United Nations Development Programme in Azerbaijan

Educational Programme

on climate change and conservation of agro-biodiversity for decision-makers and population

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November 2013

Educational Programme: on climate change and conservation of agro biodiversity
for decision-makers and population

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Cover photo: Pasturies in Ismayilli region of Azerbaijan. © Serdar Hajiyev / GIZ

List of abbreviations

AOGCMs	Atmosphere-Ocean General Circulation Models
CBA	Cost Benefit Analysis
CC	Climate Change
CCA	Climate Change Adaptation
CDM	Clean Development Mechanism
CEA	Cost Effectiveness Analysis
CoP	Conference of Parties
IPCC	International Panel on Climate Change
GCF	Green Climate Fund
GCM	Global Climate Models
EU	European Union
ECCP	European Climate Change Programme
ENP	European Neighbourhood Policy
NAPA	National Adaptation Plans for Action
NIF	Neighbourhood Investment Facility
MCA	Multi-Criteria Analysis
M&E	Monitoring and Evaluation
OECD	Organization for Economic Cooperation and Development
OSCE	Organization of Security and Cooperation of Europe
PCA	Partnership and Cooperation Agreement
PRA	Participatory Rural Appraisal
PRECIS	Providing Regional Climates for Impacts Studies
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNFCCC	United Nation Framework Convention on Climate Change
WMO	World Meteorological Organization

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Background

"Identification and implementation of adaptation response to Climate Change impact for Conservation and Sustainable use of agro-biodiversity in arid and semi-arid ecosystems of South Caucasus" project is regional project implemented in three South Caucasus countries by The Regional Environmental Centre for the Caucasus.

The overall objective of the project is to build adaptive capacities in three South Caucasus countries to ensure resilience of agro-biodiversity of especially vulnerable arid and semi-arid ecosystems and local livelihoods to climate change. There are also three other specific objectives envisaged within the project:

- To promote agro-biodiversity conservation and adaptation to Climate change through introduction of supportive policy framework at national and local level
- To improve institutional and individual capacity for sustaining agro-biodiversity in arid and semi-arid ecosystems and increasing livelihood level in face of climate change
- Support in development and implementation of coping mechanisms to improve resilience of local communities to future climate change through introduction of sustainable agricultural practices in selected regions.

As the main objective of the project is to increase capacities of local communities, as well decision-makers and local authorities on general issues on climate change, its impact to agro-biodiversity and sustainable farming practices, it is planned to organize a series of training sessions to target groups in selected pilot regions. Current training programme (educational programme) is designed for decision makers at national and local level and for local population taking into consideration results of institutional analysis and needs assessment.

The goal of these programme is to increase awareness among local population and authorities on the following issues:

(i) General climate change phenomena and related problems at global, regional and local levels;

(ii) on-going national policy, legal framework and implemented activities on climate change;

(iii) Impact of climate change into agro-biodiversity, local production systems and food security in light of existing forecasts and researches;

(iv) Sustainable farming practices and available adaptation modules and practices to be used for conservation of traditionally used agro-biodiversity gene pool, and introduction of international best practices of adaptation and development of local adaptation programmes and plans.

Current training programme provides information on goals and objectives of the programme, training topics, training groups to be trained, training approach, training curricula and schedule, as well information of needed logistic issues. Training modules to the used during planned training session are provided in another chapter.

Training programme

As the main objective of the project is to increase capacities of local communities, as well decision-makers and local authorities on general issues on climate change, its impact to agro-biodiversity and sustainable farming practices, it is planned to organize a series of training sessions to target groups in selected pilot regions. Current training programme (educational programme) is designed for decision makers at national and local level and for local population taking into consideration results of institutional analysis and needs assessment.

Goals and objectives of training programme

The main objective of this programme is to increase awareness among local population and authorities on the following issues:

(i) General climate change phenomena and related problems at global, regional and local levels;

(ii) on-going national policy, legal framework and implemented activities on climate change;

(iii) Impact of climate change into agro-biodiversity, local production systems and food security in light of existing forecasts and researches;

(iv) Sustainable farming practices and available adaptation modules and practices to be used for conservation of traditionally used agro-biodiversity gene pool, and introduction of international best practices of adaptation and development of local adaptation programmes and plans.

To achieve these objectives, the following activities (or measures) will be implemented:

- Develop set of educational programmes for decision-makers, local authorities and local residents of pilot communities;
- Develop relevant training modules based on identified training topics (training modules should be prepared in relevance to knowledge appropriation of audience – in this case decision-makers, representatives of local authorities and local residents);
- Conduct training sessions using prepared training modules;
- Provide pre-test and post-test in order to evaluate dynamic of knowledge improvement of training participants;
- Develop specific case-studies and involve training participants to group works in order to improve gained knowledge of participants by practical exercises.

Training topics

According to project proposal document it is planned to provide training on the following topics:

Topic 1: General climate change phenomena and related problems at global, regional and local levels;

Topic 2: On-going national policy, legal framework and implemented activities on climate change;

Topic 3: Impact of climate change into agro-biodiversity, local production systems and food security in light of existing forecasts and researches;

Topic 4: Sustainable farming practices and available adaptation modules and practices to be used for conservation of traditionally used agro-biodiversity gene pool, and introduction of international best practices of adaptation and development of local adaptation programmes and plans.

Training modules have been developed based on above-mentioned training topics. The following training modules will be conducted during training sessions:

Module 1: Introduction to the concepts of climate change

Module 2: International policies and actions on adaptation to climate change

Module 3: Climate change hazards and forecasting climate change

Module 4: Climate change and agriculture: impact of climate change into agro-biodiversity

Module 5: Agro-biodiversity – the key for food security and adaptation to climate change

Module 6: On-going national policy, legal framework and implemented activities on climate change

Module 7: Assessment of vulnerability to climate change

Module 8: Adaptation to climate change

Module 9: Sustainable farming practices and adaptation measures at local level

Module 10: Developing local adaptation plans

Training groups

The audience – training participants will be grouped in 3 groups:

1) Decision-makers at national and regional level

2) Representatives of local authorities (Executive communities, local municipalities and other relevant local state organizations)

3) Local residents representing different social status (civil workers, teachers, farmers and so on).

Table 1: Training groups

Training group	Number of participants	Duration	Topics to be covered	Location
Decision-makers at national and regional level	10-15	2 day	All 10 modules	Baku city
Local authorities	10-15	2 day	All 10 modules	Shamakhi region
Local community	15	2 day	9 modules (simplified	Target communities

			versions, expect module 2)	

Training approach

Applied approach will differ depending on target group. But, trainings will be all training sessions using interactive methods. It means that sessions will be supported with question-answer sessions, group works, case study analyses and other practical tools. Brainstorming tool will be used during group discussions in order to involve all participants to active participation.

It will be prepared a special pre-test questionnaires to assess the level of knowledge of all participants before the start of the training session. The same type of test will be conducted at the end of the training sessions in order to assess the level of improvement in the knowledge of training participants.

Training modules will be prepared as power-point presentations and presented to audience using projectors. Special cards will be used during brainstorming exercises. Group presentations will be provided using flipcharts.

For each type of training, this section describes how the training will be delivered, including the methods to be used, the communication medium, techniques, tools, and aids.

Table 2: Delineation of the approach for each training group

Training group	Method	Techniques	Tools	Aids
Decision-makers at national and regional level	Interactive method	Presentations, group works, exercises	Brainstorming exercises, cards, film shows	Desk board, projector, flipcharts
Local authorities	Interactive method	Presentations, group works, exercises	Brainstorming exercises, cards, film shows	Desk board, projector, flipcharts
Local community	Interactive method using simplified training modules	Presentations, group works, exercises	Brainstorming exercises, cards, film shows	Desk board, projector, flipcharts

It will be prepared brief summaries of training modules. These summaries will be published, copied and delivered among training participants.

Training participants will be registered using special registration form.

Training curricula and schedule

As it was indicated above, training sessions are planned to conduct for 1 day. The session will start at 09^{30} and finish at 17^{30}. Total length of the sessions will be 8 hours. It is devoted 15 minutes per tea-coffee break (it will be organized 2 tea-coffee breaks during training session) and 1 hour for lunch break. Thus, the length of effective training session will be 6 hours and 30 minutes. As it is

planned to organize 2 training session per target group, training modules will be divided into 2 days program.

Training agendas of training sessions for each target group are provided in below:

For decision-makers:

Table 3: Tentative training agenda (first training session)

N	Time	Activity, topic, module	Techniques, tools
1	09^{00} - 09^{30}	Registration, preparative works	Registration list, aids
2	09^{30} – 09^{45}	Training opening, acquaintance with participants, pre-test questionnaire	Presentation
3	09^{45} – 10^{25}	Module 1: Introduction to the concepts of climate change	Presentation
4	10^{25} – 10^{40}	Questions- answer session	Group discussion
5	10^{40} – 11^{00}	Tea/coffee break	
6	11^{00} – 11^{40}	Module 2: International policies and actions on adaptation to climate change	Presentation
7	11^{40} – 11^{55}	Questions- answer session	Group discussion
8	11^{55} – 12^{35}	Module 3: Climate change hazards and forecasting climate change	Presentation
9	12^{35} – 12^{50}	Movie on climate change hazards	Movie show
10	12^{50} – 13^{00}	Questions- answer session	Group discussion
11	13^{00} - 14^{00}	Lunch break	
12	14^{00} – 14^{40}	Module 4: Climate change and agriculture: impact of climate change into agro-biodiversity Module 5: Agro-biodiversity – the key for food security and adaptation to climate change	Presentation
13	14^{40} – 15^{00}	Questions- answer session	Group discussion
14	15^{00} – 15^{40}	Case study: climate change and agriculture	Presentation
15	15^{40}- 15^{50}	Group presentations	Presentations on flipcharts
16	15^{50} – 16^{10}	Tea-coffee break	
17	16^{10} - 16^{50}	Module 6: On-going national policy, legal framework and implemented activities on climate change	Group work, brain storming, discussions
18	16^{50} - 17^{20}	Questions- answer session	Group discussion
19	17^{20} - 17^{30}	Final remarks, plans for next training sessions	

Table 4: Tentative training agenda (second training session)

N	Time	Activity, topic, module	Techniques, tools
1	09^{00} - 09^{30}	Registration, preparative works	Registration list, aids
2	09^{30} – 09^{45}	Training opening, revision of topics of first training session	Presentation
3	09^{45} – 10^{25}	Module 7 : Assessment of vulnerability to climate change	Presentation

N	Time	Activity, topic, module	Techniques, tools
4	$10^{25} – 10^{40}$	Questions- answer session	Group discussion
5	$10^{40} – 11^{00}$	Tea/coffee break	
6	$11^{00} – 11^{50}$	Case study: assessment of vulnerability for target regions	Group work, brain storming, discussions
7	$11^{50} – 11^{55}$	Group presentations	Presentations on flipcharts
8	$11^{55} – 12^{35}$	Module 8: Adaptation to climate change	Presentation
9	$12^{35} – 12^{50}$	Movie on adaptation to climate change	Movie show
10	$12^{50} – 13^{00}$	Questions- answer session	Group discussion
11	13^{00} - 14^{00}	Lunch break	
12	$14^{00} – 14^{40}$	Module 9: Sustainable farming practices and adaptation measures at local level	Presentation
13	$14^{40} – 15^{00}$	Questions- answer session	Group discussion
14	$15^{00} – 15^{40}$	Module 10: Developing local adaptation plans	Presentation
15	15^{40}- 15^{50}	Questions- answer session	Group discussion
16	$15^{50} – 16^{10}$	Tea-coffee break	
17	16^{10} - 16^{50}	Case study: Real case study from EU experience	Group work, brain storming, discussions
18	16^{50} - 17^{20}	Group presentations	Presentations on flipcharts
19	17^{20} - 17^{30}	Final remarks and evaluation	

For local authorities:

The same agenda will be applied for training sessions considered for representatives of local authorities. Only difference will be in the style of training modules. The training modules will be slightly simplified to make it easy understandable for local authorities.

For local population:

The issue of climate change and adaptation to climate change are difficult topics for local residents as they have not too much information on those issues. Thus, training expert will try to make training modules easy understandable as much as possible. Besides, there is not a need for conduction of training modules on international action and national policy on climate change and the trainer will just provide briefly information on those topics. Tentative agenda for trainings to local residents is provided in below tables:

Table 5: Tentative training agenda (first training session) for local community residents

N	Time	Activity, topic, module	Techniques, tools
1	09^{00} - 09^{30}	Registration, preparative works	Registration list, aids
2	$09^{30} – 09^{45}$	Training opening, acquaintance with participants, pre-test questionnaire	Presentation
3	$09^{45} – 10^{25}$	Module 1: Introduction to the concepts of climate change	Presentation
4	$10^{25} – 10^{40}$	Questions- answer session	Group discussion

5	$10^{40} – 11^{00}$	Tea/coffee break	
6	$11^{00} – 11^{10}$	*Brief information on international policies and actions on adaptation to climate change*	Lecture, information materials
7	$11^{10} – 11^{25}$	Questions- answer session	Group discussion
8	$11^{25} – 12^{05}$	Module 3: Climate change hazards and forecasting climate change	Presentation
9	$12^{05} – 12^{45}$	Movie on climate change hazards and adaptation to climate change	Movie show
10	$12^{45} – 13^{00}$	Questions- answer session	Group discussion
11	13^{00} - 14^{00}	Lunch break	
12	$14^{00} – 14^{10}$	*Brief information on-going national policy, legal framework and implemented activities on climate change*	Lecture, information materials
13	$14^{10} – 14^{30}$	Questions- answer session	Group discussion
14	$14^{30} – 15^{10}$	Module 4: Climate change and agriculture: impact of climate change into agro-biodiversity Module 5: Agro-biodiversity – the key for food security and adaptation to climate change	Presentation
15	15^{10}- 15^{30}	Questions- answer session	Group discussion
16	$15^{30} – 15^{50}$	Tea-coffee break	
17	$15^{50} – 16^{40}$	Case study: climate change and agriculture	Group work, brain storming, discussions
18	16^{40} - 17^{20}	Group presentations	Presentations on flipcharts
19	17^{20} - 17^{30}	Final remarks, plans for next training sessions	

Table 6: Tentative training agenda (second training session) for local community residents

N	Time	Activity, topic, module	Techniques, tools
1	09^{00} - 09^{30}	Registration, preparative works	Registration list, aids
2	$09^{30} – 09^{45}$	Training opening, revision of topics of first training session	Presentation
3	$09^{45} – 10^{25}$	Module 7: Assessment of vulnerability to climate change	Presentation
4	$10^{25} – 10^{40}$	Questions- answer session	Group discussion
5	$10^{40} – 11^{00}$	Tea/coffee break	
6	$11^{00} – 11^{50}$	Case study: assessment of vulnerability for target regions	Group work, brain storming, discussions
7	$11^{50} – 11^{55}$	Group presentations	Presentations on flipcharts
8	$11^{55} – 12^{35}$	Module 8: Adaptation to climate change	Presentation
9	$12^{35} – 12^{50}$	Movie on adaptation to climate change	Movie show
10	$12^{50} – 13^{00}$	Questions- answer session	Group discussion
11	13^{00} - 14^{00}	Lunch break	
12	$14^{00} – 14^{40}$	Module 9: Sustainable farming practices and adaptation measures at local level	Presentation
13	$14^{40} – 15^{00}$	Questions- answer session	Group discussion

N	Time	Activity, topic, module	Techniques, tools
14	15^{00} – 15^{40}	Module 10: Developing local adaptation plans	Presentation
15	15^{40}- 15^{50}	Questions- answer session	Group discussion
16	15^{50} – 16^{10}	Tea-coffee break	
17	16^{10} - 16^{50}	Case study: Real case study from EU experience	Group work, brain storming, discussions
18	16^{50} - 17^{20}	Group presentations	Presentations on flipcharts
19	17^{20} - 17^{30}	Final remarks, plans for next training sessions	

Training logistics and materials

Training sessions will be organized at 3 different venues. There will be a need for a venue in Baku city for trainings session to decision-makers group. The venue is needed in Shamakhi region and in target pilot communities for local authorities and local community residents training group subsequently. In below, it is provided the list of needed training logistics:

- Venue (training room, small conference hole etc.) with **П** – shaped table design. The capacity of the venue should be at least 15-20 participants;
- There should be regular electricity supply for use of projector during presentation and movie shows;
- All participants should be provided with training materials (brief summary of training modules and CDs of movies);
- There will be a need for at least 4 flipcharts, markers, cards etc.;
- Venue should be suitable for organization of tea/coffee breaks;
- Lunch break should be organized in a place close to training venue for not spending additional time.

Brief summary of all training modules will be printed-out and delivered to all participants. Regards movies on climate change and climate change adaptation the following movies will be showed to training participants (participants will be provided with CDs of movies as well):

- Dangerous vagaries of climate (Опасные капризы климата)
- An inconvenient truth, Albert Gore movie, (simultaneous translation will be provided by trainer expert)

Training modules

In this chapter, it is provided structure and content of training modules to be used during training sessions for decision-makers, local governance and local population. It is planned to use 9 training modules during training sessions:

Module 1: Introduction to the concepts of climate change

This training module will be used during training session for all 3 target group. For local population, the training module will be simplified and brought to easy understandable language for local residents.

Module 2: International policies and actions on adaptation to climate change

This training module will be used during training session for decision makers and local authorities target group. For local authorities, the training module will be simplified and brought to easy understandable language for local residents.

Module 3: Climate change hazards and forecasting climate change

This training module will be used during training session for all 3 target group. For local population, the training module will be simplified and brought to easy understandable language for local residents.

Module 4: Assessment of vulnerability to climate change

This training module will be used during training session for all 3 target group. For local authorities, the training module will be simplified and brought to easy understandable language for local residents.

