

9-13 COFFEE



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9-13 COFFEE



FACTSHEET 13: COFFEE

Learning targets for farmers:

- › Learn good husbandry practices of coffee trees
- › Understand proper propagation techniques of coffee seedlings
- › Learn how to properly establish a coffee agroforestry system
- › Receive guidance on marketing and organic certification of coffee production

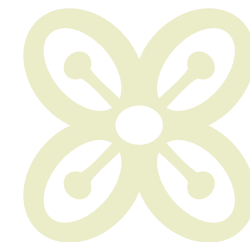
1 Introduction

Coffee is a major commodity on the global market. In Africa the crop is grown in many sub-Saharan countries and mainly by small-holder farmers. Although many species of coffee exist, commercial production is based principally on *Coffea arabica* and *Coffea canephora*, commonly referred to respectively as Arabica coffee and Robusta coffee. Arabica coffee grows better at higher altitudes, while Robusta coffee is better suited to warmer, more humid lowland environments.

Common challenges to coffee production in Africa

Coffee production in most major producing African countries is reported to be declining. The decrease in productivity has been attributed to a range of factors, mostly production related, such as:

- › **Low yields** - Most coffee comes from very old and poorly managed coffee gardens with old trees. Since coffee is a perennial crop that can produce coffee beans for many years, most farmers leave it to overgrow and only remember it at the time of harvest. Such old and poorly managed trees usually have reduced production potential.
- › **Declining soil fertility** - Most farmers leave coffee plants to grow naturally and do not give much attention to them. They harvest the coffee every season, but do not add any nutrients essential to soil fertility. Even the coffee husks after pulping in wet processed coffee are taken to plots where annual crops are grown (in dry processed coffee the husks are sold along with the coffee). As a result, soil is continuously mined and its fertility continues to decline.





CHALLENGES FACING COFFEE PRODUCTION



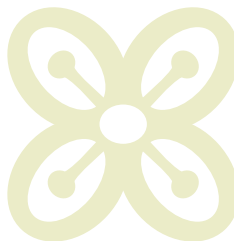
- › **Soil erosion** - Soil erosion is most common in the Arabica systems at higher altitudes. It is also a problem in Robusta systems on sloping land. Without erosion control measures, running water from uplands washes down the nutrient-packed topsoil into the lowlands. Lack of appropriate erosion control measures encourages soil degradation and decreases productivity.
- › **Use of poor quality planting materials** - Coffee is normally treated as a side crop and given very little attention. Many farmers use undergrowths from fallen berries under the coffee trees as planting material. This practice negatively affects the quality of the transplanted seedlings and eventually the coffee trees.
- › **Pest and disease problems** - The larvae of the Coffee Berry Borer (*Hypothenemus hampei*), which feed on the coffee beans, can result in total yield loss. The coffee wilt caused by the fungus *Fusarium xylarioides* is a major disease threat to the coffee industry in Africa. It has been reported in all major coffee producing countries like Uganda, Democratic Republic of Congo, Tanzania (on Robusta coffee) and Ethiopia (on Arabica coffee).
- › **Low returns from coffee production** - Although most coffee is grown under low input systems, the costs of production are reported to be increasing. The major costs include hiring labour for weeding, general maintenance of gardens, harvesting and postharvest handling. At the same time coffee prices are decreasing. This situation has forced many farmers to abandon their coffee fields for other crops.
- › **High postharvest losses** - When coffee prices increase, many farmers harvest coffee berries prematurely (green or half green) hoping to get more money. Such beans will then be sorted out during milling and grading. Poor handling during drying results in additional losses. In some areas, lack of coffee pulping machines for wet processing lead to more postharvest losses.
- › **Limited knowledge on organic market potential and certification** - The market for organic coffee is reported to be growing, especially in the export markets of Europe, USA and Japan. In order for farmers to benefit from these premium export markets, they need to conform to organic production requirements and certify their systems according to the applicable organic standards.



Discussion: Assessment of the local situation

Inquire about the farmers' knowledge of coffee production and especially about the common challenges faced in coffee production by asking the following questions:

- › Do you experience any of the above or other challenges?
- › How have you tried to address them?





A WELL-MANAGED COFFEE GARDEN

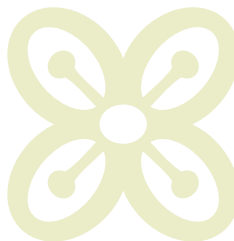


As a result of the many challenges associated with coffee production, many African coffee farmers are increasingly abandoning coffee for other crops. This situation calls for interventions, making the coffee production more sustainable and profitable for the producing communities. This chapter introduces organic approaches to address coffee production challenges, which can be adapted to the prevailing local conditions.

2. Selection of good planting material

Selection of good quality planting material begins with the selection of suitable coffee species for the local climate. Arabica coffee does well at higher altitudes while Robusta coffee grows better in hotter and more humid areas at lower altitudes. At a moderate altitude of about 1200 to 1500 metres, both Arabica and Robusta varieties can be grown. However, the prevalence of the berry borer and coffee rust are important indicators as to whether the coffee variety is suited to the site conditions. For example, an Arabica plantation at this altitude that is heavily infested by coffee rust and berry borer despite good management conditions is an indication that Arabica is not suited to the site and should, in time, be replaced with Robusta.

In addition to the coffee species, varieties which are resistant to common diseases like coffee wilt disease (CWD), coffee berry disease (CBD) or coffee leaf rust (CLR) should be selected. These improved varieties can be obtained through local extension officers or coffee research stations. It is advisable to plant different varieties in a coffee garden. In case one variety develops susceptibility to a certain pest, disease or even an environmental stress, then the whole field will not be threatened to be wiped out.



