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Naturland

HOW TO GROW ORGANIC COCOA

A handbook on organic principles of cocoa production in the South-Western region of Cameroon

CONTENTS

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Preface

KONAFCOOP a pioneer in organic cocoa production

For over five million smallholders, mainly from West Africa, cocoa is the primary source of income. Despite numerous schemes and initiatives, the international cocoa business is as ruthless as ever. The cocoa farmers are prey to speculation on the world market and pricing pressure exercised by a handful of major corporations.

The Konye Area Farmers Cooperative (KONAFCOOP) is in the advantageous position to have access to a reliable fair-trade partner, the Gepa Fair Trade Company. However, Gepa is looking for **organic cocoa**. Hence, the cooperative decided to go for organic production with a ready market for the export of organic beans in larger volumes and an awareness of the importance of sustainable cocoa production.

This manual provides the experience gained in the production of organic cocoa in the South-West Region of Cameroon.

This guide is based on the Naturland standards for organic production. Naturland cocoa must be grown in agroforestry systems.

Naturland is an international association for organic agriculture. Naturland supports smallholder organisations, farmers' groups, and individual farmers in converting to organic production according to Naturland standards. Since we always have people in mind, our organic is also always social. Our standards are based on the principles of sustainable management. Organic farming in line with our Naturland Standards means to practice nature, climate and biodiversity protection. It means to preserve and maintain soils, air and water resources, as well as to ensure consumer protection.

The Naturland standards existed long before the first statutory regulations on organic farming were introduced by the EU and go far beyond the legal minimum requirements for organic production in the EU.

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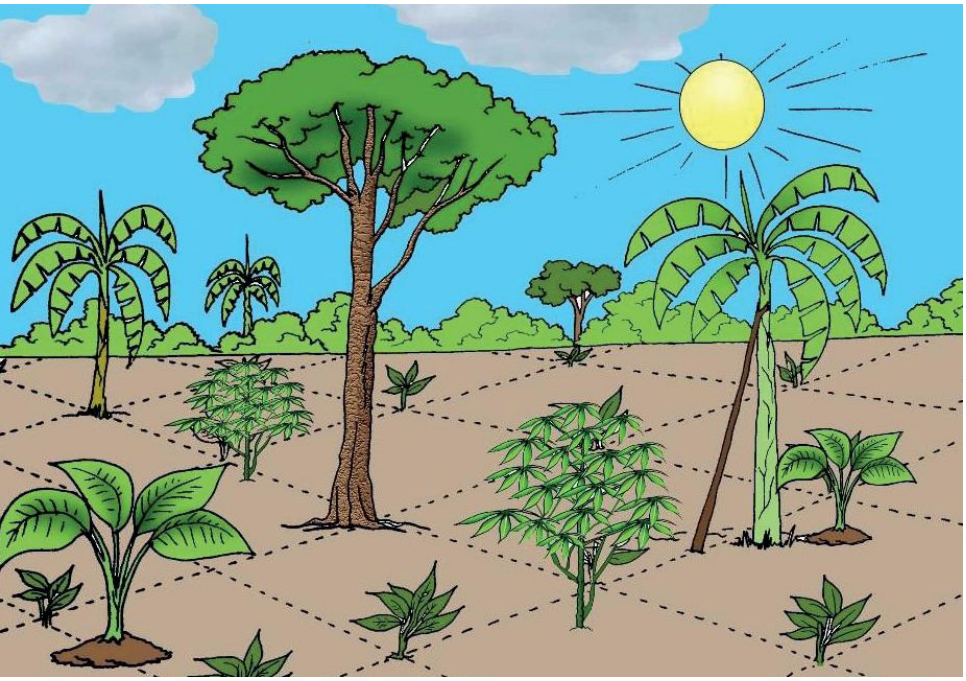
Principles of Organic Cocoa Production

The aim of producing organic cocoa is to establish a production system that is socially, economically, and environmentally sustainable in the long term. There are **four guiding principles** to achieving organically produced cocoa.

1. Maintain forest ecological potential.

The existing forest must maintain its ecological potential, especially when a new plantation is established. Cocoa trees can be integrated into the existing forest structure. This way, any negative environmental impact is minimized so that the multiple canopy storeys for successful cocoa production are retained. Cocoa trees do best when they grow in combination with shade and other associated trees. Other trees than cocoa should be planted on degraded sites to provide the **agroforestry environment** (Figure 1).

Naturland prohibits the clearing of primary forests.



Benefits: The presence of other trees on the plantation helps with:

1. pest control,
2. soil fertility improvement,
3. pollinator habitats,
4. environmental and micro-climate buffering,
5. diverse human food sources,
6. improved cocoa yields,
7. and better income.

Figure 1:
Cocoa trees in combination with shade trees and other crop plants such as bananas.

By having more diverse food sources, farmers become food sovereign and can improve their income by relying less on the cocoa market for their income. More food sources enable farmers to sell products on the local market and use them for self-consumption. **Crop succession** is a vital practice in producing diverse food sources.

When establishing a new plantation, it is important to incorporate crop successions. This is done by planting, for example, plantains, bananas, papaya, and pineapples and reducing them as the cocoa trees develop. This practice improves soil fertility, cocoa tree growth, food availability, and farm income.

2. No chemical pest control is allowed.

The conventional chemicals upset the ecosystem's balance by killing pest predators, being poisonous to animals and humans, and causing damage further downstream in the ecosystem. Instead, biological or cultural methods should be used, for example, removing and burying cocoa pods affected by black pod disease.

Naturland prohibits the use of synthetic pesticides.

Benefits: Such biological methods do not kill pest predators; they are non-toxic, less costly, and, therefore, better for farmers and their environment.

3. No chemical fertilizer is allowed.

Chemical fertilizers disturb the balance of vital soil biota, cause eutrophication of waters (pollution by too many nutrients), are expensive, and make farmers dependent on agro-chemical companies. Practices **promoting biological soil fertility, such as compost, vermicompost, and fertilizer trees**, avert all the risks and should be integrated.

Naturland prohibits the use of chemical fertilizers.

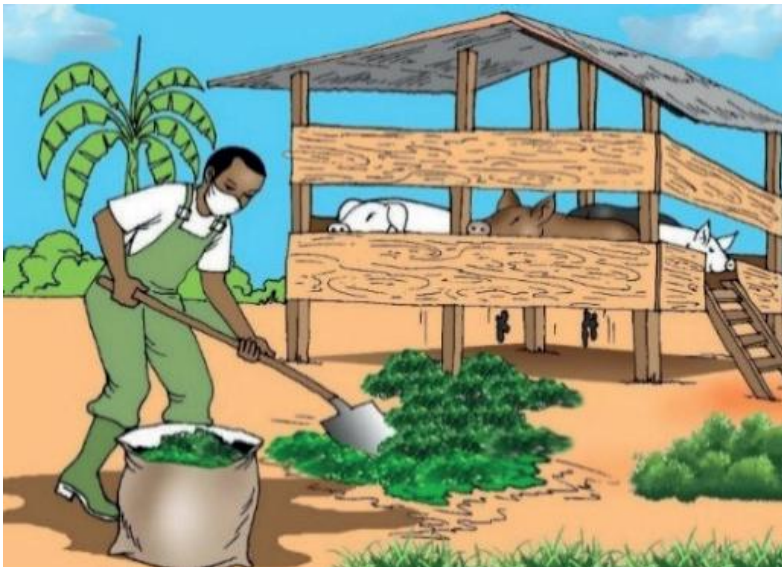
4. Good care

Good care must be taken in the management of the plantation by carefully pruning cocoa and shade trees and maintaining phyto-sanitation[1] to control pests and diseases.

Naturland organic production prohibits the use of chemical substances

These **four principles** are the main difference between conventional and organic cocoa production. Organic production calls for other solutions to soil fertility, pest management, and quality assurance that are better for people and the environment. It is important to note that organic production **represents a general switch in how we look at cocoa production. Organic cocoa farmers look at the system as a whole and not only at single aspects**. For example, soil fertility management is achieved by switching from chemical fertilizers brought onto the farm to compost and manure produced on the farm (Figure 2) and by having a diversified agroforestry system. So, if we don't have a diversified system, we lack organic material and, thus, fertilizer.

Figure 2: *Organic fertilizer produced on farm*



[1] For example, to control black pod disease regular farm inspections to remove all diseased, dead and pods with early symptoms should be carried out.