Module 5: Agro-biodiversity – the key for food security and adaptation to climate change

This training module will be used during training session for all 3 target group. For local authorities and local community members, the training module will be simplified and brought to easy

Module 6: On-going national policy, legal framework and implemented activities on climate change

This training module will be used during training session for decision makers and local authorities target group. For local authorities, the training module will be simplified and brought to easy understandable language for local residents.

Module 7: Climate change and agriculture: impact of climate change into agro-biodiversity

This training module will be used during training session for all 3 target group. For local population, the training module will be simplified and brought to easy understandable language for local residents.

Module 8: Adaptation to climate change

This training module will be used during training session for all 3 target group. For local population, the training module will be simplified and brought to easy understandable language for local residents.

Module 9: Sustainable farming practices and adaptation measures at local level

This training module will be used during training session for all 3 target group. For local population, the training module will be simplified and brought to easy understandable language for local residents.

Module 10: Developing local adaptation plans

This training module will be used during training session for all 3 target group. For local population, the training module will be simplified and brought to easy understandable language for local residents.

Some training modules include case studies in order to provide information to participants on practically applied project or activity related to training topic. Under current training programme it is considered to include the following case studies to relevant training module:

Case study 1: Vulnerability assessment for Agsu-Shamakhi-Gobustan region

Case study 2: Case Study: Quezungual Agro-forestry System Of Honduras

Case study 3: Real case from EU experience

As it was indicated in above sections, it will be shown movies related to climate change and climate change adaptation in order to increase awareness level of participants on training topic. For movie in English language, the trainer expert will provide simultaneous translation. It is planned to show the following movies:

Movie to be shown: Opasniye kaprizi klimata (in Russian) and An inconvenient truth (Alber Gore)

Module 1: Introduction to the concepts of climate change and adaptation

Module structure:

Part I (Climate Change)

- What is climate change?
- What are the causes?
- How does it manifest?

Part II (Climate Change Adaptation)

- What is climate change adaptation?
- How does it differ from mitigation?
- Why should we adapt to climate change?
- How can CCA be approached and what types of measures exist?

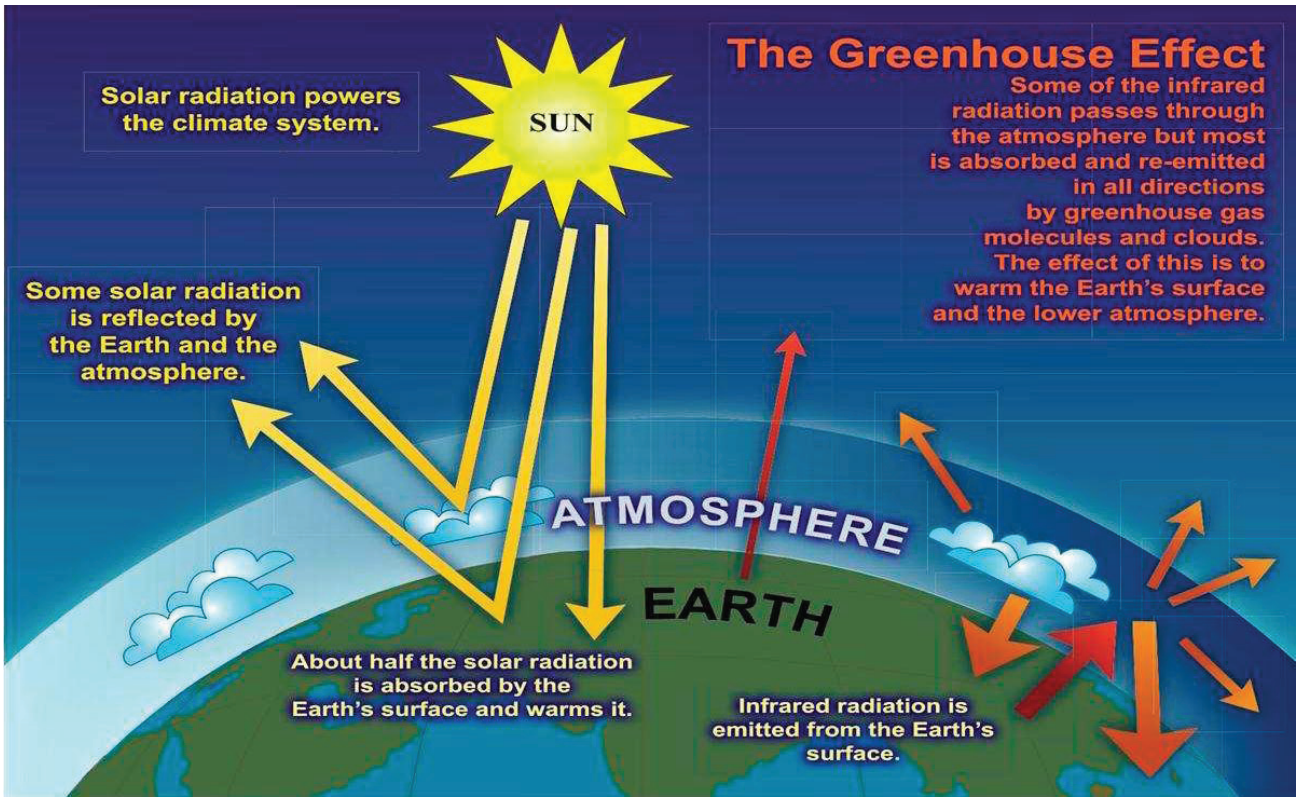
Part I – Climate Change

"'Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." (UNFCCC, Article 1(2.))

Climate change is a global phenomenon, characterized by changes in the composition of the earth's atmosphere over and above the natural variability in climate. In general, among scientific researchers, there is consensus that climate change is very likely caused to a large extent by anthropocentric greenhouse gas emissions (anthropogenic or man-made climate change). Natural factors only play a secondary role. Thus, for example volcanic eruptions, changes in solar irradiation, or changes in the earth's rotational path around the sun only play a minor role in the explanation of climate change.

In the past centuries and millennia there have always been warmer or colder periods on earth but never has there been such a fast warming of the planet as we have experienced it in the last 100 years. The rapid warming of our planet is caused by the increase of greenhouse gases in the atmosphere. Since the late 1800s, gases like carbon dioxide and methane have accumulated high up in the atmosphere. Some of the sun light that hits the surface of our earth is transformed into heat that reflects back into space. Before there was a high concentration of greenhouse gases in the atmosphere, more of the heat was able to escape into space. Now the greenhouse gases reflect larger parts of the heat back on earth which increases the temperature globally. The gases act like the glass or plastic cover of a greenhouse which trap the heat inside.

Figure 1: Greenhouse effect (source IPCC, 2007)



Where do greenhouse gases come from?

Greenhouse gases occur naturally but human activities have caused a strong increase in their concentration. The main sources of greenhouse gas emissions are:

Energy supply: When producing electricity by burning coal, natural gas (fossil fuels) or oil greenhouse gases are emitted into the atmosphere.

Industry: Many industrial processes require heat or electricity that is taken from fossil fuels.

Transport: Car, planes and trains usually run on burning of fossil fuels.

Deforestation: Trees and the soil store a lot of carbon, if trees are burned or cut down some of that carbon is realized into the atmosphere as carbon dioxide, a greenhouse gas.

Agriculture: The production of fertilizers and their use is often greenhouse-gas intense; intensive animal husbandry significantly contributes to greenhouse gas concentrations as well; flooded rice fields and the bacterial processes that take place in and above the flooded soil are also a source of greenhouse gases.

To mitigate climate change human-beings all over the world will have to drastically reduce greenhouse gas emissions.

Definitions: What is climate? What is weather?

Weather, is the short term for the state of the atmosphere in a particular area, as perceived daily with a regard to temperature, rainfall, wind etc. Weather is what you see and experience every day when you are outside.

Climate is the average weather or the characteristic progression of weather in a given geographical area over a longer term. Climate is the status of the climate system with a statistical description of the weather in the form of average values and the variability of relevant parameters over a period of time. These parameters are mainly surface values, such as temperature, precipitation, and wind. The World Meteorological Organization (WMO) defines the time period (climate normal) as 30 years.

Climate variability refers to the **variations in the mean state of the climate**. Variability is generally a natural feature of a climate system. For the future it is projected that the variability of the climate will increase.

An **extreme weather event** is an event that is rare for a given area during a given time of the year. Single extreme weather events cannot be directly attributed to climate change as their genesis is so complex that it cannot be shown if they were caused by climate change.

However, the increase in the number of extreme weather events in recent years can be related back to climate change. Extreme weather events are events such as intense rainfalls, heat waves, storms or cyclones.

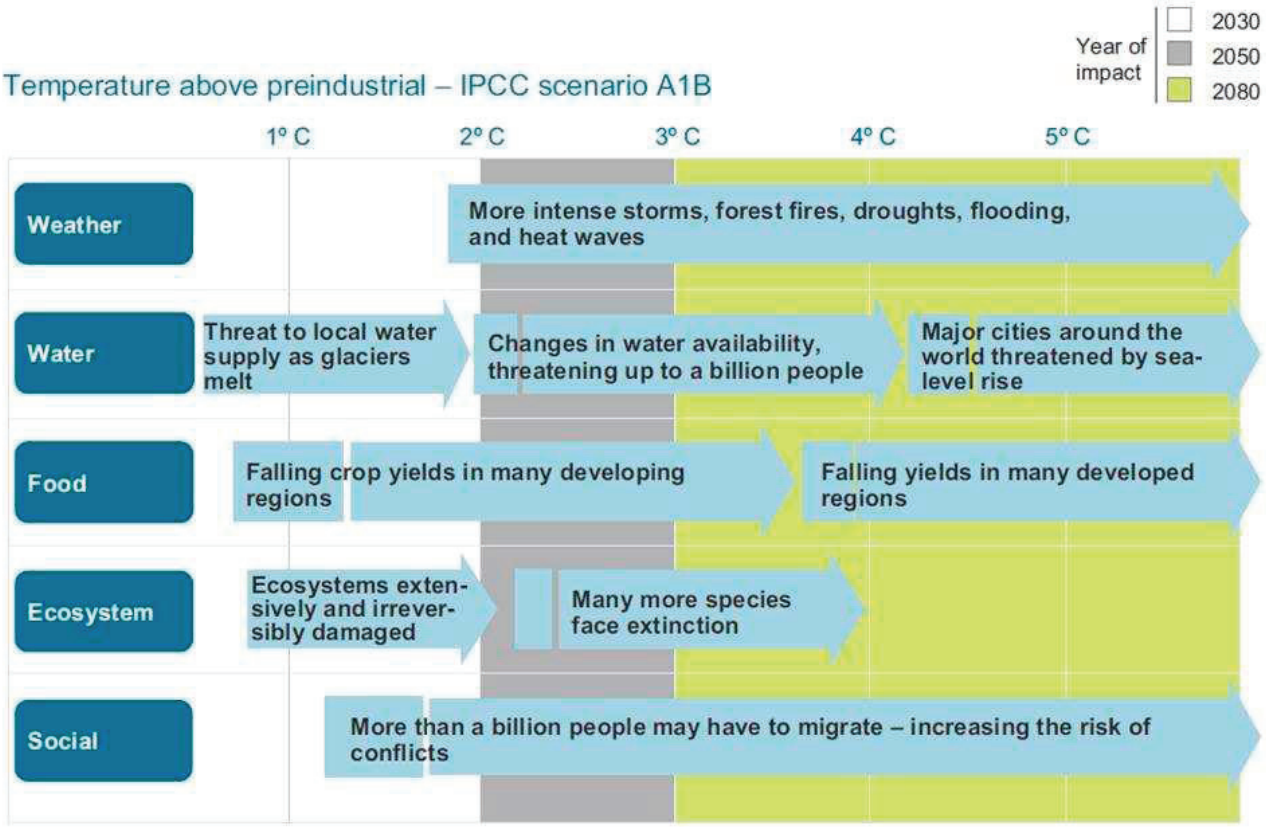
=> *Climate is what you expect; weather is what you get.*

The Intergovernmental Panel on Climate Change (IPCC) in its fourth and latest assessment report (2007) showed that the climate has changed and further change is very likely to happen. Warming of the climate is now evident from observations of increases in global average surface and ocean temperatures, widespread melting of snow and ice and rising global average sea level. Observational evidence from all continents and most oceans shows that many natural systems are being affected by regional climate changes, particularly temperature increases.

Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. Continued greenhouse gas emissions at or above current rates would cause further warming. This will induce many changes in the global climate system during the 21st century that would very likely be larger than those observed during the 20th century.

Climate Change is an on-going Process. People have been coping with it for many year. The difference is that the **Rate of change** is expected to increase…..

Figure 2: Examples for climate change impacts (Source: IPCC 2007)



Summarizing the climate change discourse…

- Anthropogenic climate change is happening
- Scientific evidence is clear (enough)
- Climate change impacts are already visible today
- Climate change is now accepted by most decision-makers in Europe
- Climate change is speeding-up (2007 compared to 2001 IPCC findings)

Part II – Climate Change Adaptation

"Green house gas emissions in the atmosphere have already committed the earth to at least 50 years of climate change, the kind of impacts that occur depend on adaptation." (Kristie Ebi, IPCC)

Why is adaptation necessary?

Warming of the climate system is unequivocal. Because of the inertia of the climate system some adaptation will be necessary in any case. Rising temperatures are associated with higher concentrations of CO2 but climate impacts are long-lived. Thus, stringent mitigation does not deliver early results. Even under the IPCC scenario B1 (low emissions/stringent CO2 cuts), there

will be warming progresses. Because of the inertia of the climate system, one cannot expect that the global warming trend will reverse in the coming decades.

Adaptation is defined as the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC 2001 Annex B).

Adaptation to the adverse climate change effects is essential to reduce current impacts and increase resilience to future impacts of climate change. This includes measures that aim to reduce the vulnerability of human and natural systems.

- There is a whole range of approaches towards adaptation from technical solutions like building sea walls to “soft” measures like awareness raising and knowledge sharing;
- Adaptation should be integrated into wider development activities of the community and consider existing approaches like disaster risk reduction (DRR).

Benefits of climate change adaptation:

1. Reducing vulnerability to climate change impacts

2. Strengthening capacities to deal with climate change impacts

- Reducing risks for vulnerable population and livelihoods
- Protecting climate-sensitive sectors
- Strengthening existing approaches like DRR
- Contributing to the goals of sustainable development
- Climate proofing development activities

Note that timely and anticipatory action is often more cost-effective than reactive adaptation.

Some examples of different adaptation strategies are provided in below table:

Some examples of different adaptation strategies:

Table 7: Different adaptation strategies

Strategy	Examples
Share losses	Support from extended family, insurance or social programs
Modify threats	Change the management of dikes and damps to modify flood patterns
Prevent impact	Redistribute water to avoid scarcity
Change use	Change crops or soil management
Change location	Relocate settlements or economic activities
Research	Improved seed research
Change behavior and rules	Conservation cultivation

Before and while implementing these strategies, the following aspects will have to be considered:

- timing (anticipatory vs. reactive; ex ante vs. ex post)

- scope (short-term vs. long-term; localized vs. regional)
- purposefulness (autonomous vs. planned; passive vs. active) and
- adapting agent (private vs. public; societies vs. natural systems).

Adaptation vs. mitigation

Mitigation is defined as "*an anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks*" (IPCC Fourth Assessment Report, Appendix 1 2007).

Mitigation aims to limit climate change itself, by reducing the emissions of GHGs, for instance by promoting energy efficiency, the use of renewable energy such as solar and wind power, and avoiding deforestation.

This differs from adaptation: Adaptation consists of deliberate actions undertaken to reduce the adverse consequences, as well as to harness any beneficial opportunities that might arise from climate change.

Climate change adaptation and mitigation efforts must be applied as complementary – not exclusive – options. The reasons for this lie in the recognition that even if the global community successfully manages to mitigate climate change by reducing greenhouse gas emissions, the climate is still expected to warm for several decades. So, mitigation is not enough. Yet adaptation alone is also not a sufficient answer to the problem, as adaptation options have limits, especially if certain levels of warming are exceeded.

Figure 3: Mitigation and adaptation: differences

Mitigation	**Adaptation**
Slow down global warming by reducing greenhouse gas emissions	**Respond to likely impact of unavoidable climate change**
• Approach to mitigation is inside-out: what are our impact to climate change?	• Approach to adaptation is more outside-in: what are the climate's impact on us
• Examine emissions in all sectors; global level	• Examine the impacts; local level very diverse responses

Module 2: International policies and actions on adaptation to climate change

Module structure:

Part I (International Policies on Adaptation to climate change)

- What is the role of adaptation within the international climate change policy process?
- What does the international framework for adaptation look like?

Part II (EU Policies on Adaptation)

- What role does the EU play with regards to adaptation?
- What is the European framework for adaptation?

Movie to be shown: Opasniye kaprizi klimata (in Russian)

Part I (International Policies on Adaptation):

Adaptation is part of the international climate policy process

Climate change was identified as a serious problem at the **first world climate conference** held on 12-23 February 1979 in **Geneva, Switzerland**. At this scientific forum the possible impacts of human activity on climate change were analyzed. A declaration was adopted urging world governments to consider and avoid climate change.

The **United Nations Framework Convention on Climate Change (UNFCCC)** was signed along with other conventions in 1992 in Rio de Janeiro, Brazil, at the world summit on sustainable development. The UNFCCC addresses adaptation through Article 4 by calling on Parties to "formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate change […] and measures to facilitate adequate adaptation to climate change" (UNFCCC, 1994). Adaptation is also mentioned in the **Kyoto Protocol**, negotiated in 1997.

The implementation of adaptation has been further promoted with the establishment of three funds dealing with adaptation at the Seventh Conference of the Parties (**CoP-7**) in **Marrakesh** in 2001.

