



Climate Change and Coffee

Training for coffee organizations and extension services



Introduction

- 1** What does climate change mean for smallholder coffee farmers? p. 6
 - a) What is climate change? p. 7
 - b) Why is our climate changing? p. 9
 - c) What are the climate risks and impacts on coffee production? p. 9
 - d) What do these changes mean for smallholder coffee farmers? p. 12

- 2** How can we facilitate climate change adaptation in coffee production? p. 14
 - a) How do farmers perceive climate change and its impacts on their coffee farms? p. 16
 - b) How can we improve coffee plantation management to better adapt to climate change? p. 18
 - c) How can we manage the variability in coffee plantations to make them more resistant to climate change? p. 21
 - d) How can we conserve soil fertility? p. 23
 - e) What is the importance of shade in buffering climate change impacts? p. 25
 - f) How can we manage the changes in the incidence of pests and diseases due to climate change? p. 27
 - g) How can we conserve and better use water sources? p. 28
 - h) How can we manage the changes in coffee phenology due to climate change? p. 31
 - i) Which agricultural practices have farmers used and how can we evaluate them? p. 34
 - j) How can a training plan be developed so that farmers can manage climatic variability in their coffee plantations? p. 37

- 3** How can adaptation strategies with smallholder coffee organizations be identified? p. 39
The process of Risk and Opportunity Analysis (ROA)
 - a) What is the ROA process? p. 40
 - b) The 7 steps of the ROA process p. 41
 - c) The goal of the ROA process p. 42

d) Basic toolkit - the participatory workshop	p. 48
1) Climate Diagram	
2) Time Line	
3) List of Animals and Plants	
3) Seasonal Calendar	
5) Presentation and revision of results	
6) Meditation: Two Way Vision	
7) Priority Values	
8) List of Problems	
9) Problem Tree	
10) Sun Ray Exercise	
11) Assessment of Adaptation Options	
12) Action Plan	
e) Lessons learned	p. 63

4 What are the opportunities and limitations for climate change mitigation in coffee production?

	p.67
a.) Introduction	p. 68
I. Greenhouse gases (GHG)	
II. Greenhouse gas pools	
III. The relationship between adaptation and mitigation	
IV. How can we share this topic with farmers?	
b) What opportunities do the voluntary carbon markets offer smallholder coffee farmers? p.70	
I. An example: the Voluntary Carbon Standard (VCS)	
II. How can we facilitate this topic with farmers?	
III. Project design	
IV. What are the limitations for smallholder farmers in accessing the voluntary carbon market?	
c) What opportunities do "climate friendly" certification systems offer smallholder coffee producers?	p. 75

Glossary

Annexes

Acknowledgements

Imprint

How can the capacity of smallholder coffee farmers and their organizations be strengthened so that they can meet the challenges of climate change?

Smallholder coffee farmers all over the world have always had to manage good and bad coffee harvest years, as well as deal with a high dependency on climatic conditions and consequently, volatile coffee prices. Now, they face a new challenge: climate change and its negative impacts on agricultural production. In several coffee growing regions we can now observe that rising temperatures are affecting smallholder farmers. Coffee production areas decrease moving to higher altitudes, coffee quality decreases and changes in pest and disease patterns. In addition, rainfall is already becoming more unpredictable and is causing a loss of soil and soil fertility and even landslides. Unpredictable and erratic rains as now often seen in especially Kenya are also affecting coffee berry quality, impeding their maturity or the shade drying process. With all of these uncertainties, poor smallholder farmers in rural areas are going to be more susceptible to climate change. Due to a lack of information, a lack of training in adaptation and limited access to technical and financial assistance, smallholder farmers are going to be affected most by climate change.

To meet these challenges and to help coffee farmers, the British Fair Trade coffee company, Cafédirect, and the German Technical Cooperation, GTZ, implemented a pilot project from April 2007 to February 2010 to create examples of how the Latin American coffee sector can adapt to climate change. Through a participatory process, small producer organizations together with this project, AdapCC (Adaptation to Climate Change) developed and implemented strategies to adapt to climate change. One of the principle aims of this project was to respond to the tremendous demand for training in climate change by farmers, extension agents and their producer organizations. Consequentially, cooperation between CATIE (Tropical Agriculture Research and Higher Education Center), CIAT (International Center for Tropical Agriculture) and AdapCC began with the aim of creating a training program with smallholder farmers about coffee and the organizations that represent them. This manual contains all of the technical information as well as the didactic material that was used in these training events, and, thus, serves as a guide for learning step-by-step how to identify climate change risks for smallholder coffee farmers and their organizations and how to seek and implement the most appropriate solutions in response.

In order to take the experience and lessons learned within AdapCC further GTZ, on behalf of the German Ministry for Economic Cooperation and Development, and Sangana Commodities Ltd., ECOM's Kenyan coffee exporter, decided to look further into climate change affecting Kenyan coffee. The "Sangana PPP" is carried out between October 2008 and September 2011 focusing on one pilot group in Kenya. The aim of the project is to develop an additional component to the existing 4C (Common Code for the Coffee Community) standard taking into account climate change adaptation and

mitigation. In this ambitious approach the World Bank as well as the 4C Association are important partners. Within this framework the training manual for Latin American coffee producers developed by AdapCC has been translated, adapted to the African coffee context (it may also serve as a guide for other English speaking coffee countries) and further elaborated. The Sangana PPP has also developed further trainings such as a training module for on-farm carbon monitoring which shall be available with the 4C Association at the end of the project. For now we are happy to share our gained knowledge, findings and instruments with you and invite you to use this manual for tackling climate change in your particular coffee region.

Kerstin Linne, Sangana Project Manager / GTZ, September 2010

How can the exercises in this training manual be used?

This manual has been written to train extension services of coffee organizations, who then train coffee farmers and who become promoters or extension agents in their communities and cooperatives. We want to emphasize that farmers do not have to apply all of the techniques offered in this manual. Rather, we recommend selecting those techniques that are most appropriate for meeting each farmer's specific objectives.

Thus, the first chapter explains important basic facts about climate change and how it will affect coffee production and the well-being of farming families. The main messages should be presented in a way that people who depend on coffee for their livelihoods understand the risks of climate change.

The second chapter shows ways to develop farmers' capacities so that they can adapt to climate change by applying soil, shade and pest management techniques as well as more efficient water use in their coffee plantations.

Chapter three offers participatory analysis tools when working with farmers including the seven steps in identifying risks, possible damage and basic causes and solutions to minimize these risks in order to address climate change. As a final product of this participatory analysis, a medium and long-term adaptation strategy for producer organizations is presented.

Chapter four serves as a guide to implementing options for climate change mitigation in coffee plantations as well as in processing coffee. It also helps explain the opportunities and limitations that carbon markets and certification systems offer smallholder farmers.

Adaptation to climate change is a complex process that requires continual learning. Even today, there are uncertainties and managing them is a huge challenge. Thus, this guide is not the final word on this important topic. Rather it is a useful companion along your personal and specific road to a successful future. By reading the following pages, we hope to motivate you to take action and build on your experiences to discover workable solutions to these new challenges. Don't forget: the biggest winners over climate change will be those who are best prepared.

Kathleen Schepp, Coordinator of AdapCC / GTZ, January 2010



Chapter 1

What does climate change mean for
smallholder coffee farmers?



Chapter objective

To understand what climate change is, know the impacts for smallholder coffee farmers and know how to facilitate this topic with farming families.

Training target group

Technicians or promoter farmers from coffee organizations who then apply the tools we present here with farmers in their member organizations.

Method for facilitating these topics

Trainers and coffee organization technicians should present and explain to farmers what climate change is and how it impacts coffee production. They should summarize the following technical information and present it to farmers, for example, using a "Power Point" presentation.

a) What is climate change?

According to international scientific research, climate change is the warming of the planet which has greatly increased during the last few decades due to human influence. The Intergovernmental Panel on Climate Change (IPCC)¹ predicts a rise in the average global annual temperature between 1.1°C and 6.4°C by the year 2100. Climate change is already affecting diverse geographic areas and economic sectors across the world. The effects include a rise in the intensity and frequency of extreme meteorological events such as storms, floods, droughts; the expansion of infectious tropical diseases; the extinction of countless plant and animal species; the loss of agriculture harvests in vulnerable areas and much more. One of the economic sectors that will be most affected is also the most dependent on environmental stability and the natural resources: agriculture. At the same time this sector is responsible for a huge amount of emissions and can serve as a sink for these. The most vulnerable to the expected impacts of climate change will be developing countries and their citizens, in particular, smallholder farmers in rural areas, such as coffee farmers.

In addition to the rise in temperature, we expect a change in the distribution and intensity of precipitation. The rise in temperature will provoke more water evaporation and, as a consequence, the water cycle will be more intensive with more clouds and rains especially in tropical areas. But while some areas will become wetter, at the same time other areas will become drier. These areas will be greatly affected by the lack of rain for crops. However, it is not just the quantity of water that will change; rather there will be more variability meaning some years will be very wet and other years will be very dry. Another problem is the change of precipitation throughout the year, e.g. the shift of the rainy season.

¹ The IPCC created in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) specifically to assess the scientific, technical and socio-economic information relevant for understanding the risks of human-induced climate change. <http://www.ipcc.ch/index.htm>

Scientists predict an increase in the frequency and intensity of tropical storms and hurricanes as well as the phenomena of El Niño and La Niña. The African continent will be hit hard by changing climate conditions as well as by those weather extremes. The agricultural sector, which many African countries base their economies on, is one of the economic sectors hit hardest by climate change.

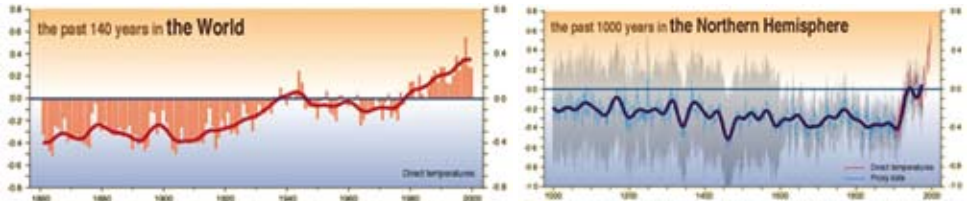
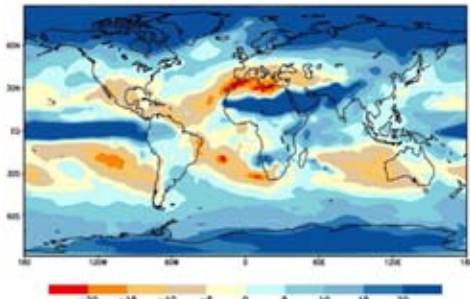


Figure 1

**Facts:**

- + Precipitation patterns are already changing
- + The world is getting warmer
- + Some areas will become drier
- + Some areas will become wetter

Figure 2

Where to learn about climatic trends?**Information about climate change in general and for different African countries:****General**

World Bank - <http://sdwebx.worldbank.org/climateportal/>

AdapCC - www.adapcc.org/

IPCC - www.ipcc.ch/

Climate Competitiveness Index - <http://www.climatecompetitiveness.org/>

Africa specific

Kenya Meteorological Department - <http://www.meteo.go.ke/>

CIAT - <http://gisweb.ciat.cgiar.org/dapablogs/dapa-climate/?p=321>

Climate Land Interactive Project - <http://clip.msu.edu/>

African Agriculture Blog - www.africanagricultureblog.com/search/label/climate%20change

The Green Belt Movement - www.greenbeltmovement.org/w.php?id=98

IPCC Special Report on Climate Change in Africa -

http://www.grida.no/publications/other/ipcc_sr/?src=/Climate/ipcc/regional/022.htm

Kenya Atlas Of our Changing Environment - <http://www.unep.org/dewa/africa/kenyaatlas/>

b) Why is our climate changing?

Solar energy heats the earth and as the temperature increases, the heat is radiated back through the atmosphere as infrared energy. The atmosphere is a belt of gases surrounding our planet that absorbs part of this heat thanks to some of the "greenhouse gases." The greenhouse effect is a natural phenomenon that makes life on our planet possible and we use this name because the earth acts like a real greenhouse. If this natural greenhouse mechanism did not exist, our planet would be much colder and we would all freeze! The main gases that create this greenhouse effect are carbon dioxide (CO_2), methane, (CH_4) and nitrous oxide (N_2O).

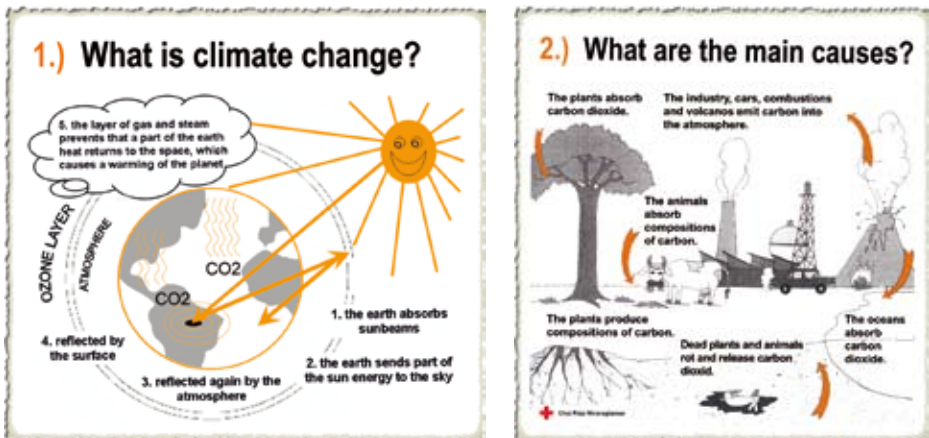


Figure 3

The climate is currently changing due to human activities such as the large expansion of industry, and the accelerated growth of the population; it is a direct consequence of burning petroleum, coal and natural gas and to a lesser extent, deforestation and slash and burn agriculture. The accumulation of greenhouse gases in the atmosphere generates "the greenhouse effect" by trapping solar energy close to the surface of the earth and impeding their return back into space causing a global warming of the earth.

c) What are the climate risks and impacts on coffee production?

The impacts of climate change on coffee production are very specific for each geographic region. Generally, we can say that in the near future the impacts will include:

- + some traditional areas will no longer be suitable for growing coffee
- + some traditional areas will still be suitable for growing coffee, but new agricultural practices will be necessary to adapt to climate change
- + some areas will newly become suitable for growing coffee
- + This will impact negatively on yield, quality, pests and disease.

The images show areas appropriate for coffee growing in Kenya current, 2020, 2050:

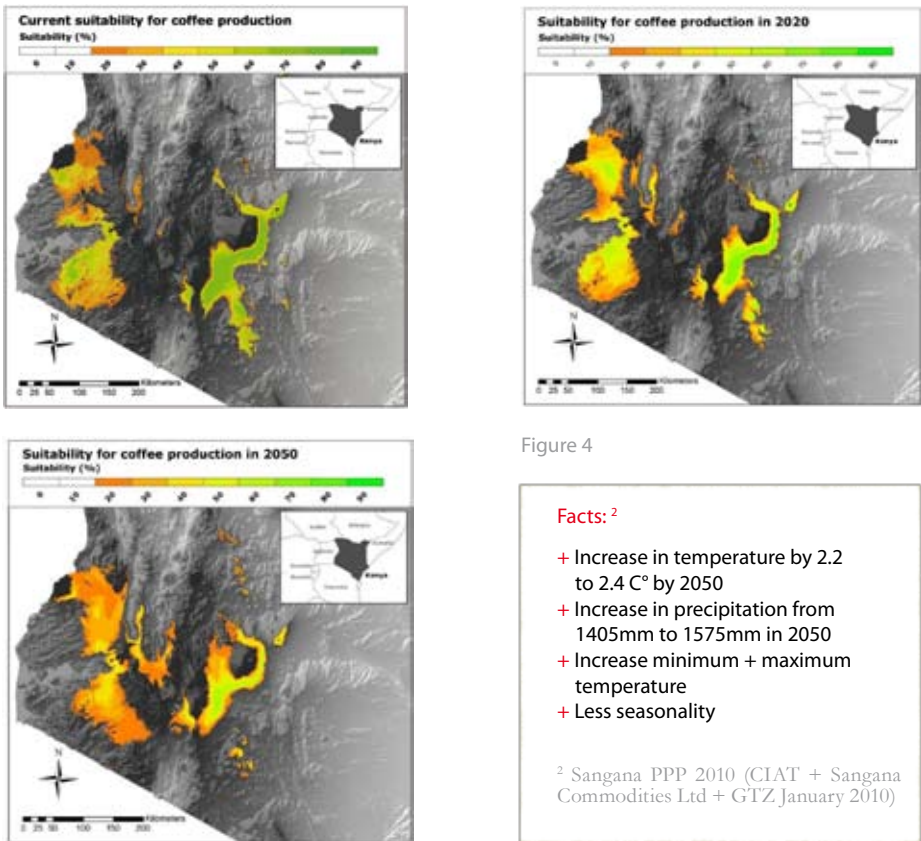


Figure 4

Facts:²

- + Increase in temperature by 2.2 to 2.4 C° by 2050
- + Increase in precipitation from 1405mm to 1575mm in 2050
- + Increase minimum + maximum temperature
- + Less seasonality

² Sangana PPP 2010 (CIAT + Sangana Commodities Ltd + GTZ, January 2010)

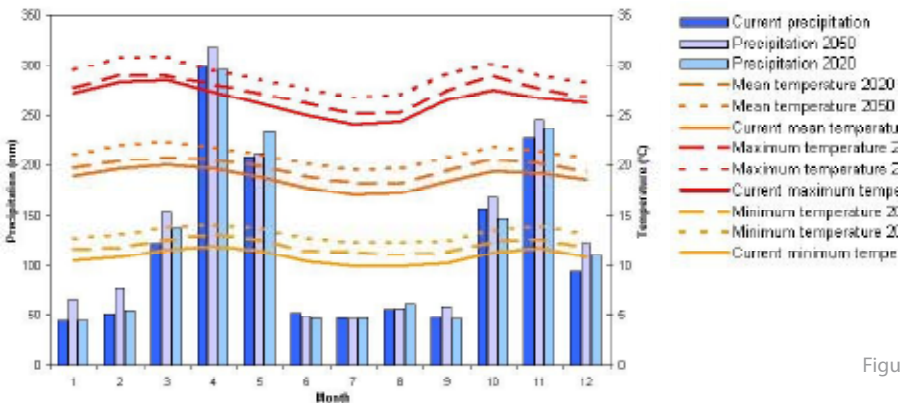


Figure 5

Predicted climatic changes for Kenya

- + The maximum temperature of the year increases from 28.6°C to 31.2°C in 2050
- + The minimum temperature of the year increases from 9.8°C to 12.0°C in 2050
- + The wettest month gets wetter with 330 mm instead of 305 mm in 2050
- + The driest month keeps constant with 30 millimeters in 2050

The most severe impacts on the coffee harvest will be caused by increasing temperatures and changes in rainfall patterns:

Temperature increase ³

- + Will cause coffee berries to ripen quicker, reducing the overall growing season, and thus reducing coffee yields.
- + In mountainous regions, the coffee production will move into higher altitudes.
- + Will cause a decrease in pollination and coffee berry production. It will also reduce the distance that the pollen tubes extend over the flowers. Because pollen tubes need to extend far over the whole plant, there will be fewer chances for fertilization of the female ovules, which produce the coffee berries.
- + Change in pest and disease patterns.