Benefits from organic cocoa production

Famers are benefiting from organic cocoa production in various aspects:

- Less costs for external inputs[2]
- Less environmental and health risks
- More income by receiving organic premium pay
- Additional income due to diversification of crop production (intercropping or crop succession)
- Increasing the sovereignty of farmers with less dependence on chemicals
- Supporting farmers exchange and knowledge transfer

Agroforestry Systems in organic Cocoa Plantations

Cocoa originally grows in a so-called agroforestry system in the understory of primary forests and is always associated with a variety of palm and tree species. This agroforestry system benefits cocoa trees. For example, trees in the first canopy layer lose their foliage during months of shorter daylight hours. This results in an increase of light which encourages the development of cocoa blossoms, and the falling leaves provide organic material to the soil (Figure 3).

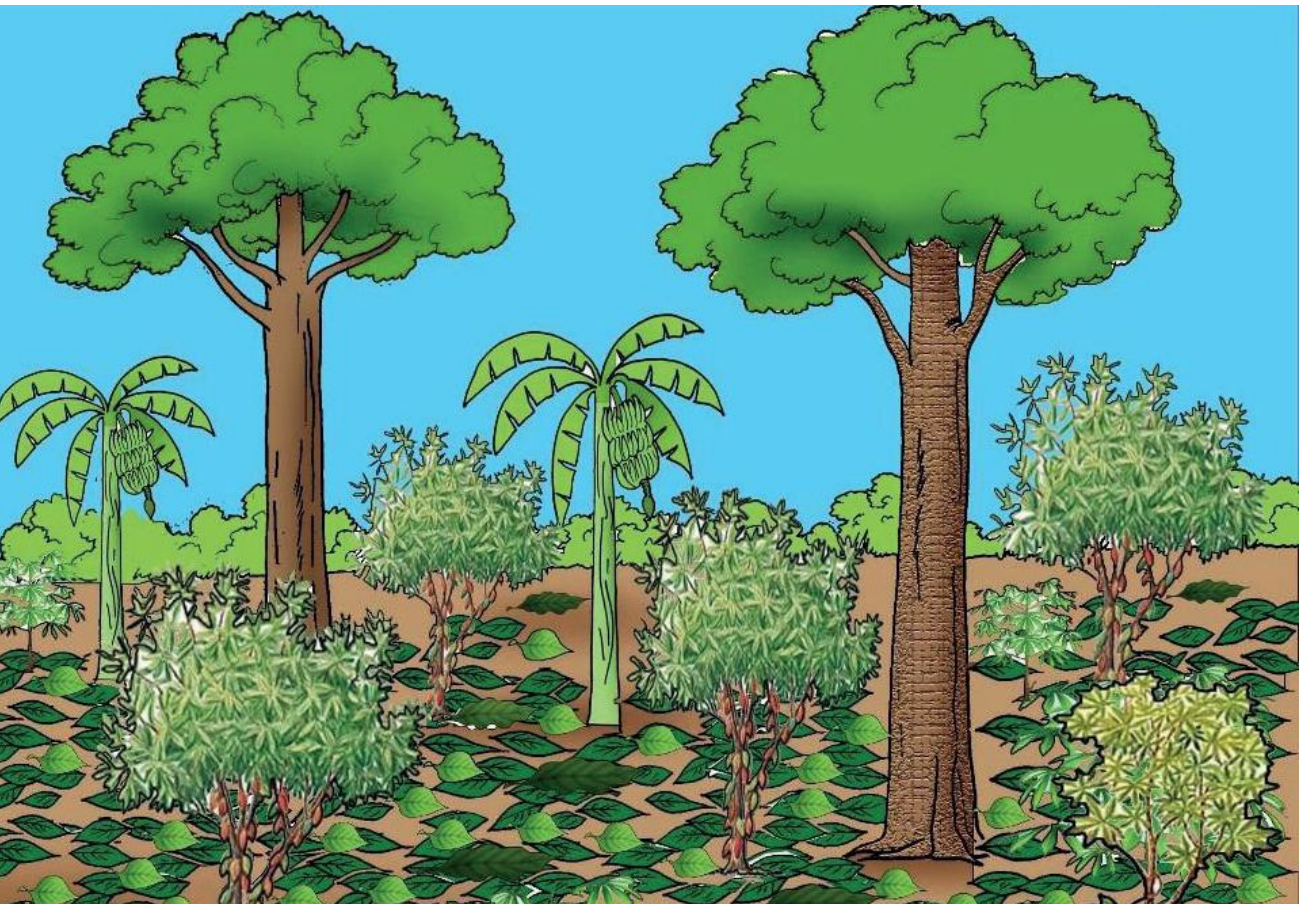


Figure 3: *Leaves from the agroforest system providing organic material to the soil*

[2] However, labor input can be increased through producing on farm compost

The combination of agriculture and forestry improves overall crop yields per hectare and provides a more diverse range of crops. The various trees and shrubs interact to provide shade, nutrients, refuges to beneficial organisms, pest control, micro-climate buffering, nutrient cycling, improved moisture availability, and reduced weed competition. All components of the system benefit from this. Therefore, an agroforestry system is the best way to cultivate cocoa so that the taller trees provide shade as well as nutrients to the cocoa trees.

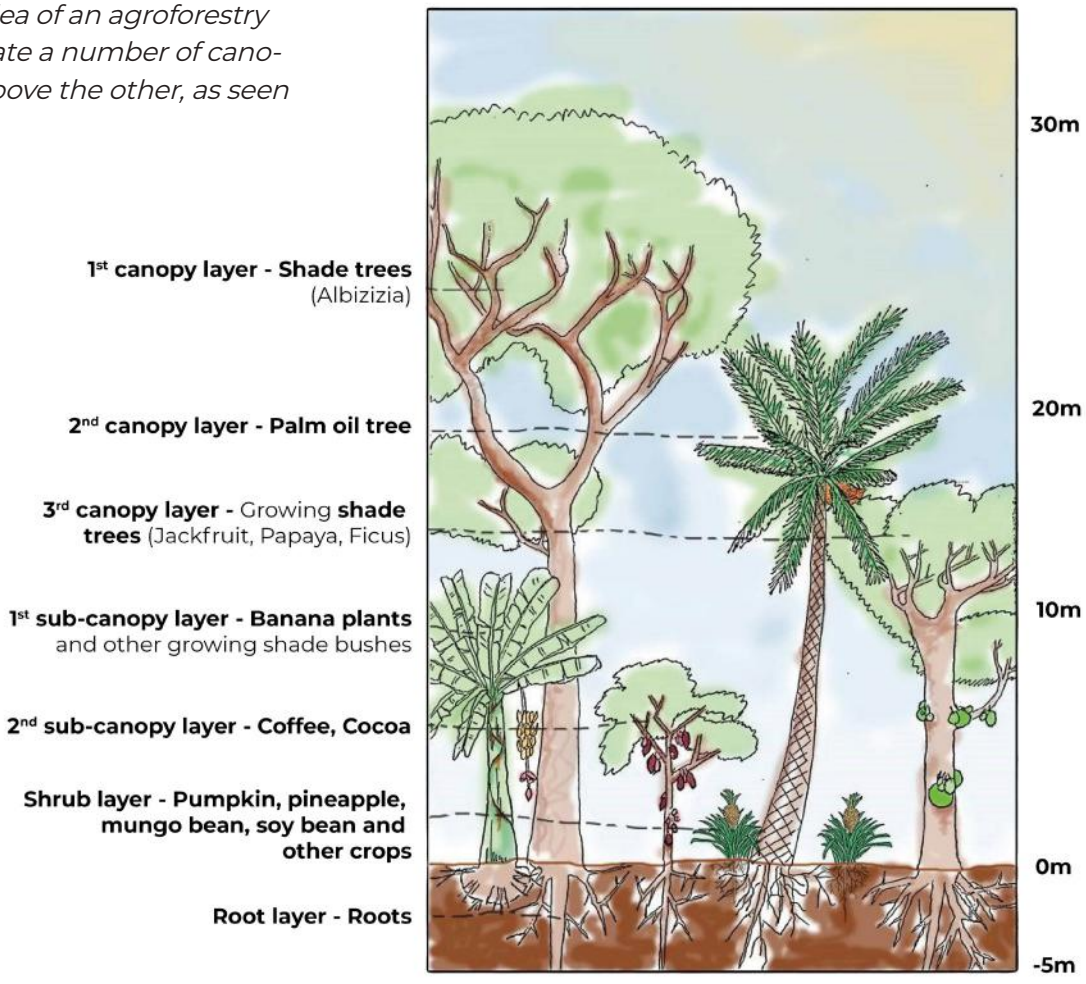
Naturlands standards requires that organic cocoa is cultivated in agroforestry systems appropriate to local conditions, under shade trees.

See Annex 3 for cultivation guideline information and detailed benefits.

The idea of an agroforestry system for cocoa production is to create a number of canopy storeys or layers based on the different heights of trees. In Figure 4 the tall Albizia zygia tree forms the first canopy layer, the oil palm the second, the jackfruit the third, and so on. One can divide the uses by showing the products the farmer can harvest and the ecosystem services provided by the different plants.

