II

PRIMARY SCHOOL AGRICULTURE
Teacher's Manual Part Two

Crops

German Agency for Technical Cooperation gtz

PRIMARY SCHOOL AGRICULTURE

Teacher's Manual

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Published by
German Agency for Technical Cooperation (GTZ), Eschborn (Ts),
Federal Republic of Germany, 1980

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Part Two

Crops

by Herbert Bergmann

Published in August 1980 by the
German Agency for Technical Cooperation (GTZ)
Section General Education, Evaluation
Dag-Hammarskjöld-Weg 1, 6236 Eschborn (near Frankfurt)
Federal Republic of Germany

Documentation
Part Two

C R O P S

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Introduction

This booklet provides information about some of the most common crops in Cameroon. Together with the crop calendar provided in the booklet on farming methods, this information should help in the selection of school farm crops and in actual farming.

Apart from pure botanical and agricultural facts, information about the origin of the crops and their economic importance has been given wherever possible. This is meant to make an integration with geography, history, social studies or civics lessons easier. The text on rice is the most elaborate in this respect; unfortunately it was not possible to go into the same amount of detail with the other crops.

The reader will also find a lot of figures, e.g. on planting distances, yields, or overall production. He or she must not think that pupils are supposed to learn - and possibly to memorize - all this. The figures are supposed to help the teacher to set mathematical problems related to the pupils' immediate experience. In this way, integration between agriculture and mathematics teaching becomes possible.

Reading through the texts on the various crops readers will realize that a common outline has been followed. Here it is with the main points underlined. It can be used as a survey guide in order to find out

- characteristics of the local varieties of a given crop,
- farming methods used in the locality,
- information about important crops not covered in our booklet.

Introduction

The Plant

- growth period: annual, biennial, perennial
- structure: herb, shrub, tree
- the root system
- the stem
- the leaves
- the flower
- the seeds
- method of propagation

Origin

Production (at regional, country, continental and world level)

The Crop in Cameroon

- varieties used
- farming areas
- farming methods used in Cameroon
- economic importance

Farming

- requirements as to
  - soil
  - water
  - temperature, light
  - labour
- farming methods
  - tilling (depth, making of mounds, ridges, flat beds)
  - sowing/planting (planting material, planting distances, planting time, depth of planting)
  - weeding (number of weedings between planting and harvesting, best time for weeding)
  - manuring/fertilizing

- other farm work:
  (e.g. hilling or earthing up, staking, mulching, pruning)
- harvesting
  (harvesting time, signs of maturity, method of harvesting)

Processing

The booklet ends with a list of figures on yields, a table showing the vocabulary for various crops, and the list of references.

LEGUMINOUS CROPS

There is a large number of plants known as leguminous plants. Many of them are farmed, for example all the varieties of beans, peas, and groundnuts. Some are eaten, some are used as fallow crops, e.g. tephrosia and mucuna. Some leguminous crops are trees, some are shrubs (e.g. tephrosia), some are small plants not more than 10 cm in height like the groundnut.

Despite wide differences in appearance, they have certain things in common:

1) They are able to take nitrogen, one of the most important plant foods, from the air while all other plants have to rely on nitrogen available in the soil. This has an important consequence: They do not compete with other crops for nitrogen. They even enrich the soil with nitrogen they do not use up themselves.
2) The fruit of leguminous crops is always pods. These pods contain the seeds of the plants.
3) They have tap roots which usually go down deep, some of them reaching a depth of 1.50 m.
4) Their leaves are compound leaves and consist of several small leaflets.
5) Their flowers resemble the bean or groundnut flower in shape.

How do leguminous plants manage to use the nitrogen in the air? If you look carefully at the root of a bean or groundnut you will see small swellings. They are called nodules. The nodules are filled with bacteria. These bacteria feed on sugars and starches

supplied by the plant. They fix nitrogen and make it available to the plant.whose roots they are living in. By living together, plant and bacteria both gain. Each of them produces something the other needs. This living together is called symbiosis. Each nodule functions for only four weeks. Afterwards, it dies and breaks open, releasing nitrogen into the surrounding soil and thus enriching it. In this way, the plant gets so much nitrogen that additional nitrogen from chemical fertilizers is not necessary.

There are two main groups of leguminous crops, those that produce mainly fat and oil, and those that produce mainly protein. Groundnuts and soya beans are grown for the oil they contain, whereas all the peas and beans supply protein.
The leguminous crops most common in Cameroon are beans, cowpeas, and groundnuts. We shall therefore concentrate on them and leave out the rest.

Information on farming these crops is bound to be sketchy since systematic knowledge is scarce:

> " Generalizations on weeding, staking, earthing up, irrigation, fertilizers, labour requirements, etc. are not possible since information is only available for a few crops and only for special regions. Therefore, only some aspects of pulse (grain legumes, H.B.) growing are treated below."
>
> (Westphal, E., 1977/78, p. 65)

Teachers should rely on their own experience as it builds up over years of bean and groundnut farming.

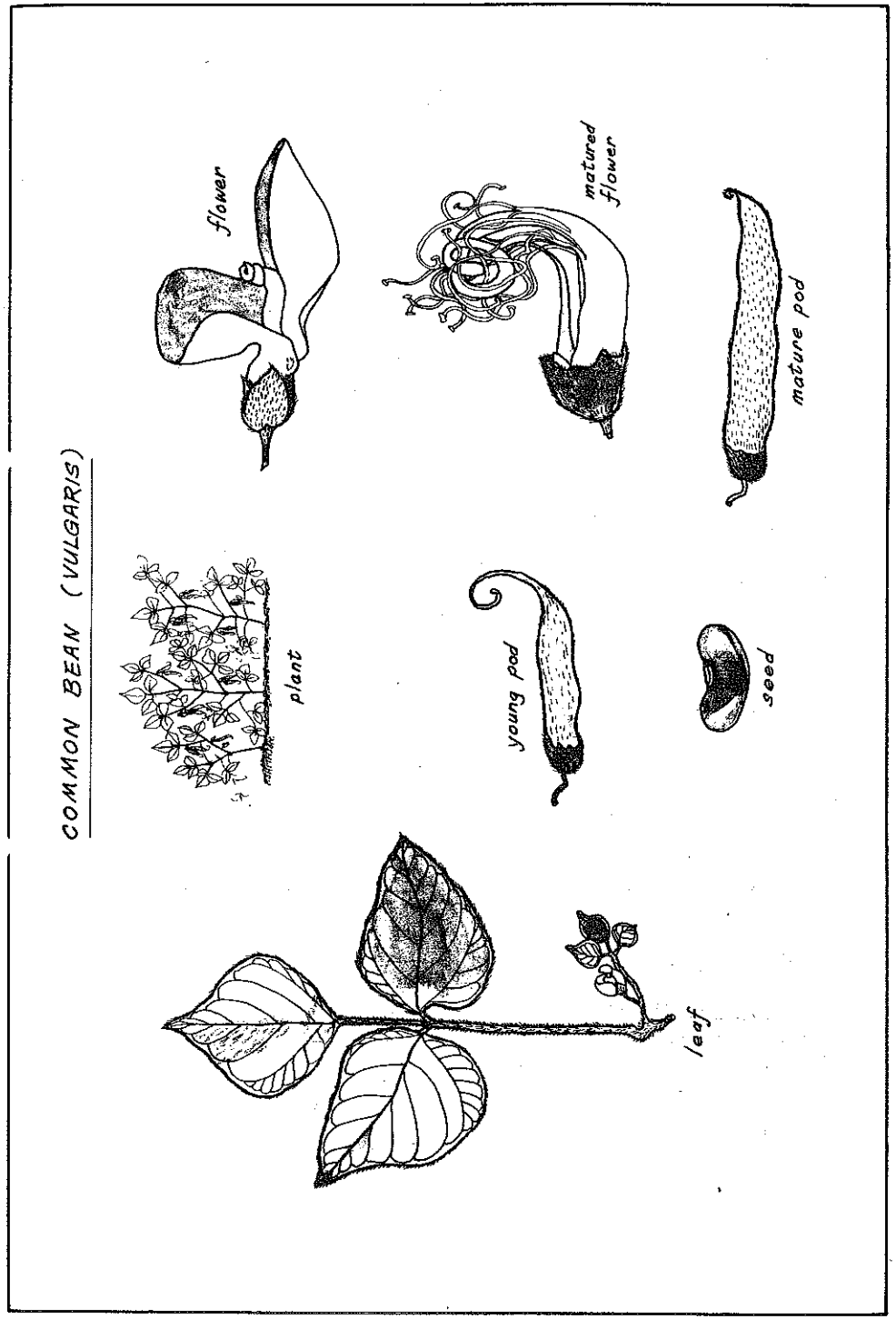
The Bean

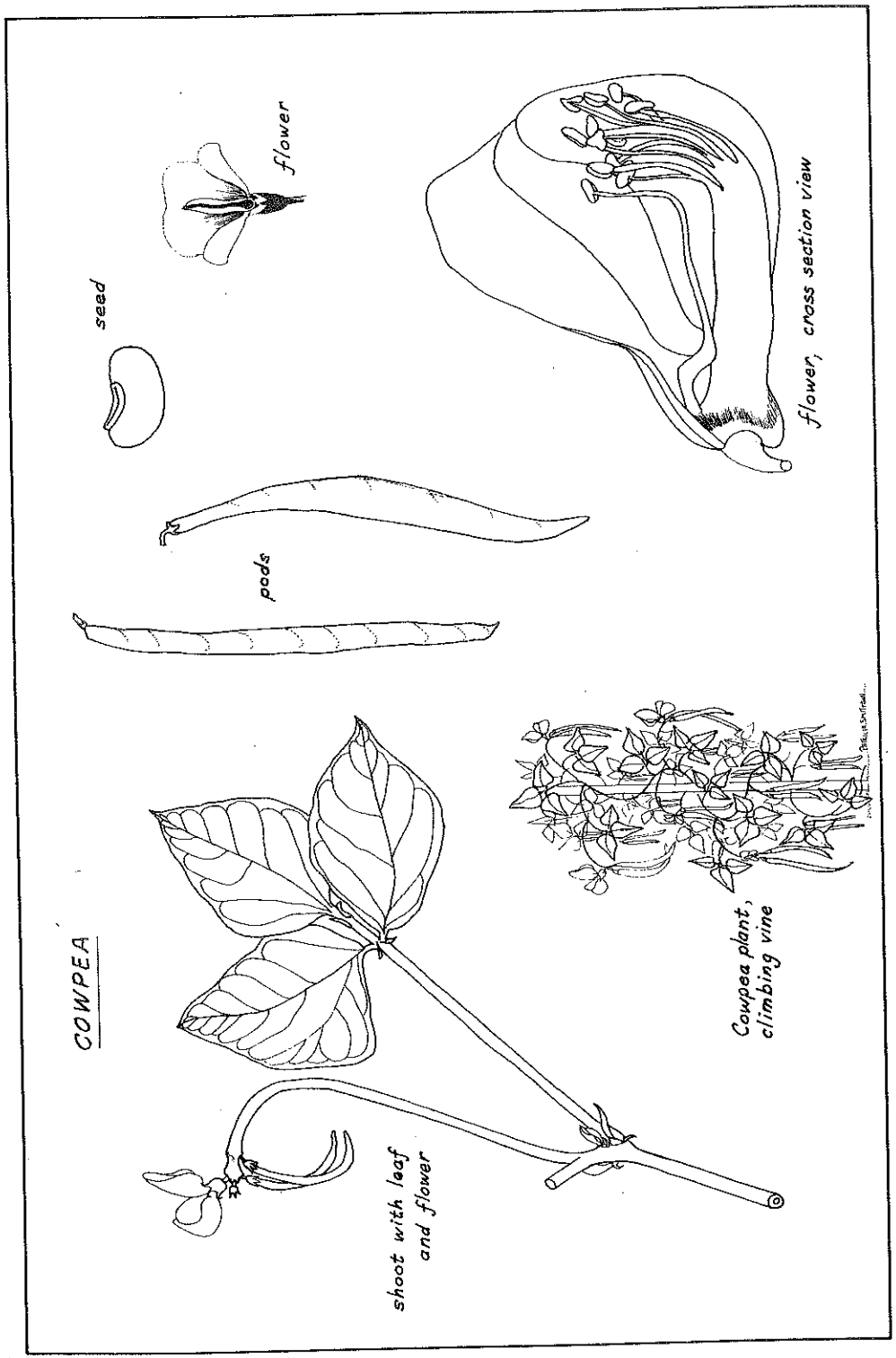
There are two main types of beans in Cameroon, the short bush or dwarf bean, and the climbing bean. Bush beans grow to a height of 20 cm, whereas the climbing varieties may reach as much as 3 m, depending on the support they have (stick, tree, maize stalk, etc.). Bean leaves are compound leaves, each one consisting of three small leaves. Bean flowers are white or light purple in colour. Bean fruits are straight pods ending in a beak-shaped point.

Its origin is Mexico in Central America, and one can only guess how the plant first came to Cameroon - probably rogether with maize at the time of the slave trade.

Beans are a common food in Cameroon, especially in the Western highlands (Province de l'Ouest, North-West Province). But they are also grown in the forest areas. They are usually farmed together with other crops under the system of multiple cropping. The most common crop combination is maize and beans where the climbing beans use the maize stalks as support.

Farming: Beans are not very demanding where soil is concerned. For high yields, the common French bean needs well-structured, rich soil unless phosphorus is supplied in some form. Since they have deep roots, they easily outlast dry periods. Some varieties of beans do not like waterlogged soil, so it is important that the soil drains well. They need full sunlight for good yields and must therefore not be shaded. But the soil temperature must not exceed 30° C. If the soil gets any hotter, the nodules where the nitrogen is





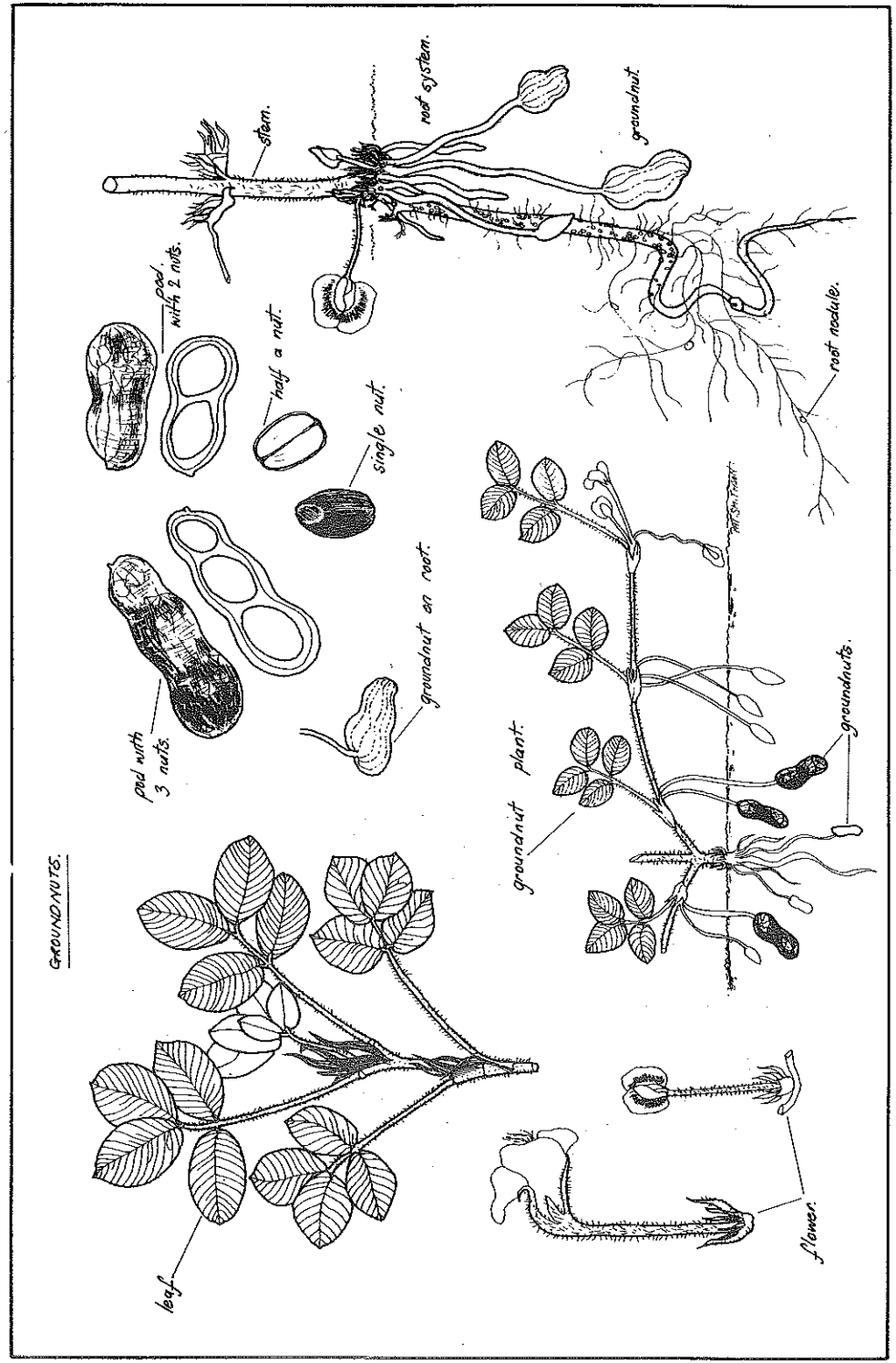
This leads to plant densities of up to 150.000 plants per hectare.

The plant densities for the spacings shown above can easily be calculated. The planting time is usually the beginning of the rains or 1 to 2 months before the end of the rainy season so that the flowers are not damaged by the heavy rains.
Harvesting extends over a long period since the pods do not mature all at the same time. If the ripe pods are left too long, they dry up completely, open up, and scatter the grains. Therefore, repeated picking is necessary in order to avoid heavy losses.

The Groundnut

Groundnuts or peanuts are the most important fat producing leguminous crop in the tropics, yielding a total annual harvest of roughly 13 million tons of unshelled nuts. They are mainly grown as a cash crop for industrial processing into oil, much less for direct consumption. In 1971, India produced about 31 per cent of the world groundnut crop. In Africa, the most important producers are Nigeria, Niger, and Senegal. In Senegal, groundnuts are the only cash crop. At times, they took on so much importance that the economy of the country depended on the world market price of that one crop. In 1972, Senegal exported 230.000 tons of groundnut oil and 331.000 tons of the residue called "cake".

The groundnut is a relatively small herb, its height varying between 15 and 60 cm, depending on the variety grown. Some varieties grow as a bunch like the bush bean, some are creepers, developing long stems that trail along the ground. Groundnuts have compound leaves consisting of two pairs of little leaves. They develop small yellow flowers. The most peculiar feature of the groundnut is the fact that the fruit develops below the surface of the soil. When the flower has been pollinated, a thin stem grows down towards the soil and penetrates the surface. Only after reaching a depth of 10 - 15 cm will the fruit start to form. If the thin stem cannot penetrate the soil there will be no fruit.
The pods are round and contain between 1 and 6 seeds. They are ready for harvesting 13 to 20 weeks after planting.



The plant originated in Latin America. Brazil, Peru, and Bolivia are all mentioned as countries of origin. Therefore, historically the groundnut, too, is linked with the intercontinental slave trade which followed the discovery and colonization of America by the European powers.

In Cameroon, groundnuts are widely grown. An estimate for 1971 puts the groundnut production at about 170.000 tons. Groundnuts are mostly grown for home consumption; they are very important for soups and sauces. They are farmed nearly always in multiple cropping with maize or yams, but occasionally, depending on soil fertility and availability of water, groundnuts are grown in pure stand.

Farming: The groundnut is a plant which needs high temperatures for germination and good growth. On the other hand, it does not need much sunshine. Therefore, it is particularly well suited for multiple cropping under maize or tree crops. As groundnuts rapidly develop deep roots, they can easily cope with drought. In areas with more than 1.000 mm of rain per year, drainage is important since water-logged soil is a great danger. Farming on ridges may be necessary to improve drainage. In Cameroon, one would always have to pay attention to the problem of excess water. Groundnuts need light, well-aerated soil. Soil that bakes hard in the sun prevents the fruit-bearing stems from going underground. The plants cannot tolerate acid soils. Nitrogen fixation is usually very effective so that the use of nitrogen fertilizers is not necessary. Only light tilling is required. It should not be deeper

than 20 cm. Recommended planting distances for single cropping and planting in rows are:

distance between rows	distance within rows
60 cm	15 cm
30 - 45 cm	7.5 cm - 10 cm

The latter recommendation will result in a much higher plant density than the first one. Planting distances also depend on the growth patterns of the groundnut variety planted. Bunch types can be spaced closer than creeping types. As a general rule, a high plant density, providing a dense ground cover, is essential for a good crop. 100.000 - 125.000 plants per hectare, which is 10 - 12 plants per m^2, is an acceptable density.
The seeds are planted at a depth of about 5 cm. Going deeper unduly weakens the young plants. Planting time is in March/April, at the beginning of the rains. In some West African countries, e.g. Senegal, farmers use small animal-drawn sowing machines to achieve regular spacing in straight or contour lines.
Weeds during the early stages of growth greatly reduce yields. Therefore, weeding should be done twice during the early growth period. When the plants flower, a good groundnut crop should cover the soil completely and prevent any further weed growth. Mechanical weeding at or after flowering will damage the plants.
If fertilizer is applied at all, single superphosphate should be given before planting. The exact rate will have to be determined by the local agricultural extension service.

Harvesting requires much labour. The plants are cut at the root and lifted from the soil. They are left to dry for at least 10 days, after which the pods are stripped from the stems and again dried. Unless the pods are really thoroughly dry they do not store well and may become toxic. Once they are well dried they may be stored shelled or unshelle.

