Beba Befang to Weh, the same pattern with arabica coffee is found. Further to the east, it reappears in transition zones like Mayo Binka (Donga Mantung), and Bamali near Ndop.

e) Transition zone pattern II



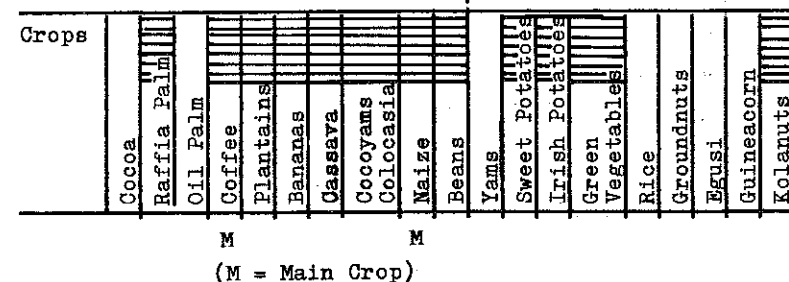
The tree crops are oil palms and arabica coffee, but coffee is much more important than oil palms. Kola trees are very common. The raffia palm is grown everywhere. Food crop farming here includes yams, beans, sweet potatoes, Irish potatoes, and green vegetables. Plantains and maize are equally important as the main staple foods. This highlights the transition from the forest zone to the savannah even more than the preceding pattern.

Irish potatoes do not as well as in the higher areas since the average temperature is too high. They are therefore less important.

This pattern can be found from Batibö towards Mbengwi, around Baligham and Bambalang, and from Belo/Njinikom through Bambui and Mankon to Bamenda.

The cropping patterns of the high altitude areas

f) high altitude pattern I



The tree crops are arabica coffee, and kola nuts. Irish potatoes are grown as a cash crop, but most money is earned from coffee. Yet, in roughly one quarter of all communities following this pattern, Irish potatoes provide more income than coffee. Food crop farming here includes beans and green vegetables. A local variety of yams is found in many places but not everywhere. The staple food is clearly maize, followed by cocoyams and beans. But whereas maize dominates in Bui where it has replaced guineacorn during the last forty years, cocoyams take on much more importance in the Ngemba area as the daily staple food. Raffia palms are grown every-

staple food. Only the remoter communities stick to maize. This pattern is close to the preceding one and may be considered its poorer variant.

k) The cropping pattern of swamp rice cultivation

The cultivation of swamp rice is relatively recent and is done extensively only in suitable areas in the North West Province: in the Ndop plain, the Obang-Tingo area, and the Mbo-Nso plain. Whether in the South-West Province it will be extended beyond the experimental plots near Kumba remains open to doubt. Rice is grown as a single crop, but traditional food cropping continues on the slopes of the surrounding hills and is done by the women.

Summary table of cropping patterns

Crops	Cocoa	Raffia Palm	Oil Palm	Coffee	Plantains	Bananas	Cassava	Cocoyams	Colocasia	Maize	Beans	Yams	Sweet Potatoes	Irish Potatoes	Green Vegetables	Rice	Groundnuts	Erusi	Guineacorn	Kolanuts
forest zone pattern I																				
forest zone pattern II																				
coast line pattern																				
transition zone pattern I																				
transition zone pattern II																				
high altitude pattern I																				
isolated lowland pattern																				
Esimbi/Akwaya pattern																				
swamp rice pattern																				

2.3. Instruments for school surveys of traditional agriculture

- 2.3.1. Calendar of Farm Work (one crop only)
- 2.3.2. Crop Calendar Schedule (several crops)
- 2.3.3. Survey Schedule on Farming in the Community
- 2.3.4. Interview Guide for a survey on traditional farming