

CLIMATE ACADEMY
KENYA 2017



CLIMATE ACADEMY GUIDE

**FOR FAIRTRADE CERTIFIED
COFFEE PRODUCERS**

A GUIDE FOR PRODUCER'S
ADAPTATION AND MITIGATION TO
CLIMATE CHANGE





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PREAMBLE

Climate change is putting coffee production and the livelihoods of coffee farmers and their families around the world at risk. Changes in temperature and rainfall patterns, as well as extreme weather events, can impact production cycles and negatively affect coffee production. In order to develop a strategic approach that responds effectively to climate change and its effects on coffee production, coffee farmers and farming communities need to be equipped with the necessary tools that will help them adapt to the changes.



The impacts of climate change on coffee production depend on how resilient or strong a system is i.e. the farming communities, the broader landscape and the whole supply chain, including road infrastructure, storage facilities, etc.

Coffee farmers' adaptive capacity can be enhanced by increasing the resources and knowledge of farmers and by supporting individuals and organizations in responding appropriately to climate change risks. It can also be enhanced through adaptation options such as training farmers on how to develop and apply insights and learnings from climate change adaptation and mitigation measures.

Adaptation allows coffee producers to both reduce the negative impacts of climate change and benefit from new opportunities that might arise from it. Adaptation can be at plant level such as coffee plant pruning, farm level such as enhanced pest management, household level such as adoption of improved cook stoves so as to reduce deforestation, strengthening farmer organizations to facilitate and improve access to climate information and other relevant support services. Farmers should make sustainable agriculture and climate adaptation part of their farm management practices, tackling issues such as water scarcity and soil erosion. Looking at the future, farmers are introducing renewable energy to mitigate carbon emissions from the production process.

Therefore, climate change adaptation strategies might focus on increasing the resilience of groups of people as well as the resilience of the agricultural systems that their livelihoods rely on. Vulnerability of both coffee agro-ecosystems and communities are, therefore, important factors when considering the effects of climate change.

Climate change impacts are experienced locally, which means the adaptation responses will have to be defined on a site or regionally specific level. This is the gap that this guide intends to fill by providing farmers with readily available information that can be customised to suit the local conditions.



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1. INTRODUCTION

GENERAL FACTS ABOUT CLIMATE CHANGE

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1.1. COFFEE PRODUCTION

Climate change and its effects have been pronounced globally. Its impacts have been acknowledged on a global scale, in a range of different sectors – agriculture being one of them. The main effects on agricultural production are expected to be increased variability, a decrease of production in certain areas and changes in geography. Farmers are experiencing increasingly extreme and unpredictable weather and climate patterns. They can no longer

expect the favourable conditions that a perennial crop like coffee needs for consecutive harvests. This has major implications on their livelihoods and strategies – should they invest more to adapt or to diversify?

How does climate change affect coffee production?

Coffee production is highly dependent on a regular sequence of weather events. Ideal climatic conditions for Arabica coffee are:

With the current changes in the climatic conditions, these conditions may not be met.

WHAT HAPPENS TO COFFEE THEN?

Alteration in precipitation patterns, temperature, storms, strong winds and other extreme weather events directly impact coffee quality and productivity levels. These potentially damaging hydro meteorological events or phenomena are called **climate hazards**.

The effects of climate change in natural or human systems are called **climate impacts**. These effects can be direct (on the coffee tree) or indirect. Some potential negative climate impacts on Arabica varieties, which are particularly sensitive to climate extremes, are listed on the next page.

IDEAL CLIMATIC CONDITIONS FOR ARABICA:

- ✓ A MOISTURE DEARTH PERIOD OF 2 MONTHS TO PREPARE FOR FLOWERING
- ✓ A GOOD RAIN TO PROVOKE FLOWERING AT THE END OF THE DRY PERIOD
- ✓ ADEQUATE TEMPERATURE FOR FLOWERING AND FRUIT SETTING
- ✓ REGULAR RAINFALL THROUGHOUT BERRY DEVELOPMENT
- ✓ A DRIER PERIOD GETTING CLOSE TO HARVEST
- ✓ A DRY PERIOD AROUND HARVEST



POTENTIAL NEGATIVE IMPACTS ON ARABICA VARIETIES:

A) PROLONGED DRY PERIOD/DROUGHTS

- TREES BECOME WEAK AND WILTED
- AFFECTS FLOWERING AND FRUIT SETTING
- YOUNG TREES MAY DIE
- STRESSED TREES MORE SUSCEPTIBLE TO SOME PESTS

B) UNSEASONAL RAINS OR PROLONGED RAINS

- AFFECTS FLOWERING AND FRUIT SETTING
- THEY MAKE SUN-DRYING DIFFICULT
- INCREASED HUMIDITY PROVOKES MORE FUNGAL DISEASES

C) HIGH TEMPERATURE (ABOVE 23°C)

- HINDERS THE DEVELOPMENT OF CHERRIES
- DECREASED TREE GROWTH
- LEADS TO FLOWER AND FRUIT ABORTION
- INCREASED PESTS AND DISEASES



D) HEAVY RAINS

- CAUSE SOIL EROSION AND EVEN LANDSLIDES
- WASH-AWAY AGROCHEMICAL APPLICATIONS
- CAUSE FRUIT FALL AND TREE DAMAGE
- SUBSIDENCE DAMAGE TO ROADS AND OTHER INFRASTRUCTURE; INCREASES COSTS

Climate change is a very complex phenomenon. Its impact on future production systems remains unclear. Coffee production is also very intricate and varies greatly from country to country. However, the adopted production system within each region is often quite static, with only moderate changes over time. This means that coffee producers will require major investments of time and funds if they are to cope with the challenges of climate change.

IT SEEMS INEVITABLE THAT:

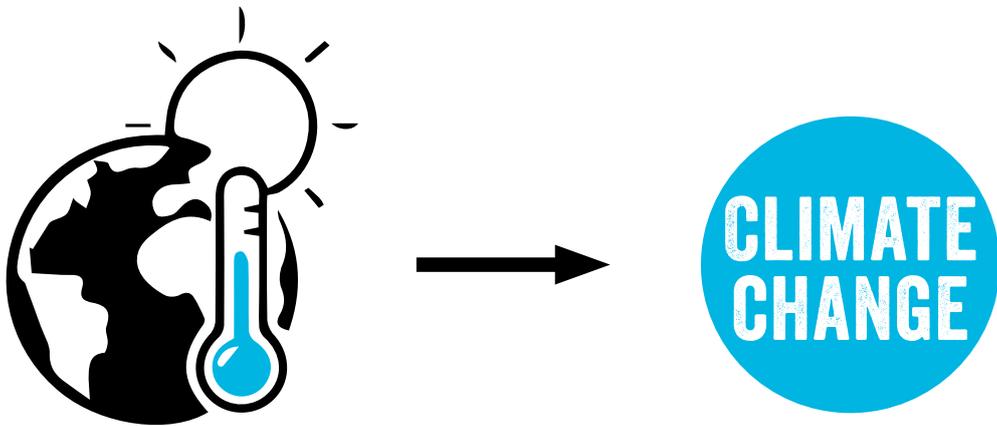
1. Some traditional coffee production zones will no longer be suitable for growing coffee, creating a need to find crop diversification and substitution

solutions. This is already happening at the lower margins of coffee production in many countries, but is mostly poorly researched and unsupported (see related information under climate change impact).

- 2.** Other traditional areas will still be suitable for growing coffee for many years, but new agricultural practices will be necessary to adapt to climate change, and especially to extreme weather events.
- 3.** A few zones may gain climatic suitability for coffee production.



1.2. CLIMATE CHANGE



GLOSSARY OF CLIMATE RELATED TERMS

Weather: Describes atmospheric conditions at a particular place in terms of air temperature, pressure, humidity, wind speed, cloudiness and precipitation.

Climate: Is often defined as the weather averaged over a long period of time (normally 30 years).

Global warming: Increase in average global temperature.

Climate change: Any significant change in climate, such as temperature or precipitation, that lasts for an extended period of time, typically decades, whether due to

natural variability or human activity.

Climate variability: Refers to variations in the current state of the climate, e.g. the amount of rainfall received from year to year; also includes extended droughts, floods, and conditions that result from periodic El Niño and La Niña events (ENSO).

Regional or local warming: Can be caused by a change in land use and can exacerbate local climate conditions and extremes.

Climate hazards: The potentially damaging hydro-meteorological

events or phenomena, such as increasing temperatures or changes in rainfall patterns, as well as the intensity and frequency of extreme events, like storms, floods or droughts.

Climate impact: The effects of climate change in natural or human systems.

Climate Change is one of the major challenges affecting the agricultural sector. The International Panel on Climate Change (IPCC) estimates that it is 'extremely likely' that greenhouse gas emissions are changing the world's climate.