Cocoa grown in such a way provides cocoa beans for sale, cash income, and additional services and goods that directly or indirectly benefit the farmer. The diversification of food sources helps farmers become food sovereign by being more independent from cocoa prices.

Figure 4: *The idea of an agroforestry system is to create a number of canopy layers, one above the other, as seen in this diagram.*



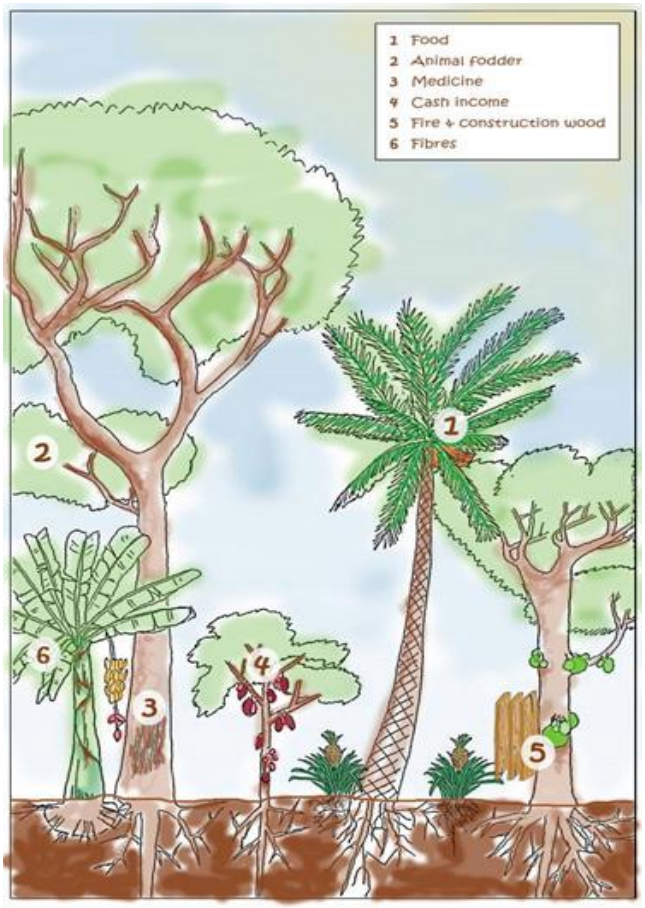


Figure 5:
Diagram showing the different products that can be derived from the components of the system. Please note that any one tree may yield more than the one product indicated here. For simplification of the diagram they have not been included, however.

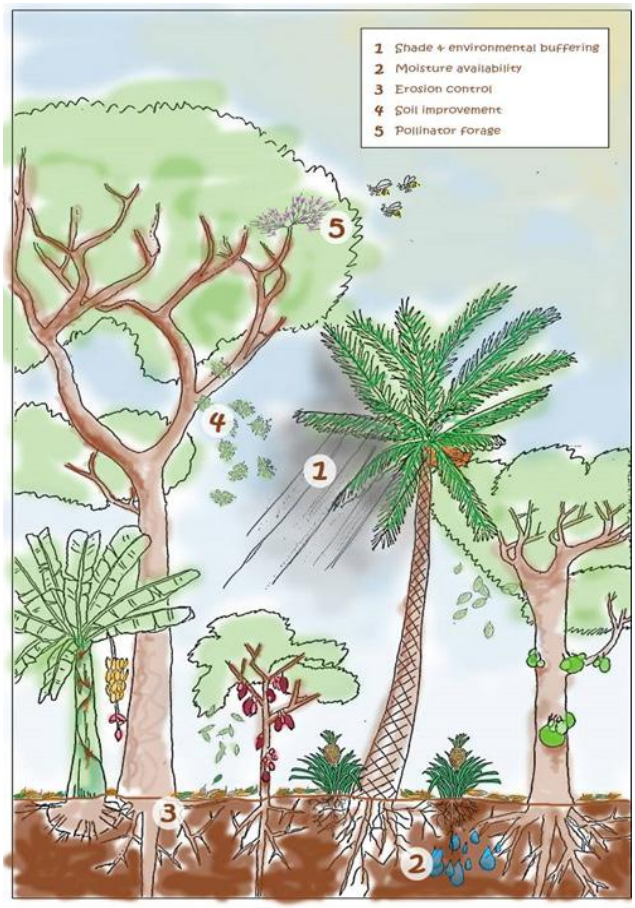


Figure 6:
Diagram showing the ecosystem services provided by the different trees. Again, please note that any one tree may yield more than the one service indicated here. For simplification of the diagram they have not been included, however.

Recommended Trees for Intercropping Organic Cocoa Plantations in South-West Cameroun

The following tables present recommended trees, fruit trees, timber trees and spices & food tree/crops for intercropping organic cocoa in South-West Cameroun. Please note that the recommended trees vary from region to region and the tables below are not valid for all countries and regions globally.

Fruit trees

Table 1: *Recommended shade tree species for Cameroon*

Common Name	Scientific names	Purpose
Plantains, banana	*Musaseas*	For food security; good management required
Oranges, lemons, limes	*Citrus sinensis, Citrus lemon, Citrus aurantiifolia*	does not provide biomass; can be with cocoa; local market
Plums (safou)	*Dacryodes edulis*	Good biomass provider; good local market
Bush mango	*Irvingia gabonensis*	Excellent for cocoa, good local market
Avocado (called pear)	*Persea americana*	Excellent for cocoa; can be easily pruned
Bitter Cola	*Garcina kola*	Excellent for cocoa
Mango	*Mangifera indica*	Excellent biomass provider; better be planted at farm boundaries
Oil Palm	*Elaeis Guineensis*	Important for cocoa production, but lower leaves have to be pruned; palm oil
Bread fruit, jackfruit (Bele food)	*Artocarpus altilis*	Income, food, up to 12 m

Timber trees

Common Name	Scientific names	Purpose
Boma tree	*Ceiba pendandra*	Excellent for cocoa; improves soil fertility; tall tree occupying space; poor timber quality
Iroko	*Milicia excelsa and Milicia regia*	Excellent for cocoa, very good timber, 30 – 40 m
African Mahagony	*Khaya ivorensis*	Excellent for cocoa, tall timber tree with light shade
Sapele	*Entandrophragma cylindricum*	Excellent for cocoa, wood is valuable, up to 45 m

Timber trees (continued)

Common Name	Scientific names	Purpose
Black afara	*Terminalia ivorensis*	Excellent for cocoa, self-pruning, fast growing, one of the mayor timber tree
White afara	*Terminalia superba*	Excellent for cocoa, self-pruning, one of the mayor timber tree
Camwood	*Baphia nitida*	Improves soils, high quality timber
Njabe, bush kennel (Moabi)	*Baillonella toxisperma*	Timber exploitation and oil for consumption, tall tree
Small leaf tree	*Albizia sp.*	Soil fertility, medicinal, good timber
Tuku-Tuku tree		Excellent for biomass production
Ayingah (Crying tree)		Good biomass provider, fast growing
Dousseh tree		Grows very tall, good biomass
Kombonbon		Food, income generating, tall tree
Drumer stick		Improve soils, medicinal
Guaria and Bubinga		Medicinal, timber
Gliricidia	*Gliricidia sepium*	Nitrogen fixing tree, most important shade tree for coca in Central America, good life fence. Not recommended explicitly for SW Cameroun; biomass production is not very high;
Leucaena	*Leucaena leucocephala*	Not recommended for SW Cameroun; no tall tree, much better tree for Intercropping cocoa with trees in SW Cameroun available
Moringa	*Moringa oleifera*	Can be useful in the beginning of new plantation, does not support shade, poor biomass production. Not really useful in cocoa plantation, but excellent source of food planted around the houses

Spices and food trees/crops

These trees and crops are good association with cocoa plants and provide a good source of income.

Common Name	Scientific names	Purpose
Njangsang	*Ricinodendron heudelotii*	Spice, Excellent for cocoa, fast growing, multi-purpose tree
Country onion	*Afrostyrax lepidophyllus*	Spice, up to 20 m, medicinal
Aidan tree	*Tetrapleura tetraptera*	Edible fruit, local medicine, up to 25 m
Febber tree	*Podocarpus sp.*	Income generating, food, medicinal
Ikongoh tree		Medicinal, repellent production
Ikakanga tree		Food, income, medicinal, up to 3 m
Water eye		Soil fertility, shed leaves during dry season
Bush pepper (black & white types)		Medicinal, food, income, soil improvement, low humidity
Alargathar pepper		Income, medicinal
Ibarba spice		Climber, food, lifecycle 1 year
Dunny mushrooms		Food, income generating

Benefits & Impact on Soils and Environmental Sustainability by practicing Agroforestry

- Reduced soil erosions
- Soil fertility improved
- Soil organic matter increased, more humus content
- Less nutrients leached
- Water holding capacity of soil improved
- Natural mulching by litter fall
- Biological activity of soil improved
- Nutrient and water cycling
- Microclimate more favourable for cocoa plants
- Multifunctional landscape mosaics

Impact on farmers‘ and community livelihood by practicing Agroforestry

- Food security
- Health and nutrition
- Cash income and market access
- Wood security: firewood, poles, sticks...
- Animal health and productivity
- Risk reduction, risk aversion
- Labor savings, however preparing and applying compost could increase the family labor input for cocoa farming.