Another milestone on the international adaptation agenda has been achieved by the adoption of the **Nairobi Work Programme** on impacts, vulnerability and adaptation to climate change at the 11th session of the CoP to the UNFCCC in 2005. Its objective is to assist all Parties, in particular developing countries to improve their understanding and assessment of impacts, vulnerability and adaptation to climate change; and make informed decisions on practical adaptation actions and measures to respond to climate change on a sound scientific, technical and socio-economic basis, taking into account current and future climate change and variability.

At the CoP 13 session in Bali, the **Bali Roadmap**, including the **Bali Action Plan** was adopted, recognising adaptation as one of the key elements required for an effective response to climate change in the future. In particular, the Bali Action Plan addresses the issue of provision of financial resources, investment and technology to support action on adaptation. To conduct the process, a subsidiary body under the Convention was established called the Ad Hoc Working Group on Long-term Cooperative Action under the Convention (AWG-LCA). At the first meeting of AWG-LCA in Bangkok in April 2008, the parties agreed on a work program that structures the two-year

negotiations on a long-term agreement. As to the strong inter-linkages between the issues, they also agreed to discuss all five main elements – adaptation, mitigation, technology, finance and a shared vision for long-term cooperative action – in conjunction at each of the fowling sessions.

In Cancún, Mexico, at the most recent Climate Change Conference (CoP 16) in 2010, the parties affirmed that adaptation must be addressed with the same level of priority as mitigation. The **Cancun Adaptation Framework (CAF)** and an associated **Adaptation Committee** is the result of three years of negotiations on adaptation under the AWG-LCA that had followed the adoption of the Bali Action Plan. The Framework relates to the following set of priority areas for action:

- the development of plans, projects and programs;
- strengthening institutions;
- improving research, observation and information management systems;
- impact, vulnerability and financial needs assessments; and
- adaptation technology

The Adaptation Committee has been assigned with the tasks of identifying gaps in action, highlighting good practices, and formulating recommendations on existing needs.

Innovations in the Framework include attention to migration, disaster risk reduction, and strengthening of institutions. Another result achieved in Cancún was the establishment of the new multilateral “Green Climate Fund” (GCF) to be the key international financing instrument of climate and rainforest protection via adaptation measures.

Many parties supported the proposal and a the COP agreed for a loss and damage work program under the Framework that will consider, through expert meetings and workshops, climate impacts among developing countries and may develop a climate risk insurance facility.

Establishment of three Adaptation Funds

In the course of the CoP 7 in Marrakesh in 2001, three following funds dealing with adaptation have been established:

- The **Least Developed Countries Fund** addresses the particularly low adaptive capacity of the least developed countries (LDCs) in order to help them prepare their National Adaptation Programmes of Action (NAPAs). Furthermore, the fund supports institutional capacity building and other activities.
- The **Special Climate Change Fund** finances different kinds of mitigation and adaptation activities in all developing countries. The activities can be specific to sectors – energy, transport, industry, agriculture, forestry and waste management –or aimed directly at adaptation, technology transfer and economic diversification.
- The **Adaptation Fund** – the only Marrakech fund linked to the Protocol rather than the Convention – provides funding only to parties to the Protocol. Like the other two funds, its resources come from voluntary contributions, but it also benefits from a 2% share of the proceeds of certified emissions reductions from projects under the Protocol’s Clean Development Mechanism (CDM). Estimates of potential resources available for the Adaptation Fund from April 30, 2011 to December 31, 2012 range from approximately USD 309.05 million to USD 418.85 million.

National Adaptation Action Programmes (NAPA)

In line with the establishment of adaptation funds by the Marrakesh Accords, the **LDC Expert Group (LEG)** was established "to serve in an advisory capacity to the LDCs, for the preparation and strategy for implementation of **National Adaptation Plans of Action (NAPA)**" (Decision 29/CP.7 contained in FCCC/CP/2001/13/Add.4).

The rationale for NAPA rests on the limited ability of LDCs to adapt to the impacts of climate change. In order to address the urgent adaptation needs of LDCs, a new approach was needed that would focus on enhancing adaptive capacity to climate variability. The development of a NAPA also includes short profiles of projects and/or activities intended to address urgent and immediate adaptation needs of LDC Parties.

The NAPA' objective is to serve as a simplified and direct channel of communication for information relating to the **urgent and immediate adaptation needs** of the LDCs.

The steps for the preparation of the NAPAs include:

- Synthesis of available information;
- Participatory assessment of vulnerability to current climate variability and extreme events and of areas where risks would increase due to climate change;
- Identification of key adaptation measures as well as criteria for prioritizing activities;
- Selection of a prioritized shortlist of activities.

Upon completion, the NAPA is submitted to the UNFCCC secretariat and the LDC Party becomes eligible to apply for funding for implementation of the NAPA under the LDC Fund. A copy of the NAPA is also sent to the Global Environment Facility (GEF).

Adaptation beyond the international climate negotiations

Besides the process of international climate negotiations, adaptation is addressed through several international development guidelines, characterized by a lower degree of institutionalization. The Millennium Development Goals, the World Development Reports of World Bank or declarations of Organization for Economic Cooperation and Development (OECD) that integrate development and climate policy goals and build the extended political institutional and normative context for adaptation.

Part II (EU Policies on Adaptation)

Adaptation to Climate Change in the EU

"Due to the varying regional severity and nature of climate impacts most adaptation initiatives will be taken at national, regional or local levels. However the ability to cope and adapt differs across population, economic sectors and regions within Europe.

A European approach complementing EU Member State activities can support action at national, regional and local level through, for instance, enhanced coordination and information sharing and by ensuring that adaptation considerations are addressed in all relevant EU policies.

The EU's role will be particularly relevant when climate change impacts transcend the boundaries of individual states (e.g. river basins) and when impacts vary considerably across regions. The EU can enhance solidarity among Member States to ensure that disadvantaged regions and regions most affected by climate change will be capable of taking the necessary measures to adapt. In addition for certain sectors (e.g. agriculture, water, biodiversity, fisheries etc.) that are largely integrated at EU level through the single market and common policies, coordinated EU action will be necessary.

European legislation influences decisions right down to the local level. This is particularly the case for environmental legislation and for the common policy areas such as agriculture and fisheries. These are also areas where climate change will have a strong impact. The EU regional and cohesion funds can be used to give direct support to adaptation projects." (http://ec.europa.eu/clima/faq/adaptation/index_en.htm, last access on 31.05.2011)

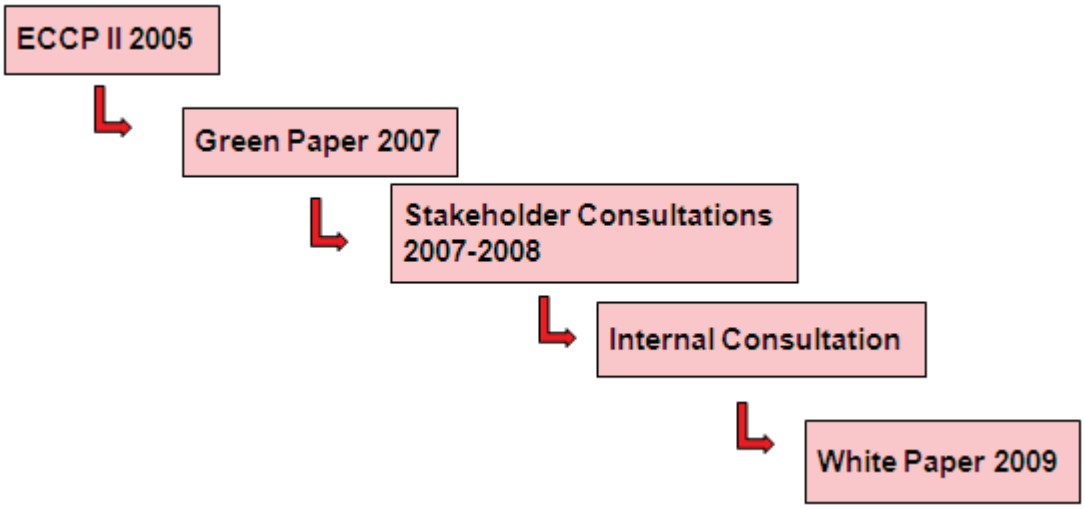
Furthermore, through concerted EU policies and actions, wider international efforts on adaptation are supported by helping for example non-EU countries to improve their resilience and capacity to adapt to climate change.

Key steps and documents in developing the EU adaptation framework

In 2000, the **European Climate Change Programme (ECCP)** was launched as an EU strategy for the implementation of the Kyoto Protocol. An adaptation component was only added in the second phase of the ECCP in 2005 – ECCP II lead to the development of a Green Paper.

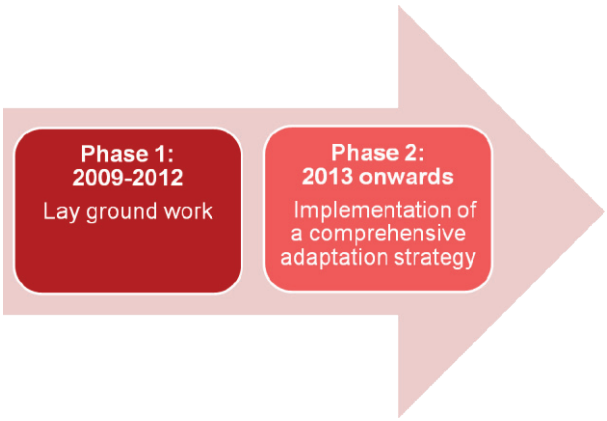
The **Green Paper** presents an initial overview of how adaptation can be considered in existing EU legislation and policies. The Green Paper on Climate Change suggests to take early action where knowledge is insufficient and to support further research where there are knowledge gaps. It was followed by a public consultation (& international consultation) which lead to a **White Paper on adaptation to climate change** in 2009, which presents the framework for adaptation measures and policies to reduce the European Union's vulnerability to the impacts of climate change.

Figure 4: Key steps and documents in developing the EU adaptation framework



The White Paper lays the foundation for a Europe-wide adaptation strategy that is split into two phases. The intention is that phase 1 (2009-2012) will take forward the work identified under the four pillars (see Figure 10) leading to the elaboration of a comprehensive adaptation strategy for the EU which will be implemented during phase 2 commencing in 2012.

Figure 5: EU Adaptation Framework – a two-phased approach



To successfully lay the ground work in Phase 1, good cooperation between the EU, national, regional and local authorities is required. In the frame of a long and continuous process, the EU will support international and national adaptation efforts ensuring that there are adequate resources for efficient and cost-effective adaptation action so as to provide a sustainable and sound economic basis for future generations. The European Commission will regularly review the progress in implementing the actions identified in the White Paper with a view to developing further adaptation measures.

EU framework for action on adaptation to climate change

The White paper establishes a framework for action focusing on four key pillars:

1) building a stronger knowledge base on CC vulnerability (impacts and adaptive capacity)and on the costs and benefits of adaptation options;

2) ensuring early implementation of no-regret and win-win measures and avoid mal-adaptation, by mainstreaming adaptation into EU policies

3) put in place a process to better co-ordinate adaptation policies and assess next steps, review instruments and launch a debate on future funding

4) supporting wider international efforts on adaptation by helping for example non-EU countries to improve their resilience and capacity to adapt to climate change.

European Neighbourhood Policy (ENP) & adaptation

The EU is committed to take advantage of existing institutional frameworks and its extensive network of delegations and representations in order to increase the dialogue on climate change as part of both, political dialogue and regular country policy dialogue. This includes the identification

and implementation of EU initiatives to support the preparation of national strategies for sustainable development including climate change as a horizontal component. Furthermore, the EU sees its role in promoting regional co-operation among partner countries.

In the effort of assisting EU partner countries in the frame of the European Neighbourhood Policy (ENP) to improve their resilience and capacity to adapt to climate change, it has been agreed upon within the bilateral **Partnership and Cooperation Agreement (PCA)** and the respective Action Plans to enhance cooperation in addressing global climate change by implementing provisions under the Kyoto Protocol and the UNFCCC.

Furthermore, the **Neighbourhood Investment Facility (NIF)** that finances capital-intensive infrastructure projects in EU partner countries explicitly supports projects addressing adaptation to climate change. The NIF brings together grants from the European Commission and the EU Member States with loans from European public finance institutions, as well as own contributions from the partner countries.

Module 3: Climate change hazards and forecasting climate change

Module structure:

Part I (Climate change hazards)

- What are the main hazards expected from climate change?
- What climate change hazards are potential threat for Azerbaijan?

Part II (Forecasting climate change)

- What methods are used for forecasting climate change?
- What are forested climate change expectations?
- What are climate change forecasts for Azerbaijan?

Part I (Climate change hazards)

On the broadest scale, the rate at which energy is received from the sun and the rate at which it is lost to space determine the equilibrium temperature and climate of Earth. This energy is distributed around the globe by winds, ocean currents, and other mechanisms to affect the climates of different regions.

Factors that can shape climate are called climate forcing or "forcing mechanisms". These include processes such as variations in solar radiation, variations in the Earth's orbit, mountain-building and continental drift, clouds and changes in greenhouse gas concentrations. There are a variety of climate change feedbacks that can either amplify or diminish the initial forcing. Some parts of the climate system, such as the oceans and ice caps, respond slowly in reaction to climate forcings, while others respond more quickly.

Forcing mechanisms can be either "internal" or "external". Internal forcing mechanisms are natural processes within the climate system itself (e.g., the thermohaline circulation). External forcing mechanisms can be either natural (e.g., changes in solar output) or anthropogenic (e.g., increased emissions of greenhouse gases).

Whether the initial forcing mechanism is internal or external, the response of the climate system might be fast (e.g., a sudden cooling due to airborne volcanic ash reflecting sunlight), slow (e.g. thermal expansion of warming ocean water), or a combination (e.g., sudden loss of albedo in the arctic ocean as sea ice melts, followed by more gradual thermal expansion of the water). Therefore, the climate system can respond abruptly, but the full response to forcing mechanisms might not be fully developed for centuries or even longer.

Evidence for climatic change is taken from a variety of sources that can be used to reconstruct past climates. Reasonably complete global records of surface temperature are available beginning from the mid-late 19th century. For earlier periods, most of the evidence is indirect—climatic changes are inferred from changes in proxies, indicators that reflect climate, such as vegetation, ice cores, dendrochronology, sea level change, and glacial geology.

The instrumental temperature record from surface stations was supplemented by radiosonde balloons, extensive atmospheric monitoring by the mid-20th century, and, from the 1970s on, with global satellite data as well. TIce core samples used to deduce ocean temperature in the distant past is an example of a temperature proxy method, as are other climate metrics noted in subsequent categories.

Climate change in the recent past may be detected by corresponding changes in settlement and agricultural patterns. Archaeological evidence, oral history and historical documents can offer insights into past changes in the climate. Climate change effects have been linked to the collapse of various civilizations.

Glaciers are considered among the most sensitive indicators of climate change. Their size is determined by a mass balance between snow input and melt output. As temperatures warm, glaciers retreat unless snow precipitation increases to make up for the additional melt; the converse is also true.

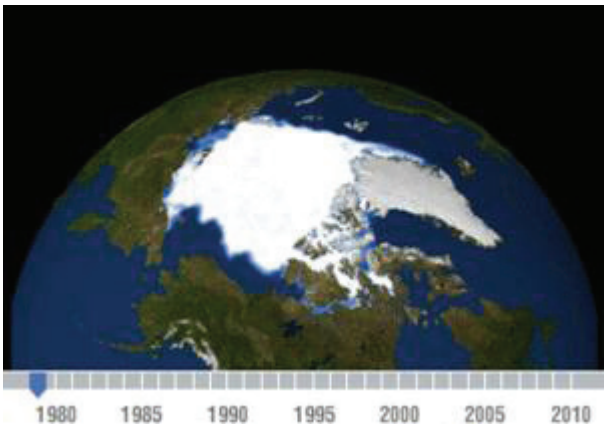
Glaciers grow and shrink due both to natural variability and external forcings. Variability in temperature, precipitation, and englacial and subglacial hydrology can strongly determine the evolution of a glacier in a particular season. Therefore, one must average over a decadal or longer time-scale and/or over a many individual glaciers to smooth out the local short-term variability and obtain a glacier history that is related to climate.

A world glacier inventory has been compiled since the 1970s, initially based mainly on aerial photographs and maps but now relying more on satellites. This compilation tracks more than 100,000 glaciers covering a total area of approximately 240,000 km^2, and preliminary estimates indicate that the remaining ice cover is around 445,000 km^2. The World Glacier Monitoring Service collects data annually on glacier retreat and glacier mass balance From this data, glaciers worldwide have been found to be shrinking significantly, with strong glacier retreats in the 1940s, stable or growing conditions during the 1920s and 1970s, and again retreating from the mid 1980s to present.

The most significant climate processes since the middle to late Pliocene (approximately 3 million years ago) are the glacial and interglacial cycles. The present interglacial period (the Holocene) has lasted about 11,700 years. Shaped by orbital variations, responses such as the rise and fall of continental ice sheets and significant sea-level changes helped create the climate. Other changes, including Heinrich events, Dansgaard–Oeschger events and the Younger Dryas, however, illustrate how glacial variations may also influence climate without the orbital forcing.

Glaciers leave behind moraines that contain a wealth of material—including organic matter, quartz, and potassium that may be dated—recording the periods in which a glacier advanced and retreated. Similarly, by tephrochronological techniques, the lack of glacier cover can be identified by the presence of soil or volcanic tephra horizons whose date of deposit may also be ascertained.

Figure 6: Reduction of the area of glaciers



This time series, based on satellite data, shows the annual Arctic sea ice minimum since 1979. The September 2010 extent was the third lowest in the satellite record.