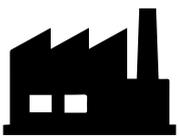


1.3. CAUSES OF CLIMATE CHANGE

COMMON GREENHOUSE GASES



CO₂: CARBON DIOXIDE
NO₂: NITROUS OXIDE
CH₄: METHANE



ENERGY

Power production: burning coal, oil and gas produces carbon dioxide and nitrous oxide.



TRANSPORT

Cars, lorries, trucks, commercial aircraft, and railroads, among other sources, all contribute to transportation end-use sector emissions.



TIMBER

Trees help to regulate the climate by absorbing CO₂ from the atmosphere. When they are cut down, the beneficial effect is lost and the carbon stored in the trees is released into the atmosphere.



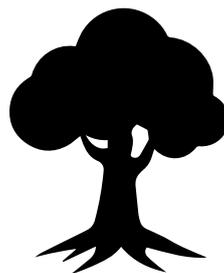
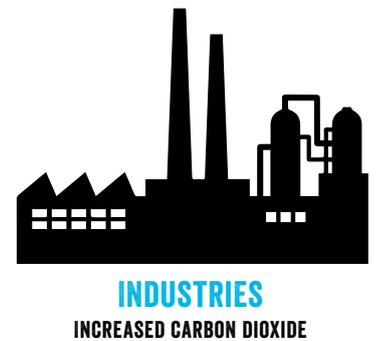
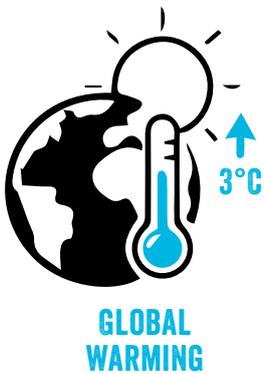
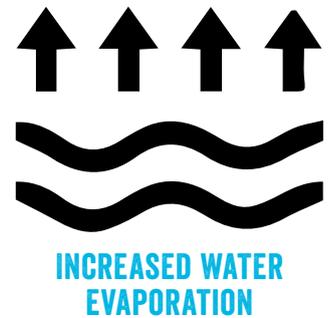
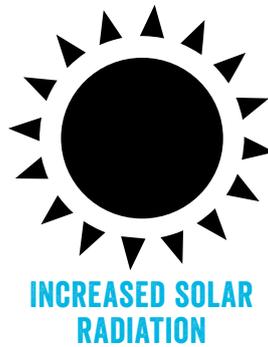
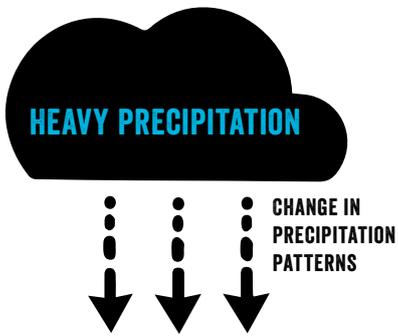
LIVESTOCK

Cows and sheep produce large amounts of methane when they digest their food.



EMISSIONS

Fertilizers containing nitrogen produce nitrous oxide emissions.





1.4. CLIMATE CHANGE IMPACT

Increased flooding:

Due to increased water evaporation and changes in precipitation patterns characterized by heavy rainfall, it is projected there will be increased flooding and soil erosion in coffee growing regions.

Effects:

- Shift in areas suitable for coffee
- Changes in rainfall patterns and temperatures leading to irregular flowering and difficulties in pests and diseases management
- Change in pest and disease incidence by affecting their distribution and severity

Extreme dry weather

Prolonged dry spell characterized by little or no rain at all will result in the coffee plant and other crops being exposed to water stress that growers will need to find ways to manage.



WHAT CAN WE DO?

Site or regionally specific level

Climate change impacts are experienced locally, which means adaptation responses also have to be defined on a site or regionally specific level. Effective adaptation to climate change must be based on a thorough understanding of the vulnerability (or susceptibility) of the targeted coffee agro-ecosystem and coffee farmer communities.

System resilience or strength

The impacts of climate change on coffee production depend on how resilient or strong a system is. A 'system' does not simply refer to a farm level system of production, but also to farming communities, the broader landscape and the whole supply chain, including road infrastructure, storage facilities, etc.

Coffee agro-systems vulnerability

Therefore, adaptation strategies might focus on increasing the resilience of groups of people as well as the resilience of the agricultural systems that their livelihoods rely on. **Vulnerability** of both coffee agro-

ecosystems and communities are, therefore, important factors when considering the effects of climate change.

IMPORTANT NOTE

A farmer may perceive that the coffee farm has an increasing **exposure** to coffee leaf rust because of a changing climate (**higher temperature and higher humidity**). The coffee variety (*Coffea Arabica*) may be susceptible to the disease and hence has a high **sensitivity**. The farmer can do little to reduce exposure to the problem and instead choose to reduce sensitivity by either applying fungicide regularly or by planting a new rust-resistant variety. The correct choice is not easy and will vary according to circumstances. If the farmer receives expert advice, increases knowledge and has sufficient funding with which to make a decision, he can be said to have a good **adaptive capacity**. Therefore, even though the likelihood of disease attacks continues to rise, the farmer can balance this by reducing **vulnerability**.

GUIDANCE

ADAPTIVE CAPACITY

- ✔ CAN BE ENHANCED BY INCREASING THE RESOURCES AND KNOWLEDGE OF FARMERS AND BY SUPPORTING INDIVIDUALS AND ORGANIZATIONS IN RESPONDING APPROPRIATELY TO CLIMATE CHANGE RISKS.
- ✔ CAN BE ENHANCED BY CONCRETE ADAPTATION OPTIONS, E.G. BY TRAINING FARMERS ON HOW TO DEVELOP MORE EFFECTIVE IRRIGATION AND HOW TO CONSTRUCT WATER STORAGE SYSTEMS, OR INDIRECTLY BY IMPROVING ACCESS TO FINANCE THROUGH LOW-RATE LOANS.

VULNERABILITY

- ✔ CAN BE DEFINED AS SUSCEPTIBILITY TO HARM. OFTEN IT IS DEPICTED AS THE RESULT OF A NUMBER OF FACTORS (FIGURE BELOW) AND CAN THEREFORE BE A DIFFICULT CONCEPT TO USE OR DEFINE.

Adopted from Baker P, (CABI), 2014

There are two approaches in addressing issues related to climate change:

CLIMATE CHANGE ADAPTATION AND MITIGATION

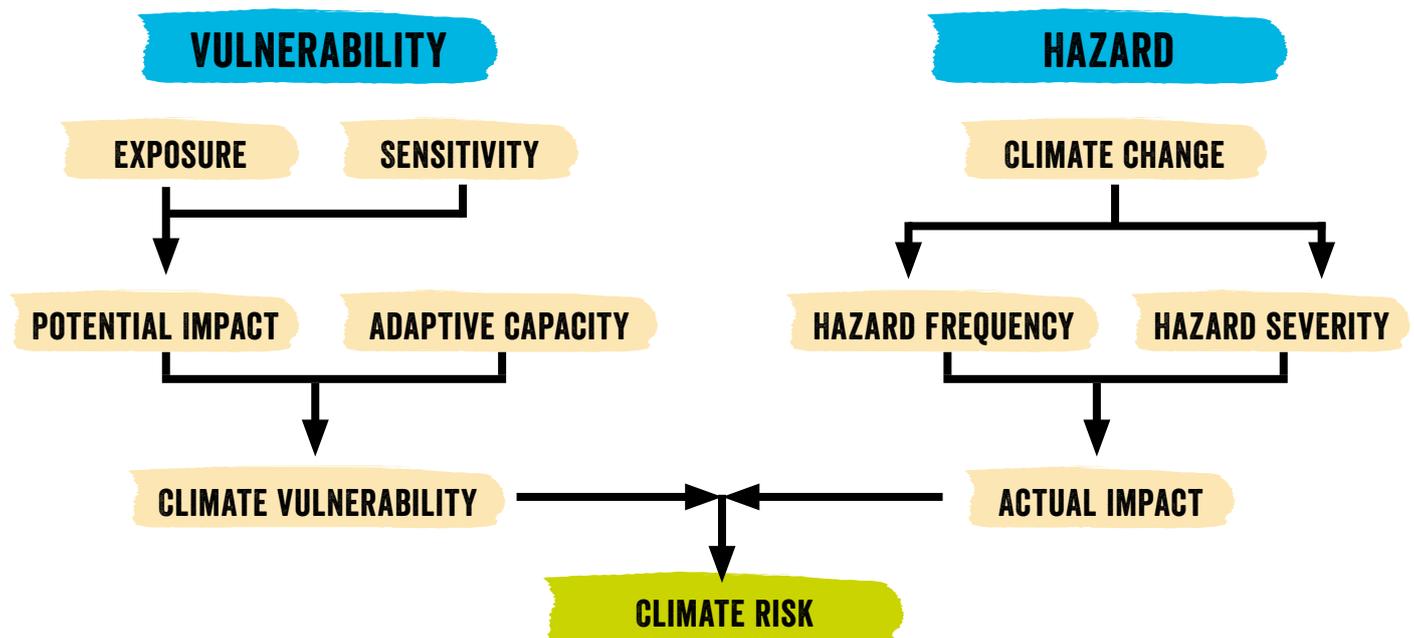
Climate change adaptation

This is the ability to manage, recover, or cope with the impacts of climate change, or actions that reduce the vulnerability of species and ecosystems to the effects of a changing climate such as planting drought-resistant varieties.