Common varieties grown in selected countries:

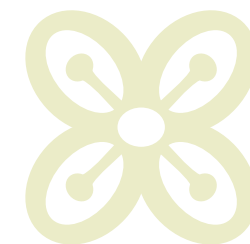
Variety	Species	Country	Comments
Ruirii II	Arabica	Kenya	For all areas, resistant to CBD and CLR
SL 28	Arabica	Kenya	Medium to high areas without serious CLR
SL 34	Arabica	Kenya	High areas with good rainfall
K7	Arabica	Kenya	Low areas with CLR
Batian	Arabica	Kenya	Resistant to CBD and CLR
Arusha	Arabica	Tanzania	
Ethiopian Harar	Arabica	Ethiopia	
Ethiopian Sidamo	Arabica	Ethiopia	
Ethiopian Yirgacheffe	Arabica	Ethiopia	
Nganda and Erecta clones	Robusta	Uganda	Mainly for clonal coffee
Tuzza (catimor)	Arabica	Uganda	Low areas, resistant to CBD
Java	Arabica	Cameroon	Resistant to CBD

In Africa, coffee is commonly propagated by seed. This is because it is easy and quick to raise seedlings by seed. Such coffee does, however, take longer to grow than vegetatively propagated coffee. Vegetative propagation (e.g. by clonal cuttings) has the advantage that the coffee will carry all the qualities of the parent plant. Cuttings are ideally obtained from selected mother gardens of desired varieties (e.g. with resistance to common diseases or high yielding). A mother garden is a parent garden reserved for supplying cuttings/scions for multiplication of given varieties. Coffee plants raised from clonal cuttings bear fruits 24 to 36 months after transplanting, whereas plants grown from seeds bear fruit commonly only after 36 months.



Discussion on propagation of coffee

Ask the farmers how they prepare coffee planting materials to establish new coffee gardens. Discuss the approaches together, while noting any shortcomings, and then introduce the guidelines below.



Coffee can also be propagated by grafting or micropropagation (tissue culture). These techniques, however, require specially trained personnel and are not easily applicable by small-holder farmers.

Whenever production of planting materials is outsourced, they should originate from either a registered nursery or one known to produce good quality seedlings.

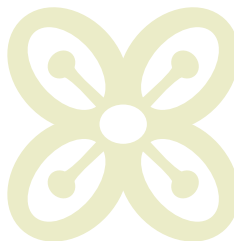
In organic production of planting materials, rooting hormones are not allowed.

Recommendations to farmers on raising coffee seedlings by seed:

- › Obtain good-sized, very ripe berries from pest and disease free high-yielding trees. Check the viability of the seeds by putting the berries in a bucket of water. Select only the berries that sink (good ones). Remove the pulp by hand or pulping machine and soak the beans in water for 24 hours to remove the mucilage. Wash the beans and air-dry in a well-ventilated environment for at least 4 days.
- › Seeds can be either directly placed into plastic bags, filled with a good mixture of compost and topsoil, or in a nursery bed to produce better seedlings. Construct a shade above the bed. Sow the seeds on shallow rows and water the seedbed regularly, but it should not get too wet.
- › Seedlings will be ready to transplant to polybags in about 8 weeks (i.e. when they have 2-3 pairs of leaves). Putting seedlings into polybags ensures minimal disturbance to roots during final transplanting to the field. It also makes long distance transportation of seedlings more convenient.
- › Transplant the seedlings to the garden when they have 6 to 8 pairs of leaves, in about 5 to 6 months. Choose only healthy and vigorously growing seedlings with dark green well-formed leaves for planting. Before planting out in the field, harden the coffee seedlings by increasing exposure to the sun daily over a period of two weeks.

Recommendations to farmers on raising coffee seedlings by cuttings:

- › Select pest and disease free, high-yielding trees within the coffee plantation. Harvest the cuttings from suckers, which are about 6 months old and bearing 4 to 6 pairs of leaves. Harvest early in the morning when the atmospheric relative humidity is high. Partially remove the leaves before cutting. Cut finger-sized vertical shoots of about 30 cm to obtain a clone.





A HEALTHY COFFEE SEEDLING READY FOR PLANTING



- › Put the cuttings in a germination box and cover with clear polythene sheeting suspended 1 metre above the rooting medium to induce high humidity. The boxes may also be placed in a germination chamber constructed on the farm or at a seed multiplication centre. Cuttings will produce roots and shoots within 8 to 10 weeks.
- › Prick the seedlings into individual polybags with rich composite soil mixture consisting of topsoil, river/lake sand and compost. Seedlings are ready to transplant within 6 to 8 months, with about 6 pairs of leaves. Harden the seedlings by gradually reducing the shade. Reduce the shade by half when the seedlings are 8 to 9 months old and reduce the shade completely one month before transplanting.

3. Improving productivity of coffee gardens

In a given situation, the productivity of a coffee garden may be limited by the high age of the coffee trees, poor coffee husbandry practices or neglected soil fertility management. In either a new coffee garden or an existing one, different strategies can be adopted to improve the coffee yields.

3.1 Establishing a new coffee garden

A coffee garden can be improved by establishing a new garden. Improving an existing coffee garden will give much quicker yields, whereas establishing a new garden will ensure more uniform and better yields.