Pests and diseases: Insect pests are of minor importance where groundnuts are concerned. On the other hand, groundnuts suffer heavy attacks from a virus, resulting in rosette disease. There is no cure to the disease, but current experiments in plant breeding have produced a few varieties which are immune to rosette disease.

The groundnut has many uses. The most important one is cooking oil, obtained by crushing the nuts. The residue from this process, called "cake", is used as animal feed. But groundnuts are also eaten roasted or salted. Groundnut butter is used in cooking as well as for spreading on bread. Teachers may discuss the use of groundnuts in local foods. Groundnuts have a dual nutritive value: they contain a very valuable plant fat and high quality protein, so that they complement very well the otherwise starchy diet based on cereals or root and tuber crops.

S T A R C H P R O D U C I N G C R O P S

Starch is one of the three most important human foodstuffs (the others being fat and protein), supplying the bulk of the energy needed to keep the body working. An intake of 400 to 500 g of starch daily is sufficient to keep a person healthy. Starch is formed in most plants as a result of a process called photosynthesis. It can be stored in seeds, fruit, stems or roots, but the plants which are farmed for food are those which store starch in their seeds, roots, or tubers. Cereals are plants which store starch in their seeds; root and tuber crops store starch in swollen roots or specially formed tubers.
We shall devote one part of this section to cereals, the other one to root and tuber crops.

C E R E A L S

All cereals are cultivated grasses and are grown from seeds. Most of them are annual plants. The seeds are grains of various shapes and sizes. Just compare a grain of maize, a grain of guinea corn, a grain of pearl millet, and a rice grain: guineacorn might grow 6 m tall, maize in Cameroon usually grows taller than a man, whereas upland rice remains rather short. Since they belong to the grass family, all cereals are somewhat similar in structure. They have a shallow rooting system. Only drought-resisting varieties have roots which go down deeper. One or several round stems grow up from the roots without any branches. The stems are divided into sections by "nodes". The sections are called "internodes". The leaves grow out from the stem. They consist of a sheath that covers one internode

tightly. From the upper node of the internode, the long, narrow, free part of the leaf branches off. The composite flowers form panicles (rice, millet, sorghum) or ears (wheat, rye, barley). Maize is an exception because it has both panicles and ears. But the maize ear is so different from other cereal ears that it has a name of its own, the cob.

Cereals are by far the most important staple food in the world. Only in the humid tropical areas of Africa, where Cameroon lies, are cereals replaced by root and tuber crops as the staple food. In Asia, rice is the main crop in the humid tropical areas. Below are a few figures illustrating the importance of cereals:

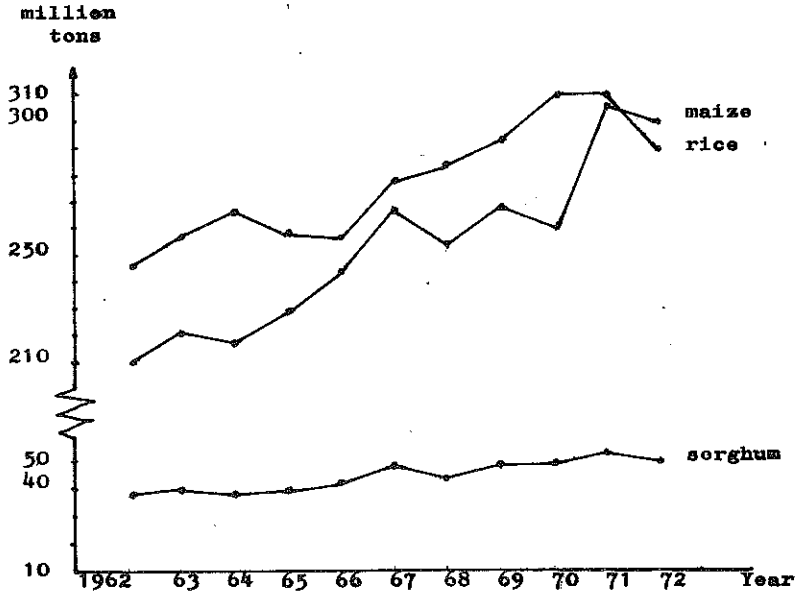
Crop	World production in million tons (1975)	Total area in in million hectares (1975)	main producer countries
Maize	323	115	USA, China, Brazil, South Africa
Rice	344	141	China, India, Indonesia, Bangladesh
Sorghum (Guinea Corn)	54	45	USA, India, Argentina, Nigeria
Other Millets	47	71	China, India, Nigeria, USSR
Wheat	355	228	USSR, USA, China, India, Canada

Source: adapted from Mutsaers, H., Les Céréales et la Canne à Sucre, Université de Yaoundé, Ecole Nationale Supérieure Agronomique de Nkolbisson, 1977, table 1, p. 2

It does not seem that cereals are better for human beings than roots and tubers. It is true that, on average, they contain more protein than root or tuber crops - in fact, cereals account for half of the protein which human beings need. But the protein content of the root and tuber crops can be increased by selection and breeding. The main advantage of cereals is that they can be stored much more easiliy than root and tuber crops.

World production of the major cereals increased dramatically betweeen 1962 and 1972, as can be seen from the following diagram:

World production of maize,rice,and sorghum



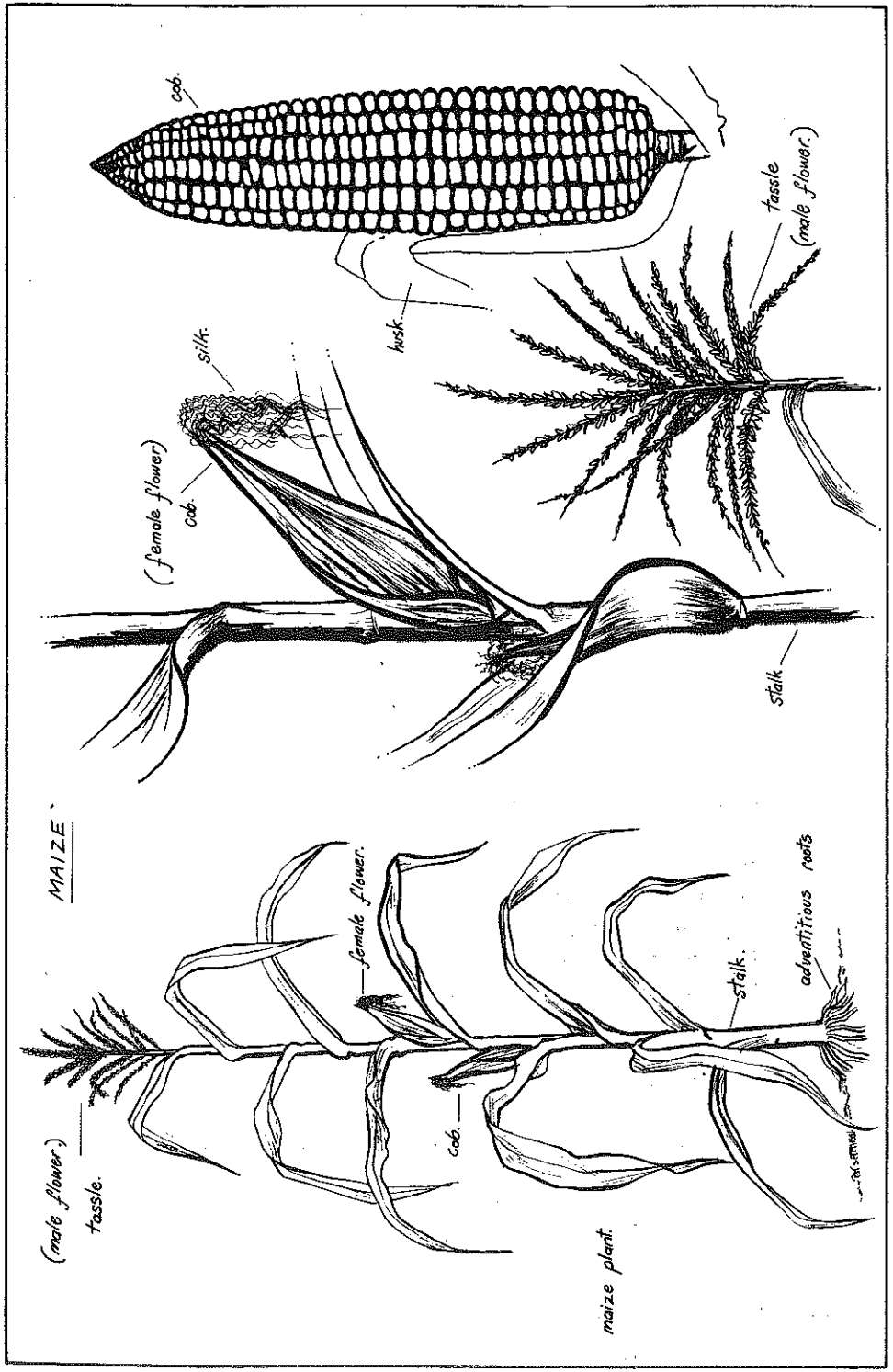
adapted from: Rehm and Espig, table 2, p.17

In Cameroon, maize, rice, sorghum, and millets are grown. Guinea corn and millets predominate in the Northern Province, whereas in the Northwest Province, guineacorn is still grown in some places but is increasingly replaced by maize. There have been a few trials with wheat and barley but their success is yet to be confirmed. In the following we shall therefore concentrate on maize, rice, and guineacorn.

Maize The maize plant belongs to the tall cereals. There are two main types of maize, Dent Maize and Flint Corn. Dent maize ows its name to the fact that the ripe, fully dry grain has an indentation which makes it look like a horse tooth. The grains contain soft starch particles which are not very densely packed. This results in shrinkage of the starch within the outer layer of the grains. The grains are thus characterized by a dent at the outer end. The cobs and grains are generally large.

Flint corn produces very hard grains with a shiny surface. The grains are often flattened and strongly coloured. When broken they look like small pieces of flint.

Like all cereals maize is propagated by seeds. Unlike root and tuber crops it cannot be propagated by cuttings. The seeds or grains develop from the maize flower. Maize has two types of flowers. When the maize plant has reached its full size. a tassle or panicle grows on top of the maize stalk. This is the male flower. It cannot produce grains but only pollen. In the axiles of the leaves cobs develop which are surrounded and covered by shucks or husks. These are the female flowers on which the grains will grow later on. From the small cobs hang the stigmas of the female flowers. known as silks. Clouds of pollen fall from the tassles when the maize plant is shaken, some of the pollen sticks to the stigmas, and the female flowers are then pollinated. The male flowers mature before the silks. This avoids self-pollination and ensures cross-pollination.



Maize develops only shallow roots and is therefore very vulnerable to lack of water and to strong winds. Out of a sample of a hundred maize plants examined at a research station, 70 were found to have roots reaching 10 cm into the soil, 24 had roots reaching down to 50 dm, and only 6 had roots reaching below 50 dm. As the plant grows taller, the first one or two nodes above the ground grow adventitious roots. These roots are short and thick and attach the plant to the soil.

Maize has a similar nutritive value to the yam in that it consists mainly of starch. But it has a higher protein content and even some fat. However, the proportion of the three foodstuffs varies from one kind of maize to another. Some special varieties have a protein content as high as 20%, while in others the starch is partly replaced by sugar.

Origin: Another name for maize is "Indian corn", and Indian here means American Indian. Maize was probably first grown in Guatemala or Mexico. These are countries in tropical Latin America. Some people believe that it was introduced to Africa by the Portuguese in the 16th century. By that time, the Portuguese were trading along the West African and Central African coast and were shipping large numbers of Africans as slaves across to their American colonies.

Maize in Cameroon

Maize is a very important food crop in Cameroon. It is grown in all provinces except in the North where the climate is too dry. In the grassland areas of Cameroon,

e.g. in the North West Province and in the Province de l'Ouest it is the main staple food. It came from the West to the highland areas, and in Bui Division it is still called "Bali corn". It has replaced guineacorn. In the forest areas, root and tuber crops are more important than maize.
There are many ways of preparing maize for eating. But maize is also used for making drinks. There are two kinds of maize beer which are brewed locally, Nkang and Kwacha. The big breweries in Douala also use maize as an ingredient in their bottled beer. Traditionally, maize is grown in multiple cropping. The cropping patterns and crop associations involving maize are dealt with in the booklet on farming methods.

Farming

Maize does not make very high demands on the soil. Under favourable climatic conditions where the soil has been well prepared, maize will do well in any soil except cold, moist clay or very light, sandy soil. Where the rainfall is heavy, good drainage is important. As far as climate is concerned, maize needs a lot of sunshine and warmth. It does not do well in the shade. It is very important for maize to get enough water during the period of early growth and flowering.

Tilling:

On light, well drained soil, maize can be planted without any tillage. On slopes or on poorly drained soils, planting on ridges, mounds or heaps is recommended. If maize is planted in rows on the flat, tilling can be limited to the narrow strips where the seeds will be put in.

Planting:

The planting distance for maize depends on the fertility of the soil, and on the water supply. The more fertile the soil and the more water is available, the closer the plants can grow together. Under multiple cropping the planting distances for maize need to be a bit larger than under single cropping. The recommended average crop population lies between 40.000 and 60.000 plants to one hectare (4 - 6 plants per m^2) with the following spacings possible:

Distance Between Rows	Distance In Rows	Plant Population/ Hectare
60 cm	25 cm	66.600
60 cm	30 cm	55.550
75 cm	25 cm	53.300
75 cm	30 cm	44.400
80 cm	25 cm	50.000
80 cm	30 cm	41.600
100 cm	30 cm	33.300
100 cm	50 cm	20.000

Each planting hole or stand takes two to three seeds. 20 to 30 kg of seed will be needed per hectare. The holes should be about a finger's depth so that the seeds are between 5 and 10 cm deep in the soil. Seeds germinate after 4 - 5 days. Two weeks after planting, the maize should be thinned to one or two plants per hole. This should be done just after it has rained or when the soil is still very damp.

Weeding:

Weeds are a greater threat to the maize crop than pests and diseases. Maize plants can tolerate compe-

tition from weeds for about 10 days after planting. Weeds that germinate one month after the maize is planted or later will not do much harm. Usually, two weedings are necessary, early weeding 10 days after planting, and late weeding 30 days after planting. Because of the importance of weeding quickly and on time, this is the most important step in farming maize.

Earthing up should be done when the plants are over 30 cm tall. This will encourage the growth of adventitious roots (or prop roots).

Manuring/Fertilizing:

Compost is rarely used for maize. In most maize-producing countries, the dry maize stalks left on the farm are much more important than compost. But it is heavy work to till them into the soil. Green manuring with Mucuna or Tephrosia could also be tried. If chemical fertilizer is used, a compound fertilizer - N.P.K. 20-10-10 at a rate of 100 kg/hectare seems to be appropriate in the grassland areas. Fertilizer should be applied twice, once during early growth, and once when the tassles show. Each time, one gramme should be givem to each plant. One gramme of fertilizer is what will go into one beer bottle top.

Harvesting:

Maize is ready for harvesting 14 - 20 weeks after planting, i.e. roughly three to four and a half months after planting. The high yielding varieties may take even longer. This long growth cycle has important consequences for school farm work: Maize planting during the second term, usually in March, should be done as

early as the rainfalls permit. Even so the crop will be ready only towards the end of July. Farm-masters and headmasters will have to make adequate provision for harvesting, drying and storing the maize during holiday time. This is the more important as the maize planted in March must not be left on the stalks during rainy season.

Signs of the maize getting ripe are when the silks dry up and when the leaves and shucks turn yellow.

Yields differ markedly according to variety and planting time. The following table summarizes a few figures on maize yields:

Yield (kg/ha)	Area	Remarks
2.800		World average
1.350 - 2.240	West Africa	early maize, weight after drying
750 - 1.120	West Africa	late maize, weight after drying
600	Ndian Division	estimate for local farmers
700	Manyu	estimate for local farmers
1.500	Wum area	estimate for local farmers
3.000 - 4.000	Wum area	experimental farming at W.A.D.A.
4.600 - 7.500	South West Province	experimental farming at Ekona
5.000 - 8.000		normal yield for maize in the tropics
20.000		maximum yield with careful fertilizing, very good insect, pest, and weed control, and high yielding varieties

Newly harvested maize may lose as much as 20% of its weight when dried. Weighing should therefore be done after careful drying.

Pests and Diseases:

Seed rot is caused by fungi. The seeds may not germinate at all or the seedling may die shortly after germination.

Seedling wilt is also caused by fungi. It starts with a grey mark at the tip of the leaf, and within one or two days the seedlings wilt. Maize rust affects the leaves and causes a conspicuous light colour in the centre of the leaves. Stalk rot causes the plants to mature too early, and therefore poorly filled grains, low yields and stalk breakage. Smuts are caused by fungi. The head smut produces a black mass of spores in the male flowers and in the earshoots.

The most important insect pest is the stem borer or stalk borer. Other pests are birds, rats, millipedes, aphids, and armyworms. Weevils may cause heavy damage to the ripe cobs.

Drying and Storage:

While in store, maize is attacked by weevils and rats. If the maize is not dry enough, it may be attacked by fungi and become mouldy. Therefore, if the harvest can not be sold immediately, it is very important that the crop be dried properly. Different types of dryers are being tried out at the moment. The cobs are stored in open cribs made from bamboo or raffia, this could also be done in airtight silos, but they are very expensive to build.

R I C E

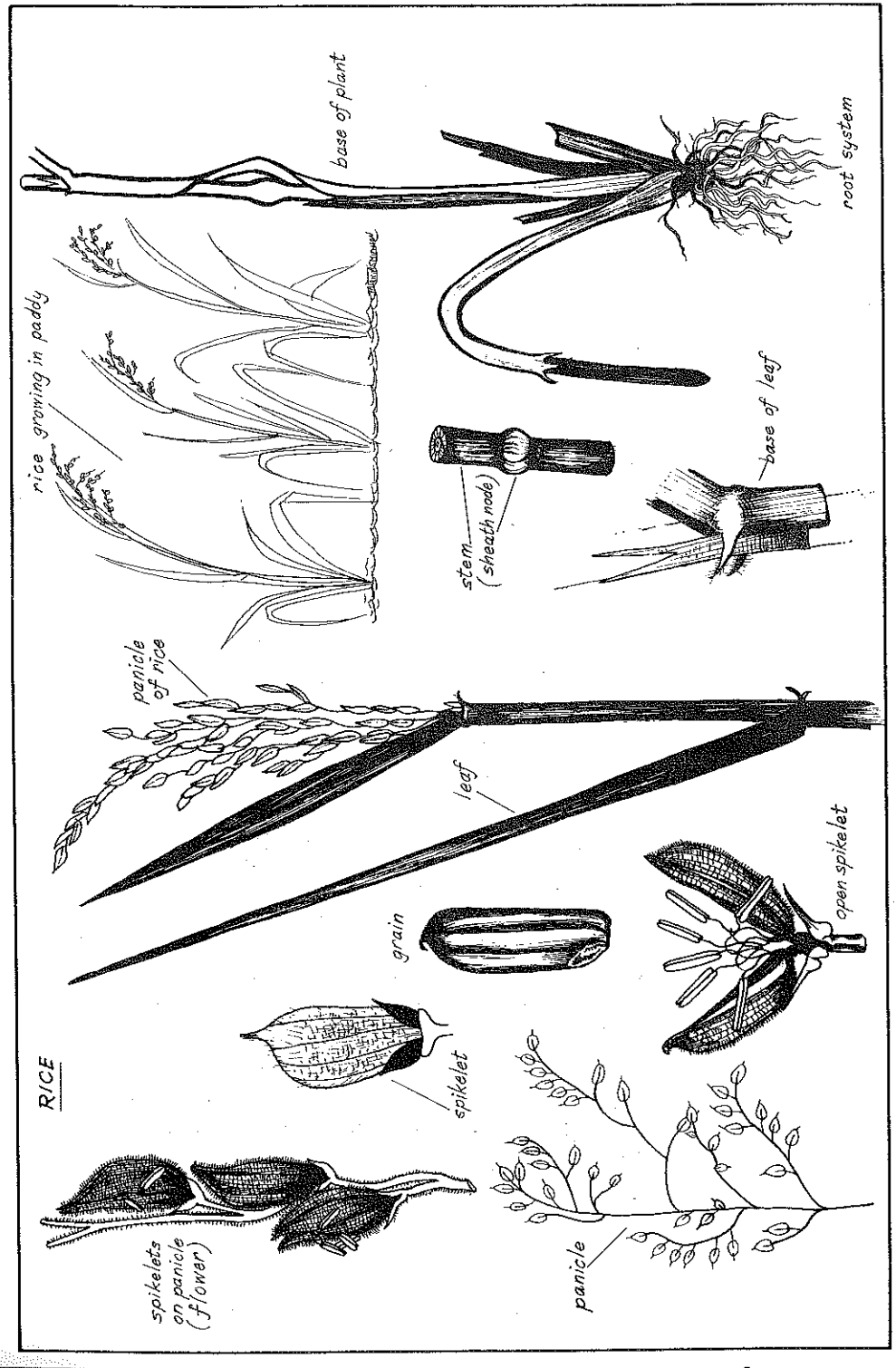
Introduction

Rice is one of man's most important food crops. It is also one of the first plants ever farmed by man.

The Rice Plant

Rice is a very peculiar plant. Some varieties of rice grow on dry land, but some grow even when the soil is flooded with water. And some varieties can only grow when the whole farm is well flooded for quite a long time. Rice which grows on dry land is called UPLAND RICE. Rice which grows only in water is called SWAMP RICE or IRRIGATED RICE. Farm work is quite different for upland rice and for swamp rice. There are very many varieties of cultivated rice, which makes it possible to grow the crop in widely differing soils and climates.