³ Resume of different publications by CATIE, Colombia and Costa Rica; CIAT, Nicaragua and others; AdapCC 2008

Change in rainfall patterns ⁴

- + During droughts, the pulp sticks to the grain and impedes the de-pulping process of cut coffee.
- + Changes in rainfall patterns, rain distribution and rain intensity will damage coffee tree development. Coffee requires more than 150 mm of rain per month (equivalent to 150 liters) during the flowering and maturation stages, followed by a dry season.
- + Strong rains during the dry season or wet season will interrupt coffee flowering.
- + The changes in the rainy season will cause major problems for drying and processing the coffee in some areas of shade grown coffee. Unforeseen rains during the drying process will affect green coffee quality reducing its marketability.
- + Strong rains can cause floods and landslides, while droughts can cause landslides and render soils useless.
- + Extreme events like hurricanes destroy soils, plantations and other vegetation.
- + Strong rains cause flooding and destroy the infrastructure for coffee transport and commercialization.

⁴ Resume of different publications by CATIE, Colombia and Costa Rica; CIAT, Nicaragua and others; AdapCC 2008

Overview on climate change impacts on coffee

Increasing Temperatures	Changing Precipitation Patterns
<ul style="list-style-type: none"> + Increasing incidents of pest + Erosion provoked by prolonged droughts + Change in planting periods reducing growing time, leading to smaller yields + shift of current suitable production areas to higher altitudes 	<ul style="list-style-type: none"> + Landslides and floods destroying Infrastructure/ reducing soil + Coffee husks stick to bean hindering maturation due to lack of rain + Reduced rainfall decreases coffee quality + Coffee trees with diseases such as anthracnosis + Rains during harvest hinder the drying process

All of the impacts mentioned will ultimately negatively affect coffee quantity and quality, reducing the incomes of smallholder coffee farmers.

Impacts on coffee

How will climate change affect coffee production in Kenya? ⁵

Main findings on future suitability of Kenyan coffee growing regions are:

- + Suitability of the coffee regions will decrease:
actual suitability: 50-70% / suitability 2050: 30-60%
- + Shift from optimal coffee producing zones to higher altitudes
currently: 1600masl / 2050: 1700masl
- + Coffee around 1300masl will suffer most / coffee around 2200masl will benefit most by the changes

⁵ Sangana PPP (CIAT + Sangana Commodities Ltd + GTZ January 2010)

d) What do these changes mean for smallholder coffee farmers?

The negative impacts on coffee production, should make us think about solutions or at least about how to react to climate change. We can still reduce the amount of greenhouse gases we produce. However, mitigation alone will not be enough. Especially in the agriculture sector, adapting production to minimize climate vulnerability and defining the necessary adaptation strategies and how these can affect greenhouse gases is also necessary. Hence, it is urgent that we define and implement adaptation strategies so that coffee production is less vulnerable to climate change.

Considering that the impacts of climate change on coffee production will be very specific to each geographic region and that the vulnerability of each coffee plantation and smallholder farmer will be somewhat unique, there is no one universal strategy that we can recommend. Rather it is necessary to understand the risks and vulnerabilities of each plantation and of each farming family and then identify the necessary and most appropriate adaptation strategies.

Mitigation strategies

Techniques that stop, slow, or reduce the amount of greenhouse gases in the atmosphere.

Adaptation strategies

Techniques that allow us to live with, and manage climate change, through understanding and minimizing its risks.

In order to adapt to climate change, the project AdapCC identified and implemented the following strategies with pilot groups:

Adaptation strategies

- + Diversification of crops and income sources
- + Application of good agricultural practices (GAP) for shade management / pruning / pest and disease control / soil management / and irrigation
- + New technologies for drying coffee / use of solar dryers
- + Management and expansion of forest cover
- + Good management of natural resources / better energy efficiency (improved stoves, renewable energy)
- + Training of coffee extension agents and farmers
- + Improved access to information and basic climate data
- + Conservation of genetic diversity / drought resistant varieties
- + Mitigation strategies / carbon sequestration to generate carbon credits / "climate friendly production" certification



Chapter 2

How can we facilitate climate change adaptation in coffee production? *

* For further technical information on coffee establishment, nutrition, canopy management, pests and diseases, processing, environmental conservation, use of agrochemicals and the Kenya coffee calendar of activities please also refer to the SMS Training Manual for Field Staff and Promoter Farmers available at Sustainable Management Services, Thika, Kenya.

Chapter Objective

To understand how to develop the capacities of smallholder farmers to adapt to a changing climate. We will specify what the climate effects are on coffee production on both farmer level and plantation level and how a farmer can respond to these changes.

Training target group

Farmers will learn to reduce their vulnerabilities to climate change, and thus reduce losses in their coffee harvest and in coffee quality and ultimately family income.

Method for facilitating these topics

In this chapter, we propose an analysis and training process for farmers in climate change adaptation consisting of 5 major elements that we can summarize as follows:

1. Understanding the relationship between climate and coffee

To develop an adaptation plan, farmers need to understand how climate change will affect their coffee production and identify the characteristics which will help coffee adapt to climate change: these are presented in sections a) and b).

2. Training to develop climate change resistant coffee farms

In sections c) to f) we propose four main topics which contribute to making coffee plantations less vulnerable to climate change.

3. Promoting techniques that reduce the impact of climate change on communities

In section g) we analyze the techniques, which support good soil and water management for buffering against climate change impacts; not just for farmers and their families, but also for the communities they live in.

4. Identifying and validating techniques, which can contribute to climate change adaptation

In sections h) and i) we explore how to adapt coffee production to some of the impacts of climate change such as changes in rainfall patterns and how to validate other adaptation techniques.

5. Designing a training plan for smallholder coffee producers

In the last section, we present how to design a training plan over the course of one year and how to develop the guides for implementing training sessions.

We hope that these training sessions will help farmers begin their own process of climate change adaptation and that they develop the knowledge and skills for the coming changes in climate.

a) How do farmers perceive climate change and its impacts on their coffee farms?

Technical guide

As we have seen in the previous chapters, the climate is changing and temperatures are increasing by at least 0.5-1° C and likewise, decrease changes precipitation patterns. We know that increasing temperatures and changing precipitation patterns will negatively affect coffee production. Different coffee growing regions of Africa have been affected by droughts and by erratic rain and tropical storms causing floods and landslides.

Farmers perceive and already feel the effects of a changing climate. They have already noted the local changes due to reduced forest cover, changes in temperatures, fewer water sources and how this affects their coffee production.

How can we use the knowledge of these farmers to guide an adaptation process in coffee plantations?

We can make a list of questions, which can be used with groups of farmers to summarize and share their knowledge.

What impacts have you felt from climate change in the last 10 years?

List the effects of climate change on a large piece of paper.

Which climatic events have affected coffee production and processing?

Next to the climatic events, note down how it has affected the coffee.

What has been the trend in coffee production in your plantation over the last 4-5 years?

On a different sheet, write down the years and note if the production was good, regular or bad according to the farmers. It is good to differentiate by geographical zones, if the farmers are from different areas (e.g. higher and lower zones).

How has the climate been during these past few years?

For each year and level of production, write a description of the climate (total rainfall and its distribution, temperature etc.)

Then, discuss with the farmers which climatic conditions affect them the most and how these impact coffee production.

Example results from this session

How have changes in climate affected coffee production during the last 10 years?

Changes in climate	Effect
Increased temperatures	Coffee zones move to higher altitudes Pests and disease also move to higher altitudes Less productivity in lower altitudes Shade trees die Faster maturing of coffee berries
Irregular rainfall patterns	"Crazy" flowering (outside of normal time) Flowers and berries fall off Irregular maturing of coffee berries Lower production and quality
Hurricanes (landslides and floods)	Soil erosion Fewer productive areas Loss of soil fertility
Droughts / Reduced rainy season	Defoliation Problems with de-pulping berries Rise in costs Poor plant nutrition Immigration to other zones
Strong winds	Loss of shade trees Coffee plantations dry out Damage to the productive infrastructure Coffee berries fall off

How have production and climate varied during the last 3-5 years? An example from Kenya (estimated production area: 160000ha).

Year/ Region	2003	2004	2005	2006	2007	2008	2009
Kenya	Moderate (52800MT)	Low (49700MT)	Low (47500MT)	Moderate (54300MT)	Low (41800MT)	Low (56400MT) High yields, low quality Prolonged drought	Lowest ever (40,000MT) Floods & continuous rains



b) How can we improve coffee plantation management to better adapt to climate change?

Technical guide

In the previous section, we saw that the climate varies a lot from one year to the next and this affects coffee production. But it is not the only factor that varies; there are also a lot of differences between coffee farms and the families who own them. These variations in farm management; some may be organic, others are conventional, some with lots of shade, others with little, also affect how plantations respond to climate variation.

If we could better understand which plantation types and which different management techniques helped a plantation be more resistant to climate variations, then we could use this information to reduce the effects of climate change on coffee productivity. But be careful! The type of coffee plantation that best resists climate variations is not the same across all regions. It will depend on whether the farm is in a dry or wet zone or, for example, if they are in a protected, shady mountain slope or an exposed, windy plateau.

How can we facilitate this topic with farmers?

Through the following questions we want farmers to demonstrate the variability between plantations and between themselves as individuals. The session could start by stating, "not only does the climate change from year to year, we too change, and so do our plantations."

How do the plantations in our community differ from one another?

(Write down the differences between plantations from one farm to the next.)

How have the plantations in our community changed in the last decade?

(Write down the ways the plantations have changed.)

How are we farmers different from one another in our community?

(Write down the ways coffee farmers differ.)

How have we, farming families, changed in the last decade?

(Write down ways that the farming families have changed.)

Use the farmer's answers to demonstrate that each one of them as well as their coffee plantations is different from one another and that over time; everyone changes just as the management of coffee plantations changes.

Indeed, most of us are always adapting our skills and coffee management techniques because of climate variation.

Example results from this session

How do the plantations in our community differ from one another?

- + some are old, others are new
- + some have shade from plantations and fruit trees, others are planted under forest cover, some barely have any shade
- + some have a lot of leaf rust, others have very little

How have the plantations in our community changed in the last decade?

- + before, there was more shade
- + before, there was no coffee berry borer
- + now, coffee quality is better / lower
- + now, we do not contaminate water sources

How are we farming families different from one another in our community?

- + in some families there is only the farmer and his wife; in others there are children who help on the farm
- + some farmers use only organic methods, others use conventional methods
- + some farmers have access to credit, others do not
- + some have good yields, others do not

How have we farmers changed in the last decade?

- + we have organized ourselves into a cooperative
- + there never used to be certified farmers
- + we have learned to keep a register of our activities required for farm certification
- + we have improved some of the wet mills

Now, with this basic orientation we can analyze with farmers and their families the characteristics of plantations that best resist climate change. Through one introductory question and then three specific questions, we want farmers to think about the topic and share their experiences.

What are the factors that best explain whether a coffee plantation does well or poorly in years of bad production or years with a lot of climate variation?

Describe plantations that do well. (Write down the answers)

Which plantations are more resistant? (Write down the answers)

What are the skills that farmers have that allow them to better manage their farm? (Write down the answers)

With the above information we can now identify:

- + The characteristics of the coffee plantations that resist climate change.
- + The skills that we need to reinforce with farmers.

Based on these lists, together with the farming families we can prioritize the topics that they think are important for training and implementation on their farms so that their coffee plantations are more resistant to climate change. Next, we ask them:

What techniques need to be improved so that the coffee plantations will be more resistant to climate change? (Write down the answers)

What skills need to be improved, in order to apply these techniques?
(Write down the answers)

Then continuing with these topics, we can develop a training plan with the farmers:

Example results from this session

What are the factors that define whether a coffee plantation does well in years of bad yield or climate variability?	
Describe plantations that are least affected	Describe plantations that are most affected
Coffee trees that are well pruned and converted (Good change of cycle) Plantations with good shade Coffee trees with good mineral nutrition Coffee trees under organic manure or compost Coffee trees that are pest and disease free	Coffee trees that are old or exhausted Plantations with little shade or only „hot shade“ Coffee trees that are malnourished Coffee trees with diseases such as coffee berry disease and leaf rust
What are the skills that farmers have who manage their plantations well?	
Renovate (change cycle) and prune their plantations / Prepare organic composts / Plant and manage shade	

What techniques need to be im-proved so that the coffee plantations will resist climate change?	What skills need to be improved, in order to apply these techniques?	Month for teaching this topic (Farmers should be trained 1-4 weeks before the task/activity is undertaken at farm level) ⁶
Renovation (changing cycle) and pruning of coffee trees	Know how to identify plants which need renovating or pruning	January-March: renovation of stumps June : handling and de-suckering September: shoot selection
Adequate fertilization	Know how much compost to apply	March & October
Shade management	Know what varieties of shade and how much is best	April & November
Control of pests and diseases	Techniques to scout for pests, prevent infestation and to control pests and diseases	February- July

⁶ This is an example for Kenya; the schedule may vary for other countries

c) How can we manage the variability in coffee plantations to make them more resistant to climate change?

Technical guide

As we just read, there are coffee plantations with certain characteristics that make them more resistant to climate variability and changes, for example:

- + Healthy, vigorous coffee trees
- + Fertile, well-protected soils
- + Appropriate shade species with an appropriate density
- + Healthy coffee trees, without high impact of plagues and diseases

In the next pages, we will see how to achieve these plantation conditions that will help them be more resistant to climate change. In this section, we will see how to evaluate and make a plan for improving the vigor of coffee trees. Plant health is important in a coffee plantation not just because healthy trees will produce more, but because they have more developed and deeper roots with more water and nutrient reserves to withstand droughts, floods or other climatic stress.

How can we evaluate the vitality of coffee trees with farmers?

Together with the farmers, classify the coffee trees according to their ability to bear crop at 4 different points, evaluating a total of 25 plants (5 plants in 5 rows) from each point. We will classify the trees as:

- + In full production
- + Sanitation pruning needed
- + Few productive branches, but with good wood and roots
- + Exhausted, no productive branches, no good wood or roots
- + Newly planted, young suckers or recently converted/stumped
- + Missing, an empty space instead of a coffee tree

In the following page, you can see an example of this productivity diagnosis. With this information we can determine the necessary management to improve the vigor of the plantation:

- + Percentage of trees that need sanitation pruning
- + Percentage of trees that need conversion/stumping
- + Percentage of trees that should be eliminated
- + Percentage of trees that are missing

By multiplying these percentages by the number of plants per hectare, a plan for improving the vigor of the plantation can be developed. Also, based on this information, an estimate of the renovation costs of the plantation can be made.

