

Climate-friendly and Productive farming

Guide for Coffee smallholders in Africa



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Author:

Reiko Enomoto, Training Manager, Sustainable Agriculture Division, Rainforest Alliance

Technical supervision:

Winnie Mwaniki, Consultant Regional Projects Manager (East Africa), Rainforest Alliance

Technical contribution:

Norman Mukuru, Consultant Programme Coordinator (Uganda), Rainforest Alliance
Benjamin Asele, Assistant Sustainable Project Manager, Kawacom (ECOM Uganda)
Marc Monsarrat, Senior Manager (East Africa & South Asia), Rainforest Alliance
Bernard M. Njoroge, Project Supervisor, Sustainable Management Services Ltd (ECOM Kenya)
Michelle Deugd, Sustainable Landscapes, Rainforest Alliance
Mark Moroge, Climate Program, Projects Manager, Rainforest Alliance
Ian Starr, Climate Program, Technical Specialist, Rainforest Alliance

Photography:

Reiko Enomoto, Training Manager, Sustainable Agriculture Division, Rainforest Alliance

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Guide for Coffee smallholders in Africa



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Introduction

towards Climate-friendly and Productive farming

Many of you are feeling that the climate has been changing for the past few years. For example, the rainy season does not start when it is supposed to start. The temperature gets much colder or much hotter than usual. It starts raining when it is not supposed to rain. Dry season lasts longer than usual. Once it starts raining, it rains too much and causes flood.....



These changes in climate are definitely affecting your coffee crop in many ways. For example, the trees do not start flowering when they normally do, resulting in delayed harvesting; Flowers and berries drop due to stress; There are more diseases and pests on the farm, and new types of pests and diseases start to appear. All these have led to lower yield and quality of coffee over time.

Climate change is real, and it can seriously affect your coffee productivity. In order to continue producing coffee in the future, you need to learn how to deal with the effects of climate change and adapt to their impact.

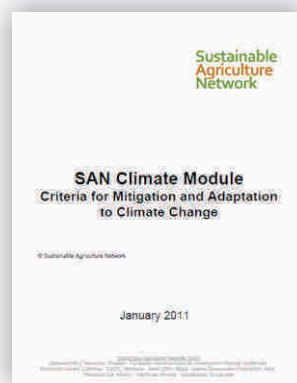
At the same time, your activities on the farm may be contributing to climate change without you realizing it. You need to manage your farms in a way that does not worsen the challenges of climate change but rather reduces them.

The practices you carry out on the farm to prepare yourself for climate change can also increase your productivity. In this guide you will learn how to reduce the effects of climate change, adapt to changes and increase coffee productivity at the same time.



SAN Climate Module

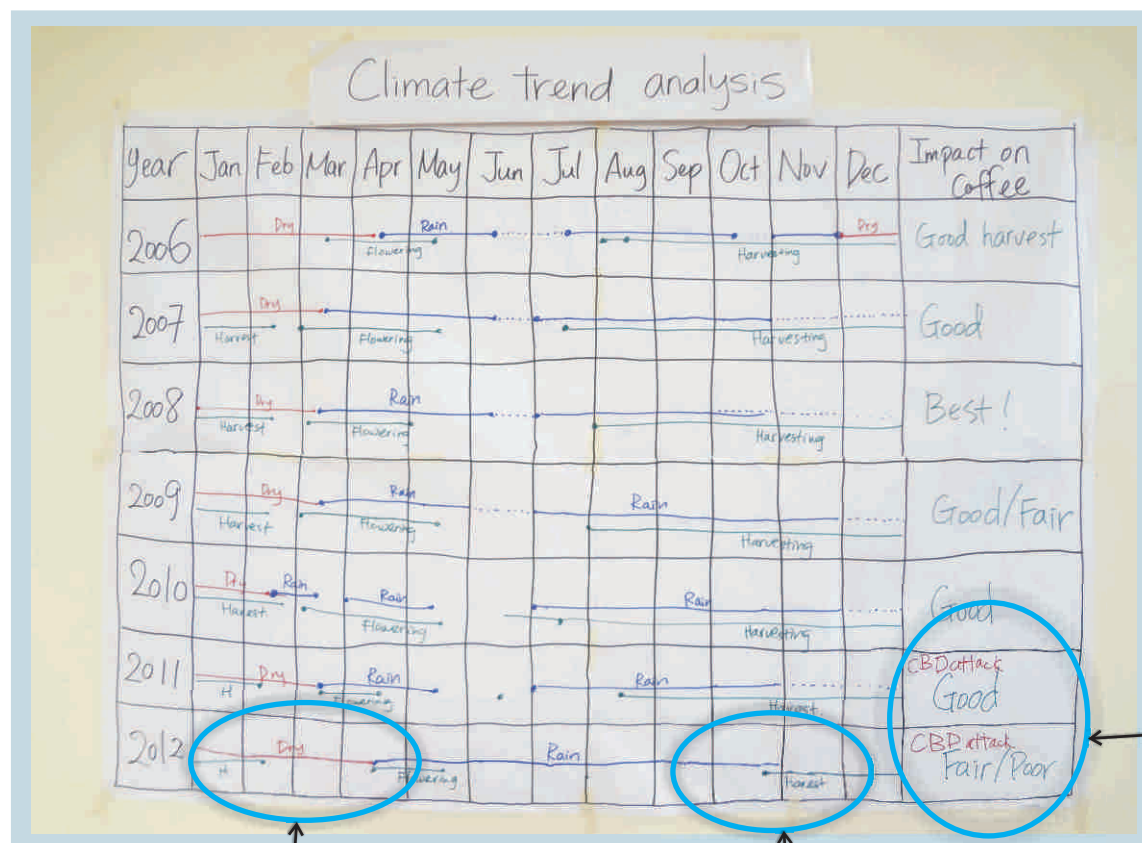
The content of this guide is based on the Climate Module of the Sustainable Agriculture Network, version January 2011. In this guide, all the criteria have been interpreted for coffee smallholders in Africa. Therefore, if you are a big plantation, a group administrator or a producer of other crops, please read the original module to better understand each criterion. Audits are based on the original Module and Policy.



Climate trend analysis

Here is a little exercise to help you understand how climate has been changing over the years and how that change has been affecting your coffee. For as many years as you can remember, indicate the following for each year.

- The start and the end of rainy season/ dry season/ flowering period/ harvesting period
- Extreme weather event (e.g. frost, drought, flood), if any
- Pest or disease attack, if any
- Level of productivity



If you can obtain the records of the temperature and the rainfall from a meteorological institution, that would be help confirm some information.

The problem of Coffee Berry Disease has worsen, and the yield has been decreasing in the past few years.

Based on this analysis, we see that the dry season is getting longer and longer in the past few years. The rainy season is starting later and later.

Because of this climate change, harvesting is also getting delayed. Whereas the harvesting used to start in August, it started in late October in 2012.

Once you understand how the climate has been changing in the past years, you can start to think how you can prepare ourselves for this change so that you can reduce its negative impact on your farms and on your life.

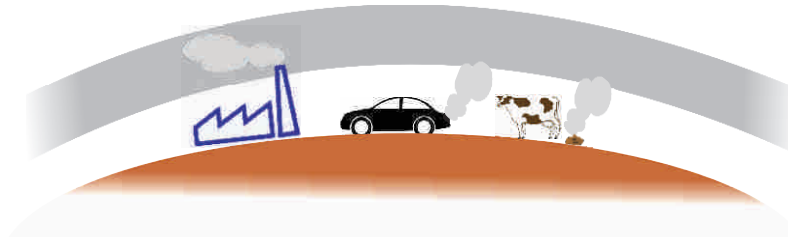
Mechanism of the climate change

Why is climate changing? What is causing this change?