Climate change mitigation

Involves reducing greenhouse gas emissions by carrying out activities that directly reduce or offset their release. This includes the utilization of non-fossil-carbon-based fuels and GHG emission control through carbon capture and sequestration.

THE VARIOUS TERMS ARE BEST EXPLAINED BY THE USE OF AN EXAMPLE:



1.4.1. CLIMATE CHANGE ADAPTATION

INCREASING RESILIENCE AND BUILDING ADAPTIVE CAPACITY

Often, climate adaptation is talked about as a way of reducing vulnerability. While this can be useful, the approach often works best when looked at in terms of increasing resilience and building adaptive capacity. This approach is more positive and may be easier to engage stakeholders by discussing opportunities to increase their resilience, rather than viewing them as victims of climate change. The message should be that adaptation helps farmers to be more successful coffee producers.

HOW CAN COFFEE FARMERS ADAPT TO CLIMATE CHANGE?

Adaptation allows coffee producers to both reduce the negative impacts of climate change and benefit from new opportunities that might arise from it. Adaptation for coffee production can be addressed in a number of ways, which can be categorized according to scale as outlined on the table on this page.

Adaptation Level	Explanation	Examples
Plant	Actions to adapt plant to climate change	<ul style="list-style-type: none"> • Introduce new varieties (e.g. more pest or drought-resistant) • Prune • Graft
Field to farm	Actions to increase the resilience of the farm, mainly done through changes in the way farmers manage their production systems	<ul style="list-style-type: none"> • Enhance pest management • Improve soil and water management • Change fertilizer plan • Establish cover crop • Mulch • Plant trees (agroforestry systems) • Establish windbreaks • Introduce solar driers • Change planting dates or planting distances
Household and farming system	Actions to prepare the household against potential negative impacts of climate change	<ul style="list-style-type: none"> • Diversify income (on and off farm) • Improve access to financial services • Train farmers to employ adaptation strategies • Improve farmers' access to seasonal forecasts and other climate information • Encourage men and women to work together to address challenges • Give households control over critical livelihoods and resources
Landscape	Actions that increase the resilience of the coffee farm's surrounding area	<ul style="list-style-type: none"> • Engage in afforestation or reforestation • Protect water catchment areas
Enabling environment/framework conditions	Actions that create and enable the operating environment of farmers or enhance the framework conditions in which farmers conduct their business	<ul style="list-style-type: none"> • Strengthen farmer organizations to facilitate and improve access to climate information and other relevant support services (training, credit for investments, crop insurance, etc.) • Improve access to early warning systems, promote local ownership (climate maps, local expert committees, adaptation as part of local development strategies, etc.)

FAIRTRADE'S APPROACH TO CLIMATE CHANGE

Fairtrade gives farmers a variety of channels and platforms to tackle climate change which help to shape sustainable supply chains.

1. Fairtrade standards

With prevention and mitigation strategies at the heart of Fairtrade environmental standards, farmers are already increasing resilience to climate change. Farmers must make sustainable agriculture and climate adaptation part of their farm management, tackling issues such as water scarcity and soil erosion. Looking to the future, farmers are introducing renewable energy to mitigate carbon emissions from the production process.

2. Fairtrade Minimum price and Premium

The increased revenue from receiving a minimum price acts as a safety net and the premium gives farmers a much-needed cash injection to respond to climate emergencies like harvest failure. This allows farmers to diversify production and develop long-term plans to strengthen their businesses and communities.

3. Connecting networks and knowledge

The Fairtrade network operates across Latin America, Asia and Africa and creates a nimble interlinked system. Fairtrade can react quickly to climate-related disasters and enact broader change by sharing knowledge and resources. Fairtrade can also provide access to funding for wide-scale development programmes.

4. Global governance

Fairtrade is a vehicle for change that brings the voice of farmers and workers to the table at climate change negotiations. For example, the Fairtrade Producer Network for Latin America

and the Caribbean (CLAC) contributed to the Lima Call for Climate Action in 2014. CLAC advocated on behalf of the vulnerable and marginalized farming communities in their network.

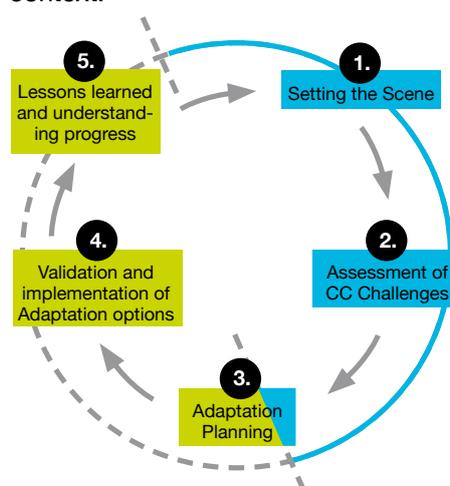
5. Strategic partnerships

Fairtrade alone cannot tackle the challenges presented by volatile prices and weather. Creating strong, adaptable and resilient coffee communities brings benefits throughout the supply chain. Fairtrade continues to seek collaboration with commercial partners, the wider coffee industry, NGOs and governments to address the impact of climate change on coffee farmers.

Farmer five step adaptation process; fitting to the local context.

The approach is a five-step process that enables coffee farmers to effectively respond to climate change by a systematic risk assessment, as well as the identification and implementation of suitable adaptation options (see figure below).

Step 1: Setting the scene allows for a quick look at how important climate change is in the given working context.



Step 2: Assessment of climate change challenges creates an understanding of the impacts of climate change on coffee production and the

livelihoods of producers, and identifies suitable adaptation options to respond effectively.

Step 3: Adaptation planning prioritizes adaptation options for a specific context and structures their implementation process.

Step 4: Validation and implementation of adaptation options offers different methods to facilitate implementation work and stresses the importance of validating or testing the selected adaptation practices on a small scale, before dissemination takes place.

Step 5: Lessons learned and understanding progress looks at the implemented process in phases of monitoring, evaluation and learning. This is critical to the cyclical process, as it provides the lessons and evidence on which to base future adaptation approaches.

NOTE

In addition, the climate is continuously changing, which means adaptation efforts need to be continuously revised. It should be noted that the climate change approach does not provide a single set of answers, but instead provides the information concepts and tools to support the development of locally appropriate adaptation measures.



The practices below could fall under different categories- adaptation and mitigation that are either farm or plant specific;

- a)** Coffee plants management
- b)** On farm forestry
- c)** Soil management
- d)** Water management
- e)** Waste management
- f)** Solar energy
- g)** Diversification
- h)** Farm management/ planning



2. COFFEE TREE MANAGEMENT

In order to adapt to climate change, you need to adopt practices that keep your coffee healthy and robust. In this chapter, we will go through good management practices of coffee trees that are especially important in the face of climate change impacts.

2.1. PRUNING

In the event of prolonged rains and higher temperatures, humidity tends to increase within the tree canopy—therefore increasing exposure to diseases. Pruning, to keep the branches aerated becomes important to prevent disease outbreak. Removal of shoots, dead and unproductive branches also reduces breeding ground for diseases and pests.



2.2. CHANGING OF THE VARIETY

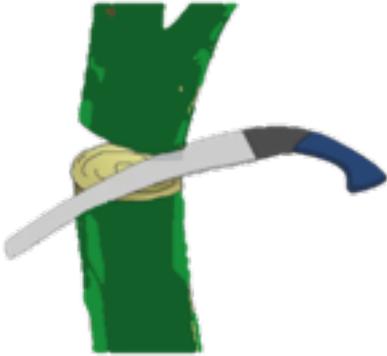
- o When replanting or considering a change of varieties, look out for the following traits:
 - Drought tolerant/resistant to higher temperature,
 - Resistant to pests and diseases,
 - Highly productive and well adapted to the local soil conditions,
 - Has acceptable and desired quality for the market.
- o There are two methods of switching the variety. The easier method is **replanting**. Obtain a seedling of a new variety and plant on your farm.
- o You can plant the seedlings between the existing rows of coffee. Once the new plants mature, uproot the old coffee plants as seen in the photo below where there is a mix of the old and young plants.



