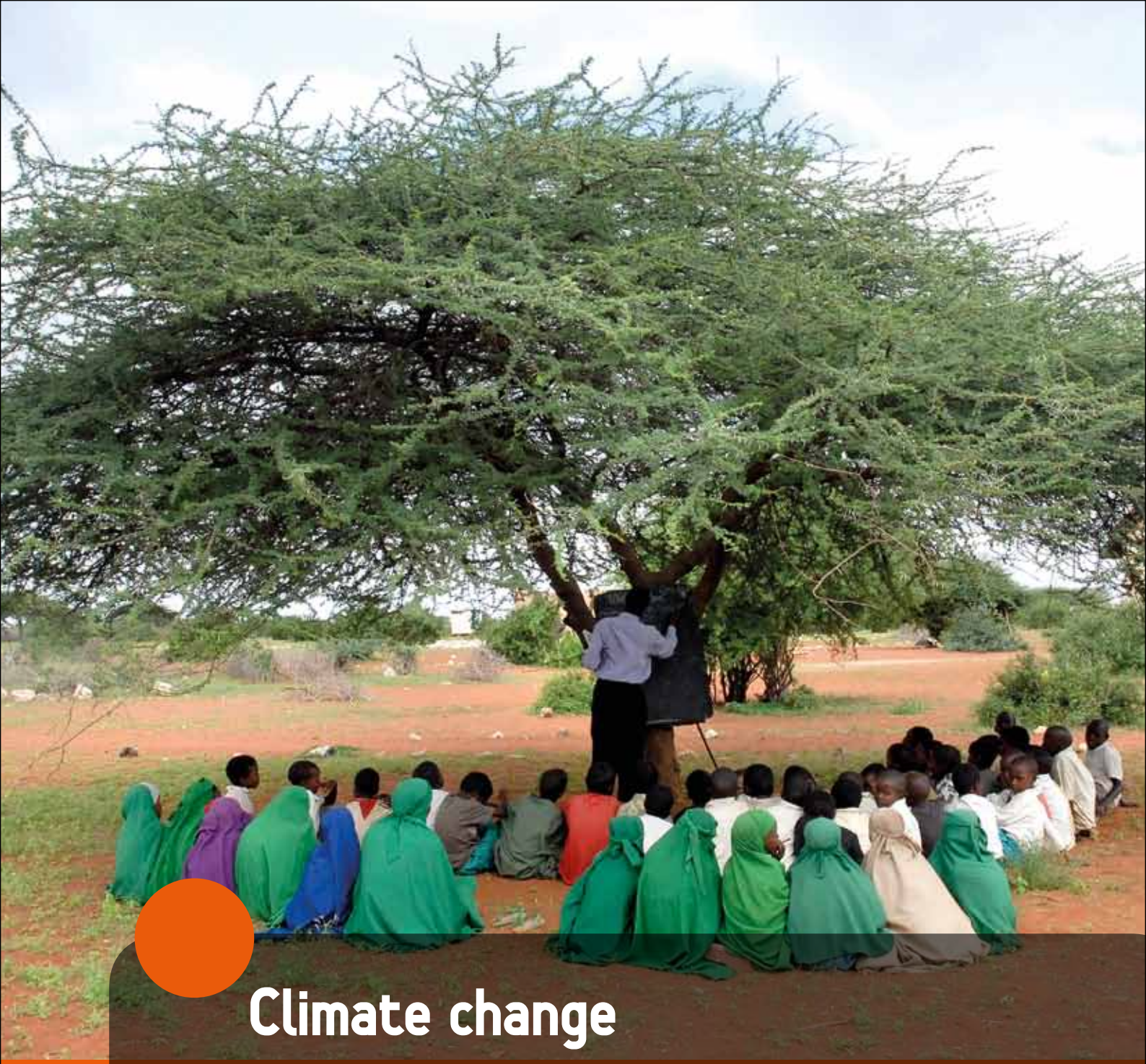

Climate change

Junior Farmer Field and Life School – Facilitator's guide

YOUTH & UNITED NATIONS GLOBAL ALLIANCE YUNGA

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Module: Climate change

Junior Farmer Field and Life School – Facilitator's guide

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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TABLE OF CONTENTS

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Module: Climate change

INTRODUCTION FOR THE FACILITATORS

Scientific evidence shows that our planet is getting warmer. As a result of the increase in the Earth's average temperature, glaciers are melting, sea levels are rising, weather patterns are changing and extreme weather events, such as droughts, floods and storms are increasing. Global warming is occurring due to the significant increase in emissions of greenhouse gases (carbon dioxide, nitrous oxide and methane) into the atmosphere, which trap heat that would otherwise escape from the Earth.