The decline in Arctic sea ice, both in extent and thickness, over the last several decades is further evidence for rapid climate change.[45] Sea ice is frozen seawater that floats on the ocean surface. It covers millions of square miles in the polar regions, varying with the seasons. In the Arctic, some sea ice remains year after year, whereas almost all Southern Ocean or Antarctic sea ice melts away and reforms annually. Satellite observations show that Arctic sea ice is now declining at a rate of 11.5 percent per decade, relative to the 1979 to 2000 average.

A change in the type, distribution and coverage of vegetation may occur given a change in the climate. Some changes in climate may result in increased precipitation and warmth, resulting in improved plant growth and the subsequent sequestration of airborne CO_2. A gradual increase in warmth in a region will lead to earlier flowering and fruiting times, driving a change in the timing of life cycles of dependent organisms. Conversely, cold will cause plant bio-cycles to lag. Larger, faster or more radical changes, however, may result in vegetation stress, rapid plant loss and desertification in certain circumstances.

Satellite data available in recent decades indicates that global terrestrial net primary production increased by 6% from 1982 to 1999, with the largest portion of that increase in tropical ecosystems, then decreased by 1% from 2000 to 2009.

Past precipitation can be estimated in the modern era with the global network of precipitation gauges. Surface coverage over oceans and remote areas is relatively sparse, but, reducing reliance on interpolation, satellite data has been available since the 1970s. Quantification of climatological variation of precipitation in prior centuries and epochs is less complete but approximated using proxies such as marine sediments, ice cores, cave stalagmites, and tree rings.

Climatological temperatures substantially affect precipitation. For instance, during the Last Glacial Maximum of 18,000 years ago, thermal-driven evaporation from the oceans onto continental

landmasses was low, causing large areas of extreme desert, including polar deserts (cold but with low rates of precipitation). In contrast, the world's climate was wetter than today near the start of the warm Atlantic Period of 8000 years ago.

Estimated global land precipitation increased by approximately 2% over the course of the 20th century, though the calculated trend varies if different time endpoints are chosen, complicated by ENSO and other oscillations, including greater global land precipitation in the 1950s and 1970s than the later 1980s and 1990s despite the positive trend over the century overall. Similar slight overall increase in global river runoff and in average soil moisture has been perceived.

Dendroclimatology is the analysis of tree ring growth patterns to determine past climate variations. Wide and thick rings indicate a fertile, well-watered growing period, whilst thin, narrow rings indicate a time of lower rainfall and less-than-ideal growing conditions.

Analysis of ice in a core drilled from a ice sheet such as the Antarctic ice sheet, can be used to show a link between temperature and global sea level variations. The air trapped in bubbles in the ice can also reveal the CO_2 variations of the atmosphere from the distant past, well before modern environmental influences. The study of these ice cores has been a significant indicator of the changes in CO_2 over many millennia, and continues to provide valuable information about the differences between ancient and modern atmospheric conditions.

Regards animals, remains of beetles are common in freshwater and land sediments. Different species of beetles tend to be found under different climatic conditions. Given the extensive lineage of beetles whose genetic makeup has not altered significantly over the millennia, knowledge of the present climatic range of the different species, and the age of the sediments in which remains are found, past climatic conditions may be inferred.

Similarly, the historical abundance of various fish species has been found to have a substantial relationships with observed climatic conditions. Changes in the primary productivity of autotrophs in the oceans can affect marine food webs.

Global sea level change for much of the last century has generally been estimated using tide gauge measurements collated over long periods of time to give a long-term average. More recently, altimeter measurements — in combination with accurately determined satellite orbits — have provided an improved measurement of global sea level change. To measure sea levels prior to instrumental measurements, scientists have dated coral reefs that grow near the surface of the ocean, coastal sediments, marine terraces, ooids in limestones, and nearshore archaeological remains. The predominant dating methods used are uranium series and radiocarbon, with cosmogenic radionuclides being sometimes used to date terraces that have experienced relative sea level fall.

Part II (Forecasting climate change)

Decision-makers and resource managers require information regarding future changes in climate average and variability to better anticipate potential impacts of climate change. However, in order to formulate adaptation policies in response to climate change impacts, reliable climate change information is usually required at finer spatial scales than that of a typical GCM grid-cell (which is usually about 300 x 300 km). Although GCMs provide adequate simulations of atmospheric general

circulation at the continental scale, they do not capture the detail required for regional and national assessments.

Climate models are mathematical representations of the climate system, expressed as computer codes and run on powerful computers. One source of confidence in climate models comes from the fact that model fundamentals are based on established physical laws along with wealth of observations. Models show significant and increasing skill in representing many important mean climate features, such as the large-scale distributions of atmospheric temperature, precipitation, radiation and wind, and of oceanic temperatures, currents and sea ice cover. A second source of confidence comes from the ability and skill of models to simulate important aspects of the current climate. Global Climate Models (GCMs), which are built on well-established physical principles, have shown convincing skill in reproducing observed features of current climate and its changes in the past.

Models are routinely and extensively assessed by comparing simulations with observations of the atmosphere, ocean, cryosphere and land surface. There is considerable confidence that Atmosphere-Ocean General Circulation Models (AOGCMs) provide credible quantitative estimates of future climate change, particularly at continental and larger scales (adapted from IPCC, 2007). However, the use of AOGCMs is limited in projecting climate change at the regional and sub-regional level, because significant differences in climate occur at a scale below the resolution of the AOGCMs. However, even given the limitations and uncertainties associated with modelling, global circulation models and regional climate models can be applied usefully to identify a range of uncertainties allowing strategic policymaking for adaptation.

The predicted climate changes for the selected years will depend greatly on the model and scenario selected. The wrong choice will result in false predictions which are difficult, costly, and often impossible to change at a later date. For that reason this review of the different climate change models and scenarios is being undertaken since detailed foreknowledge of the problems likely to be encountered is essential at the outset to make sure that the choices have been made as wisely and with as much understanding and forethought as practicable.

This is also the case for the decision with respect to the spatial extent of the assessment and the length of time into the future. Studies of the regional impacts of climate change must confront the problem of choosing climate-change scenarios. The task of downscaling global climate model simulations is often so demanding that only a limited selection of models and greenhouse gas emission scenarios may be considered. However, it is preferable to consider a range of scenarios in climate impacts studies (see, for example, IPCC, 2001, page 741). The use of several models and emissions scenarios better reflects the uncertainty in the range of possible future climate change. Furthermore, model performance varies for different regions or process under consideration. Thus, impacts studies must consider several model simulations and must evaluate model performance, using simulations of present-day conditions.

The recent Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report concluded that there is considerable confidence that current fully coupled global models can provide credible quantitative estimates of future climate change, particularly at continental and larger scales (IPCC 2007). Numerical weather prediction was developing in the 1950s as one of the

first computer applications. Almost immediately it became evident that computers could be used for numerical simulation to study climate.

These developments spurred interest in accelerating the development of improved climate models. The primary focus of Working Group 1 of the United Nations Intergovernmental Panel on Climate Change (IPCC), which began in 1988, was the scientific inquiry into physical processes governing climate change. IPCC's first Scientific Assessment (IPCC 1990) stated, "Improved prediction of climate change depends on the development of climate models, which is the objective of the climate modelling programme of the World Climate Research Programme."

It is important to note that there is a very high uncertainty around the scientific predictions of specific future climate changes associated with carbon dioxide emissions. In addition, climate change is expected to have vastly different effects on different regions of the world. This paper focuses on rainfall variability, droughts and floods. Other changes, such as increasing temperatures and changes in the length of growing season, are not examined in this study, as it was not possible to observe the impact of these long-term changes on farmer well-being in the short duration.

There are different methods applied during forecasting of climate change.

National Communications Support Unit (NCSU) is developing an integrated package of methods to assist developing countries to develop adaptation measures to climate change. Assessments of vulnerability are informed by estimates of the impacts of climate change, which in turn are often based on scenarios of future climate. These scenarios are generally derived from projections of climate change undertaken by Global Climate Models (GCMs). These GCM projections may be adequate up to a few hundred kilometres or so, however they do not capture the local detail often needed for impact assessments at a national and regional level. One widely applicable method for adding this detail to global projections is to use a regional climate model (RCM). Other techniques include the use of higher resolution atmospheric GCMs and statistical techniques linking climate information at GCM resolution with that at higher resolution or at point locations.

The provision of a flexible RCM is thus part of an integrated package of methods, which would also include a range of GCM projections for assisting countries to generate climate change scenarios and hence to inform adaptation decisions. The Hadley Centre has developed such a flexible RCM to provide non-Annex I Parties with a practical tool to make their own projections of national patterns of climate change and hence estimate the possible impacts and assess their vulnerability. It must be stressed that the RCM does not replace GCMs, but it is a powerful tool to be used together with the GCMs in order to add finescale detail to their broad-scale projections.

This new regional modelling system, PRECIS (Providing Regional Climates for Impacts Studies, pronounced pray-sea, i.e. as in French), has been developed at the Hadley Centre.

According to the Intergovernmental Panel on Climate Change (IPCC), average global temperatures have already risen by 0.6°C due to anthropogenic forces, and scientists expect a further 1.5° to 3° of warming by the end of the 21st century (Alley et al 2007). Climate change will have a disproportionately large effect on developing countries that still rely heavily on agriculture and other ecosystem services (World Bank 2008).

Scholars expect that climate change will reduce agricultural productivity in the developing world by 10-20% by 2050 because of changing rainfall patterns, warming temperatures, increases in the

frequency of extreme weather events, and more prevalent crop pests and diseases (Nelson et al 2009; Rarieya and Fortun 2009). All of the studies reviewed have a very high error term in their predictions of future climate changes, particularly at the local level (Nelson 2010). Despite this potential for error, according to the World Bank (2008), "scientific evidence about the seriousness of the climate threat to agriculture is now unambiguous."

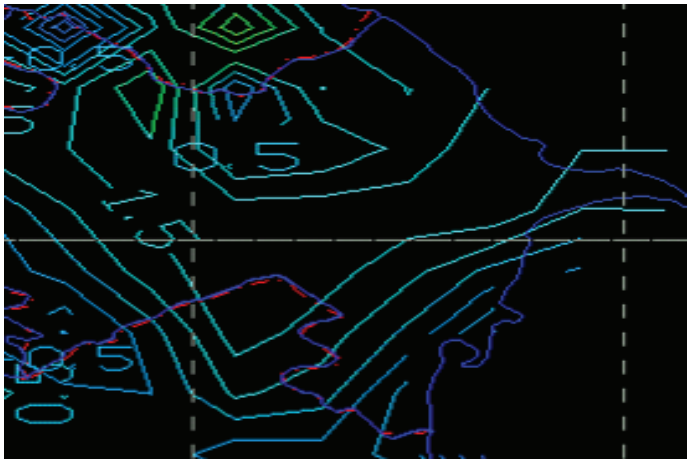
Regards the climatic forecast for Azerbaijan, last analysis on that have been provided in Second National Communication to UNFCCC. In this document,

Climate scenario has prepared based on the "PRECIS 1.4" ((Providing Regional Climate for Impact Studies) model developed by the Center of Climate Prognosis and Research of the Great Britain Meteorological Organization.

It was identified a version of calculation based on PRECIS model by differing border conditions and emission scenarios. Due to this version, ECHAM4 border conditions and A2 emission scenario was elected. Calculations have been provided for 3 periods:

- I period: plays role of basis covering the period of 1960-1990
- II period: is the period of scenarios for 2020-2050
- III period: it is also scenario period and covers 2070-2100 years

Figure 7: Map of differences between average annual temperatures and climate data for 1961-1990 (1961-1990, PRECİS, Emission Scenario)



As it is clear from the figure, the difference in our region is +0,5^{o} to +1,5^{o}. This is to say that, PRECIS model increases temperatures within our borders in compare with current observations. These numbers have taken into account in PRECIS model.

Temperature change in 2020-2050 years

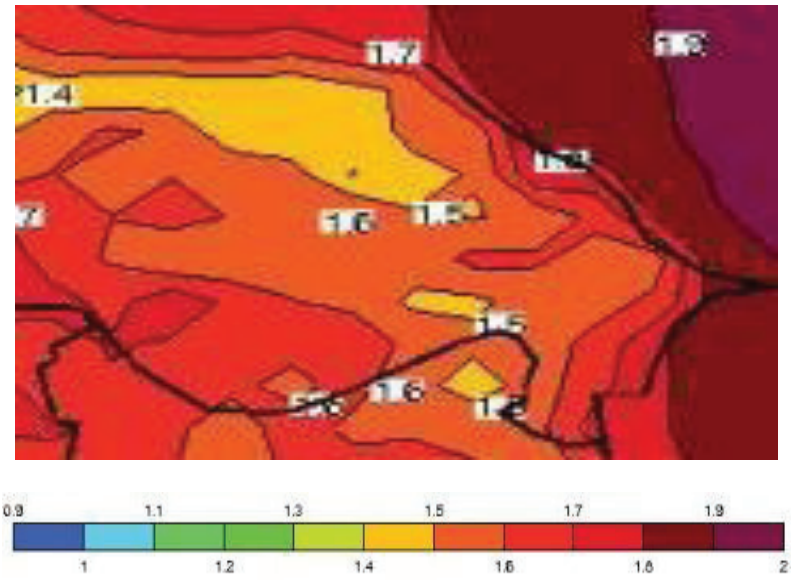
Due to border conditions of PRECİS model and emission scenario in 2020-2050 years the average yearly temperature increase will be 1,6-1,7 C^{0} (table 6). When in Agsu and Shamakhi districts this

increase will be 1,6^{0}C, in Gobustan it will be 1,7^{0}C. The temperature increase in 1991-2010 years was approximately 0,8^{0}C. This proves the accuracy of climate change information of the model.

Table 8: Temperature change in 2020-2050 years

District	Period 2020-2050 (^{0}C)
Gobustan	1.7
Shamakhi	1.6
Agsu	1.6

Figure 8: Increase of average annual temperature in the region (difference between data of 1961-1990 and 2020-2050 period)



Change in rainfalls in 2020-2050 years

Rainfalls will increase by 15% in 2020-2050 years in compare with 1961-1990. That is to say that, the decrease of rainfalls is not expected (table 7). Despite of increase of rainfalls, evaporation also increases. And this will increase demand for irrigation water.

Table 9: Change of rainfalls in 2020-2050 year, in percentage

Districts	Period 2020-2050 (%)
Gobustan	15
Shamakhi	15
Agsu	15

Due to provided comparative analyses of different forecasting methods, it was finally agreed that the most suitable forecast is that the amount of rainfall will going to decrease in the region.

Temperature change in 2070-2100 years

Temperatures calculated based on PRECIS model for 2070-2100 years will increase by 5.0-5.1^{0}C in compare with 1961-1990 years.

Table 10: Change of rainfalls in 2020-2050 year, in percentage

Districts	Period
	2070-2100 (%)
Gobustan	5
Shamakhi	5.1
Agsu	5.0

Change in rainfalls in 2070-2100 years

Rainfalls increase by 30 % in the region. Sharp increase in the amount of rainfalls creates some doubts on accuracy of the model related to rainfalls. For this, when creating the scenario of rainfalls it must be analyzed results of other border conditions.

It is interesting that, with increased rainfalls (30%), the evaporation is observed more and as a result water supply of the area is reduced as well. And this will lead to increase of water demand in the area.

Due to provided comparative analyses of different forecasting methods, it was finally agreed that the most suitable forecast is that the amount of rainfall will going to decrease in the region.

In below, it is provided information on forecasted climate change on water resources, agro-climatic sources and agriculture.

Water resources. Surface water resources are projected to reduce by 23% between 2021 and 2050, a loss of 22.5 km3. In the period 2071 to 2100, water resources are likely to reduce up to 20.7km3, or 29% lower than the baseline year level. The level of water shortage in that period will likely be 3.5 to 4 times higher than the baseline level. As today, agriculture, hydroenergy and water supply will continue to be the most vulnerable areas. In order to mitigate the adverse effects of future climate change, the following adaptation measures are proposed: enhancement of the water resources management system; introduction of additional sources of water; clean-up of river channels, strengthening defenses against inundations and flash floods; reducing water wastage and improving quality in supply networks; restoration and reconstruction of main water channels, watering and drainage systems; and construction of small HESs on mountain rivers and irrigation channels, etc.

Agro climatic resources. It is forecast that in 2021-2050 the number of days with mean temperatures above 100C will rise by 100-700%, for an additional 10 to 35 such days per year. during 2071-2100 the number of days with mean temperatures above 100C will rise by 1100-1500% over the baseline figure, for an additional 25 to 80 such days per year. As for humidity, evaporation will likely rise by 15% over the baseline year level by 2050. However, because of the projected simultaneous rise of 10 to 20% in rainfall levels, a shortage of humidity experienced by

plants during vegetation (climatic water balance) will be reduced by 85 to 260 mm, as compared to the baseline year. In 2071-2100 the level of precipitation is forecast to rise by 20 to 40% in most of the irrigated areas of the country. But because of the forecast prevailing increase in the level of evaporation, the climatic water balance might rise 20-100mm during vegetation.

Agriculture. The forecast increase in warming resources and extension of the duration of vegetation could favorably impact cotton plantations. Thus, presently cultivated medium-ripening varieties can be replaced with better quality late-ripening long fiber ones. It is possible to raise their productivity to match the high numbers achieved in 1980s or even improve this figure even higher. In both periods there will be favorable conditions for the present borders of areas where cereals are grown to move towards mountains (much more in the second period). However, due to a shortage of favorable soil resources in these areas, the expansion will be limited. Despite the fact that the duration of plant's potential vegetation in conventional areas of cereals growing will extend due to global warming, the actual plants' vegetation will shorten by 10-15 or 20-25 days. This will make it possible to grow cereals in wider areas. In addition, early harvest of wheat followed by sowing of forage, melons, greens, etc. will make it possible to harvest two and three times a year, raising overall productivity. However, this will be greatly dependent on water supply. In 2021-2050 the borders of vineyards of industrial importance might, dependent on region, move up from the present 800-900m elevation another 200-450m toward the mountains. In 2071-2100 favorable conditions for plants may exist at 1400-1700m, but a lack of suitable lands for vineyards will limit the expansion. Harvest on fallow vineyards is expected to rise by 4-5 times in the first period. The level of sugar in grape juice will likely rise 2-3% in the first period and 6 to 7% in the second. In both periods a slight rise (up to 1%) in the level of acid in grape juice is expected to take place.