Normally, the sun heats the earth during the day, and the earth cools down at night.



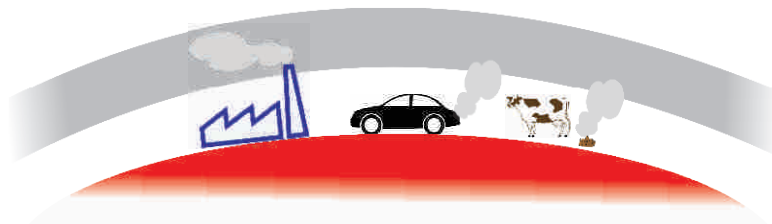
However, industries, vehicles and even agriculture have emitted a lot of gases, called greenhouse gases. Greenhouse gases include carbon dioxide, methane and nitrous oxide. These gasses, once emitted, go up in the air and cover the earth like a blanket.



When there is a lot of green house gasses in the air, the heat from the sun is contained under this blanket of the gasses, so the earth does not cool down even at night.



As the result, the earth gets hotter and hotter. As the earth gets hotter, the rain pattern changes, the seasons changes, and you start to have various climate disasters.

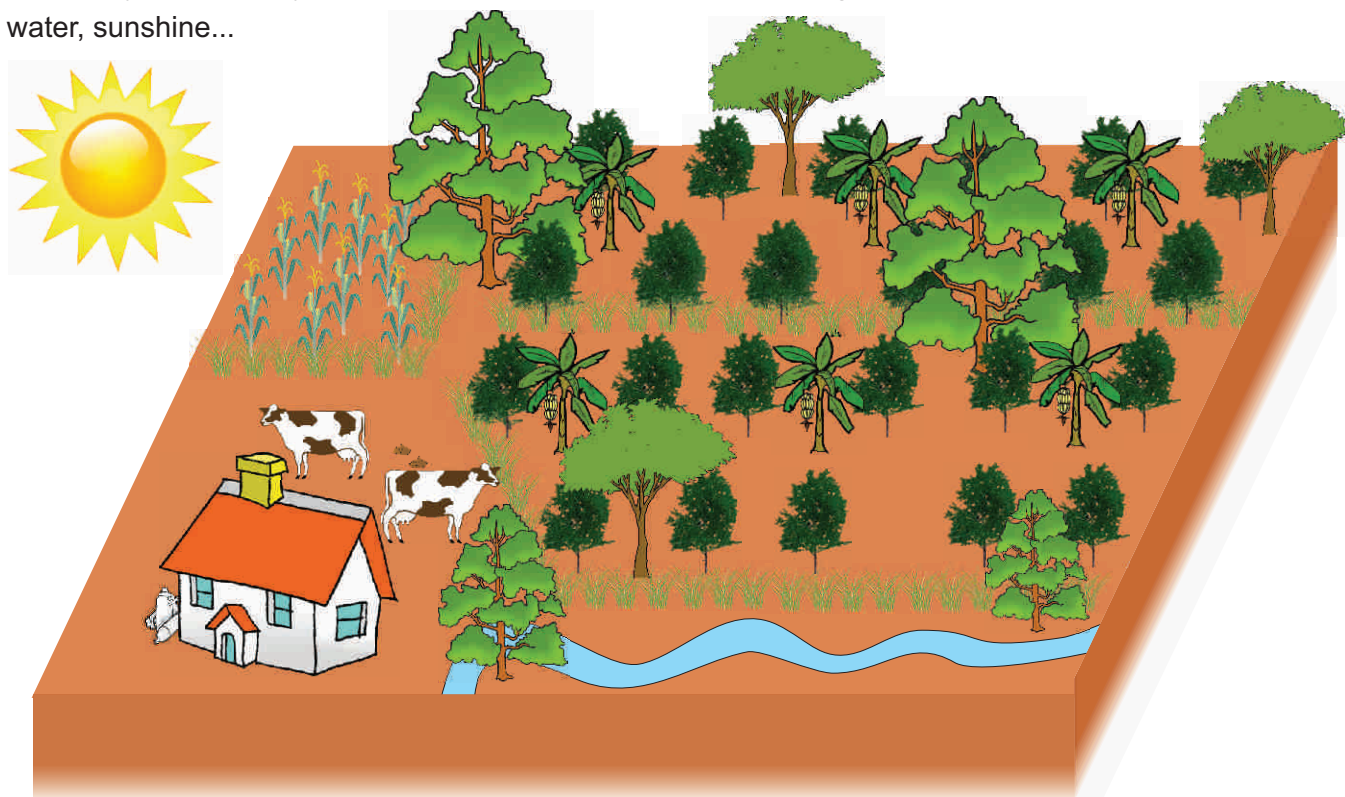


This is what is happening to us right now.

Different elements on the farm

Does your farm have anything to do with climate change? Yes, if you do not manage your farm well, your farming could potentially be contributing to climate change. Think about different things you have on the farm, and see how each one of them is related to climate change.

What do you have on your farm? Trees, coffee, banana, maize, grasses, cow, house, plastics, soil, water, sunshine...



Each of these elements are closely related to climate change as well as the productivity. The coming chapters of this guide will explain these elements one by one.

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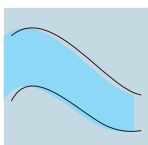
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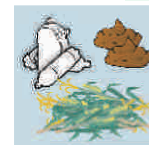
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Chapter 1

Coffee

In order to increase productivity, you need to manage your coffee trees very well. When a tree is weak, it would not produce much cherry. When the farm is infested with pests and diseases, the cherries will be lost. Your coffee trees need to be kept strong and healthy, free of pests and diseases.

When the trees get old, the productivity starts to go down. The trees need to be rejuvenated using a stumping technique. When a new improved variety is available, changing of the variety is another way to increase the productivity.

All the other chapters in this guide include practices to increase productivity, but this chapter will particularly focus on the techniques and ways to increase your productivity.

Pruning

Pruning is essential to keep your crop healthy and productive. When the dead branches are still on the trees, they host pests and diseases, which would spread to the healthy branches. The old branches that do not yield any fruit only take energy from the tree and make it weaker. Dead branches and unproductive branches need to be removed.



Removing a dead branch



Removing an unproductive branch hanging downwards

The shoots and secondary branches also take energy from the tree and make the canopy too dense, which creates a favorable environment for pests and diseases. Pruning of these shoots and secondary branches helps to improve the aeration within the canopy and keeps the trees healthy and strong.



Removing shoots from the main stem



Removing shoots on a primary branch



Removing secondary branches



Stumping

When a tree is old and no longer productive, you can stump the whole tree to rejuvenate it. The best time for stumping is before the flowering.

Among the stems of the tree, choose the best stem to leave and cut off all the other stems. Make a clean slanting cut with the surface facing the East. The sunlight helps the wound to dry and to heal quickly.



Since you left one best stem, you can still harvest from the stem in that year.

After several months, many shoots start to come out from the base of the tree. Select a few best shoots that are growing below the cut surface. These are going to grow to become the new stems of the tree.



About two years from stumping, new shoots will begin to flower. Then you can remove the one remaining original stem.



Changing of the variety

If a new improved variety is available, changing of the variety is another way to increase productivity. If you were to change the variety, the new variety should be more resistant to pests and diseases, more productive, well-adapted to the local climatic and soil conditions, and have acceptable and desired quality for the market.



There are two methods of switching the variety. The easier method is re-planting. Obtain a seedling of a new variety and plant in your farm. You can plant the seedlings between the existing rows of coffee. Once the new plants start producing, uproot the old coffee plants.

Re-planting is technically easier for smallholders, but it takes around three years until you can start harvesting from the new variety.