In the following we present an example of a plan based on a real coffee plantation diagnosis. The plan to restore a coffee plantation should take into consideration current climate trends. In East Africa Coffee is normally recommended to be planted during the long rains, i.e. between March and June in highlands and between October and November in low altitude areas.

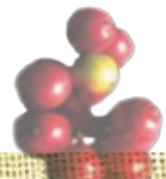
Example of a productivity diagnosis in a coffee plantation

Point	Productive trees	Trees that need pruning	Trees that need conversion	Trees that need to be removed	Trees re-sprouting or recently planted	Missing trees
1	1	8	6	10	1	0
2	0	5	11	9	0	0
3	0	5	5	14	0	0
4	0	10	13	2	0	0
Total	1%	28%	35%	35%	1%	0

In Kenya one hectare has around 1330 coffee trees. By tradition 20% of the trees are converted per year. For a smallholder pruning and conversion cost between 3 and 5 Kenya Shilling per stem, depending on the amount of vegetation to be removed. Tree removal costs 3 Kenya Shilling per stem. Therefore, a cost estimate for conversion is based on the following calculations:

Planting

- + Buying & transporting of seedling = KSH 15 for SL and 20 R11 varieties
- + Dig planting hole = KSH 7.5 to KSH 10
- + Manure & Fertilizers =KSH 10
- + Mixing and planting = KSH 7.5 to KSH 10



d) How can we conserve soil fertility?

Technical content

Soil fertility also influences the capacity of the coffee plantation to resist climate variability. Soil fertility consists of three components:

- + Physical fertility: is the physical structure of the soil (a loose or a compacted, hard soil).
- + Chemical fertility: is the quantity of nutrients that the soil has so that plants can grow.
- + Biological fertility: is the biological life of a soil, the worms, insects, fungus and bacteria that live in the soil.

Soil fertility affects the capacity of coffee trees to resist climate variability like droughts or excessive rainfall.

- + Physical fertility of the soil affects the rainwater infiltration into the soil and the ability to maintain soil humidity when it is not raining.
- + Chemical fertility of the soil affects the development of plant roots. The larger the root systems, the better capacity they have to absorb water and then store it in times of drought. Large root systems also hold the plants better when there is danger of a landslide and can also help to prevent landslides and can also help to prevent landslides.
- + Biological fertility of the soil complements the two components above: it helps create a soil structure that allows better rainwater infiltration and better root growth and development.

The following are most important techniques for conserving soil fertility:

- + Physical fertility is improved by keeping the soil covered with living plants as well as leaves and other natural debris. A bare soil is washed away easily and has less capacity for water infiltration.
- + Chemical fertility is maintained through adequate fertilization. Correct application of chemical fertilizer is commonly known. For organic farmers we recommend applying at least four 100-pound bags for every 100-pound bag of green coffee produced in order to maintain soil fertility levels. For more exact quantities, one can calculate the exact amount of nutrients entering and leaving the coffee plantation each year.
- + Biological fertility is improved through the accumulation of leaf litter and the branches pruned from the coffee trees and shade tree. The living organisms in the soil improve the physical structure of the soil as well as its fertility by processing and decomposing the accumulated organic material.

How can we facilitate the topic of soil fertility with farmers?

With farmers we can use the following exercises related to their knowledge of soil fertility by asking the following questions:

How do you recognize a soil with good physical characteristics?

(Write down the answers)

How do you recognize a soil that is rich in nutrients?

(Write down the answers)

How do you recognize that a soil is "alive" with abundant populations of insects and other microorganisms?

(Write down the answers)

Then, decide in agreement with the farmers, the best practices to apply to conserve or improve the physical, chemical and biological fertility of soil. In Kenya farmers mainly rely on the results of soil analyses carried out by the Coffee Research Foundation. An example of such results can be found under Annex 1.

Examples of soil characteristics evaluated by farmers in Latin America are shown below. Soil characteristics were rated as ☺ good or ☹ bad. The numbers indicate how many points on the farm were surveyed.

	Conventional coffee		Organic coffee	
	☹	☺	☹	☺
Physical characteristics				
Texture		5		4
Color		5		5
Depth		5		4
Structure		5		5
Drainage		5		4
Slope	2	3		1
Erosion	2	3		5
Chemical characteristics				
Plant vigor / deficiency		5	4	1
Weeds		5		1
Diseases		5		2
Coffee yield		5	1	
Biological characteristics				
Leaf litter		4		4
Fungus		3		5
Worms	3	5		5
Otros animales		5		5

Proposed action to take:

Conventional coffee:

- + Use techniques that stop soil erosion.
- + Apply organic fertilizers to improve soil life.

Organic coffee:

- + Apply more organic composts to recover coffee tree vigor and productivity.



e) What is the importance of shade in buffering climate change impacts?

Technical content

Coffee is an understory crop. Therefore it grows best under shade. Shade trees play 3 important roles in helping coffee farms adapt to climate change:

- + Shade trees buffer against high (and low) temperatures. Temperatures under the shade of trees in a coffee plantation are usually 2-3 °C less than the temperature in the full sun. This is one of the reasons why shade helps to improve coffee quality. More than likely, high altitude farmers, who did not need much shade in the past, will need to increase the amount of shade in the future.
- + Shade trees also help to diversify the products from a farm. For many smallholder farmers, coffee plantations are also an important source of bananas, fruits, firewood and even timber for construction or sale. These products are particularly important in years of low coffee yield or poor prices.
- + Shade trees help to fix carbon dioxide, the principal cause of climate change. Although this may not be an immediate benefit for the farmer, it is part of their contribution towards mitigating climate change.

At the same time, we have to recognize that shade trees can also negatively affect coffee production. All plants have similar basic needs: shade trees compete with coffee trees for water, shade and nutrients. Thus, it is important to prune shade trees to reduce competition, at the same time maintaining the benefits mentioned above. However, too much shade can also favor certain disease and pests. The right level of shade is important.

How do we facilitate the topic of shade tree benefits with farmers?

In general, farmers have a lot of knowledge about the trees in their coffee plantations. Thus, we have developed a process to rank and use their knowledge so that they can better manage the shade in their plantations. This is a three-step process:

- + Make an inventory of the shade trees in a plantation writing down the species and quantity of each.
- + Judge the benefits of each tree for its shade use in coffee as well as for other on-farm uses or for sale.
- + Then, based on this evaluation, the farmer decides if the quantities and proportions of the different species that they have are correct or they should be changed, increasing some, reducing or eliminating others.

In Kenya shading is a new concept in coffee production. Therefore a general first recommendation is to establish nurseries for shade trees and to introduce some shade into the plantation. In two Kenyan coffee cooperatives that took on the topic, namely KOMOTHAI and KARANDARA, the trees recommended for shade were Muring'a (Cordia Africana), Mubariti (Gravelia Robusta) and Mukurwe (Erythrina Abscinica).

In order to identify suitable shade trees a participatory approach was chosen asking the farmers to name the trees in the area and to describe their abundance and their uses. Then ask the farmers to highlight and recommend the trees that are good for coffee shading. Good shade trees do not act as alternate hosts for coffee pests and do not compete with coffee for nutrients, i.e. have roots at different depths to those of coffee. In the following you can see an example of defining shade trees with the Kenyan coffee cooperative KOMO'THAI in Kiambu District:

Name of the tree	Abundance	Use
Muring'a	Scarce	Shade
Mukuyu	Scarce	Food for animals
Mutare	Plenty	Roots: herbal medicine; fruits
Mubariti	Plenty	Wood, fire wood, charcoal, shade

In Latin America, where shade is a well-known and established practice, farmers themselves determine how to change the shade in their coffee plantation when necessary. You can see in the example below that the farmer chose to eliminate some of the trees like "carbón" because it loses its leaves during the dry season, and thus stops being a good shade tree during the months shade is most needed.

Re-design of the shade in a coffee farm in Las Sabanas, Nicaragua⁷

Tree species	Number of trees	Number needed	Value or Use		
			On-farm	For Sale	Coffee
Guayaba	1		☹	☹	☹
Achotillo	135		☺	☺	☹
Carbón	108		☺	☺	☹
Majagua	11		☹	☹	☹
Mampás	10		☹	☹	☹
Matorral	12		☹	☹	☹
Zopilote	7	10	☺	☺	☺
Teposán	3		☺	☹	☺
Guachipilín	1	10	☺	☺	☹
Chaperno	1	5	☺	☺	☺
Guaba	0	10	☺	☺	☺
Cuya	5		☹	☹	☺
Quebracho	1		☺	☹	☹
Aguacate	0	10	☺	☺	☺
Naranja	0	16	☺	☺	☹
Total: 15 types	295	61			

⁷ More information is available at the CATIE in Costa Rica in the manual: "Design of an agroforestry system with coffee".

Notes:

The "number of trees" is the number of trees found on 1/4 hectare lot. The value of trees is based on its use on-farm, for sale, and for the growth of the coffee trees. Finally, based on these values, the appropriate number of trees for each species can be calculated optimizing these benefits.

f) How can we manage the changes in the incidence of pests and diseases due to climate change?

Technical content

The development of pests and diseases is highly correlated with climatic conditions. Hence, we are sure that pest and disease populations will be greatly modified due to climate change and variability from one year to the next. At the same time, as mentioned earlier, shade modifies the micro-climatic conditions, specifically the temperature and shade within a coffee plantation.

To know how to manage pests and diseases in their coffee plantations, farmers need to continually monitor them to know how their populations are changing and under which conditions they are most active. As a pest outbreak develops, the farmer can adjust the management of the shade to reduce or control pest populations:

- + Diseases such as leaf rust and leaf spot are favored by high humidity and high precipitation. In years with plentiful rain, farmers should reduce the amount of shade or carry out a strong pruning during the rainy season so as to not create the conditions that favor them.
- + Diseases such as cercospera and insects such as leaf miners are favored by a lot of light and high temperatures. Thus, during dry years, pruning shade trees should be minimized so as to not create these favorable conditions.
- + The coffee berry borer is already being favored by climate change because the rising temperatures are allowing it to establish in higher altitudes where it was not found before. In this case, shade will not help much. The only thing that farmers can do is carefully monitor its presence and apply cultural management practices such as removing the berries from the plantations after each harvest, use borer traps or apply biological control.

How do we facilitate the topic of pests /diseases and its relationship to shade with farmers?

This exercise has two parts: + Diagnosis of shade in the coffee plantation
+ An integrated scoring of pests and disease

Preferably this exercise would be done during the dry season to determine the development stage of pests and diseases. Then the exercise would be repeated two months after the start of the wet season to determine how the diseases are developing in order to make decisions about pruning shade trees. The most important points are:

- + What are the shade conditions associated with a low level of pests and disease this year?
- + In a year drier than the current one, what shade conditions could minimize the incidence of pests and diseases?
- + In a year wetter than the current one, which shade conditions could minimize the incidence of pests and diseases?
- + How can we regulate the shade to adjust it to the different climatic conditions from one year to the next?



In order to make the best decisions about shade management, the weather forecasts for the next few months should serve as a guide to whether it will be wetter or drier than normal. In chapter 1 sources of where to get good climate information are listed.

g) How can we conserve and better use water sources?

Technical content

Water is essential for life and especially for coffee farmers. They have a special relationship with water because of their dependence on this resource but also for their capacity to conserve or degrade this resource. We can summarize their special water relationship as follows:

- + Coffee plantations are generally located in areas of hydraulic recharge, or in mountainous regions with higher rain fall and where streams and rivers are formed. As a consequence, coffee plantation management has a strong impact on the conservation of water sources and the quality of the water itself for the whole community.
- + Coffee plantation management affects water sources positively or negatively. Coffee management without shade, with bare soil, and use of agrochemicals can result in water contamination and soil erosion due to pesticides and high levels of nitrates and phosphates.
- + Also, during wet milling, the water used for pulping and washing the coffee can produce large amounts of waste water contaminated with the coffee mucilage and pulp.

- + Coffee production needs secure access to water for traditional wet milling, in some cases for irrigation and to a lesser extent for the use by the farmers and their workers.

Thus, the quality and availability of water has a direct impact on the way a farmer manages their coffee plantation. With a changing climate, and the probability of less water in certain zones, management practices that conserve water will be indispensable.

How do we facilitate the topic of water conservation and use of water sources with farmers?

With farmers we should discuss the use and management of water in their farms via the following questions:

- + What are the water sources on your farm?
- + How are the environmental conditions around these water sources?
- + How can water conservation around these sources be improved?
- + What are the water sources that you use on your farm and for what are they being used?
- + How can the sources of water pollution on your farm be managed?
- + How can the wet milling process and use of the mucilage water be improved?
- + How can any other source of water pollution on your farm be better managed?



The following is an example of this type of questionnaire:

What are the water sources on my farm?		
Two springs and a stream		
What are the environmental conditions around these water sources?		
There are trees around the springs; on one side of the stream there is coffee, on the other side a cattle pasture		
How can we improve water conservation around these sources?		
Plant trees on both sides of the stream and restrict the access of cattle to the stream.		
What are the water sources that you use on your farm and for what?		
Source	Use	
Spring	Water for household needs	
Stream	Water for the wet mill	
What is the distance between the wet mill and these water sources?		
Less than 10 m	Between 10 and 50 m X	More than 50 m
In what steps of the milling do you use the water?		
Holding tanks	Yes	
De-pulping	Yes	
Washing	Yes	
Bean classification	Yes	
What do you do with the mucilage water?		
It is dumped below the mill and it drains away down the hill		
What is done with the coffee pulp?		
It piles up next to the mill		
How can we improve the wet milling process and the use of the mucilage water?		
Steps where the water is used:	How can we improve?	
Holding tanks	Recycle the washing water	
De-pulping	Use a dry mill	
Washing	Recycle the water	
Bean classification	Use manual bean classification	
How can we reduce the water volume used?		
Reduce the number of steps which use water / Recycle all the water		
How can we treat the mucilage water?		
Use this water as a foliar fertilizer or water the coffee trees or other crops with it. Any additional water should be deposited in an infiltration chamber, far from water sources.		
How can we improve coffee pulp management?		
Protect it by covering it or storing it under a roof, and then apply it to the coffee.		

h) How can we manage the changes in coffee phenology due to climate change?

Technical Content

Coffee phenology, or the process of flowering, coffee berry formation, and ripening, is highly related to climatic factors. It is known that flowering of the coffee is stimulated by at least 10 mm of rainfall after a short dry spell. With climate change, many people have noticed changes in rainfall patterns. The principal changes observed so far are:

- + Rise in the number and distribution of flowering dates due to rains "outside of the normal season" (during the dry season) and an instability of when the rainy season begins causing several partial flowerings on the coffee trees.
- + This results in a longer time period for the coffee to ripen. Consequently, the coffee must be picked during several cycles, which is more costly.
- + In extreme cases, coffee ripens well past the normal harvest time and the collecting stations are no longer open to accept the beans.
- + It is more difficult to pick coffee at the beginning of a wet period. Similarly, when the rainy season is longer than normal, the logistics of harvesting, milling and drying the coffee is more difficult.
- + Increased occurrence of cold fronts also slows down the berry ripening process.

Although it is difficult to completely avoid the impacts of these climatic changes, there are some actions we can take to mitigate their effects:

- + Flowering is stimulated by rain or water. If we want to ensure that there is only one main flowering period, and thus a uniform harvest, irrigation is a viable option.
- + Although rains stimulate flowering, flowering is also affected by shade because the shade intercepts the rain. If too much rain is intercepted, the flowering will not be stimulated. In some cases, coffee grown in full sun was ready to harvest in August due to an early flowering, while coffee grown under shade is not harvested until November during a normal year. Thus, one way to control flowering is to not prune trees until the appropriate time for flowering.
- + The impact of rains during coffee harvest on coffee quality can be reduced using solar dryers. Even if it is cloudy, the accumulated heat helps dry the coffee.

In the section of evaluation practices we will specify these options.

How can we facilitate the topic of phenology changes with farmers?

In summary, there are two primary changes we can expect: changes in flowering and changes in weather conditions during harvest. First, we need to determine how phenology and flowering in the region have changed and how this will affect the harvest.

Has the number of flowerings and when they occur changed? What are the changes? (Write down the answers)

Has the number of coffee pickings needed to harvest all the berries changed?
(Write down the answers)

What factors determine coffee flowering?
(Write down the answers)

What factors can we modify to manage coffee flowering?
(Write down the answers)

What options should we consider to make flowering more uniform?
(Write down the answers)

Which of these options are we willing to try?
(Write down the answers)

How can we facilitate the topic of harvest and milling with farmers?

Has the climate changed during coffee harvest and in which ways has this affected the coffee harvest and milling?
(Write down the answers)

Which techniques should we consider applying in order to adapt harvest and milling processes to ensure high quality coffee?
(Write down the answers)

Which of these options are we willing to try?
(Write down the answers)

After defining the options that the farmers are most interested in trying, go to the section about evaluating the adaptation practices.

How can we manage changes in coffee flowering?