In spite of the increasingly favorable climate for winter pastures, their area might diminish due to soil erosion and an increased crops growing. In both periods the increased precipitation might cause a rise in the productivity of winter pastures both in winter and spring.

Module 4: Climate change and agriculture: impact of climate change into agro-biodiversity

Module structure:

Part I (Climate change and agriculture)

- Agricultural vulnerability towards climate change
- What are impact of climate change to agriculture?
- Adaptive measures in agriculture

Part II (Climate change and agro-biodiversity)

- Agro-biodiversity and climate change
- Adaptive measures for conservation of agro-biodiversity in light of climate change

Part I (Climate change and agriculture)

Agriculture is extremely vulnerable to climate change. Higher temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. Although there will be gains in some crops in some regions of the world, the overall impacts of climate change on agriculture are expected to be negative, threatening global food security.

Populations in the developing world, which are already vulnerable and food insecure, are likely to be the most seriously affected. In 2005, nearly half of the economically active population in developing countries—2.5 billion people—relied on agriculture for its livelihood. Today, 75 percent of the world's poor live in rural areas.

Global agriculture will be under significant pressure to meet the demands of rising populations using finite, often degraded, soil and water resources that are predicted to be further stressed by the impact of climate change. The ongoing buildup of greenhouse gases in the atmosphere is prompting shifts in climate across the globe that will affect agro-ecological and growing conditions.

In addition, agriculture and land use change are prominent sources of global greenhouse gas emissions. The application of fertilizers, rearing of livestock, and related land clearing influences both levels of greenhouse gases in the atmosphere and the potential for carbon storage and sequestration.

Therefore, whilst ongoing climatic changes are affecting agricultural production, the sector itself also presents opportunities for emissions reductions.

Despite these opportunities, warming of the climate — as the IPCC warns above — is unequivocal. Even if emissions from all sectors were reduced to zero, climate warming would continue for decades to come. As a result, it is of interest to stakeholders in the agricultural sector to understand the kind of impact climate change will have on food and crop production. There will undoubtedly be shifts in agro-ecological conditions that will warrant changes in processes and practices — and adjustments in widely accepted truths — in order to meet daily food requirements.

In addition, climate change could become a significant constraint on economic development in developing countries that rely on agriculture for a substantial share of gross domestic production and employment.

However, adapting to new climate scenarios may not be feasible in all situations. A lack of adaptive capacity due to constraints on resources, like access to weather forecasts or better seed varieties, may result in further food insecurity. In order to better prepare vulnerable regions, climate scientists and economists are using integrated assessment models to help identify those regions and crops that may be at high risk due to climate change and its resulting socio-economic impact.

Potential direct effects on agricultural systems:

- Seasonal changes in rainfall and temperature could impact agro-climatic conditions, altering growing seasons, planting and harvesting calendars, water availability, pest, weed and disease populations, etc.
- Evapotranspiration, photosynthesis and biomass production is altered.
- Land suitability is altered.
- Increased CO2 levels lead to a positive growth response for a number of staples under controlled conditions, also known as the “carbon fertilization effect”.

Decisions about what adaptation measures to adopt are not taken in isolation by rural agricultural individuals, households or communities, but within the context of a wider society and political economy.

End choices are thus shaped by public policy, which can either be supportive or which can at times provide barriers or disincentives to adaptation. Adaptation policy is in many cases an extension of development policy that seeks to eradicate the structural causes of poverty and food insecurity. The complementarities between the two will enable a streamlined approach towards achieving both adaptation and poverty alleviation goals.

General policies that should be supported include those:

- promoting growth and diversification; strengthening institutions;
- protecting natural resources; investing in research and development, education and health;
- creating markets in water and environmental services;
- improving the international trade system;
- enhancing resilience to disasters and improving disaster management;
- and policies promoting risk-sharing, including social safety nets and weather insurance.

Selecting appropriate adaptation measures to pursue is context and project specific. Criteria to consider include the:

- net economic benefit;
- timing of benefits;
- distribution of benefits;
- consistency with development objectives;
- consistency with other government policies;
- costs involved;
- environmental impacts;

- spill-over effects;
- implementation/implementing capacity;
- and social, economic and technical barriers.

Once an adaptation strategy has been evaluated, the measure that yields the greatest net benefit should be chosen.

For Azerbaijan, initial attempts in identification of adaptive measures in agriculture was launched during preparation of Initial Second Communication. Identified adaptive measures in agricultural sector in Second National Communication of Azerbaijan to UNFCCC:

Agriculture (is the sector of the economy most dependent on climate conditions – e.g. cotton, winter wheat, vineyards, winter pastures, summer pastures):

- Continued work on selection and introduction of drought resistant and highly productive winter wheat varieties
- Continued work on selection and introduction of heat-loving, drought resistant and highly productive cotton varieties
- Restoration of conventional vineyards and expansion of their area by planting new vineyards on mountain terraces
- Restoration of conventional tea plantation lands and creation of new plantations on favourable lands
- Continuation and expansion of measures to prevent soil erosion and salinity, and of drought response
- Application of water-saving technologies in irrigated lands
- Development and implementation of government programmes to facilitate growth in the manufacture of competitive products by processing plants in the agricultural sectors
- Creation of small processing plants for fast-rotting products in villages
- Improvement and expansion of existing storage systems (warehouses, refrigerators etc.) of agricultural products

Part II (Climate change and agro-biodiversity)

The agricultural sector is one of the largest contributors to greenhouse gas emissions, second only to the energy sector. Conversely, climate change affects agriculture throughout the world.

According to the fourth assessment report of the Inter-governmental Panel on Climate Change, crop yield losses as a result of climate change will be more severe in the tropics than in temperate regions. Estimates indicate that between 75 million and 250 million people in Africa will be affected by water shortages caused by climate change.

As in any situation of economic imbalance, the poor will be the most affected – losing livelihood opportunities and access to food and water. Many mitigation and adaptation measures are beyond the reach of countries with severe resource constraints.

Adapting to climate change

Adaptation to climate change should be considered from a contingency planning process perspective. Many least developed countries have had the opportunity to develop National Adaptation Plans of Action in the context of the United Nations Framework Convention on Climate Change but implementation of those programmes and strategic links to resourcing actions are often lacking.

Adaptation in the agricultural sector can be seen in terms of both short-term and long-term actions. The provision of crop and livestock insurance, social safety nets, new irrigation schemes and local management strategies, as well as research and development of stress resistant crop varieties form the core of short-term responses. Long-term responses include redesigning irrigation systems, developing land management systems and raising finances to sustain adoption of those systems.

Agriculture and mitigation

Livestock and crops emit carbon dioxide, methane and nitrous oxide making agriculture a major source of greenhouse gases. Some 80 per cent of these emissions come from developing countries. Agriculture is also a major cause of deforestation according to reports of the United Nations Framework Convention on Climate Change. Nitrous oxide emissions from soils, because of the use of fertilizers and manures and methane from livestock production account for a third of noncarbon dioxide emissions. Land use change, compounded by agriculture, also reduces carbon sequestration.

Challenges

In light of the foregoing, the agricultural sector faces multiple challenges. While intensification and diversification of agriculture is key to securing food for local people, in the absence of clear understanding of their impacts on agriculture, they can be problematic.

Though measures to reduce the use of fertilizers, to increase organic inputs and to deploy new varieties of crops are suggested as better agronomic practices, more clarity is required regarding their impacts on climate. For example, the selection of rice varieties that include wetland rice in sub-Saharan Africa can reduce deforestation as well as management costs and emissions.

Agriculture could also benefit from emerging areas of climate change action. For example, it could profit from the benefits of land uses that sequester carbon, from the emerging markets for trading carbon emissions. Such activities offer higher returns than those arising from forest conversion to agricultural land.

Livestock improvements brought about by more research on ruminant animals, storage and capture technologies for manure and conversion of emissions into biogas are additional contributions that agriculture can make towards mitigating climate change.

National agricultural priority setting should consider climate change responses. While the biophysical impacts of climate change on agriculture and vice versa are better understood, the social and economic impacts have not been researched adequately in many developing countries. With increasing trade distortions and the changing prioritization of agriculture in developed countries, developing countries affected by climate change should focus on developing suitable

national, regional and global measures that will provide a safety net in the short term, should productivity fail owing to climate variability and change.

Institutional and human resource capacities supported by sustained funding options in the form of direct or indirect investments into adaptation to climate change in agriculture are essential. Mainstreaming climate change issues into national economic and development plans is critical to enabling countries tackle the impacts of climate change on agriculture and reducing the negative effects of agricultural practices on climate change.

Module 5: Agro-biodiversity – the key for food security and adaptation to climate change

Module structure:

Part I (Agro-biodiversity and its loss)

- What is agro-biodiversity and its loss?
- Importance of agro-biodiversity
- What are the implications of agro-biodiversity loss

Part II (Why conserve agro-biodiversity?)

- Food security
- Adapting to climate change
- International initiatives

Part I (Agro-biodiversity and its loss)

What is agrobiodiversity? Biological diversity – or biodiversity – is the "variability" of living organisms. It includes diversity within species, between species and among ecosystems. Agrobiodiversity is part of biodiversity: it covers the species and their ecosystems that are used for agriculture.

Loss of agrobiodiversity: Agricultural diversity has fallen sharply since the beginning of the 20th century in the industrial world, though this decline has since slowed. Today, genetic erosion is taking place mainly in the developing world, especially in tropical regions that initially had very high initial diversity. This loss of diversity in the tropics is also important for developed countries: it means the irretrievable loss of options to ensure food security and to adapt agriculture to climate change.

Importance of agrobiodiversity: Agricultural biodiversity makes it possible to use infertile land in a productive way, so contributing to the food security of people who are subject to poverty and hunger. In doing so, it boosts global farm production. Genetic diversity is crucial to enable agriculture to adapt to changes in the climate and the environment, for example through crops that tolerate heat or drought.

Causes of the decline in agrobiodiversity: Major reasons for the disappearance of species and varieties include the industrialization of agriculture, the introduction of genetically modified varieties, a lack of economic incentives to conserve biological diversity, and the increasing privatization of genetic resources.

Existing agreements: In the past 50 years, three international agreements have been created that are relevant to biodiversity:

• The Convention on Biological Diversity (CBD) grants signatories the rights to the biological resources in their territories and requires them to maintain these resources. The Convention includes the Cartagena Protocol on Biosafety that aims to avoid the risks of gene technology.

• The Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), administered by the World Trade Organization, deals with patenting issues for plants and animals.

• The International Seed Treaty (the International Treaty on Plant Genetic Resources for Food and Agriculture or ITPGRFA), requires member countries to maintain agricultural crops, ensure their free exchange, and recognize farmers as custodians and users of genetic diversity (this is known as “Farmers’ Rights”).

To enhance the conservation of agricultural diversity, it is necessary to place Farmers’ Rights on the same legal footing as TRIPS and national legislation on seed. In terms of development policy, the incorporation of Farmers’ Rights into national laws and regulations has high priority. Because many developing countries lack technical expertise on the links between biodiversity conservation, food security and poverty reduction, there is a considerable demand for advice to enable these countries to design appropriate policies. A further urgent task is to implement the Cartagena Protocol on Biosafety. Such legislation must be accompanied by appropriate agricultural policies. These include targeted economic development (e.g., ensuring that biodiversity- related products have an economic value), developing infrastructure (such as creating genebanks at the farmers’level), research (e.g., breeding crops and animals to adapt to climate change), and training of specialists and raising awareness in this field. A separate policy area should not be created; rather, agricultural biodiversity should be incorporated as an integral part of existing initiatives.

Agriculture is an important but little-regarded component of biological diversity. Agricultural biodiversity is special because it was created by humans: it is a cultural asset. Ever since agriculture was developed over 10,000 years ago, farmers have bred crops and animals. Over time, farmers have created an enormous range of crops from more than 10,000 plant species. The resulting varieties are suited to different conditions. Each has its own characteristics and cultivation requirements, and produces a specific type of product. In India, for example, there were at one time up to 30,000 different local rice varieties. A similar process took place in livestock to create different breeds of cattle, sheep, goats, pigs, etc. Over the last 12,000 years, livestock keepers have developed more than 5,600 breeds of 40 species of animals.

Parallel to this biological diversity, farmers have developed detailed knowledge about how to protect, use and develop these crops and animals. This is closely linked to the emergence of humanity’s enormous cultural diversity. The term “agrobiodiversity” encompasses this spectrum. It is a major contributor to our survival, providing us with food, clothing, fuel, building materials, medicines, spices, dyes and perfumes.

Agrobiodiversity has enabled humankind to colonize new habitats, build civilizations, cope with environmental changes, and survive in difficult locations. Agrobiodiversity plays a growing role outside the agricultural sector: in food processing, as raw materials for industry, in the pharmaceutical and cosmetics industries, and recently also for energy supplies.

What are the implications of agrobiodiversity loss?

The rich diversity of crops and livestock has been declining for over 100 years. In developed countries most losses took place in the 20th century, though the rate of decline there has now slowed. But the trend continues unabated in developing countries. In China, for example, there were still 10,000 local varieties of wheat in 1949; today fewer than 1,000 are grown on a large scale. In other words, 90 percent of the wheat varieties have disappeared from farms in just half a century. The rapid fall in agricultural genetic diversity in the countries of the South is important for developed countries too: almost all the centres of biodiversity for crops – and many of those of livestock too – are found in the developing world.

Part II (Why conserve agro-biodiversity?)

Of the more than 925 million hungry people, around four-fifths live in rural areas. They are mainly farmers and livestock keepers. They are dependent on a wide range of local crop varieties and locally adapted breeds – which ensure their survival even in difficult environments. They do this even though the farmers use few inputs such as fertilisers, pesticides and irrigation. These people have few alternative sources of income. That means they can overcome hunger and poverty only by using the resources they have available in a better, more sustainable way.

Food is in short supply worldwide, and food prices are rising. The main reasons are:

• Continued population growth

• Changing diets, including a shift from plant to animal products and rising consumption of animal products in emerging and developing countries

• The associated increase in fodder production for livestock

• Competition for land from crops grown for biofuels

There is little opportunity to expand the world's agricultural production area significantly. But intensifying production in high-potential areas is not enough to overcome the shortage of food. At the same time, it is necessary to exploit the huge potential of agrobiodiversity to develop ecologically disadvantaged regions. In areas with low soil fertility and without reliable rainfall, local varieties often outperform high-yielding varieties, and mixed cropping significantly reduces the risk of total crop failure. They make it possible to stabilize and boost food production even without peak yields.

In many developing countries, edible wild plants and minor traditional local crops are important sources of food for people in rural areas, especially if harvests are poor and in times of crisis.

Knowledge about these plants must be preserved because of its contribution to food security.

Global warming is expected to have dramatic consequences for agriculture and food security, though the effects will be different from region to region. The first credible projections indicate that by the year 2080 the 40 poorest countries, located mainly in the tropics of Africa and Latin America, will lose up to 20 percent of their grain production capacity because of drought. Individual crops in rainfed areas have already reached the upper limits of their heat tolerance.

Adapting farming to climate change will soon be a central task for rural development efforts. Agricultural biodiversity is gaining new importance as “risk insurance” for the future.

Their genetic diversity gives plants and animals the ability to cope with challenges such as drought and rising temperatures. This adaptation is a dynamic process through which the organism comes to terms with its environment. Research in molecular biology has revealed the mechanisms responsible for the inheritance of adaptability to environmental influences. That means that drought-tolerant millet varieties, for example, should not only be stored for decades in a gene bank (this is known as ex-situ conservation). They must also be grown and bred in the field under various environmental conditions (called in-situ conservation) so they can adapt to the changing environment. At the same time, policies must ensure that the scale of environmental change does not exceed the potential of the organisms and ecosystems to adapt – otherwise a collapse could threaten previously stable systems. The social dimension of climate change is also important. Poor people must be enabled to adapt to changing environmental conditions, and their traditional knowledge and social organization must be strengthened and further developed.

Discussions about the conservation, use and development of agrobiodiversity go back 50 years. During this time, various sets of rules and institutions have emerged. These include the International Seed Treaty, the most important agreement for agriculture, which is based on a resolution of FAO (the Food and Agriculture Organization of the United Nations) passed in 1959. The Convention on Biological Diversity was negotiated between 1990 and 1992 in the run-up to the “Earth Summit” in Rio de Janeiro.

Parallel to these and largely independently from them, agreements on the protection of trade-related intellectual property rights (TRIPS) were developed as part of the process of creating the World Trade Organization. It is now necessary to harmonize these three major sets of rules in relation to the conservation and sustainable use of agrobiodiversity, and to specify how they should work in detail.

Convention on Biological Diversity - The 1992 United Nations Conference in Rio de Janeiro passed the internationally binding Convention on Biological Diversity (CBD). The Convention has three objectives:

• the conservation of biodiversity,

• its sustainable use, and

• the fair and equitable sharing of benefits arising from the use of genetic resources (access and

benefit sharing, ABS)

Before then, genetic resources were often regarded as the common heritage of mankind, and it was assumed that they should be freely accessible to all.