In the coming years, food production needs to increase by 60 percent in order to be able to feed the growing world population, while at the same time coping with changing weather conditions. Climate change may affect the agricultural sector in different ways depending on the geographical location, such as increasing or reducing crop yields, increasing or reducing availability of water resources and increasing the spread of pests and diseases.

Many people, in particular those who are dependent on agriculture for their incomes and livelihoods, will be heavily affected. Raising awareness about these climatic changes and increasing and exchanging knowledge on methods and practices, in particular climate-smart agricultural practices, such as mulching, intercropping and integrated farming systems, that may help to increase yields, reduce production losses, remove and/or reduce greenhouse gas emissions and contribute to building sustainable and resilient livelihoods is therefore very important.

AIM OF THIS JFFLS MODULE

The aim of this module is to provide Junior Farmer Field and Life Schools (JFFLS) facilitators with information to enable them to discuss the topic of climate change, in particular its impact on agriculture and actions that farmers can undertake to reduce their vulnerability to climate change.

Through a series of exercises, story-telling and discussions, climate change issues in relation to agriculture are highlighted. The module also helps the participants of the JFFLS to learn about agriculture's role in climate change, the impacts of climate change on agriculture, and ways to reduce these impacts by applying relevant actions, methods and practices such as climate smart agriculture practices.

The exercises can be undertaken at different points in the JFFLS cycle and/or this module can be used as a stand-alone topic.

Exercises

exercise 1

SHORT STORY OF A FARMER

OBJECTIVE:

To start a discussion on climate change among the JFFLS participants. The story provides an illustration of people's observations regarding climatic changes.

TIME:

45 minutes

MATERIALS:

None

STEPS:

1. Tell the JFFLS participants that you are going to read a short story. Ask them to listen carefully to the following story:

   Emile Jean is 54 years old and lives in a small village in the south of Madagascar. Emile is a farmer and cattle breeder, just like his father and his grandfather. He owns a few cattle, but mainly plants maize and vegetables. Half of what he produces is sold, while the other half is grown to feed his family. Emile and his wife have eleven kids - six boys and five girls.

   During the past years there have been noticeable changes in the rainfall patterns. Five years ago, the annual rainfall fluctuated between 800 to 900 mm, while nowadays it rarely reaches 500 mm. Storms have become less frequent but more intense. The temperature has also been increasing every year. And there is a longer dry period (seven to eight months) and a shorter rainy season (two months), which make it harder for farmers to plant crops all year round.

   Emile says: 'When my father was young, they had a 'bad year' every seven years, but now it's every two years'. A bad year is a year when the dry season is longer than normal. It did not regularly happen 20 or 30 years ago, but now bad years are becoming more frequent and the former bad years are now becoming the normal years (Oxfam International, 2010).

   This story can be adapted to suit the local conditions and the following steps can be used to guide the discussion:

2. Discuss with the participants whether they have observed similar climatic changes in their country in the past years (see facilitators' notes 1).

3. Ask the participants whether they know the difference between 'climate' and 'weather' (see facilitators' notes 2) or whether they have heard about 'greenhouse gases', the 'greenhouse effect' or 'global warming' (see facilitators' notes 3).

4. Ask the participants how these climatic changes are affecting agricultural activities related to crop production, livestock, forestry and fisheries (see facilitators' notes 4 and 5).

5. Summarize the main points discussed by the participants.

facilitators' notes 1

For generations, farmers and their communities have changed and adapted their practices on the basis of changes in temperature, rainfall and dealing with extreme weather events like drought, floods and storms. This is not something new. However, it is foreseen that in the future these extreme events will be more intense and will happen more frequently. For example, in Malawi it is said that 'bad years' (a year when the dry season is longer than normal), which in the past only happened every 5 years, are now believed to be more frequent. Dry spells and strong winds are destroying crops, and people, in particular the poor and marginalized, will be heavily affected by the effects of climate change. They will have to deal with the unpredictable weather, which will impact their food security and livelihoods as they are often heavily dependent on agriculture.

SCIENCE VS. RELIGION

In some countries, in Ethiopia for example, people believe that changes in the climate happen because of God and that He determines when (or if) it rains. In exchange for God's protection during difficult times they sacrifice a zebu and promise to protect nature and the forest. However, nowadays there is less and less rainfall and the village elders look for signs of rain and make many sacrifices in order to keep God happy, although the rain is not coming.