The other method is top-grafting. It can be done on the shoots that come out after stumping. Top-grafting is technically more difficult, so you need to be either trained or contract a person who has been trained. After top-grafting, you can start harvesting from the grafted stems in a year or two.



Prepare a scion of the improved variety by cutting the end to V shape



Cut a shoot vertically and insert the scion.



Wrap the union tightly with plastic



Put water in a plastic bag and cover the scion to protect it and to keep it in a humid environment



When new leaves start to come out from the scions, remove the plastic cover



When the scion is completely connected with the shoot, remove the plastic around the union



Successful side-grafting

Gap filling

When a tree has died and left a gap within a row, that gap needs to be filled by new planting. When many gaps are left on a farm, this affects the productivity. Gap filling is an important practice to maintain your productivity.



Gap filled with new planting

Removal of old cherries

After harvesting, it is extremely important to remove all the old cherries that are left on the trees. If you leave them on the trees, these cherries will host various pests and diseases, and these pests and diseases will stay on your farm and will attack the cherries the next year.



Removing old cherries



Tree left with old cherries



Boiling old cherries to kill all the pests and diseases in them



In order to eliminate the pests and diseases on the farm, remove all the cherries which are left on the trees, boil them in hot water, and bury them underground.

This way, you can ensure that the pests and diseases that were on the cherries will not stay on the farm and will not attack your harvest the next year.



Burying the boiled cherries



Insect trap

***Note:** If you are an organic farmer, this section may not apply to you. Please contact your certification body to verify the updated approval status of pheromone.



Insect trap with pheromone

Insect traps with pheromone are an effective way to monitor or to control Coffee Berry Borer. If you use insect traps to control Coffee Berry Borer, you need to set one trap for each 100 coffee trees.



Insect trap made with plastic bottles



If insect traps are not easily accessible, you can make insect traps using plastic bottles. Coffee Berry Borers are attracted to red colors, so it is more effective to paint the traps in red.

Marigold planting

Marigold is a flower that can repel insects. By planting marigold within or around the farm, you can reduce the insect attack to some extent.



Application of copper

When the attack of Coffee Berry Disease is severe, application of copper could be considered. Consult your field officer before taking the decision to spray copper.



Application of Tephrosia extract

Tephrosia is a leguminous plant, from which you can make a natural insect repellent. You can harvest the leaves, crush and mix them in water, and cover the mixture for 3 hours. Then remove the leaves and use the extract to spray coffee. Use personal protective equipment while spraying.

You need 1kg of leaves to make 5 liters of extract. You should apply the extract right after the flowering when the cherries are still green and also right after harvesting is finished.



Tephrosia



Rubbing the leaves in water



Leaving them in water for 3 hours



Removing the leaves



Spraying with protective equipment



Pouring the extract into a knapsack



Nursery management

If you are growing coffee seedlings, it is important to do it well. Starting with healthy seedlings is the key for the productivity.

Good soil is especially important for the seedlings. Mix compost, sand and top soil from woodlots or conservation areas. Put the mixture into a pot. Do not put any soil randomly.



Sand, compost and top soil from woodlots or conservation areas



Putting the mixture into a pot



Plant only healthy and strong seedlings. Do not plant weak or diseased seedlings.



By implementing these practices, you can keep your coffee trees strong and healthy, reduce the attack by pests and diseases, and increase your productivity.



Soil



Soil and climate

Among the various elements on your farm, the soil is where a huge amount of carbon is being stored. Around half of the total amount of carbon on a farm could be stored in the soil. Therefore, it is extremely important to ensure that the carbon stored is not released to the air.

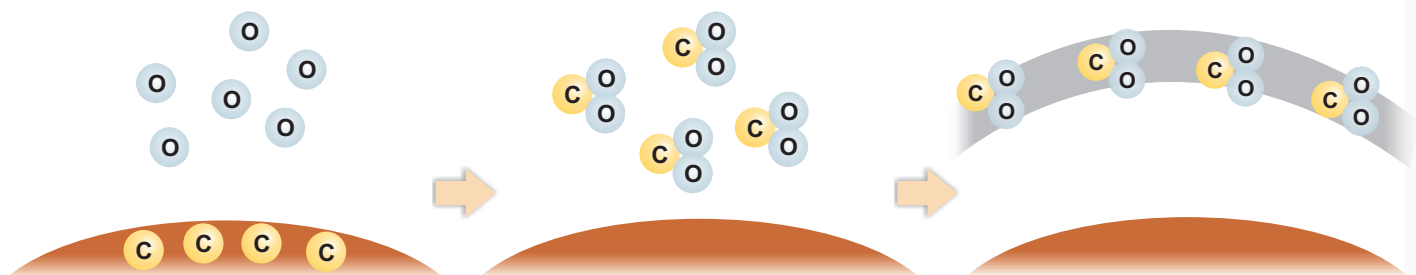
What if the soil is exposed to the air because of soil erosion?

What happens if you dig up the soil for weeding or ploughing, and expose the soil to the air?

Soil



Once you expose the soil to the air, the carbon that was stored in the soil gets released. It becomes a greenhouse gas, and will start to contribute to the climate change.



Severe soil erosion can even result in a landslide. When a landslide happens, you could lose your house, your farm, your animals and even your life. A landslide could be a serious climate disaster.



Soil and productivity

Soil is the key to coffee productivity. The top soil is especially very rich in nutrients and microorganisms, and is essential for productivity. When the top soil is exposed to the air and the water, nutrients are lost through volatilization or washed away by the rains. In order to maintain or to increase your productivity, you need to control soil erosion and protect your soil.

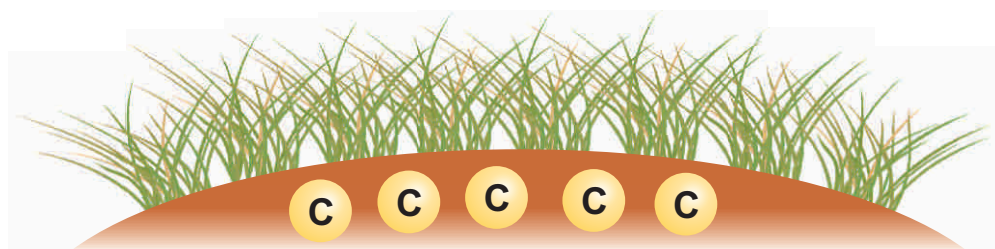


Vegetative cover

There are various ways to control soil erosion and to protect our soil. One method is to keep vegetative cover over the soil. It is especially important to keep vegetative cover on slopes so that the grasses can hold the soil and prevent it from being washed away. Instead of digging up the soil for weeding, you can use a machete to weed so that you do not disturb the soil.



By keeping vegetative cover, the soil is protected and the carbon will continue to be stored in the soil. More carbon in the soil leads to increased productivity.



Planting of grasses

Where there is a slope, plant grasses to hold the soil. If you make terraces, planting grasses at the edge of the terraces is especially important.



In addition to soil erosion control, grasses can be harvested and used for mulching. Some grasses can also be fed to the animals.

Grasses for soil erosion control

- Elephant grass
- Napier grass
- Themeda triandra
- Tripsacum
- Calliandra
- Vertiver grass



Themeda



Calliandra
(Note: Calliandra is not a grass, but if you prune it and keep it small, it can be used for soil erosion control. The pruned leaves are good animal feed.)

Mulching

Mulching is very important for soil erosion control. Mulching materials get decomposed and add nutrients to the soil. Mulch also prevents weeds from growing. Mulch maintains humidity in the soil. You can mulch the soil with pruned branches, harvested grasses, maize and banana stems and leaves. Good mulch should be 5cm thick.



