german cooperation

LASOONA
Relief and Development Organization

CHANGING MINDS

For Climate Resilience through Awareness Raising and Local Capacity Measures

TRAINING MANUAL FOR

Climate Change Impact on Agriculture & Adaptation Measures

CHANGING MINDS

For Climate Resilience through Awareness Raising and Local Capacity Measures

TRAINING MANUAL FOR

Climate Change Impact on Agriculture & Adaptation Measures

CONTENTS

PREFACE

Climate change, once a distant murmur, now sits at the farmer's table, a silent guest threatening the bountiful harvests of crops, fruits, vegetables, medicinal plants, livestock and livelihoods and so on.

This training manual is not a shield against the storm, but a seed of resilience, a guide to cultivate agriculture that thrives in the face of uncertainty. Within its pages, you will find not just techniques, but an understanding of the delicate bridge between soil, seed, and the ever-evolving climate.

The manual covers climate change reasons, impacts on agriculture and climate smart technologies. The climate smart practices including varieties resistant to diseases, shifting sowing time either early or late, crop rotation, improved agronomic practices, solarization of tube wells, water harvesting techniques and efficient irrigation techniques like drip irrigation etc.

This manual emphasizes the importance of collaboration, of sharing knowledge and resources, of weaving a net of support that stretches across fields and villages. Together, we can weather the storms, and together, we can ensure that future generations inherit a land that blooms with life. This manual is not merely a collection of words, but a call to action. It is an invitation to join a movement, a revolution where knowledge is the weapon, and resilience the shield. Let us sow the seeds of a climate-smart future, where agriculture not only survives, but thrives in the embrace of change.

Munawar Khan
Expert, Climate Change Impact on Agriculture
Peshawar, KP, Pakistan

MODULE A - UNDERSTANDING CLIMATE CHANGE

OVERVIEW

The first module of this manual is an introduction to the science of climate change needed to understand the broad concept of climate-smart agriculture. It aims to increase the participants' understanding and knowledge of climate change and its causes. The module also highlights how climate change affects agro-ecosystems and how agricultural sectors contribute to climate change through greenhouse gas emissions.

KEY QUESTIONS

- What is climate and climate change?
- What is the difference between climate change and natural climate variability?
- What are the causes of climate change?
- How does agriculture contribute to climate change?
- What are other sources of greenhouse gas emissions?

OBJECTIVES

After completing this module, participants will be able to:

- Explain the difference between weather and climate
- Distinguish between climate change and climate variability
- Describe the greenhouse effect and global warming
- List the main causes of climate change
- Describe the likely effects of climate change
- Explain the effects of climate change on agro-ecosystems: crops, livestock, fisheries and forestry
- Describe how different agricultural practices contribute to greenhouse gas emissions
- Describe the causes of global warming and how contributions to greenhouse gas emissions differ across world regions
- Analyze the gender dimensions of climate change.

DURATION

3.5 hours

EXERCISE A1: PARTICIPATORY INTRODUCTION OF THE PARTICIPANTS

EXERCISE OVERVIEW

When the ambiance is good, people feel comfortable and give their best. The first step in establishing a good learning environment is to ensure the participants know and feel comfortable with each other. Even when the participants already know each other it is useful to do this exercise to encourage participation from the beginning. It breaks the ice. Method for participant introduction is presented below:

METHOD: PAIR-WISE INTERVIEWING

Split the participants into pairs. Ask each participant to interview their partner by focusing on questions such as: “What is your name?”, “Can you share your experiences as a farmer?”, “What do you do?”, “What is your interaction with extension workers?” and “Can you name two likes and dislikes?” After interviewing each other, participants then report in a plenary session about their partner, summarizing the main information. The key to this exercise is that participants do not introduce themselves. In this way they do not become nervous while waiting for their turn.

MATERIALS

A piece of paper and a pen/pencil for each participant who can write.

TIME

30 minutes.

EXERCISE A2: TO KNOW THE EXPECTATIONS OF PARTICIPANTS

EXERCISE OVERVIEW

To avoid disappointment and drop-out among participants, it is important that the facilitator and the group are aware of what everybody expects of the training workshop. In this way, at a very early stage, unrealistic expectations can be recognized and aligned before the participants commit themselves. Only a well-informed person can fully commit themselves. In addition, being aware of expectations helps the group to plan the climate agriculture adaptation and, later on, to monitor whether they are still focused on the initial objectives.

METHOD

The facilitator presents the questions: “Why have you joined the training workshop?”, “What do you hope to gain?”, “What do you expect from the facilitator?” and “What do you think the facilitator expect from you?”. The facilitator divides the group into sub-groups each with a maximum of five participants who then discuss the questions among themselves. The facilitator invites a representative of each sub-group to present their responses to the whole group.

MATERIALS

Flip charts, marker pens, pins/clips.

TIME

30 minutes.

EXERCISE A3: TO KNOW THE UNDERSTANDING LEVEL OF PARTICIPANTS

EXERCISE OVERVIEW

This exercise helps to measure changes in knowledge levels of participants. During the first and the last training sessions, the participants take a test to evaluate their knowledge on the focal topic of the training such as climate change impact on agriculture and adaptation measures. The pre-test provides the training facilitator with some diagnostic information that he/she can use to adjust the training learning program to the knowledge level of the group. The post-test results are an indicator of progress made as a result of the training.