In the past, farmers were able to use their traditional or indigenous knowledge that has been carried over from one generation to the next. However, with climate change becoming more apparent, farmers are less able to rely on their knowledge and practices to adapt to climatic changes. For example, in the past the rainy season 'normally' started in June, whereas this year it may start in August and next year it may start in May. Communities with rain gauges and knowledge of how to read and interpret them are able to collect rainfall data and have more accurate data to make more accurate predictions regarding future rainfall patterns. This can help them, especially if they have access to up-to-date seasonal weather forests (three monthly, monthly and 10 days) so that they can decide what, when and which crop to plant and are therefore better able to better adapt to climate change.

facilitators' notes 2

DIFFERENCE BETWEEN WEATHER AND CLIMATE

The difference between 'weather' and 'climate' can be distinguished as a measure of time:

- **Weather** refers to what we experience over a period of hours or days in terms of temperature, precipitation, wind and so on.
- **Climate** focuses on the average conditions of the atmosphere over relatively long periods of time. It also indicates climate variability, for example the seasonal minimum and maximum temperatures and the frequency of extreme events, such as hurricanes, cyclones. Therefore, climate is the average weather for a particular region over a particular period of time. It is usually calculated for periods of at least 30 years, for example Indonesia's rainfall data for the period of 1981-2010.

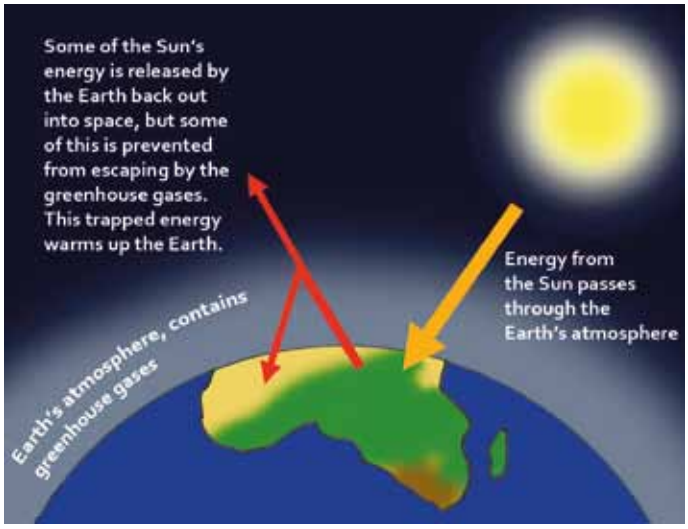
facilitators' notes 3

GREENHOUSE EFFECT AND GLOBAL WARMING

The Earth's climate has changed over time. Since its formation about 4.5 billion years ago, there have been both warmer and colder periods, for example, during the glacial periods (Ice Ages) most of the planet was covered in ice. According to data from the last 650 000 years, temperatures and carbon dioxide levels in the atmosphere have fluctuated.

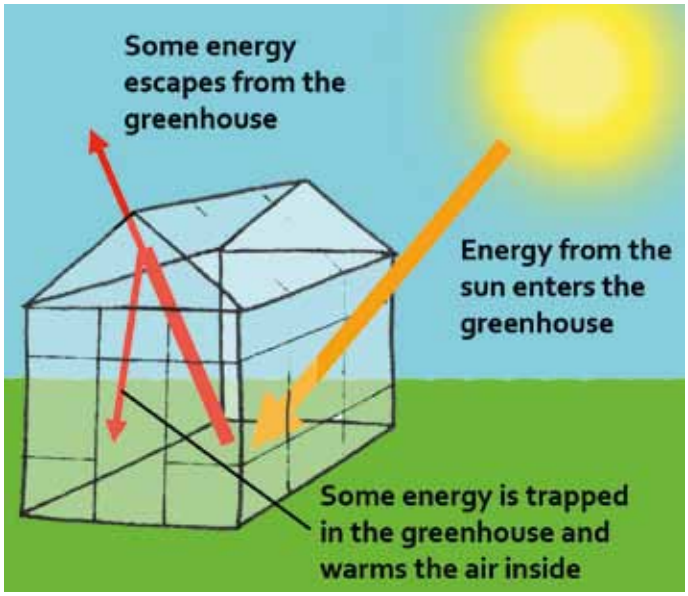
Carbon dioxide is a 'greenhouse gas', which exists naturally in the atmosphere. Greenhouses gases, like carbon dioxide (CO2), trap heat in the atmosphere so that the Earth is warm enough for humans, animals and plants to live. This process is called the 'greenhouse effect' and works as follows:

The sun provides energy, which the Earth receives in the form of sunlight. Some of this energy is absorbed by the Earth's surface and causes it to warm up, whilst some of it is reflected back into space as infrared radiation, which helps the Earth to cool down. However, greenhouse gases form a layer that prevent part of this radiation from being released back into space and instead the heat is trapped in the atmosphere and warms the Earth's surface as a result.