Planting cover crop

Planting a leguminous cover crop, such as Mimosa, Vetch, Jack bean and Mucuna, is another way to control soil erosion. These plants grow laterally to cover all the soil surface, so other weeds cannot grow.

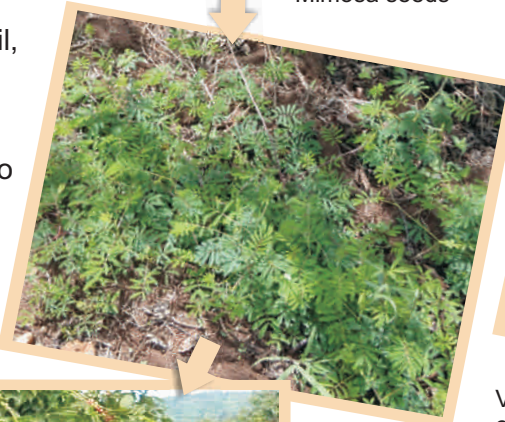
Leguminous cover crops can fix nitrogen in the soil, so they can also enrich the soil.

Be careful not to plant too close to coffee trees to avoid competition.

Mimosa growing gradually to cover the soil surface



Mimosa seeds



Mimosa has completely covered the soil surface



Vetch seeds



Vetch growing gradually to cover the soil surface



Vetch has completely covered the soil surface

Trenching

In order to guide rainwater to go through the field evenly without creating one big gully, you can create trenches across the slope.

It is recommended to plant grasses along the trenches to protect them.

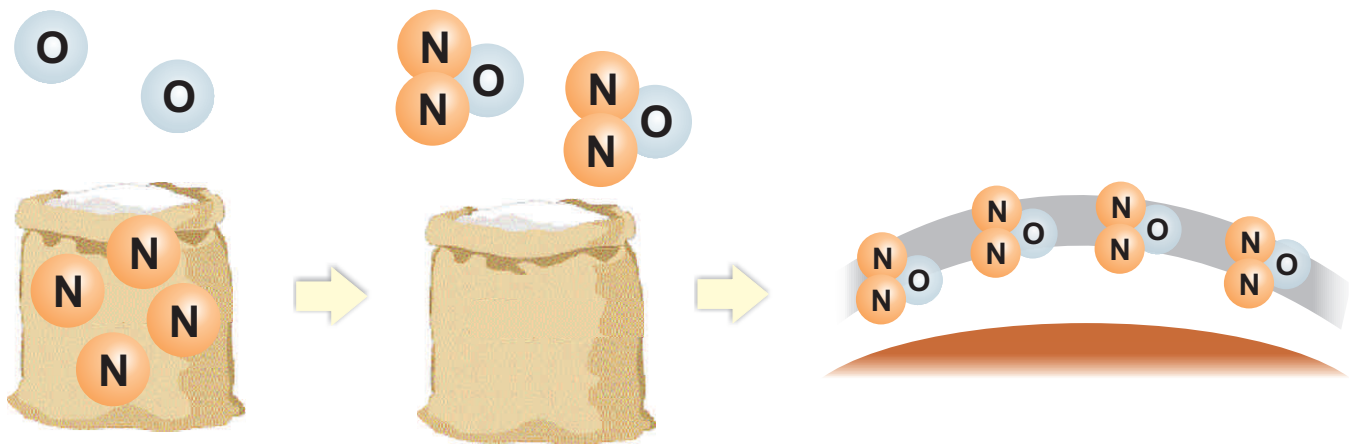


Trench protected with grasses

Fertilizer

Fertilizer and climate

You need to be very careful with the use of chemical fertilizer, as it could significantly contribute to the climate change. Most of the fertilizers contain nitrogen, and when the nitrogen is exposed to the air, it gets together with oxygen and become nitrous oxide. Nitrous oxide is a greenhouse gas, and contributes to the climate change.



Fertilizer and productivity

Fertilization is very important to increase our productivity, but fertilizers can be effective only if you apply them in a correct way. Keep in mind the 4Rs of fertilizer application: Right product, Right rate, Right time and Right place.

If you apply more fertilizer than what is required by the crop, the rest that has not been absorbed by the crop would be wasted. Too much chemical fertilizer could also result in the acidification of the soil, whereby certain nutrients become less available for the crop. If you apply when the weather is dry, the fertilizer is not going to be absorbed by the crop. If the fertilizer applied is exposed to the air, it would be lost through evaporation or by water run-off.

If you apply chemical fertilizer carelessly, your productivity will not increase, and you will lose your investment.



Soil analysis

In order to define the optimum quantity of fertilizer, it is recommended to conduct soil analysis or leaf analysis to find out what nutrients are lacking. Contact your agronomist or group administrator for help on collection and analysis of soil samples.

Take samples from various spots on the farm to make a representative sample of 1kg. Do not take samples from recently fertilized areas, road sides, ditches, marshy patches, near trees and non representative areas.

To take a soil sample, remove surface litter, break up the soil and mix well. Take top soil (0-15cm) and sub soil (15-30cm) separately.



Put the top soil and the sub soil separately into plastic bags.



Once you receive the soil analysis result from the laboratory, you can find out which nutrients are either excessive or lacking in the soil, and follow recommendations in the report.

LABORATORY ANALYSIS AND RECOMMENDATIONS				
TEST	RESULTS	OPTIMUM RANGE	RATION	RECOMMENDATION
1. Soil Type	Clay based	N/A	N/A	N/A
2. Ph (Acid)	5.2	6.5 - 7.0	Low	Apply lime
3. Soluble Salts	10	10 - 20	Normal	N/A
4. Nitrates	12	10 - 20	Normal	Increase nitrogen 2 lbs.
5. Ammonium	4	5 - 10	Normal	N/A
6. Calcium	35	150 - 200	Low	Apply Calcium 50/1000
7. Phosphates	7	2 - 5	Normal	N/A
8. Potassium	4	5 - 25	Low	Increase potassium
9. Magnesium	10	10 - 20	Normal	N/A
10. Iron	7	.5 - .5	Low	Apply Iron times a season
11. Manganese	.25	.5 - .5	Low	Increase Trace Elements
12. Sulfates	.35	1 - 100	Normal	N/A
13. Chlorides	.52	0 - 30	Excessive	Salt De-Tox 25 lbs/M
14. Organic Matter Content	.2.5	7 - 10%+	Low	Apply soil booster 2-3 times a season. 10 lbs/M +Sea Kelp Humic acid at 8 oz/M
A. Coring Depth	1/4"	7" - 10" +	N/A	Apply soil conditioners 2-3 times a season 6-8 oz/M OR 25 LBS/M
B. Thatch Layer	.1.7"	N/A	N/A	

An example of a soil analysis result. The nutrients indicated in red squares are the ones that are either lacking or excessive in the soil.

Application of chemical fertilizer

**Note: If you are an organic farmer, this section does not apply.*



If you apply chemical fertilizer, measure the quantity carefully to ensure that you are applying exactly the intended dose. You can use a simple tool, such as a cooking oil container or margarine container to measure the recommended quantity.

When you apply chemical fertilizer, apply it in a ring 30cm (length of a school ruler) away from the stem, where the feeder roots are located. Applying it directly at the stem does not allow the tree to absorb the nutrients efficiently.



After applying chemical fertilizer, you need make sure that you cover it with soil or mulch. If it is exposed to the air or to the rain, its nutrients would be lost by volatilization or could be washed away. By covering the chemical fertilizer, you can ensure that the nutrients will be absorbed by the tree.

Application of compost

You should apply compost in the same way, ensuring that the nutrients will not be lost. It is recommended to use gloves while applying compost.