Have there been changes in the number of flowerings and when they occur? What are they?	
Before	Now
Three flowerings total between March and April	More than six flowerings between January and May
Has the number of coffee pickings needed to harvest all the berries changed?	
Before	Now
Three pickings total between December and January	More than six pickings between October and February
Which factors determine coffee flowering?	
The rain The amount of shade	
What factors can we modify to manage coffee flowering?	
We cannot change the rains Regulate/manage the shade Irrigate to have good flowering	
Which of these options are we willing to try?	
Regulate the shade up until the time of coffee flowering - 10 farmers Try irrigating in some areas as a test to improve flowering - 3 farmers	

How can we ensure good quality management during coffee harvest and milling if it is raining?

Has the climate changed during coffee harvest season?
There are stronger cold fronts with colder fog
How have these affected the coffee harvest and processing?
The coffee pickers do not like working in the rain and they are not able to pick as much The berries fall off the tree before they are mature The coffee beans turn moldy before they are dry
Which techniques should we consider applying in order to adapt harvest and milling processes to ensure high coffee quality?
There is not much we can do, even when pickers ask for more money for working in the rain Dry the coffee in solar dryers
Which of these options are we willing to try?
Build solar dryers - 5 farmers

i) Which agricultural practices have farmers used and how can we evaluate them?

Technical content

Climate change and climate variation have affected coffee farming families and their organizations for some time now. So, more than likely, they have been trying different techniques to adapt. In addition, throughout a given region, they have seen how other producers and coffee research or development organizations have been experimenting with new techniques. In order for farmers to learn about and evaluate these options, field trips to visit other farms to talk with other farmers should be made. Then testing of different agricultural practices a farmer considers suitable should be facilitated on-farm.

How to facilitate field trips with farmers?

When a trip is planned for exchanging ideas and experiences and seeing new techniques, it is important to concentrate everyone's attention on a few questions to understand what they expect from the trip and what they will be evaluating. In the example presented, each participant must answer three questions for each new technique they see.

Is this technique relevant in my area?

Is the technique available to farmers in my area?

What is missing so that farmers can use this technique?

How do we facilitate experimenting with implementing and evaluating agricultural practices?

Upon returning from a field trip or farmer field day, focus on the farmers who want to try the new practices that they saw. To better evaluate these new techniques, it is important to ask two central questions:


What will we compare the new technique with?


When trying a new technique, it is important to define other techniques as a comparison to really know if the new one is beneficial or not. In some cases, it can be compared with traditional management, establishing two plots side by side; in other cases, the comparison will be with last year's management or with another farm where the new technique is not being used.


How will we evaluate the new technique?


Likewise, it is important to specify how we will make the comparisons, or what criteria (in terms of production, costs, quality, incidence of pest and diseases etc.) will be used to know if a new technique represents progress over the traditional technique.

Example of farmer discussions on several techniques

Solar dryers	
Brief description	Are they relevant in my area? (Common answers)
Solar dryers are plastic tunnels with benches for pre-drying or final drying of green coffee and thus they protect the coffee quality, even when it is raining.	Yes, principally in very humid areas. Yes, and it is necessary. Yes, when there is an over-production or very large harvest. Yes, it helps maintain quality. Yes, in areas where it rains during harvest.
How do they help in terms of climate change adaptation?	Is this technique available to farmers in my area?
Some areas have high precipitation or humidity during harvest. The solar dryers enable coffee quality to be conserved under these conditions.	Depending on the economic capacity of the farmer. It is not too expensive; it is accessible to a smallholder. It is simple and easy to manage, using materials from the farm, except for the plastic.
	What is missing so that farmers can use this technique?
	Training and technical assistance to understand how it works and what its benefits are. Also help in financing their construction.

Water conservation and water harvest	
Brief description	Are they relevant in my area or country?
These are the works that help conserve soil that contribute to better water infiltration and reduced erosion. These include living and dead barriers and water infiltration pits.	Yes, it is necessary and obligatory. Yes, even though not everyone does it, a lot of people do. Yes, to help conserve soil fertility and water sources. No, but maybe! Yes, it is best to do infiltration pits to stop erosion. Yes, everyone should do it.
How do they help in terms of climate change adaptation?	Are these techniques available to farmers in my area?
Water and soil conservation are indispensable prerequisites to maintaining soil fertility and ensuring water availability	Yes, it depends on the farmer and their conscience; it is easy to do.
	What is missing so that farmers can use this technique?
	Training and technical assistance. An education campaign to motivate people and explain the benefits as well as financing of labor.

Coffee hybrids	
Brief description	Are they relevant in my area?
Hybrids are special genetic crosses between coffee from Ethiopia and the traditional varieties of Latin America. The plants from a first generation have "hybrid vigor" that maximizes the traits from the cross. In order to keep this vigor, new plants must be made through clonal propagation (not seed) and laboratory in vitro techniques work the best	No. Yes, but it is not available for smallholder farmers. It is productive, but it requires a high investment. No, not for small holders. For some farmers yes, but these techniques are expensive and sophisticated.
How do they help in terms of climate change adaptation?	Is this technique available to farmers in my area?
They are Arabica coffee lines, but they are distinct from the current varieties used. They can offer some new characteristics that help adapt to the new climatic conditions.	No, due to a lack of financing-it is expensive. No, but they could offer good alternatives for climate change adaptation. If financing and low interest rates are available. No, due to production costs. Maybe, with the right farmer organizations. This material may create dependence on the institutions supplying the clonal material.
	What is missing so that farmers can use this technique?
	Training and investment. To be accessible, plants should be from seed. More knowledge, investment and demonstration are necessary to create demand among farmers. There would have to be an international market. Need to see the results in organic production.

Micro-irrigation	
Brief description	Is it relevant in my area?
Irrigation is applied during the first coffee flowering for 2 to 3 months until the rains start. Drip irrigation is used with a low water rate (1.5 liters per plant per day) with an approximate cost of US\$850 per hectare. In some cases, production has increased 20% to 30%.	Yes. No. Very important in dry areas. Yes, but difficult to implement, maybe.
How does it help in terms of climate change adaptation?	Is this technique available to farmers in my area?
It allows a uniform flowering and thus a concentration of the harvest time. Helps keep plants vigorous when the rains are not constant especially at the beginning of the rainy season.	Yes, but necessary to carefully check the cost of materials for the best prices. When there is water available. It is not a viable option for smallholder farmers. Yes, requires technical and economic support. Yes, but it is expensive. Not, due to lack of water.
	What is missing so that farmers can use this technique?
	Organization, financing and training. Need to use water-holding tanks during the rainy season to collect the water. Need to reduce the cost, need to analyze the costs vs. the benefits.

j) How can a training plan be developed so that farmers can manage climatic variability in their coffee plantations?

Technical content

In section two, the topics farmers want to develop for further training were identified. With this input, it is necessary to develop a training plan for one year. Developing this plan or training curriculum has two parts:

- + Define the distribution of topics throughout the year.
- + Define the content of each topic.

For the first part, base the planning on the coffee phenology so that each topic can be planned according to the most opportune time to implement the techniques. The following table shows an example of a training plan according to the coffee growth and production cycle.

For the second part, it is necessary to plan each session well, defining the various aspects of the training event using the following guide:

- + What is the general objective of the training?
- + For "What do we wish to achieve?" specify the change in the participants' abilities that should be achieved.
- + For "What tangible products will we have achieved?" specify concrete things that will be produced or worked on such as an evaluation implemented or plants pruned or plans developed.
- + For "Session development" specify steps in how the topic will be presented.
- + Specify how much time and materials will be needed.
- + Finally, consider the assumptions made for achieving the training and difficulties, which may be encountered so that it is guaranteed that the training objectives are met.

Planning training sessions for one year

Topics	Coffee phenology phases				
	Dormant	Flowering	Berry initiation	Berry Development	Berry Maturation
Stumping and pruning	Coffee pruning		Re-population	Shoot selection	
Shade management		Shade level and type		Shade level and type	
Fertilization			Organic fertilization		
Pest and disease control	Berry borer control			Pest and disease management	
Quality control					Pre-drying of parchment coffee

Title:

Field practice for integrating pest control with shade evaluation to develop a shade management plan

Date: April 28, 2000

Facilitator: Jeremy Haggard

<p>General description: Evaluate the shade level and its influence on pests, develop a proposal for shade management and develop the methods that would be used.</p>		
<p>What do we wish to achieve? That we can interpret the information we collect from a shade evaluation as well as from a survey of the pests and then apply this information in a practical way</p>		<p>What tangible products will we have achieved? A mapping of the shade and a survey of pests in three areas. A proposal for shade management under three different conditions</p>
Time	Session development (outline of the steps)	Materials needed:
20 min	Ask the participants about their knowledge about the relationships between shade and diseases with the following questions: Which diseases are most prevalent with lots of shade? Which diseases are most prevalent with little shade? Affirm with the participants that the purpose of today's work session is to determine which level of shade minimizes the development of pests in coffee plantations.	large paper 3 paper holders (or tape)
5 min	Divide the participants into 3 groups, each one works in a different type of shade environment (perennial, deciduous, mixed)	Forms for shade evaluation
45 min	In each environment, evaluate the shade, count the number of insects as well as weeds	Forms for pest surveys Markers
30 min	Each group presents a summary of the information collected: incidence of pests and diseases and state of the coffee trees	
20 min	Each group proposes how to manage the shade to minimize pest levels and obtain better coffee production results	
<p>Variations / precautions / assumptions: Look for sites where trees need pruning. Participants already learned in earlier sessions how to do a shade evaluation and a pest survey</p>		<p>Method: Learning exercise</p> <p>Difficulty: High</p>





Chapter 3

How can adaptation strategies with smallholder coffee organizations be identified?

The process of Risk and Opportunity Analysis (ROA)

Objective of the chapter:

- + To learn how to apply the ROA process in order to identify adaptation strategies for climate change on the level of a coffee organization.
- + To learn how to apply the participatory analysis techniques with the producers in order to analyze climate risks and vulnerabilities and develop adequate adaptation measures.

Target training group: technicians and promoter farmers of the coffee organization

The main questions to answer:

- + What are future (scientific) predictions or tendencies of climate change for the pilot region?
- + What are the forecasted impacts of climate change on coffee cultivation in the region?
- + How will coffee areas change in terms of coffee production in the future?
- + Who are the main actors working in the pilot region with the ambition of confronting climate change and with the capacity to support and implement an adaptation strategy?
- + What are the climate risks, root causes, possible damages and vulnerabilities for coffee production?
- + What are the measures to confront climate change in coffee production?
- + How can we develop an adaptation strategy in the short-, middle- and long-term together with a coffee organization?
- + How can we implement an adaptation strategy with producers and families?

Method to facilitate the knowledge:

- I. Present the analysis process to selected members of the coffee organization and local stakeholders and jointly adapt the process to the local context during a technical workshop.
- II. Select a producer pilot group and, together with qualified promoter farmers and technicians, implement a two-day participatory workshop.

a) What is the ROA process? ⁸

The ROA process is an analysis, carried out in 7 steps, which allows us to identify climate risks for coffee production in a specific region and to understand the basic causes of climate variability or extreme weather events. The final product of the analysis is a specific strategy for adapting to climate change, which is implemented by the affected producers in a determined region.

⁸ The ROA process was developed based on the Risk Analysis for Disaster Risk Management, developed by GTZ and a Climate Witness Toolkit, developed and applied by WWF South-Pacific on Fiji Islands.

This adaptation strategy contains specific measures to reduce climate risks and address vulnerabilities of the producers' coffee plots. The expected outputs of the ROA process are as follows:

- + Detailed information about the impacts of climate change on coffee production in the focus region (risks, damages, vulnerabilities of smallholders)
- + Identified countermeasures to reduce climate risks for the producers (adaptation measures)
- + Adaptation strategies for the pilot group
- + Options to access financing of the implementation of the adaptation strategies
- + Regional network of institutions and producers to exchange experience and results

To carry out the ROA process it is necessary to facilitate a participatory approach, allowing the affected population to make decisions in the consolidation of the process. On the one hand, the process itself is an analysis and on the other, it contains sessions of capacity building and sensitization. In this way the coffee organization and its producers are supporting the analysis, making decisions and becoming sensitized for climate risks and the need to adapt. Especially the promoter farmers (technicians) of the organization learn to apply the analysis and to carry out the 7 steps. Accordingly the ROA process is a procedure of various analyses as well as a process to build capacities.

b) The 7 steps of the ROA process

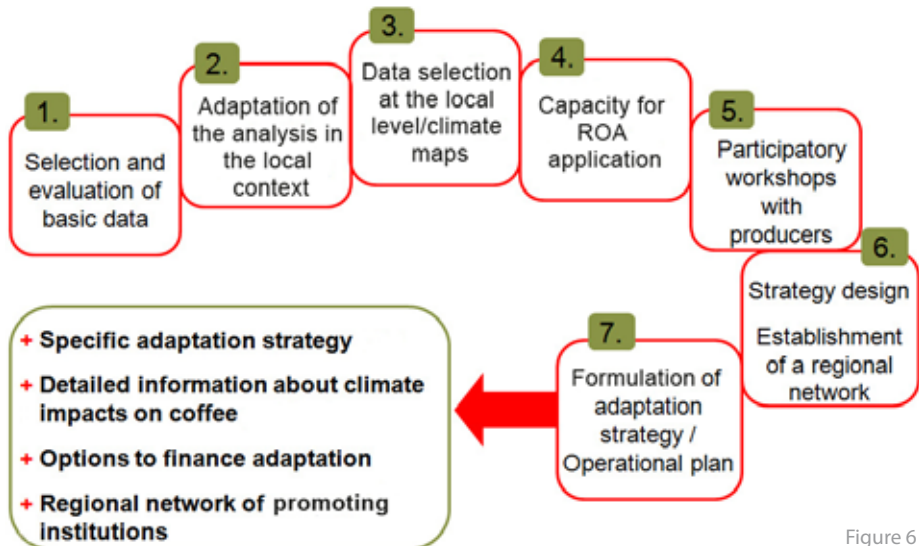


Figure 6

c) The goals of the ROA process

- + The 7 steps of the analysis link scientific aspects and technical know-how with the practical experiences of the producers. In this way, past experience with climate impacts can be considered as well as damages and losses with the present situation and the predictions for the future.
- + The heart of the analysis is the participatory workshop with the producers. Those workshops support the affected people to understand the relation between climate risks, possible damages and the basic reasons they are affected. The producers identify their vulnerabilities and develop corresponding actions to reduce the risk of being affected by extreme weather events and/or the changing climate.
- + The participatory approach allows the producers to make decisions and encourages their capacity and ownership and motivates them to take actions.
- + The method integrates traditional knowledge of the producers.

Step 1 - Selection and evaluation of the basic data

Objective: To know and to understand how the climate will change in the determined region and how this will impact the population and agricultural production.

Activities to carry out:

- + Review and evaluate existing studies and predictions of the IPCC (International Panel on Climate Change) for the specific region.
- + Find out if there are existing regional predictions of climate change like from the Ministry of Environment, the Meteorological service, scientific institutes or from international development organizations.
- + Review the United Nations Framework Convention on Climate Change (UNFCCC) of the country in which you want to carry out the analysis. The National Communications are the official reports from governments which are members of UNFCCC. They contain detailed information regarding the expected impacts of climate change on the country in question, levels of Greenhouse Gas emissions as well as their reduction/mitigation strategy. (Please see the example of Mexico <http://unfccc.int/resource/docs/natc/mexnc4s.pdf>)
- + If possible, deduct conclusions for the region's coffee production.

Expected outputs:

- + List of available documents, studies and reports.
- + Summary of the available information regarding climate change on the level of the pilot country and possible impacts on the coffee production.

(Please see the summary of national report of AdapCC "Impacts of Climate Change" http://www.adapcc.org/download/Report_CC_Impacts_AdapCC-20071113.pdf)

Technical methods to carry out the activities:

- + Basic studies, revision of available documents, internet research.
- + It is recommended to put a consultant in charge that is an expert in the topic of climate change and gives advice during the realization of the ROA process, especially during steps 1, 3, 6 and 7.

Required time:

- + 1 - 2 weeks, depending on the availability of data and on the knowledge of the person who undertakes the revision.

Step 2 - Adaptation of the analysis to the local context

Objective: Adapt the activities of the two-day participatory workshop of the ROA process to apply them under local conditions. Sensitize and qualify the "ROA team" in the application of the ROA.

Activities to carry out:

- + Form a "ROA team" at the local level. The team members should be technicians of the coffee organization, a trainer of the ROA process and an expert in climate change and agriculture or an expert in coffee and climate.
- + Identify the trainer of the "ROA team".
- + Carry out a technical workshop to present, discuss and adapt the ROA process to the local level and to discuss the results of the basic study (step 1).

Expected outputs:

- + "ROA team" knows the ROA process well and the predictions of climate change for their region.
- + Locally adapted ROA process.

Technical methods to carry out the activities:

- + Dialog with the coffee organization or the pilot group.
- + Technical workshop.