The main rooting system develops from nodes below the ground. When the heads or panicles grow, there is a matted mass of roots near the surface of the soil. With swamp rice, this mat of roots is often covered with green algas, and it is believed that this helps the plant to breathe. When the roots are firmly established, the plant tillers, that means that it develops several stems each with seed bearing heads instead of only one. The stems are erect, cylindrical, smooth, and hollow except at the internodes. They terminate in a branched, open panicle. Varieties of rice vary in

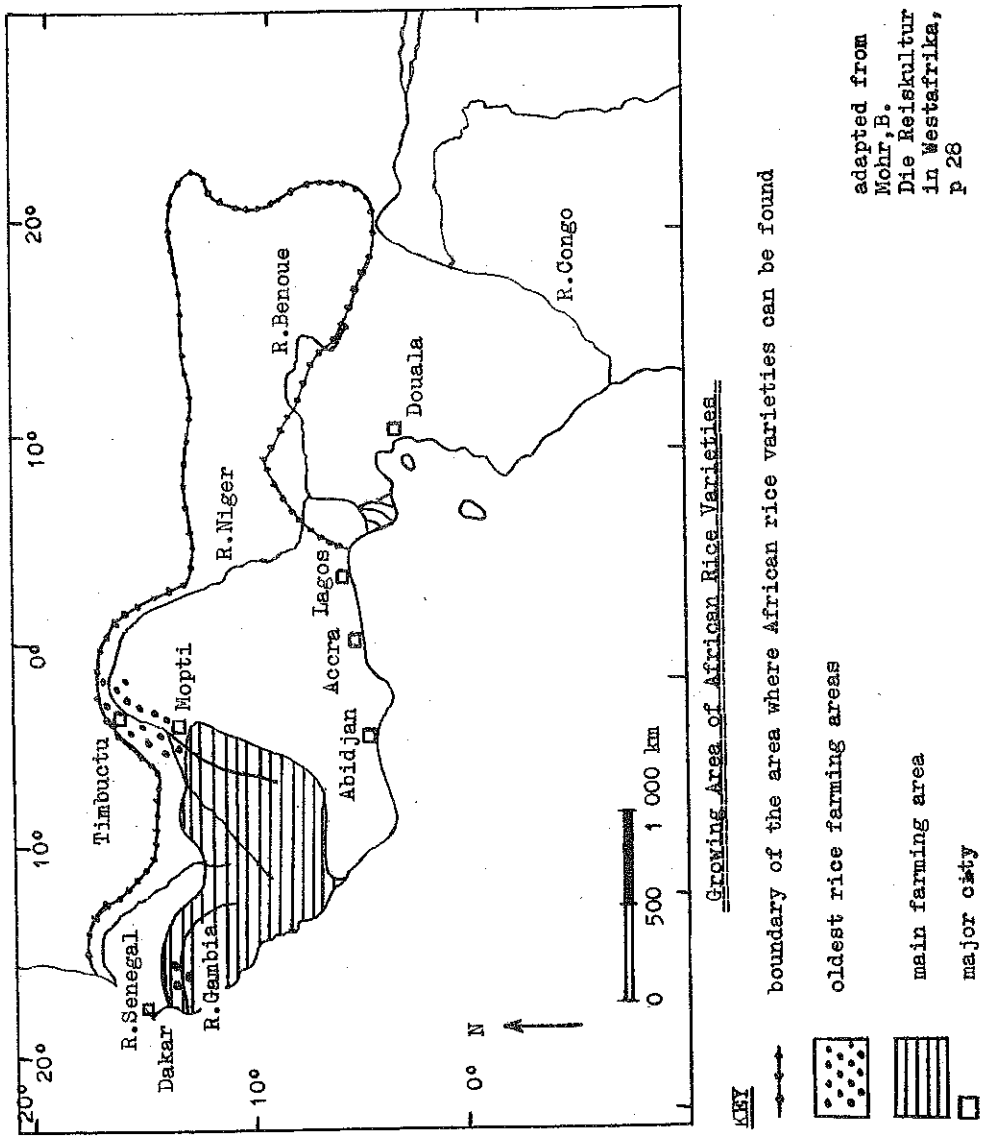


height from 30 cm to 1.80 m. The growth cycle from germination to maturity depends mainly on the variety, but climate, too, has some influence. Some rice varieties get ready for harvest in four months, others take six months. Rice has small green flowers which are self-pollinating. The small fruits are pointed at each end and are covered with a strong seed coat or husk. They grow on the panicles. Generally, one month after flowering rice is ripe and ready for harvesting.

Origin:

Rice has two areas of origin, one is Asia, and the other is West Africa. The Asian varieties of rice have white grains. In Asia, rice is the single most important cereal. In China, Asia's largest country, rice has been farmed for at least 5.000 years, and in India, books written 3.000 years ago already mention several varieties of rice. Even now, Asia is still the most important continent for rice farming. It produced 266 million tons of rice in the early seventies, this represents more than 90% of the total world harvest. Here are the main producing countries in Asia:

China	104	million	tons
India	58	"	"
Indonesia	18	"	"
Japan	15	"	"
Bangladesh	15	"	"
Thailand	12	"	"
Other Asian Countries	44	"	"
Total	= 266 million tons		



Growing Area of African Rice Varieties

KEY

- boundary of the area where African rice varieties can be found
- oldest rice farming areas
- main farming area
- major city

adapted from
Mohr,B.
Die Reiskultur
in Westafrika,
p 28

But rice farming in West Africa also has a long tradition. It originated in the interior delta of the river Niger, in a country which today is called Mali, around the towns of Mopti and Timbuctu. African rice has yellow, reddish, or brown grains, and there are both upland and swamp varieties. From its area of origin, the African rice spread towards the west, and rice farming in Senegal and the Gambia may date back as far as 1500 years B.C. From the time of the first contacts between Europeans and Africa, Asian rice was gradually introduced to West Africa. Throughout the 15th, 16th, 17th and 18th centuries, new varieties of rice were grown along the West African Coast and slowly found their way into the hinterland. Asian rice was not grown on a large scale in Africa until after 1920. But already between 1800 and 1850, white-grained rice had been found right in the old area where African rice came from, in the interior delta of the river Niger.

Rice in Cameroon

Rice has become more and more important in Cameroon. This is shown by the following figures:

Rice (in tons)

Year	Consumed in Cameroon	Produced in Cameroon (hulled)	Imported
1965	13,680	7,740	5,940
1968	19,134	10,164	8,970
1970	18,549	10,755	7,794
1971	40,182	8,236	31,946
1972	37,376	9,143	28,233
1973	31,187	7,314	23,873
1974	24,189	9,559	14,630

Rice imports still are more than double the home production. Farmers who started growing rice would therefore find a ready market. Rice farming is greatly encouraged in Cameroon. But rice has also been grown traditionally in certain areas in the South West and North West Provinces.

Traditional Rice Areas in the Anglophone Provinces

Area or Sub-Division	Division	Type of Rice
Esimbi Area	Menchum	Upland rice
Akwaya Sub-Division	Manyu	Upland rice
Mbembe, Mfumte, Yamba and Mbaw Area	Donga Mantung	Upland rice

In many areas, rice farming is sponsored by Government or by other agencies. Below is a list of the main projects involving rice farming in the anglophone provinces.

Area	Type of Rice	Agency running the project	Abbreviation
Obang-Tingoh, Menchum Division	Swamp Rice	None, smallholder scheme started by Taiwanese Technical Assistance	None
Wum - Weh, Menchum Division	Upland "	Wum Area Development Authority, Ministry of Agriculture	W.A.D.A.
Ndop Plain, Mezam Division	Swamp "	Upper Nun Valley Development Authority, Ministry of Agriculture	U.N.V.D.A.
Rural Areas around Kumba Meme Division	Swamp "	Rural Training Centre Kumba, Presbyterian Church of Cameroon	R.T.C.
Mbaw-Nso, Bui Division	Swamp "	Mbaw - Resettlement Scheme Catholic Church	None

At present, there is no Division in the North West Province without rice cultivation. In 1975/1976 the situation was as follows:

Volume and Importance of Rice Cultivation in the North West Province 1975/76

Division	No. of Farmers	Swamp Rice Area (ha)	Upland Rice Area (ha)	Total Rice Area (ha)	Paddy Production (tons)
Bui	787	453	38		1238
Donga Mantung	1122	492	24		1599
Menchum	2407	204	1481		1942
Mezam	3482	990	456		2753
Momo	352	-	250		187
Total	8150	2139	2249	4388	7719

Source: Provincial Delegation of Agriculture, North West Province

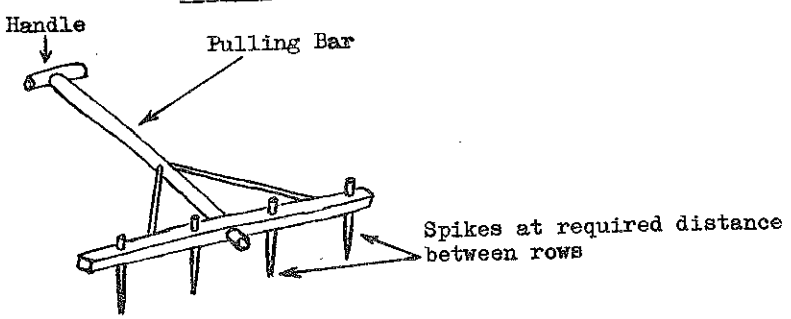
In the shops and at markets one sometimes finds packets labelled "Riz de Yagoua" - Rice from Yagoua. Yagoua is a huge rice farming project in North Cameroon. It is situated in the plain created by the big Logone River, along the border with Tchad. Like all the other rice projects in Cameroon, it is a smallholder scheme: families of peasant farmers have been allotted a piece of land. They farm this with the assistance and guidance of the project organization. Finally, around Nanga Eboko, on the Sanaga River north-east of Yaounde, in the Centre-South Province, and around Bertuoa there are other rice development projects.

Upland Rice Cultivation

Upland rice is grown on the light soils of the open savannah and does well even on steep, stony slopes of hillsides provided its requirements of water (800 - 1500 mm annual rainfall) are met. Traditionally,

it is cultivated under a system of shifting cultivation on a newly cleared piece of land. For details see the booklet on Farming Methods.
The plot where the upland rice is to be farmed is tilled lightly after clearing and burning have taken place. The seed is sown broadcast at the beginning of the main rains. Weeding is done shortly after germination, and later on as required. One of the main problems in rice farming is the damage done by birds. It is usually the children's job to scare birds away from the time the rice heads have formed until the harvest. Often, a raised platform is built at one corner of the field, - and from it ropes are stretched all over the field. Things that make a noise or odd movements are tied to these ropes and scare away the birds when the ropes are pulled from the observation platform. When the time comes to protect the rice against birds and other animals, school classes lose many of their pupils!
The Agricultural extension agents give the following advice for farming upland rice:
The soil should be tilled 15 to 20 cm deep. Planting should be done in straight lines. This will make weeding easier. The distance between rows varies between 25 and 40 cm, the seed rate varying between 100 and 30 kg per hectare accordingly. Along the lines, seeds are planted at intervals of 1 - 2 cm. In order to save work, lines can be drawn by using a marker (which can easily be made from bamboo or raffia.)

The Marker



adapted from FAO, better farming series, vol.20
Upland Rice, Rome 1970, p 5

The seeds are planted 2 - 2.5 cm deep and then firmly covered with soil.

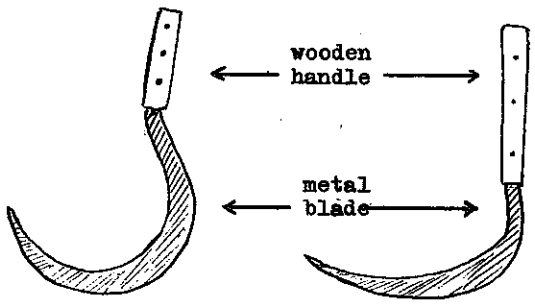
Fertilization

High yielding varieties especially need chemical fertilizers in order to produce really high yields. The first application of fertilizer is done one month after planting. A compound fertilizer NPK 20:10:10 is used at the rate of 200 kg/ha. The second application follows two months after planting. This time, urea is used at a rate of 50 kg/ha. Fertilizer is always applied along the rows.

Harvesting and Threshing

Harvesting is done 15 to 25 weeks after sowing, depending on the variety. This involves cutting the whole rice plant at the base with a special knife called a sickle. Cutting the rice should start early in the morning, so that threshing can be done around 11.00 a.m. when it is getting hot and dry.

Sickles Used For Harvesting Paddy



adapted from R.T.C.Kumba, Rice - a short introduction...

Threshing, i.e. removing the seeds from the heads, must be done immediately after harvesting, because upland rice is already very dry at harvest time, and the seeds would soon fall off by themselves. Threshing can simply be done by gathering a handful of rice and gently beating the heads on a log

of wood so that the grains fall off. But there are also simple hand-operated machines for threshing. Yields for upland rice vary between 900 and 1.700 kg/ hectare. Under very good conditions, one might get 3 tons (3.000 kg) per hectare. This is the paddy yield, i.e. seeds covered by their husks.

Labour Estimates

Agricultural experts at W.A.D.A. (Wum Area Development Authority) have estimated that upland rice farming, if done by manual labour alone, requires 90 days of labour per hectare. This includes all the labour needed for land preparation, weeding, fertilizing, bird watching, harvesting, and threshing. Diseases and pests are the same for upland and swamp rice. They will therefore be discussed later.

Swamp Rice Cultivation

While upland rice farming does not require more skill than maize or yam farming, swamp rice farming is a very skilful activity. Swamp rice fields need careful planning and upkeep. They have to be prepared in such a way that the water level in the field can be controlled at any time. This means building irrigation and drainage canals.

Of course, swamp rice could also be grown in natural swamps or fresh-water mangroves. But here the water level cannot be controlled, so that the crop is much more exposed to climatic hazards then in artificially prepared rice fields. Swamp rice has three principal advantages over upland rice:

1. Crop failure due to drought or badly distributed rainfall is almost eliminated;
2. Yields are consistently higher;
3. Soil fertility is maintained and continued cultivation on the same plot is feasible.

Why is it so important always to control the water-level in a rice field? In order for rice to yield maximum crops, the water level should be as follows, due to the water requirements of the plant as it grows:
At planting and up to 6 to 8 days afterwards:
the water should not be visible, but the plot should be covered by liquid mud. Under these conditions, seedlings transplanted from their nursery will easily establish firm roots.
After this, the field should be flooded to a depth of only 2 - 3 cm. This level should be maintained for 45 days = $1\frac{1}{2}$ months. During this time, the seedlings tiller: one plant develops several stems all of which will later form their own heads or panicles.
Two months after transplanting, the water level should be raised to 10 cm and kept there for another 5 weeks. From the time the panicles or heads have formed until they start turning yellow, the rice field must always be well flooded. It should stand in about 20 cm of water.
Afterwards, i.e. about 17 weeks or 4 months after transplanting, the water level should go down gradually.
Ten days before harvesting, the water should be drained away completely.

In natural swamps such as can be found in the wide valleys of gib rivers, a long and heavy rainy season produces a natural rise and fall in the water level,

and this is indeed the environmental condition to which wild swamp rice has become adjusted. If in such swampy areas the water starts rising shortly after the heavy rains have set in, goes up to a certain height and then gradually goes down again towards and after the end of the rains, why should farmers bother to lay out special rice fields where they can control the water level at will?

1. The rains might fall unevenly throughout the rainy season so that the height of the water level does not match the development of the rice plants.
2. The rains might stop too early or too late. In both cases, the harvest will be less than expected or might be lost altogether.
3. There are areas which are not regularly flodded but which have a stream nearby that could ensure an adequate water supply. Such areas can be irrigated, i.e. artificially provided with the water necessary for rice farming. Thus irrigation enlarges the area suitable for swamp rice cultivation.
4. With enough water available from a stream or river, a second or third rice crop can be grown during dry season. This has the same effect as if the area under rice had been doubled or tripled. It should be clear by now how important it is to lay out rice fields which can be flooded and drained at will.

Planning and Opening up a Swamp Rice Field

Planning a swamp rice field requires much thought, skill, and experience. The area to be flooded must be level. Only then will all the plants have the same depth

of water. Steep slopes cannot be used, but gentle slopes can be. A plot with a gentle slope must be subdivided into "checks" marked off by small dams called "bunds". Inside the checks, the ground must be levelled.

There is no traditional knowledge about farming swamp rice in the anglophone provinces. Therefore one should be sure to consider all the important points in order not to make mistakes in the layout.
Digging irrigation and drainage canals, building dams and the first clearing all are very heavy work, to be done at the very beginning. Planning at the beginning has to be very thoroughly in order not to waste this effort. In any case, an adviser should be called in to check before the work actually goes ahead.

The following points should be investigated before work starts:
Is there enough water available? If one cannot draw on the experience of previous years, observation should be made over at least one year. A small experimental plot would be of great help.
Is the soil suitable? Rice does not make heavy demands on the soil; as long as there is enough water, it will grow. Pure sand and pure laterite soils cannot hold water and are therefore unsuited for rice farming. Simple soil tests should be made all over the plot intended for rice farming. A hand test of the soil structure will be sufficient.
Can the plot be levelled without too much effort?
It has to be levelled because there must be the same depth of water all over. The more small hills and depressions there are on the plot, and the more it slopes in one direction, the more levelling and building of bunds will have to be done.

Clearing the Plot

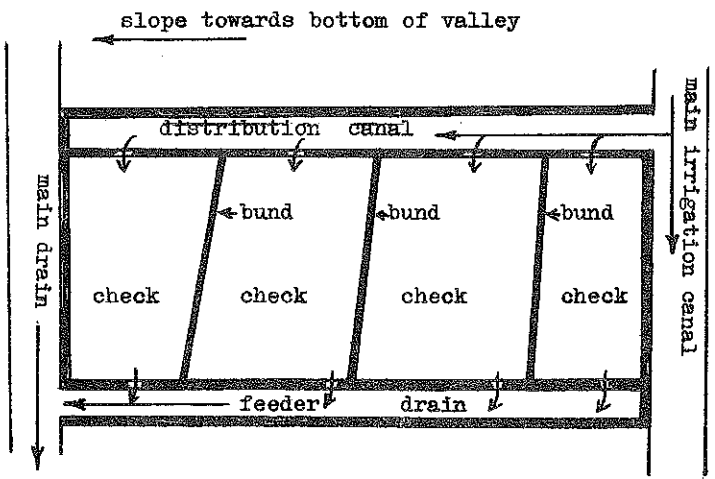
Plots overgrown with grass and small shrubs do not present any serious problem for clearing. When there are trees or gib shrubs, they have to be cut down. Small stumps should be uprooted and the big ones left to decay in the field. If there are gib trees, it is advisable to kill them instead of cutting them down.

It is not possible here to go into details of how to build dams and dig the canals. A few remarks is all we can provide:

1. In order to provide irrigation water a small dam will have to be built across a nearby stream, or a small river. Such dams can be built from earth and sticks. Concrete dams are better, they last longer, but they are more expensive.
2. From the dam, the main irrigation canals are dug so that they run round the upper boundary of the future rice farming area. At the lower boundary, a canal is dug through which irrigation water from the fields can flow away. This canal is called the main drain.
3. The whole area surrounded by the main irrigation canal and the main drain is subdivided into smaller plots with boundaries running at right angles from the main irrigation canal down to the main drain.
4. Exactly on these boundaries smaller canals are dug with small, strong dams at both sides. These canals serve as distribution canals and feeder drains.
5. It is these plots surrounded by the main irrigation

canal, the distribution canal, the feeder drain, and the main drain that are subdivided into checks according to the slope that exists between the main irrigation canal and the main drain.

Irrigation and drainage of a swamp rice field



When it is time to flood a check, water is allowed into the distribution canal from the main irrigation canal. Through an opening in the small dam alongside the distribution canal, it flows into the check until the water level has reached the desired depth. When it is time to drain the water away, an opening is made in the dam of the feeder drain of that particular check, the water flows out and runs into the main drain.

Water is a main cause of erosion. Water weeds will grow in canals. Therefore, regular upkeep of all parts

of the irrigation and drainage works is very important for the good functioning of the whole system.

Swamp Rice Farming and Cooperative Work

It should be clear by now that swamp rice farming is more than just growing a crop on a piece of land. Before the first rice crop can be grown, a lot of work is needed in order to build the irrigation and drainage system. And over the years, this system has to be kept in good order, otherwise there will be no harvest.

Where several farmers in one area grow rice, they will not build individual irrigation and drainage systems. It would not be possible, and even if it were technically possible it would be too costly. Rather, farmers using water from the same source will join forcas to build a common irrigation and drainage system: one dam to store irrigation water, a few main irrigation canals and main drains. Once this system has been built, there is need for a joint effort to keep it in good condition. It would be unfair to ask one man to look after the dam since all the farmers profit from it. Furthermore, if a farmer does not maintain the main irrigation canal or the main drain supplying his fields with water - the other farmers will suffer.

Swamp rice farming therefore inevitably leads farmers towards joint effort or cooperation. And because they learn to join hands in order to carry out farming, it should be easy for them to raise money jointly in order to buy a rice thresher and a rice huller.

The Nursery

Unlike upland rice, swamp rice cannot be sown straight into the future rice plot. There would be too much loss. Rather, nurseries are made and young rice plants are transplanted from the nursery into the field.

The soil of the nursery must be rich and of a good structure. Poor or too heavy soil should be manured with compost. A nursery can be made on one of the checks in the rice field, or close to the house. If the nursery is near the house, it is easier to look after, but if it is on a check, less work is needed to transport the seedlings and water.
Because good growth in a nursery is so important, somebody will have to watch it in order to keep away birds, rats, cattle, goats and pigs.