METHOD: BALLOT BOX TEST

The facilitator prepares test by formulating questions that relate directly to local (field) problems. To answer the questions, participants choose from three alternatives. Each question and the three answers are written on cardboard. The participants are requested to go to the different ballot boxes and read the questions and make their choice they think has the correct answer. This provides the facilitator with valuable information that can be used in the development of the learning program (pre-test) or to check on participants' strengths and weaknesses after the training (post-test).

MATERIALS

A piece of paper and a pen/pencil for each participant who can write.

TIME

30 minutes.

SESSION A1

WHAT IS CLIMATE CHANGE?

SESSION OVERVIEW

This session introduces participants to the basics of climate change and distinguishes climate from weather and climate variability. The session encourages learners to consider climate trends and recent extreme weather events in their area.

WEATHER AND CLIMATE

To understand what climate change really means, it is important to first differentiate between weather and climate:

- Weather is the state of atmospheric conditions at a particular place and time. The most common aspects of weather are felt by everyone during the course of a day and include rain, humidity, wind, sunshine, cloudiness and temperature but also include extreme events such as tornadoes, droughts and tropical cyclones. Weather is dynamic and can change within a very short period of time, even within the same day.

- Climate is the set of weather conditions prevailing in an area over a long time, typically three consecutive decades (IPCC, 2007a). Several factors contribute to the definition of climate, including long term averages of temperature and precipitation, but also the type, frequency, duration, and intensity of weather events such as heat waves, cold spells, storms, floods and droughts.

CLIMATE VARIABILITY

Climate variability is the natural fluctuation within the climate, including swings above and below the mean state and other parameters. It reflects the different weather conditions over a day, month, season or year. For example, if we consider rainfall in a given period in a particular region of the world, the variability can be low, meaning that there is not much difference in quantity or timing of rains from one year to another. In another region, there may be high variability, meaning that rainfall quantity swings from far below average to far above average from year to year, and the timing is unpredictable. Climate variability affects weather conditions including cyclone activity and temperature, as well as rainfall. Climate variability results from natural internal processes within the climate system, such as the El Niño Southern Oscillation (Box A1), or from variations in natural external forces, such as volcanic eruptions.

CLIMATE CHANGE

The main difference between climate variability and climate change is that a trend over a time scale indicates a change in climate. While fluctuations over shorter terms – days, seasons, years or several years – and in cycles is climate variability, a consistent linear trend will define climate change as patterns shift over decades. Climate change is detected when the climate – the long-term pattern of climate variability – and the mean exhibit significant measurable changes. For example, on average the climate gets warmer or cooler, or wetter or drier, over decades. Climate variability averages out as climate over years in a steady state. Climate change averages out to a change trend over decades.

CLIMATE CHANGE AND GLOBAL WARMING

The Earth's climate has always been changing due to natural causes that include widespread volcanic activity and oscillations in the planet's rotational and orbital cycles. However, scientists have been measuring trends to higher average global temperatures that are happening much faster than observed previously and that cannot be attributed to natural causes. Instead, scientists conclude this longer-term warming is anthropogenic, meaning it is caused by human activities. For this reason, the United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as "change of climate that is attributed directly or indirectly to human activity, that alters the composition of the global atmosphere, and that is in addition to natural climate variability observed over comparable time periods" (UNFCCC, 1992).

CLIMATE CHANGE ASSESSMENT TOOLS AND METHODS

Scientists use different tools to understand how climate is evolving over time and to forecast possible changes, including prediction models, emission scenarios and climate projections.

Scientists also use simulations to better understand the future effects of climate change. For example, they can simulate the possible effects of different future climate conditions on agricultural productivity and population health. Because future conditions are uncertain, scientists typically consider a set of alternative possible scenarios that are likely to occur in future years. For instance, in estimating the productivity of rice yields in 2050 in Sub-Saharan Africa, two scenarios could be considered:

- One characterized by high temperatures, but without the adoption of new technologies; and
- A second one characterized by the same high temperatures as well as the adoption of new efficient agricultural technologies in rice farmers' practices.

In these cases, simulations of how the scenarios evolve help to quantify the changes in expected rice production according to the two alternatives. This allows policymakers and other stakeholders to evaluate potential benefits of new farm technologies and practices against business-as-usual practices, in the context of changing climate.

Future effects of climate change include and depend on many factors – temperature and precipitation patterns, possible influence of CO2 on plant growth, incidence of pests and diseases, among other things – that can challenge simulation of potential agricultural production. However, successful simulations of these conditions produce crucial information for the design and implementation of sustainable agricultural policies that minimize the detrimental effects of climate change on agricultural production and on peoples' lives.