Nutrient cycling on the plantation

The creation of organic material through mulching and pruning activities is sufficient for an economically viable production – provided a diverse and densely planted agroforestry system is in place.

Mulch

The creation of organic material through mulching and pruning activities is sufficient for an economically viable production – provided a diverse and densely planted agroforestry system is i n place.

All cocoa shells from healthy plants that remain after harvest must stay on the plantation. This means the fruits should be broken open on site, and the resulting shell material should be spread as evenly as possible on the ground (Figure 7)

Figure 7: *Mulching*

Nitrogen fixing plants

Nitrogen is an essential nutrient for cocoa's health and productivity; therefore, it is important to include various species of Nitrogen fixing plants in the plantation. This can be done by adding to the agroforestry system leguminous or Nitrogen fixing trees. In West Africa, *Albizia zygia* is such a tree. Leguminous trees are able to fix Nitrogen from the air and make it available to the plants growing around them, including the cocoa trees[3].

For example, recommended trees such as Small Leave tree, Camwood, and Aidan tree are fixing Nitrogen within their root systems.

[2] Legume species form relationships with bacteria called rhizobia. Therefore, the legume species provide the bacteria with sugars. In return, rhizobia bacteria fix nitrogen from air meaning converting atmospheric nitrogen into ammonia. Furthermore, various microorganisms transform ammonia to other nitrogen compounds that are easier for plants to use. Plants can take up nitrogen *indirectly* from the air via soil microorganisms and in certain plant roots.

Biological methods of plant protection

A very important aspect of organic cocoa production is the management of pests and diseases. Because chemical inputs except copper based products (a metal)[4] are not an option, the diversity of the agroforestry system and other biological control methods should be used to fight these problems.

The approach encouraged by Naturland makes use of a variety of methods such as:

- crop diversity,
- biological pest control agents (such as herbal extracts and beneficial fungi and bacteria species), and
- pruning to control pests and diseases.

Naturland encourages biological methods of plant protection

Cocoa Diseases

There are several cocoa diseases of which the black pod disease is the main one. Cocoa diseases are mostly caused by the following issues:

1. Cultivation in mono-cropping systems with insufficient diversity and amount of shade and crop trees
2. Bad maintenance, no regular pruning
3. Too little space between trees of the same species due to a failure to thin out the agroforestry system
4. Degraded or poor soils which exhibit a lack of organic material and wrong weed control
5. Unsuitable site (water-logged, too dry, or not enough soil depth for proper root development)

Effective measures are often only possible in the form of improvements to the whole system.

Black pod disease

The main disease farmers in the South-Western region of Cameroon are facing is the black pod disease caused by the fungi *Phytophthora palmivora* and *Phytophthora megakarya*. These fungi spread rapidly on the cocoa pods affecting both the external and internal parts leading to poor yields and poor-quality beans.

Black pod disease occurs by excessive rainfall (1037–1604 mm), relative high humidity (70-100%) insufficient sunshine, low temperatures (23-32°C)), and swampy farm areas, resulting in high moisture content and soil dampness. Dark and poorly ventilated areas on the farm are often more likely affected, which happens when cocoa shrubs are planted too close to each other. Good farm sanitation and good organic management techniques allow farmers to get black pod controlled at the very beginning stages of its spreading.

[4] Application of copper derivatives **up to 3 kg pure copper per hectare are allowed** according to Naturland organic producer standards.
[4] Meaning that biomass of weeds including roots was completely removed from the sites, and not given back via composting. Weeds should only be cut down, the roots should be left in soil and not be removed.

Symptoms of black pod manifestation

Infected pods firstly show signs of yellow or brown spots which eventually become black and spread to the whole cocoa pod, which is visible after 5 days. The lesions develop quickly and cover the whole pods within 8 days, both externally, as well as internally.

The growths of white mycelia (spores) on the black pods are visible 11 days after infection.

Figure 8: *Symptoms of black pod disease*
From left to right: Yellow or brown spots, advanced black pods symptoms, black pods with white mycelia (spores)

Black pod disease spreads to healthy cocoa pods through splashes of rainwater, by wind, plant to plant contact, ants, squirrels, monkeys, direct contact between pods and other vectors. Also infected flowers of mature cocoa trees and moss harbor the spores of black pod disease. The infection occurs at any stage of pod development. This causes wilting and dying of young pods. P. palmivora can also cause branch and trunk cankers. Cankers on the trunk of the cocoa plants can extend to the main roots. Now the infection moves from the ground upward to the canopy of the cocoa trees. Reddish gum is coming out of the cankers reducing the life of the tree thus affecting the yields.

Susceptible Clones

Some Clones, such as ICS95 and SCA6 are highly affected by the black pod disease.

- ICS95: Purple in colour almost round with big leaves. High productivity mostly in the dry season.
- SCA6 is also highly affected with high rate of black pod. The cocoa pod of SCA6 is green in color, very rough surface, deeply ridged and elongated shape. SCA6 has an early maturity.

Management of Black Pod disease

The main management practice for black pod disease is good farm sanitation, which means regular and adequate pruning should be carried out. This shade management will reduce the level of humidity and allows sunlight to penetrate and air to circulate. Additional management practices are planting and soil management practices.

General black pod disease management practices:
Carry out:

- regular farm inspections to remove all diseased, dead and pods with early symptoms immediately when you see them (Figure 9). Dig a pit and bury all these pods away from the cocoa farm.
- regular sanitary harvesting of ripe and healthy pods to prevent post-harvest infections. During phytosanitary harvest, avoid touching healthy pods; otherwise, pathogens from diseased pods will be transferred to healthy pods.
- periodic weeding under trees to reduce humidity in the cocoa plantation.

Remove from infected cocoa trees:

- all cocoa shells around the cocoa stems after pods breaking,
- all chupons, moss, and climbers from the cocoa tree, and
- ant hills and ant castles on the surface of cocoa trunks.

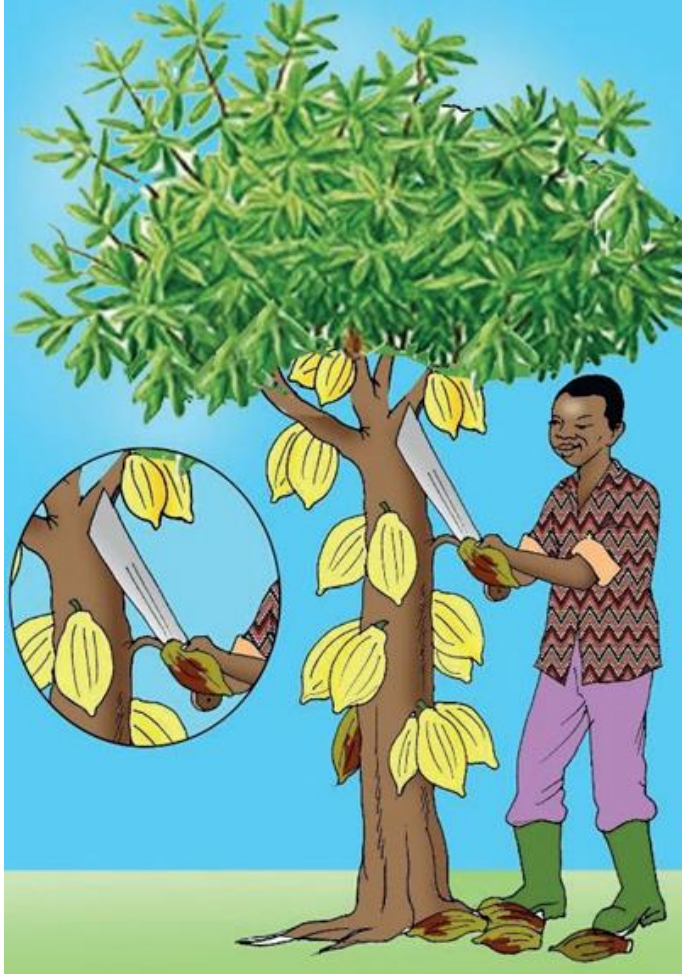


Figure 9: *Removing diseased pods from cocoa trees*

Correct planting to control black pod disease

Space between the cocoa plants is very important to keep humidity low. The planting distances of cocoa plants should be 3m by 3m. Maximum 1110 cocoa trees per hectare and maximum 70 accompanying trees (Figure 10).