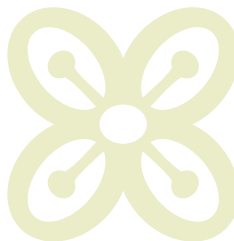
Establishing a new coffee garden is a good idea when introducing new coffee varieties into an area, expanding coffee acreage or when the old garden is heavily infested with pests or diseases.

However, a new garden may be established at the same site after removing the old one, as long as there are no pest or disease threats from the old crop. An old coffee site will have numerous coffee tree stumps, which are very cumbersome to remove. It is better to cut them close to the ground and cover them with soil to prevent regermination. The entire root system will eventually rot.



Inquire about local practices for establishing coffee gardens and discussion on improvements

Ask the participants how they normally establish new coffee gardens. Collect their responses. Present the recommendations below and discuss them together.



If a new site is chosen for establishing a new coffee garden, it should have deep soils that are free-draining. The land should be prepared early so that planting can be done at the onset of the major rains.

a. Land preparation

Recommendations to farmers for proper planting of coffee without intercrops:

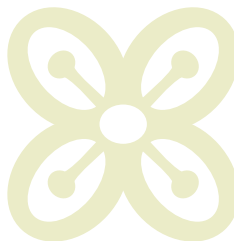
- › Prepare the land well when planting coffee to enable rapid establishment of young coffee seedlings. In case of a new site, plough or dig deeply to remove any noxious weeds like kikuyu grass or couch grass. This will make the soil soft so that the young coffee roots can penetrate easily up to the deeper soil layers.
- › Remove some tree stumps and roots to allow the proper size planting holes to be dug out. If the land has steep slopes, make terraces to control soil erosion. Grass such as Bahia grass (*Paspalum notatum*) *should be planted* along terraces in order to make them stable.
- › The appropriate spacing of coffee trees depends on the type of coffee. Recommended spacing for Arabica coffee is about 2.4 metres by 2.4 metres. Spacing for Robusta coffee is about 3 metres by 3 metres, as it makes bigger trees.

b. Arrangement of trees

In the young fields of coffee, the uncovered space between the seedlings can be used for growing short-term crops (e.g. beans, maize or cassava) for 1 or 2 seasons, or long-term crops like bananas and vanilla. Proper spacing is needed to ensure that the extra plants do not compete with the coffee plants. For example, banana trees can be planted as temporary shade at a spacing of 6 metres by 6 metres, resulting in one banana tree for every 4 coffee trees. The bananas should be pruned regularly and thinned in order to maintain the required shade for the growing coffee.

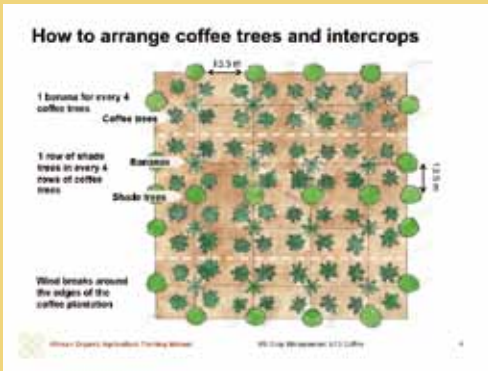
A row of shade trees can also be planted in every 4 rows of coffee trees or around the edges of the coffee plantation, at a spacing of 13.5 metres by 13.5 metres.

In the coffee agroforestry (without annual intercrops), shade trees should be established at least one year before planting coffee at a closer spacing. The density of the shade trees varies with the type of coffee. In the Arabica coffee system, the density of shade trees is lower than in the Robusta coffee system. Shade trees should be planted at a spacing of about 8 metres by 8 metres in Arabica coffee fields and about 6.5 metres by 6.5 metres in Robusta coffee fields (a





ARRANGEMENT OF COFFEE TREES AND INTERCROPS



COFFEE AGROFORESTRY SYSTEM



row of shade trees should be planted in every 4 rows of coffee). In cases of newly opened land, many trees can be left when clearing the land to provide the required shade.

Coffee agroforestry (multistorey) system

A coffee garden should be established in a mixture of tall and short crops to form a multistorey system. Multistorey means that there are different layers of plants growing to different heights in the system. Three levels (storeys) are important in a coffee agroforestry garden:

a. Crops of the upper storey (shade)

Shade trees protect coffee plants against strong sunlight, contribute to prevention of soil erosion and increase humidity in the coffee garden. Common tree species that can be used as shade trees in both Arabica and Robusta coffee systems include *Grevelia robusta*, *Ficus natalensis*, *Albizia coriaria*, *Mesopis emini*, *Cordia africana*, *Acacia* or *Erythrina spp.* Fruit trees such as mango, avocado or jackfruit can also be included at intervals.

Desirable characteristics of shade tree species:

- > **Wind resistant** - The species should have a deep rooting system that adds stability to withstand strong winds.
- > **Small open crown/canopy** – This allows for partial shading of coffee trees, allowing shade of about 50 %.
- > **Quick growing** - The species should have quicker growth than coffee so as to provide the required shade.
- > **Nitrogen fixing** - Trees provide nitrogen to the cropping system through nitrogen-rich leaves and roots.

b. Crops of the middle storey

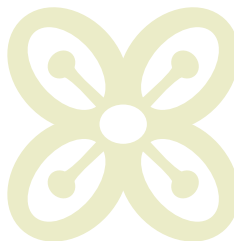
Depending on the needs of the farmer, fruit trees (e.g. citrus, paw paws or bananas) can be integrated as middle storey crops. However, these should be included at a much wider spacing since coffee itself feeds at this level. Multipurpose leguminous trees can also be planted within the coffee garden or along the boundaries (e.g. *Leucaena diversifolia*, *Calliandra calothyrsus*, *Sesbania sesban* and *Gliricidia sepium*). They fix nitrogen into the soil and also provide



Discussion on the establishment of a coffee agroforestry system

Inquire whether the farmers are aware of the potential of intercropping coffee with other crops and trees and about the resulting requirements for management, by asking the following questions:

- > Which types of crops and trees are suitable to grow with coffee?
- > How should these crops and trees be managed within the coffee garden?
- > How do these other trees and crops benefit the coffee and the farmer?