The Size of a Nursery

A nursery must be big enough to supply seedlings for the whole rice field. Some of the seedlings will not be healthy and strong at the time of transplanting. It is therefore important to have more seedlings than will actually be transplanted. This enables the farmer to select the best seedlings only. It will also give him the seedlings needed to replace the ones that do not grow after transplanting. A nursery which covers one tenth (10%) of the area of the future rice field is about the right size. A farmer who wants to farm an area of 0,5 hectare (5.000m^2) will have to make a nursery of 0.05 hectare or 500 m^2.

Preparing the Nursery

The soil should be tilled to a depth of at least 20 cm, 2 - 4 weeks before sowing. It is then kept flooded, and the loose soil is worked into a fine mud which is completely level. If the nursery is big, it might be subdivided into seed beds that are 1,5 to 2 m wide and 20 cm high. This will make things easier later on, since the paths in between give easy access to all the seedlings. Before sowing, all small lumps of earth should be broken up, all hollows should be filled in and all little stones removed. If the soil of the nursery is poor, it should be enriched with chemical fertilizer where compost is not available. For each 100 m^2 of the nursery, one will need

1,5 kg ammonium sulphate
1,5 kg dicalcium phosphate
1 kg potassium chloride

These fertilizers must be spread evenly all over the nursery.

Preparing the Seeds

Only rice grains covered with their husks, i.e. paddy, should be used for sowing. They are taken from healthy, well developed plants. If there is an Agricultural Extension Office nearby, it might be possible to buy high quality seed. Swamp rice seeds are pre-germinated. This means making the paddy grains germinate before they are sown. Pre-germinated seeds grow better and faster. Rats and birds do not like them as much as ordinary paddy grains, and so fewer seeds will be eaten.

To pre-germinate the seeds, they are first of all covered with water and left there fo a full day, 24 hours.

The rice grains are then taken out of the water and spread out on mats, baskets, or sacks, and covered with damp material. Within one or two days, a tiny sprout will appear, and the grains have effectively germinated. It is now time to sow them. Seeds are broadcast at a rate of 6 kg to each 100 m^2 of nursery. Remember that the nursery is one tenth the size of the final rice field. Therefore, 6 kg of paddy will be enough to plant a field of 1.000 m^2, and the seed rate per hectare is 60 kg. The grains should be covered with very fine soil. Light mulching with rice straw and thorough weeding are important.

Transplanting

Transplanting is done 1 month after sowing. The rice field is prepared in the same way as the nursery. The seedlings are ready for transplanting when they have four or five leaves. Only strong and healthy seedlings should be used. The seedlings are cleaned from mud, the tips of the leaves are cut off, and they are tied into small bundles. This makes it easier to carry them.

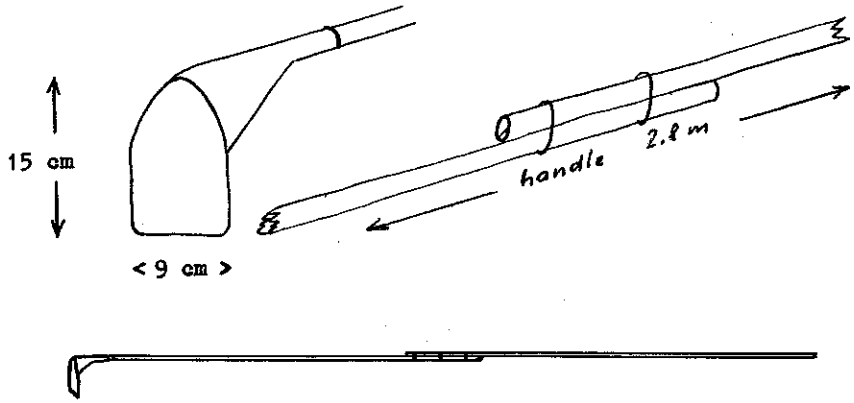
The seedlings must be transplanted into mud. Planting is done along straight lines which are 20 cm apart. The planting distance along the lines is 20 cm to 30 cm. Each time, 2 - 4 seedlings are planted together at one spot. 6 - 10 days after transplanting, all the seedlings should have taken proper root. Those that are dying off must be replaced.

Weeding

Two weeks after transplanting, the first weeding is necessary. Later on, weeding is done as the weeds

develop. Generally, if the rice field is kept well flooded, there will not be much need for weeding. But since rice is very vulnerable to weeds, careful weeding pays off by increasing the yield.

Special Weeding Hoe for Rice



adapted from R.T.C.Kumba, Annmual Report 1977

Applying Fertilizer

The application of fertilizer depends very much on the

type of soil, the nutrient content in the irrigation water, and how intensive the farming is. In a newly opened field it is certainly not necessary to use chemical fertilizers. The time when such fertilizer is needed can be found out by watching the yields over a few seasons. It is, however, very important to provide sufficiently fertile soil, because the labour input is the same whether the soil is poor or rich, but the harvest will be different. Economising on fertilizer when the natural soil fertility has gone down therefore means wasting human labour. Trials have shown that nitrogen is the most important fertilizer for rice production.

Two weeks after transplanting, when the rice field has been drained for weeding and replanting, fertilizer is applied at a rate of 100 kg of ammonium sulphate for every hectare of rice field. When the panicles are forming, the field is drained again and fertilizer is applied, this time at the rate of 50 kg of ammonium sulphate for every hectare.

Harvesting

It is difficult to know exactly when swamp rice is ready for harvesting. There are a few signs, however:

- The heads are yellow, although the stem and leaves might still be green.
- The grains are hard. They make a crunching noise when one bites them.

Harvesting too late might cause loss of yield since over-ripe grains will fall out before or during harvesting. Harvesting is done with a sickle after the field has been drained and left to dry for 1 to 2 weeks.

The harvested rice is tied into sheaves and kept stacked in the field to dry further. Threshing is done in the same way as for upland rice.
Swamp rice after harvest will yield one or two ratoon crops provided there is enough water and warmth. For a good ratoon crop the rice should be cut just above the roots. The ratoon crop will need 2 - 3 weeks less than the first crop to get ripe, and it may even give higher yields.

Yield

The average yield for the whole world is about 2.3 tons of paddy per hectare. But high yielding varieties can yield 6 - 10 tons/hectare under very good conditions. Experiments at R.T.C. Kumba point to yields above 4 tons per hectare.

Yields	Kg/Hectare Paddy	Hulled Rice
Very high from high yielding varieties	10.000	6.500
Medium from high yielding varieties	6.000	3.900
Yield at R.T.C. Kumba 1977	4.220	2.743
Total North West Province	1.760	1.144
World Average	2.300	1.495
Poor Yields	1.500 1.200 1.000	

Hulled rice = 65% of paddy
= 0.65 x paddy

Processing Paddy

Paddy rice is not yet ready for consumption. It must be hulled. The husks covering the rice grain must be removed. Hulling reduces the weight of rice considerably, at a rate of about 35%. The above table of yields shows how much hulled rice one can expect for given quantities of paddy. This, by the way, is the same for upland and swamp rice.
After hulling, rice is often polished. This makes the grains white and shiny but removes important foodstuff like proteins. Sometimes, you will find on the market parboiled rice. This means that the paddy has been boiled briefly and dried again. Parboiling protects the rice from breaking up when it is hulled and polished and improves the nutritional value of polished rice. Parboiled rice also needs less cooking than ordinary rice.

Other Uses of Rice

But it is not only the rice grains that are useful to man. The husks removed in the hulling process are used for fuel. The bran removed when the grains are polished can be used to feed domestic animals. The rice straw itself has several uses. Immediately after harvesting, the stems and leaves are still green and are therefore valuable food for cattle, sheep, and goats. When rice straw is completely dry it is very suitable for handicrafts, e.g. for weaving bags, mats, and hats. It can even be used for thatching houses.

Diseases

Blast: This is a fungus disease which is very common.

It is mostly found on the leaves although it may attack other parts of the plant. Small spots appear, turning grey or brown. The nodes and branches show dark rings, the heads lose their colour and do not develop. Plants infected in this way should be uprooted and burned.

Narrow brown leaf spot: Plants suffering from this fungus disease may lodge. All trash that shows signs of the disease should be burned.

Brown leaf spot: This disease affects the leaf, the leaf-sheat, and the husk of the grain. The disease can be transmitted through the seed. Seeds should therefore be disinfected before sowing.

Pests

Various borers attack the stems of the rice plants. They can be controlled to some extent by crop rotation. Also, certain bugs damage the stems, leaves, or ripening heads. Much damage is done by grain-eating birds, e.g. the weaver bird.

Improving the Rice Plant

Like maize, rice has received a lot of attention from scientists in order to improve such important features as yield, taste of the grains, resistance to pests and diseases, adjustment to different climatic conditions etc. The International Rice Research Institute (IRRI) in the Philippines has succeeded in breeding various so-called high yielding varieties which have been already mentioned in the text. They are very important since the world population is increasing, and in order to feed all of them, more food must be grown by farmers everywhere. Rice varieties from IRRI always have names starting with IR: IR32, IR42, IR442. But research on

rice (and on other crops) must and can be done in every country where the crop is grown. Only then can the best farming methods be found. Even school farms can be used for this purpose. Here is a report on a trial of a particular variety done by R.T.C., Kumba, taken from their annual report for 1977:

"Wet Paddy or Swamp Rice

Varieties:

Besides our normal varieties, IR 4-2 and IR 22, the following varieties were tried out: M.45; Tainan V; 1632; IR32; IR 34; IR 442. Out of these varieties only one was clearly disappointing: 1632. It had poor germination, the yield was lowest and the grains were difficult to thresh. The following results were obtained with the other varieties:

Variety	Theoretical resistance against disease	Theoretical time till maturity	Our own experience of the time needed from pregermination to harvest	Yield per ha in paddy
IR 4-2		130 days	130 days	4,800 kg
IR 22	sensible	130 days	136 days	4,600 kg
M. 45	resistant	120 days	116 days	4,000 kg
Tainan	sensible	120 days	122 days	5,500 kg
IR 32	resistant	150 days	164 days	5,700 kg
IR 34	resistant	135 days	153 days	5,100 kg
IR 442	sensible	135 days	139 days	6,000 kg

The figures on the yield must be taken with caution since some of the trials were only very small and none of them was repeated. New trials during the next season will have to show if the results can be confirmed.

Seed: Due to bad experience in the past we used double the quantity of seeds: for 100 m^2 of field we used 1 kg of seed which was sown in a nursery area of 4 m^2. All the seed was treated with Panogen 15 and pre-germinated before sowing. When transplanting 2-3 stems at distances of 20 x 20 cm we had a small surplus of seedlings.

Fertilizer: Fertilizer was given in two applications: The first, before transplanting, at a rate of 400 kg ha of 20-10-10 and the second about 6 weeks later at a rate of 200 kg per ha of 20-10-10. When transplanting is done in strips, it would probably be better to give the first fertilizer after transplanting and not before.

Planting in Strips and Weed Control: The rice was planted in strips of 4 m with a distance of 0.8 m between the strips. The single lines go across the strips. The strips were still of advantage when applying fertilizer and for the installation of bird scaring systems. The loss of area could be disregarded since the rice nearly covered these patches of ground when getting ripe.

Damage by fish: During and after transplanting the rice, the water level was unusually high and this allowed many fish from the nearby stream to enter the ricefield. These fish were observed feeding on the stems of the freshly transplanted rice and they destroyed completely two sections that were under deep water.

Damage by birds: Due to an intensive campaign at scaring the birds, the damage was estimated to be below 10%, which we consider to be a good result."

Note: Panogen 15 is a chemical used to desinfect seeds and other planting material.
20-10-10 is the short name for a compound chemical fertilizer combining 20 parts of nitrogen, 10 parts of phosphorus, and 10 parts of potassium.

TOOLS AND IMPLEMENTS USED WITH RICE

1. The Marker

The marker shown on page 34 is a tool used to mark lines or rows on a farm. It is like a rake but is of course much bigger. It can be made from Indian Bamboo or from raffia. Its use is not limited to marking rows for rice planting. It can be used for any crop whose rows are less than 50 cm apart. After tilling, the marker is pulled from one end to the other and replaces ropes in the marking of straight lines.

2. The Sickle

Sickles used to be unknown in Cameroon, and the one on the left of the illustration on page 35 is still not produced in the country but is imported from abroad. The sickle on the right can be bought in many markets in the North-West Province, but it usually has a shorter blade. It is produced by Cameroonian blacksmiths.

One might ask why people do not use the cutlass which usually serves very well when used to cut grass. The answer is simple if we remember that ripe paddy grains tend to fall off the panicles very easily. Using the cutlass on rice would result in heavy losses because many grains would fall to the ground. It is better to grasp a handful of rice plants, hold them firmly so that they do not shake, and then cut. A cutlass would be too heavy and too long for this kind of work.

3. The Threshing Box and Threshing Trestle

They are shown in the illustrations on page 56

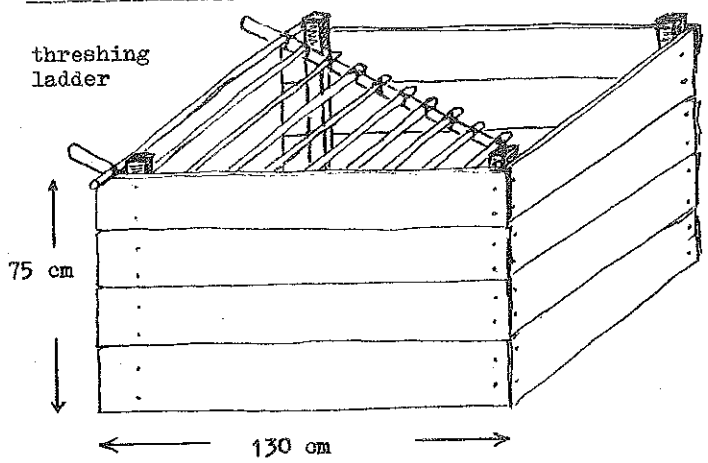
They can be made entirely from local material, using planks, bamboo, raffia, old bags, plastic sheets, mats, or whatever is available. The measurements given are examples only, they can be modified in order to suit the people using them. The main piece is a wooden grille against which the rice heads are beaten. The grains fall off. In order to prevent the grains from spreading over a large are, the grille is surrounded by some kind of wall or screen. This keeps the grains just below the grille where they can be removed very easily.

4. The Rice Thresher

The rice thresher is a small machine. The one shown in the illustration is operated by a man or woman, just like a sewing machine. But the same model could easily be operated by a small engine. Inside the thresher there is a drum which keeps turning. On the drum there are many small loops made from wire. The man threshing the rice starts turning the drum and feeds a good handful of rice into the thresher, heads on to the drum. As the loops brush through the rice heads, they quickly remove the grains.

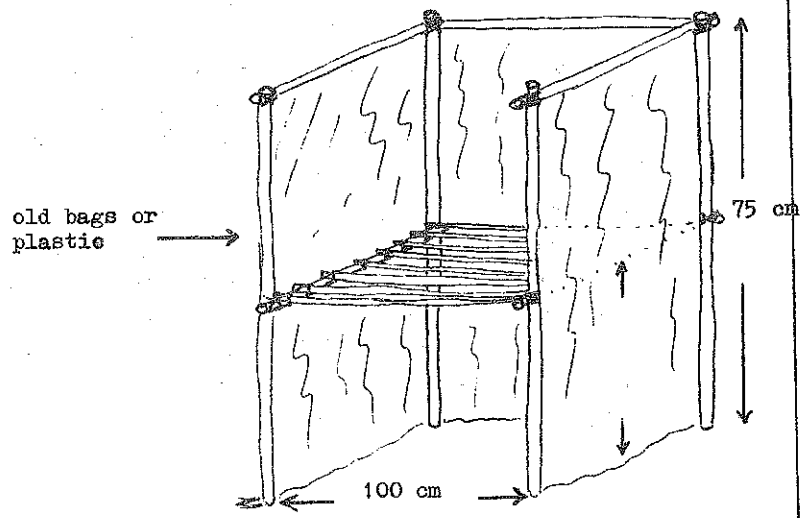
The thresher is expensive, however. Also, threshing is not much faster than using a threshing box or threshing trestle. Experience at WADA (Wum) has shown that one person alone finds it difficult to operate the thresher and keep feeding in the rice to be threshed. Two people are needed. As a consequence, the rice thresher is hardly ever used in the North West Province.

Threshing Box With Threshing Ladder



adapted from R.T.C. Kumba, Rice-a short introduction...

Threshing Trestle



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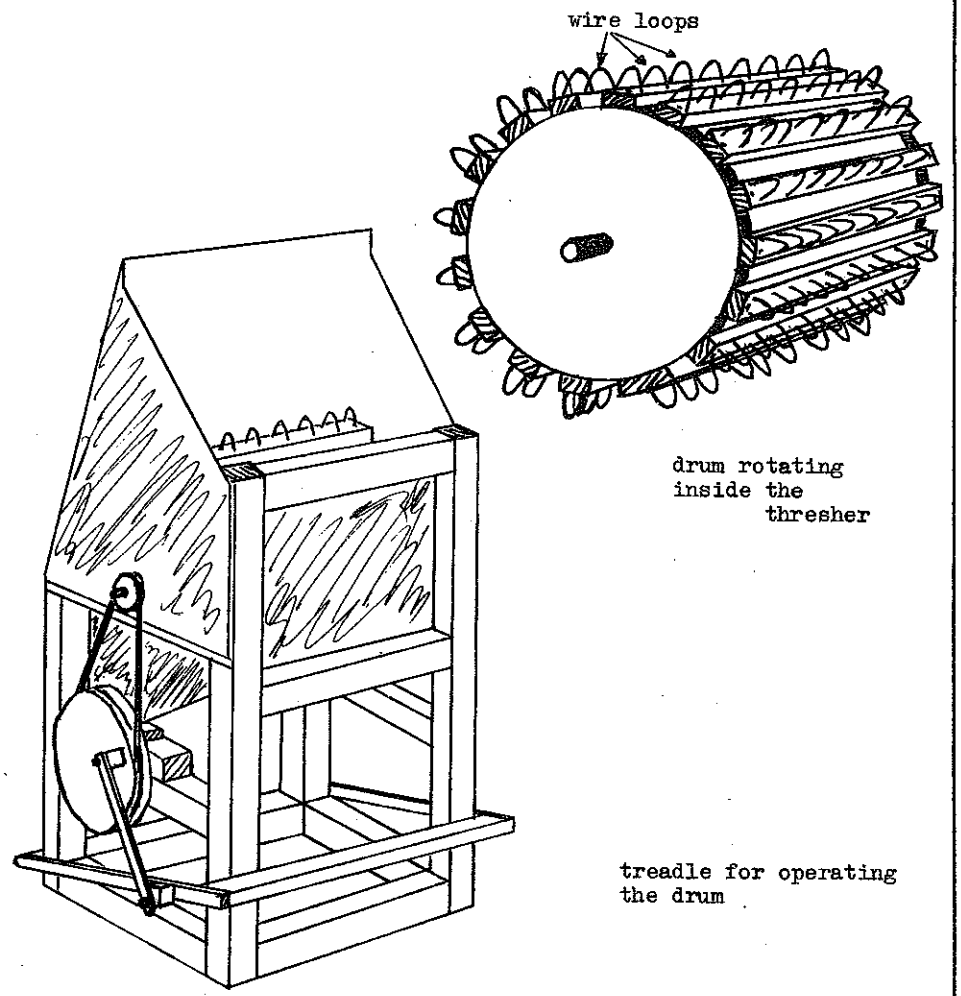
Rice Thresher



Guineacorn

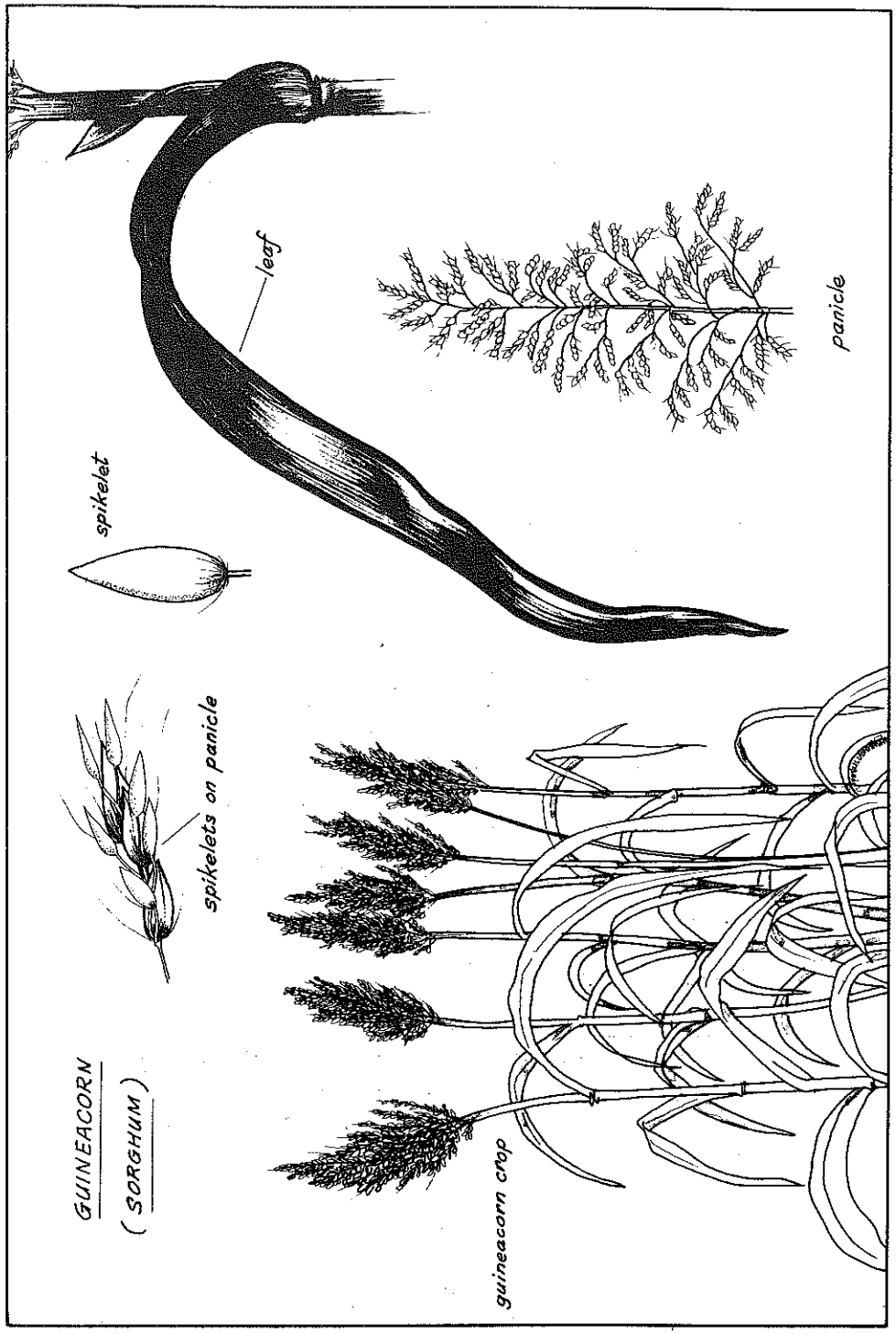
Guineacorn belongs to the sorghum family. It is a very tall cereal, easily reaching 3 - 6 m in height. Like rice, it is a biennial plant so that ratooning is possible: when the stem is cut, at harvesting, the the root will grow another shoot which is likely to produce as well as the first one. Guineacorn develops one big panicle. Since it grows very tall, it also develops adventitious or prop roots. The main rooting system reaches down deeper than maize roots. Therefore, guineacorn resists drought much better than maize. When a drought becomes very severe, the plant stops growing. As soon as there is sufficient water, it starts growing again.
Like maize, guineacorn does not tiller. According to the particular variety and climatic conditions, its growth cycle is between 90 and 200 days. After flowering, it takes 35 - 70 days to come to full maturity. At flowering, both self- and cross-pollination occur.