Source: Sarah Bisbing, 2012 http://earlycareerecologists.files.wordpress.com/2012/11/greenhouse_effect2.jpg (Adapted)

The greenhouse effect can be depicted as the warming of a glass greenhouse via the Sun's energy, where some of the energy in the form of heat is trapped due to the glass walls, which represent greenhouse gases like carbon dioxide.



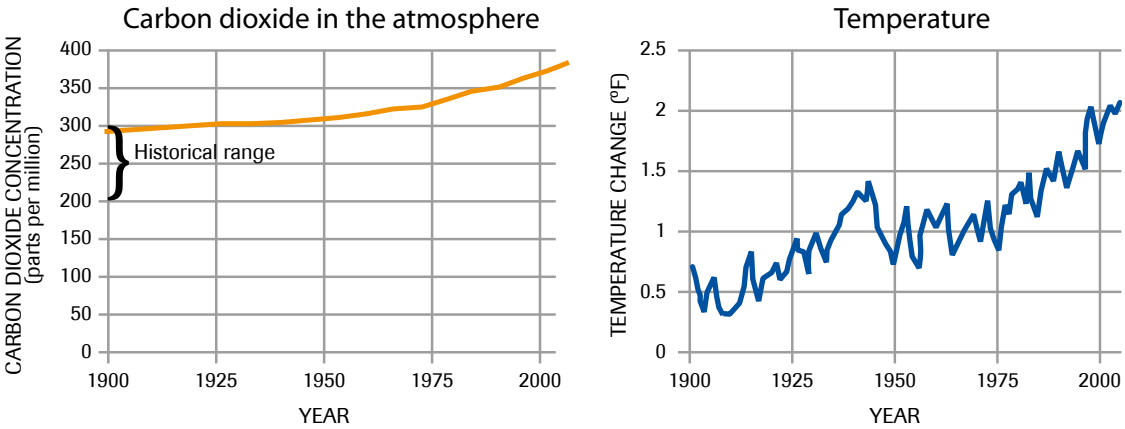
Source: Sarah Bisbing, 2012 http://earlycareerecologists.files.wordpress.com/2012/11/greenhouse_effect1.jpg (Adapted)

Carbon dioxide levels have varied at different times in the Earth's history. However, scientists believe that the average temperature of the Earth has been increasing, especially since the late 19th century. This is called 'global warming'.

For over 100 years now, humans have significantly added greenhouse gases to the atmosphere by burning large amounts of fossil fuels, such as coal, oil and natural gas to power factories, vehicles and their homes. Burning fossil fuels releases carbon dioxide into the atmosphere. The

upper graph below shows that since 1900, the concentration of carbon dioxide in the atmosphere has significantly increased to nearly 400 parts per million, compared to the historical range of between 200 and 300 parts per million. As a result of increased carbon dioxide, heat is trapped in the atmosphere and the Earth's surface warms up. This is further adding to the 'greenhouse effect'.

RECENT CHANGES



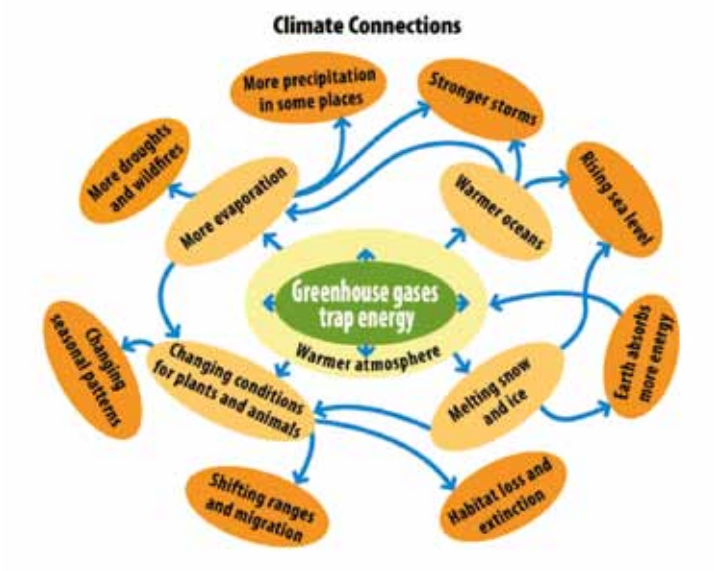
Source: EPA's Climate Change Indicators, 2010 and Petit et al., 2001

Besides carbon dioxide, other greenhouse gases are also released into the atmosphere, such as methane (CH_4) and nitrous oxide (N_2O). Current agricultural practices both directly and indirectly release these greenhouse gases into the atmosphere. For example, methane is released from cows, humans, rice farms and waste water; whereas nitrous oxide is part of fertilizers and pesticides used for crop cultivation. Deforestation, which can occur to make way for agriculture, is also one of the contributors to global warming as it reduces the number of trees that would normally absorb CO_2 from the air, thus reducing the concentration of CO_2 in the atmosphere. As well as being one of the major sectors that contributes to global warming and the changing of the climate, agriculture is also strongly affected by it.

facilitators' notes 4

EFFECTS OF CLIMATE CHANGE

The figure below shows the many interactions and feedbacks between the different effects of climate change, such as the changing conditions for plants and animals, the increase in evaporation[1], warmer oceans and the melting of snow and ice.