Required time: + 2 - 3 days for preparation, 1 day for the workshop

Step 3 - Selection of data at the local level "climate maps"

Objective: Know and understand how the climate will change in the pilot region and how it will impact the producer families and the coffee. Determine measures and existing strategies to confront climate change as well as relevant actors that work on climate change at the regional/ local level.

Activities to carry out:

- + Identify the main actors at the local level like the local /regional government, public, private and scientific institutions, NGOs that have information about climate change and its impacts on coffee cultivation or that implement programs and measures to confront climate change in the region.
- + Carry out interviews with the identified actors to involve them in the ROA process and the formulation of the adaptation strategy.
- + Check which main actors can offer technical and/or financial support to implement adaptation measures.
- + Revise studies, documents and available reports at the local level to better understand the forecasted impacts of climate change on coffee cultivation.
- + Revise documents of existing programs and projects who work on adaptation to climate change to learn from their experiences.
- + Elaborate climate maps of the regions where coffee is produced to forecast how the areas suitable for coffee cultivation will change under the influence of the forecasted climate change by IPCC. Therefore it is necessary to put a scientific institution in charge, like the International Center for Tropical Agriculture (CIAT), which is able to model the future suitability of current coffee growing zones and possible impacts on coffee quality.

Expected outputs:

- + A list of main actors and projects about climate change (stakeholder mapping).
- + A summary of the interviews with the main actors (stakeholders).
- + An evaluation of available data and a summary of relevant information for adapting coffee production which contains the first suggestions and ideas of possible adaptation measures.
- + Climate maps showing the future suitability of coffee regions.

Technical methods to carry out the activities:

- + Interviews, data revision.
- + Scientific modeling of suitable future areas for coffee production under the influence of forecasted climate change.

Required time:

- + 1 week for the identification of main actors and for the preparation of interviews
- + 3 - 4 days of interviews
- + 1 - 2 weeks to revise and evaluate the generated information
- + 4 - 8 weeks to model the future coffee growing areas, depending on the size of the area and the availability of geographic data (GPS coordinates)

Step 4 - Capacity to apply ROA

Objective: To apply the participatory workshops with producer families and to identify their demands on adaptation and on adequate measures to respond to climate change.

Activities to carry out:

- + Carry out a qualification workshop for the promoter farmers (technicians) of the organization and for the ROA team, approximately 10-15 people.
- + Demonstrate the participatory instruments of the basic toolkit step by step.
- + Plan, along with the technicians the participatory workshops for the producers (selection of the communities or cooperatives, elaboration of the time frame, determine the instruments to apply, plan the logistics).

Expected outputs:

- + Trained promoter farmers (technicians) to apply the participatory workshop.
- + A plan to carry out the participatory workshop with coffee producers.

Technical methods: + Capacity building session with promoter farmers.

Required time: + 1 - 2 days of preparation, 1 day capacity building workshop

Step 5 - Participatory workshops with producers (basic toolkit)

Objective: To identify, along with the coffee producers, their climate risks and vulnerabilities and what they see as the root causes for the impacts of the climatic changes they are experiencing. Finally, identify adequate measures to respond to climate change.

Activities to carry out:

- + A two-day participatory workshop carried out within a specific coffee community.

Expected outputs:

- + An action plan for each coffee community or the coffee cooperative containing concrete measures to confront climate risks and vulnerabilities.

Technical methods: + Participatory workshops with coffee producers.

Required time: + 2 days per community or cooperative, 1-2 days for documentation.

Step 6 - Design of the adaptation strategy and establishment of a regional network

Objective: To systemize and summarize the results of step 1-5 and prepare, based on this, an adaptation strategy at the level of the coffee organization. Establish a regional network so that other public or private institutions can support the implementation of the adaptation strategy and that the results of the ROA process can be integrated in other activities, programs and strategies that confront climate change.

Activities to carry out:

- + Systemize and summarize the results of step 1-5 and deduce primary conclusions and activities that are part of the adaptation strategy.
- + Carry out a regional workshop to present the results and the first version of the adaptation strategy to the main actors and discuss if the proposed measures and the possible contributions of the main actors are feasible.
- + Have participants fill out the technical records of each component of the strategy.
- + Nominate the main people from the involved institutions which will be responsible for the support and implementation of the adaptation strategies → form an expert group that advises the implementation of the adaptation strategy.

Expected outputs:

- + First version of the adaptation strategy.
- + Carried out and documented regional workshop with all relevant stakeholders.
- + Technical record of the components of the adaptation strategies worked out during the participatory workshop with the producers.
- + Expert group advising the implementation of the adaptation strategy.
- + Network of the main institutions in the pilot region.

Technical methods:

- + Systematization of the results of the participatory workshop.
- + Regional workshop with main actors (stakeholders).
- + Facilitation of the local network.

Required time:

- + 1 - 2 weeks to systematize results and design the first version of the adaptation strategy
- + 2 - 4 days to prepare the regional workshop
- + 1 day for the regional workshop
- + 2 days for the documentation of the regional workshop

Example of a technical record

Component 1: Water management				
Activity	Timeframe	Required resources	Feasibility and Effectiveness	Responsibility
Elaborate a study on how to improve water management within the coffee plots	1 month	\$XX for a consultant	Yes	Coffee organization

Based on the study, develop a plan on how to improve the irrigation systems in the communities	2 weeks	Promoter farmers	Yes	Coffee organization together with the Ministry of Agriculture
Set up irrigation systems as demonstration units in 10 communities	2 months	Financing for buying irrigation systems. Promoter farmers for installing the irrigation systems	Yes, because the Ministry of Agriculture promotes irrigation systems and supports with financial resources.	Coffee organization together with the Ministry of Agriculture
Realize capacity building sessions with producers from 10 communities on how to use irrigation systems correctly	6 months	Financial resources for capacity building. Promoter farmers for realizing capacity building workshop	Yes, because the national umbrella coffee organization offers financial support for capacity building	Coffee organization together with the national coffee umbrella organization

Step 7 - Formulation of the adaptation strategy

Objective: To finish and agree on the adaptation strategy for the pilot group.

Activities to carry out:

- + Complete the adaptation strategy based on the results of the regional workshop and available scientific climate data for the region.
- + Agree with the management of the pilot group, the ROA team and the external stakeholders and experts involved in the adaptation strategy.
- + Elaborate an operational plan to implement the agreed upon measures.
- + Start with the implementation.

Expected outputs:

- + Consensus on the adaptation strategy.
- + Operational plan to implement the strategy.

For examples of adaptation strategies and operational plans please see <http://www.adapcc.org/en/kenya.htm>.

Technical methods:

- + Design of the strategy, elaboration of the operational plan.
- + Meeting of the management, the ROA team and expert group to agree on the adaptation strategy.

Required time:

- + 1 week to finish the adaptation strategy
- + 1 day for the meeting with the responsible people
- + 1 week for the development of the operational plan

**d) Basic toolkit - the participatory workshop**

Objective: To sensitize the producers and include their knowledge and experience in the analysis process. The workshops are the heart of the ROA process (please check step 5). Step by step the smallholders discover the climate related risks threatening the quality and quantity of their coffee. They discover as well the basic reasons for being affected and they identify measures to reduce risks and vulnerabilities. The process permits analysis of the climate impacts on the coffee production as well as helping to sensitize smallholders and to motivate them to make decisions and take action to reinforce their resistance towards climate change.

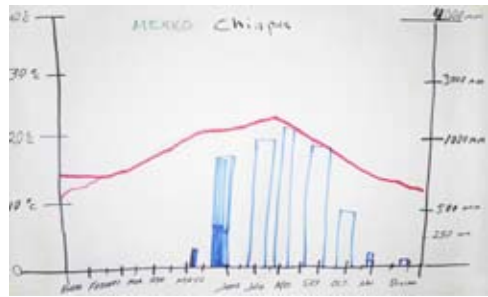
Method to facilitate knowledge: In a participatory manner that can be applied in two days together with the producers of a selected cooperative or community. The following group exercises can/should be used:

Day 1	Day 2
<ul style="list-style-type: none"> + Climate Diagram + Time line of the coffee organization + Seasonal Calendar + List of Animals and Plants + Inventario de flora y fauna + Present and revise results relating them to climate change + Meditation: Two Way Vision 	<ul style="list-style-type: none"> + Priority Values + Problem Tree / Root Cause Analysis + Sun Ray Exercise + Assessment of Adaptation Options + Action Plan

Expected outputs: As a general result a community action plan is expected, which contains concrete measures to confront climate change. Moreover the producers will be sensitized for climate risks and they will better understand the relation between their plot management and the degree to which they are affected by extreme weather events or climate variability.

1) Climate Diagram⁹

Climate diagrams are summaries of average climatic conditions (temperature and precipitation) during one year at a specific location. Starting off the participatory workshop with the producers ensures a focus on climate related issues and also serves as a first analysis of climate conditions for that specific region.



Climate Diagram, Example from Mexico

The climate diagram displays monthly averages (30 years average) of temperature and precipitation during one year. Each tic mark along the horizontal line indicates a month. The diagrams start with January in the left corner of the diagram for the northern hemisphere and with July for the southern hemisphere respectively. Thus the astronomic summer is always shown in the middle of the diagram. Draw 20 mm of monthly precipitation (right ordinate) equal to 10°C average temperature (left ordinate). When the precipitation curve undercuts the temperature curve, the area in between them is dotted indicating dry season. When the precipitation curve supercedes the temperature curve, vertical lines are plotted for each month indicating moist season. A very important ecological variable is also frost; the diagram shows daily average minimum temperatures below zero in black bars below the horizontal line.

Objective: To draw the current climate diagram based on community knowledge and subsequently estimate the future climate.

Material: Paper (pin board size) and pens of different colors

Method:

- 1.) Prepare raw diagram with horizontal and vertical axis: Divide horizontal axis into 12 equal sections (12 months of the year). Divide left ordinate into temperature and right ordinate into precipitation (20 mm of monthly precipitation equal 10°C average temperature).
- 2.) Divide the participants into groups (5-6 persons in one group).

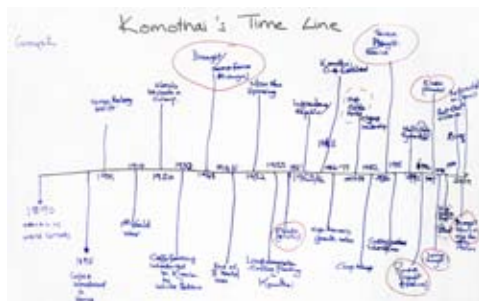
⁹ Activity developed by P. Läderach from CIAT, Nicaragua
<http://www.zoolex.org/walter.html>
<http://www.weatheronline.co.uk/reports/climate/>
http://commons.wikimedia.org/wiki/Category:Climate_diagrams
<http://www.globalbioclimatics.org/plot/diagram.htm>

- 3.) Ask each group to draw the climate diagram for their current climate:
 - a) Group discussion on precipitation and temperature values for each month.
 - b) Draw points of values and connect lines
 - c) Identify dry seasons and frost periods
- 4.) Predict future prediction of climate diagram
 - a) Group discussion on expected climate change (precipitation and temperature values) for each month.
 - b) Draw points of values and connect lines
 - c) Identify dry seasons and frost periods
 - d) Compare your estimates with specific prediction data for your area if available, otherwise compare with climate predictions for your country or continent.
- 5.) Draw a combined diagram with the results of the current and future diagram
 - a) Indicate precipitation as bars and temperature as lines in different colors
- 6.) Ask one representative per group to present the group's results and discuss.

Duration: 1 to 2 hours

2) Time Line

A time line is a chronological listing over many years of key events in the history of the organization and its area. The time line facilitates discussion and examination of past trends, actions, problems and achievements. It is useful in resource planning and decision making to think back on these past events and experiences and look at how they influence present attitudes and actions.



Time Line, Example from Kenya

The events which are recorded on the time line may include spiritual and cultural events, movements of people, introduction of new technology, natural disasters, political events or decisions, development projects and so on. In developing a time line participants make a record of events from as many generations back as they can recall. Group discussions of the time line provide a good opportunity to ask elders about previous happenings and traditional responses.

Objective: To help the organization better understand what natural and human events have influenced their lives and their surroundings.

Material: Paper (pin board size) and markers

Method:

- 1.) Explain the objective of the time line. Ask the participants to identify those events which influenced individual activities and the activities of the organization. Start with someone identifying an important event in the past and try to determine the year that it happened, it does not have to be the earliest activity remembered. Record the year and event, then ask for another event. Record this and the years above and below the first. Help the group to work back to the earliest events they can remember.
- 2.) Discussion may start off slowly therefore the following prompt questions may be used to speed up the process:
 - a) When did people start to migrate to the area and where did they come from?
 - b) When did hurricanes, floods, periods in which the crops failed or other natural disasters occur?
 - c) Which development activities were implemented in the region?
- 3.) Register the events mentioned on a long sheet of paper. Write in big letters and in a language that everyone understands.
- 4.) If there are problems identifying specific dates for some events, try to relate them to well-known events (e.g. independence).
- 5.) Once the time line is finished one of the participants should sum up the results.

Duration: 1 hour

3) List of Animals and Plants

The producers will often have in-depth knowledge of the plants and animals located in their environment. Some are also a strong resource with regards to the relationships of plants and animals. The inventory allows for a rapid overview of plants and animals in the region of the organization.

NAME	USE	NUTRITION	LOCALITY
1. Banana	Food	Carbohydrate	Kenya / Uganda
2. Pineapple	Food	Vitamin C	Kenya / Uganda
3. Orange	Food	Vitamin C	Kenya / Uganda
4. Mango	Food	Vitamin A	Kenya / Uganda
5. Apple	Food	Vitamin C	Kenya / Uganda
6. Strawberry	Food	Vitamin C	Kenya / Uganda
7. Watermelon	Food	Vitamin C	Kenya / Uganda
8. Peach	Food	Vitamin A	Kenya / Uganda
9. Pear	Food	Vitamin C	Kenya / Uganda
10. Plum	Food	Vitamin C	Kenya / Uganda
11. Cherry	Food	Vitamin C	Kenya / Uganda
12. Grape	Food	Vitamin C	Kenya / Uganda
13. Lemon	Food	Vitamin C	Kenya / Uganda
14. Lime	Food	Vitamin C	Kenya / Uganda
15. Kiwi	Food	Vitamin C	Kenya / Uganda
16. Guava	Food	Vitamin C	Kenya / Uganda
17. Passion fruit	Food	Vitamin C	Kenya / Uganda
18. Jackfruit	Food	Vitamin C	Kenya / Uganda
19. Breadfruit	Food	Vitamin C	Kenya / Uganda
20. Taro	Food	Vitamin C	Kenya / Uganda
21. Cassava	Food	Vitamin C	Kenya / Uganda
22. Sweet potato	Food	Vitamin C	Kenya / Uganda
23. Yam	Food	Vitamin C	Kenya / Uganda
24. Plantain	Food	Vitamin C	Kenya / Uganda
25. Cocoyam	Food	Vitamin C	Kenya / Uganda
26. Arrowroot	Food	Vitamin C	Kenya / Uganda
27. Manioc	Food	Vitamin C	Kenya / Uganda
28. Cassia	Food	Vitamin C	Kenya / Uganda
29. Peanut	Food	Vitamin C	Kenya / Uganda
30. Sesame	Food	Vitamin C	Kenya / Uganda
31. Sunflower	Food	Vitamin C	Kenya / Uganda
32. Soybean	Food	Vitamin C	Kenya / Uganda
33. Chickpea	Food	Vitamin C	Kenya / Uganda
34. Lentil	Food	Vitamin C	Kenya / Uganda
35. Bean	Food	Vitamin C	Kenya / Uganda
36. Pea	Food	Vitamin C	Kenya / Uganda
37. Corn	Food	Vitamin C	Kenya / Uganda
38. Wheat	Food	Vitamin C	Kenya / Uganda
39. Rice	Food	Vitamin C	Kenya / Uganda
40. Oats	Food	Vitamin C	Kenya / Uganda
41. Barley	Food	Vitamin C	Kenya / Uganda
42. Rye	Food	Vitamin C	Kenya / Uganda
43. Buckwheat	Food	Vitamin C	Kenya / Uganda
44. Millet	Food	Vitamin C	Kenya / Uganda
45. Sorghum	Food	Vitamin C	Kenya / Uganda
46. Amaranth	Food	Vitamin C	Kenya / Uganda
47. Quinoa	Food	Vitamin C	Kenya / Uganda
48. Buckwheat	Food	Vitamin C	Kenya / Uganda
49. Speltz	Food	Vitamin C	Kenya / Uganda
50. Emmer	Food	Vitamin C	Kenya / Uganda
51. Enecho	Food	Vitamin C	Kenya / Uganda
52. Farro	Food	Vitamin C	Kenya / Uganda
53. Kamut	Food	Vitamin C	Kenya / Uganda
54. Kaniro	Food	Vitamin C	Kenya / Uganda
55. Speltz	Food	Vitamin C	Kenya / Uganda
56. Emmer	Food	Vitamin C	Kenya / Uganda
57. Enecho	Food	Vitamin C	Kenya / Uganda
58. Farro	Food	Vitamin C	Kenya / Uganda
59. Kamut	Food	Vitamin C	Kenya / Uganda
60. Kaniro	Food	Vitamin C	Kenya / Uganda

List of Animals + Plants, Example from Kenya

Objective: Collect information on existing biodiversity.