DIGGING OF THE PLANTING HOLE, APPLICATION OF COMPOST AND PLANTING OF COFFEE SEEDLINGS



PROPER MULCHING OF COFFEE SEEDLINGS



mulch for the coffee field when pruned. These shrubs are better managed as the middle storey crops through continuous pruning to provide mulching material.

c. Crops of the understory

The understory will comprise the annual crops that will be intercropped with coffee during early growth. As coffee trees grow bigger, the ground cover will then be replaced with green manure legumes. Legume ground covers are preferred as understory crops, for example jack bean (*Canavalia ensiformis*) or Lablab (*Lablab purpureus*). Any other perennial non-climbing species can also be used, but they should be regularly pruned. They should be sown at the point of establishing new gardens or when the shading trees and coffee bushes are trimmed in order to allow for enough light for their growth.

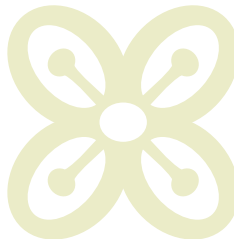
c. Planting

The coffee seedlings should be planted at the onset of the rainy season into holes, 2 feet by 2 feet large. Ideally the holes are filled with topsoil mixed with 1 bucket/basin of well-prepared manure or compost before planting. A small shade around each young plant protects it from drought stress. In the first year during the dry season the young coffee plants should be watered regularly. Ring mulching keeps the soil around the trees moist.

d. Training

Proper training of coffee seedlings is important to ensure adequate tree size for easy management as well as to encourage additional branching for maximum production. When coffee has reached a height of about 2 to 3 feet above the ground, it should be bent and pegged onto the ground. This allows for the formation of more stems, thus increasing the yield potential of the tree.

After establishing a good coffee garden, it should be well-maintained in order to ensure good yields. The same management practices applied to an existing coffee garden should be implemented on an on-going basis.





TRAINING OF COFFEE

Training of coffee seedlings

Bend the coffee plant, when it has reached a height of about 2 to 3 feet to allow for the formation of more stems increasing the tree's yield potential



African Organic Agriculture Training Manual

10. Crop Management of Coffee

3.2 Improving an existing coffee garden

An unproductive coffee garden can be brought back into production. The applicability of rehabilitation depends on the status of the coffee garden. Improving an existing coffee garden only makes sense if the garden is not infested with pests or diseases and when the farmer wants to protect and multiply the existing varieties.

a. Gap filling

Yield depends, first, on the proper plant population in the coffee garden. If some trees died off or were destroyed by wind or disease, they should be replaced to ensure optimum yields. In case the gaps were created due to coffee wilt disease, remaining plant material should be burnt to stop it from spreading to other coffee trees. The gap should then be used for planting a shade or fruit tree.

b. Pruning of coffee

Coffee pruning is very important to rejuvenate old coffee trees. Removal of unproductive branches and stems promotes building of new stems.

Recommendations to farmers regarding proper pruning of coffee:

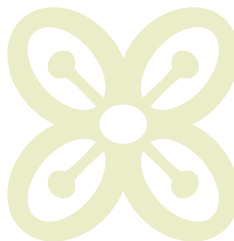
Pruning should be done at the end of the main crop harvest, before the trees start flowering again. Pruning should be done in 4 stages:

- › **Main pruning** - This is where the number and spacing of primary branches is regulated. The number of stems on each tree should be limited to a maximum of 3 to 4 in number. A higher number will result in lower productivity due to increased competition for nutrients and light.
- › **Tipping** - This is the removal of the growing tip at a height of about 7 feet to keep the base of the tree stronger and to facilitate picking at harvest time.
- › **Secondary pruning** - Coffee beans are produced on the lateral branches. Each lateral branch should bare two crops and then be pruned. This will encourage new lateral branches higher up the tree each year. It is also important to remove most of the inside laterals to let light into the coffee canopy to promote ripening of the berries and encourage rapid drying of the leaves to reduce risk of fungal infections. Secondary branching of laterals should also be removed.



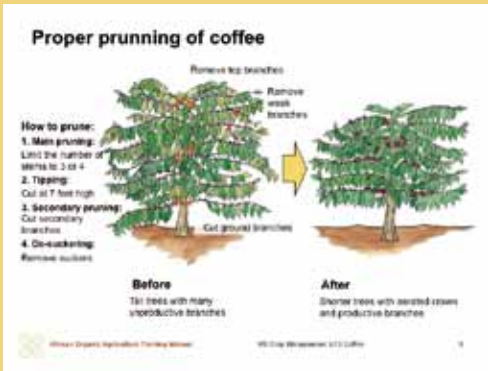
Discussion on improving an existing coffee garden

Inquire among the farmers how they normally improve unproductive coffee gardens. Do they cut them down to establish new ones or just abandon them? Get ideas on the common practices and introduce the following guidelines.





PROPER PRUNING OF COFFEE



- › **Sucker control** - This is the removal of unwanted growing shoots called 'suckers'. This should be done continuously, several times a year. The selection of some 'suckers' to grow into new bearing stems should be done every 4 to 6 years. Therefore, leave well positioned ones that will replace the original stems.