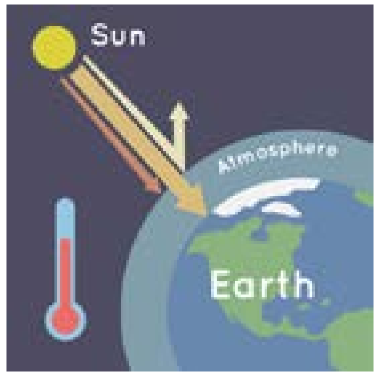
SESSION A2

CAUSES OF CLIMATE CHANGE

SESSION OVERVIEW

This session explores the causes of climate change. It examines the greenhouse effect and the main sources of greenhouse gases. The exercises help participants understand the greenhouse effect and to visualize how various human activities influence the emission of greenhouse gases.

THE GREENHOUSE EFFECT



Energy from the sun, arriving as ultraviolet radiation, drives the Earth's weather and climate. It heats the Earth's surface land and oceans, which in turn heat the atmosphere as infrared radiation. Most of that energy is radiated back into space, but some is trapped in the ground, the ocean and the atmosphere. The Earth's atmosphere consists mainly of nitrogen, oxygen and argon, which have no effect on climate. It also contains small amounts of other gases, including water vapor, carbon dioxide, methane and nitrous oxide, called greenhouse gases because they act like the glass in a greenhouse: they block heat from escaping, allowing the atmosphere to warm up. The atmosphere, in turn, further warms the ground and the oceans. This is known as the greenhouse effect. Earth's natural greenhouse effect makes life as we know it possible, otherwise it would be too cold for human life. As we have seen in the previous session, it has been observed that the Earth is getting warmer. This is due to an increasing concentration of greenhouse gases that trap heat in the atmosphere caused by human activities since the industrial revolution in the late 18th century.

MAJOR GREENHOUSE GASES

The Earth's atmosphere contains a number of greenhouse gases, in different concentrations:

- Water vapor (H2O) is water that evaporates from the sea, lakes, rivers and the soil surface, and that is transpired by plants and often felt as humidity. Human activity makes little direct contribution to the large amount of water vapor or clouds in the atmosphere.

- Carbon dioxide (CO2) can be found in nature produced by volcanoes and geysers. It is emitted by human activities including transport and energy production based on combustion engines burning fossil fuels such as coal, mineral oil, gas. All animals exhale it through respiration, as do plants at night when they are not photosynthesizing. It also enters the atmosphere through the decay of organic matter, deforestation, burning vegetation and certain industrial processes such as cement-making.

- Methane (CH4) enters the atmosphere when produced by livestock, as well as by microbes in the soil and in water, such as in flooded rice fields. It is released when permanently frozen ground thaws in mountains and polar regions and when wetlands, marshes, swamps, bogs and peatlands are dried.

- Nitrous oxide (N2O) is produced by farming, including organic and synthetic fertilizer applications, industrial processes and burning fossil fuels.

- Fluorinated gases (F-gases) are made by humans and used in refrigerators, air-conditioners, foams, cosmetics and fire extinguishers.

- Note that nitrous oxide is different from other compounds of nitrogen and oxygen:

- Nitrous oxide (N2O) is a greenhouse gas.

- Nitric oxide (NO) and nitrogen dioxide (NO2) are pollutants emitted by motor vehicles. They cause respiratory problems but do not cause global warming. They are collectively known as NOX.

CARBON DIOXIDE EQUIVALENTS

Different greenhouse gases have different effects, depending on their concentration in the atmosphere, their ability to alter the radiation balance, and the amount of time they remain in the atmosphere. To allow comparisons of the global warming impacts of different gases, the IPCC (IPCC, 2014 a) uses global warming potential (GWP) as a measure to "represent the combined effect of the differing times these substances remain in the atmosphere and their effectiveness in causing radiative forcing". The larger the GWP value, the higher the warming effect of a given gas compared to carbon dioxide over a time period, usually in terms of 100 years. For example, one ton of methane is equivalent to 25 tons of carbon dioxide, while one ton of nitrous oxide is equivalent to 298 tons of carbon dioxide (IPCC, 2007b).

- A molecule of carbon dioxide has the smallest effect on the climate, but it is by far the most common anthropogenic greenhouse gas, so it has the biggest overall effect. The GWP of carbon dioxide is 1 regardless of the time period and it is used as the reference that allows comparison with other gases. Carbon dioxide accounts for around three-fourths of total emissions and its overall contribution to radiative forcing continues to rise. It is difficult to provide a single lifetime of carbon dioxide because the gas is not destroyed over time, rather it moves through the Earth System: so far, most of the excess has been incorporated in the oceans over decades, while the rest will remain in the atmosphere for thousands of years.

- Methane is a more potent greenhouse gas than carbon dioxide, but sunlight converts methane molecules to carbon dioxide after about 12 years. Averaged out, the GWP over 100 years of methane is 28.

- Other gases are more powerful sources of warming and last much longer in the atmosphere. Nitrous oxide lasts 121 years and has a GWP over 100 years of 265, while some types of fluorinated gases may last thousands of years with a GWP over 100 years of more than 6500.

WHAT ARE THE MAIN SOURCES OF GREENHOUSE GASES?

Human activities play an important role in the emission of greenhouse gases. The amount of carbon dioxide released by each country depends on the type and share of its main economic activities. Therefore, the shares of carbon dioxide emissions are different across the regions of the world.