- o Re-planting is technically **easier for smallholders**, but it takes around three years until you can start harvesting from the new variety.
- o The other method is **top-grafting** (see illustration in the next page). 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 an expert. After top-grafting, you can start harvesting from the grafted stems in a year or two.

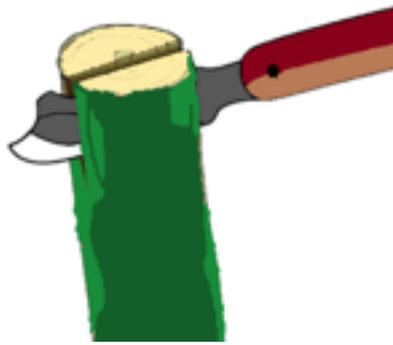
1.

Amputate your rootstock. Choose a point below which the branch is straight and blemish-free for six inches and then make a clean perpendicular cut, removing the rest of the branch.



2.

Cleave your rootstock. Use a cleft-graft knife or a hatchet to split the branch straight down the center for about 6 inches.



3.

Prepare the scions. Remove the tip and the base of the scion. Beginning just below the bottom bud, make a sloping cut on either side of the scion that reaches all the way to the bottom.



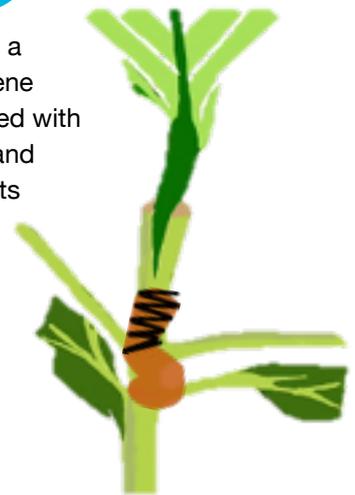
4.

Insert the scion into the rootstock. Using a large screwdriver or small chisel to hold open the cleft in the rootstock, insert a scion into the cleft. No cut surface on the scion should be visible above the top of the rootstock.



5.

Secure a polythene bag filled with water and nutrients



3. SOIL MANAGEMENT

Among the various elements on your farm, the soil is where a huge amount of carbon is 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 into the air.

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.

3.1. TECHNOLOGIES FOR MITIGATING AGRICULTURAL EMISSIONS IN THE SOIL

a) Conservation agricultural practices (reduced slash and burn practices on the farm). Residues or the crop remains should be left on the land surfaces. Don't burn. Instead of burning agricultural waste such as maize stalks, it is advisable to slash and use the same as mulch material on coffee farm.



b) Reduce the soil exposure to erosion activities through protection of the steep areas.



Coffee farms with steep slopes are prone to soil erosion that leads to soil loss and reduced capacity for carbon sequestration.



Well managed soil on the steep slopes support soil erosion control and enhanced carbon sequestration.

c) Promote soil carbon sequestration by increasing the time and amount of crop residues left on the soil surface; and reducing soil disturbance, thereby decreasing CO₂ emissions. *Related good practices in section 3.2.*

d) Farm afforestation and re-afforestation is encouraged. However, it is important to consider planting trees that are environmentally friendly; broad-leafed and don't compete with other crops. Once there is leaf fall, soil nutrients replenishment is realized.

e) Tillage and residue management. Plant crops in the previous crop's residues, which are purposely left on the soil surface. This shields the soil from rain and wind and also adds organic matter, reduces soil compaction and improves soil tilth.

f) Organic and degraded soils restoration. This involves restoration of the soils to their original state after disturbance. This could be realised through cover cropping and mulching. The use of mulch is critical in soil moisture conservation and soil nutrient replenishment.



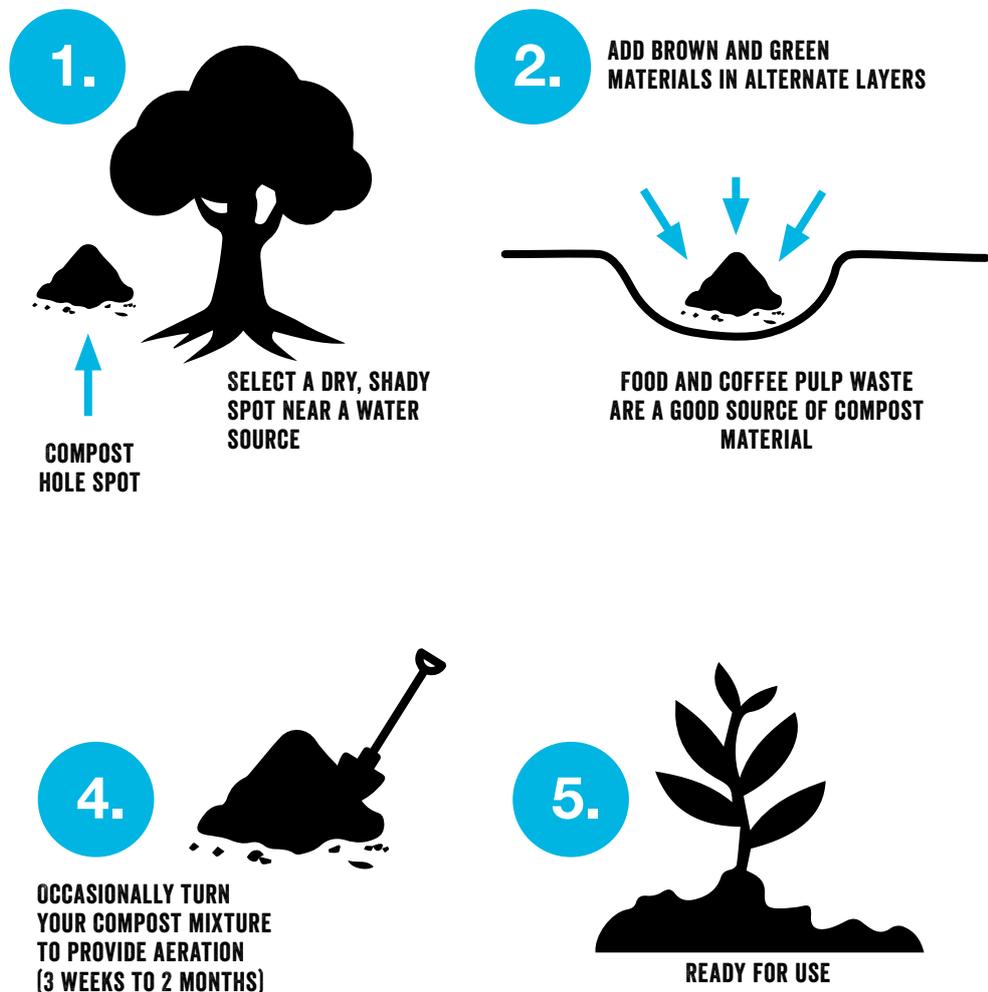
BENEFITS OF RESIDUES ON THE FARM

- The residues are broken down providing nutrition for crops and reducing fertilizer requirements especially those that could lead to GHG emissions.
- Residue protects the soil from wind erosion, it slows down and prevents water from running off and acts as a wick, allowing rain water to infiltrate deep into the soil, recharging it with water.
- Residue acts as a continuum gap between water in the soil and water in the atmosphere, which basically means that evaporation of water, in soil covered with residue, is diminished.
- Water harvesting can only be done if the soil is in a healthy state; physically, chemically and biologically.



g) Manure composting.

Under high temperatures, waste undergoes aerobic decomposition by microorganisms which kills pathogens, making it suitable for use on coffee farms.





4. WATER MANAGEMENT

As the climate changes, you could be encountering reduced rainfall, delayed rains or even drought. Therefore, you need to prepare yourself as much as possible to mitigate the negative impacts of such changes on your lives, animals and crops. In this chapter, you will learn how to conserve water in the context of climate change.

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4.1. WATER MANAGEMENT METHODS

- a) Rain water harvesting
- b) Protection of water sources
- c) No crops near rivers
- d) No running water taps
- e) On farm water harvesting
- f) Efficient irrigation system

a) Rain water harvesting

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 reduces the time spent fetching water and covers your needs during the dry season. Rainwater harvesting is the collection, storage and use of rainwater for



domestic consumption and other uses such as crop irrigation.