Material: Paper (pin board size), books on local plants and animals, pencils.

Method:

- 1.) Divide the participants into 4 groups and give each the formats or the inventory:
 - a) Trees and plants and b) Plants for agricultural use
 - c) Birds and animals and d) The ecosystem of tea

- 2.) Ask each group to prepare the following information on their sheets:
 - a) Name of the plant, animal and b) Use, importance
 - c) Abundance or loss and d) Locality
- 3.) If time allows have the groups rotate so that each group has the chance to work on all four topics.
- 4.) One member of each group presents the results - discuss the findings.

Duration: 1 to 2 hours

4) Seasonal Calendar

A seasonal calendar is a tool for documenting regular cyclical periods and significant events that occur during a year and influence the life of the organization. It provides a general picture of important environmental, cultural and socio-economic periods throughout the year. The seasonal calendar is of particular value as it allows local people to represent their understanding of seasons in congruence to cultivation. These are often different from "official" seasons and the International calendar.

Seasonal Calendar, Example from Kenya



Objective: Develop a seasonal calendar for the organization.

Material: Paper, tape or push pins, pencils, pens, coloured pens/markers

Method:

- 1.) Form 4 groups and make sure to mix young and old.
- 2.) Draw a circle on each (4) sheet of paper and hand mark the highest point of the circle as "beginning of the year/January". Explain that the lowest point of the circle represents the middle of the year and that reaching the top again represents a new year. Divide the circle into 12 sections, one for every month. Hand out paper to each group so that they can prepare their own Seasonal Calendar (It is advisable to prepare these formats beforehand and after explaining the circle handing them out to each group).
- 3.) The 4 groups are divided into the following topics and each group should think of the events which occur in each field for every month of the year:
 - a) Flora and fauna – for example, blossoming of trees / bird migration
 - b) Agriculture – ripening of fruits/planting and harvest times/processing steps
 - c) Climate – rainy seasons/dry seasons/hurricane seasons/droughts
 - d) Social events – public holidays, local customs on specific days/local markets

- 4.) Participants can use writing or symbols for depicting any event throughout the year. Make sure to include a legend and everyone's names.
- 5.) Once every group has finished, one representative from each group presents their results which will be discussed and completed within the entire group.

Duration: 1 to 2 hours

5) Presentation and revision of results

Objective: To identify changes to the environment and community life that is linked to climate change.

Material: Paper, results from earlier activities, pens

Method:

Climate Diagram

Ask the participants to look at their generated climate diagrams and discuss if they differ. Then discuss if there have been major changes in the past years (this will also be further discussed looking at the Seasonal Calendars) and what future changes are expected by the producers.

Time Line

Get the participants to divide the information generated in activity 3 into categories such as environmental/natural changes (e.g. occurrence of natural calamities) or human made events (e.g. economic activities). Select certain highlighted environmental aspects such as hurricanes or water shortage and get participants to determine whether intensity and/or frequency is increasing or decreasing and record results.

List of Animals and Plants

Get the participants to look at the inventory and identify those plants and animals that are now in low abundance. Ask them to discuss and record possible causes for their decline and the likely impact of its loss on their lives. Also identify species that may be new to the area and discuss their possible impacts.

Seasonal Calendar

Ask the participants to review the seasonal calendar developed in activity 2. Discuss changes or uncommon events that have been observed with regard to seasonality of their environment in recent years. This can be events such as prolonged drought, increased rainfall, early fruiting/flowering of trees etc. Record observed changes and discussion. Trend lines can also be used for selected aspects on the seasonal calendar for example agricultural productivity or water availability.

Duration: 1 to 2 hours

6) Meditation: Two Way Vision

Objective: Determine how the organization perceives climate change, how these changes will affect their lives and how they would want their future to be instead.

Material: not necessary

Method:

- 1.) Before leaving home after day 1, get the participants to think in the future of their coffee production and also of their homes, families and communities.
- 2.) Everyone should think of the future that is most likely to happen if everything continues as present.
- 3.) Now everyone should think of what their "ideal" future would look like.
- 4.) Everyone should think of three values they consider of high importance. Taking this as a basis, they should try to identify individually what the biggest problems/risks are, and what role they could play on their lives and their coffee production. Consider how the risks or problems would impact the important values mentioned previously (put an emphasis on climate related risks). Have them think about their three values while at home. They should also think of prominent risks / problems endangering these three values to be preserved for the future. The next day the shared values and problems should be discussed and prioritized.

Duration: 5 Minutes before the end of day 1

Day 2

7) Priority Values

The values of the organization once identified may be widely spread, as values vary from participant to participant. It is therefore important to prioritize values that are appreciated more by the collective group rather than by the individual.

Objective: To assist the members of the organization to determine which values are of great importance to them and which values they would like to see maintained.

Material: Paper, pens, markers

Method:

- 1.) Based on the reflections at the end of day 1 everyone should recall their values (if possible three) they would like to see maintained.
- 2.) Ask each person to choose a partner and to share their three choices and the reason for their selection. Each pair should discuss these and select just three which they think are the most important.
- 3.) When all the pairs have completed the task, combine pairs into groups of four members. Ask each group to repeat the task, with each pair explaining their three choices, each foursome should then discuss and choose a new set of three.

- 4.) Combine the groups of four into groups of eight and repeat the task, then form groups of 16 and so on until there is only one group.
- 5.) Finally, ask the larger group to present their three choices and the reasons for their selection. Review the choices that were given less importance. Ask "How did you decide on this?", "Were there major disagreements?", "What did you do when there were disagreements in the organization over values?".

Duration: 1 to 2 hours

8) List of Problems

It is always important to allow producers to identify their own needs and arrive at possible solutions. This tool provides a simple but systematic way to help the organization to identify and further define the specific issues. It helps them to define the problems or conflicts that concern them most (concerns) and to look for possible ways to solve or address these (opportunities).

By listing the problems (you can split this list into ,Concerns' and ,Opportunities) on a sheet (or sheets) of paper, this tool provides an effective framework with which an organization can determine its priorities.



List of Problems, Example from Kenya

Objective: To systematize the organization's climate change related issues and consider options that should help address them.

Material: Paper, markers

Method:

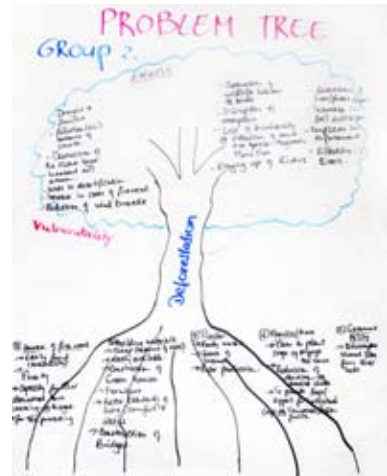
A List of problems (Concerns and Opportunities) can be generated in several ways. The list might include items generated from many sources, including meetings, brainstorming, individual discussions, small group exercises, transects or theatre sessions. The list should be retained in the organization and continually revised to include more information throughout the process.

- 1.) Based on the mediation of day 1, everyone should name their identified problems (vulnerabilities/risks) which threaten the values they identified as most important. Choose 3-4 problems from the list and prioritize them.
- 2.) Mark the chosen problems as well as the values in red and hang the list up where everyone can see it. Try to be as specific as possible. Insert further information or ideas which may develop throughout the rest of the day.

Duration: Half an hour for as long as necessary

9) Problem Tree

A clear understanding of a problem is essential when trying to determine what effective actions to take to resolve it. The Problem Tree (Root Cause Analysis) is a useful tool that will enable the organization to identify the many parts of a problem, the dominant causes and the most effective areas for action. Climate change is a very tricky topic and to remove the possibility of bias that the organization's problems are the direct result of it, one has to have a broad overview of all the contributing factors to decide whether climate change is the dominant factor or not.



Problem Tree, Example from Kenya

Objective: To determine whether or not problems of the organization are related to climate change.

Material: Paper, markers

Method:

- 1.) As an example use one of the prioritised problems from earlier and define clearly what the "problem", "cause" and "effect" are. Using the sample chart show a tree with leaves. Written within the trunk of the tree is a problem. Explain that your tree is sick. Point out the problem it is suffering from. Point out that trees often become sick due to problems in the roots from which it feeds. Point out that trees often become sick due to problems in the roots from which it feeds. Explain that to understand why the tree is sick, we must follow the problem back to the roots. Let the participants brainstorm over the causes of the problem by asking the question "why?". Draw a root for each cause and write the cause on the root.
- 2.) Repeat the question "why?" for each cause mentioned to identify secondary causes. Write these lower down on the roots, below the primary causes identified. Allow participants to continue until they can identify no more secondary causes.
- 3.) Ask the participants to identify effects or impacts of the problem by asking "what happened?". Draw a branch for each effect and write the effect on the branch.
- 4.) For each effect identified, repeat the question "what happened?" to reveal secondary effects. Place these higher up the branches above the primary effects. Allow the participants to continue until they can identify no more effects.

- 5.) After this demonstration give each group (3-4 depending on how many problems were identified as "very pressing" earlier) one problem from the prioritized list and ask them to follow the same process, identifying the root cause(s) of the problem and the effect on their organization.
- 6.) Have the groups present the results and discuss.

Duration: 2 hours

Example - problem tree

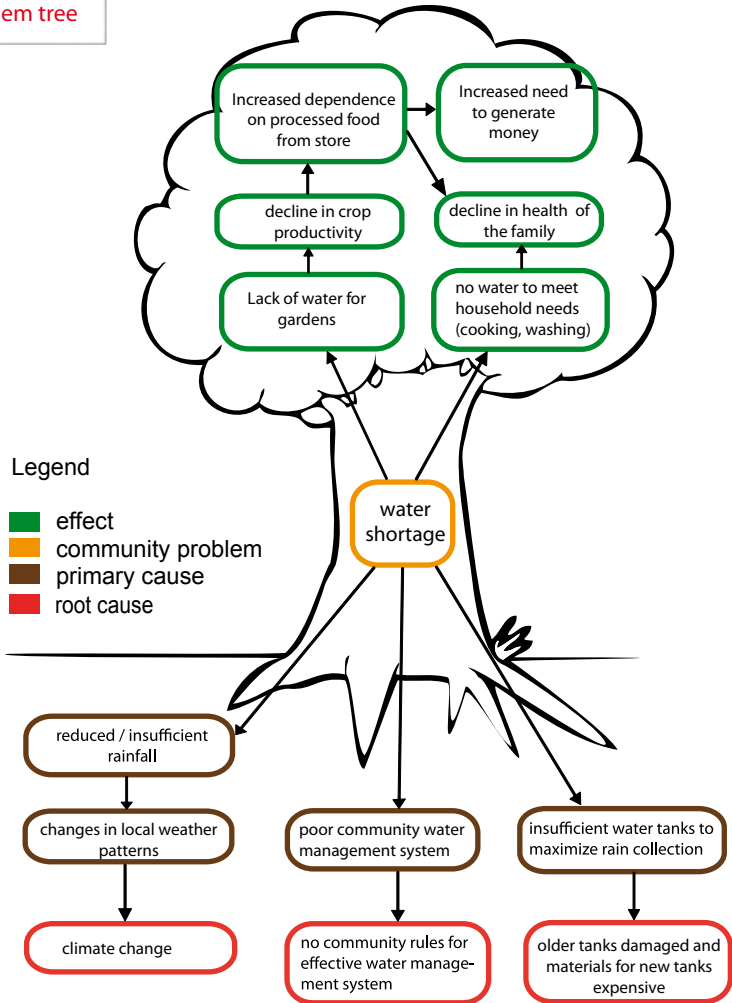


Figure 7

10) Sun Ray Exercise

The sun ray exercise allows for the organization to brainstorm ideas for solving a problem in a structured and logical manner. It is a visual method of developing solutions and breaking them into achievable activities. The name of the exercise comes from the form of the result, which resembles the rays of the sun.



Sun Ray Exercise, Example from Kenya

Objective: This exercise can be used to break down problems as well as to develop solutions. It may be used in much the same way as the Root Cause Analysis.

Material: Paper, markers, post-its

Method:

- 1.) Form sun ray exercise groups (it is advisable to form the same groups as in the prior activity).
- 2.) Ask the groups to brainstorm and come up with the general solutions needed to address the root cause of the problem. Write the solutions on small pieces of paper and stick them at the end of the rays. (You may also hand out the template with the sun and the problem already written in the middle of the sun to each group).
- 3.) Ask the groups to think of how to achieve each of the general solutions at the end of the rays. Write the answers on separate pieces of paper and place them on the rays under the solution. Add new rays if they are needed.
- 4.) Where the group has identified large or complex activities for achieving the general solutions, break them down into smaller activities by adding more ideas off the rays. Keep working at them until all possibilities are exhausted.
- 5.) Check that all the rays end with a full solution to the problem. Take out what is not needed and add new solutions where necessary. Rearrange items if necessary.
- 6.) Nominate one person from the group to draw the final Sun ray on paper (or use the version of the group if already put on pin board sized paper).

Duration: 1 to 2 hours

Example - Solution Rays

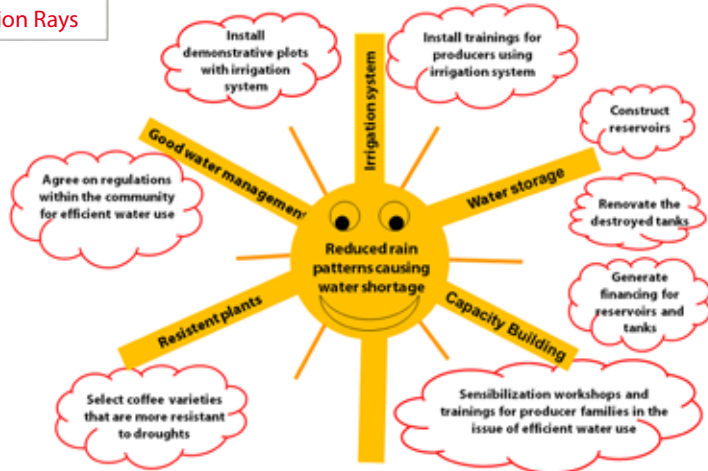


Figure 8

11) Assessment of Adaptation Options

This activity may help the organization to decide on a range of actions which they could undertake to either address issues relating to impacts of climate change or meeting agreed development objectives. Central to this activity is the compilation of a table of "options". Down the far left hand column of the Table, list either impact issues (erosion, water scarcity, food security) or integrity enhancement objectives (for example, maintain a certain area in good condition, protect a certain forest area, etc). Across the table, other columns are actions (or options) which can be taken to address the issue or meet the objective. Systematically, the organization assesses the appropriateness of each of these possible actions for each issue or objective listed. The list of issues or objectives should be recorded in the order of priority the participants have given them.

Objective: To assist the organization in deciding which specific actions will be taken by the producers to adapt to the impacts of Climate Change.

Material: Options Assessment Table (blank), pens

Method:

- 1.) Explain the objective of the activity and from the groups as earlier.
- 2.) Present the Options Assessment Table and explain how to use it.
- 3.) Decide on and write the issues or objectives in the far left column corresponding to the problem.
- 4.) Discuss possible solutions or actions arising out of the sun ray exercise and put them in as column headings.

- 5.) Each group should revise their agreed on solutions and actions and discuss their feasibility and appropriateness/effectiveness. Each group has to fill in the Options Assessment Table (it is advisable to already have copies prepared and hand one out to each group).
- 6.) Explain that the issues or objectives should be given a value. If an action seems highly appropriate to the problem then mark the square with a ,+‘. If the action does not seem like an appropriate solution then mark it as ,-‘ and if its appropriateness is unknown mark it as ,?’. Specific details or information on how that action will work should also be recorded in the square or off to the side. Appropriateness may also be marked with a high, medium or low value, ask the villagers to explain the reasons behind the chosen value as sometimes options may have been applied in the past and participants may have insight into its effectiveness.
- 7.) After the group-work is complete ask everyone to return to the large group.
- 8.) Ask each of the small groups to present their assessment and recommendations. At the end of each presentation discuss the results.
- 9.) Record the specific actions which the large group has agreed to. Include these actions in the Community Action Plan (see below).
- 10.) Repeat these steps again if time allows for another set of issues or actions.

Duration: 1 hour

Example of the Options Assessment Table (in blank please see annex)

Problem of the organization	Adaptation Option	Level of effectiveness ¹⁰		
		Low	Medium	High
Water shortage	Develop and implement a water-usage-plan based on the water available and include maintenance of tanks for water storage			■ +
	Increase water storage capacity by obtaining water tanks			■ ?
Erosion	Plant more trees for securing the soil		■ +	
	Care for existing plants and comply with controlled deforestation		■ -	
Loss of yields/ production	Determine how plagues can be treated more effectively			■ ?
	Include various species and varieties in the production area (biodiversity)		■ -	

¹⁰This evaluation is only given as an example and does not reflect the actual effectiveness of the activities listed.