Applying 7-10kg of compost around the tree



Covering the compost with mulch



As the climate is changing, you could be facing a reduction in rainfall, delay of the rainy season or even a drought. You need to prepare ourselves as much as possible, to mitigate the negative impacts of such climate change on our lives, on your animals and on your crops. In this chapter, you will learn how to conserve water.

Collection of rainwater

Rain is an important source of water. By collecting rainwater that falls on the roof, you can keep a stock of water at home. This saves the time to fetch water, and gives you an important stock of water during dry season.



Harvesting rainwater into a basin or a bucket is a good starting point. Depending on your financial capacity, you can buy a bigger plastic tank or build your own tank with cement.

No home processing

Processing of coffee at home consumes a lot of water, and the water used for processing is very contaminated.

You should bring coffee to a washing station with proper water treatment system. You should not process the coffee at home.



No Eucalyptus near streams

Eucalyptus trees are not an indigenous tree from Africa, and is originally adapted to harsh dry climate. Therefore, when they are planted near a stream, they vigorously absorb water to the extent that they could dry up the stream.

In order to protect the streams, remove the Eucalyptus that are planted next to the streams and replace them with indigenous trees. This way, you can ensure that you will continue to have water in the streams in the future.



Eucalyptus planted near the stream



Removing Eucalyptus planted near the stream



Stream dried up

No crop near water sources

If you grow coffee or vegetables near a lake, river or stream, the soil near the water source will get eroded and will contaminate the water source. If you spray the coffee or vegetables, the chemical drift will enter into the water and will contaminate it as well.



You should not plant any crop near a water source. If you already have any crop already planted near a water source, do not spray those crops. From the next year, do not plant anything there again.

Keeping a tap closed

If you have piped water, install tabs so that you can close them when you are not using the water. Without tabs, the water would be constantly flowing from the pipe, even when you are not using it. By installing tabs, you can stop wasting water.



Washing of equipment

After spraying chemicals, you must not wash your equipment in a lake, river or stream. Water used to wash the equipment needs to be poured into a soak pit that is filled with charcoal. Charcoal has an effect to purify contaminated water.



Domestic waste water

If you wash your clothes and plates directly in a stream, the soap and detergent would contaminate the water source. You can create a simple soak pit with stones so as to avoid pouring dirty water directly into water sources.

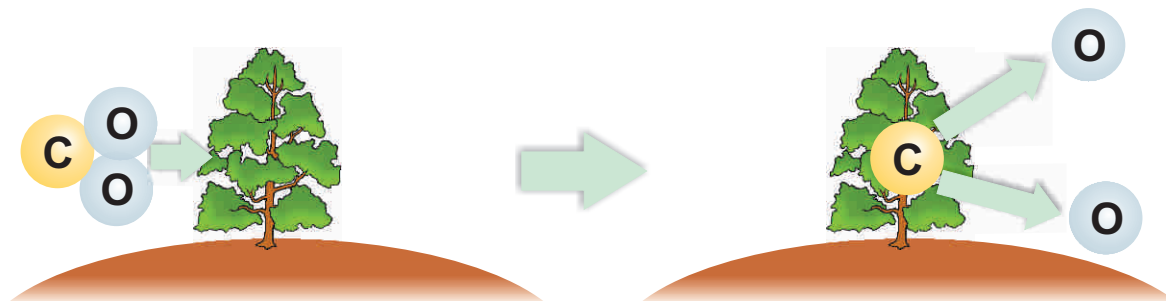


Trees

Trees and climate

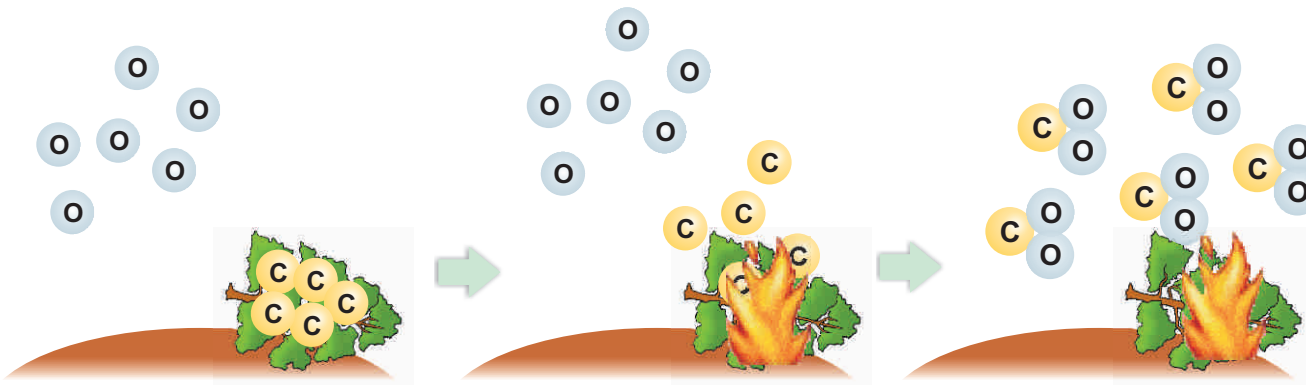
Trees play a very important role in reducing climate change, as well as protecting your farm from climate change.

Trees breath in a way that is different from human being. When trees breath, they take carbon dioxide (CO_2) from the air, absorb carbon and release oxygen into the air.

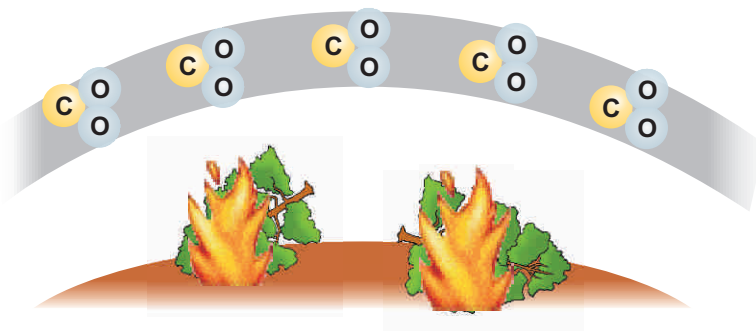


Therefore, trees have a function of reducing carbon dioxide, which is a greenhouse gas, and increasing oxygen, which we need to breath.

What happens if you slash and burn? When a tree is cut down and burned, the carbons in the tree rapidly get together with oxygen and form carbon dioxide. The carbons that the tree has accumulated over its lifetime get released back to the air.



Therefore, when you conduct slashing-and-burning, greenhouse gases will be increased as a result.



Trees and productivity

You may think that shade trees compete with coffee trees for the nutrients and lower the productivity. On the contrary, well-managed shade trees have various long-term benefits, and will help maintain the productivity of coffee in a long run.



Farm without any shade tree

If you cut down all the shade trees on the farm, or do not plant any shade tree at all, your productivity may be high for the first few years, but it is unlikely to be maintained.

When the coffee trees and the soil are exposed to the strong sunshine, they will become exhausted, and the productivity will start to go down. Unless you put a significant amount of synthetic fertilizers, it would be difficult to maintain the same level of productivity in a long run. Too much synthetic fertilizers is expensive, and it makes the soil acidic and unsuitable for coffee production.

For the shade trees to benefit coffee trees, you need to manage them well. If shade trees are not pruned and overgrown, too much shade would negatively affect coffee. It is important to prune shade trees regularly to maintain an adequate amount of shade.

Well-managed shade trees can provide the following benefits.