The latest estimates of emissions from human activities totaled more than 46 billion metric tons of greenhouse gases, expressed as carbon dioxide equivalents, representing a 35 percent increase over the previous decade (IPCC, 2014a).

Electricity and heat production represents the biggest source of greenhouse gases emissions globally, mainly due to the burning of coal, oil and natural gas. Agriculture, forestry and other land use sectors are the second most important source of emissions, responsible globally for around 24 percent. Other sectors include industry that accounts for 21 percent of all emissions, transport – road vehicles, trains, ships and aircraft running on fossil fuels – accounting for 14 percent, other energy sources accounting for 9.6 percent and buildings accounting for 6.4 percent.

MODULE B - CLIMATE CHANGE IMPACTS ON AGRICULTURE AND FOOD SECURITY

OVERVIEW

The aim of this module is to understand the relationships among climate change, agriculture and food security. It does so by reviewing some possible effects that a changing climate could have on the agro-ecosystems and how ultimately this affects agricultural development and food security, putting vulnerable communities at risk, and taking into account that men and women are affected in different ways. In the first session, the module reviews some of the possible impacts of climate change on agricultural sectors. This is followed, in the second session, by a presentation of the concept of food security and an explanation of the reasons why, in absence of appropriate policy interventions, climate change can be harmful to the four dimensions of food security and nutrition in the short and long term. Participants are encouraged to debate how a changing climate is likely to affect a particular aspect of human activity in their area.

KEY QUESTIONS

- What are the effects of climate change on the agricultural sectors?
- How is agriculture contributing to climate change?
- What is food security and what are its dimensions?
- Why is it important to understand the relation between climate change and food security?
- What are the means through which extreme climate shocks can put food security and nutrition at risk?
- How are male and female agricultural producers affected by climate change in similar and different ways?

OBJECTIVES

After completing this module, participants will be able to:

- Identify key possible effects of climate change on agriculture
- Recognize agricultural producers' different vulnerabilities and capacities
- Explain the concept of food security and its four dimensions
- Explain the difference between short-term and long-term food security, the causes of food insecurity and measures to address it
- Describe the transmission mechanisms of climate shocks - from their occurrence to the risk of food insecurity
- Describe how different climate shocks affect the four dimensions of food security.

DURATION

3.5 hours

SESSION B1
CLIMATE CHANGE AND AGRICULTURE

SESSION OVERVIEW

This session introduces the importance of understanding the evolution of climatic conditions for agricultural production. It explains the effects of climate change on agricultural sectors – crops, livestock, forestry, fisheries and aquaculture – and livelihoods. It also examines the effects of agriculture on climate change, and it discusses how agriculture plays a role in both releasing emissions and sequestering carbon in soils and biomass. Finally, it examines the different greenhouse gas emissions across agricultural practices.

UNDERSTANDING THE EFFECTS

Climate change affects plants and animals in a variety of ways: directly or indirectly, by changing their natural equilibrium inside. Understanding the effects of climate change on ecosystems is important to the design of policies and adaptation strategies.

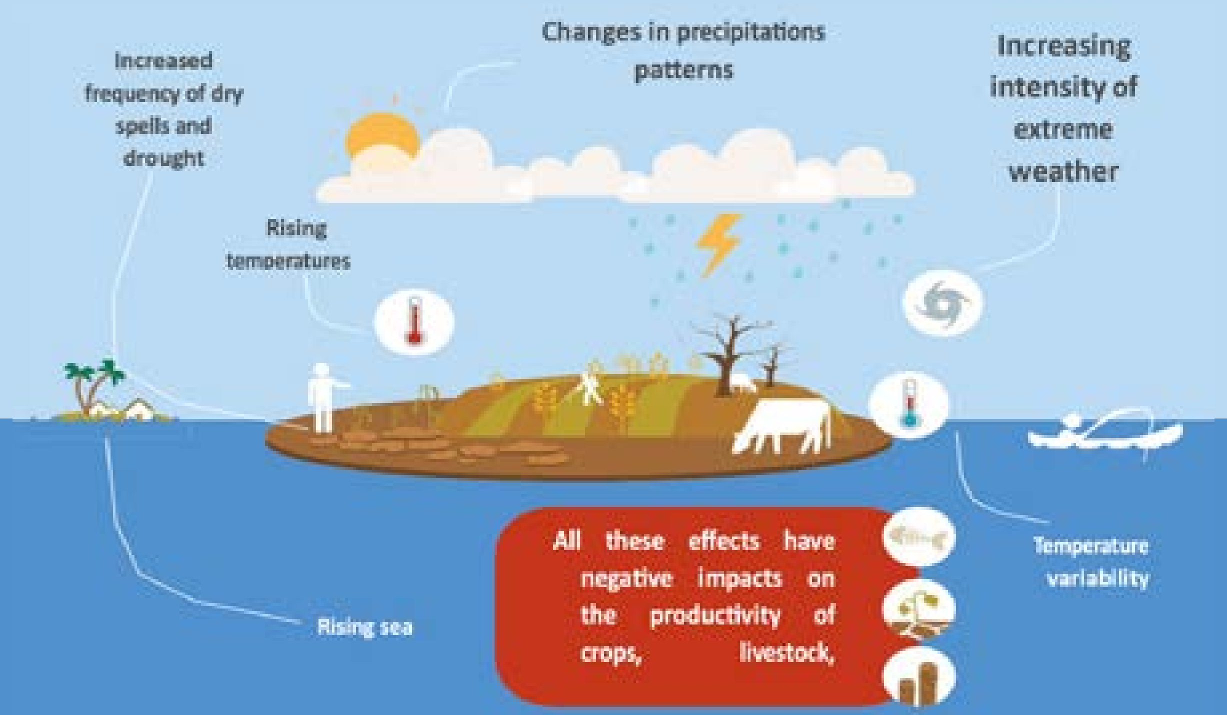
Bearing in mind that climate impacts are highly site-specific, some of the possible effects of climate change on agro-ecosystems reported by agricultural producers include:

- Increased variability and unpredictability of weather and climate events: for example, changes in seasonal rainfall variability, high rainfall variations such as longer dry periods, higher or lower temperatures, heatwaves etc.
- Changes in timing of seasons: for example, some areas are witnessing an earlier arrival of spring that affects the lives of migratory animals; but also planting periods and wet seasons start late or finish early
- Dry spells that affect crops at different points in the growing season
- Alteration in land suitability for agricultural production or grazing
- Increased intensity of extreme weather events such as sudden downpours and windstorms, droughts, floods, cyclones
- Increased pest and disease outbreaks

THE IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

The agricultural sectors – including crop, livestock, forestry, fisheries and aquaculture – are highly dependent on climate stability. Temperature increases lead to a number of consequences affecting the whole of ecosystems and human activities (Figure B1).

Figure B1. How climate change affects agriculture



Source: FAO, 2016c.

Higher temperatures not only melt ice that discharges water into the oceans, but warmer water expands: the resulting rising sea levels flood low-lying areas, especially at high tide and during storms. Islands, coastal cities and farmland close to the sea are particularly at risk. Moreover, as sea temperature gets warmer, many types of plants, corals and animals will be affected. Rainfall is becoming more variable and unpredictable. This may cause water shortages, shorter growth periods, and more frequent flooding and drought.

Crops: Changes in temperature and rain patterns, as well as the frequency and intensity of weather events, have significant consequences for crop production and will reduce yields of some staple crops such as wheat, rice and maize. In some regions, where cool temperatures are currently constraining crop growth, an increase in temperature and CO2 levels may increase plants growth and yields. However, in temperate and tropical regions, excessive temperatures and precipitation could harm crops and reduce yields, posing serious challenges for farmers to ensure productivity. As well, these challenges could increase the work load of women responsible for household food provision and for water and fuel collection. Increasing temperatures can damage the physical structure of soils, while increasing erosion and affecting soil fertility (FAO, 2013a).

It is estimated that in the medium to long term climate-related changes will lead to negative effects on yields, effects that are likely to accelerate. These effects will be more severe in lower than at higher latitudes. The situation is particularly harmful for developing countries, whereas developed countries show a larger share of potential positive effects driven by climate change. Depending on the scenario used, researchers estimate that with no adoption, maize yields could decrease by up to 45 percent, wheat by 50 percent, rice by 30 percent and soybeans by 60 percent, compared with simulations that do not include climate change (FAO, 2016b).

SESSION B2
CLIMATE CHANGE AND FOOD SECURITY

SESSION OVERVIEW

Ensuring food security for a growing global population is one of the greatest challenges of our time. After looking at the effects of climate change on ecosystems in previous sessions, this session focuses on the concept of food security and provides a definition of its four dimensions. Participants will also be exposed to a framework to understand how climate-related risks cause direct or indirect consequences to food security. Finally, the concept of vulnerability is introduced.

THE FOUR DIMENSIONS OF FOOD SECURITY

Food security is the result of an efficient food system including all the activities related to production, distribution and consumption of food that finally affect human nutrition and health. An efficient food system positively contributes to all the four dimensions of food security: availability, access, utilization and stability.

WHAT IS FOOD SECURITY?

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). This definition of food security implicitly identifies availability, access, utilization and stability as four essential pillars, while the nutritional dimension is integral to the concept of food security (Table B4).