12) Action Plan

Objective: To coordinate tasks and resources so that the organization is able to implement the identified climate change adaptation options.

Material: Paper (pin board size) with the format of the Action Plan, markers

Action/Task	Adaptation Option	Timeframe	Resources	Responc.
Identification	Controlled logging/harvesting	1-2 yrs	field officers, accountability system	local govts
	Creation of forest reserves	1-2 yrs	forest lands, specific laws, permit	"
	Reforestation/afforestation	2-4 yrs	seedlings	"
	Succession selection	1 yr	promoter (forest)	"
	Stakeholder agreement	3 yrs	insurance, external resources (training, inputs, tools)	"
Revision of National Boundaries	Impact and policy	3 yrs	technical, financial, political, social, training, inputs	local govts, community
	Application of GAPs	3 yrs	"	"

Sun Ray Exercise, Example from Kenya

Method:

- 1.) Discuss the activities listed in the Options Assessment Table and collect further ideas for the different tasks which have to be carried out in order to realize the Adaptation Measure (the tasks listed will not be in any particular order). The participants should define these tasks as precise as possible thinking of every step that has to be taken for implementation, thinking of necessary resources and identifying the responsible people for each task.
- 2.) The group should together prioritize the activities related to implementation and priority of the problem as elaborated earlier. (Depending on the dynamic of the group it may be easier to have the small groups already prioritize the activities and then present them to the rest).
- 3.) The whole group should revise and evaluate the activities listed. As they agree on each activity insert them in the Action Plan (see annex).
- 4.) In case of agreeing on specific dates or timeframes for any tasks, insert them accordingly.
- 5.) When inserting the tasks put one responsible person down for each activity. Ask again which resources are necessary for implementing the task and insert them accordingly. Should further actions be necessary for collecting the resources, include these as well.
- 6.) Repeat these steps for each adaptation measure.
- 7.) Once all adaptation measures are completed, revise the Action Plan so that everyone agrees on it and so that all tasks are complete and structured. Make sure for every task it is defined WHAT is to be done, WHO will be responsible for its implementation and WHICH ORGANIZATIONS may be included in the process, WHICH resources are necessary and UNTIL WHEN the task will be completed. This will be the Action Plan (AP).

Duration: 1 hour

Example of an Action Plan (in blank please see annex)

Problem	Adaptation Option	Timeframe	Resources	Responsible
Deforestation	Controlled logging / harvesting	1-2yrs	Field officers, accountability system	Society members
	Creation of forest reserves	2-5yrs and continuous	Farmers	Society members
	Reforestation / Afforestation	2-5yrs and continuous	Seedlings	Society members
	Awareness creation	1yr and continuous	Promoter farmers	Management, Promoter farmers, Field officers
	Sustainable agricultural management practices	3 yrs	Trainings + material, personnel, farming inputs, tools	Management + members
Expansion of agricultural boundaries	Improve soil fertility	3 yrs	Trainings + material, personnel, farming inputs, tools	Management + members
	Application of GAPs	3yrs	Trainings + material, personnel, farming inputs, tools	Management + members
	Improve coffee productivity + marketability	3yrs	Trainings + material, personnel, farming inputs, tools	Management + members
Cultivation in water catchment areas	Soil conservation	2-3yrs and continuous	Trainings + material, personnel, farming inputs, tools	Management + members
	Education / awareness building	1yr and continuous	Trainings + material, personnel	Management + members
Draining waste water into rivers	Educating the public on the dangers of water pollution	1yr and continuous	Trainings + material, personnel	Management + public officers



e) Lessons learned

The process of Risk and Opportunity Analysis (ROA) was developed in the frame of the pilot project AdapCC to identify adaptation measures for climate change. As a basic toolkit the analysis of risk management has been developed and used by the GTZ. Later on participatory manners were added, which were elaborated and applied in Fiji by the WWF ¹¹. Finally the whole process was adjusted to the context of the Latin American coffee and African tea production.

The most important results of the AdapCC project (the four pilot cases of adapting to climate change); demonstrate that this process serves to elaborate adaptation strategies on the level of producer organizations in a participatory manner.

The analysis is **very flexible regarding its application**. Depending on the objective of the analysis, the expected outputs, the target group, the region of investigation, and the available resources, the process can be adjusted as follows:

Step 1 - 7

It is recommended to have an expert in climate change and agriculture to support and advice the analysis and the formulation of the adaptation strategy. If no expert is available or financial means are missing the process could also be carried out without an expert.

Step 1

If there is no profound basic study needed, the process can be started directly with step 2. Perhaps a report or summary already exists describing the impacts on agriculture in the pilot region, which could be used as primary information.

Step 2

It is recommended to carry out this activity because this participatory step supports the sensitization of the pilot organization and motivates them to take action.

Step 3

It is a participatory method and integrates the professional know-how of the local actors, which will later support the implementation and identify the adaptation strategy. Therefore, it is recommended to undertake the interviews and revise the available data. In case there are no other actors in the region who are working in the field of climate change, step 3 could be omitted.

The elaboration of the climate maps is quite an expensive scientific analysis. In case the financial means are missing the investigation could be omitted and instead the results of the participatory workshops could be focused on.

¹¹ WWF South Pacific Programme, 2007: Climate Witness, Community Toolkit

Without climate maps, the future predictions of the expected changes in the coffee production under the influence of climate change are missing. The AdapCC project already has climate maps of the following regions: Piura in Peru, coffee areas in Nicaragua, as well as Veracruz and Chiapas in Mexico. The Sangana PPP has elaborated future suitability maps for Kenyan coffee growing regions. To use these existing maps please visit <http://www.adapcc.org/en/results.htm> for the Latin American regions and check with the 4C Association (<http://www.4c-coffeeassociation.org/en/>) for the Kenyan one. For the predictions it is recommended to put CIAT (<http://www.ciat.cgiar.org/Paginas/index.aspx>) in charge.

Step 4

It is urgently recommended to carry out training for the promoter farmers (technicians) of the organization so that promoters for the application of the participatory workshops can be found.

Step 5

Since it is the heart of the analyzing process, the participatory workshop would also work out as a single activity, without necessarily applying the other steps of the ROA process. The workshops could be carried out also as a sensitization process for producers and communities to encourage their ownership and to motivate them to take action against climate change. To integrate traditional knowledge of the population, it is recommended to let young and old people, men and women, coffee producers and non-coffee producers participate. The group should include between 20 and 25 participants. It is recommended to work with one facilitator per group.

Basic Toolkit (participatory workshops) – Lessons Learned / Recommendations

- + Hold a regional/local workshop with related stakeholders before the two-day participatory workshop takes place in order to adapt the toolkit to local and commodity specific issues.
- + Ensure logistical support for participants of the workshop (e.g. provide money for local transport or organize transport).
- + Keep the number of participants around 20 to 25 and then work in groups no bigger than 5 people.
- + Have one facilitator in each group during the group work sessions in order to guide – but not influence – discussions towards results.
- + Respect and include local customs (e.g. prayers).
- + Make sure to involve all necessary stakeholders right from the start in order to secure adoption of project activities.
- + Participatory elevated data should be backed up by scientific information and possibly future climate predictions for the region.

- + Expectations should be managed from the start. Proposed activities in the action plan may be very complex or require long-term investment – match finances and time available or clearly state which identified activities can be included in the project and which need extra funding and/or go beyond the project lifetime.
- + Involve local staff where possible in order to secure ownership and trust and to ensure implementation on the ground.
- + Build local capacities, when your project ends people will still have to face climate change. Climate change adaptation is a continuous process and does not end with your project.
- + Results must be delivered from you as well, do not only expect the producer organization to do so.
- + Do not force anything upon the producers as implementation will only be done if the concept is accepted by them.
- + Use the wording of the producers when discussing adaptation measures and strategies.
- + Share information at each step of the project so the producer organization feel they are part of ongoing activities.
- + Respect local/regional timetables and cycles e.g. harvesting seasons and plan project activities accordingly.
- + Involve local/regional/national institutions from the start in order to build networks which producer organizations can access/use even after the project ends.
- + Gaining knowledge and understanding linkages of local problems and climate change leads to ownership of producer organizations → creates the base for further projects.
- + Identifying real climate vulnerabilities and risks puts a face on climate change – the face of climate witnesses – and can be used to further make a case for adaptation action at the producer level. It can support pushing political and business agendas.
- + Analyzing climate vulnerabilities and risks, and deducing suitable adaptation options, quite often results in development issues and prepares grounds for strategic partnerships between the public and private sector, research institutions and civil society.

Step 6

In case step 3 is not applied, step 6 could be omitted.

Step 7

Helps to receive the final product of the analysis. The identified activities should be feasible and practical depending on the available resources to implement them. Be sure to take into consideration the expectations of the participating population.

There are still some weak points in the ROA process:

- + The process does **not include a cost-benefit analysis** for implementing the identified adaptation strategy.
- + The analysis supports the identification of financial mechanisms for the implementation of adaptation measures but **cannot assure its financing**.
- + In case the elaboration of the climate maps is not possible the adaptation strategy only focuses on the present situation but **cannot necessarily be applied with long-term strategies**.
- + Communication of the results of the climate maps might be difficult due to low **confidence of the population** in future predictions and more importantly **heavy implications** for the daily lives of communities.
It is recommended to carefully communicate about the results and always explain the limits of the study carried out.
- + The **participation of local actors** will depend on the logistical support and the financial means to reimburse their travel expenses.

We warmly invite you to make your own experiences and to communicate your lessons learned regarding the application of the ROA process with us:

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Chapter 4

What are the opportunities and limitations for climate change mitigation in coffee production? *

* More information on climate change mitigation and the carbon markets in relation to agroforestry systems (like coffee) is available in the training "On-farm carbon monitoring in agroforestry systems" and the corresponding manual available at the 4C Association.

Chapter objective

To understand the opportunities and limitations for the sequestration of greenhouse gases (GHG) in coffee production and understand the opportunities and limitations that the carbon markets and certification systems offer smallholder coffee farmers.

Training target group

Technicians from coffee organizations will learn about and understand the opportunities and limitations of mitigating climate change effects in coffee production and further introduce the instruments we present here to their member farmers.

Method for facilitating these topics

The trainers and the technicians should present and explain to farmers the opportunities and limitations of mitigating climate change in coffee production. They should be able to summarize the following technical information and present it to farmers, for example, through the use of a "Power Point" presentation.

a) Introduction

I. Greenhouse gases (GHG)

Climate change not only affects agriculture, agriculture also affects climate change. Different agriculture processes and techniques release greenhouse gases, compounding even more the problems we face with climate change.

On a global level, agriculture contributes 13% of GHG released into the atmosphere. If we include GHG released with major land use changes (like from forest to agriculture), accounting for another 18%, then agriculture's total contribution is 31% of all GHG emissions. Within agriculture, the biggest contributors of emissions are livestock, fertilizers, and biomass burning which release methane (CH_4), nitrous oxides (N_2O) and carbon dioxide (CO_2), respectively. When we talk about "carbon" all these gases are included in the total calculation of GHG emissions, which are expressed in tons of CO_2 equivalents ($\text{CO}_2\text{-e}$). The increase of GHG in the atmosphere results in climate change. Because agriculture plays an important role in climate change, there should also be corresponding mechanisms that can help minimize or slow this problem down.

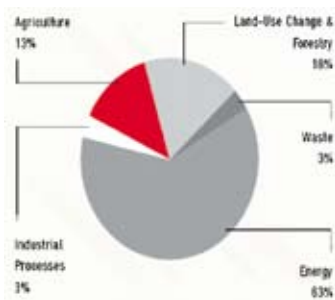


Figure 9
Share of global GHG emission by sector, 2000

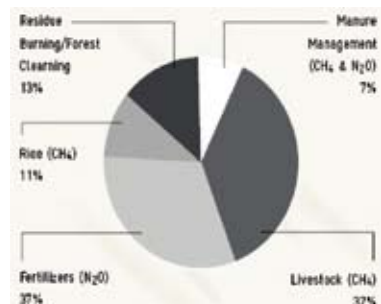


Figure 10
Source of emissions from the agricultural sector, 2000

II. Greenhouse gas pools

To remove (sequester) GHG emissions in agricultural systems it is important to know where these gases originate or in other words, know where carbon stocks are located. The earth has three main carbon reservoirs: the ocean, the atmosphere, and the soil. Within the land or terrestrial system, there are different stocks corresponding especially within different agriculture systems like coffee.

Normally, there is a transfer or a permanent "flow" of carbon between these different carbon reservoirs. This cycle is very important for our climate. The balance of carbon that naturally exists in the different reservoirs is influenced by human activities, which emit additional GHG emissions into the atmosphere. The GHG emissions in coffee systems are influenced by farm management activities, which produce mainly carbon dioxide (CO_2), methane (CH_4), and nitrous oxides (N_2O).

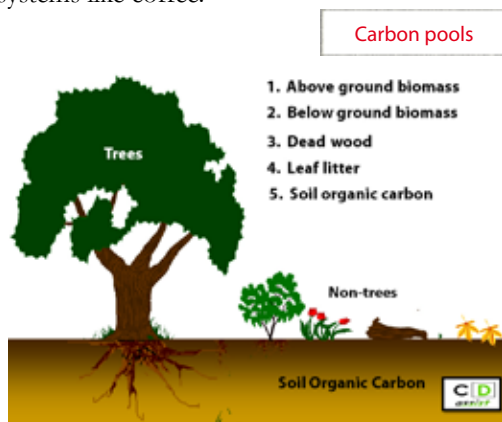


Figure 11

III. The relationship between adaptation and mitigation

In coffee production, good agriculture practices can help to reduce emissions. For example, soil carbon content can be increased if more organic residues are incorporated into the soil while using little or no tillage. Another example is to increase the vegetation cover to reduce erosion.

When thinking about the effects of climate change on coffee and the possible adaptation techniques, it is important to keep in mind that many of these adaptation techniques also have mitigation effects meaning that they also fix carbon. Thus, whenever possible, it is important to find synergies between adaptation and mitigation. For example, good shade management protects against soil erosion and also results in less GHG released into the atmosphere.

At the same time, mitigation strategies can have positive socio-economic and environmental effects. They can contribute to soil productivity and improve quality of products as well as of air and water.

It is also important to mention that in addition to good agricultural practices and reforestation, there are other ways to reduce GHG emissions produced in agriculture, such as improved energy efficiency, alternative energy use, pulp waste recycling, etc.

IV. How can we facilitate this topic with farmers?

Exercise: Which carbon pools are located in the coffee ecosystem?

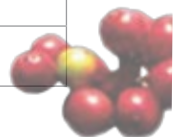
Objective: Know the carbon pools in the coffee ecosystem

Material: Pens, large pieces of paper

Method: Group discussion to answer the questions

Example results from this exercise

Reservoirs	Types of reservoirs
Above ground biomass	Shade trees: + Grevelia (Mubariti) + Cordia Africana (Muringa) + Macadamia + Erythrinia Abscinica (Mukurwe) + Coffee + Herbaceous plants
Below ground biomass	Roots
Dead wood	Logs / Branches/ Seeds
Leaf litter	Leafs
Soil organic carbon (SOC)	Soil

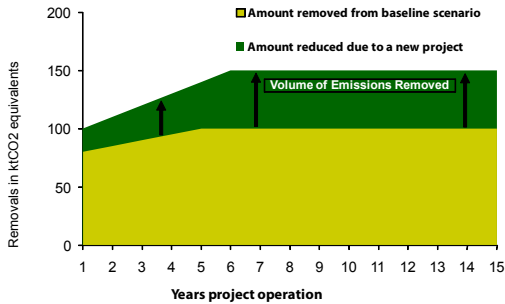


b) What opportunities do the voluntary carbon markets offer smallholder coffee farmers?

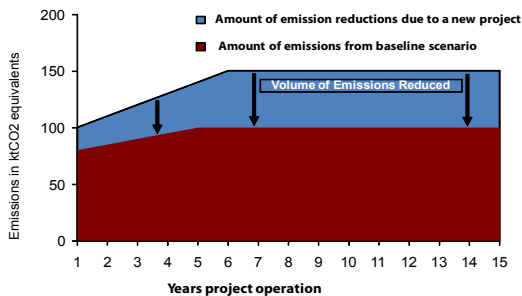
In 1992, the world's governments signed the Convention on Climate Change (UNFCCC) with the goal of seriously confronting climate change. In order to meet this goal, the reduction of GHG emissions is absolutely necessary. In 1997 the Kyoto Protocol was developed. Each country that ratified this protocol has obligatory targets for reducing GHG emissions.

In general, there are two options to mitigate climate change: **remove or reduce** GHG emissions (Figure 11). Removal means to "capture" or "sequester" GHG like carbon dioxide in a pool other than the atmosphere. For example, when new trees are planted, we talk of removal because the trees absorb carbon dioxide which is already in the atmosphere. They remove carbon. Reduction means minimizing GHG already captured in a reservoir or minimizing GHG emissions which would normally occur through management of the system. For example, in the coffee sector, GHG emissions from the soil could be decreased through implementing good agricultural practices or through better or less fertilization.