Source: EPA, 2006

facilitators' notes 5

IMPACTS OF CLIMATE CHANGE ON AGRICULTURE

There are still many uncertainties with regards to climate change. However, small changes in the Earth's average temperature can result in large shifts in climate and weather. Therefore, agriculture, as a sector that is highly climate sensitive, is extremely vulnerable. For many people in developing countries, agriculture is critical for their food and livelihood security.

Although the impact of climate change on agriculture will differ among continents, regions and between and within countries, some examples of expected impacts of climate change on crop production, livestock, forestry and fisheries are outlined in the following paragraphs.

Impact of climate change on crop production:

- Increases in temperature can make some crops grow faster as warmer temperatures increase growth. However, for other crops, faster growth reduces the amount of time that seeds grow and mature, which can reduce yields;
- Increase in weeds, pests and fungi, which thrive under warming temperatures;
- Increase in extreme weather events, such as floods and drought can affect crops and reduce yields;
- Higher CO_2 levels may increase yields of some crops, although if these crops do not have adequate levels of water and nutrients, yields may be reduced.

Impact of climate change on livestock:

1 Evaporation is the change of water from liquid to gas.

- Higher temperatures and heat waves can cause distress to animals, which can increase their vulnerability to diseases, reduce their fertility and milk production;
- Climate change may increase the spread of livestock diseases and parasites;
- Higher CO_2 levels may increase the yield of some grass species on which livestock feed, although according to research the quality of some of the forage may decrease;
- Water scarcity and drought may reduce the availability of drinking water and forage for livestock, thereby affecting livestock production (FAO, 2009; IFAD, 2009).

Impact of climate change on forestry:

- Climate change can affect the growth and productivity of forests. If trees have enough water and nutrients, higher CO_2 levels may help trees to be more productive. Higher temperatures may increase the length of the growing season, but may shift certain tree species to different geographical locations;
- The expected increase in the frequency and intensity of extreme weather events such as, drought, wild fires, flooding, hurricanes and wind storms can cause damage to forests, which can reduce forest productivity. Drought can make trees more vulnerable to insect outbreaks and wild fires of which the latter can also contribute to climate change, because CO_2 is quickly released into the atmosphere;
- Insect outbreaks may increase because higher temperatures may enable some insect species to develop faster. These outbreaks can weaken and kill trees, which results in CO2 that was stored in these trees being released into the atmosphere, further contributing to global warming.

Impact of climate change on fisheries and aquaculture:

- Rising sea levels, due to melting glaciers, ice sheets and as a result of thermal expansion[2], will affect fishing communities, in particular those that are living in low-lying countries, deltas and coastal areas. These areas will become more susceptible to, among others, flooding;
- Climate change may change marine and freshwater species as some species can only live in a certain water temperature range and as water temperature increases some may not be able to survive;
- Some fish diseases may become more prevalent in warmer water;
- Temperature increase may increase the salinity (saltiness) of ocean water and inland water supplies;
- Changes in temperature and seasons may impact the timing of reproduction and migration;
- Extreme weather events, such as hurricanes, changes in monsoonal rainfall patterns, droughts, or flooding are currently affecting fisheries, aquaculture[3] production and infrastructure, and the human lives and livelihoods that depend on them. Extreme drought, as a consequence of climate change, is impacting inland water fish stocks and habitats in particular.

[2] The expansion of ocean water as it warms up.
[3] Aquaculture refers to the cultivation of various fish species in fish farms or ponds.

exercise 2

THE TIMELINE

OBJECTIVE:

This exercise helps the JFFLS participants to get an insight into past disasters and changes that have taken place in natural resources (e.g. deforestation) as well as human measures taken to reduce their vulnerability to these disasters and future human, livestock, economic and social losses.

TIME:

45 minutes

PREPARATION:

- Invite an elder community member to act as a resource person to help participants remember which disasters have happened in the few past years, when they have happened, and what kind of measures farmers and the community members undertook to reduce the impact of the disaster;
- Draw a line on a flip chart and place it in a way so that all participants can see this line (see facilitators' notes 1).