Stumping is recommended for all old long and unproductive stems in order to encourage fresh, stronger and more productive stems. A pruning saw is the most effective tool for pruning. It leaves a 'clean cut' and allows the plant to recuperate faster than if pruning was carried out with a machete.

c. Improving soil fertility

Growth and yields of coffee are highly dependent on fertile soil. There are two approaches to building a fertile soil in the coffee garden. The first approach is to prevent soil and organic matter loss. The second is to grow crops that feed the soil or directly add organic manures, compost and other organic amendments to improve the soil organic matter content and nutrients.

Soil conservation

Soil erosion is normally a problem whenever production takes place on the hill slopes. This is particularly common in the Arabica coffee system, although it happens in the Robusta system as well. Whenever the land is sloping, water will flow downwards taking with it topsoil and organic materials. This implies that the most nutrient-packed part of the soil is lost. To avoid soil erosion, common soil conservation measures must be adopted. This includes digging trenches in the form of contour bands across the slope to collect topsoil and rainwater. These can be further strengthened by planting grasses and tree shrubs along the contour bands. Mulching also helps to reduce the speed of runoff rainwater.

Improving soil organic matter content and nutrients

- › **Organic materials and mulching**

Organic materials such as plant materials, compost or animal manures should be applied. Plant materials like crop residues should be added continuously to act as mulching material on top of the pruning materials from shade trees and green manure cover crops. Top dressing with animal manures is also recommended at about six months before main flowering to improve growth

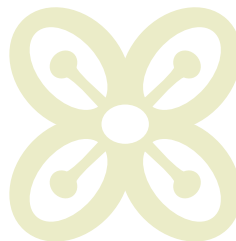


Discussion on improving soil fertility in coffee gardens

Ask the farmers which organic materials are commonly added to coffee gardens to improve soil fertility.



STUMPING OF OLD COFFEE STEMS





WATER CONSERVATION TRENCHES IN A BANANA-COFFEE GARDEN

Water conservation trenches



Trenches along the hillside contour lines collect valuable topsoil that washes down from the rain and prevent it from being lost. They also increase water infiltration into the soil.

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IMPROVING SOIL FERTILITY IN COFFEE

How to improve soil fertility in coffee



Apply compost during planting and after harvest, as a top dressing



Cover the soil with mulch to preserve moisture and prevent erosion



Grow a leguminous cover crop or a green manure (in green coffee) and cut it regularly



Use the pruned branches from shade trees to cover the soil

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and productivity. Compost is best applied in the planting holes of young coffee seedlings. There is also a variety of factory made soil amendments that are suitable for use in organic agriculture. To avoid the spread of diseases, coffee husks from milling machines should not be used unless the farmer is sure of the source of the milled coffee to. For certified organic coffee, organic farmers should cross-check to find out which products are allowed according to the applicable organic standards.

Mulching is very beneficial especially to young coffee trees. It preserves moisture in the soil during the dry months. It also suppresses weed growth and provides nutrients when it decomposes. However, it is important that the mulching material does not touch the trunk of the tree to avoid any possibility of infections and rotting. The best time for mulching is during the dry season before the beginning of the rainy season. The mulching material should also be harvested before it bears seeds to avoid introduction of weeds into the coffee garden. Any plant material can be used as mulching, as long as it is not obtained from other coffee gardens. This is to avoid the spread of coffee pests and diseases.

> Legume cover crops and trees

Planting legumes helps improve nitrogen levels in soil. As already mentioned, leguminous cover crops such as jack beans (*Canavalia ensiformis*), velvet beans (*Mucuna pruriens*) or Lablab (*Lablab purpureus*) can be planted as under storey crops within the space between coffee plants. They will provide mulching material to cover the soil, suppress weeds and control soil erosion. However, cover crops should be pruned regularly so that they do not compete with the coffee plants.

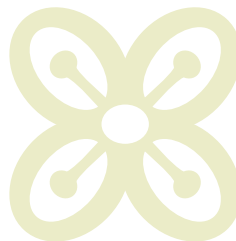
4. Effective pest management

Coffee can be attacked by a range of pests, including beetles such as the coffee berry borer (*Hypothenemus hampei*) and the white coffee stem borer (*Monochamus leuconotus*), green scales, mealy bugs and nematodes. With proper management practices, however, coffee farmers will not have problems with most pests, and developing pests will not, in most cases, result in economic losses.



Working group/ field visit to identify pests and diseases

Visit different coffee fields and identify any observable signs of pest or disease problems. Ask the farmers whether they are familiar with those signs of infection and whether they have monitored to see when the pests and diseases attack.



The most important coffee pest is the coffee berry borer. Adult females of this insect bore holes into the coffee berry, where they deposit their eggs. Upon hatching, the larvae feed on the coffee seeds inside the berry, thus reducing yield and quality of the marketable product. Many natural enemies of the coffee berry borer have been reported, including parasitoids, predators such as ants, birds and thrips, nematodes, and fungal entomopathogens.

Therefore the coffee berry borer can be controlled by:

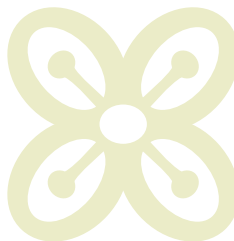
- › **Encouraging natural enemies** - The presence of different plant species within the coffee garden encourages a diversity of organisms to survive including natural enemies to coffee pests. This can be encouraged by introducing shade trees and cover crops. They provide the habitat for the natural enemies that feed on the pests.
- › **Proper cultural management** - Proper sanitation by regular removal and destruction of infected branches and leaves, prompt harvesting and collection of fallen beans from beneath trees. Restricting the movement of organic materials like mulches from one garden to another reduces development of pests. Nursery seedlings can also be protected by using natural sprays such as black jack, tephrosia or neem extracts or by covering them under nets.