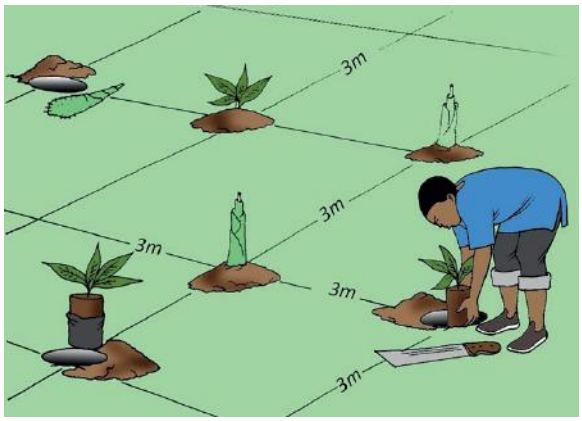


Figure 10: *Planting space between cocoa trees*

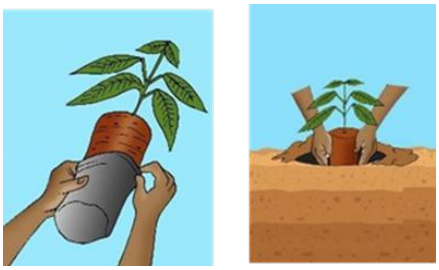


Figure 11: *Planting cocoa seedlings*

Improved and resistant varieties of cocoa should be planted. Seeds should be selected from healthy and resistant parent stock. If black pod-resistant cocoa material is available, propagate and plant this material on the farms. If not available, seek out healthy trees during the black pod season so that you can use their shoots for grafting old trees when rejuvenating your plantation. Seedlings should be planted well apart and in a well-drained site (Figure 11).

Soil Management for controlling black pod disease

Soil health is essential in many ways and for controlling black pod disease. ”Healthy soils” have lots of organic matter and good drainage.

- Create high organic matter in the soil with a diverse and abundant microbial activity through a diversified agroforestry system.
- Create a good drainage system without standing water on the farm. When establishing new cocoa farms, avoid areas known to have black pod-infested soil.

Application of plant protection products against fungal diseases

Spray only products allowed by the Naturland Standards for Organic Production (found at www.naturland.de/en/ Naturland Standards, Appendix 1 and Appendix 2).

- Respect the recommended dose.
- Respect the application period:
  - Spray in March and April with copper hydroxide, such as Kocide 2000. Cocoa pods should still be finger size.
  - Use Copper oxide such as Nordox 40 and Nordox 75, especially when the rains become heavier. This is done from June to September, depending on the infestation rate.
  - Application of copper derivatives **up to 3 kg pure copper per hectare** (according to Naturland standards).
  - Target the leaves and fruits during spraying at the base of the trunk moving upward.
  - Do not spray during the onset of flowering to avoid damage and abortion of cherelles (pollinated flowers developed into immature pods).
  - Wear protective clothes such as long sleeves and trousers, a hat, gloves, mouth/nose cap and boots while spraying.

Pests

Capsids

Capsids, or mirids, are sap-sucking bugs. These insects attack by piercing the surface of the cocoa stems, branches, and pods to suck the sap and cause the tissue to die.
In organic cultivation, capsids also pose the most significant risk for production. A population of 6 capsids per tree is already endangering the tree. The lesions on the pods are circular, while the lesions on the stems are usually oval and of a larger size.

Capsids feed on the sap of trees. They are good flyers and active during the day’s warm hours. In the evening, they hide in the tree. A good method to observe the infection rate is to put plastic paper under the tree, then shake the tree. While shaking the tree, the capsids will fall down; this way, you can observe the infestation rate.

Figure 12: *Capsids*

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Control measures against Capsids

There are three main control measures against capsids described in detail below: Proper farm management, promotion of plant and insect diversity on the farm, and an adequate shade and light management.

Farm management

Carry out proper and timely farm sanitation and regular farm inspection.

- Remove infested pods, chupons, and suckers.
- Prune regularly from April to June (especially young branches in the lower part of the tree, which attracts capsids).
- Weed on the cocoa farm between November and February. Heavy clearing is done on the farm to keep it free from weeds and airy. Ring clear around the tree stem from May to June.
- Remove moss regularly. Use a hand brush to brush down moss from the trunks with water before flowering begins.
- Keep buffer zones clean.

Diversity on farm

Promote plant and insect diversity.

- Promote primarily beneficial ants, praying mantis, other beneficial insects, birds, and lizards through a diversified system, where trees and crops on the same land there are more nesting sites and food resources for them .
- Plant a good diversity of trees in the cocoa plantation, mainly plants or crops associated with repellent characteristics against capsids and other devastators. Examples are country onions, citrus and bush mango trees.

Good shade management

Avoid too much shade due to higher risk of black pod disease and too much light. Capsids prefer light conditions at the top of the trees: the more light, the more capsids.

- Plant tolerant varieties.
- Select planting materials from vigorous seed/plant.
- Plant density should be regulated.
- Several trees are known to serve as alternate hosts of Mirids, including *Cola sp., Theobroma sp.* and *Adansonia digitata* (Baobab). These should not be used as shade trees on cocoa farms.

Moss

Moss reduces the chances of flowers to develop. It is a very good hide out for capsids and other pests.

Biological control of moss
A soft brush can be used to remove the moss from the cocoa tree. Care should be taken not to wound the stem of the cocoa tree. Moss can highly affect the production of cocoa if not managed well.

Plantation maintenance

Pruning
"Cocoa starts with pruning"
Pruning is essential through any stage of the plantation. The cocoa tree should get the right architecture from the very beginning. Regularly work on its shape by regular pruning needs to be conducted (Figure 13).

In the first years of the cocoa tree, it is crucial to ensure the trees do not grow too tall and have the right shape. The correct shape allows the cocoa trees to capture maximum sunlight with minimum branches without leaving holes in the canopy. This is done by removing branches that trees do not need (Figure 14).

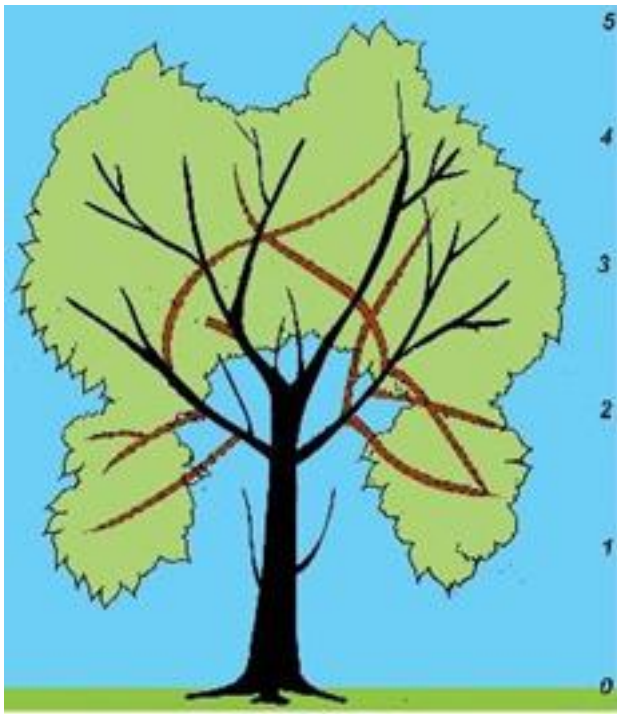


Figure 13: *Removing the right (brown color) brunches to make space for the light*