A simple gutter system and a storage tank is all a farmer needs to harvest rain water.

b) Protection of water sources

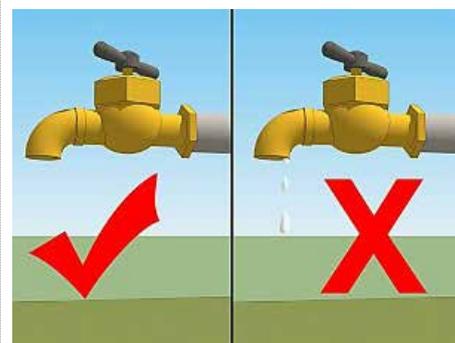


c) No crops near rivers

Farming near streams/rivers or other water sources degrades the soil and vegetation cover. Plant roots suck in water, causing the soil to loosen which then gets into the water causing siltation and water pollution for consumers downstream.

d) No running taps

Leaking taps and running water that is not being put to use is a waste of a scarce and precious resource. Repair leaking taps and water pipes to reduce water wastage. Also, always ensure to turn off running water when not in use.

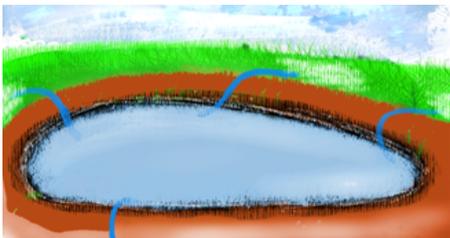




e) On-farm water harvesting

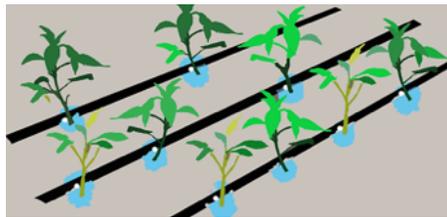
This can be realized through the use of water pans, retention ditches and mulching among others.

Water pans can be used to store water during the rainy season. They have a black polythene sheet lining to prevent water seepage into the ground. The water can be used for irrigation during dry seasons.



f) Efficient irrigation system

Do not use overhead systems but drip irrigation. Drip irrigation is more efficient and conserves water.





5. ON-FARM FORESTRY

Trees play an important role in climate change in that they can help mitigate it by removing CO₂ from the atmosphere.

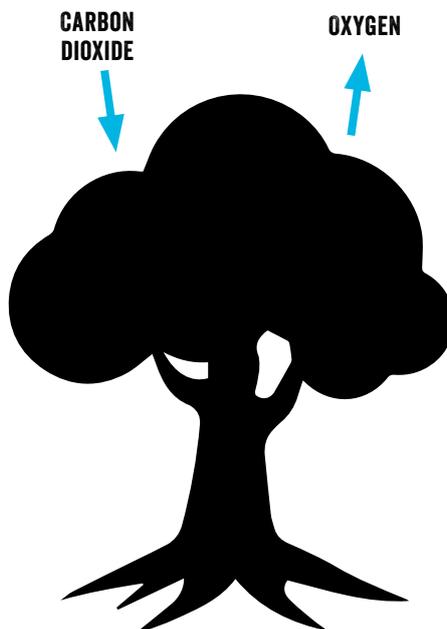
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Trees breathe in a way that is different from human beings. When trees breathe, they take carbon dioxide (CO₂) from the air, absorb carbon and release oxygen into the air.

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

WHAT HAPPENS IF WE CUT DOWN TREES?

When a tree is cut down and burnt, 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, trees play a critical role in carbon sequestration and at the same time play a significant role in the productivity of the coffee plants.



If you cut down all the shade trees on the farm, or do not plant any, your productivity may be high for the first few years, but it is unlikely to be maintained. When coffee trees and the soil are exposed to strong sunshine, they become exhausted and productivity starts to reduce. Unless you apply a significant amount of synthetic fertilizers, it would be difficult to maintain the same level of productivity in the long run. Too much synthetic fertilizer is expensive and makes the soil acidic and unsuitable for coffee production.



5.1. MANAGING TREES ON THE FARM

BENEFITS OF SHADE TREES

- They protect coffee trees from strong sunshine.
- They maintain moisture and humidity in the soil.
- Fallen leaves and pruned branches contribute organic matter to the soil.
- They maintain a micro-climate on the farm and protect coffee trees from dry weather and extreme temperatures.
- Some trees such as calliandra are leguminous thereby fixing nitrogen in the soil.
- Some trees provide fruits and timber which can provide an extra income.
- Due to the protection of coffee trees and the soil, productivity improves and stabilizes in the long run.

For shade trees to benefit coffee trees, you need to manage them well. If shade trees are not pruned and left to overgrow, too much shade would deprive coffee trees of sunlight and cause more fungal diseases due to increased humidity. It is important to prune shade trees regularly to maintain an adequate amount of shade.

IT IS BENEFICIAL TO PROTECT AND PRESERVE THE TREES AROUND YOUR FARM

It is important to protect the trees on or around your farm. If there is a forest, wetland, lake or river within or around your farm, such an area could be converted to a conservation area. This means that felling trees or cultivating crops should be restricted in such areas unless sustainable management practices are applied.



Banana and other shade trees planted within a farm to provide shade to coffee plants.



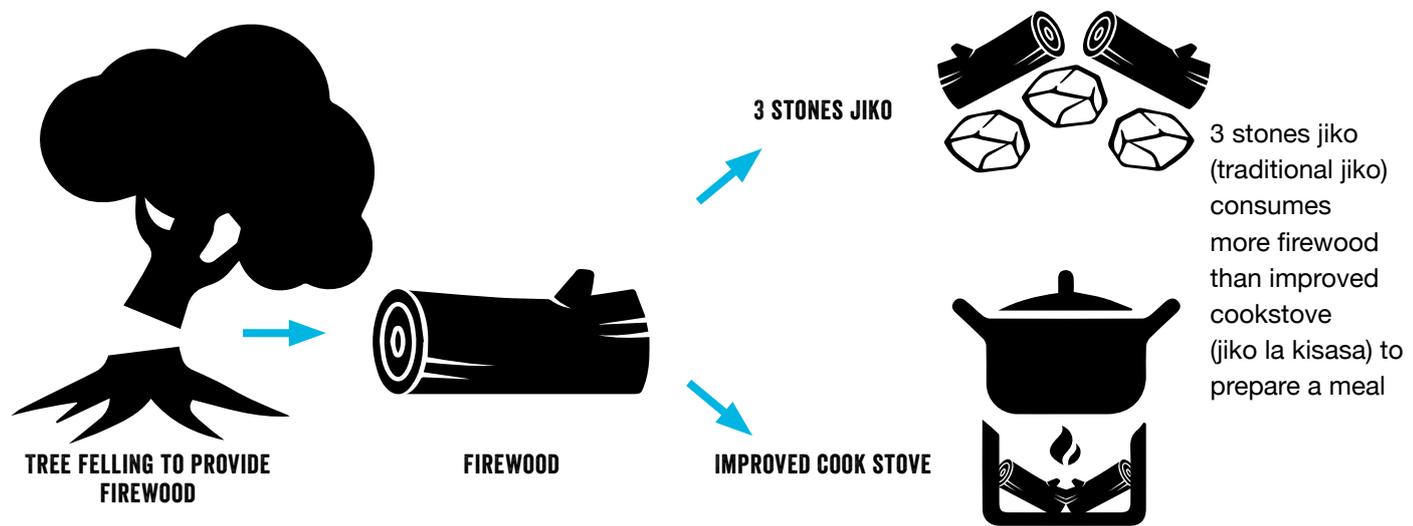
Coffee trees without shade tree

BENEFITS OF FARM FORESTRY

- Forestry enhances the environment by increasing biodiversity, capturing carbon and reducing the use of fertiliser and pesticides
- Providing own sustainable fuel source thus reducing fossil fuel imports when the branches are used
- Provides shelter to the farm helping livestock to thrive
- Less time consuming than other farm activities allowing more time to be spent on more productive tasks



5.2. REDUCED DEPENDENCE ON WOOD AS FUEL



You may need firewood for cooking, but you can reduce the amount needed by using an improved cooking stove. **An open fire consumes a lot of firewood and produces smoke which affects the health of users.**

- An energy saving stove retains heat from firewood much longer and cooks more 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 sustainable firewood supply. Pruned coffee branches can also be used as firewood.



5.3. PLANTING APPROPRIATE TREE SPECIES

If you harvest wood for firewood or other purposes, you should replant the same number of trees. You can plant indigenous trees within your farm as shade trees, and around the farm as a live hedge.

In the next pages, you will see which trees are recommended for planting. These trees are either indigenous trees or naturalized. They can coexist with coffee trees under the agroforestry system.

Recommended species for shade:

Markhamia - Mtalawanda, Mgambo
Calliandra - Mkaliandra
Alnus - Mvumo, Mkarambati
Inga
Leuceana - Lusina
Ficus - Mkuyu
Polycias fulva
Cordia Africana - Mkobokobo
Maesopsis - Musizi

DO NOT PLANT EXOTIC TREES SUCH AS EUCALYPTUS AS SHADE IN YOUR COFFEE FARM. EUCALYPTUS CREATES AN ENVIRONMENT THAT IS NOT FAVOURABLE FOR COFFEE AND OTHER CROPS.