Origin

Guineacorn and the other varieties of sorghum are truly African plants. West Africa, Ethiopia, East and South Africa are said to be the home of the sorghum family.

Guineacorn in Cameroon

Guineacorn was the staple food in the grassland areas of Cameroon before it was replaced by maize. Visitors to the Queen Mother at the court of the Fon of Bali will notice a few guineacorn plants in her compound. North of Bamenda it is still grown in relatively large quantities, e.g. in the Kom and Belo area, and also



in some areas in Bui division. It is invariably grown in multiple cropping together with cowpeas or maize.

Farming

Requirements: Guineacorn adapts itself to a great variety of different soils. It accepts heavy soils which crack under the heat, it even tolerates a certain amount of acidity and salt. As mentioned above, it can do with a little bit of water. It can grow in areas with 375 to 1000 mm of rainfall per year. The optimum rainfall is 500 to 600 mm. For a short time it can endure waterlogging of 25 - 30°C, the best temperature for growth and high yields seems to be 27 - 28°C. It tolerates very high temperatures better than any other cereal and is therefore very well adapted to conditions in semi-acid climates.
Its nutrient requirements are very high, but as its root system is very efficient, it grows on poor soils. It can easily be included in a crop rotation. In forest zones it could be grown after clearing. But in savannah areas, where grasses are left to rot after clearing, it might not do well in the first year after clearing. The reason is that the decaying grass absorbs too much soil nitrogen which will be released afterwards but will not be available when the first year crop needs it most.

Tilling is done in the same way as for maize.

Sowing/Planting: Guineacorn is planted during the first rains. Planting distances vary widely according to soil and climatic conditions. The following table gives an idea of various spacings, assuming planting in rows:

Distance between rows	Distance in rows	Plant Population per hectare
25 cm	20 cm	200.000
25 cm	6 cm	660.000
90 cm	20 cm	55.000
110 cm	60 cm	15.000
60 cm	20 cm	83.000

Guineacorn seeds are planted at a depth of 2.5 to 5 cm. Depending on the planting density one would need 5 to 15 kg of seed per hectare. In some areas, e.g. in North Cameroon, young shoots are transplanted after germination.

Weeding must be done early. Guineacorn does not do well if there is competition from weeds during the early growth period.

Earthing up is recommended since it stimulates the growth of adventitious roots.
Guineacorn is likely to suffer from nitrogen deficiency. Fertilization with up to 150 kg of nitrogen per hectare might be necessary, especially in the case of improved varieties. Two thirds of this quantity should be given at planting time, one third when the plants flower.
The average yield in Africa is about 730 kg per hectare; the world average stands at 1.200 kg per hectare. In Italy, an average production of 4.400 kg per hectare is achieved, and the highest yields recorded are around 20 tons per hectare.

Pests and Diseases

Guineacorn suffers from the same diseases and pests as maize. It is heavily attacked by smuts, less severely by rust. Stem borers are a problem, but

weevils do more damage. Birds are the main enemies of guineacorn. When the grains get ripe, people take turns to scaring off the birds in order to reduce losses.

Improvement

Like the other cereals, guineacorn can be improved by breeding. High yielding varieties with shorter stems and an even higher tolerance towards drought and flooding have been developed.

Guineacorn Production

Guineacorn and other varieties of sorghum are produced in relatively large quantities in Africa:

Nigeria:	3.6 million tons in 1972
Sudan	1.4 million tons in 1972
Total Africa:	8.9 million tons in 1972

ROOT AND TUBER CROPS

Root and tuber crops are the main food of about 400 million people living in the tropics. In Africa, they provide about one third of all food. Root and tuber crops have not been improved much by selection and breeding. There is still much scope for improvement. Already now they yield as well as most cereals or grain legumes farmed in the humid lowland tropics, especially in the forest zones. Botanically, they belong to a number of different plant families. They all have underground organs, i.e. parts of the plant for storing energy in the form of starch, sometimes sugar. These storage organs may be swellings on the roots (cassava), whole underground stems or stem tubers (cocoyam and xanthosoma where they are called corms and cormels) or a portion of the underground stem as in the case of yams and Irish potatoes.
The edible roots and tubers contain much starch, little protein, hardly any fat, few vitamins, and much water. Cassava is particularly poor in protein, and if it is used as the main staple food, people may well suffer from lack of protein. On the other hand, cassava leaves are very rich in protein so that a diet consisting of garri and cassava leaf soup comes close to being a balanced diet, at least as far as starch and protein are concerned.

> "Cereals contain a little more protein than most tuber crops, but in every other aspect of food quality tuber crops are superior to cereals."
>
> (Westphal, E., 1978, p. 17)

Yams and Irish potatoes especially produce as much protein as some cereals.

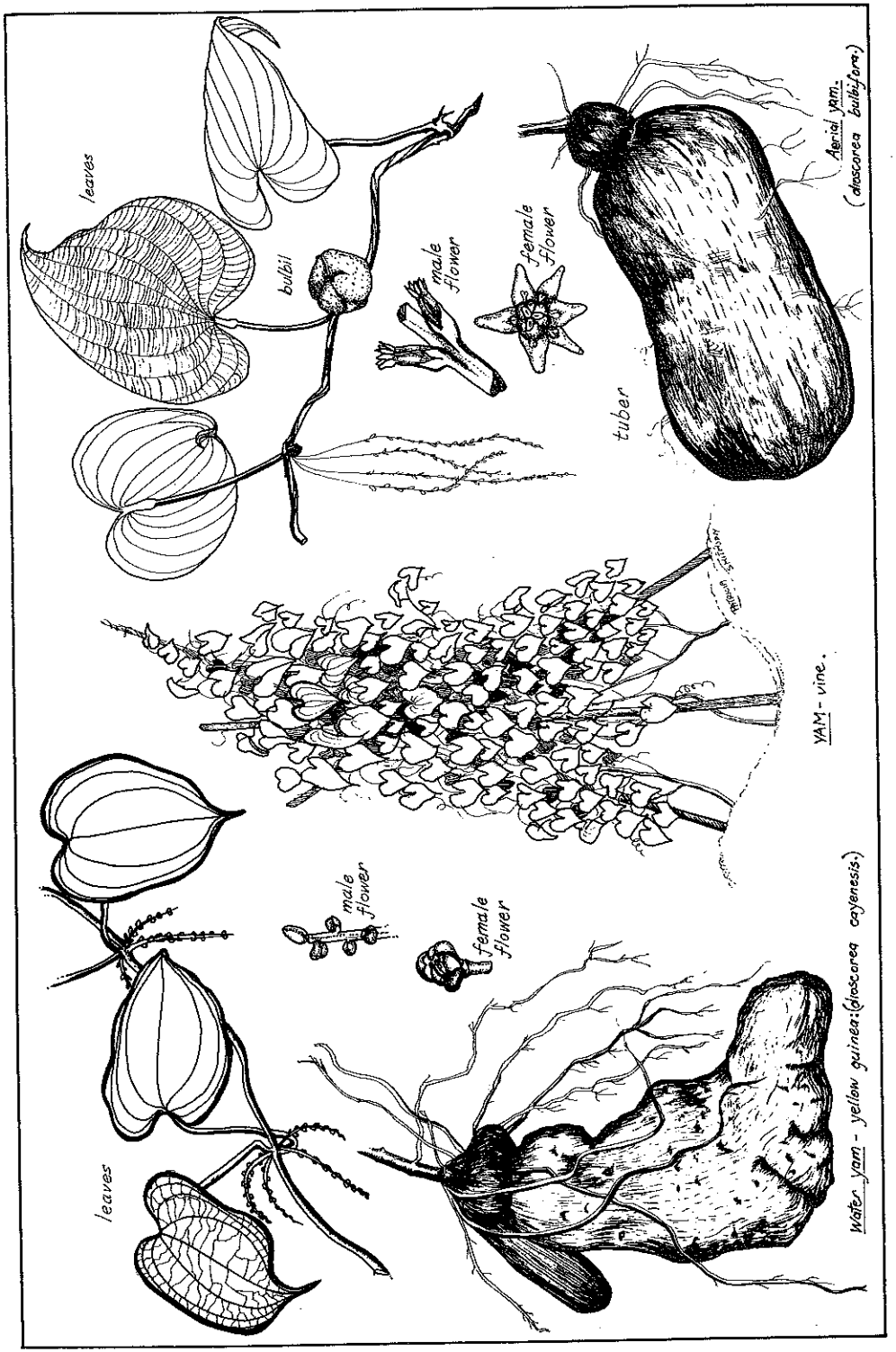
Information on the farming of root and tuber crops is scanty. Most of them have not been subjected to intensive farming on scientific lines. Apart form traditional farming methods, there are a few rules of thumb that teachers will have to develop.

Yams

Yams belong to the forest fringes and the open savannahs rather than the more humid areas, although there are varieties that are very well adapted to high humidity. There are very many cultivated varieties. In Eastern Nigeria and in many parts of Cameroon, yams are appreciated as high quality food and fetch good prices.

The Plant

The yam is a climbing plant. Its root system is rather weak. The yam tubers are large underground stems varying in number, size, and form according to the variety. There are "eyes" on the tubers, buds from which shoots grow when the right conditions prevail. Some varieties produce one tuber, others two or three. Some tubers are round and long, others may branch out and take curious shapes. If the yam is not harvested it is a perennial plant. The stem dies off at the end of each growing season, which created the impression of the yam being an annual plant. But the tuber lives on and grows a new stem during the next year. Yams climb by turning round a support. The stem itself is too weak to stand on its own. The leaves often have the shape of a heart and are compound leaves with three smaller leaves making up the total leaf. Yams are usually propagated vegetatively, i.e. by tubers or tuber cuttings. Therefore, people do not pay much attention to yam plowers. However, the plants produce male and female flowers seperately. But whereas in the case of maize the two types of flowers are on the same plant, in the case of yams they are on different plants. They are only important when it comes to breeding



improved varieties. This can best be done by cross-pollinating plants with different characteristics.

Origin

The origin of the yam is in Asia, Africa, and the Carribean islands. The yellow Guinea yam originated in West Africa, together with the white Guinea yam. The three-leaved or bitter yam, also called cluster yam, likewise originates from Africa. The aerial yam or potato yam has its origins both in Africa and Asia, and the water yam, also called ten months yam is an Asian plant.

Yam Growing in Cameroon

Yams are grown in the southern and western parts of Cameroon and to the north of Ngaoundere, in the Northern Province. Varieties grown are:

1. White Yam (eight-months yam): it has white or cream flesh, stores well and produces high yields. It matures 8 months after planting. The variety "Oshie White" is the best one for eating because of its high protein content. But it tends to develop branches on the tuber. Thus, peeling is more difficult and results in more wastage than with other varieties.
   The Bonakanda variety grown on the slopes of Mount Cameroon also has white flesh and is well adapted to the local conditions.
2. Yellow Yam (Twelve-months yam): It has yellow flesh and matures only 12 months after planting. It does not store well nor does it produce high yields. If continually tapped it grows for as long as 3 years.

In Cameroon, the variety "Batibö Yellow" is farmed In the North-West Province, it is preferred to the white varieties.

3. Water Yam (Ten-months yam): It has white, red, or purple flesh which is very soft because of its high water content. Its storage qualities are poor.
4. Three-Leaved Yam (bitter yam): It has yellow, white or pink flesh of poor quality, but it produces high yields. Its leaves are prickly with three little leaves and the stem climbs clockwise.
5. Aerial Yam (potato yam or air potato): It does not develop tubers but bulbils that grow in the axils of the leaves or underground. It is of relatively poor quality and is not widely grown, but it stores well.
6. Chinese Yam (lesser yam): This yam produces very small tubers with pale-yellow smooth skin that resemble sweet potatoes. It does not store well and matures in 12 months. Its stem is prickly and climbs clockwise. It grows best in dry, open areas.

Farming is done according to traditional methods under the system of multiple cropping. For details see the section on Traditional Farming. Only on school farms are yams farmed in single cropping since they represent one of the most important school crops.

Farming

Requirements: Yams need a deep, well drained soil. The best soil is sandy loam. If the soil is too heavy, the

tubers may start to rot in the ground. There are varieties adapted to dry conditions (600 mm rainfall per year) and to very wet conditions (3000 mm annual rainfall). Usually the varieties grown locally are adapted to the local climate unless they have been recently introduced. The white yam needs an annual rainfall of 1000 to 1500 mm evenly distributed over 6 - 7 months. Yam grow best at temperatures around 30°C. Frost will kill them, and if the temperature falls below 20°C, their growth is slowed down. This is the case in much of Bui Highland and in areas around Nkambe.
Of all the root and tuber crops yams need the most labour.

For planting, small tubers (seed yams) or parts of larger tubers (setts) are used. If setts are used, tops are preferable. Setts weighing 500 g give the best yields with Oshie White. Other varieties grow on setts weighing 250 to 300g. Setts are planted with the cut part pointing upwards and the eyes downwards. After planting, the setts should be covered or "capped" by a layer of dry grass about 2 - 3cm thick on top of the soil. This has the usual advantages of mulching. Planting holes should be 50cm deep and 60 x 60cm large. They should be filled with rich surface soil or manure. Yams are usually planted on mounds or ridges and only occasionally on the flat. Recommended distances are

Distance between rows	Distance on rows	area per plant	plant population per hectare
2 m	70cm	1.4 m^2	7,140
1.2 m	1.2 m	1.44 m^2	6,900
1.2 m	90 cm	1.08 m^2	9,260
1.8 m	60 cm	1.08 m^2	9,260

There are two planting times. Early planting is done in November if the soil has retained enough water to allow germination and growth during dry season. Late planting is done in February and March.

Staking allows the plant to develop more leaves than if no stakes are used. With more leaves the plant produces more starch and the tubers grow bigger. Stakes or "poles" should be put as near to the yam plant as possible. A strong stake, 2 - 2.5m high, takes up to four yams. Young vines are guided in the direction of the stake, usually along stalks of maize or dry grass. Cluster yams are not staked.

Weeding is done occasionally during the rains.

Hilling or earthing up becomes necessary when the upper part of the yam tuber is no longer covered with soil.

Manuring depends very much on local soil characteristics. No general indications can be given. On old farms or on sandy soil it would be good to put some compost manure in the planting holes. Chemical fertilizer should be applied when the shoots are about half a meter tall, about six to seven weeks after germination. Chemical fertilizer is applied in a ring around the plant and must not touch it directly, otherwise it might burn the yam. One or two matchboxes full for every plant would be about the right quantity.

Harvesting can be done twice. About six months after planting, the yams may be tapped. The tuber is cut so that the top remains attached to the stem. When the top is put back into the soil, it usually produces a number of smaller tubers which can be used as seed yams. The main harvest is done towards the end of the growth cycle, when the tubers are completely

ripe. This is the case when the leaves begin to turn yellow.
Since damaged tubers do not store well, harvesting must be done very carefully.

Yields vary a lot. Here are a few figures:

3.5 tons/hectare	smallholders in Cameroon
7.5 tons/hectare	African average
9.33 tons/hectare	World average
20 tons/hectare	good yield on well prepared and fertilized soil
30 - 35 tons/hectare	yields from high yielding varieties.
70 tons/hectare	highest yield recorded

Storage

The folloing rules should be applied when storing yams (for details see section on crop storage):

- Do not store direcly on the floor. This then allows air to pass freely and prevents moisture from damaging the tubers.
- Tubers should not touch each other so as to reduce the risk of mutual infection.
- Do not expose tubers directly to light, or else they might start sprouting too early.

Methods in keeping with these rules are:

1) packing tubers in ashes and covering them with soil,
2) covering them with soil and a grass mulch,
3) suspending yam tubers from branches which shade them,
4) tying them to a framework of poles,
5) putting them on rafters in a barn.

Pests and Diseases

The yam beetle attacks the tubers. No other serious pest is known. Wilting leaves or black-brown spots on leaves are caused by anthracnose. The affected leaves should be removed and destroyed as soon as possible.

Plant Improvement

Improvement by breeding and selection is difficult with yams because the flowers rarely produce seeds which germinate. The IITA (International Institute for Tropical Agriculture) at Ibadan has made some promising steps into the right direction, however.

Cassava

Cassava farming is on the increase in West Africa. In many areas it gradually replaces yam as the staple food. Yet, it is extremely low in protein content and may lead to protein deficiencies if the daily food is not supplied with protein from other sources. The main producer countries are Brazil, countries in West Africa, Indonesia, Malagasy, Southern India, and Thailand.

The Cassava Plant

Cassava is a perennial plant growing to between 1 and 5 m tall. All its parts contain latex, a white liquid that forms an elastic cover when it dries. It has a relatively deep rooting system with feeder roots going down to a depth of 40 to 80 cm. Some of the adventitious roots start swelling and store starch. 5 to 10 such root tubers may grow on a cassava plant. The stem shows very pronounced leaf scars. The leaves are divided and look vaguely like a hand with the fingers spread out. Cassava flowers are small and light green in colour. They produce seeds. But since cassava is propagated vegetatively from stem cuttings, farmers do not pay any attention to flowers and seeds. Depending on the variety, the tubers reach a length of 15 to 100 cm. They are covered with a hard skin whidh has to be peeled before they can be prepared. All varieties of cassava contain a certain poison which must be washed out by soaking or destroyed by fermentation or boiling.

Origin

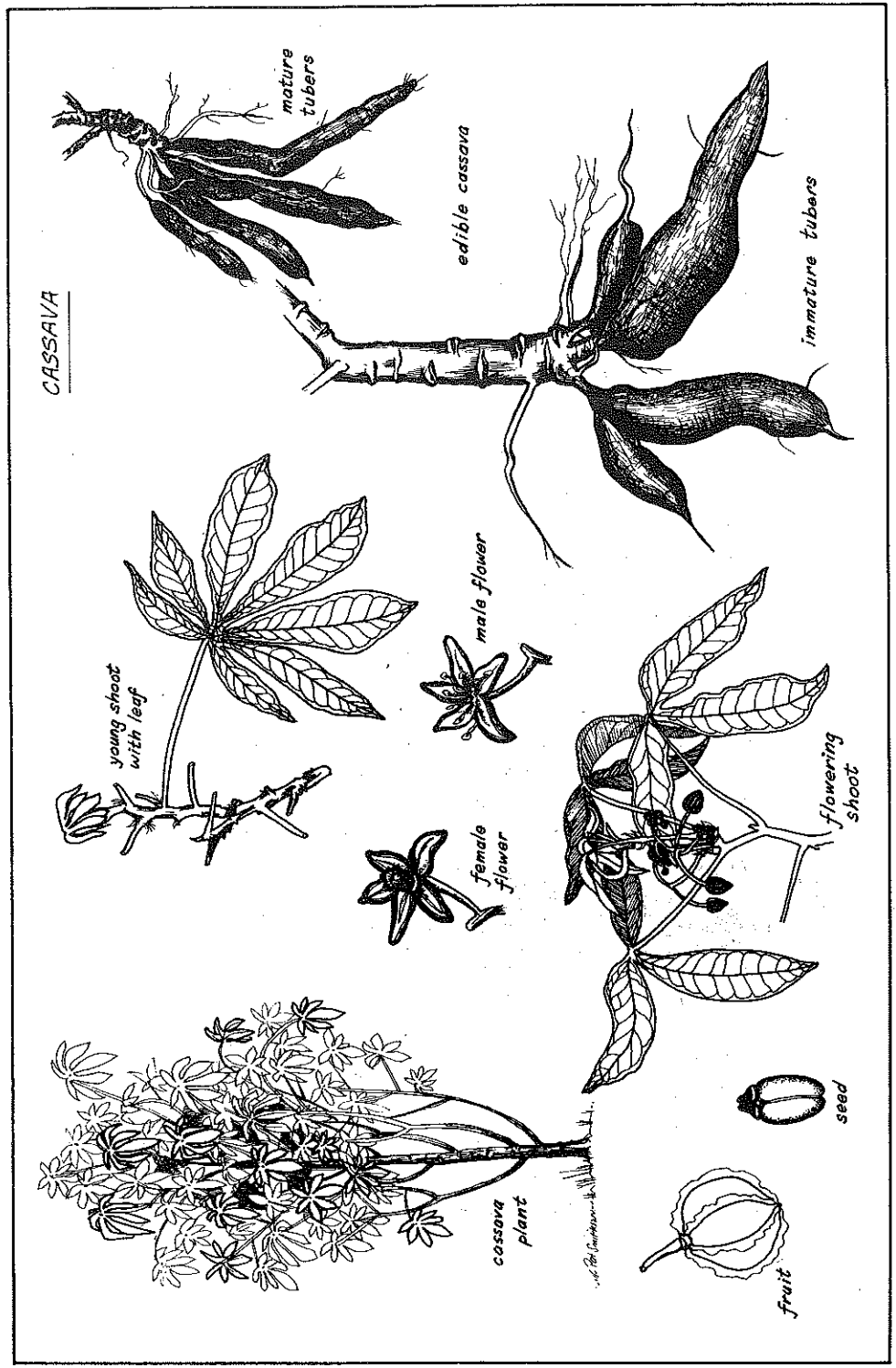
Cassava has its origin in South America from where it has spread to all other tropical regions.