In 1996, the CBD signatories launched a programme for the conservation of agricultural biodiversity. This is regularly reviewed and updated. However, it is very general and is not seen as a high priority in the CBD process. Currently, the topics of agrobiodiversity, climate change and biofuels are under discussion in this context. These also played a prominent role at the CBD Conference of the Parties in Bonn in May 2008 (COP 9) and in Nagoya, Japan (COP 10) in October 2010.

The Cartagena Protocol on Biosafety was adopted in 2000. This stipulates that the import of genetically modified plants intended for cultivation may occur only with the consent of the importing country. It applies the precautionary principle, which requires someone taking an action to prove that the action will not result in harm.

Agreement on Trade-Related Aspects of Intellectual Property Rights - As part of negotiations that led to the creation of the World Trade Organization (WTO), the Agreement on Trade-Related Aspects of Intellectual Property Rights, TRIPS) was adopted in 1994. This obliges the signatory states to introduce protection for intellectual property (usually in the form of patents) in all fields of technology, specifically in biotechnology. This protection also extends to living organisms.

However, the TRIPS agreement permits the exclusion of plants and animals from patent protection. In such a case for plants, however, a special (sui generis) system of protection, or a combination of patents and a sui generis system, has to be introduced. Such a special protection system already exists in the form of “Plant Variety Protection”, established under the International Convention for the Protection of New Varieties of Plants (UPOV).

International Seed Treaty - The International Seed Treaty (International Treaty on Plant Genetic Resources for Food and Agriculture, ITPGRFA) was adopted by the members of the Food and Agriculture Organization (FAO) in 2001. It is an international agreement based on FAO’s constitution. The treaty obliges member states to conserve their plant genetic resources for food and agriculture in accordance with the CBD, to ensure their sustainable use, and to share equitably the benefits arising from their use via information exchange, technology transfer and capacity building.

The treaty also recognizes “Farmers’ Rights”: the traditional rights of farmers as producers, maintainers and developers of agrobiodiversity. Farmers’ Rights include:

• The protection of farmers’ traditional knowledge of plant genetic resources,

• The equitable sharing of the proceeds arising from their use,

• Participation in decisions on issues related to conservation and sustainable use of these resources, and

• Their right to keep seeds and planting materials grown on their farms, to plant them, to share them with others and develop them.

The implementation of Farmers’ Rights is the responsibility of the signatory states. The International Seed Treaty established a multilateral system to facilitate access to plant genetic resources for food and agriculture. It also created a system for sharing benefits, covering 64 food and forage crops of special importance for food security. This is in essence an association of national and international gene banks. For them, it provides for the exchange of genetic material between the parties and the equitable sharing of benefits arising from commercial use. It enables them to do this on the basis of standard contracts and without the need for negotiations.

Module 6: On-going national policy, legal framework and implemented activities on CC

Module structure:

Part I (On-going national policies)

- What is current national policy of Azerbaijan on climate change?
- Legislative basis
- International conventions ratified by the country

Part II (Implemented and on-going activities on climate change)

- What activities have been implemented?
- What activities are still in implementation stage?
- What is nearest future plans of the country related to climate change?

Part I (On-going national policies)

The environmental strategy of the Azerbaijan is aimed at the protection of natural resources at national, regional and international levels by strengthening coordination of actions, the application of scientifically-grounded development principles, and ensuring the sustainable use of resources to meet the needs of the present and future generations.

Ensuring environmental sustainability of development requires the elimination and restriction of serious problems arising from industrial activities. Given the contemporary state of the environment and socio-economic conditions, three main directions of national policy can be identified:

1. Prioritizing the maximum reduction of environmental pollution and stringent environmental regulation;

2. Sustainable use of natural resources to meet the needs of the present and future generations, including the use of renewable sources of energy and more efficient consumption;

3. Assessing global environmental problems at the national level and working to ameliorate them by identifying possible solutions and broadening relations with international institutions.

The following principles should be taken as priority to achieve objectives in environmental policy:

• Use of contemporary methods of economic and human resources management for improving the quality of the environment;

• Development and introduction of incentive-inducing economic models and technologies to meet the needs of the present and future generations;

• Implementation of principles of fair distribution of resources among present and future generations;

• Protection of the ecosystems and biodiversity that support daily human activities;

• Consideration of alternatives in the effort to meet short- and long-term economic, environmental and social objectives;

• Wider involvement of representatives of the public and non-governmental organizations in decision-making processes on environmental issues;

• Prevention of any activities likely to result in an irreversible damage to the environment;

• Ensuring the development of a strong, multifaceted economy that provides for the protection of environment;

• Broadening relations with international institutions and developed countries in the area of environment protection;

• Enhancement of education and public awareness-raising.

In 1996, the national environmental policy was presented as part of the National Report on the State of the Environment in Azerbaijan. The National Environmental Action Plan was prepared in 1998, in which priority projects on alarming environmental issues were identified.

Evidence of its successful promotion include: the development of a relevant legislative base to European standards; improved governance on environment protection; and steady implementation of priority projects in partnership with international institutions.

As socio-economic processes develop rapidly, new methodologies and principles are emerging in the environmental policy realm. The National Programme on Environmentally Sustainable Socio-economic Development prepared by MENR and approved by the President in 2003 has reflected an improved environmental policy and provided opportunities for its application.

A number of laws on environmental issues adopted by the National Parliament of the Republic of Azerbaijan in recent years, including the Law on Public Environmental Education and Awareness-Raising, have made it possible to fill gaps in this area.

Particular attention is given by MENR to the development of relations with international institutions and donor countries, with a view to the resolution of current problems. Notably, cooperation has now been extended with UNDP, UNEP, the EU, UN Industrial Development Organization, OSCE, the Global Environmental Facility, the Organization for Economic Development and Cooperation, the World Bank, the Asian Development Bank, the World Wildlife Fund and other agencies. In addition, bilateral cooperation has been established with various developed countries. Up to date, The Republic of Azerbaijan has joined 20 international environmental conventions and signed relevant protocols.

Since the first EPR, and following the completion of the first National Environmental Action Plan (NEAP) for the period 1998–2003, a second NEAP was not adopted, although one was developed. This happened despite the fact that the first NEAP can be credited with major successes, including contributing to the establishment of the Ministry of Ecology and Natural Resources and strengthening the development of Local Environmental Action Plans (LEAPs). It appears that when the new Ministry was established in 2001, it was decided that the Ministry would develop its own national plan, following its own format developed around State programmes and related action plans.

In the absence of a second NEAP, the main environmental policy document since the first EPR has been the National Programme on Environmentally Sustainable Social and Economic Development for the period 2003–2010**,** which was endorsed by the 2003 Presidential Decree No. 1152

Approving the National Programmes on Ecology. The National Programme covers the environmental aspects of the country's overall development strategy and is accompanied by an action plan covering the years 2003–2010 for its implementation. The action plan focused on five major areas, namely environmental protection and use of natural resources; global environmental problems; industrial complexes; agriculture and tourism; and education, science and culture.

The National Programme and its action plan were further complemented by the Comprehensive Action Plan on Improvement of the Environmental Situation for the period 2006–2010, which dealt with improving the environmental situation in various areas (Baku Bay, the Bebiheybat area, the areas adjacent to Heydar Aliyev international airport, Absheron peninsula, and other parts of Azerbaijan). The Comprehensive Action Plan also aimed to address general ecological problems and improve legislation.

MENR has been the main institution responsible for the implementation of the Action Plan and the Comprehensive Action Plan, providing key technical support and guidelines along the way. One of the strengths of the Action Plan has been the identification not only of the actions envisaged but also of the main implementing agencies and the required timelines. The main implementing agencies included those directly involved in key sectors, including agriculture, education, the environment, industry, science, and tourism.

However, there have also been considerable challenges in terms of implementation. This was partly due to the fact that the National Programme and the Action Plan lacked a clear identification of priority areas for funding purposes and did not include cost estimates. Additionally, and perhaps more importantly, priority items were not linked to budgetary sources but rather usually relied on sector-specific funding from a variety of often external sources.

Continuity and predictability in setting environmental priorities are important elements for ensuring effective environmental protection and management and signalling the intentions of the environmental authorities and the Government to domestic and international actors.

Global climate change is one of the greatest threats to the world community, a cause of adverse socio-economic and environmental effects. The continuing increase in atmospheric concentrations of greenhouse gases has had a perturbing effect on the earth's radiation balance, which has resulted in the rise of the annual mean temperature around the globe.

Recognizing the importance of this issue, the Republic of Azerbaijan joined other nations in ratifying the UN Framework Convention on Climate Change in 1995 and joining the Kyoto Protocol in 2000 with a view to supporting initiatives towards the mitigation of climate change effects.

This Second National Communication has been prepared as part of commitments under the UN Framework Convention on Climate Change. The report presents a national situational analysis, quantifies greenhouse gas emissions, posits a number of future climate scenarios, assesses the vulnerability of various economic sectors and ecosystems, and calls for various adaptation measures. For the first time, the Communication presents an assessment of possible climate change impacts on human health.

In recent years the country's economy has grown rapidly. Fortunately, the use of new technologies and the implementation of abatement measures have prevented a concurrent rise in greenhouse gas emissions. Energy efficiency has increased as alternative energy research and projects are

implemented, and ever-more carbon dioxide is removed from the atmosphere with expanding forest and vegetation cover zones.

Part II (Implemented and on-going activities on climate change)

The Republic of Azerbaijan ratified the UNFCCC in 1995. In order to facilitate the implementation of the Convention a State Commission on Climate Change was established in 1997 by a resolution of the President of the Azerbaijan Republic. The Commission was composed of representatives of all related institutions and ministries. In 2000, the Kyoto Protocol was ratified. Under financial support of Global Environmental Facility and UN Development Programme a project on Initial National Communication of the Republic of Azerbaijan to UNFCCC was developed during 1998 to 2000.

The Initial National Communication by the Republic of Azerbaijan was prepared in 1998-2000. At that time, the Republic of Azerbaijan was recovering from the economic crises and difficulties in collecting statistical data and the cessation of operations by a number of plants led to the rise of uncertainties in a wide range of data, particularly in the calculation of the amount of greenhouse gases emissions and evaluation of abatement measures.

The Second National Communication of the Republic of Azerbaijan has been prepared as part of commitments under the UNFCCC. The report provides information on national circumstances, the amount of emissions from greenhouse gases sources, analysis of the present and future climate, the assessment of vulnerability of the economic sectors and ecosystems to climate change effects and adaptation measures to these effects. An assessment of climate change impact on the human health has, for the first time, been presented in the Second National Communication (Second National Communication to UNFCCC, 2010).

Examples: Selected adaptation options from the National Communications to UNFCCC

Azerbaijan:

Water (most vulnerable sectors are hydro energy and water supply):

- Reducing water leakages in water management facilities
- Introduction of additional sources of water
- Use of hydrologic cycle water, including groundwater (there is still high potential for ground water use in Azerbaijan)
- Regulation of flows
- Taking protective engineering measures in stream beds of lakes and rivers against floods
- Building small HESs (hydroelectric stations) on mountain rivers and construction of new water impoundments
- Building small HESs on existing irrigation channels
- Clean-up of rivers channels etc.

Agriculture (is the sector of the economy most dependent on climate conditions – e.g. cotton, winter wheat, vineyards, winter pastures, summer pastures):

- Continued work on selection and introduction of drought resistant and highly productive winter wheat varieties
- Continued work on selection and introduction of heat-loving, drought resistant and highly productive cotton varieties
- Restoration of conventional vineyards and expansion of their area by planting new vineyards on mountain terraces
- Restoration of conventional tea plantation lands and creation of new plantations on favourable lands
- Continuation and expansion of measures to prevent soil erosion and salinity, and of drought response
- Application of water-saving technologies in irrigated lands
- Development and implementation of government programmes to facilitate growth in the manufacture of competitive products by processing plants in the agricultural sectors
- Creation of small processing plants for fast-rotting products in villages
- Improvement and expansion of existing storage systems (warehouses, refrigerators etc.) of agricultural products

There are a number of on-going projects in the country related to adaptation to climate change funded by international donors such as World Bank and EU. In below it is provided brief information about 2 on-going adaptation project:

Reducing Vulnerability to Climate Change in Azerbaijan's Agricultural Systems: *Developing Adaptation and Mitigation strategies*

The program aims to assess the potential impacts of climate change on the agricultural sectors in the South Caucasus countries, and identify strategies for climate change adaptation and mitigation measures to increase the climate resilience of the agricultural systems while maximizing co-benefits for sustainable development. The overall aim is to increase the ability of the South Caucasus countries in mainstreaming climate adaptation and mitigation into sector-specific agricultural policies, programs and investments.

"Identification and implementation of adaptation response to Climate Change impact for Conservation and Sustainable use of agro-biodiversity in arid and semi-arid ecosystems of South Caucasus" project is regional project implemented in three South Caucasus countries by The Regional Environmental Centre for the Caucasus.

The overall objective of the project is to build adaptive capacities in three South Caucasus countries to ensure resilience of agro-biodiversity of especially vulnerable arid and semi-arid ecosystems and local livelihoods to climate change. There are also three other specific objectives envisaged within the project:

- To promote agro-biodiversity conservation and adaptation to Climate change through introduction of supportive policy framework at national and local level
- To improve institutional and individual capacity for sustaining agro-biodiversity in arid and semi-arid ecosystems and increasing livelihood level in face of climate change

Support in development and implementation of coping mechanisms to improve resilience of local communities to future climate change through introduction of sustainable agricultural practices in selected regions.

Module 7: Assessment of vulnerability to climate change

Module structure:

Part I (Vulnerability terminology and functions)

- What is the vulnerability?
- What are the main vulnerability functions?
- What are the most important terms when discussing vulnerability and adaptation?

Part II (Assessment of vulnerability at local level)

- How can the concept of vulnerability be applied?
- How can adaptation be approached in a local context?

Case study: Vulnerability related data for Agsu-Shamakhi-Gobustan region

- Group work: assessment of vulnerability at local level

Part I (Vulnerability terminology and functions)

Vulnerability is the degree to which a system is susceptible to, and unable to cope with adverse effects of climate change. Vulnerability is a function of exposure to climate stresses, sensitivity and adaptive capacity. Vulnerability increases as the magnitude of climate change or sensitivity increases, and decreases as adaptive capacity increases.

Climate related stresses = Exposure: Character, magnitude and rate of climate variation to which a system is exposed.

Sensitivity: *degree to which a system can be affected, negatively or positively, by changes in climate.*

Adaptive Capacity: *ability to adjust to climate change to moderate damage, take advantage of opportunities or cope with consequences.* Adaptive capacity is a function of the relative level of a society's economic resources, access to technology, access to climate information, skills to make use of the information, institutions and equitable

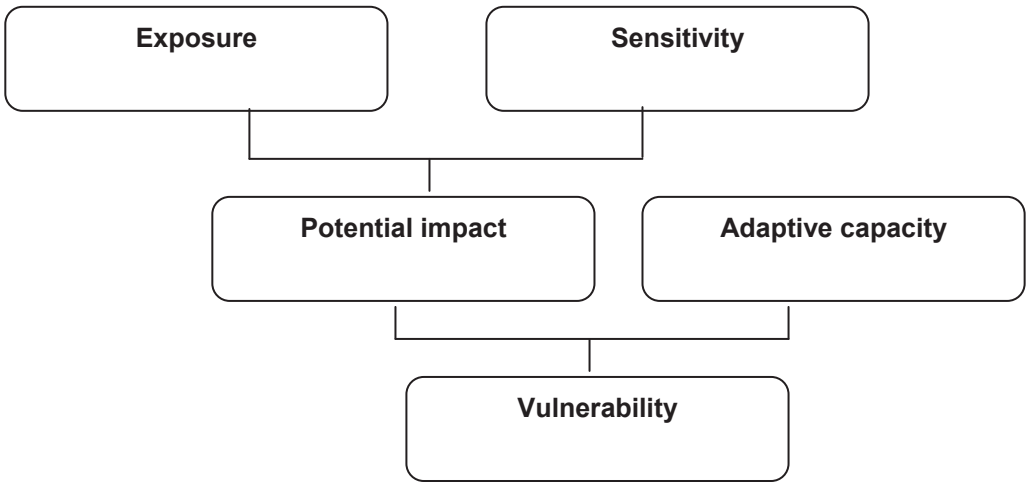
distribution of resources. In ecosystems, adaptive capacity is closely linked to biodiversity .

Impact: *the potential effect of a climate change hazard on a system of interest. Can be positive or negative.*

Biophysical impacts are those impacts that result from climate change factors, e.g. damaged infrastructure due to flooding or erosion of shorelines due to storm surge.

Socioeconomic impacts are those impacts that (for the bigger part) follow biophysical impacts and affect socio-economic development, e.g. declines in access to services due to damaged infrastructure or losses in tourism revenues due to shoreline erosion.

Figure 9: Vulnerability functions



Sensitivity and adaptive capacity:

- at the local level are influenced by many factors, e.g. income level, education, settlement patterns, infrastructure, ecosystem and human health, gender, political participation and individual behaviour (for an exhaustive list see IUCN 2010).
- shape the way in which people are able to reduce exposure to, cope with, and/or recover from negative impacts of climate change or, alternatively, take advantage of the opportunities afforded by climate change.
- Individuals, households, communities and municipalities have longstanding experience in responding to climate variability and change, but with varying levels of success. These coping strategies can be used to form the basis of successful adaptation strategies. However, some of these coping strategies could prove to be unsustainable over time as climate change progresses, leading to a greater risk of mal-adaptation, e.g. short-term adaptation strategies in response to a decrease in rainfall could include over-exploitation of groundwater resources, which could actually exacerbate vulnerability over the longer term.
- Poverty is an important determinant of vulnerability to climate change; and precarious livelihoods will be further challenged through climate change. Lower-income groups are hit hardest because of greater sensitivity (e.g. those living in makeshift housing on unsafe and/or remote sites) and less capacity to cope and adapt (e.g. lack of assets and insurance). There are strong complementarities between reducing poverty and reducing vulnerability to climate change, e.g. higher incomes increase the adaptive capacity of households.
- Adaptation to climate change requires bottom-up thinking. On the one hand, local knowledge on climate change and response options enlarges the overall management capacities, e.g. climate information from local observation may bring historical information far beyond meteorological observation. On the other hand, local people's participation is a development value as such and especially important to avoid conflicts.