Figure 14: *Cutting branches of cocoa tree*

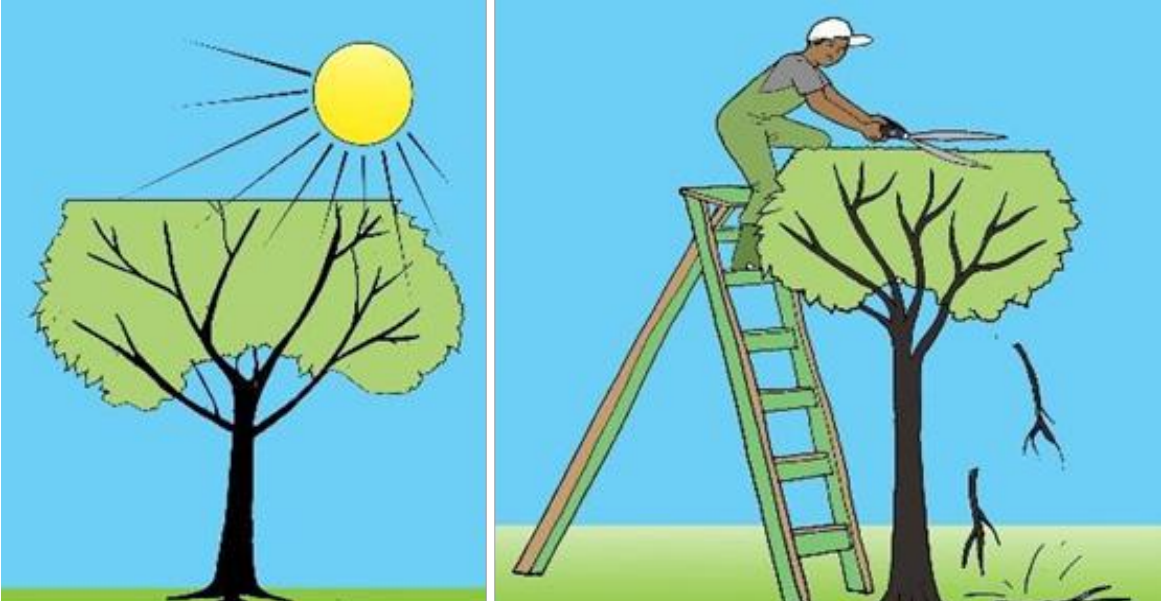


Figure 15: *Well shaped, maximum 4 meter high*

A well-shaped cocoa tree has a single, straight trunk. A crown of 3 to 5 main branches forms about 1.5 metres above ground level. A tree should be at most 4 meters high (Figure 15).

During the first year, sometimes several shoots form on the trunk. Cut off these shoots and leave only the strongest.
Sometimes the crown forms too low down, at less than 1 meter above ground level. Choose a shoot that grows straight up and let it develop. A new crown will form at a good height, and the first crown will stop growing. When a young tree is about 1,50 meters, you can allow the plant to start having branches.

Shape pruning is best done at the beginning of the rainy season after most leaves have dropped and trees have no pods yet. Leave enough branches and leaves to make sure little or no sunlight reaches the ground, as this will increase weeds. You can prune cocoa trees more severely when there is shade from other trees.

Removing new shoots and new branches that are not needed for the health and strength of the tree throughout the year is called maintenance pruning. This type of pruning can be done at any time of the year:

- Respect the application period:
- Take away any chupon that is coming out straight.
- Remove all dried branches and forgotten pods.
- Cut always out all dead branches and dry twigs.
- Remove all suckers; these are twigs that grow upward out of the trunk. Chupons and suckers must be cut off very close to the tree trunk.
- Prune regularly; this will help significantly in improving plant hygiene (Phyto sanitation) and thereby reduce the incidence of pests and diseases.
- Always prune with very sharp cutters/machetes; if they are not sharp, you stress the cocoa too much. Pruning can be compared to doing an operation.

Figure 16:
Well pruned cocoa tree

Good pruning means less pests and diseases, good flower development, easier harvesting, maintenance, and spraying of copper.

Weeding and mulching

During the first three years, the cultivation measures consist almost entirely of selective regulation of weed growth. The grasses and flowering weeds are cut down and used as mulching material, which improves soil quality and nutrient availability. Trees that do not lose their leaves need to be radically trimmed during the blossoming period of the cocoa trees (6 months before the main harvest begins). This is necessary because cocoa blossom tends to take place due to a higher availability of light. The resulting organic material should be chopped and spread out over the soil as green mulch. Diseased plant parts and fruits should be removed and buried (Figure 17).

Figure 17: *Handling of diseased pods*

Harvest and post-harvest steps

The quality of cocoa beans determines the price. Therefore, it is important to ensure the highest possible quality of the beans. To ensure high quality of beans, all treatment steps need to be handled with care, starting at harvest and ending at storage.

Harvest begins when the fruits are completely ripe. Ripe fruits have an orange discoloring of the shell. The usual harvesting phases in the South-West region are from June to November. It is advised to harvest all the ripened fruits every 30 days to achieve a uniform ripeness of the harvested fruits. Make sure to harvest only those pods that are fully ripe.

The best way to avoid harming the bark is to cut off the fruits at the base of the blossom with a sharp knife, secateurs, or other suitable tools.

Overripe and diseased fruits should not be mixed with healthy cocoa fruits. Process them separately. If the fruits are harvested when overripe, then germination can already have begun in the shell. A large number of already germinated cocoa seeds will not pass quality control.

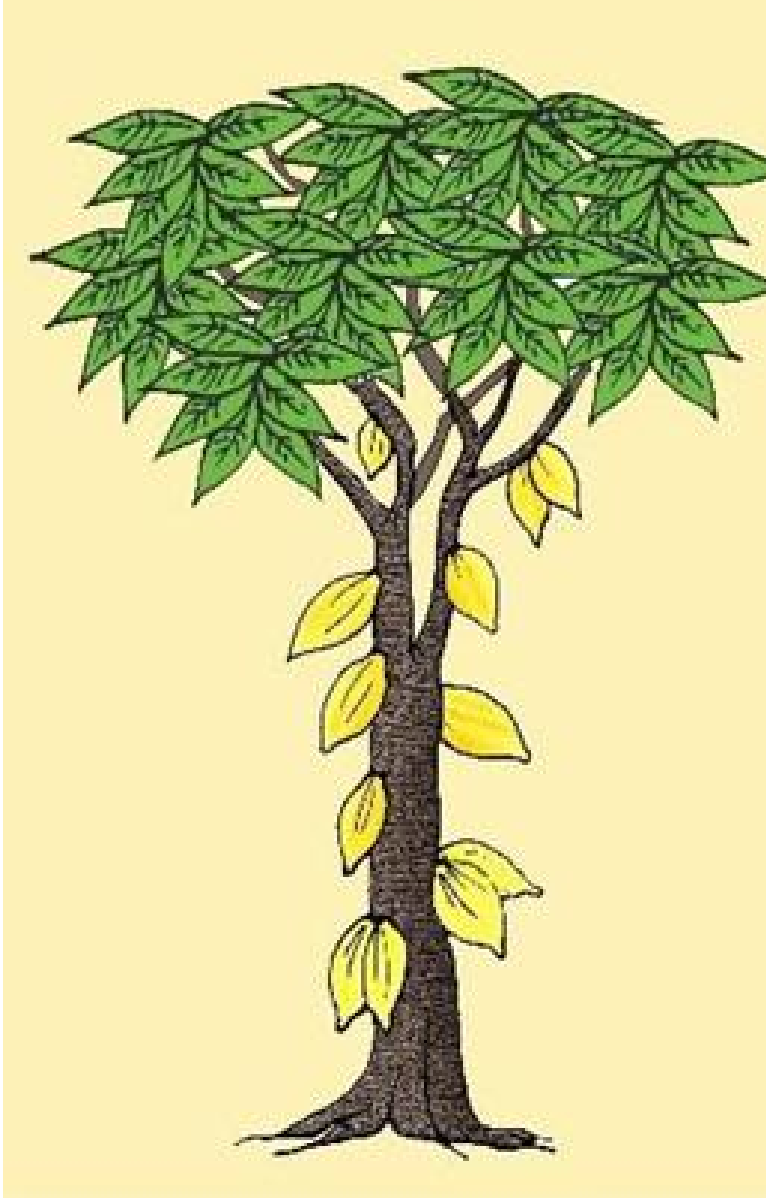


Figure 18: *Ripe cocoa pods*

Ripe cocoa fruits are split open (either in the field or near the fermenting places) with a large splitting knife or iron bar or piece of wood or cracked on a hard surface (stone or wood), taking care not to harm the seeds (Figure 19).

Figure 19: *Splitting open cocoa fruits with a knife*

Processing of the beans

Fermentation

The aim of fermentation is to remove the fruit pulp residues that remain, kill off the seed, and commence the development of aroma, taste and color in the beans (Figure 20, 21). In Table 2 an overview of the different steps is given.

Fermentation should be finalized within 6 days. Fermentation is ideal when using baskets and boxes.