- They protect coffee trees from the strong sunshine.
- They maintain moisture and humidity in the soil.
- The roots hold the soil and prevent soil erosion.
- The fallen leaves and pruned branches contribute organic matter to the soil.
- They maintain microclimate on the farm, and protect coffee trees from dry weather and extreme temperatures.
- Some trees, such as Calliandra, are leguminous, and fix nitrogen in the soil.
- Some trees provide fruits and timber as an extra income.
- Due to the protection of the coffee trees and the soil, the productivity improves and stabilizes in a long run.



Farm with sufficient shade trees

Trees are extremely important both for the climate and for the productivity.

Protecting trees

It is important to protect the trees on or around your farm. If there is a forest, wetland, lake and river, within or around your farm, such an area could be converted to a conservation area. In a conservation area, cutting of trees or cultivating crops is prohibited.



Deforestation



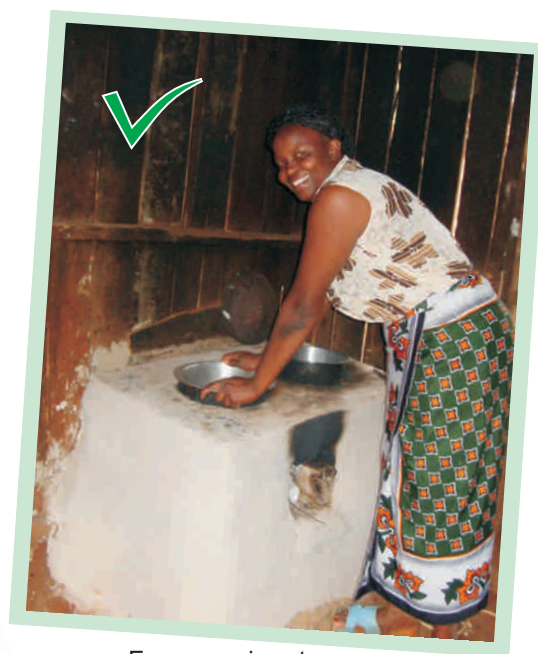
Conservation area

Reducing firewood use

You may need firewood for cooking, but you can reduce the use of firewood by using an improved cooking stove. An open fire consumes a lot of firewood, and the person who is cooking suffers from the effects of smoke.

An energy saving stove contains the heat from the firewood and cooks very efficiently. The person cooking does not suffer from the effects of smoke.

Do not cut indigenous trees for firewood. It is advisable to establish a woodlot with *Grivellia* or *Eucalyptus* to ensure the firewood supply. Pruned coffee branches can also be used as firewood.



Energy saving stove

Planting trees



Planting *Cordia Africana*

If you harvest wood for firewood or other purpose, we should plant the same number of trees.

You can plant indigenous trees within your farm as shade trees, and around the farm as live hedge.

In the next pages, you will see which trees are recommended for planting.

Shade trees

These trees on the list below are either indigenous trees or naturalized trees in Africa. They can co-exist well with coffee trees under the agroforestry system.

Recommended trees for shade

- ✓ Markhamia
- ✓ Calliandra
- ✓ Alnus
- ✓ Inga
- ✓ Leuceana
- ✓ Ficus
- ✓ Polycias fulva
- ✓ Cordia Africana
- ✓ Maesopsis



Markhamia



Calliandra



Inga



Alnus



Leuceana





Ficus



Polycias fluva



Maesopsis



Cordia Africana



Eucalyptus

Do not plant exotic trees such as Eucalyptus as a shade in your coffee farm. Eucalyptus creates an environment that is not favorable for coffee and other crops.

Fruit trees such as mango, avocado, banana, papaya and macadamia should be planted only around the farm, as they create too much shade and compete with coffee for nutrients.

Banana can be intercropped with coffee, but it is important to respect the correct spacing for intercropping. We will learn about correct spacing on the next page.

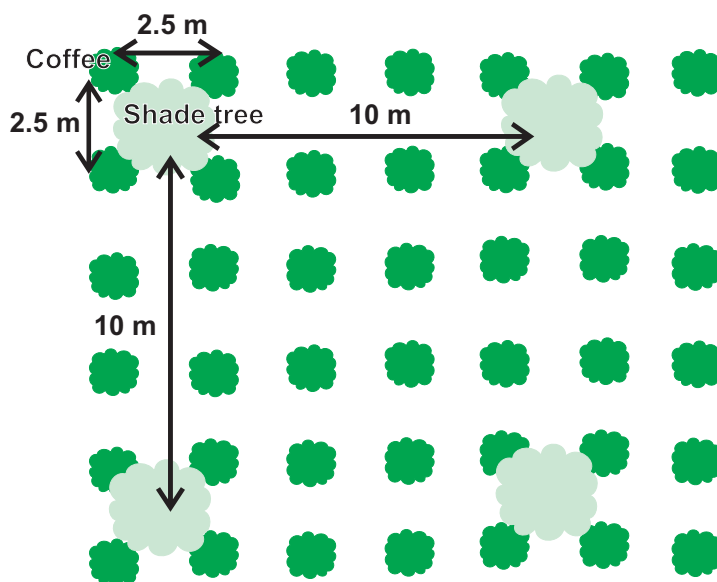


Banana

Correct spacing

Recommended spacing for coffee without intercropping is 2.5 m X 2.5 m.

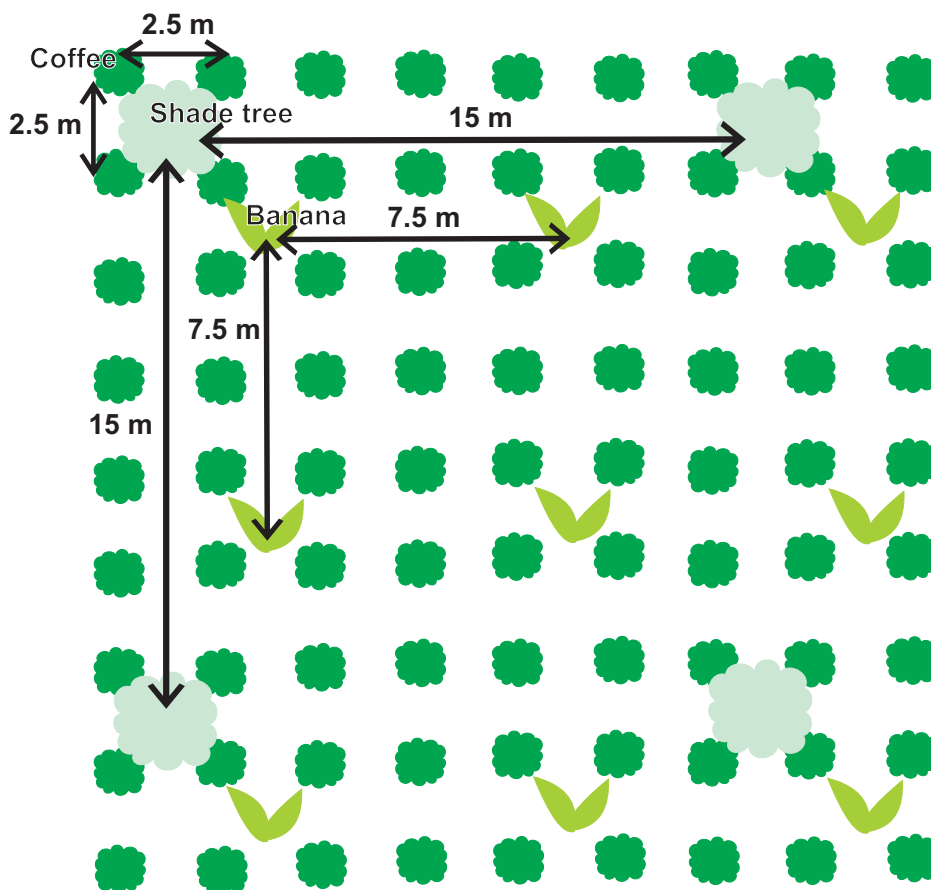
In this case, the spacing for shade trees should be 10 m X 10 m.