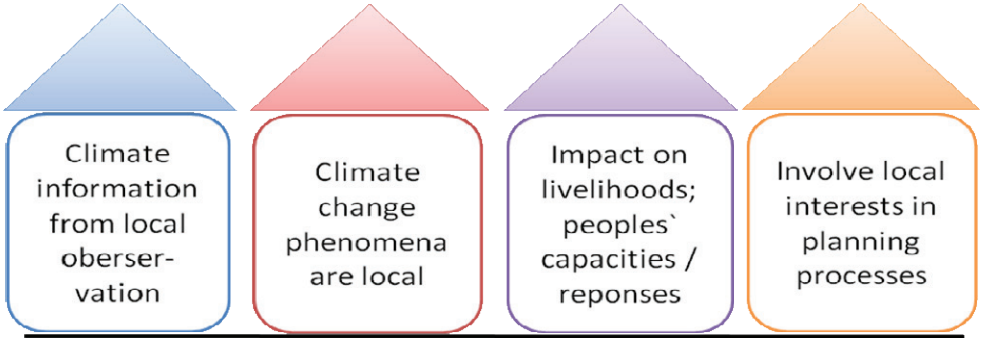
- Participatory Rural Appraisal (PRA) Tools can support the vertical integration in planning and make interventions more targeted.
- However, conflicts do not only occur between vertical levels, but also between competing interests at local level. Some have structural reasons and need support from outside to be solved, some can be solved at the local level.

Part II (Assessment of vulnerability at local level)

Mostly climate change forecasts are provided at global level. The same is for provided vulnerability assessments. For instance, in Second Communication of Azerbaijan to UNFCCC climate change forecast and vulnerability assessment are provided on country level. But, when implementing a specific project in identified target area, there is need for local approach. It needs conduction of separate vulnerability assessment for pilot areas as it was made under "Identification and implementation of adaptation response to Climate Change impact for Conservation and Sustainable use of agro-biodiversity in arid and semi-arid ecosystems of South Caucasus" project for selected Shamakhi-Agsu-Gobustan districts.

In below figure, it is provided the main reasons for assessment of vulnerability at local level:

Figure 10: Reasons for assessing vulnerability at local level



Entry points

- Local government planning processes – village, district or city plans – can consider climate change trends or scenarios and no-regrets adaptation (with strong co-benefits in the absence of climate change). These primarily have a 1-5 year time horizon.
- Local service provision, i.e. technical expertise and information related to climate change adaptation, can be provided to resource managers or farmers.
- Civil society processes play an important role in advocating for local people, informing research agendas, raising awareness, capacity development and service delivery in some cases (such as health, disaster risk reduction, etc.).
- Participatory rural appraisal (PRA) processes can incorporate the identification of climate vulnerability factors and integrate discussions about trends, priorities and options for adaptation.

Main lessons learnt

- Local refers to a sub-national scale, but can mean something as specific as a particular area or place. (Local includes urban and rural settings, but the exercise with Gobustan deals mainly with rural settings.)
- Local level analysis gives insight into climate change impacts on the ground, i.e. how people's lives and everyday activities are affected and how they deal with challenges.
- Adaptation is a multi-level planning process. Local interests need and deserve to contribute to planning processes in order to ensure uptake and the sustainability of initiatives. Local assessments can guide targeted action from other levels (regional, national) towards highly vulnerable communities and areas at the highest risk (bottom-up).

Case study: Vulnerability assessment for Agsu-Shamakhi-Gobustan region

Selection of indicators for assessment of vulnerability and detailed description

Methodology for selection of vulnerability indicators has been proposed by international expert. In accordance with widely accepted approach on vulnerability it has been chosen to use the three major vulnerability components:

1. Adaptive capacity of communities to climate change

2. Exposure of communities to climate–hazards

3. Sensitivity of communities to climate–hazard exposures

Each of these three vulnerability components is further divided on subcomponents. For each vulnerability sub-components, a set of vulnerability indicators has been assigned.

Based on the data provided by national experts, vulnerability indicators have been assessed for each vulnerability sub-component. This has been done separately for each of pre-selected region.

Table 11: Vulnerability components

Component	**Sub-component**
ADAPTIVE CAPACITY	Social capital
	Human capital
	Financial capital
	Physical capital
Exposure	Climate hazards
Sensitivity	Ecosystems
	Communities
	Agriculture

Then, it was identified indicators within each sub-component. Each indicator have been provided with relevant weight within the sub-components by project team based on the significance of appropriate indicator. The division of weights between indicators is given below:

For Adaptive Capacity:

Social capital	
Farm organisations	0,80
Female work	0,20
Total social capital	0,25
Human capital	
Literacy	0,40
Education	0,40
Agricultural education	0,20
Total human capital	0,25
Financial capital	
Livestock density	0,30
Average salary	0,70
Total financial capital	0,25
Physical capital	
Infrastructure	0,65
Access to market	0,35
Total physical capital	0,25

The potential of region as a whole should be considered in the process of selection of most vulnerable region to climate change where it is necessary to lay a foundation of adaptive measures.

So, Shamakhi district has been recently developing as one of the most important tourist centers. Therefore, there is doing a great work in this district and there are formed prerequisites for the conservation of forests and vegetation in general, and for the new activities (tourism).

However, there are no prerequisites for the development of tourism and other alternative activities on the border with Gobustan area in the floodplain Pirsaat river in semi-arid zone. Basically there is developed extensive breeding with all the attendant negative effects (erosion, salinization, reduced agrobiocenosis, land degradation).

The most urgent issue is climate change adaptation in the Gobustan region as, the negative factors climate change affecting the environment in the area may get even worse.

The area is located in the arid zone, there is an acute problem of water shortage, and the existing brackish underground sources are brackish, there is observed a significant over-grazing, with corresponding negative consequences.

There have been considered scenarios of climate change calculated from models recommended by the IPCC GCA GISS, GFDL-3 and an expert scenario proposed by the Department of Climatology, Institute of Geography of ANAS (I), and PRECIS 1.4 (II) in the framework of I and II National Communication on Climate Change of the Azerbaijan Republic. The analysis of climate change scenarios shows scenario calculated by the model PRECIS 1.4 for the period 2021-2050gg that is

the most realistic. In accordance with the scenario, there is expected increasing of average annual temperature for 1,6^{0}C with a simultaneous increase in annual precipitation amounts compared with the base (1961-1990gg) standards by an average of 15%. As a result, there will be observed changes in agroclimatic resources the borders of thermal boundaries and zones of moisture, which directly affect the agricultural production. Preliminary results showed that as a result of climate change on the territory should be expected:

- increase amounts of active temperatures above 10^{0}C for about 300-400^{0}C;
- increase the duration of a possible vegetation of plans for 15-25 days;
- reduction of the duration of the actual vegetation for 8-10 days (due to greater heat supply);
- increase evaporability for 15% or 120-150mm in the plains and the 60-80mm in the lowlands and midlands (Gobustan district);
- Climatic norm of irrigation will be 725-800 mm in the plain area, and in the middle mountain area of Gobustan it will remain around current levels;
- Thermal boundaries will mix at height of 200 - 300m above sea level in the mountains, which take place around at 650-900m above sea level;
- Boundaries of moisture zones will be shifted to the direction of mountain for 50-100m above sea level, in general, there will be arid area by expanding the areas of semi-deserts and dry steppes.

Expected climate change can have both positive and negative consequences. Expected climate change can have the following results on base agricultures of the district:

- there is expected increase the period of possible vegetation as with the simultaneous reduction of the actual 10-15 days that would allow the cultivation of more demanding to the warmth of winter wheat;
- after harvesting in case of irrigation water it is possible plant of other crops- forage, grain and getting two or even three harvests a year;
- thermal boundaries of industry viticulture will increase;
- increase of the quantity and quality of grapes is also possible.

However, the fully implementation of these possibilities seem unlikely, as the region now suffers from a lack of moisture, which will increase in future. The situation is aggravated by the fact that in the most arid areas, the possibilities of irrigation are limited or don't exist. This primarily relates to the plain - foothill areas of Gobustan district and Shamakhi district in most parts of which are spread semiarids and dry steppes. Based on this adaptation activities should be aimed primarily at:

- providing agricultural with irrigation water;
- application of water-saving irrigation technologies (sprinkler, drip, etc.);
- carrying out, where it is possible, measures of wash of salinized soils;
- introduction of drought-resistant varieties of crops;

The vulnerability of water resources to climate change is defined on the basis of models GISS, GFDL-3, GFDL-T, and the artificial scenario. The resulting estimates, calculated as the difference between the total water demand and available water resources without regard to adaptation, suggest that in all scenarios of climate change the situation is tense, while GFDL-T scenario, the

situation becomes most difficult, i.e. water resources could be reduced till about 40%. Thus, the most vulnerable sectors for climate change of the economy are energy, agriculture and the provision of drinking water.

Climate change will affect the amount and rate of irrigation norm of crops - for some it may be reduced by reducing the growing season, but for others, such as perennial forage plants increase. Such a scenario would adversely affect the environmental situation of all 3 districts, but it can be disastrous for Gobustan region, as the most arid, i.e. up to the formation of deserts and complete degradation.

Calculation of vulnerability indices and selection of pilot regions

The vulnerability index of an indicator is calculated by multiplying its weight factors by its coefficient. In Table 17, it is provided weight factors, coefficients and indices for vulnerability sub-components and indicators for the three proposed pilot regions:

Table 12: Vulnerability indices, weights and coefficients

Vulnarability category	Weights	Values			Coefficients		
		Shamakhi	Agsu	Gobustan	Shamakhi	Agsu	Gobustan
Adaptive capacity							
Social capital	**0.25**						
Farm organizations	0.8	0.38	0.42	0.80	1.00	0.91	0.47
Female work	0.2	30.00	30.00	30.00	1.00	1.00	1.00
Human capital	**0.25**						
Literacy	0.8	99.20	99.10	99.10	1.00	1.00	1.00
Education	0.2	83.30	83.20	83.20	1.00	1.00	1.00
Agri workers		0.10	0.10	0.10	1.00	1.00	1.00
Financial capital	**0.25**						
Livestock density	0.2	0.66	0.64	0.63	0.96	0.98	1.00
Average salary	0.8	150.00	165.00	180.00	1.00	0.91	0.83
Physical capital	**0.25**						
Infrastructure	0.65	153483	108642	82785	0.54	0.76	1.00
Access to market	0.35	994	1272	936	0.78	1.00	0.74
Exposure							
Climate hazards							
Rainfall	0.4	535.50	390.20	379.20	0.71	0.97	1.00
Temperature	0.4	0.40	0.90	1.00	0.40	0.90	1.00
Droughts	0.2	106.30	70.70	58.40	0.55	0.83	1.00
Sensitivity							
Ecosystems	**0.33**						
Plant cover	0.4	57.78	59.25	61.23	1.00	0.98	0.94

Ground water	0.1	8.74	8.36	0.10	0.01	0.01	1.00
Land use	0.4	14.76	3.80	0.31	0.02	0.08	1.00
Number of varieties	0.1	169.00	128.00	93.00	0.55	0.73	1.00
Communities	**0.33**						
Women	0.15	51.00	51.00	50.00	1.00	1.00	0.98
Children	0.15	5.83	11.00	10.60	0.53	1.00	0.96
Below poverty	0.4	6.17	6.07	6.39	0.97	0.95	1.00
Population growth	0.3	2.30	2.10	2.50	0.92	0.84	1.00
Agriculture	**0.33**						
Small-scale farming	0.15	17.05	20.94	29.96	0.57	0.70	1.00
Rural population	0.15	53.00	72.00	80.00	0.66	0.90	1.00
Land degradation	0.1	80.55	75.42	100.00	0.81	0.75	1.00
Production	0.2	75.72	181.50	202.88	1.00	0.42	0.37
Crop diversification	0.2	2.24	2.15	6.67	0.96	1.00	0.32
Irrigation	0.1	8.74	8.36	0.10	0.01	0.01	1.00
Agri workers	0.1	60.00	60.00	71.00	0.85	0.85	1.00

First of all, it was provided calculation for each vulnerability component: adaptive capacity, exposure and sensitivity. Calculation have been provided for each pre-selected region. The results is provided in table 18:

Table 13: Results of calculations of vulnerability indices for each component

#	Components	Shamakhi	Agsu	Gobustan
1	**Exposure**	0.55	0.91	1.00
2	**Sensitivity**	0.69	0.70	0.89
3	**Adaptive capacity**	0.90	0.92	0.84

Then, to have final value of calculation of vulnerability indices the following formula has been applied:

$$VI = (I_{exposure}^{1/3} \times I_{sensitivity}^{1/3} \times I_{adaptiv\ capacity}^{1/3})$$

As a result of provided calculations, Gobustan district has got the highest vulnerability indices value – 0.91. Then, it is followed by Agsu district 0.81 and Shamakhi – 0.70.

Group work: Discussions on the results of vulnerability assessment and group presentations

Module 8: Adaptation to climate change

Module structure:

Part I (Adaptation to climate change)

- What is adaptation to climate change?
- What are the main strategies that typically underlay adaptation measures?

Part II (Adaptation measures)

- Why it is important?
- Methodology for identification of adaptation measures

Part I (Adaptation to climate change)

Adaptation to climate change, as defined by the IPCC, is an adjustment in ecological, social or economic systems in response to observed or expected climatic changes. Adaptive capacity is the ability of individuals and groups to adapt or adjust to climate variability and change; and accommodate shock and stress to systems.

Adaptive capacity also includes communities' capacity to take advantage of the benefits and opportunities associated with a changing climate. It identifies five key elements that contribute to adaptive capacity, which this paper will reflect on. These include: the asset base; institutions and entitlements; knowledge and information; innovation; and flexible forward-looking governance. This approach to understanding adaptive capacity will be used because these elements are derived from IPCC's assessment reports.

Although the asset base and institutions are the most influential elements of adaptive capacity as they lay the foundations for all other elements, the other three elements are also significant.

First, the asset base constitutes various financial, physical, natural, social, political and human capital needed to enable a system to respond appropriately to a changing climate. Natural capital consists of natural resource stocks (soil, water, air, genetic resources, etc.) and environmental services (hydrological cycle, pollution sinks, etc.); physical capital refers to infrastructure and machinery; financial capital is the capital base (cash, credit/debt, savings and other economic assets, which include basic infrastructure and production equipment and technologies); human capital consists of the skills, knowledge, ability to labour, good health and physical capability; and social capital are the social resources (networks, social claims, social relations, affiliations, associations) upon which people draw when pursuing different livelihood strategies requiring coordinated actions. Political capital is not typically linked with the other five capitals, which are associated with the sustainable livelihoods approach. The definition of political capital ranges from the (favourable) opinion people have about an individual or a group to an asset that links an individual or a group to power structures and policy outside the locality. This is a term that is vague and ill-defined but extremely important as it relates to power and authority where a person with high levels of political capital can influence how others behave and what he/she has that can influence adaptive capacity.

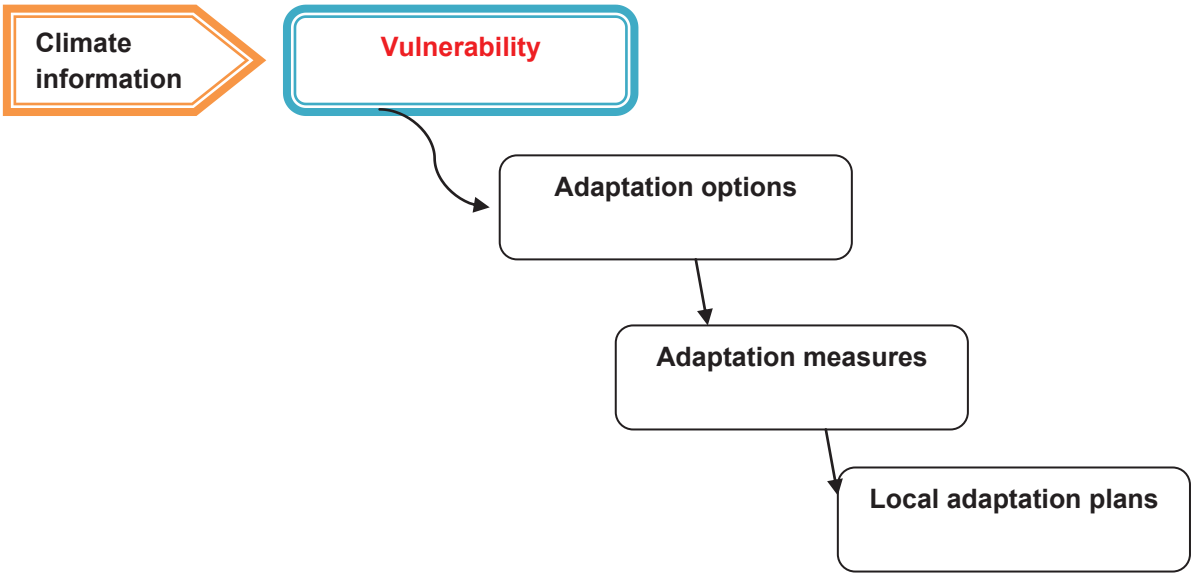
Second, formal or informal institutions or rules; norm and beliefs that facilitate decision-making and social practices are considered fundamental characteristics of adaptive capacity. Institutions may include public (i.e. governmental agencies), private (i.e. seed banks, businesses, service organizations) or civic (i.e. labour exchanges, collective gatherings, cooperatives) groups. Institutions help to structure the distribution of climate risk impacts; and constitute and organize incentive structures for adaptation responses at an individual and collective level. They also mediate interventions into local contexts and "articulate" between local and extra-local processes, such as finances, knowledge and information, skills training, new institutional inputs and technological support that facilitate adaptation. Local institutions play a key role in acquisition and distribution of interventions at the local level. Although institutions can empower actors to have access and entitlement to assets vital to adaptive capacity, access and entitlement may be based on age, ethnicity, class, religion and gender. Access and entitlement is also dependent on the types and number of assets an individual or group has. Institutions that promote equitable entitlement to resources can foster adaptive capacity in many ways, such as encouraging a variety of perspectives and solutions; enabling people to learn and improve their institutions; motivating actors to adjust their behaviour; mobilizing leadership qualities and resources for implementing adaptation measures; and supporting principles of fair governance.