5. Effective disease management

Most of the important coffee diseases are caused by fungus, for example, the coffee wilt disease, coffee leaf rust, coffee berry disease, coffee bark disease and the brown eye spot. The same type of pathogen implies that similar approaches to management of these diseases can be applied.

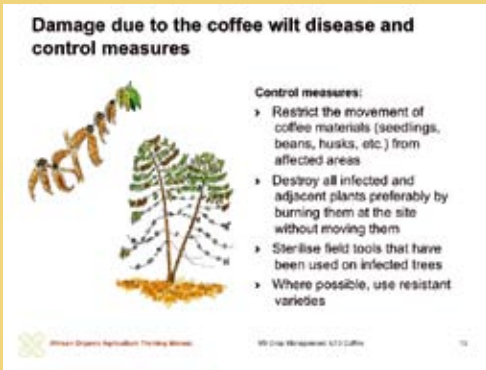
Effective management of these coffee diseases starts with the choice of suitable varieties for the local climatic conditions. Disease resistant varieties, where available, should be chosen. Resistant varieties to the coffee wilt disease, coffee berry disease and the coffee leaf rust are available in many coffee producing countries. Farmers should therefore contact a local extension officer or research station for proper advice on resistant varieties and healthy planting material for a given area.

Good cultural management practices are also necessary in order to enhance the ability of the coffee trees to tolerate and limit infection. For example:





DAMAGE DUE TO THE COFFEE WILT DISEASE AND CONTROL MEASURES



- › Soil fertility improvement to produce stronger trees.
- › Pruning and de-suckering to increase airflow and reduce the humidity around the plant.
- › Proper sanitation by ensuring infected plants or parts are removed and destroyed. Materials and equipment should not be moved from infested fields to healthy ones.
- › Nursery plants can be protected by routine sprays with a protective, copper based fungicide (e.g. Bordeaux mixture or Copper oxychloride). However, such sprays must be approved by the certifier in case of certified organic coffee production.

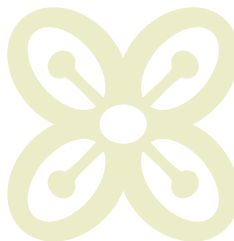
Managing pests and diseases in coffee requires regular scouting of the coffee fields to identify infections early. This gives the farmer enough time to intervene before much damage is done. The coffee wilt disease and the coffee berry disease have been highlighted as the most devastating diseases in most coffee producing areas in Africa.

a. Coffee Wilt Disease

Also known as ‘fusarium wilt’ or ‘tracheomyces,’ coffee wilt disease is the most destructive coffee disease and can lead to 100% yield losses. It affects Arabica and Robusta coffee as well as wild coffee species. It is a vascular wilt disease caused by the fungus *Fusarium xylarioides*. The first signs of the disease include yellowing, folding and inward curling of the leaves. The leaves then dry up and become brown and eventually drop off, leaving affected trees completely leafless. The disease spreads when infected trees are dragged through the garden for use as firewood, fencing, or left in the garden. It also spreads through contaminated tools, human beings or soil that gets into contact with healthy plants.

The control of this disease requires strict quarantine measures, involving restrictions on the movement of coffee materials (seedlings, beans, husks, etc.) from affected areas, destroying all infected and adjacent plants preferably by burning them at the site without moving them. Field tools that have been used on infected trees should be sterilized by flaming fire over the the metal part before using them on other fields.

In some areas, resistant varieties have also been produced so it is therefore advisable to contact the local extension officer or research station for more information.



b. Coffee berry disease (CBD)

CBD is caused by *Colletotrichum kahawae* and is a major constraint for mainly Arabica coffee cultivation in Africa. The disease is specific to green or immature berries and can lead to 20 to 30 % harvest losses. It causes sunken lesions, which spread to cover the berry and the inside bean may also be affected. Older coffee will have higher disease pressure due to the build up of primary inocula in the bark.

To control this disease, resistant varieties are widely available and should be planted to replace traditional susceptible varieties. In addition, field crop hygiene by removing infected beans is also helpful.

6. Minimizing postharvest losses

The final quality of coffee depends a lot on how well the coffee has been picked, processed, dried, packed and stored. In order to minimize contamination until safe storage, it is therefore important to carefully harvest and safely handle the harvested coffee through primary processing activities.

Timely harvesting

The quality of the final coffee depends on how and when picking is done from the field. Many farmers mix red ripe berries with shrivelled, black, discoloured and defective beans. The unripe berries produce beans that break easily, are of inferior quality, are small in size and are usually eliminated as part of the husks during milling, resulting in qualitative and quantitative postharvest losses. Furthermore, the immature beans give a bitter taste to the coffee.