Cassava in Cameroon

Cassava is very common in the southern and western parts of Cameroon. It is grown extensively along the coast where it is processed into garri and sold to the fishermen. But it is common throughout the anglophone provinces, as can be seen from the cropping patterns. Very often it remains as the last crop in a cropping sequence when the soil is already too exhausted to produce anything else.
It is normally grown in multiple cropping, but towards the end of a crop sequence it is grown as a single crop after all the other crops have been harvested. Also, along the coast there is a tendency to farm cassava as a single crop.

Cassava Farming

The crop grows best on sandy loams but does well on all other types of soil if they are well drained, allow the roots to penetrate deeply, and are not too stony. Even poor soils are acceptable if the roots can penetrate deep enough.
It is suited to rather dry conditions with 500 mm of annual rainfall as well as to very humid climates with a rainfall of 2 500 mm per year. It does best with an annual rainfall of 1 000 to 1 500 mm. Because of its well developed roots it can withstand lengthy periods of drought.



It needs an average annual temperature of 25 - 29°C. It is therefore unsuitable for areas where temperatures fall below 10°C or rise for long periods above 30°C. Areas higher than 1 400 m above sea level are definitely not suited for cassava growing.

Tilling is the same as for other crops.

For planting, stem cuttings are used. These cuttings should be 20 - 30 cm long with at least three buds. They ought to be selected from the lower or middle part of the stem. Plants must be 10 months old at least before they can be used for propagation. Stems from plants suffering from a cassava disease must not be used for planting.
According to local circumstances, cassava is planted on the flat, on mounds, or on ridges. Where the soil is poorly drained, ridges or mounds are required. The cuttings may be planted upright, horizontal, or at an angle. None of these methods so far has shown a definite advantage over the others.
The following are planting distances with their corresponding densities (plant population)

Distance between rows	Distance in rows	Area per plant	Plant Population per Ha
60 cm	60 cm	0.36 m^2	27,800
80 cm	80 cm	0.64 m^2	15,625
120 cm	75 cm	0.90 m^2	11,100
140 cm	140 cm	1.96 m^2	5,100
150 cm	150 cm	2.25 m^2	4,450

The planting distance depends again on soil fertility

and the availability of water.
The best planting time is the beginning of the rainy season.

Weeding is necessary during the early growth period. During the first four months, a cassava farm should be weeded twice. Afterwards, cassava forms such a dense canopy that weed growth is negligible.
Harvesting starts 6 months, ten months or even two years after planting, depending on the cassava variety. Sort-season cassava, if availble, would be an interesting school farm crop. Cassava tubers do not store well when harvested. But they can be left in the ground for a prolonged period of time, usually double the time that they needed to get ripe. If they are left too long, however, they develop fibres and connot be eaten any more. Harvesting is done by hand. Even in commercial cassava plantations, ploughs or other implements are rarely used for harvesting.
Yields depend very much on careful crop husbandry and good planting material.

5 tons/hectare	low average yields
9 tons/hectare	world average yield
30 - 40 tons/hectare	average on commercial farms and plantations
100 tons/hectare	highest yields recorded

Processing

Since cassava tubers start rotting immediately after harvest, they have to be stored in the soil again or must be processed. They are turned into garri or into a white powder.

Pests and Diseases

African mosaic disease and cassava bacterial blight are the most important diseases affecting cassava. Mites and nematodes cause serious damage.

Improvement

Attempts at improving cassava through breeding and selection are under way, especially in Latin America. The main aim is to make cassava varieties resistant to virus diseases.

Sweet Potato

The Plant

The sweet potato is a herb with trailing or twining stems. They grow 1 - 5 m long and spread out over the ground. It is a perennial herb if left undisturbed, but it is cultivated as an annual crop, i.e. replanted after every harvest. Like cassava, it has latex in all its parts. From the nodes of the stem adventitious root systems grow out, so that one plant is fixed to the ground at several points. Some of these adventitious roots thicken and turn into tubers. The root system is shallow. These tubers have white, yellow, orang, red, purple or brown skin, the flesh may be white, yellow, orange, reddish or purple. The leaves have a number of different shapes. The flowers are in the form of a funnel, and are purplish in colour. Sweet potatoes produce fruits with seeds but these are not used for propagation by farmers.
In West Africa there are three main varieties in use, one with white skin and flesh and a rather sweet taste, one with red skin and creamy flesh,and one variety with yellow flesh. The tubers are ready 3 - 8 months after planting which makes them attractive as a school farm crop.

Origin

Sweet potatoes originated in the tropical areas of South America. Nowadays they are of particular importance in Asia (Japan, Taiwan, Indonesia, Korea, India). Brazil is also a main producer.

Sweet Potatoes in Cameroon

Sweet potatoes do not count among the most popular food crops. They are cultivated in large quantities only in the extreme North of the country. In the South West Province they are grown in less than half of all communities, whereas in the North West Province, they are grown in most communities. However, they seem to supplement the habitual staple food rather than to be the staple food itself.

Farming

The crop needs sandy soils with a lot of organic matter. Good drainage is important since the plant does not like being waterlogged. It thrives best with an annual rainfall of 750 to 1250 mm so that it is not adapted to the very wet conditions of the forest zones, e.g. on the southern and eastern slopes of Mount Cameroon. The best temperature for sweet potatoes is an average of 24°C. Cool weather slows down plant growth, and at temperatures below 10°C the plant is damaged. It likes sunshine from a slightly hazy sky.

Planting is done using stem cuttings about 20 - 45 cm long. In some areas, the tubers are used for propagation but this is not widespread in Cameroon. Planting is done on ridges or mounds. The mounds or ridges should be 60 cm apart, the distance between plants in the rows/ridges is 22 - 30 cm. As long as there is sufficient moisture in the soil for the plants to get established, they can be planted. Sweet potatoes quickly form a very dense soil cover so that weeds are effectively suppressed and weeding is unnecessary. This means that between planting

and harvesting there is no work to be done. Harvest can start when the leaves turn yellow and begin to drop. Another sign of maturity is that the latex of a tuber no longer turns black rapidly. When digging up the tubers, great care must be taken not to damage them since they easily get infected by fungus.

Yields

3 tons/hectare	low yield
8.8 tons/hectare	world average
20 tons/hectare	satisfactory yield
40 - 50 tons/hectare	exceptionally high yield

Storage

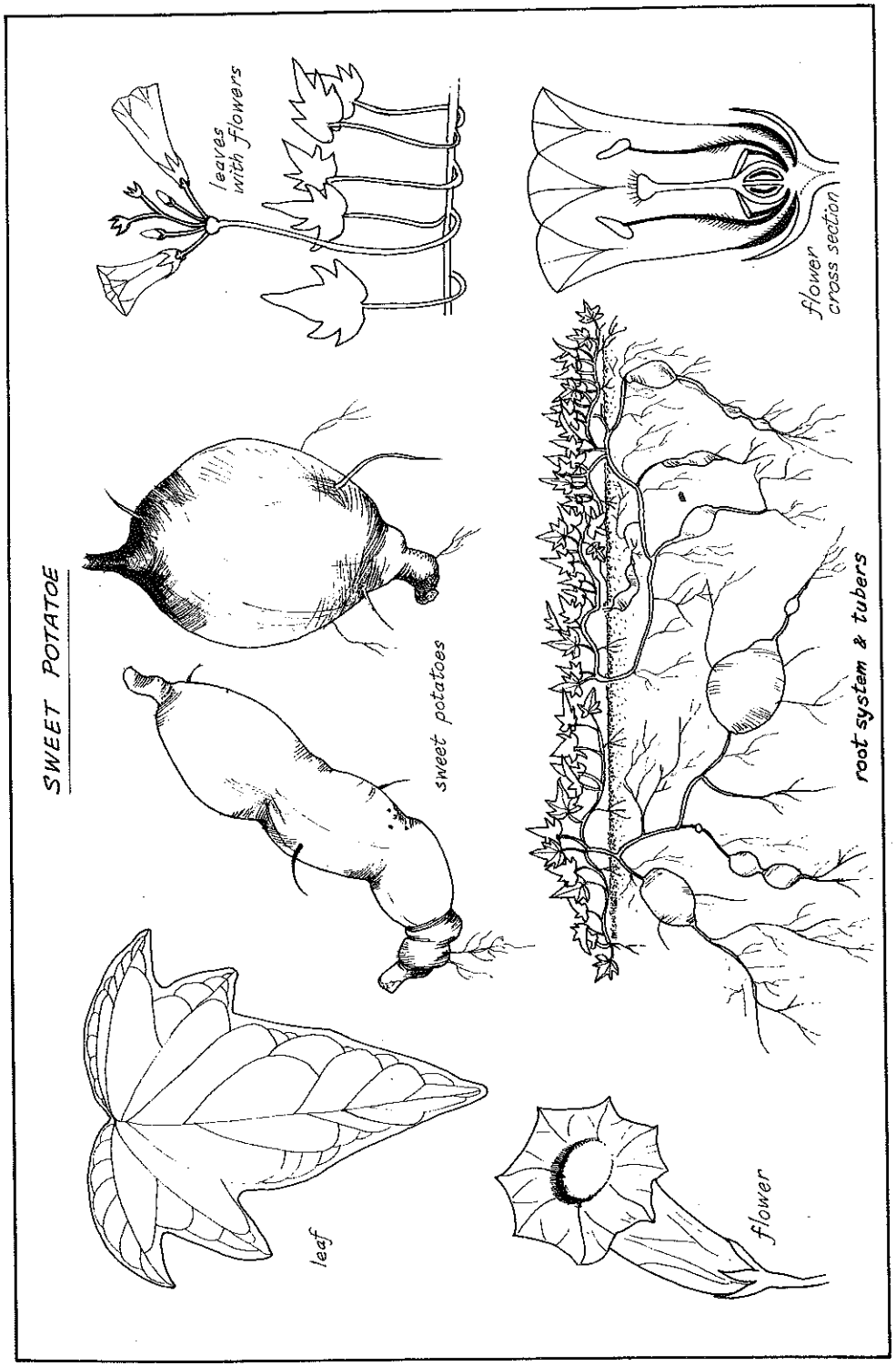
Storage is difficult. In native stores (baskets under the roof, etc.) they may last up to four weeks but no longer. On the other hand, the tubers can safely be left in the ground for some time after they are ready for harvest.

Pests and Diseases

Black rot in the stems and soft rot in the tubers during storage, together with virus diseases, are the most important diseases. Various weevils, moths, and nematodes also attack the sweet potato.

Plant Improvement

Especially in the U.S.A. the plant has been greatly improved.



Colocasia and Xanthosoma

These two crops look similar and produce similar tubers. We shall therefore treat them together. To the Cameroonian reader, they are more familiar under different names:
Colocasia is known as cocoyam or taro, Xanthosoma is known as new cocoyam, mamicoco (Pidgin), or macabo, in other countries as tania.

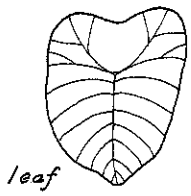
The Plants

Colocasia is a herb, some varieties are annuals, others are perennial. It grows up to a height of 1 - 2 m and develops a stem tuber, the corm. The corm is cylindrical in shape and has short internodes. It may develop a few small side tubers. Some varieties have a substance in their tubers which irritates the throat so that swallowing becomes difficult. The leaves are large, their shape vaguely resembling African hoe. The plant may produce a flower if left growing for long enough (see illustration). But since colocasia is propagated vegetatively, the flowers and seeds are of no importance.
Xanthosoma is an annual herb reaching a height of 2 m or more. Its corm is shaped like a flask and bears 10 or more side tubers called cormels. The leaves are large, growing on a strong stem, and resemble an arrowhead. The flower looks much like that of colocasia.

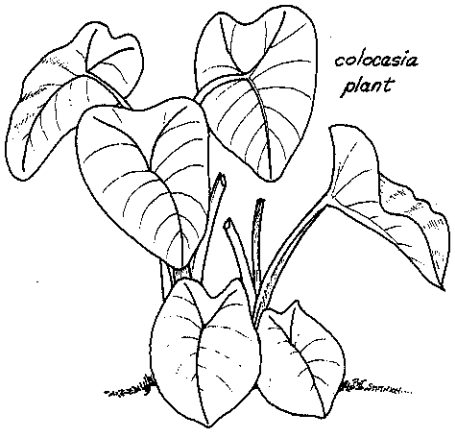
Origin and Areas of Cultivation

Colocasia (cocoyam) comes from Asia, Xanthosoma (mamicoco) originated in South America. Cocoyams are mainly grown in Nigeria, Ghana, Cameroon, and Ivory Coast,

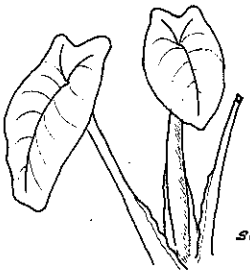
COLOCASIA – (TARO)



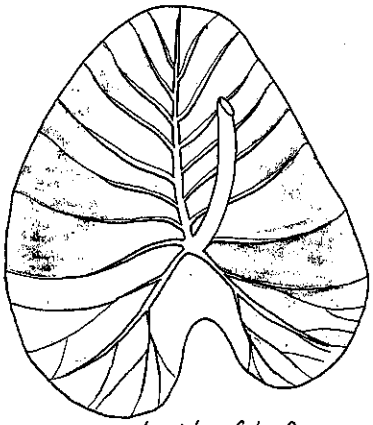
leaf



colocasia plant



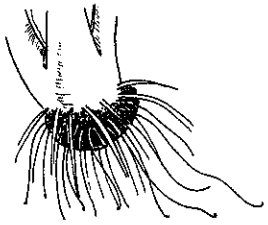
stalks



underside of leaf

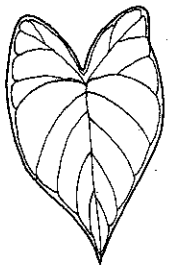
flower

edible colocasia

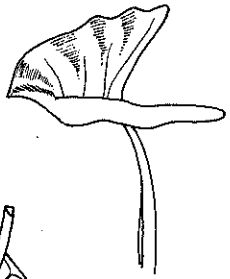


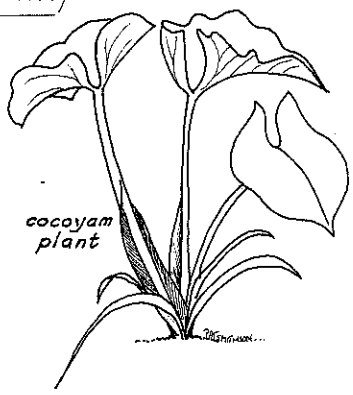
roots

COCOYAM – (TANNIA)

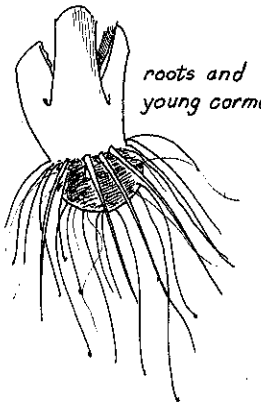


leaf

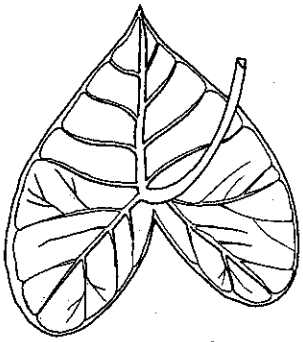




cocoyam plant



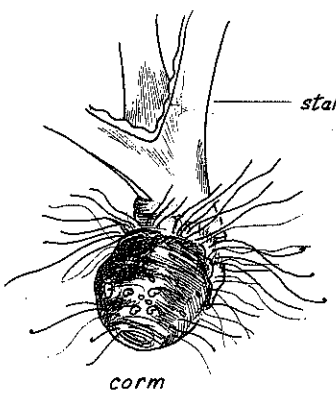
roots and young cormels



underside of leaf

mature cormels

flower



stalk

corm

whereas Xanthosoma is more common in South America and the Carribean islands than in West Africa.

Colocasia and Xanthosoma in Cameroon

Both crops are grown extensively in Cameroon, in some areas they are the staple food. Xanthosoma is frequently grown in the more humid forest areas of Cameroon, while cocoyams are more common in the drier areas, e.g. the North West Province grasslands.
Cameroonian farmers grow varieties of both cocoyam and mamicoco with red tubers and varieties with white tubers.

Farming

Colocasia prefers deep, well-drained, friable loamy soils and does not mind being waterlogged. Xanthosoma does well on a variety of soils but not on pure sandy soil or hard clay. It cannot cope with waterlogging.
Colocasia does well in areas with an annual rainfall of 1750 - 2500 mm. Xanthosoma is suited to much more rain but will still thrive with as little as 1000 mm of rain. The best temperature for cocoyams lies between 21 and 27°C. Xanthosoma adapts to a wider range of temperatures (13 - 29°C). Both plants are forest plants rather than savannah plants. They do well under shade.

For planting, corms or cormels are used. Pieces of corms or cormels are planted at a depth of about 10 cm. Often, planting is done on mounds or ridges. Planting distances are

for Colocaia	for Xanthosoma
30 x 30 cm (very wet farms)	60 x 60 cm
60 x 60 cm average spacing	90 x 90 cm (West African habit)
90 x 90 cm (areas with very high rainfall)	180 x 180 cm

Planting time is at the beginning of the rainy season. Both crops are usually grown under the system of multiple cropping. Since they do not mind shade, they can do well on tree crop farms, especially with coffee and young cocoa.

Weeding is necessary only in the early stages of growth.

Colocasia harvesting starts six to 18 months after planting, depending on the variety grown. Xanthosoma is ready 12 months after planting at the latest, and early varieties are ready after six months. Xanthosoma would seem to be better suited for school farm work than cocoyams. Both crops are ready when the leaves start turning yellow. They are then dug up and stored.

Yields

	Colocasia	Xanthosoma
average	5 - 20 tons/hectare	5 - 20 tons/hectare
maximum	75 tons/hectare	70 tons/hectare

Pests and Diseases

Colocasia suffers from leaf blight, various leaf spot diseases, soft rot and tuber rot. A number of insects attack the crop, mostly the leaves. Xanthosoma suffers much less from pests and diseases.

TREE CROPS

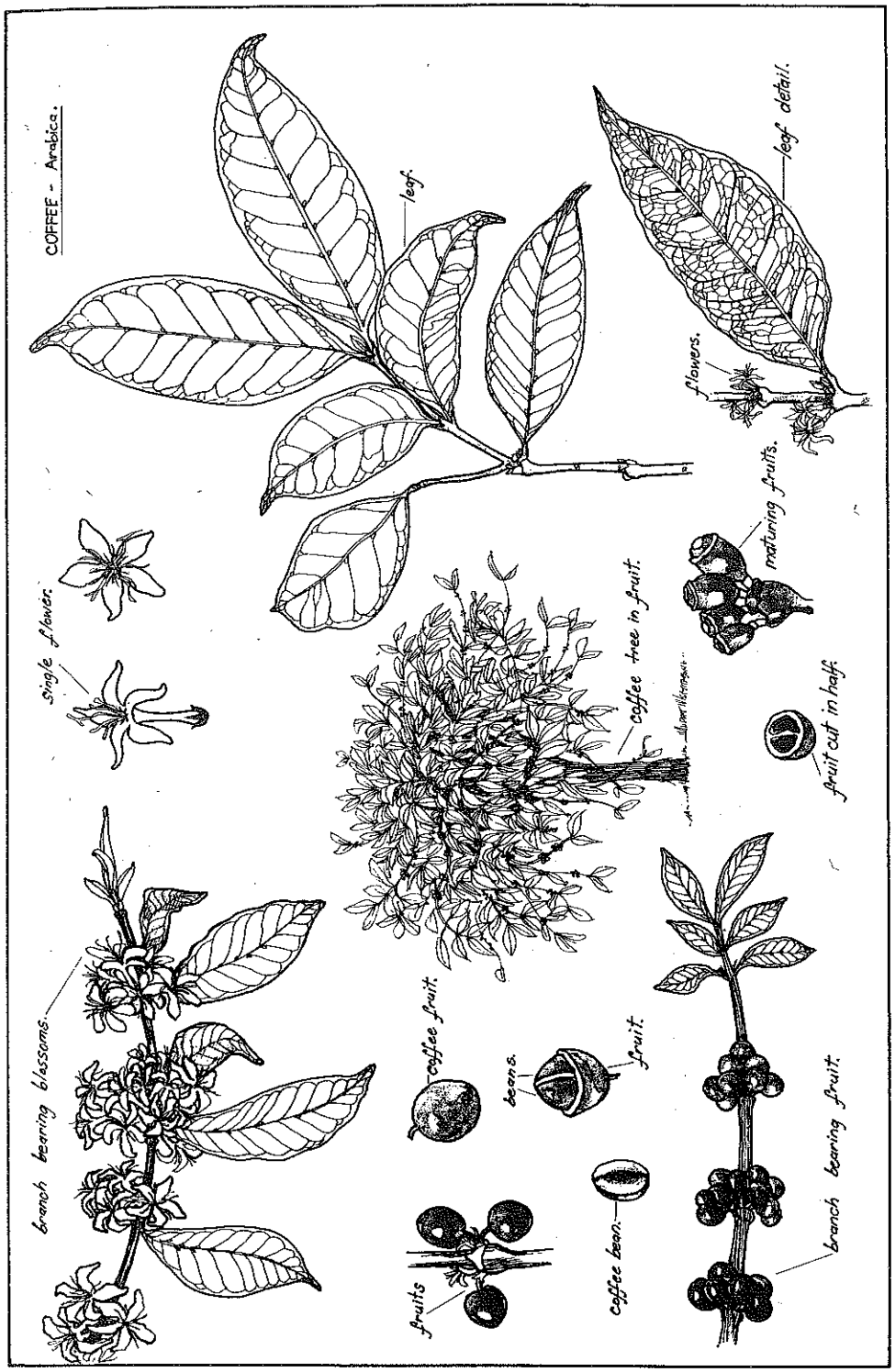
Coffee

Coffee, like tea, and to some extent cocoa, is grown for the stimulant contained in parts of the plant. Stimulants are substances which activate the human body. For example, coffee relieves fatigue. The stimulant in coffee is concentrated most in the coffee seed, the so-called coffee bean.