MATERIALS:

- Flip charts
- Pens

STEPS:

1. Show the participants the line that you have drawn on the flip chart and ask them whether they know what a time line is and what and how data can be recorded and shown on this line (see facilitators' notes 1).

2. Ask a volunteer to come up and help record the data on the time line.

3. Ask the participants if they can remember which disasters have taken place that affected their crops, livestock, forestry or fisheries. Also ask them whether they remember in which year these events happened. Ask them what actions their parents and/or other community members took after the disaster had happened (see facilitators' notes 2).

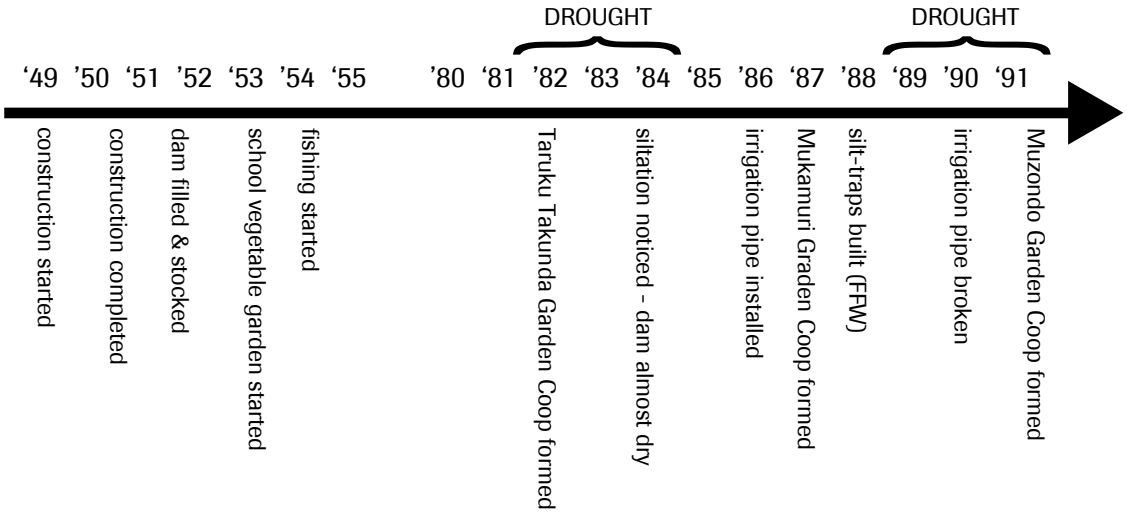
4. Introduce the resource person and explain that the participants can ask him/her additional questions about past events that he/she remembers to help fill in the time line.

5. Once the events and the actions remembered by the participants and the resource person have been recorded on the time line, analyze the timeline with the participants by asking questions, such as: i) were similar actions undertaken for the same disaster or did the actions change over time; ii) can we still apply these actions and will they be effective or should we undertake other actions and if so which ones?

facilitators' notes 1

WHAT IS A TIME LINE?

A time line is a very simple tool that visually shows the history of disasters and significant events related to changes in natural resources that have happened in a community. This exercise helps participants observe changes related to their surroundings and describe what has changed, how it has changed and the time period over which it changed and the different actions or coping measures the community has undertaken (Abarquez and Mushed, 2007).



Source: FAO, 1996

facilitators' notes 2

DEFINITION OF 'DISASTER'

A disaster is any event or situation that results in losses and damage to people, their property and their environment, that they and their community are not able to recover from by using their own resources (UNISDR, 2009).

Examples of disasters that can result in large losses and damage to food and agriculture include floods, hurricanes, tsunamis, earthquakes, landslides, drought, wild fires, and transboundary animal and plant pests and diseases.

exercise 3

SEASONAL HAZARD AND CROP CALENDAR

OBJECTIVE:

This exercise helps the JFFLS participants to think about which natural hazards occur during the year and when they occur, as well as if and when they affect specific cultivation activities of certain crops. This exercise can be done in combination with the cropping calendar exercise.

TIME:

45 minutes

MATERIALS:

- Flip charts
- Coloured pens
- The flip charts of the cropping calendars made by the participants during the cropping calendar exercise

PREPARATION:

Draw a hazard calendar on a flip chart. This will serve as an example of how to draw a hazard calendar, as shown below:

TYPE OF HAZARDS	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC

STEPS:

1. Inform the participants that this activity will use the cropping calendar that was done previously.

2. Ask the participants to divide into small groups (preferably the same groups in which they made the cropping calendars). Give them back their cropping calendars.

3. Ask each group to copy the hazard calendar onto a flip chart, which was prepared in advance.

4. Ask the participants which natural hazards affect the area (see facilitators' notes 1).

5. Tell the groups to write the different types of hazards in the first column on the left: one hazard per row.

6. Ask the groups to answer this question: during which months do the hazards occur? Encourage the participants to discuss among themselves.