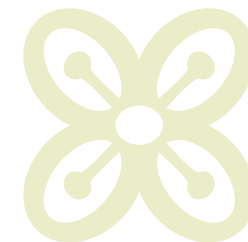
Recommendations to farmers for proper coffee harvesting:

- › When picking coffee, carefully pick only the mature red beans leaving the green ones on the trees to ripen further. Always pick, do not strip.
- › Hessian bags, tarpaulin or propylene bags should be spread out below the coffee trees to avoid harvested beans from falling onto the bare ground. This is done to ensure proper collection of all falling beans during harvesting and to minimize contamination from beans falling on the ground. All beans on the ground should be collected and mixed with composting materials. This ensures that any beans infested with pests, like the coffee berry borer, will be



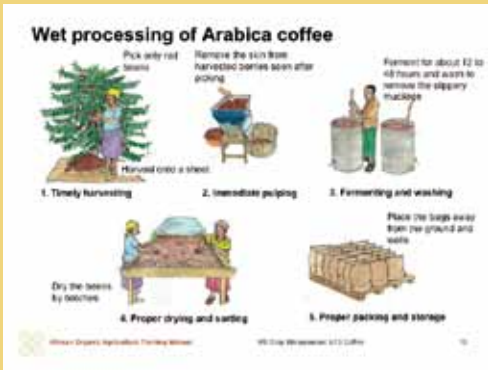
Discussion on post-harvest handling of coffee

Ask the farmers how coffee harvesting and processing is done in the area. Identify gaps and suggest possible improvements.





WET PROCESSING OF ARABICA COFFEE



- destroyed, hence reducing spread of infections.
- › Remove all inferior or green beans, leaves, twigs and foreign matter from harvested beans. Pick regularly, every 2 weeks, to get good yields and better quality.

Primary processing

Coffee farmers in Africa lose on average up to 30 % of their harvest due to poor handling during wet and dry processing. This is mainly due to moulding as a result of slow drying or poor ventilation in the storage units of the dried coffee. Such coffee also develops off-flavours, which eventually affect its cupping quality. Most of these losses are avoidable if the farmer makes an extra effort to carefully handle the harvested produce.

a. Wet processing

It is better to wet process Arabica coffee so that its superior quality can be maintained. Wet processing begins by removing the skin of the berries before drying. A pulping machine is used to remove the skin from harvested berries soon after picking. Pulped coffee beans should then be fermented for about 12 to 48 hours to remove the slippery mucilage before drying.

Recommendations for proper washing and drying of pulped coffee:

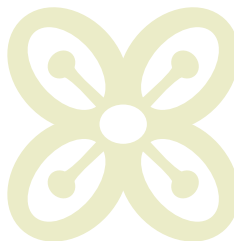
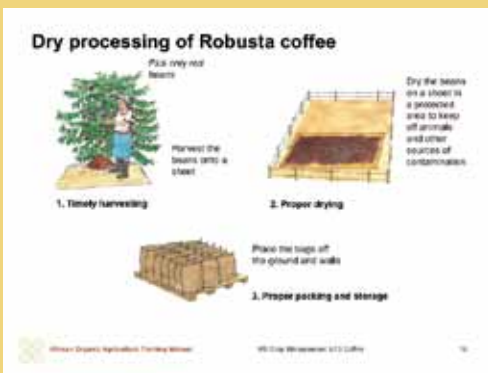
Wash with clean water the fermented beans and dispose off the mucilaginous water in a 3-series ditch. Spread the washed coffee beans to a thin thickness and turn frequently to ensure even drying up to 12 % moisture content before sale. The moisture content can be measured using a moisture meter, where available, or by biting it—a dry bean will snap open easily. Mats, tarpaulins, concrete floor or mesh on raised platforms can be used for drying to maintain good quality. Dry coffee in batches following the fermentation procedure and avoid mixing coffee fermented on different days.

b. Dry processing

Robusta coffee can be dry processed, but the drying process should start immediately after harvesting to avoid moulding. A lot of losses are normally incurred during the drying stage. Most farmers dry their coffee on the ground. This has several implications in terms of postharvest losses:



DRY PROCESSING OF ROBUSTA COFFEE





DAMAGE DUE TO COFFEE BERRY DISEASE

Damage due to the coffee berry disease and control measures



Control measures:

- Use resistant varieties
- Ensure field crop hygiene, by removing infected beans, is also helpful.
- Proper pruning of the coffee trees and shade trees

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- › A lot of chaff and dirt is collected with the coffee as it is being removed from the ground resulting in qualitative losses.
- › In the event that it rains, farmers find it extremely difficult to collect the coffee beans from the ground resulting in quantitative postharvest losses. In addition, beans get wet resulting in moulding and hence qualitative losses.
- › Animals and humans walk through the coffee, destroying some of the beans and/or spreading them, leading to quantitative losses.

Recommendations to farmers for proper drying of coffee:

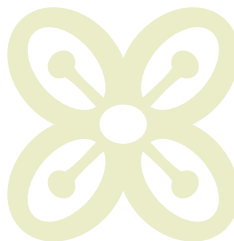
Avoid drying coffee on the bare ground, instead use mats, tarpaulins, concrete floors or mesh on raised platforms in order to maintain good quality. In case you do not have any materials available, drying coffee on the ground is possible, but it is recommended that a fence or barrier be constructed around the drying area. This will keep children and farm animals from trampling over the drying coffee. Spread the beans to a thin thickness and turn frequently to ensure even drying. Dry the coffee in batches as it is harvested and avoid mixing coffee harvested on different days. Each batch should be dried properly to 13 % moisture content before selling or delivering to the milling centre.

c. Packaging and storage

Most farmers store their coffee in the houses in which they sleep. Coffee that is stored with other crops (and at times with animals), is prone to attack from vermin (such as rats) resulting in qualitative and quantitative losses. In-house stored coffee may also acquire unfavourable odours, thus lowering its quality.