Farm congested with banana

When you intercrop coffee with banana, be careful not to plant too many bananas. If one banana is planted for each coffee, that creates too much congestion and competition for both crops, and the productivity of both crops will be low.

When Arabica coffee is intercropped with banana, the recommended spacing of coffee is 2.5 m X 2.5 m, and the spacing of banana should be 7.5 m X 7.5 m, which means that 1 banana is planted for each 9 coffee trees. Shade trees should be planted at 15 m X 15 m.



Tree inventory

If you conduct a tree inventory of the farm, you can collect data that are necessary to calculate the carbon stock in the trees. It is recommended to conduct a tree inventory once in 5 years to monitor the health and growth of trees on the farm.

For a tree inventory, take sample area of 10m X 20m within the farm. Try to choose a representative area. If there are different landscapes on the farm, you can take more than one sample areas per farm.

We are going to measure the height and diameter of the trees within the sample area. In order to measure the height of the trees, in the case a professional measuring equipment is not easily available, you can use a simple method using a stick.

First, prepare a stick at your arm length.



Then hold a stick and try to see the top of the tree through the top of the stick, and try to see the bottom of the tree through the bottom of the stick. Go back and forth until you can see the stick exactly fitting the height of the tree.

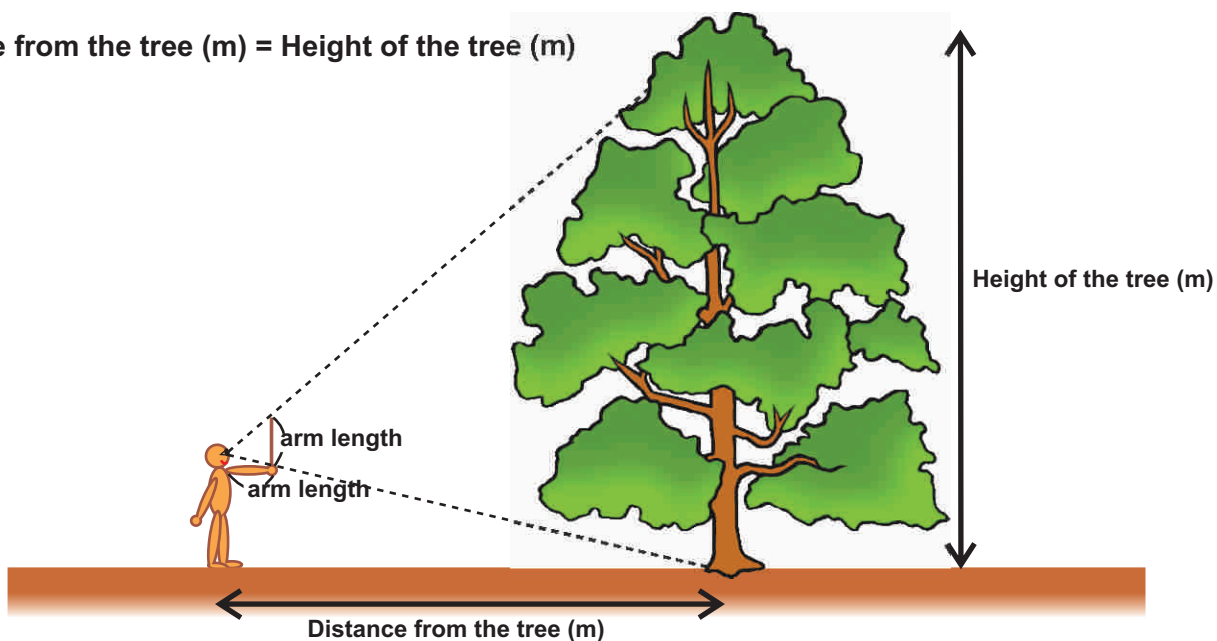


Going back and forth until finding the right spot

According to this method, the length of the stick equals to your arm length.

Therefore, once you conduct the measurement and stand at the right spot, the height of the tree should correspond to distance between the tree and where you are standing.

Distance from the tree (m) = Height of the tree (m)





Measuring the distance between the tree and where you are standing

For measuring the diameter, you can measure the circumference at the breast height. "Breast height" means 130cm above the ground level.

Once you measure the circumference, you can divide it by 3.14 to obtain the diameter.

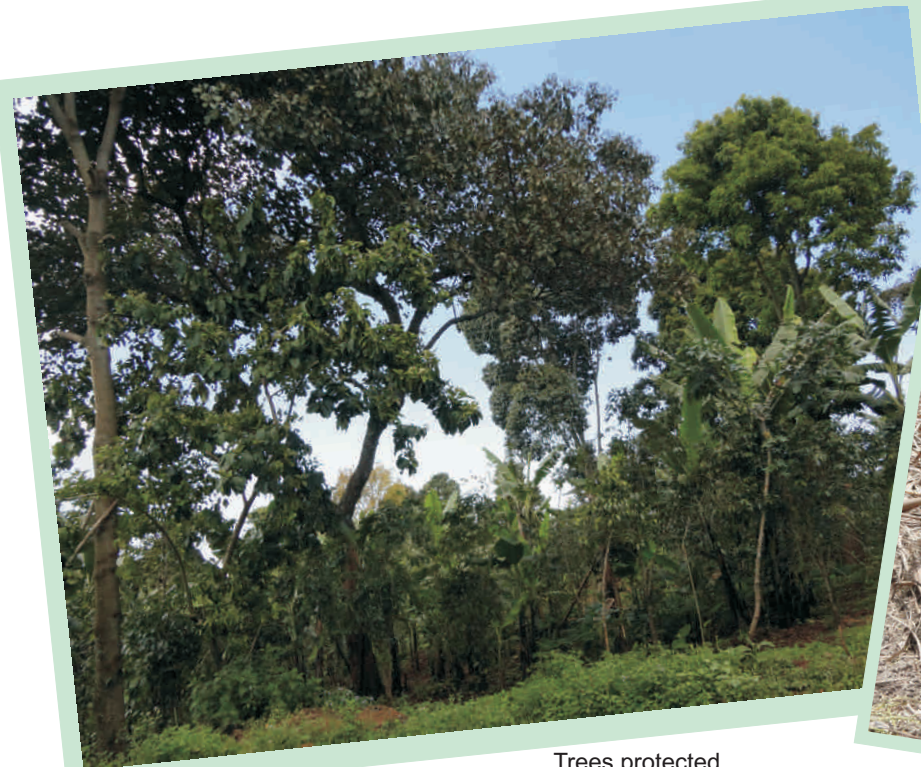
$$\text{Diameter (cm)} = \text{Circumference (cm)} \div 3.14$$



Measuring the circumference of a tree

You can organize the collected data in a table like the following.

Farmer: <i>Benjamin Asele</i>		Date: <i>15/03/2013</i>		
No	Species	Height (m)	Circumference (cm)	Diameter (cm)
1	<i>Ficus</i>	10	145	46
2	<i>Cordia</i>	15	180	57
3	<i>Africana</i>	7	68	22
4	<i>Calliandra</i>	18	305	97



Trees protected



Tree planting

Waste

What waste do you produce on your farms? You probably have plastics, kitchen waste (vegetable peels, ash), farm waste (pruned branches, crop residue from maize, banana and other vegetables), animal waste (cow dung and other animal droppings), etc. Each element on our farm produce some waste.



What if you mix them all together and burn them?