The Plant

Coffee is a perennial plant, a shrub growing up to a height of 3 m if left alone. Two main varieties are known, both of which are grown in Cameroon. One is arabica or highland coffee, the other is robusta coffee, adapted to lowland conditions. The two varieties differ in many respects which will become clear as we discuss them. The plant is a shallow feeder with the mass of its roots concentrated near the surface of the soil. Arabica coffee develops a deeper root system than robusta and therefore resists rought better.

On the coffee stem there are two types of buds. One type of buds grows horizontal branches, the other grows new stems if the initial stem is removed or bent down. This feature is used in coffee pruning to produce trees with several stems. The leaves are single, and dark green in colour. The leaves of arabica coffee are smaller than those of robusta coffee. Coffee flowers are white and have an intense, pleasantly sweet smell. They grow in groups at the leaf axils all along the branches. The coffee fruit is a berry with a dark red coat, juicy, red



pulp, and a seed clearly divided into two halves. The time between flowering and harvesting is 9 months for arabica coffee, 10 - 11 months for robusta coffee. Flowering always starts after the first rains in the case of arabica coffee whereas there is no exact time for flowering with robusta coffee. Arabica coffee has a better taste than robusta coffee and less caffein, the stimulant for which coffee is grown. Arabica coffee produces lower yields per hectare than robusta coffee.

Origin

Coffee is an African plant. Early reports name Ethiopia as the home of coffee. Initially, coffee leaves were used like tea leaves to prepare a drink. Coffee was widely used in the Muslim world. When the Turkish army broke off the siege of Vienna (Austria), they left a load of coffee beans in their camp. Coffee drinking in Europe started from that time, and the first coffee houses were opened.

Production

Arabica coffee is still by far the most important type; 74% of world coffee production is arabica, 25% is robusta, the remainder being shared between three other minor coffee varieties. Robusta coffee is on the increase, however, due to the fact that it can easily be processed into instant coffee without too much loss of taste. The following table shows some production figures for 1962 and 1972 (in 1000 tons):

	Arabica-coffee			Robusta-coffee	
Country	1962	1972		1962	1972
Brazil	1720	1500	Ivory Coast	195	270
Columbia	468	680	Angola	185	215
Mexico	140	222	Uganda	120	200
Ethiopia	132	216	Indonesia	111	185
El Salvador	97	150			
Guatemala	108	140			

Source: adapted from Pehm/Espig, 1976, table 35, p. 241

Kenya and Tanzania, too, are important coffee producers.

Coffee in Cameroon

Coffee is together with cacao the most important export crop grown by smallholders. In the anglophone provinces there is only the Santa Coffee Estate where coffee was produced on a large scale for a number of years, before production was given up as uneconomical and the Estate converted to a research station. In the "Province de l'Ouest" there are a few big coffee plantations employing large numbers of workers. Coffee is a relatively new crop in Cameroon. Concerning Nso, P. M. Kaberry writes:

> "Prior to World War II coffee, potatoes and castor seed were grown on a very small scale; but since 1948 there has been a rapid increase in areas under coffee."
>
> (Kaberry, Phyllis M., Some Problems of Land Tenure in Nsaw, Southern Cameroons, Journal of African Administration, p. 21 - 28, p. 21)

Being a cash crop coffee has long been considered a man's crop with women helping occasionally but men doing most of the work. In the South West Province, robusta coffee is grown in most areas, whereas in the North West Province arabica coffee is cultivated. Linked

with coffee farming, a powerful cooperative movement has developed in the North West Province. The economic appeal of coffee was so strong that coffee farms thrive even in areas that are inaccessible to vehicles. A day's transport by headload to the nearest cooperative store or licensed buyer is still considered economically profitable.

The following table shows coffee production at the Santa Estate from 1959 to 1966

year	area under coffee (ha)	harvest (tons)	yield (kg/ha)
59/60	236	43.5	184
60/61	236	50.7	215
61/62	236	82.0	347
62/63	236	45.0	191
63/64	225	42.0	187
64/65	225	58.2	258

These are small quantities compared to total coffee production in Cameroon. The table below shows how much coffee was produced annually in Cameroon, in Africa, and in the whole world between 1967/68 and 1976/77. Before 1970, Cameroon produced about 2.4 per cent of all coffee sold on the world market. In 1976/77, Cameroon's share in coffee exports had risen to 3.4 per cent. Although Cameroon is an important coffee producer with more than 90.000 tons exported in 1976/77, its share in the international coffee trade, in the world market for coffee, is too small to have any influence on prices.

Coffee Production (in 1,000 tons)

Year	Cameroon	Africa	Cameroon's share in Africa	World
1967-1971	67.9	1,083.8	6.3%	2,839.6
1972/73	84.6	1,207.3	8.4%	3,430
1973/74	88.4	1,012.8	8.7%	2,627.5
1974/75	101.3	1,126.6	9.0%	3,723.7
1975/76	88.3	1,006.7	8.8%	3,248.6
1976/77	91.2	1,014.3	9.0%	2,680.6

Adapted from: Foreign Agriculture Circular, FCCF 4-76, US-Department of Agriculture

In the North West Province coffee is sold exclusively through the various cooperative societies. In the year 1975/76 there were 11 cooperative unions with a total membership of 23,690 coffee farmers. These people farmed 47,550 hectares[1] of coffee, so that the area which an average cooperative member had under coffee was about 2 hectares. According to the planting distances used this means between 5,000 and 8,000 coffee trees. One ought to remember, however, that a registered member usually not only sells his own harvest but also that of farmers who do not produce enough to become members themselves. Therefore, individual coffee farms tend to be much smaller than 2 hectares.

The amount of coffee marketed through the cooperative societies in the North West Province rose steadily from 1960/61 to 1974/75, after which there were two poor years, as can be seen from the graph overleaf.

Prices paid to the farmer for arabica and robusta coffee have kept rising over the years as the following table shows:

Year	Arabica coffee		Robusta coffee	
	price per kg (FCFA)	price per produce bag (58 kg)	price per kg (FCFA)	price per produce bag (58 kg)
1969	150	8,700	-	-
1970	165	9,570	-	-
1971	170	9,860	125	7,250
1972	165	9,570	125	7,250
1973	175	10,150	125	7,250
1974	200	11,600	130	7,540
1975	190	11,020	135	7,830
1976	245	14,210	145	8,410

1) Figures from: Provincial Delegation of Agriculture, Technical Report of the North-West Province, 1976

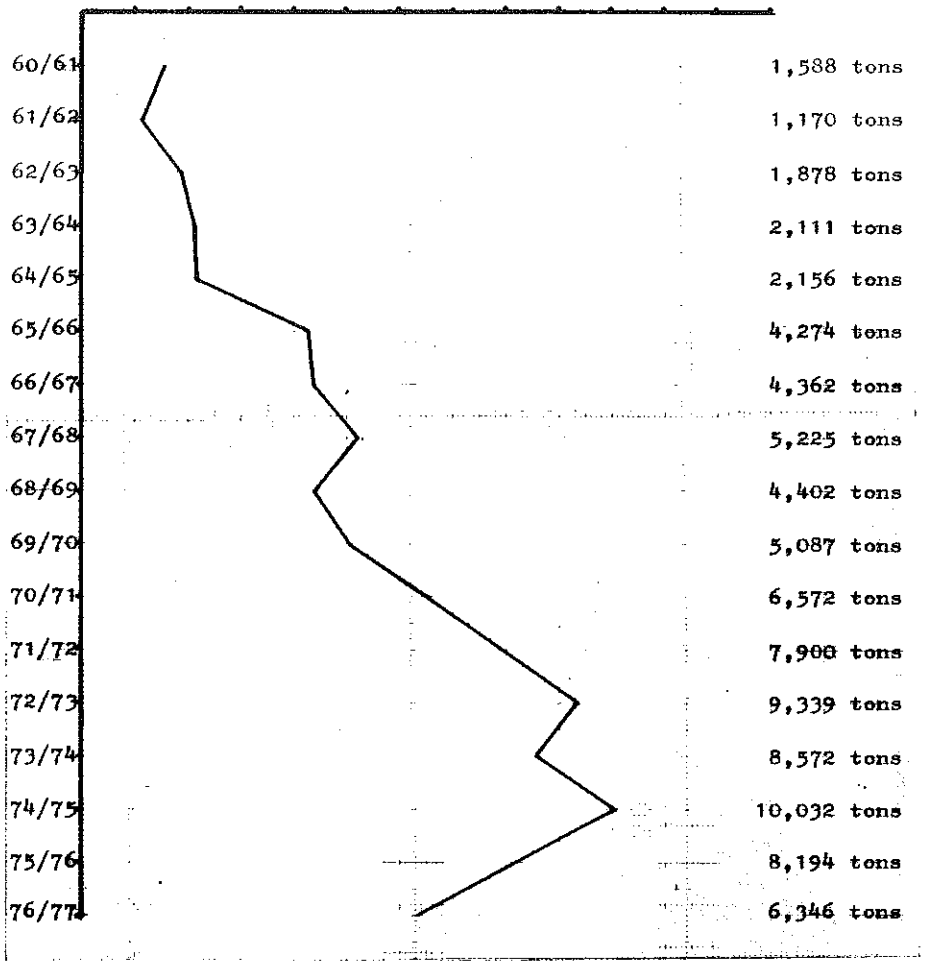
The Produce Marketing Organisation (P.M.O.) handles all coffee sales in the two provinces. In the South West Province the cooperative movement is still in its infancy and, therefore, Licensed Buying Agents (L.B.A.s) play a much bigger role.

Coffee farming is encouraged by the Department of Agriculture. The Agricultural Extension Service advises farmers on the proper methods. Most of the time, modern methods such as the use of fertilizers, insecticides and pesticides are not practised. In many communities there are skilled men who perform certain jobs like pruning and spraying for payment.

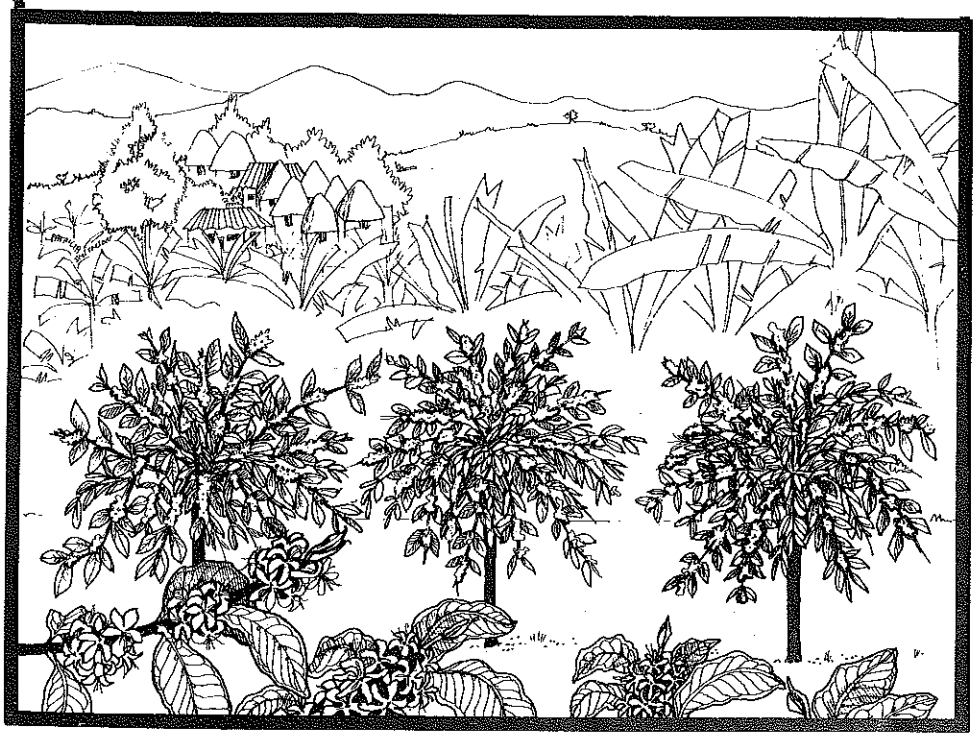
Farming

Coffee needs deep, well drained and well aerated soil. It does not like acid soils. Because of its high nutrient requirements it needs manure or chemical fertilizer.

Sales of Arabica Coffee by the Cooperative Marketing Unions (in tons)



Source: CENADEC, Bamenda Sector, field branch, and PMO



Arabica coffee does best at an annual rainfall of between 1500 mm and 2000 mm and an annual dry season of 2 - 3 months. At the beginning of the first rains the trees start flowering immediately. Robusta coffee needs an annual rainfall of between 2000 and 3000 mm. It does not need a definite dry season but can withstand one to two months of drought.
Coffee needs a relatively high average temperature, arabica coffee between 17 and 23°C, robusta coffee between 18 and 27°C. In order to do well coffee must grow under shade, at least during the early stages of growth. Where shade cannot be made available, thick mulch serves the purpose of keeping soil temperatures low. Once the trees are well established and have started yielding, shading is no longer required. They yield best under full sunlight.

Farm preparation should be done at least six months before planting, i.e. roughly at the same time that the nursery is made. Planting distances on the coffee farm vary with local conditions, as can be seen from the following table:

Planting distance	plant population per hectare	remarks
2 m x 1.5 m	3,330	arabica coffee, very wet conditions
2 m x 2 m	2,500	arabica coffee, normal spacing in Cameroon
2.7 m x 2.7 m	1,370	normal spacing in Kenya
3 m x 3 m	1,110	robusta coffee, standard spacing in Cameroon
4 m x 4 m	830	spacing under very dry conditions

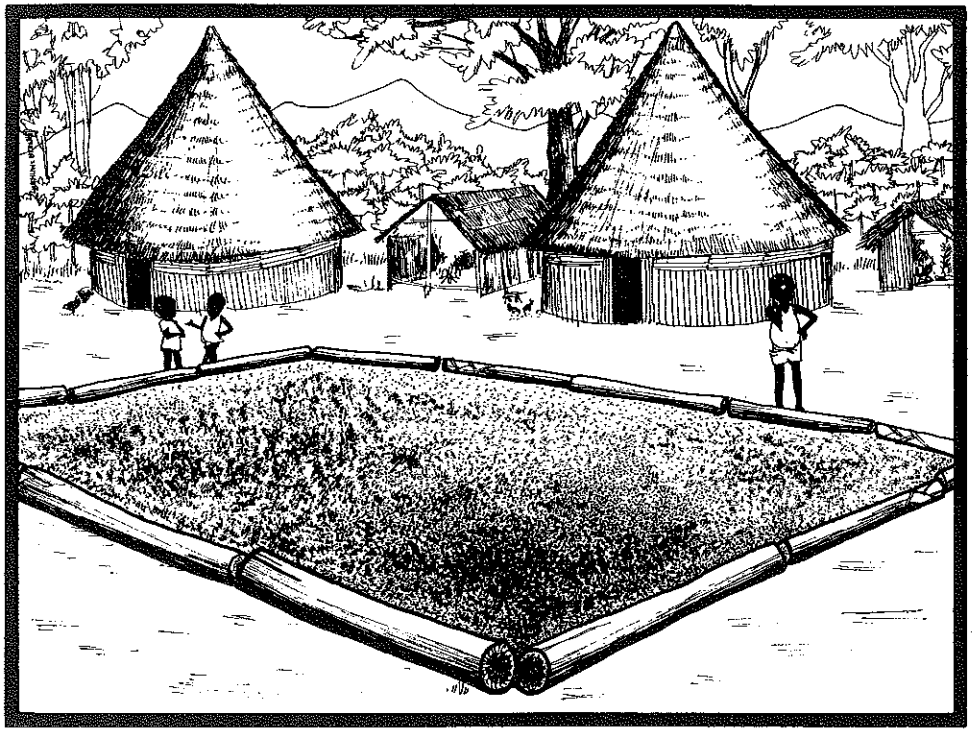
The planting holes should be filled with rich, manured top-soil.

Coffee is propagated by seedlings that are raised in a nursery. Nurseries are usually made by using polythene bags. These are filled with rich soil in which a coffee berry is planted. For healthy seedlings berries from strong, well-yielding trees should be collected. These must be pulped, dried and packed in wood-ash if they are not to be used immediately for planting. Seedlings are ready for transplanting when they have six pairs of leaves. Hybrid varieties such as "arabusta" are propagated from stem cuttings. The Agricultural Department grows coffee seedlings of high quality and distributes them to interested farmers. In order to do well, the seedlings need shade. It is therefore advisable to leave some trees on the future coffee farm for shade. If this is not possible as in most grassland areas, bananas, plantains or tephrosia should be planted in order to provide sufficient shade. A 20 cm layer of mulch can replace shading if necessary. The best time for transplanting from the nursery to the farm is the start of the rainy season.

Intercropping in coffee is possible provided that only very light tilling is done. Since the mass of the roots are quite near the surface, they are easily damaged during tillage.

It is recommended that the young trees be pruned in such a way that they grow several instead of only one stem. Since each stem grows its own branches, the yield per tree will be higher than with only one stem. By cutting the main stem, the farmer forces the tree to replace it. This it does by growing several stems at the same time.

Weeding should be done carefully on the young coffee farm. Shading and/or mulching will keep weed growth in check,



however. Once a good canopy has been formed it will suppress most of the weeds.
Pruning is done each year in order to cut off unwanted branches which would use up plant food that would otherwise go into the growth of coffee berries.
The use of artificial fertilizer of course also varies with soil conditions. Quantities to be applied are:
Nitrogen: 150 - 200 kg/hectare
Phosphorus: 25 - 40 kg/hectare
Potassium: 80 - 160 kg/hectare
Coffee yields start going down after 7 - 10 years of harvesting. In this case, it is not necessary to replant the whole farm. It is possible to rejuvenate the trees (i.e. to make them young again): the main stem is cut off as low as possible just above the lowest branches. New shoots quickly grow, bringing back the full yield of earlier years.
Harvesting extends over a long period because only fully matured, red berries sould be picked. Green berries are not suitable for high quality coffee. A well trained worker can pick between 30 and 60 kg of berries per day.

Coffee Yields:

210 kg of dry beans/hectare	North-West Province/Cameroon
514 kg of dry beans/hectare	world average
1500 - 2500 kg of dry beans/ hectare	well tended arabica coffee
2300 - 4000 kg of dry beans/ hectare	well tended robusta coffee

Farmers have to process their coffee before they sell it. They either dry the whole coffee berry and sell it afterwards, or they pulp it, i.e. remove the juicy flesh from the coffee beans. Coffee pulpers, small machines, are widely used in Cameroon. The pulped beans are left

fermenting and are dried afterwards. Now they are called parchment coffee and are ready for sale. The buyers hull and polish them so that they can be sold for export.