Recommendation to farmers for packing and proper storage of coffee:

- › Pack organic coffee in clean sacks made from natural fibres (sisal/jute) that are free from any form of contamination.
- › If possible, construct special rooms for storage of coffee or at a collective store well separated from other products. This avoids introducing other aromas into the coffee.
- › Ensure that dried coffee does not get wet again to prevent fermentation, which would otherwise spoil the quality of the coffee.
- › Place (standing) coffee sacks on pallets or wooden poles, off the wall, in a leakproof store with good ventilation.



7. Increasing income from coffee production

The first consideration in order to increase income from coffee production is to make significant changes in the way coffee is managed. As discussed in the previous sections, this can be done by improving the soil fertility, better management of the coffee trees and by managing pests and diseases better. Together, these practices will ensure that more yields can be obtained from the same piece of land. The farmer can further expand the acreage of coffee, coupled with good management, the yields will be higher and enable more income. Organic coffee production also emphasizes use of locally available and, as much as possible, on-farm inputs for planting materials, soil fertility and pest and disease management. This ensures that the farmer is more self-reliant and spends less on off-farm inputs and hence money is saved. Through diversification by growing different crops along with coffee, the farmer minimizes a number of risks. In case coffee prices drop, the farmer can still get extra income from the intercrops like bananas, cocoa or vanilla. Many harvests are realized from the same garden over a long period of time. Coffee is, therefore, a long-term investment. Even if prices are low in one season, the farmer should manage the crop well to be prepared for seasons when higher-prices are offered.

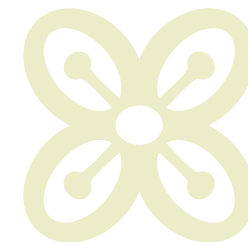
Depending on the location, climatic conditions and growth stage of the coffee plants, coffee can be grown together with other crops, which can benefit the farmer:

- › **Intercropping** - In young fields of both Arabica and Robusta coffee, there is enough space for growing short term crops such as beans, maize or cassava or long-term crops like bananas, cocoa and vanilla. On top of providing extra income to the farmer, such crops will provide the needed shade to the young coffee seedlings.
- › **Fruit trees** - Fruit trees can be included in the coffee garden as shade or wind break trees. Fruit trees such as mangoes, jackfruit and avocados are commonly used. Fruit harvests can be eaten by the household to diversify their nutritional needs and extra harvests sold to earn extra income.
- › **Timber trees** - Some species of shade and windbreak trees can serve as sources of timber in the longer term. This is a long-term investment for the farmer for future income needs. Tree species like *Grevelia robusta*, *Albizia coriaria*, *Mesiopsis eminii* and *Cordia africana* grow very well in the coffee system and provide good timber.



Group work on improving incomes from coffee production

Guide the farmers on how they can estimate total incomes and costs/expenses of coffee production. Take case studies from volunteer coffee farmers from each group, let the participants analyse the situation independently and present the results in a plenary session. Together discuss potential for saving costs and increasing earnings in coffee production.



- › **Working together** - Farmers who are willing to work together, for example, in the form of a producer group of organic producers can minimize the costs of production. Especially during postharvest handling, farmers in a group can share machinery for pulping and milling and storage space. As a group, it also becomes easier access to loans and market information.

8. Marketing and organic certification of coffee production

Many coffee companies have well established supply chains directly linked to farmer groups or cooperatives. Under such schemes, the companies manage the entire system from advisory services, procurement, processing to final marketing and in some cases organic certification. In addition to such schemes, independent farmers and groups are still common and they also contribute a significant amount of coffee.

Most coffee produced in many countries is exported to other coffee consuming countries where certified coffee is in high demand. Since organic certification comes with costs, it will only be rewarding if there is a market that demands organic coffee. To reduce certification costs, individual farmers may either join an existing collective certification scheme or organise themselves into a new group. This will help them save on costs especially during postharvest handling. Also, farmers in a group can share machinery for pulping and milling, as well as storage space. As a group, it also becomes easier access to loans and to make links to the market.

General requirements on organic certification of coffee production:

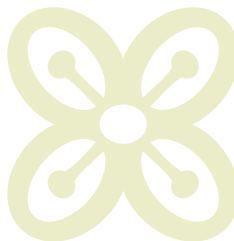
- › During coffee production, the use of synthetic pesticides including herbicides and fertilizers or genetically modified planting materials is not allowed. Any pesticide contamination from neighbouring conventional coffee gardens through soil erosion or wind drift should also be avoided. Machines and equipment used in conventional application of pesticides and fertilizers need to be cleaned well before handling organic coffee.
- › During postharvest handling of coffee, clear separation of milling, grading and packaging of organic coffee beans to avoid cross contamination from conventionally grown beans is necessary. Ideally, organic coffee farmers should identify a separate facility where their coffee will be processed. The



Discussion on assessment of the local situation on coffee marketing and organic certification

Inquire among the farmers about knowledge on potential for marketing and certification by asking the following questions:

- › Who are the main buyers of coffee in the area?
- › Are there any certified organic coffee farmers?
- › Are there any companies that require certified organic coffee?
- › What are their requirements in terms of quantity and quality?



farmers will additionally sign an agreement with the facility owner in order to guarantee preferential treatment of the organic beans.

Specific national or international organic standards may define additional requirements for production and postharvest handling of coffee. Farmers should therefore consult the national organic movement or organic certification body operating within the region or country.

Further reading

- > Pests and diseases of Coffee in East Africa: A technical and Advisory manual. By Noah Phiri, CABI Africa Regional Centre and Mike Rutherford, CABI, UK Centre 2006. www.dfid.gov.uk
- > Manual for sustainable coffee production, Ibero Uganda Ltd, November 2005. www.defoundation.org