7. Once they have agreed, they can tick the columns associated with the months where the hazard usually takes place, as shown in the following example:

TYPE OF HAZARDS	JAN	FEB	MAR	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC
FLOODS							X	X				
PESTS										X		
DROUGHT			X	X								
FIRES				X								

8. Ask the groups to compare the hazard calendar with the cropping calendar and answer the following questions:

   - Do hazards occur during cropping periods?
   - Do hazards coincide with peak working seasons?
   - Do hazards threaten peak production periods or the harvest?

Encourage the participants to discuss among themselves.

9. Ask each group to select a person to present their results to the whole group. The selected person presents the hazard and cropping calendars and what the group has discussed when trying to answer the questions asked by the facilitator during the previous step.

10. Allow time for questions. You can ask additional questions, such as: which crops are the most threatened by which hazards?

facilitators' notes 1

DEFINITION OF A 'HAZARD'

A hazard is a dangerous event, situation or condition that may lead to losses and damage to people, their property and their environment (UNISDR, 2009).

A hazard may not necessarily develop into a disaster if people and their community have sufficient resources to recover from the losses and damage caused by the hazard. Examples of hazards that may cause significant losses and damage to food and agriculture include floods, hurricanes, tsunamis, earthquakes, landslides, drought, wild fires, and transboundary animal and plant pests and diseases.

facilitators' notes 2

WHAT IS A SEASONAL HAZARD AND CROPPING CALENDAR?

- Hazard calendars indicate seasons during which hazards usually occur;
- Cropping calendars indicate the growing and harvesting seasons of typical crops for a particular area.

When combining both calendars it visually shows which hazards occur, during which months of the year and whether these hazards have an impact on specific cultivation activities of certain crops. An example of a seasonal hazard and cropping calendar in Juye, Shandong province, China is illustrated below.

Cropping calendar Juye, Shandong, P.R. China

KEY CROPS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Cotton												
Wheat												
Corn												
Soybean												
Rice												

Seasonal calendar of natural hazards Juye, Shandong, P.R. China

HAZARDS RISKS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Flood												
Drought												
Hot wind												
Hailstorm												
Strong wind												

Source: FAO, 2008

This example of a seasonal hazard and cropping calendar shows that during the cultivation of cotton, corn, soybean and rice, the plants and crops are exposed to flooding, hail storms and strong winds as hazard risks. The hazards might especially affect the harvest of the corn and soybean crops. With this information, farmers can make informed decisions and identify actions or measures to reduce the impact of this hazard on their farming activities.

exercise 4

SMALL GROUP DISCUSSION ON ACTIONS TO PREVENT AND REDUCE THE IMPACT OF CLIMATE CHANGE ON AGRICULTURE

OBJECTIVE:

To discuss different options, methods and practices that farmers can apply in order to reduce the impacts of climate change on agriculture.

TIME:

45 minutes

MATERIALS:

- Flip charts
- Coloured pens

STEPS:

1. Divide the participants into small groups of five to six people and provide each group with a flip chart.

2. Ask each group to draw a table with two columns, as shown below:

Hazard	Actions to prevent and reduce losses and damage caused by a hazard
e.g. Drought	
Floods	
Storms	

3. Ask the participants to discuss in their small groups what actions, methods or practices can be implemented to reduce the losses and damage done by the different hazards that were identified in the seasonal hazard and cropping calendar exercise.

   Questions that can be asked to the participants to help them with this exercise:

   - When there is water scarcity during the dry season, what do or can farmers do to prevent

and reduce the impact of drought? Are there specific measures or actions that farmers do during the wet season?
- When there are heavy storms, how do farmers protect their crops or livestock?
- How do farmers plan the cultivation of crops when they know that floods, storms or droughts will occur during planting or harvesting?
- Do farmers use different crop varieties that reduce losses and damage due to floods or drought?
- What do farmers do to prevent and reduce losses and damage due to pests and insects?

4. Ask each group to present their findings and discuss the final outcomes of the different groups.

5. The facilitator provides comments and adds suggestions to the findings that the participants mentioned (see facilitators' notes 1).

facilitators' notes 1

PRACTICES TO PREVENT AND REDUCE THE IMPACT OF CLIMATE CHANGE ON AGRICULTURE

- **Flexible planning**
  Agriculture is heavily dependent on the weather and climate. Even though there is still a considerable amount of uncertainty about the exact implications of climate change on this sector and on natural ecosystems, the ability of farmers to adapt will be very important so that they can better respond to future changes in climate. Crop cultivation should be flexibly planned, so as to accommodate these climatic changes.