Table B4. The four dimensions of food security

Pillar	Explanation	Example
The availability of food	The supply side of food security. Sufficient quantities of quality food must be present in a given area either supplied by domestic agricultural production or imported from abroad.	Food is available, and people can find it in markets or purchase it from producers and traders.
Economic and physical access to food	Whether the households or individuals have enough resources to access – through purchase, production, or other means – appropriate quantity of quality foods. Food access depends on several socio-economic factors including income and food prices.	A sharp increase in food prices may lead poor households, mainly net food buyers, to buy less food and/or low-quality food since their income availability has decreased. It is important to notice that men and women within the same household or community might have different access to markets and traders, which affects their access to available food.
Food utilization	How much food is eaten, and what and how people eat. General hygiene and sanitation, water quality, health care practices and food safety and quality are determinants of good food utilization by the body. Sufficient energy and nutrient intake by individuals are the result of good care and feeding practices, food preparation, diet diversity and intra-household distribution of food. Combined with good biological utilization of food consumed, this determines the nutritional status of individuals.	The Swat River has faced environmental degradation due to the multiple sources of pressure such as rapid population growth, industrialization and intensive agricultural development. Water quality is becoming dramatically degraded from upstream to downstream in many parts of the basin: this threatens animal, ecosystem and human health since this water source is intensively used for irrigation and domestic services.
The stability of food security	The stability of the other three pillars. People cannot be considered food secure until there is stability of availability, accessibility and proper food utilization conditions. This recognizes that people's food security situation may change. It emphasizes the importance of having to reduce the risk of adverse effects on the other three dimensions.	Adverse weather conditions can affect food security, such as various extreme weather events. Depending on the phase of the oscillation, weather conditions may include increases in rainfall and temperature, tropical cyclones, drought, and flood. Food stability can be also threatened by political instability (social unrest), or economic factors (unemployment, rising food prices) which affect people's food security and nutrition status.

MODULE C - CLIMATE-SMART AGRICULTURE

OVERVIEW

The previous two modules explored the causes and impacts of climate change. This module introduces the concept of climate-smart agriculture as an approach that aims to overcome challenges posed by climate change: to maintain or improve food security, to help farmers adapt to climate change, and to reduce the amount of greenhouse gases in the atmosphere.

This module looks especially at current agricultural practices and their effect on the environment and on climate change. It then introduces the concept of climate-smart agriculture before identifying practices that fulfil one, two or all three of its aims. However, climate-smart agriculture is comprehensive: it is not limited to a single set of practices but must be tailored to the context. It requires comprehensive capacity-development at various levels with the objectives of promoting behavioral change, enhancing the institutional and political setting, strengthening organizations and institutions and building the individual capacities of various stakeholders.

KEY QUESTIONS

- What is climate-smart agriculture?
- How does climate-smart agriculture contribute to adaptation, mitigation and food security?
- What makes climate-smart agriculture different from current agricultural practices?
- What is the role of gender in climate-smart agriculture?

OBJECTIVES

After completing this module, participants will be able to:

- Explain why it is important to implement sustainable agricultural practices for long-term food security
- Explain the long-term perspective of the climate-smart approach
- Explain the strategies through which farmers can strengthen resilience to climate change
- Describe the concepts of adaptation and mitigation
- List examples of adaptation and mitigation practices

DURATION

5 hours

SESSION C1 CLIMATE SMART AGRICULTURE DEFINITION AND CHARACTERISTICS

SESSION OVERVIEW

This session defines the concept of climate-smart agriculture and its main features. It further explains its three objectives: food security, adaptation and mitigation. In addition, this session gives participants the opportunity to look critically at common practices in their area and to evaluate their positive and negative effects.

DEFINITION AND CHARACTERISTICS

In 2010, FAO introduced the concept of climate-smart agriculture, often abbreviated to CSA, at The Hague Conference on Agriculture, Food Security and Climate Change. The concept integrates the three dimensions of sustainable development – economy, society and environment – by jointly addressing food security and climate challenges. It is an approach aimed at developing the technical, policy and investment conditions to achieve sustainable agricultural development for food security under climate change (FAO, 2013a). It is usually defined by its three main objectives:

1. Sustainably increasing agricultural productivity and incomes.
2. Adapting and building resilience to climate change.
3. Reducing and/or removing greenhouse gases emissions, where possible.

This does not mean that every agricultural practice should achieve all the three objectives. Rather, climate-smart agriculture seeks to re-orient agriculture by taking these objectives into consideration and informing farmers' decisions. It is an interdisciplinary approach that is not limited to a single set of practices. Its application is tailored to specific situations using information from many sources. It requires comprehensive capacity-development efforts at various levels to promote behavioral changes and to enhance institutional and political settings, while strengthening organizations and institutions and building the individual capacities of various stakeholders. Since it focuses on broader social and ecological outcomes it requires the participation of both farming communities and decision-makers and an understanding of the synergies and trade-offs. National priorities need to be set according to each country's social and economic characteristics, on-going development processes and natural resource availability.

Climate-smart agriculture is site-specific rather than a universal approach. What can be defined as 'climate-smart' in one location may not be smart in another context. Climate-smart agriculture therefore is strongly evidence-based with the aim to identify practices that are appropriate to the local context. This base is rooted in a process of building knowledge and dialogue on the technologies and practices that a specific country has prioritized in its agricultural planning. To be effective and sustainable, climate-smart interventions need to consider local social differences, particularly gender and economic inequalities, to ensure equal benefits for men, women, and marginalized groups and to avoid exacerbating existing discriminations. Finally, climate-smart agriculture evaluates which strategies can be adopted to ensure food security.

EXERCISE C1
CURRENT AGRICULTURE PRACTICES VS CLIMATE SMART AGRICULTURE

EXERCISE OVERVIEW

Both current agricultural practices and climate-smart agriculture are context-specific. What is practiced in Swat and Lower Dir may not be practiced in the other parts of Pakistan or outside the country. This exercise enables the participants to differentiate between current agriculture practices and climate smart agriculture in their own locality.