Sample shade trees

Grevillea robusta

Also known as silky oak or Mukima, Mubariti (Kikuyu, Meru), Muvariti (Embu), Mukima (Kamba) it provides shade and windbreak to the coffee plant. Because of its deep rooting system, the tree does not interfere with rooting system of the coffee plant. When planted as a windbreak the recommended spacing should be 2 to 2.5 meters between single rows. Regular pruning is recommended so as to reduce competition with coffee plants.

Other benefits: Timber, fuel

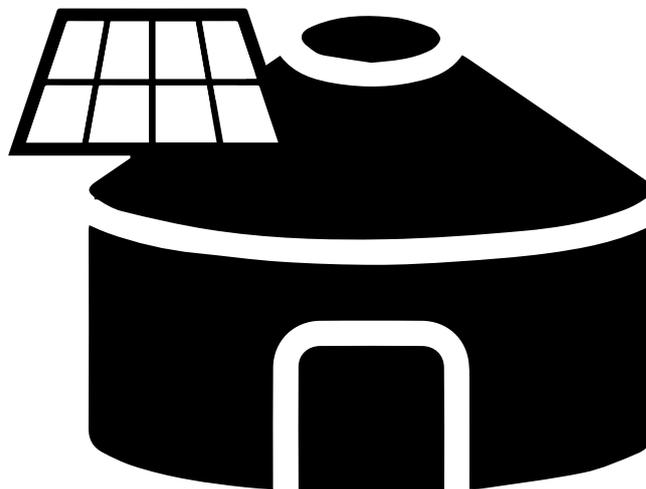


GREVILLEA ROBUSTA



6. ENERGY USE ON THE FARM

A SOLAR PANEL MOUNTED ON THE ROOF

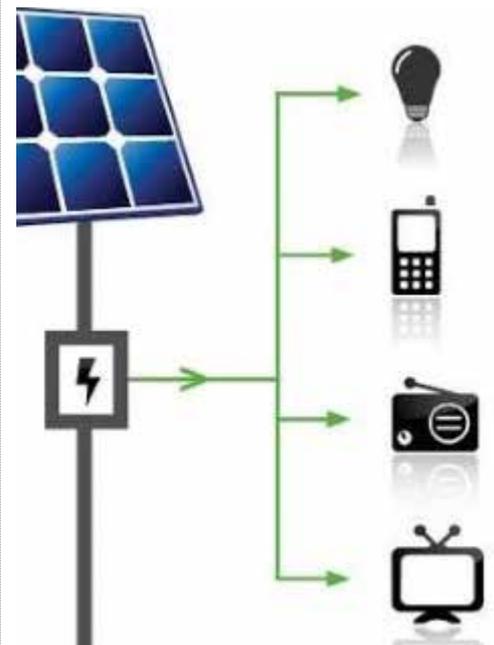


A 20-30Wp solar PV system can generate enough power for average household lighting, communication and entertainment needs. Solar PV provides clean renewable energy that is carbon neutral.

Exploitation of renewable energy sources such as solar and biogas is one way to adapt to climate change. The two energy sources are clean and renewable and thus do not contribute to carbon emission and the resultant effect of global warming and climate change.

The sun is the energy source that is available to all of us every day. Unlike petroleum, you can make use of sunlight to generate electricity without polluting the environment or contributing to subsequent climate change.

Use of biogas as an alternative to firewood and charcoal, similar to solar, is environmentally safe, healthy and a cost effective way to meet the family's fuel needs. Biogas can be generated from cow dung.





7. WASTE MANAGEMENT

The reduction and recycling of solid waste can help address global climate change. The distribution, application and manufacture of products, as well as management of the resulting waste, all result in greenhouse gas emissions. The prevention and recycling of waste reduces greenhouse gases associated with these activities by reducing methane emissions, saving energy, and increasing forest carbon sequestration. It is thus imperative that the waste practices adopted do not lead to the release of GHG to the atmosphere.

“DO NOT BURN WASTE”

When you burn waste, you emit a lot of greenhouse gases, such as carbon dioxide and nitrous oxide. The increase in GHG in the atmosphere compounds the effects of climate change on the planet.





7.1. SOUND WASTE MANAGEMENT

Burning waste or leaving it in the open to decompose leads to loss of nutrients contained in organic waste. Organic waste has a huge potential to boost your productivity. If managed well, it provides very good organic fertilizer that makes your coffee trees healthier, stronger and more productive.

The practices for sustainable waste management include:

a) Composting

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 pit which needs to be under tree shade or a simple roof for the following reasons: exposure to the sun leads to loss of nutrients through volatilization while direct run-offs or floods would wash the nutrients away.

b) Waste to energy (biogas generation)

Animal waste contributes to methane emissions which is a greenhouse gas. This can be overcome by utilizing the waste; especially cow dung to generate biogas which also reduces reliance on wood fuel.

FOR BIOGAS GENERATION
 Keep your cows under a roof and on a cemented floor so that you can collect the dung.

In principle waste is best managed through the application of the 4Rs—recycle, reuse, recover and reduce. Burning of plastic wastes should not be practiced as this will in the process lead to emissions that could contribute to GHG. Collect and return the plastic to the supplier or recycling companies.

For cattle, typically 1 kg of dung fed to a digester produces about 40 litres of biogas per day. Values for other substrates will differ; pigs, poultry and human excreta typically have higher yields.

One cubic meter of biogas daily will provide 2.5 to 3.5 cooking hours. This could, depending on family size, be enough for e.g. breakfast and lunch preparation, and would then provide a meaningful contribution.



THE CASE OF BIOGAS: HARNESSING ENERGY FROM ANIMAL DUNG



c) Waste to energy (briquettes)

Waste from coffee processing such as husks can be recycled and made useful once more. This can be realized through the production of coffee husk briquettes which are an efficient source of fuel. The briquettes can either be carbonized or non-carbonized. This reduces the pressure on the forests which act as carbon sinks in the atmosphere.



BRIQUETTES MADE OF COFFEE HUSKS AS A SOURCE OF ENERGY

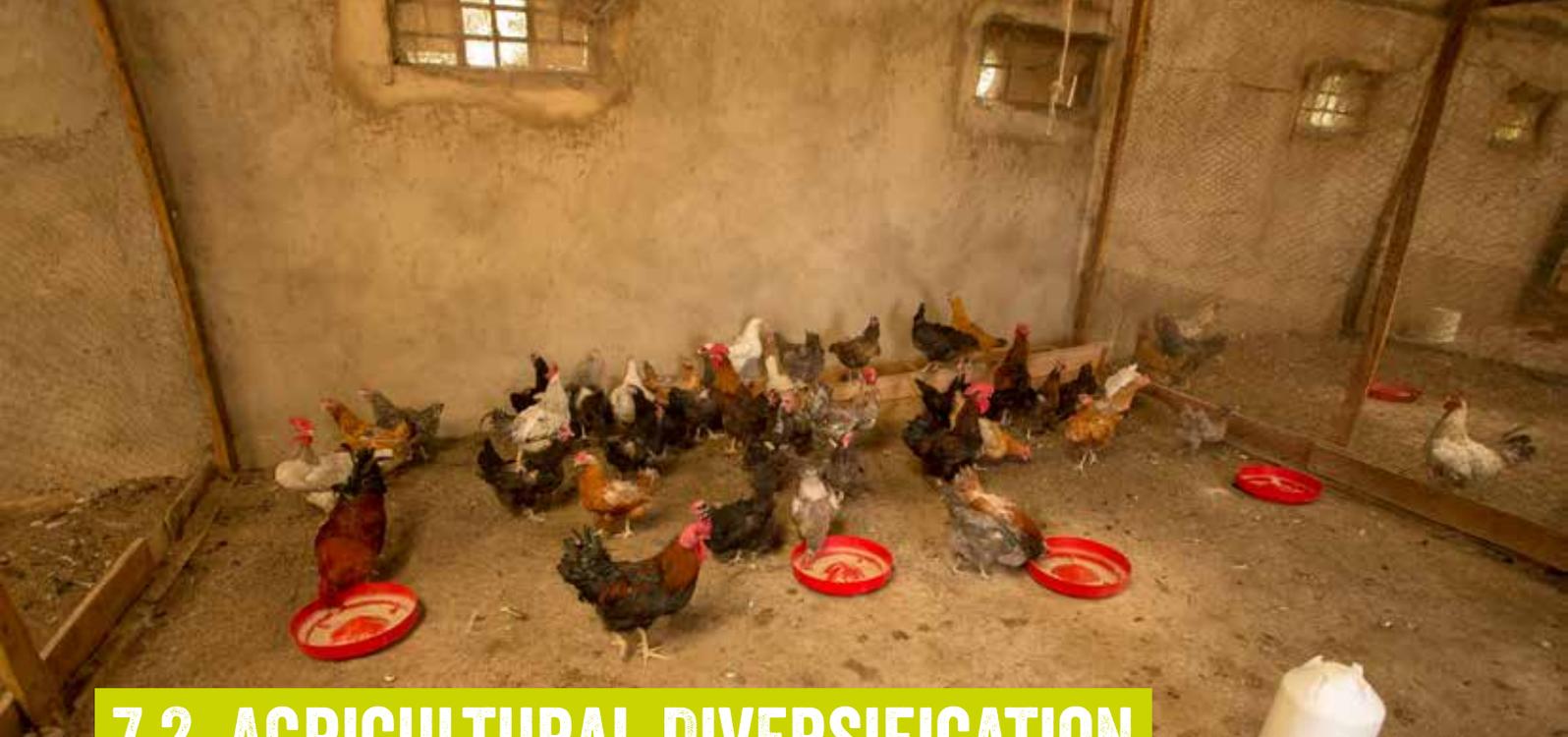
WHY BRIQUETTES?