- **Early or late planting and or harvesting**
  Farmers could adapt to climate variability by using early or late planting and or harvesting, depending on the seasonal conditions and climatic changes.

- **Select crop varieties that are more drought or flood-resistant**
  Depending on the specific context and location, crop varieties that are more drought or flood-resistant could be used by farmers.

- **Integration of trees, agricultural crops and/or livestock**
  Combining trees with crops and livestock has various benefits, among others, trees enhance soil fertility and this increases agricultural productivity by reducing the need to use fertilizers. Multi-purpose trees can be used that help to provide food in the form of fruit, nuts or leaves, or to provide firewood. Alley cropping can also be practiced, which involves growing a long-term tree crop along with agricultural crops. Tree species like walnut, oak, ash and pecan are among the species used in alley cropping systems. Trees also act as natural buffers that protect crops from strong winds, floods, storms or pests and store carbon dioxide. Certain forage species can serve as feed for the animals and their manure can be used as fertilizer to improve soil health. This practice can contribute to increases in productivity, resilience and reductions in CO2 emissions.

- **Diversification of crops and livestock**
  Cultivating different types of crops instead of mono-cropping or rearing fish and animals, such as pigs and chickens, helps to: diversify farmers' products; reduce the risk of total production losses; and contribute to their food security and livelihoods by possibly generating additional income.

- **Reduce loss of water through irrigation, mulching, and minimum tillage to reduce wilting of seedlings**
  In case of drought or severe dry spells, water loss can be reduced through irrigation measures, as well as through the use of mulching and minimum tillage, in order to reduce the chance of the seedlings wilting. Improved water harvesting and retention practices, such as pools, dams, pits, retaining ridges and water-use efficiency mechanisms like irrigation systems, are fundamental for increasing production and addressing irregular rainfall patterns. Irrigation is currently practiced on 20 percent of the agricultural land in developing countries, but it is estimated that it can generate 130 percent more yields than rain-fed systems (FAO, 2010).
  Mulching involves adding an additional layer of material over the soil, such as leaves, grass clippings, peat moss, wood chips, bark chips, straw, hay or plastic sheeting to cover the soil, which helps to keep the soil moist and fertile, protects it from the sun, rain and wind and reduces weed growth. It also conserves and enhances biodiversity as well as reducing greenhouse gas emissions because the extra plant coverage over the soil helps to absorb CO_2 and means that less nitrogen fertilizer is needed.
  Minimum tillage focuses on reducing tillage so that there is minimal disturbance of the soil, which helps to reduce soil erosion and keeps the soil fertile by retaining nutrients.

- **Targeted fertilization and applying fertilizer in smaller quantities and more frequently**
  Targeted fertilization helps to ensure balanced fertilization, which focuses on finding a balance between the nutrients externally added to the soil and those nutrients that are already available in the soil. Moreover, adding fertilizer in a targeted way instead of using the broadcast method will also help to increase the efficiency and effectiveness of the applied fertilizer. If there is a high variability in rainfall during the cultivation period, applying fertilizer in smaller quantities and more frequently during the cultivation period will help to reduce the washing away of fertilizer as a result of heavy rainfall.

- **Reduce vulnerability to flooding through e.g. growing crops on raised beds, using drainage systems, building embankments, floating vegetable bed cultivation**
  In areas where short periods of intense rain occur followed by short periods of hardly any rain, a practice that can be used is to grow crops on raised beds. This practice helps to reduce water logging and flooding; it uses water more efficiently so as to reduce the risk of crop failure. If longer periods of rainfall occur, adequate drainage systems, such as trenches, can be used. By using the slope of the land or gravity, these trenches help to remove excess water away from crops and livestock. Embankments can also be built to protect rice farms from floods.
  In fields that are flooded for certain periods of time, vegetables can be grown on floating beds. Floating gardens[4] are established by growing crops such as water hyacinth and/or use paddy straw and other material like coconut straw, bamboo and rope, which will help to make a platform or raft on which vegetables are grown.

Some of these practices, such as mulching, intercropping using multi-purpose trees and integrated farming management are **climate-smart agriculture** (CSA) practices[5], which aim to increase yields and income, contribute to making agriculture more resilient to climate change and reduce or remove where possible greenhouse gas emissions. CSA also includes practices, such as improved weather forecasting, use of drought-resistant and flood-tolerant crops and risk insurance.

[4] For more information about how to establish a floating garden, refer to the following link: http://www.fao.org/climatechange/17849-0e277b46b31f98942e6bc81bb22319243.pdf.
[5] See for more information http://www.fao.org/climatechange/climatesmart/en/, http://www.climatesmartagriculture.org/en/

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