METHOD

Facilitator present the following table C1 to participants and encourage them to ask questions how and why and where the climate smart agriculture practices can be used.

Table C1. Comparing current agricultural practices and climate-smart agriculture

	Current agricultural practices	Climate-smart agriculture
Land	Expand agricultural area through deforestation and converting grassland to cropland.	Intensify use of existing areas rather than expanding to new areas. Expand the area cultivated by restoring degraded land rather than deforesting new areas.
Natural resources	Make the most use out of natural resources - the land, water, forests, and soils used in production - without paying much attention to their sustainability over the long term.	Restore, conserve and use natural resources sustainably.
Varieties and breeds	Rely on a few crops and/or few high-yielding varieties and breeds.	Use a mix of traditional and modern, locally adapted varieties and breeds to maintain output, increase yields and ensure their stability in the face of climate change
Inputs	Increase use of fertilizer, pesticides and herbicides.	Improve efficiency of agrochemical use. Control pests and weeds using integrated management approaches. Apply compost, manure and green manure. Rotate crops with legumes to fix nitrogen and reduce use of artificial fertilizers.
Energy use	Use farm machinery that usually relies on fossil fuels – such as tractors and diesel pumps	Use energy-efficient methods, such as solar power and biofuels.
Production and marketing	Specialize production and marketing to achieve greater efficiency.	Diversify production and marketing to add stability and reduce risk.

Source: Adapted from FAO, 2013a

EXERCISE C2
UNDERSTANDING SOME SUSTAINABLE AGRICULTURE PRACTICES

EXERCISE OVERVIEW

Understanding basic sustainable agricultural practices is prerequisite to plan and implement adaptation strategies in current farming system. Innovations that strengthen the resilience of smallholder farming systems to climate change include enhanced resource-use efficiency through sustainable intensification of production and the adoption of agro-ecological production systems. Agro-ecological principles are particularly relevant to climate change adaptation (Table C2).

This exercise enables the participants to understand sustainable agriculture practices and how to apply practically in the field.

METHOD

Facilitator present the following innovations to participants and encourage them to ask questions how and why and where these innovations/agriculture practices can be used.

Table C2. Description of some sustainable agricultural practices

Zero-tillage or no-tillage	Exposing the soil only where the seeds are placed, with minimal soil disturbance and retention of plant residues on surface.
Adoption of nitrogen-efficient crop varieties	Increases agricultural productivity and minimizes nitrogen losses from the soil. Example: varieties that use nitrogen more efficiently will produce global yield increase for rice.
Adoption of drought and heat-tolerant crop variety cultivation	Specifically designed to resist specific climate related challenges, like droughts, floods, saline or acidic soils, and pests. Example: adopting varieties resistant to heat and drought can produce global yield increase for maize.
Improved feed management	Storing fodder such as stover, legumes, grass and, grain and making better use of feed by combining types, growing grass varieties specifically suited to the agro-ecological zone.
Livestock manure management	The collection and storage of livestock manure for future application to producers' fields. It dries and composts during storage.
Water harvesting irrigation	Collects water from a surface area for irrigation or for improved filtration. These systems can be small or large, ranging from individual farms and plots to a much more considerable area. Structures can include open water ditches and water pans that must be managed well to avoid insects' proliferation, as well as closed tanks and cisterns.
Drip irrigation	A form of irrigation that allows water to drip slowly to the roots of many different plants thanks to a network of pipes, tubing and emitters. Narrow tubes deliver water directly to the base of the plant. It saves water and fertilizers.

Source: Adapted from World Bank, FAO and IFAD, 2015

SESSION C2
STRENGTHEN RESILIENCE TO CLIMATE CHANGE THROUGH ADAPTATION

SESSION OVERVIEW

This session explains the concept of strengthening resilience to climate change through different adaptation measures. Farmers apply practices according to the environment and local context. It explains how and when adaptation measures are applied. This session gives participants the opportunity to look critically at farm system exposure to climate change, risks and their response.

CLIMATE CHANGE IMPACT AND ADAPTATION

Agricultural producers and systems have always had to cope with variable weather conditions. The season may be hot or cool, or wet or dry, in general. But agricultural producers adapt, and usually they still produce enough food to eat and a surplus to sell. Sometimes, though, conditions are very unusual: it is much hotter, wetter or drier than normal. In such cases, crops may fail, and animals may die. In some places, the mean amount of rainfall is declining and the rains are becoming more erratic. In other places, rain arrives more frequently and with greater intensity than before.

With climate change, we can track that such shocks are getting more and more intense and unpredictable. Adapting to climate change means enabling agricultural producers to deal with such shocks. Adaptive capacity is the ability for farmers to adopt strategies that help them maximize their agricultural productivity even in the presence of adverse climate events. As presented in Module B, there are three variables that can be modified at local levels and within communities to reduce vulnerability of farm systems:

- Reduce the farm system's exposure. Planting healthy windbreaks and hedgerows and following no-tillage planting practices help soil to stay put and resist erosion. Storing feed off the ground helps keep it safe from floods and vermin

- Reduce the sensitivity of the farm systems to these shocks. Using drought-resistant varieties or keeping adequate stocks of hay can reduce sensitivity to drought. Water harvesting, storage and conservation apply management techniques to reduce runoff and balance supply against demand.