- More cost effective + less consumption.
- Uniform size, and thus get even heat.
- Due to the greater density briquettes burn 3-4 times longer than charcoal and occupy 2 times less storage space.
- Charcoal briquettes do not spark when burning; thus good for fuel for fireplaces.
- Charcoal briquettes do not emit carbon dioxide, and thus are safe indoors with working ventilation.
- Produce more energy than wood charcoal.
- Environmentally friendly; fuel does not emit fumes and noxious compounds.
- Charcoal briquettes do not crumble during transportation

Coffee husks and other agricultural waste products are a good source of raw material production for briquettes.

A coffee society can invest in briquette production equipment. The briquettes produced can then be sold to the coffee society and community members.

Well produced briquettes have a high **calorific** value, burn longer and are a better alternative to charcoal and firewood.



7.2. AGRICULTURAL DIVERSIFICATION

A farming system that encompasses several concurrent enterprises aimed at spreading risks, increasing income and enhancing food security at the household level.

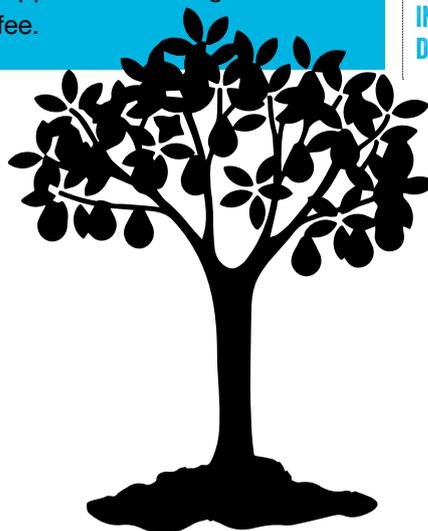
This is a system of farming that encompasses several concurrent enterprises aimed at spreading risks, increasing income and enhancing food security at the household level. On separate fields, plant fruits such as guava, pawpaws and tree tomatoes that are rich in vitamins and good for domestic consumption and export. Local vegetables e.g. pumpkins, amaranth (*terere*) and black night shade (*managu*) are good for food security. They are also nutritional as they are rich in vitamin C and iron. They grow fast and can be planted in small plots that satisfy the family's food needs.

Diversification can also entail:
a) Producing horticultural crops for the domestic and export market.

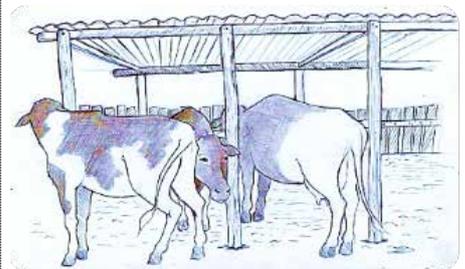
Coffee growing areas are well suited for production of a wide range of horticultural crops. Farmers can plant horticultural crops in separate portions of land.

AVOCADO

Avocado trees have well shaped umbrella type canopies that provide shade to the coffee plant thus mitigating against excessive ambient temperatures and heat stress that are responsible for flower and fruit failure. Other benefits: avocado fruits have a local and international market. A farmer can sell the fruit to supplement earnings from coffee.



b) Livestock farming - indigenous cows can be bred with exotic breeds to improve milk yields.



INCOME DIVERSIFICATION- DAIRY FARMING





IN ESSENCE, DIVERSIFICATION AIDS FARMERS DURING DRY SPELLS AND PROVIDES COPING MECHANISMS IN TIMES WHEN THE EFFECTS OF CLIMATE CHANGE ARE DIRE.

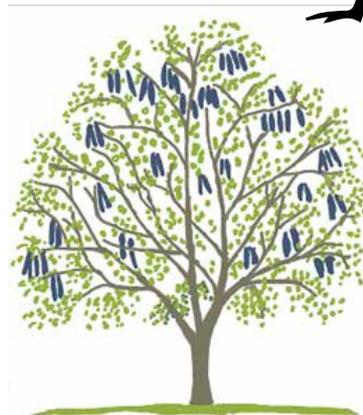
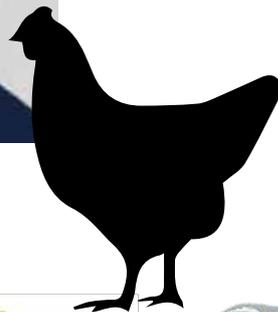
c) Fish farming (aquaculture)

Farmers in areas with streams or rivers can utilize the water to create fish ponds. Fingerlings can be obtained from various fishery departments across the country.

d) Bee keeping (apiculture)



e) Poultry and rabbit farming





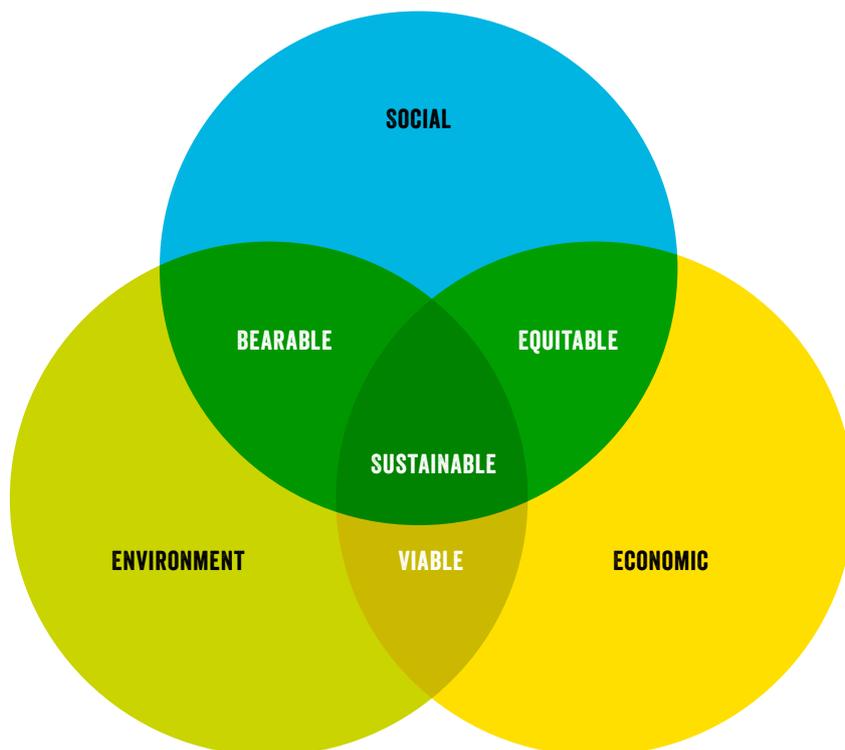
8. FARMER PLANNING FOR CLIMATE CHANGE ADAPTATION & MITIGATION

Well planned farms play a critical role in climate change adaptation and mitigation.



Ideally farm planning should encompass the principles of sustainability that are hinged on social, environmental and economic pillars.

All the things you have learned in this guide need to be implemented on your farm. Develop your farm map and an action plan of the activities to adapt to climate change.





8.1. MAPPING THE FARM AND PLANNING ACTIVITIES

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

.....

Once you have a map, analyse the following:

- o Has your land usage pattern changed over the last years?
- o Do any of your land practices contribute to climate change?
- o Are there any areas that are vulnerable to climate disasters, such as floods or landslides?
- o What should be done in an emergency situation, such as a flood, landslide, hurricane, earthquake or thunderstorm?
- o Are there any areas that are susceptible to soil erosion?
- o Where do you need to plant more trees or grass?
- o Where are the water sources to be protected?

As you plan your activities, assess whether climate change has the biggest impact on your farm. Highlight unfriendly activities/ practices that you need to change.