Figure 20: *Fermentation of cocoa*

Aeration ↓↓↓ Day 1	Aeration ↓↓↓ Day 3 to 4	Day 5 to 7
· fruit pulp strongly acidic (pH 3.5)	· contents acidic (pH 4.5)	· contents slightly acidic (pH 5.5)
· contents white in colour	· contents light brown in colour	· contents brown in colour
· pH 6.5 in seed interior	· pH 4.5 in seed interior	· pH 5.5 in seed interior
· violet colour of seed interior	· violet colour of seed interior · edges brown	· brown colour of seed interior
· no development of heat	· temperature increase of contents to 45-50 °C	· temperature decrease of contents to 40 °C
· smell swee-sour, aromatic	· strong smell of acetic acid	· smell of acetic acid somewhat weakend

Table 2: *Overview of fermentation*

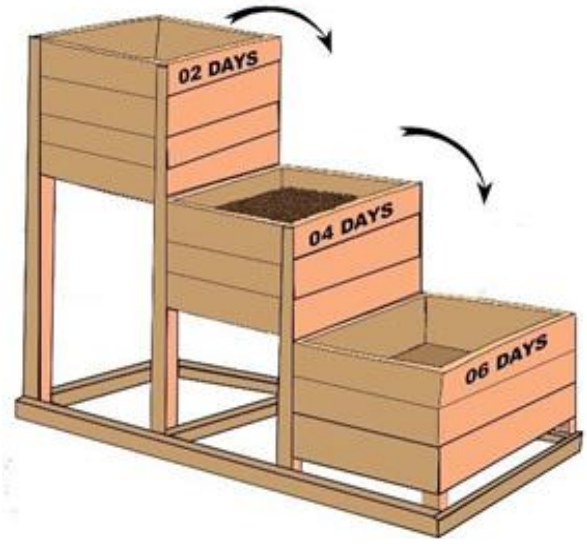


Figure 21: *Fermentation in boxes*

Drying

After the fermentation process, any unripe or damaged beans must be sorted out and the rest dried to develop the typical chocolate aroma. The starting water content level in the beans is around 55%, which must be reduced through drying to around 6-7% before the beans are stored.

Figure 22:
Drying cocoa under the sun

It is important to dry the cocoa beans carefully to maintain certain stability and storability. The beans are dried on equipment specially created for this purpose, such as reed mats, or wooden, plastic, or metal racks (Figure 22). When drying on bands or tarpaulins, the beans need to be placed high enough above the ground to prevent them from becoming dirty by animals or dust. Drying in solar dryers brings the best effects.

Sunlight will increase the browning process and the development of aroma. Slow, careful drying in the sun can take up to 7 days. It is important to turn the cocoa beans by often raking them through with a large rake; this will ensure that the beans are dried uniformly and carefully. Drying apparatus that utilize warm air are recommended for use in those regions where it is often cloudy during the harvest season. Yet it is important to note that the cocoa should not come into contact with the fumes from the fuel as this would adversely affect their taste and smell, and, therefore their quality and price.

Figure 23:
Storing of coca bean

Storage

High temperatures and humidity levels cause a rapid infestation during storage with pests and mold fungi. Because cocoa is strongly hygroscopic, even a product that has been well dried can rise in moisture content up to 10% in regions with 80-90 % humidity, and thereby lose its capacity to be stored, the critical value for which is 8 %.

The cocoa should be stored in air- permeable sacks in a dark, dry and well- ventilated room on the production site for only a short time. Best would be 16 °C and a relative humidity of 55% for short- term- and 11°C and a relative humidity of 55 % for long-term storage. The sacks should be stacked on wooden planks or boards.

Sacks made from organic fibers (e.g. jute, sisal) are recommended (Figure 23), but not if they have been treated with pesticides. The cocoa butter part in the cocoa shell is an excellent solvent for chlorinated hydrocarbons. These diffuse into the cocoa seed through the outer shell when they come into contact with jute or sisa bags treated with chemicals. In such cases, tests have shown limits for certain agricultural poisons being exceeded – although no pesticides had ever been used on the site.

On organic cocoa plantations, it is not permitted to use either insecticides against storage pests, or to gas the beans. So, beans may not be stored in conventional warehouses.
Should the organic cocoa beans be stored alongside conventional ones it is important to avoid mixing these two. This is best achieved by training and informing the warehouse personnel, having explicit signs in the warehouse (silos, pallets, tanks etc.), establishing color differentiation (e.g. green for the organic product) and documenting incoming/dispatched goods separately by keeping a warehouse logbook.

Wherever possible, storing both organic and conventional products in the same warehouse should be avoided.

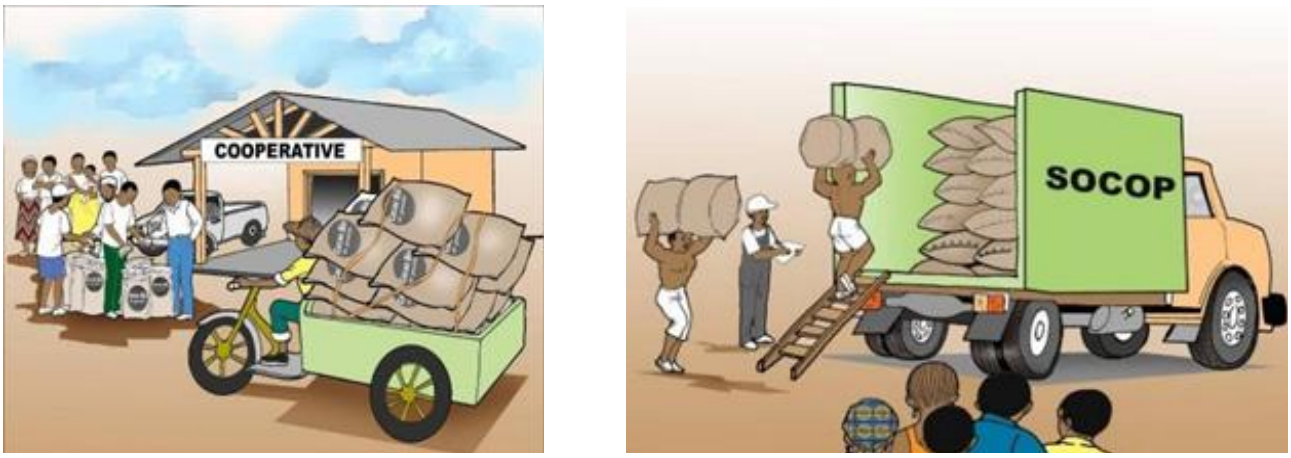


Figure 24: *Storing and transporting cocoa*

ANNEX 1

Starting a new plantation

When choosing the site for a new plantation the natural requirements of cocoa should be observed. Ideal sites are those with well drained alluvial soils. Sites that are irrigated from wells are also favorable. Unsuitable sites are those with steep or convex slopes.

When creating a new plantation, care should be taken to reproduce as closely as possible the natural structure of forests (i.e. creating an agroforestry system). This means that all crops and trees that are to be cultivated along with cocoa in the agroforestry system should be planted at the same time (or even earlier) as the cocoa trees themselves. The best method is to leave an area free for natural growth, and to plant trees and crops which will rapidly provide shade, such as bananas and manioc, and to plant the cocoa in-between them at a later date. In this way, the biological activity of the soil is maintained, and the mycorrhiza of the cocoa can begin to develop immediately.

The general idea is to mimic natural succession of an ecosystem. This means that the system will evolve from a pioneer stage (short lived shrubs and annuals dominate) to a climax stage (long lived trees dominate). In this way the farmer can harvest different crops from the first year onwards and the diversity of the evolving system gives it stability and improves cocoa yields. Note that all crops are planted simultaneously and as time goes by the shorter-lived ones will disappear while the longer lived ones mature and start to bear fruit and pods. An important effect of this approach is that the soil is covered at all times and therefore soil quality is maintained or improved, which is very important for obtaining good cocoa yields.

Choosing the trees that are to be included in the agroforestry system depends on which species are available in the region and their uses to the farmer and the system as a whole. For example, it is always a good idea to incorporate a number of trees that provide human and animal food, medicine, shade, soil fertilisation, construction, firewood and protection from soil erosion. See the chapter on agroforestry with recommended trees for Intercropping Organic Cocoa Plantations in South-West Cameroun with Fruit trees, Timber trees and Spices.

Apart from the possible combination given in the example for West Africa (see figures in the chapter on agroforestry), an endless number of combinations are possible. The best method is to re-forest in between existing trees and to fill up spaces that open up after unproductive cocoa trees have been removed.

ANNEX 2

Cocoa Nursery Management

The nursery should be located near a water point which does not dry up in the dry season or a location with another possibility for irrigating the nursery and ideally on a flat or slightly hilly surface. A shade of 2m height should be raised and shaded with palm fronds to protect the tender seedlings from the direct intensity of sunlight and heavy droplets of rain fall (Figure 25).
Select rich humus soil either from the backyard or from compost rich in organic matter.

Figure 25: *Cocoa nursery*

Fill soil in perforated plastic black polythene bags and fill up to the upper edge of the bags (Figure 26). The bags are placed in double line (rows) and slightly buried to ensure proper grip.
Keep a distance of 60cm between each double row for movement during maintenance and watering of the plant (Figure 27).