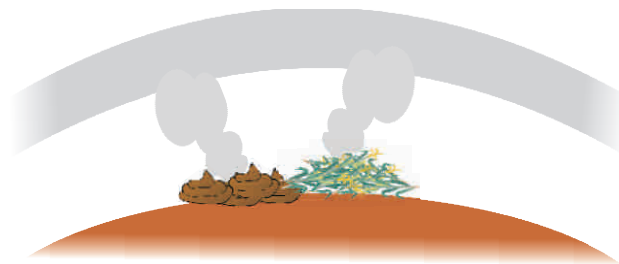


Waste and climate change



When you burn waste, you emit a lot of greenhouse gasses, such as carbon dioxide and nitrous oxide. The increase in greenhouse gasses in the air worsens the challenges of climate change.

What if you just dump them or leave them on the ground?



When you expose waste to sunshine and air, it will still emit greenhouse gasses, such as methane and nitrous oxide. You will still be contributing to climate change.

Waste and productivity

As waste gets burned or decomposed in the open air, you are losing all the nutrients in the organic waste, which could have been otherwise used as organic fertilizer or mulch. Organic waste has a huge potential to boost your productivity. If it is managed well, it can give you very good organic fertilizer that makes your coffee trees healthier, stronger and more productive.



From the next page, you will learn how to manage your waste well, so that you do not contribute to climate change but rather increase your productivity.

Making compost

Making compost is a very effective way to convert all your organic wastes into organic fertilizer. In order to make a compost, first prepare a compost pit. A compost pit needs to be under shade of a tree or a simple roof. If the compost is exposed to the sun, the nutrients will be lost through volatilization. Direct run-off or flood would wash away the nutrients, while normal rain can keep the compost moist.



Maize husks

Pruned branches



Compost pit under shade

Once a pit is ready, put dry materials, such as maize husk, pruned branches and dry leaves.

Put green materials, such as crop residue, Tithonia and sweet potato or pumpkin leaves. Chop them into small pieces so that they decompose easily.

It is highly recommended to include Tithonia and sweet potato or pumpkin leaves in your compost, because they are rich in micronutrients, called Zinc and Boron. They help trees to prevent flower abortion and berry abortion even when the trees are stressed. Zinc also prevents crinkling of leaves, and Boron helps in developing strong shoots. These nutrients are very important to increase your productivity.



Crop residue



Tithonia



Pumpkin or sweet potato



Chopping the ingredients to small pieces

Put organic waste and ash from the kitchen. They are very rich in micro-nutrients like Potassium, and macro-nutrients like Calcium, Sodium and Magnesium.



Ash from the kitchen



Kitchen waste

Put cow dung, top soil or compost, whichever items you have. These materials are all very rich in microorganisms which help the decomposition. You can add effective microorganism solution, if it is available in your area.



Repeat the process to create many layers of these materials. After each layer, add enough water to moisten every compost material.

Turn the compost every two weeks to facilitate the decomposition process. Keep a stick in the materials to be able to check the temperature.

When the decomposition is taking place, the temperature of the materials should be high. If the temperature is low and the materials are not decomposing, turn the materials for aeration. If vapor is coming out from the compost, the temperature is very high, so add water to cool it down.

The compost becomes ready in two to three months. When it is ready, it should be odorless, black and dry. Good compost enriches our soil and help your coffee trees produce better.



Making liquid fertilizer with Tithonia

If you do not have sufficient materials or time to make compost, you could alternatively make liquid fertilizer, using only Tithonia.



Tithonia



Chop Tithonia to small pieces



Put them in a bucket



Fill the bucket with water



Mix every two days



The solution will be ready in two weeks.



Sieve the leaves using a sack



Ready to be applied into the soil

Making liquid fertilizer with manure

We can also make liquid fertilizer only from manure.



Manure



Put 5 basins of cow dung in a sack



Hold the sack with a stick across a drum (or a bucket), and fill the drum with water



Keep the drum covered



Shake the sack every two days



Ready

The solution will be ready after two weeks

Remove the sack from the drum



Apply one cup per tree at the base of the tree

Biogas generation

By installing a system for bio gas generation, you can capture the methane gas that comes from the manure and use it for cooking.

For biogas generation, you should keep your cows under a roof and on a cemented floor so that you can collect the manure.



Putting the manure into the system that captures the gas



Cooking with biogas

By generating biogas, you can reduce the greenhouse gas emission and reduce the firewood consumption at the same time.



Plastic waste management

Plastics cannot be decomposed, so you should not throw them on the ground.

They need to be collected in a sack and kept, until the sack can be collected by a public waste collection system or by your group administrator.



Plastics thrown away on the ground



Collecting plastics in a sack



The sun is the energy source that is available for all of us everyday. You can make use of it to generate electricity. Using the sunlight to generate electricity does not contaminate the environment and does not contribute to the climate change, as opposed to burning petroleum to generate electricity.

Solar panel

There are different sizes and types of solar panels. There is even a portable one, which can be left outside during the day for charging the battery. Depending on the financial circumstance and how much electricity you need, you can use a solar panel to generate electricity at home.



Potable solar panel



Planning

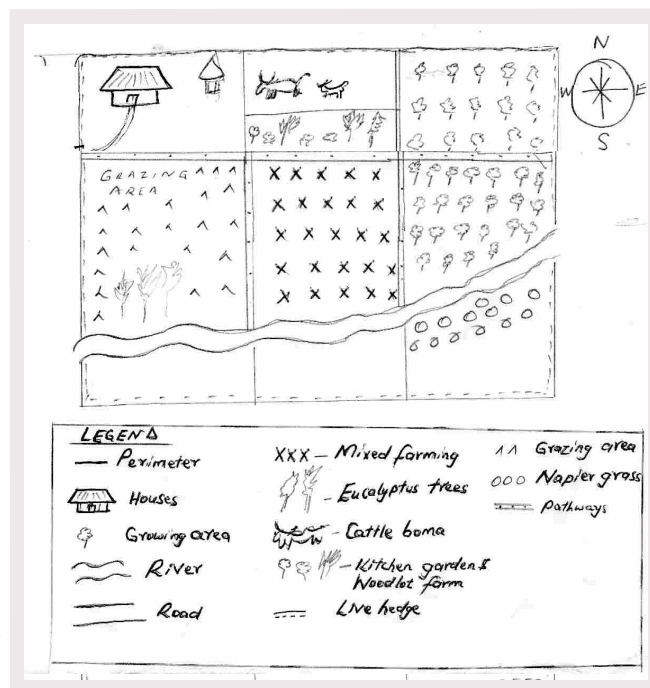
All the things you have learned in this guide need to be implemented on your farm. In order to ensure the implementation of the activities, you need to plan them and record them. Develop an action plan of the activities to improve coffee productivity and to adapt to climate change.

Map

As you plan your activities, a simple farm map is a very useful tool. On a map, indicate the plots of different crops, houses and other infrastructure, forests, grassland, river, lake and streams.

Once you have a map, analyze the following.

- Has the use of land changed in the past years?
- Is the change of land use contributing to the climate change?
- Are there any areas that are vulnerable to climate disaster, such as flood or landslide?
- What should be done in an emergency situation, such as flood, landslide, hurricane, earthquake and thunderstorm?
- Are there any areas that are susceptible to soil erosion?
- Where do we need to plant more trees or grasses?
- Where are the water sources to be protected?



Answering these questions would help your planning. As you plan your activities, the locations of the activities can be indicated on the map.

Action plan and emergency plan

An action plan needs to have the activities, timeline for the execution and the responsible person. An emergency plan for extreme weather events like a flood needs to contain the procedures, such as evacuation.

What to record in an action plan

- Activity
- Timeline
- Responsible person
- Location (if applicable)



Start the journey to become a climate-friendly and productive farm!