- Increasing adaptive capacity involves learning new skills and trying innovative solutions. This includes considering the modifications of a system and taking into account all the potential shocks and changes together as possible compensating, exacerbating and cumulative effects.

Agricultural producers need to build their own adaptive capacity to succeed in the face of increasing climate risk. Decades of sharing experiences and refining approaches have produced many innovative solutions and traditional practices as potential responses to adopt for context and site-specific circumstances (Table C3).

Table C3. Sample options for adaptation to climate change at farm level

Risk	Response
Changing climate conditions and climate variability and seasonality	↗ Optimize planting schedules such as sowing dates (including for feedstocks and forage). ↗ Plant different varieties, species or cultivars of crops. ↗ Use short duration cultivars. ↗ Varieties or breeds with different environmental advantages may be required, or those with broader environmental tolerances: use of currently neglected or rare crops and breeds should be considered. ↗ Early sowing can be enabled by improvements in sowing machinery or dry sowing techniques. ↗ Increased diversification of varieties or crops can hedge against risk of individual crop failure. ↗ Use intercropping. ↗ Make use of integrated systems involving livestock and/or aquaculture to improve resilience. ↗ Change post-harvest practices, for example the extent to which grain may require drying and how products are stored after harvest. ↗ Consider the effect of new weather patterns on the health and well-being of agricultural workers.
Change in rainfall and water availability	↗ Change irrigation practices. ↗ Adopt enhanced soil water conservation measures. ↗ Use marginal and waste water resources. ↗ Make more use of rainwater harvesting and capture. ↗ In some areas, increased precipitation may allow irrigated or rain-fed agriculture in places where previously it was not possible. ↗ Alter agronomic practices. ↗ Reduce tillage to reduce water loss. ↗ Incorporate manures and compost, and other practices such as cover cropping to increase soil organic matter and hence improve water retention.
Increased frequencies of droughts, storms, floods, wildfire events, sea level rise	↗ General water conservation measures are particularly valuable at times of drought. ↗ Use flood, drought and/or saline resistant varieties. ↗ Improve drainage, improve soil organic matter content and farm design to avoid soil loss and gullying. ↗ Consider (where possible) increasing insurance cover against extreme events.
Pest, weed and diseases, disruption of pollinator ecosystem services	↗ Use expertise in coping with existing pests and diseases. ↗ Build on natural regulation and strengthen ecosystem services.

Source: FAO, 2016a

WHAT IS RESILIENCE?

Resilience can be defined as "the capacity of systems, communities, households or individuals to prevent, mitigate or cope with risk, and recover from shocks" (FAO, 2016a). It adds a time dimension to the concept of vulnerability: a system is resilient when it is less vulnerable to shocks across time and can recover from them in a timely manner. Resilience is achieved through exposure and sensitivity reduction and increased adaptive capacity. These can be undertaken across biophysical, economic or social domains. An example would be the transport of feed in case of drought or safety nets to compensate for bad harvests. Resilience puts great emphasis on the capacity of a system to recover and transform itself in the long term. In order to adapt to the changing environment, the system itself needs to take action at multiple scales, in various dimensions: ecological, technical, economic and social as well as involving various categories of actors and enabling governance environments. Additionally, different time frames need to be integrated for specific actions to produce positive effects.

REDUCE GREENHOUSE GAS EMISSIONS THROUGH MITIGATION

The IPCC defines mitigation as "an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases" (IPCC, 2001). It is human action to permanently remove or reduce greenhouse gas emissions and the long-term risks they pose to ecosystems and human life.

The two main ways to achieve climate change mitigation benefits are:

- ↗ Reduce and avoid emitting greenhouse gases into the atmosphere
- ↗ Enhancing carbon storage through sequestration by increasing the woody vegetation that absorbs carbon dioxide from the atmosphere, for instance, planting trees or by storing carbon-rich organic matter in soils.

In agriculture, most GHG emissions are driven by the use of natural resources: conversion of forests into farm land, use of agricultural inputs, energy consumption and other activities. A key aspect of climate-smart agricultural practices, therefore, is about increasing efficiency of the food systems. Producing more outputs using less inputs is key in reducing the emissions in agriculture. Many farming techniques exist to reduce emissions, enhance carbon storage, and also increase resource efficiency in food production.

The "Changing Minds for Climate Resilience through Awareness Raising and Local Capacity Measures" is a transformative initiative spanning selected districts of Khyber Pakhtunkhwa and South Punjab. Focused on empowering vulnerable communities—particularly women, people with disabilities, youth, and children—the project seeks to enhance climate awareness, build adaptive capacities, and equip farmers with sustainable practices.Through knowledge dissemination and community engagement, we aim to forge a resilient front against climate change, fostering a united commitment for a sustainable future.

LASOONA
Relief and Development Organization

+92 946 9240071 info@lasoona.org www.lasoona.org

College Colony, Saidu Sharif, District Swat, Khyber Pakhtunkhwa, Pakistan