Pests and Diseases

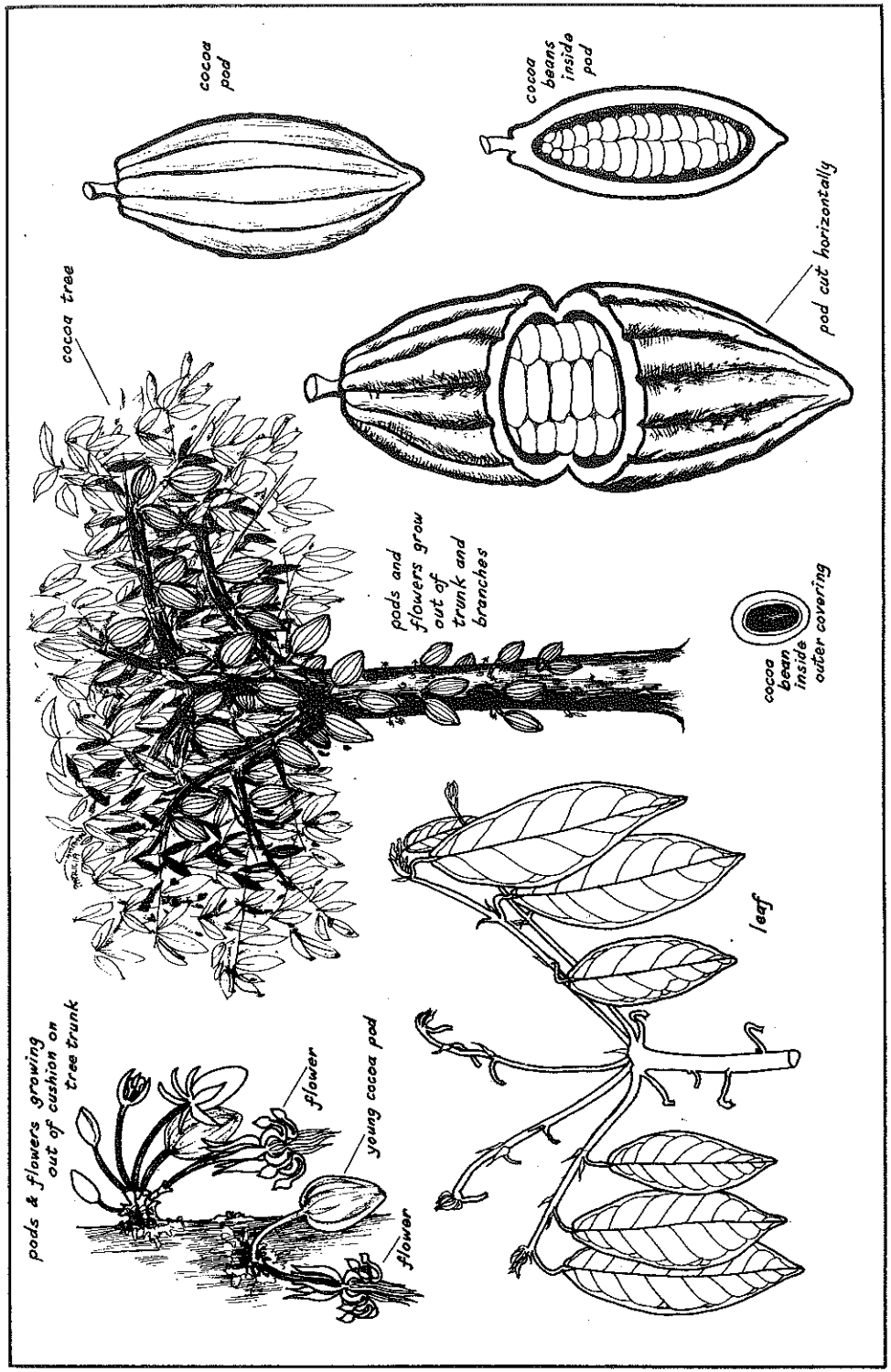
Coffee is attacked by a number of fungus diseases. The really dangerous ones are coffee rust and coffee berry disease. These can be fought by spraying. Here, the agricultural extension agents and the coffee demonstrators of the cooperative unions will be of help. There are a few insect pests like the coffee stem borer and the coffee berry borer which can be checked by insecticides.

Cacao

Cacao is another tree crop yielding a fruit which, in Africa, is mainly farmed for export. The growers themselves do not use it as food or drink. Several varieties are known. In English, the tree and its fruit are spelt "cacao" whereas the products derived from the fruit (e.g. cocoa powder, cocoa butter, and the cocoa drink) are spelt "cocoa". This rule is not universally respected, however, and some texts talk of the "cocoa tree" and the "cocoa pods".

The Cacao Tree

Cacao is a relatively short tree belonging to the vegetation of the rainforest. If left alone it would reach a height of 12 - 15 m. In cacao plantations it is kept much lower in order to make harvesting easier. The tree grows 3 - 5 main branches. Its tap root reaches about 2 m into the soil. The feeder roots, however, remain in the upper levels of the soil, preventing any deep hoeing for intercropping.
The flowers grow from "cushions", swellings on the stem and the main branches at places where leaves had formerly grown. The flowers are very small and whitish-pink in colour. In the right climate they continue growing out of the same cushion for years provided the cushions are not damaged at harvesting. Flowering is at its height from April to July. Accordingly, peak harvesting takes place from October to December. The fruits are large pods each containing 30 - 40 beans. Depending on the variety, ripe pods change from green or deep red to yellow or reddish yellow. The pods are usually ripe five to seven months after flowering. A tree bears between 20 and 60 pods



per season. It starts yielding 3 - 7 years after planting, and yields go down after about 25 years. Experience has shown that in Cameroon, a cacao tree older than 35 years has no economic value any longer. Elsewhere, the economic life of a cacao tree may be much longer. In any event, establishing a cacao plantation is a long term investment. The initial labour will yield economic returns over most of the lifetime of an adult person.

Origin

The home of cacao is South America from where it was brought to Africa and Asia. Cacao trees grow wild in the Amazonas basin. They were cultivated by the Mayas where cacao beans were used both as money and to prepare a drink. It is a relatively new plant in Africa. The Portuguese introduced it to the island of São Tomé in 1822. the English brought it to Ghana, and the Germans to Cameroon.

Production

At present, cacao is mainly produced in Africa. In 1972, the situation was as follows:

Country or region	cacao production (in million tons)
Ghana	0.42
Nigeria	0.24
Ivory Coast	0.18
Cameroon	0.08
other African countries	0.11
Total West Africa	1.03
Brazil	0.20
other Latin American countries	0.18
Total Latin America	0.33
Asia and Oceania	0.05
World Production	1.48

Cacao farming has expanded very fast in Africa during this century, as can be seen from the following figures:

Year	cacao production in Africa (in tons)	share of world production
1900/01	19,700	17.0%
1921/22	232,800	53.9%
1938/39	544,300	68.1%
1971/72	1,129,100	73.7%

adapted from: Assoumou, J., 1977, p. 81

Thus, nearly three quarters of the world cacao production come from Africa. During the same period, world consumption of cacao has grown tremendously, showing how popular such items as chocolate, cocoa powder etc. have become:

Year	world consumption of cocoa (in tons)
1910	196,000
1949	704,000
1960	922,000
1965	1,333,000
1970	1,348,889

adapted from: Assoumou, J., 1977, p. 61

Cocoa consumption in 1970 was nearly seven times that of 1910.
Cacao assumes an important place in the economy of the main producer countries. In 1972, it accounted for 60 per cent of all the exports of Ghana, for 30 per cent of all the exports of Togo, and for 22 per cent of Cameroonian exports.

Cacao in Cameroon

Cacao was introduced by the Germans in 1886/87 under Governor von Soden. It soon became the main export crop. It was grown in huge plantations as is still the practise on the island of Macias Nguema (Fernando Poo) off Victoria. It was for cacao that the Victoria-Molyko estate with its 12,665 hectares, 100 houses and 40 km of railway came into being. Cacao farming was quickly taken up by the surrounding farmers. First, the colonial administration was against this but later they encouraged local farmers, and in 1911 cacao produced by smallholders accounted for one-sixth of Cameroon's total cacao production. At present, nearly all the cacao in Cameroon is produced by peasant farmers. C.D.C. had plantations of around 500 hectares up till the mid-sixties, but they have been abandoned because of poor profits. The main cacao producing areas in Cameroon are in the francophone provinces. Thsu, in 1970/71, the Centre-South Province produced 95,289 tons, Littoral 3,357 tons, and the Eastern Province 10,890 tons. Smallholder plantations vary between 0.5 and 3 hectares in size; in 1953, an average area of about one hectare was farmed by each farmer, while in 1959/60 another sample revealed an average size of less than one hectare. Thus, family holdings are really very small and make extension work quite difficult. Sometimes, food crops that like shade are grown under the dense cacao canopy. Cacao exports have kept rising steadily over the last few decades, earning a substantial amount of foreign exchange.

Cacao exports have developed as follows:

Year	export of dry cacao beans (in tons)
1930	10,751
1940	24,351
1950	43,722
1960	58,897
1970	72,026
1974	88,928
1975	72,475

adapted from: Assoumou, J., 1977, p. 330

Farming

Requirements: cacao needs a deep, well-drained soil which **should** retain water reasonably well. If the soil contains enough organic matter it can even be slightly acidic. The tree does not do well immediately after burning. If a future cacao farm has been cleared by burning, food crops should be farmed for one season before transplanting the cacao seedlings. Cacao does not place heavy demands on soil fertility.
Its water requirements are high, doing best where the rain is distributed evenly throughout the year and totals 1500 - 2000 mm per year. It does very well under shade. As long as it has not formed a dense canopy it needs heavy shading. However, average temperatures ought to be high - about 25 - 32°C.

Farm preparation: The future cacao plantation is prepared by digging holes about 30 cm deep and 20 cm square. Before planting the seedlings, these holes should be filled with rich top-soil or manure.
Planting distances are as follows:

Planting distance	plant population per hectare	remarks
1.5 m x 2 m	3,300	observed in Haiti
2.5 m x 2.5 m	1,500	standard distances in Cameroon
3.0 m x 3.0 m	1,110	recommemded by specialists
4.0 m x 4.0 m	625	recommended by specialists
5.0 m x 5.0 m	400	observed in Angola

Nursery work: young cacao trees are usually grown from seeds. As with coffee, a nursery is made with one seedling to each bag. Since seedlings should grow 4 - 8 months before they are ready for transplanting, the nursery should be started in January so that with the onset of the heavy rains in June the seedlings can be transplanted. They must always be grown under shade. The agricultural department sets up nurseries where seedlings are grown for distribution to farmers.

Weeding is necessary as long as the canopy is not closed. As long as the trees have not started bearing fruit, food crops can be grown between the young trees. Later on, the dense canopy prevents any but the most shade-loving crops (colocasia, xanthosoma) from doing well.

Mulching is important for young cacao seedlings and trees, especially if shade cannot be provided in sufficient quantity. It is still recommended later on in order to maintain a high level of organic matter in the soil.

Pruning is said to be the most important activity in cacao farming. Pruning means cutting away dead branches, twiggy growth from the main branches, upward growing shoots, and branches too close to the soil.

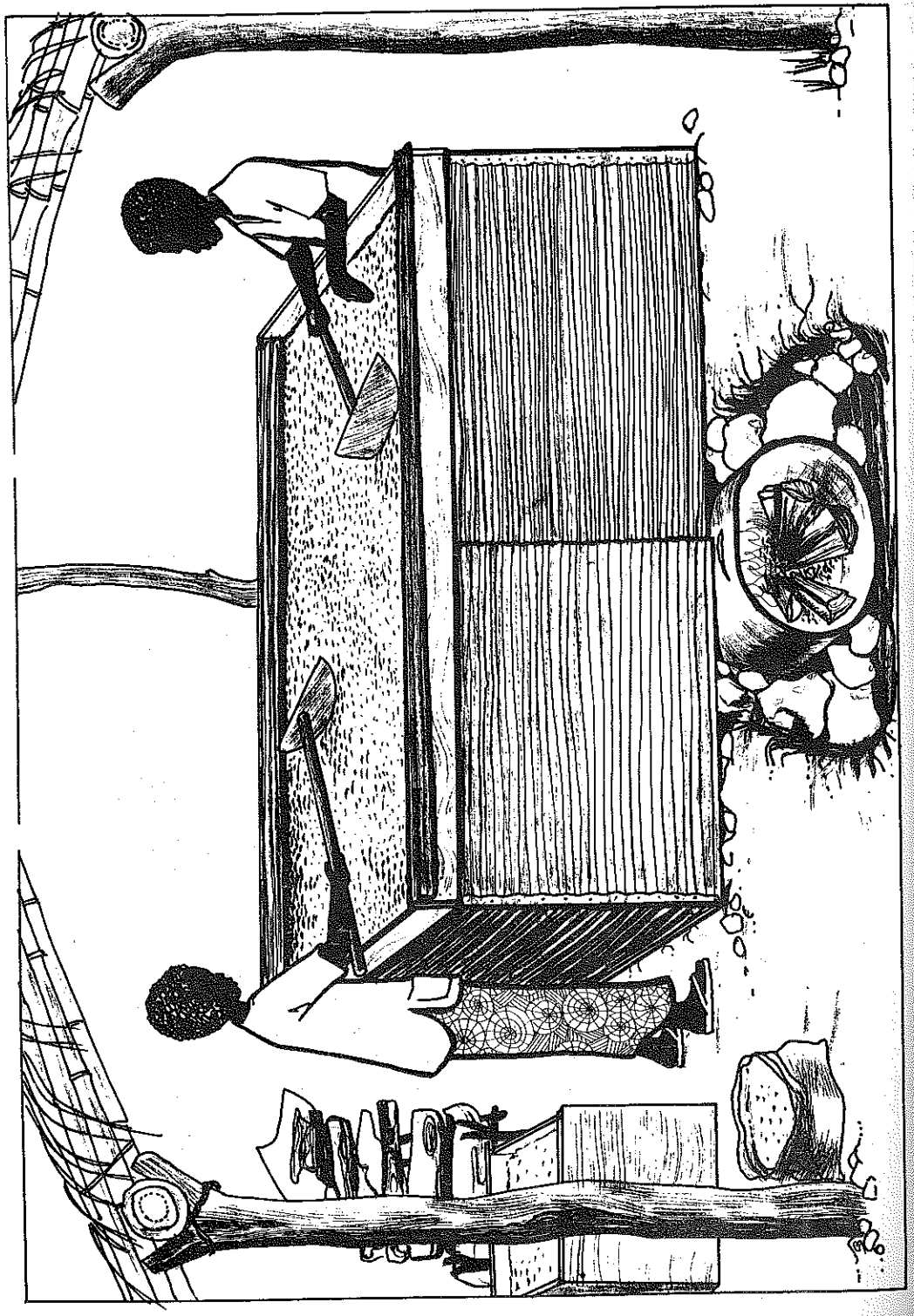
Chemical fertilizers are necessary in small quantities only. Many of the nutrients used by the fruits are returned to the soil if the shells of the cacao pods are left in the plantation. If fertilizer is applied, the recimmended rate is 100 kg of nitrogen, 20 kg of phosphorus, and 70 kg of potassium per hectare and year. This quantity is not given once but in three applications: one third at the time of most intense leaf growth, one third at the main flowering period, and one third when fruit is at its height.

Harvesting requires a lot of skill. Neither unripe nor overripe pods should be picked. In order not to damage the cushions, a sharp knife must be used. In this way, the pods are cut rather than picked. When a sufficient number of pods have been harvested, they are split open on the farm. The cacao beans, covered with their white pulp, are then carried away for further processing. About 20 pods yield one kg of dry beans.
Yields are far from what they could be. Here are a few figures on cacao yields:

Yields in kg/hectare	observations
268	average yield in the German plantations in 1906
315	world average in 1972
556	average yield in the German plantations in 1912
1000 - 1500	good yields
250 - 350	average smallholder plantation in Cameroon
600 - 900	well kept smallholder plantations in Ghana, Togo, and Nigeria
3,000	yield from high yielding varieties under best conditions

Processing

The beans are fermented in their pulp. This takes about a week, but the beans have to be stirred and well turned in the fermenting boxes every two days. The beans produce a lot of heat while fermenting. After fermentation, the beans have to be dried. In the humid rainforest areas, the heat of the sun is not sufficient to dry them properly. Many cacao farmers use drying ovens where they keep a fire



burning until all the beans have been properly dried. The extension officers have detailed instructions about how to ferment and dry cacao. The quality of the cacao, its grade and thus its market price depends as much on proper processing as on good farming practices.

Pests and Diseases

The worst cacao disease is Black Pod Disease, a fungus disease which turns the pods black and spoils the beans. Before an effective chemical was found, Black Pod Disease could ruin a whole year's crop: in Nigeria, up to 80 per cent of the crop were lost to the disease. In Cameroon, losses of up to 50 per cent have been reported. Another severe disease is Swollen Shoot Disease. Since no remedy has been found to fight it, affected trees have to be felled and burnt. Thus, between 1946 and 1967, 130 million trees had to be felled in Ghana alone. The most important insect pests are the capsids. They attack the pods and the young shoots by sucking sap from them. Capsids do not destroy the affected pods but they weaken the whole tree so that it does not yield as it normally would.

Table of yields

Coffee robusta

yield in kg/hectare	remarks
167 - 273	Fako Division, South-West Province
237	sample of farmers, South West-Province 1975
780 -1,120	Nigeria, fresh berries, average for smallholders
600	experimental plot, Kumba, dried berries
100 - 500	average range for Africa, dried berries
1,000	average in Latin America, dried berries
2,300 -4000	very well kept coffee farms, dried berries

Coffee arabica

yield in kg/hectare	remarks
210 - 320	North-West Province, dried beans
190 - 350	Santa Coffee Estate 1959 - 1966
334	sample of farmers, North-West Province in 1973/74
440	Nso and Ndu, random sample of farmers in 1971
1,500	trial plot at Wum, fresh berries
1,500 - 2,500	very well kept farms, dried berries

Cacao

yield in kg/hectare	remarks
130 - 180	Fako-Division, smallholders in 1973/74
205	sample of farmers in South-West Province 1975
270 - 550	German plantations at Victoria at beginning of century
315	world average in 1972
250 - 350	average smallholder plantation, Cameroon
600 - 900	well kept smallholder plantations, Ghana, Togo, Nigeria
1,000 - 1,500	good yields
2,250 - 3,350	maximum yields under the best conditions

Oil Palms

yield in kg/hectare	remarks
1,100 - 2,250	fresh fruit bunches, native farming, West Africa
2,000	smallholders' harvest from wild palms, West Africa
6,700	average yield in West Africa, all farmers
10,500	smallholders, Ivory Coast
5,700	CDC-estates 1972/73
14,800	Nigeria, Plantation estate 1974
26,100	Indonesia, Plantation estate

Yams

yield in kg/hectare	remarks
3,500	smallholders in Cameroon
7,500	average for Africa
9,330	world average
12,550	experimental yields, R.T.C. Kumba
16,250 - 20,960	experimental yields at TTC Nchang
30,000 - 35,000	high yielding varieties
70,000	maximum yields

Cassava

yield in kg/hectare	remarks
4,000	smallholders in Cameroon
4,500	experimental yields in North-West Province
5,000	low average yields
12,000 - 24,700	range of yields in West Africa
30,000 - 40,000	average in commercial cassava farming (large areas)
100,000	highest yields

Colocasia

yields in kg/hectare	remarks
2,800	smallholders in Cameroon
5,000 - 20,000	range of average yields
75,000	maximum yields

Sweet Potatoes

yield in kg/hectare	remarks
3,000	smallholders in Cameroon
7,4000 - 14,800	range of yields in West Africa
8,800	world average
20,000	satisfactory yields
40,000 - 50,000	exceptionally high yields

Plantains and Bananas

yield in kg/hectare	remarks
21,700 - 37,000	average in West Africa

Beans

yield in kg/hectare	remarks
62.4	trial plot at Wum, North-West Province
500 - 1,100	range of good yields, common beans, dry seeds
2,500	maximum yield

Groundnuts

yield in kg/hectare	remarks
330 - 560	smallholders, West Africa
600 - 800	average yields
670 - 1,100	experimental yields, West Africa
1,520 - 3,000	experimental yields, Wum

Cowpeas

yield in kg/hectare	remarks
300 - 400	average yields
2,800	maximum yield

Rice

yield in kg/hectare	remarks
760	smallholders, North-West Province, upland rice
900 - 1,700	upland rice, normal range of yields
3,000	maximum yield for upland rice
1,000 - 1,500	poor yields of irrigated rice
1,760	average in North West Province, irrigated rice
2,250 - 4,500	irrigated rice, West Africa, good conditions
2,300	irrigated rice, world average
4,220	experimental yield, R.T.C. Kumba 1977
6,000	medium yields from high yielding varieties
10,000	maximum yields

FARM ACTIVITIES ASSOCIATED WITH DIFFERENT CROPS

ACTIVITY		Cocoa	Arabica Coffee	Robusta Coffee	Oil Palm	Plantain/Banana	Yams	Maize	Beans	Groundnuts	Egusi	Irish Potatoes	Cocoyams	Colocasia	Sweet Potatoes	Cassava	Rice (upland)	Guinea Corn	Rice (Swamp)
FARM PREPARATION	clearing	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
	felling trees						x												
	burning		x	x		x	x	x		x		x	x	x			x		
	fencing																x		
	tilling						x	x	x	x		x	x	x			x		x
	pegging	x	x	x	x	x	x	x											
	digging holes	x	x	x	x	x	x												
	making mounds						x	x					x	x					
	making ridges						x	x				x	x	x					
PLANTING	making a nursery	x	x	x	x													x	x
	flooding the nursery																		x
	transplanting	x	x	x	x													x	x
	planting					x	x	x	x	x	x	x	x	x	x	x	x		
	sowing							x									x		
CULTIVATION UPKEEP	mulching		x	x			x						x						
	moulding up								x			x							
	earthing up						x	x											
	staking						x		x										
	training vines						x												
	propping up					x													
	thinning							x											
	removing diseased plants																	x	
	fertilizing		x	x	x	x	x	x											x
	manuring		x	x									x	x					
	pruning	x	x	x	x	x	x												
	removing off-shoots		x	x															
	cutting out suckers					x													
	weeding	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	ring-weeding				x														
	spraying	x	x	x	x														x
	scaring birds																x	x	x
HARVEST	tapping						x												
	pricking						x												
	harvesting				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	picking coffee berries		x	x															
	plucking cocoa pods	x																	
PROCESSING	breaking pods open	x																	
	hulling coffee berries		x	x															
	fermenting	x	x	x												x			
	drying	x	x	x															
	threshing																	x	x
	shelling							x											

Note:

The table shows which activities occur with a given crop. Clearly, words used with several or all crops are the most common ones and should be well taught and well learnt in all ways possible. Words occuring with only one or two crops are specialized vocabulary. Reading the table for each crop gives an idea about the word drill needed for teaching about that particular crop. It also shows the difficulty of successfully farming a crop: the more detailed the vocabulary, the more different skills are needed in farming.
The text on any particular crop will use all the words mentioned in the table for that crop. They will either be explained explicitly or become clear from the context.

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