For whatever mitigation strategy (reduction or removal), it is important to establish a base line. The base line information establishes the reasonable amount of GHG emitted, in the absence of a specific project.



Example 1 - Removal of carbon



Example 2 - Reduction of emissions

Figure 12

One of the international mechanisms for GHG emission reductions is the carbon market. There are two markets that are very different: one is "regulated" by the Kyoto protocol through the Clean Development Mechanism (CDM) and the other is the voluntary market. The idea behind CDM is that countries, which ratify the Kyoto protocol (most of them are industrialized nations), invest in projects that mitigate climate change through projects implemented in developing countries, thus promoting global sustainable development. The emissions fixed in these projects are called "Certified Emission Reductions" or CER, and they contribute to the goals defined in the Kyoto Protocol. Until now, the only types of projects that have been allowed through this mechanism are renewable energy, energy efficiency, afforestation and reforestation. Because there has been a lack of agreement on the best methods for reviewing and monitoring projects, agriculture projects have not been included. The discussions for including agricultural projects in the regulated market have started and are ongoing at the Conferences of the Parties (COP) which in 2010 will be held in Mexico.

What is a carbon credit?

- + It is a certificate of emission reduction (or removal);
CER= certified emission reduction
- + It is calculated directly from the net removal or reduction of human caused emissions
- + It can be used to show mandatory compliance or fulfillment of voluntary standard
- + It can be sold

In addition to the regulated market, there is a voluntary market focused on certain economic sectors or geographic areas not covered in the Kyoto protocol. It includes small projects, like many of those found in the agricultural sector. The voluntary market was founded because many different countries and even individuals want to compensate their emissions in order to improve their image or demonstrate social responsibility. The trade volume in the voluntary carbon markets is smaller than in the regulated market, but it is rapidly growing.

The activities which reduce GHG emissions produce a saleable unit called Verified Emission Reduction, or VER. Unlike the regulated market, there is no single institution in charge of the voluntary market nor is there one set of strict criteria for all projects. However, there is a great demand for transparency and verification to ensure that the reduction in GHG is real and that in the long-term they meet environmental standards. Furthermore, it is important that emission reductions are not counted twice. There are a couple of different voluntary carbon standards which define criteria for generating carbon credits for the voluntary markets. Some also register the different projects and credits generated to avoid double counting. Each standard for verifying voluntary projects has a different focus and some permit agricultural projects to apply.

I. An example: The Voluntary Carbon Standard (VCS)

One standard that covers agricultural projects is called the Voluntary Carbon Standard (VCS) (<http://www.v-c-s.org/afl.html>). Under the VCS, there is a category specifically for agricultural projects: VCS AFOLU (Afforestation and Other Land Uses). This standard is specifically adapted to the measurement needs in agriculture, forestry and other land uses. It guarantees that the carbon capture is real, additional, and permanent. An activity is considered "additional" if human caused emissions are significantly less than those if the project had not been implemented. VCS is generally oriented towards the Clean Development Mechanism criteria ensuring carbon credits of high quality.

Coffee production activities eligible with VCS are:

1.) Afforestation, Reforestation and Revegetation (ARR)

+ ARR – Afforestation, Reforestation and Revegetation

2.) Agricultural Land Management (ALM)

+ ICM – Improved cropland management

+ IGM – Improved grassland management

+ CGC – Cropland and grassland conversions

3.) Reduction of Emissions due to Deforestation and Degradation (REDD)

+ APD – Avoided planned deforestation

+ AUFDD – Avoided unplanned frontier deforestation and degradation

+ AUMDD – Avoided unplanned mosaic deforestation and degradation

II. How can we facilitate this topic with farmers?

Exercise: Which activities release GHG and which activities reduce GHG emissions?

Objective: Know the activities which release greenhouse gas emissions and which activities reduce these emissions

Material: Pens, large pieces of paper

Method: Group discussion to answer the questions

Example results from this exercise

Activities which release GHG emissions	Type of GHG	Activities which reduce GHG
Burning (spread of the agriculture frontier)	CO ₂ CH ₄ N ₂ O	Reduce burning practices (pre- and post harvest land clearing)
Burning firewood for cooking	CO ₂	Use alternative energy sources instead of firewood (e.g. biogas or solar energy)
Deforestation	CO ₂	Conservation Limit or regulate firewood cutting Plant trees
Degradation	CO ₂	Soil conservation
Use of fertilizers	CO ₂ CH ₄ N ₂ O	Use compost Promote organic agriculture
Processing and commercialization of coffee	CO ₂	Re-use residual water Use solar or other renewable energy

III. Project design

To certify a project with VCS, it is necessary to design a good project, use methods that demonstrate a project is "additional" and minimizes leakage. Also it is important to elaborate a monitoring plan. The following figure shows a project cycle using VCS and the approximate time needed from the beginning stage to the final issuing of the carbon credits:

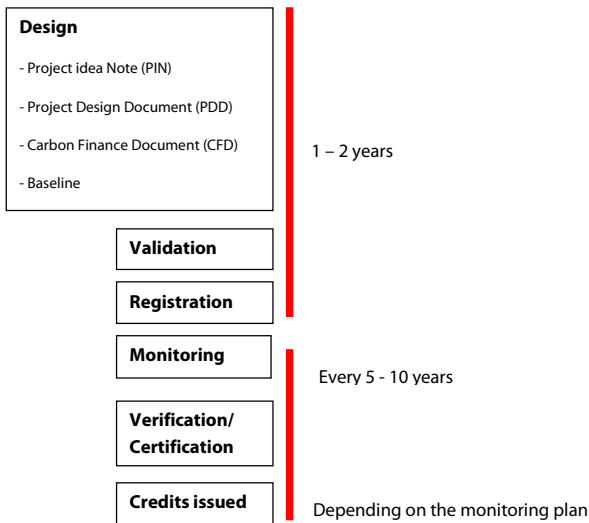


Figure 13

The Project Design Documentation (PDD) should explain how the project follows the methodology and how it will meet all the requirements of the standard as well explain all the planned activities and the expected results. The methodology includes the applicable criteria, how to demonstrate additionally, how to calculate a baseline, determines leakage and the and the monitoring of the project.

To quantify the reduction in emissions within a project, an estimate is made before the project begins, and then based on real data from project monitoring; the actual emission reductions are calculated.

IV. What are the limitations for smallholder farmers in accessing the voluntary carbon market?

As we have seen in the last few pages, the voluntary carbon market offers opportunities for coffee growers. The sale of credits can generate additional farm income that could be used, for example, to finance different adaptation techniques.

But at the same time, there are limitations:

- + Agricultural projects are not yet included within the Clean Development Mechanism
- + Uncertainty about the permanence of projects
- + Lack of appropriate methodologies
- + Projects are usually long-term
- + In some cases, lack of training
- + Lack of land titles
- + Credits are (normally) not sold for at least 2-3 years until after the project begins

One of the biggest limitations is the large investment cost to design and implement a project. During the first 2-3 years until the carbon credits are sold, there may be **no income** and the project costs are usually high (approximately \$200,000 small-scale projects the costs might be less.).

c) What opportunities do "climate friendly" certification systems offer to small-holder coffee producers?

Another trend that began some time ago is the certification of products with a "climate friendly" seal. As a direct result of the Kyoto protocol, laws will be strengthened for emissions caused by certain products. In some countries, it is already becoming mandatory to indicate a product's "carbon footprint" (see below). The seal lists all the product's GHG emissions. This trend is also happening in the coffee sector. The large trading companies and roasters are going to have to measure their carbon footprint including the emissions caused by farmers. In the future, each actor in the value chain will have to measure their emissions. The demand for "climate friendly" certification is growing.

One of these standard systems is "Stop Climate Change" (<http://www.stop-climate-change.de/en/>). Through "Stop Climate Change" an Emission Management System, EMS, is implemented for a whole company or just for a certain product. After achieving certification, the "Stop Climate Change" seal can be used by the company or on the product to demonstrate that they are contributing to reducing GHG emissions.

Another organization promotes "Carbon Labeling" (www.carbon-label.com) indicating the emissions caused by the product, the so called carbon footprint. They issue a "Carbon Reduction Label" to show all the greenhouse gases in a value chain as CO₂ equivalents. This way, consumers can easily compare the carbon footprint between different products. The "Carbon Reduction Label" can add value to a product.

In the coffee sector, "climate friendly" certification or verification is still being developed. One example is a project implemented between the German Technical Cooperation, GTZ, and the Kenyan Sangana Commodities Limited, part of the ECOM trading group, from October 2008 till September 2011.

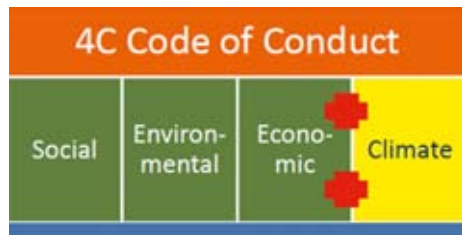


Figure 14

The project's main objective is to develop a "climate module" for the Code of Conduct of the 4C Association (<http://www.4c-coffeeassociation.org/en/>). This climate module is to be voluntary and additional to the current social, environmental and economic standards they use.

This 4C verification system plus the climate module should work similarly to other standard systems, which aim to promote sustainability in the coffee sector. The additional climate module aims to support producers in adapting their production to changing climatic conditions and consider mitigation options (GHG removal and / or reduction) where possible.

Also the Rainforest Alliance (<http://www.rainforest-alliance.org/>) is currently working on developing an addendum to their existing SAN standard which takes into account climate change adaptation and mitigation.

All these ongoing initiatives are showing the importance of the topic in the coffee sector as climate change impacts on all actors along the value chain. Looking towards the future, "climate friendly" certification is an option for coffee farmers to access a specialty market that is growing due to consumer demand and the policies in developed countries.

AdapCC - Adaptation to climate change for smallholder farmers, a pilot, public private partnership between Cafédirect and the GTZ to implement model strategies for climate change adaptation in the coffee and tea sectors (www.adapcc.org).

Adaptation - Used here as "adaptation to climate change" through strategies, which allow us to "live with" climate change while minimizing its negative impacts.

Additionality - The project would not have been able to take place without the additional money coming from the selling of carbon credits.

Afforestation - Converting areas into forests that were treeless over the last 50 years.

Baseline - Reference scenario (without a project).

Carbon capture or removal - Increase of carbon in a pool except the atmosphere.

Carbon flux - The transfer of carbon from one pool to another i.e. from the atmosphere into above ground biomass.

Carbon footprint - The total set of greenhouse gas emissions caused by an organization, event or product within a pre-defined scope.

Carbon pool - System capable of removing or emitting carbon.

Carbon stocks - The total amount of carbon stored in a pool during a specific time period e.g. carbon stored in one hectare of forest.

El Niño phenomena - In climatology, an erratic climate cycle consisting of changes in air movements provoking, a slowing of the "normal" ocean currents and a warming of South America's oceans with worldwide consequences.

Greenhouse gases (GHG) - Cause the greenhouse effect warming the atmosphere. The most important gases are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). All GHG are mostly talked about as "carbon" or "carbon equivalents" (CO₂e).

Greenhouse gas emissions - The total amount of greenhouse gases emitted or released into the atmosphere during a specific time period.

Greenhouse gas sources - A physical thing (like petroleum) or process (like burning vegetation) that emits GHG emissions into the atmosphere.

Leakage - The increase in GHG emissions outside of a project area that is measurable and caused by project activities.

Mitigation - Strategies that remove or capture greenhouse gases, and thus reduce climate change.

Non-permanence - The release of GHG emissions back into the atmosphere.

Reforestation - Human induced land use conversion of tree less areas to forests through tree-planting or seed dispersal. Under the Kyoto protocol, this is defined as areas having been deforested before December 1989.

Revegetation - Incorporation of trees, bushes or herbaceous plants that do not meet a country's national forest definition.

ROA (Risk and Opportunity Analysis) - A seven-step participatory analysis process designed and implemented to identify a climate change adaptation strategy for smallholder farmer organizations in the AdapCC project.

Solar dryers - A construction to protect coffee berries from rain during the drying period.

UNFCCC - United Nations Framework on Climate Change.

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KENYA

Our Ref:.....

DATE.....

JAMES KINYANJUI NJENGA

NEW THUITA FACTORY, S.M.S. LTD.

P.O.BOX 18630 – 00500

THIKA

Dear Sir / Madam,

The enclosed soil test result shows that the soil is rather weakly acidic and low in phosphates. It is well supplied in Calcium, Magnesium and Potash for optimum coffee production. **RECOMMENDATION:**

1.) NITROGEN FERTILIZERS

To maintain the soil reaction (pH) in the ideal range, you are then advised to alternate a neutral and acidifying N- fertilizer starting with **CAN then ASN, AS or Urea at the rate of 300g/tree if (ASN ,CAN) or 200g/tree if Urea or 400g/tree if AS** applied in two equal splits in April / May for a period of two years, two weeks after the onset of long rains. Thereafter in the third year sample again for the next analysis.

2.) POTASSIUM/PHOSPHATIC FERTILIZER

To improve the availability of **Phosphorus and maintain Potash level** you are advised to apply **SSP at the rate of 300g/tree and NPK compound fertilizer 22:6:12 or 20:10:10 or 17:17:17 at the rate of 250g/tree in October / November** six months before the main flowering. These fertilizers should shallowly be incorporated into the soil or covered with mulch.

3.) FOLIAR FEEDS

To prepare the bearing wood and induce flowering, you are advised to apply **foliar spray of boron (as solubor) and Zinc (as Zinc Oxide) at the rate of 60g/20 litres of water each**. This should be applied **2-3 months before flowering (in January/February and July/August)**.

Apply a foliar feed mixture of **Urea at 100g, Epsom Salt at 40g, Muriate of Potash (MOP) at 60g and Phosphoric acid at 40ml** all this mixed in **20 litres of water to cover ONLY 25 trees**. This spray should be done during the month of **December, February, March, June, July, August and September**.

4.) GENERAL

In order for you to benefit fully from the above recommended fertilizer programme, the following highlights should be addressed also:

- I) Proper canopy management (pruning)
- II) Proper crop protection measures (disease, pests and weeds)
- III) Proper soil and water conservation measures
- IV) Apply one debe of well composted manure/tree annually.

Yours faithfully,

J N Mburu

Head, Chemistry Section

Annex 1

Results of soil analysis carried out by
the Coffee Research Foundation


How to plan and realise the ROA process

Step	Activities	Expected Output	Timeframe
1. Selection and evaluation of basic data	<p>Desk study of existing IPCC climate forecasts for pilot region</p> <p>Review availability of regional climate models</p> <p>Explore impact of forecasted climate change on specific crop, e.g. on tea</p>	<p>Overview of expected climate change in pilot region and predicted impacts on specific crop</p> <p>List of available studies and sources of regional climate information</p>	1 - 2 weeks
2. Adaptation of analysis to local context	<p>Realise technical workshop to present ROA methodology</p> <p>Establish technical ROA team of experts</p>	Involved partners and pilot group understand ROA process and are committed to realise the analysis	3 - 5 days
3. Selection of basic data at local level, climate maps	<p>Map local stakeholders who are involved in climate change programmes and potentially will support the identification and implementation of adaptation strategies</p> <p>Realise personal interviews with local actors and affected pilot group</p> <p>Design scientific climate maps</p>	<p>Network of partners to support adaptation strategies</p> <p>Better understanding of how people perceive climate change impacts</p> <p>Baseline data for later evaluation of results and impacts of implemented adaptation measures</p> <p>Scientific baseline of expected impacts on agricultural production areas and potential diversification options</p>	2 - 3 months
4. Trainings on ROA application	Train technical staff of pilot group organisation on application of ROA process, especially of participatory instruments	Technical advisors trained in ROA application	1 - 2 weeks
5. Participatory workshops with farmers	Realise 2-day-workshops with farmers to identify their specific climate risks, vulnerabilities, reasons for being affected and potential measures to confront climate change	Community-based action plans including specific adaptation activities, timeframe and responsibilities	5 days for each pilot community
6. Design of adaptation strategy	Realise workshop to present results from regional studies, climate maps and participatory workshops (step 1 – 5) to a wider number of potential partners for implementing adaptation strategy	Supportive network established Feasibility of specific adaptation measures	1 week
7. Agreed adaptation strategy	Work out and agree on final version of site-specific adaptation strategy	Site specific adaptation strategy	1 - 2 weeks

Blank - Options Assessment Table

Problem of the Organization	Adaptation Option	Level of effectiveness		
		Low	Medium	High

We wish to thank all those people who collaborated with the AdapCC project who enabled elaborating this manual in the first place and all partners of the Sangana PPP who supported this English version of the manual:

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- 

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THE CLIMATE CHANGES

... AND I ADAPT TO IT !

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 **ASSOCIATION**
for a better coffee world