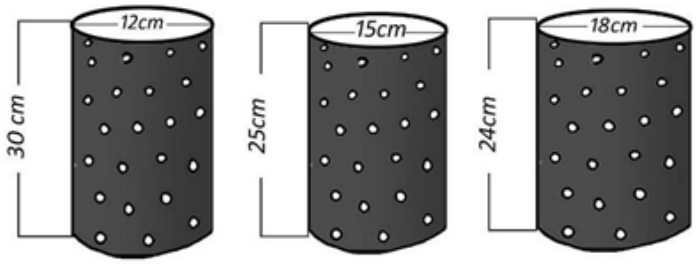


Figure 26: *Sizes of polythene bags. Bags can be 30 cm in height and 12cm in diameter.*
25 cm by 15cm or 24 cm by 18cm.

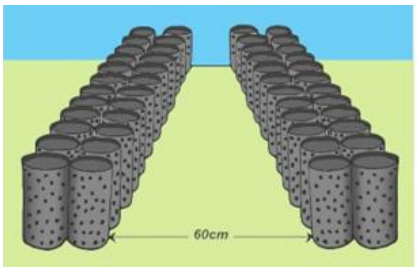
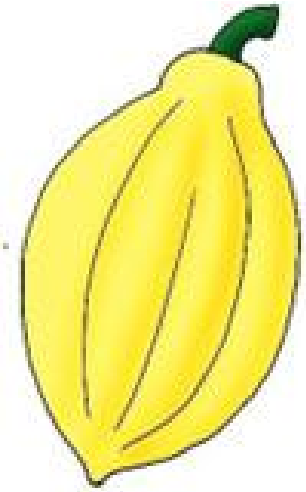


Figure 27: *Placing the perforated plastic black polythene bags at the nursery*

HOW TO PREPARE SEEDS

- Choose pod from seed gardens or fields.
- Select cocoa pods from matured highly resistant and productive trees (clones).
- The selected ripe pod should be in good condition.
- Good pods can contain an average of 30 beans. The pod breaking must be done with a club/stick instead of using a machete.
- Proper watering should be done at the evening before planting.
- Break open the cocoa pod and remove seeds from both edges of the pods from the third roll and discard them either for fermentation or consumption.
- Select seeds from the inner portion in the cocoa pods. Use saw dust or dry plantain leaves to clean the beans and get rid of mucilage to reduce chances of attracting insects and other predators.
- Eliminate flat beans, too small beans, and sprouted beans.
- The beans should be treated with nega-mogi (Neem leaves) or other organic insect repellent.
- One viable cocoa bean should be placed flat in the filled bags and press into the soil at 1 cm deep.



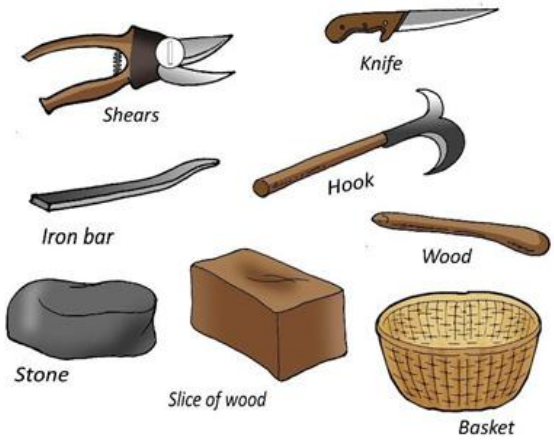
- 25 bags will occupy 1meter square of land space.
- 50 to 60 pods of cocoa will cover one hectare of land in the nursery.
- The cocoa seeds will start germinating from the 5th day of sowing.
- Carry out watering every two days and regular nursery management.
- Progressively reduce the shade one month before transplanting to customize the plant for heavy sun light.
- Seedling will be ready for transplanting from 6 to 8 months and some cocoa seedlings will attend a 70 cm to 80 cm height.

GRAFTING OF COCOA SEEDLINGS

Requirement

- The grafting knife with a special design for budding and grafting
- The scion. Got from reproductive cocoa plants which mature and already produce cocoa pods.
- The root stock. Got from germination of beans. The seedling should be 6 months to 8 months old with the stem like the size of a pencil.
- Razor blade use for peg grafting
- Tie band. Plastic elastic paper to wrap the patch.
- Alcohol and cotton. Use for disinfection of the root stock, scion and all equipment before grafting process.
- Secateurs

Figure 28: *Grafting tools*



ANNEX 3

Naturland Standards and Cultivation Guidelines for Cocoa

The cultivation of cocoa has additional specific requirements that apply to Naturland's standards: The organic cocoa to Naturland's standards is cultivated in agroforestry systems appropriate to local conditions, under shade trees. The important protective functions of trees in tropical ecosystems in maintaining the fertility of the soil, protecting it from erosion, maintaining the water balance, protecting drainage areas, maintaining biodiversity, binding carbon dioxide as a contribution to the protection of the climate, in moderating extremes of climate and as a provider of nutrition are to be encouraged by integrating shade trees in the cultivation system.

Where there are no shade trees, the conversion plan must determine how and where shade trees are to be planted depending on local conditions. The diverse products of an agroforestry system employing shade trees must be used in a sustainable manner which must be laid down in a management plan. Their exploitation may not be detrimental to the positive environmental effects of the agroforestry system.

The species of trees used are those which are adapted to local agroecological conditions. Indigenous species are to be used to encourage the variety of tree species.
Shade trees and cocoa grow in tiers and create a wide variety of structures. Depending on local agroecological conditions, the following recommendations apply to shade trees:

- at least 70 shade trees per hectare and 40 % all year coverage with shade trees,
- at least 12 different varieties of shade trees per hectare, the principal variety of tree not exceeding 60 %, and
- cocoa and shade trees should consist of three tiers, or at least two. In the case of three floors, the top tier consists of old trees.

Where there are justified exceptions to planting shade trees, for reasons of climate, buffer areas or agroforestry systems are to be installed to guarantee equivalent environmental performance.
More information at: www.naturland.de/en/

70 Shade Trees per Hectare

To determining the number of shade trees first:

1. Complete inventory for small plots: enumeration of shade trees
   → At least 70 trees per 1 ha
   → At least 140 trees per 2 ha

2. Enumeration of shade trees on 20x20m: at least 3 trees

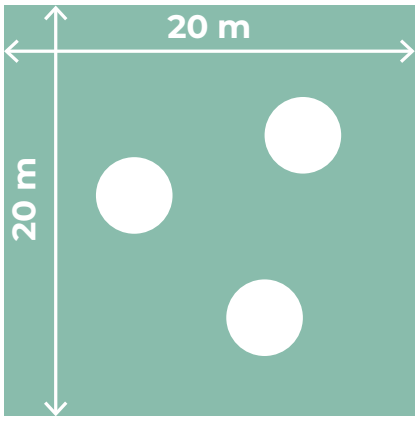


Figure 29: *Enumeration of shade trees on 20x20m*

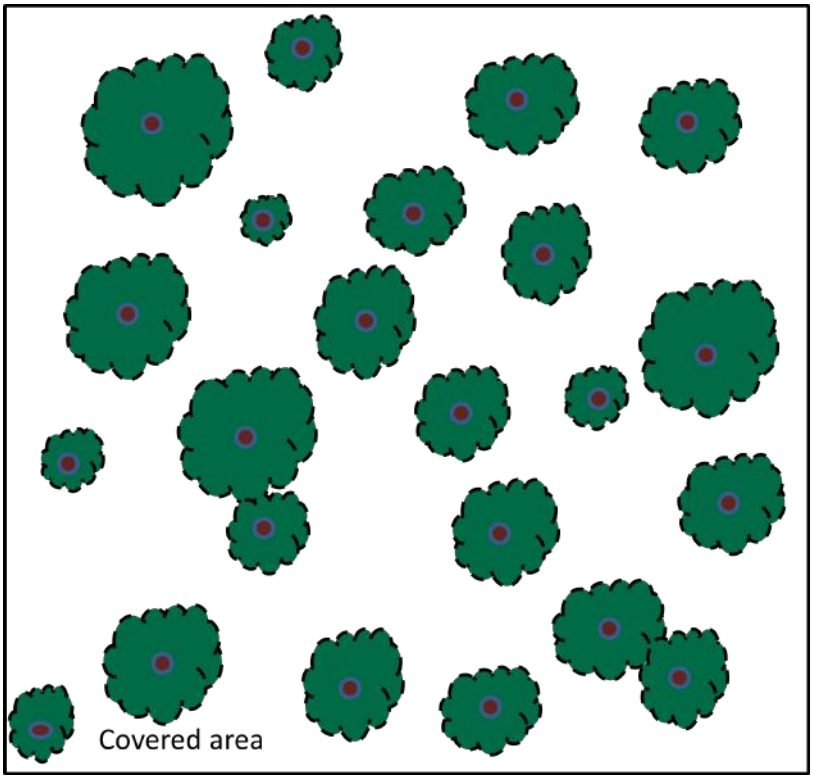


Figure 30: *Shade/canopy coverage approx. 40 %*

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