Understanding climate change risks and opportunities is a key step towards maintaining a farm that withstands the effects of climate change.

Climate risks and opportunity assessment as a tool for climate change farm planning.

What is involved?

1. Identify risks posed by climate change & possible opportunities to adapt & mitigate climate change
2. Collecting and structuring knowledge on the climate within your region
3. Activate and deepen understanding of interrelations between the climate, changing climate conditions and your production
4. Define climate change phenomenon to get a better understanding of associated risks and related vulnerabilities to your farming systems
5. Outline actions to take to adapt coffee farming and processing to the effects of climate change





Producer's timeline

For better understanding; as a coffee farmer, you should draw a timeline bearing in mind how events have changed over time. The aim here is to identify natural events that influence your life presently and analyse the frequency with which these events occur. The table below could be used.

PRODUCER'S TIMELINE:

Identify events that have influenced your life up to now as much as you can remember.



LINK THE EVENTS IDENTIFIED TO CLIMATE CHANGE

CLIMATE EXAMPLES

YEAR	EVENT	CLIMATE RELATION

THE FOLLOWING SECTION FOCUS ON:

understanding the changes in the ecosystem in terms of the species abundance and richness so as to define how changes have taken place over time.

ANALYZE THE CHANGE IN ABUNDANCE OF THE IDENTIFIED FLORA AND FAUNA AND POSSIBLE CAUSE OF THE CHANGE.

FLORA/ FAUNA	CHANGE IN ABUNDANCE	CLIMATE RELATION

With the understanding of the changes and the relation to climate change, you are now able to draw a calendar that clearly depicts how to factor in the risks in farm planning for climate change mitigation.

BY CHECKING THE PRODUCERS' CYCLIC ACTIVITIES BASED ON ANIMAL & PLANTS, WEATHER/CLIMATE AND SOCIAL EVENTS, THE PRODUCERS WILL CLEARLY IDENTIFY THE CLIMATE FACTORS THAT AFFECT THEIR COFFEE PRODUCTION

PRODUCER'S SEASONAL CALENDAR

Tabulate the results and mark out activities, changes and effects that are related to coffee farming and fill the table below:

MONTH	EVENT/ACTIVITY	CHANGES AND EFFECTS

THE FOLLOWING SECTION HELPS TO SHOW:

how the effects on fauna and flora affect the shared values within your communities.

TRY AND IDENTIFY SHARED VALUES THAT NEED TO BE CONSERVED.

Values could be listed in the table below:

	SHARED VALUE
01	
02	
03	

IN FOLLOW-UP:

there should be a link between the values identified and problems. This should only focus on the problems endangering the values.

Identify and write down problems/risks that can endanger the values identified.

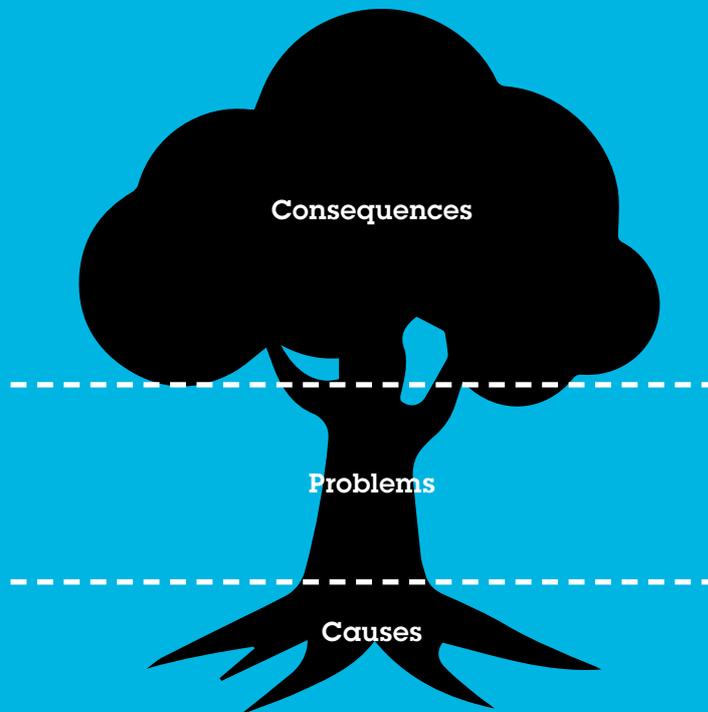
PROBLEMS TO SHARED VALUES		
SNO.	VALUE	PROBLEMS
01		
02		
03		

After listing the problems, the next step is to carry out a problem analysis.

PROBLEM ANALYSIS (PROBLEM TREE)

PROBLEM ANALYSIS (PROBLEM TREE)- HELPS PRODUCERS UNDERSTAND THE CAUSES AND EFFECTS OF THE IDENTIFIED PROBLEMS.

On the problem tree diagram list, write down all possible root causes of the problem on the roots of the tree and all possible effects of the problems on the branches.



This way you are able to link the activities that support climate change (**climate vulnerabilities**) and the related **climate risks** (impacts that threaten/affect the farming ecosystem).

PROBLEM	CATEGORY	
	CLIMATE VULNERABILITY	CLIMATE RISK

PRODUCER'S SOLUTION (SUNRAY EXERCISE)

DEVELOP SOLUTIONS TO THE IDENTIFIED PROBLEMS BY BREAKING THEM DOWN INTO MANAGEABLE STEPS

Solutions provide a clear focus on how the issues identified can be addressed. Write down as many solutions as possible to counter the problems identified. The solution in this case should be the adaptation/mitigation measure proposed. This should then help develop an action plan on how each of the problems will be addressed. This is fed into what is called a producer action plan.

PRODUCER'S ACTION PLAN

For the effective implementation of the solutions identified, the action plan should be clear in terms of : the solution, execution timeline, resources required and the person responsible.



PROBLEM	ADAPTATION/MITIGATION OPTION (ACTIVITY)	TIME FRAME	RESOURCES	RESPONSIBLE

MONITORING IMPLEMENTATION OF THE ACTION PLAN



MONITORING & EVALUATION
MONITORING & EVALUATION
MONITORING & EVALUATION

Monitoring enables the periodic review of the actions taken to mitigate the problems.

PROBLEM	ADAPTATION/MITIGATION OPTION (ACTIVITY)	TIME FRAME	RESOURCES	RESPONSIBLE	ACTIONS CARRIED OUT	RESULTS

TAKE HOME

When developing and assessing a monitoring plan, please take note of the following:

- **MAKE ORGANIZATION AND METHODOLOGY DECISIONS WHICH ALLOW MONITORING & EVALUATION TO BE AN OPPORTUNITY FOR LEARNING ABOUT CLIMATE CHANGE ADAPTATION, AND A VECTOR FOR DEVELOPING ADAPTIVE MANAGEMENT.**
- **START MONITORING & EVALUATION AT THE EARLIEST POSSIBLE STAGE.**

8.2. SUMMARY

- **INCREASING GHG CONCENTRATIONS IS CAUSING CLIMATE CHANGE WITH CONSEQUENT IMPACTS ON ECOSYSTEMS AND SOCIETIES.**
- **ADAPTATION AIMS AT REDUCING THE VULNERABILITY OF AGRICULTURAL SYSTEMS TO THE IMPACTS OF CLIMATE CHANGE AND CLIMATE-RELATED RISKS, BY MAINTAINING OR INCREASING ADAPTIVE CAPACITY AND RESILIENCE.**
- **KEY ADAPTATION STRATEGIES INCLUDE A BROAD SET OF INTERVENTIONS RANGING FROM ACTIVITIES THAT FOCUS ON REDUCING DRIVERS OF VULNERABILITY TO ACTIONS AIMED AT CONFRONTING NOT YET EXPERIENCED CLIMATE CHANGE IMPACTS.**
- **MITIGATION ADDRESSES THE CAUSES OF CLIMATE CHANGE. THE MITIGATION POTENTIAL OF AGRICULTURE IS SUBSTANTIAL AS AGRICULTURE AND DEFORESTATION CONTRIBUTE TO ABOUT ONE THIRD OF GLOBAL GREENHOUSE GAS EMISSIONS.**
- **KEY MITIGATION STRATEGIES INCLUDE ACTIONS AIMED AT REDUCING GHG CONCENTRATION AND CREATING CARBON SINKS THROUGH CARBON SEQUESTRATION IN SOILS: IN ABOVE AND BELOW GROUND BIOMASS.**
- **EVEN WITH AN IMMEDIATE STOP IN THE GHG EMISSIONS, CLIMATE CHANGE WILL OCCUR BECAUSE OF THE SLOW REACTION OF THE CLIMATE SYSTEM. THEREFORE, ADAPTATION AND MITIGATION SHOULD BE CONSIDERED AS COMPLEMENTARY.**

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