Third, knowledge and information refers to the system's ability to collect, analyze and disseminate knowledge and information in support of adaptive activities. This includes understanding of future change, adaptation options, the ability to assess them and the capacity to implement the most suitable interventions. The fourth element of adaptive capacity is innovation, which helps the system explore "niche solutions" to take advantage of new opportunities.

Finally, the fifth element, which is flexible forward-thinking decision-making and governance, is based on the idea that the system should be able to anticipate change and incorporate initiatives into future planning through informed decision-making, transparency and prioritization especially in a changing environment. These last three assets are highly dependent on the asset base and institutions. It is the interplay between the various types of assets that an individual or groups has access to and the types of institutions that support the individual or group that would allow exchange of knowledge and information, innovation to take place, and allow for "forward-thinking" decision-making. This section has primarily focused on the asset base and institutions as the main elements of adaptive capacity. This is largely because most adaptation strategies in rural areas draw on natural, financial and social capital, and common pool institutions.

It is important to note that the determinants of adaptive capacity function differently in different contexts. Drawing upon social protection and climate change literature, the next section reviews the various social protection measures that have been put in place to minimize the negative social and economic impacts of weather-related events such as droughts and floods. These social protection measures incorporate many of the aforementioned five elements of adaptive capacity.

Figure 11: Key steps to derive adaptation options



Adaptation can happen through **building adaptive capacity** and through **implementing actual adaptation measures.** Capacity building aims at enhancing the knowledge about climate change and its impacts in the community. It also comprises organizational structures and capabilities that enable community members to respond to climate change. Actual adaptation measures address specific risks. This encompasses community activities that aim at specific climate impacts. The type of adaptation measures that are needed depend on the context of the region and even on the characteristics of each community. A **comprehensive approach** includes the improvement of adaptation capacity and the development of specific adaptation projects. Keep in mind the main characteristic of an adaptation option/measure: It addresses changes that can be **related back to climate change**.

In principal, dealing with impacts can happen on the basis of three general strategies:

Table 10: General strategies to deal with Climate Change impacts

Option	Description	Example
Avoid the impact	Livelihoods can be changed so that the impact not affect the community anymore	Gradually switching to one income generating activity to other
Reduce the impact	Adapt the livelihoods in a way that they became more resistant against climate change impacts	Plant more drought resistant crops
Sharing or transferring the impact or damage	Establish formal or informal insurance mechanism for sharing the damages so that the individual is hit less hard	Try obtaining micro-insurance against weather damages

Part II (Adaptation measures)

Adaptation measures are important to adapt to and reduce impacts of climate change. It is important to provide analyses of possible negative impacts of climate change and identify more suitable measures. These process needs specific approach with application of pre-defined methodology.

Preferably, adaptation measures should address uncertainty of future climate change and be suitable for different paths that climate change might take. These options can be referred to as no-regrets, low-regrets, win- win and flexible/adaptive management.

No-Regrets Adaptation Options – adaptive measures that are worthwhile (ie. they deliver net socio-economic benefits) whatever the extent of future climate change. These types of measures include those justified (cost-effective) under current climate conditions (including those addressing its variability and extremes) and are further justified when their introduction is consistent with addressing risks associated with projected climate changes. The feasibility of implementing these types of options needs to be considered in the light of existing barriers and potential conflicts (as discussed earlier). In addition, focusing on no regrets options is particularly appropriate for the near term as they are more likely to be implemented (obvious and immediate benefits) and can provide experience on which to build further assessments of climate risks and adaptation measures.

Example: Reducing leakage from water utility infrastructure

Low-regrets (or limited regrets) options – adaptive measures for which the associated costs are relatively low and for which the benefits, although primarily realised under projected future climate change, may be relatively large.

Example: Sharing in developing and operating additional water storage facilities (eg. water groups building and operating a joint water reservoir).

Win-Win options – adaptation measures that have the desired result in terms of minimising the climate risks or exploiting potential opportunities but also have other social, environmental or economic benefits. Within the climate change context, win-win options are often associated with those measures or activities that address climate impacts but which also contribute to mitigation or other social and environmental objectives. These types of measures include those that are introduced primarily for reasons other than addressing climate risks, but also deliver the desired adaptation benefits.

Examples: Improving preparedness and contingency planning to deal with risks (including climate); Green roofs and green walls which have multiple benefits in terms of reducing building temperature and rainfall runoff from buildings, and increased green spaces within urban areas, but also reduces energy use for both heating and cooling.

Flexible or adaptive management options – involve putting in place incremental adaptation options, rather than undertaking large-scale adaptation in one fell swoop. This approach reduces the risks associate with being wrong, since it allows for incremental adaptation. Measures are introduced through an assessment of what makes sense today, but are designed to allow for incremental change, including changing track, as knowledge, experience and technology evolve. “Delaying” introducing a specific adaptation measure (or suite of measures) can be part of a flexible

or adaptation management strategy as long as that decision is accompanied by a commitment to continue building the necessary adaptive capacity while continuing to monitor and evaluate the evolving risks. A decision to delay introducing a specific action is often taken when the climate risks are below defined thresholds or when the required adaptive capacity (eg. regulatory or institutional circumstances) is insufficient to allow effective action.

Example: Delay implementing specific adaptation measures while exploring options and working with appropriate levels of government to build the necessary standards and regulatory environment

Identification of adaptive measures are provided following the below steps:

First of all forecasted climate change scenarios should be analyzed using the most appropriate model.

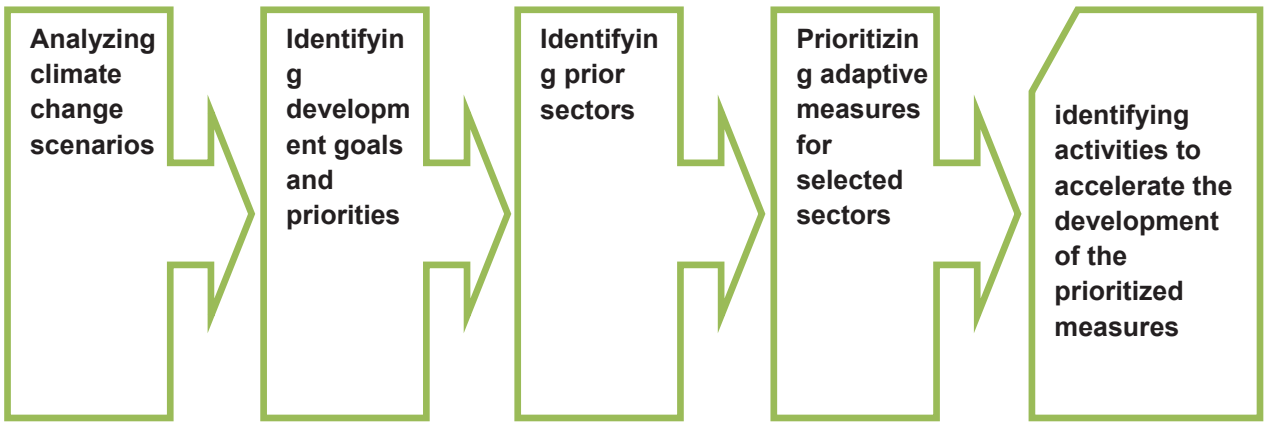
Second step is related to identifying and deciding on development priorities in view of a changing climate. The main output is a list of clustered development priorities for the country concerned which fully takes into account climate change implications.

Third step is associated with identifying and prioritizing (sub)sectors in terms of their contribution to mitigation and adaptation leading to sustainable development in a climate change challenged world. The main output is a short list of prioritized (sub)sectors for adaptation and mitigation to guide subsequent technology prioritization processes.

Forth step is related to identifying and prioritizing relevant adaptive measures to achieve maximum development goals and benefits adaptive capacity and reduced vulnerability for adaptation. The main output is a prioritized portfolio of technologies for vulnerability development for each priority (sub)sector.

Fifth steps focuses on identifying activities to accelerate the development and transfer of the technologies prioritized. These activities are characterized in terms of, e.g., resources required, timeline, risks, and required monitoring, reporting and verification activities. The activities provide input for the development of an overall technology strategy which either will be specific to the sector/technology or will be common across sectors and technologies at the system or national level.

Figure 12: Key steps in identification of adaptive measures



Module 9: Sustainable farming practices and adaptation measures at local level

Module structure:

- Sustainable farming practices in light of climate change
- Local adaptation measures to cope with consequences of climate change

Case study: Quezungual agroforestry system of Honduras

Sustainable agriculture is the practice of farming using principles of ecology, the study of relationships between organisms and their environment. It has been defined as "an integrated system of plant and animal production practices having a site-specific application that will last over the long term:

- Satisfy human food and fiber needs
- Enhance environmental quality and the natural resource base upon which the agricultural economy depends
- Make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls
- Sustain the economic viability of farm operations
- Enhance the quality of life for farmers and society as a whole.

Sustainability can be understood as an ecosystem approach to agriculture. Practices that can cause long-term damage to soil include excessive tillage (leading to erosion) and irrigation without adequate drainage (leading to salinization). Long-term experiments have provided some of the best data on how various practices affect soil properties essential to sustainability.

The most important factors for an individual site are sun, air, soil and water. Of the four, water and soil quality and quantity are most amenable to human intervention through time and labour.

Although air and sunlight are available everywhere on Earth, crops also depend on soil nutrients and the availability of water. When farmers grow and harvest crops, they remove some of these nutrients from the soil. Without replenishment, land suffers from nutrient depletion and becomes either unusable or suffers from reduced yields. Sustainable agriculture depends on replenishing the soil while minimizing the use of non-renewable resources, such as natural gas (used in converting atmospheric nitrogen into synthetic fertilizer), or mineral ores (e.g., phosphate). Possible sources of nitrogen that would, in principle, be available indefinitely, include:

1. recycling crop waste and livestock or treated human manure
2. growing legume crops and forages such as peanuts or alfalfa that form symbioses with nitrogen-fixing bacteria called rhizobia
3. industrial production of nitrogen by the Haber Process uses hydrogen, which is currently derived from natural gas, (but this hydrogen could instead be made by electrolysis of water using electricity (perhaps from solar cells or windmills)) or

4. genetically engineering (non-legume) crops to form nitrogen-fixing symbioses or fix nitrogen without microbial symbionts.

The last option was proposed in the 1970s, but is only recently becoming feasible. Sustainable options for replacing other nutrient inputs (phosphorus, potassium, etc.) are more limited.

More realistic, and often overlooked, options include long-term crop rotations, returning to natural cycles that annually flood cultivated lands (returning lost nutrients indefinitely) such as the Flooding of the Nile, the long-term use of biochar, and use of crop and livestock landraces that are adapted to less than ideal conditions such as pests, drought, or lack of nutrients.

Crops that require high levels of soil nutrients can be cultivated in a more sustainable manner if certain fertilizer management practices are adhered to.

Water

In some areas, sufficient rainfall is available for crop growth, but many other areas require irrigation. For irrigation systems to be sustainable they require proper management (to avoid salinization) and must not use more water from their source than is naturally replenished, otherwise the water source becomes, in effect, a non-renewable resource. Improvements in water well drilling technology and submersible pumps combined with the development of drip irrigation and low pressure pivots have made it possible to regularly achieve high crop yields where reliance on rainfall alone previously made this level of success unpredictable. However, this progress has come at a price, in that in many areas where this has occurred, such as the Ogallala Aquifer, the water is being used at a greater rate than its rate of recharge.

Several steps should be taken to develop drought-resistant farming systems even in "normal" years, including both policy and management actions:

1) improving water conservation and storage measures,

2) providing incentives for selection of drought-tolerant crop species,

3) using reduced-volume irrigation systems,

4) managing crops to reduce water loss,

or 5) not planting at all.

Indicators for sustainable water resource development are: ¤ Internal renewable water resources. This is the average annual flow of rivers and groundwater generated from endogenous precipitation, after ensuring that there is no double counting. It represents the maximum amount of water resource produced within the boundaries of a country. This value, which is expressed as an average on a yearly basis, is invariant in time (except in the case of proved climate change). The indicator can be expressed in three different units: in absolute terms (km3/yr), in mm/yr (it is a measure of the humidity of the country), and as a function of population (m3/person per yr).

Global renewable water resources. This is the sum of internal renewable water resources and incoming flow originating outside the country. Unlike internal resources, this value can vary with time if upstream development reduces water availability at the border. Treaties ensuring a specific flow to be reserved from upstream to downstream countries may be taken into account in the computation of global water resources in both countries.

Dependency ratio. This is the proportion of the global renewable water resources originating outside the country, expressed in percentage. It is an expression of the level to which the water resources of a country depend on neighbouring countries.

Water withdrawal. In view of the limitations described above, only gross water withdrawal can be computed systematically on a country basis as a measure of water use. Absolute or per-person value of yearly water withdrawal gives a measure of the importance of water in the country's economy. When expressed in percentage of water resources, it shows the degree of pressure on water resources. A rough estimate shows that if water withdrawal exceeds a quarter of global renewable water resources of a country, water can be considered a limiting factor to development and, reciprocally, the pressure on water resources can have a direct impact on all sectors, from agriculture to environment and fisheries.

Soil

Soil erosion is fast becoming one of the worlds greatest problems. It is estimated that "more than a thousand million tonnes of southern Africa's soil are eroded every year. Experts predict that crop yields will be halved within thirty to fifty years if erosion continues at present rates. Soil erosion is not unique to Africa but is occurring worldwide. The phenomenon is being called Peak Soil as present large scale factory farming techniques are jeopardizing humanity's ability to grow food in the present and in the future. Without efforts to improve soil management practices, the availability of arable soil will become increasingly problematic.

Some Soil Management techniques

1. No-till farming
2. Keyline design
3. Growing wind breaks to hold the soil
4. Incorporating organic matter back into fields
5. Stop using chemical fertilizers (which contain salt)
6. Protecting soil from water runoff

Economics

Socioeconomic aspects of sustainability are also partly understood. Regarding less concentrated farming, the best known analysis is Netting's study on smallholder systems through history.[12] The Oxford Sustainable Group defines sustainability in this context in a much broader form, considering effect on all stakeholders in a 360 degree approach

Given the finite supply of natural resources at any specific cost and location, agriculture that is inefficient or damaging to needed resources may eventually exhaust the available resources or the ability to afford and acquire them. It may also generate negative externality, such as pollution as well as financial and production costs.

The way that crops are sold must be accounted for in the sustainability equation. Food sold locally does not require additional energy for transportation (including consumers). Food sold at a remote

location, whether at a farmers' market or the supermarket, incurs a different set of energy cost for materials, labour, and transport.

Methods

What grows where and how it is grown are a matter of choice. Two of the many possible practices of sustainable agriculture are crop rotation and soil amendment, both designed to ensure that crops being cultivated can obtain the necessary nutrients for healthy growth. Soil amendments would include using locally available compost from community recycling centers. These community recycling centers help produce the compost needed by the local organic farms.

Many scientists, farmers, and businesses have debated how to make agriculture sustainable. Using community recycling from yard and kitchen waste utilizes a local area's commonly available resources. These resources in the past were thrown away into large waste disposal sites, are now used to produce low cost organic compost for organic farming. Other practices includes growing a diverse number of perennial crops in a single field, each of which would grow in separate season so as not to compete with each other for natural resources.[13] This system would result in increased resistance to diseases and decreased effects of erosion and loss of nutrients in soil. Nitrogen fixation from legumes, for example, used in conjunction with plants that rely on nitrate from soil for growth, helps to allow the land to be reused annually. Legumes will grow for a season and replenish the soil with ammonium and nitrate, and the next season other plants can be seeded and grown in the field in preparation for harvest.

Monoculture, a method of growing only one crop at a time in a given field, is a very widespread practice, but there are questions about its sustainability, especially if the same crop is grown every year. Today it is realized to get around this problem local cities and farms can work together to produce the needed compost for the farmers around them. This combined with growing a mixture of crops (polyculture) sometimes reduces disease or pest problems but polyculture has rarely, if ever, been compared to the more widespread practice of growing different crops in successive years (crop rotation) with the same overall crop diversity. Cropping systems that include a variety of crops (polyculture and/or rotation) may also replenish nitrogen (if legumes are included) and may also use resources such as sunlight, water, or nutrients more efficiently.

Soil treatment

Soil steaming can be used as an ecological alternative to chemicals for soil sterilization. Different methods are available to induce steam into the soil in order to kill pests and increase soil health. Community and farm composting of kitchen, yard, and farm organic waste can provide most if not all the required needs of local farms. This composting could potentially be a reliable source of energy.

Off-farm impacts

A farm that is able to "produce perpetually", yet has negative effects on environmental quality elsewhere is not sustainable agriculture. An example of a case in which a global view may be warranted is over-application of synthetic fertilizer or animal manures, which can improve productivity of a farm but can pollute nearby rivers and coastal waters (eutrophication). The other extreme can also be undesirable, as the problem of low crop yields due to exhaustion of nutrients in

the soil has been related to rainforest destruction, as in the case of slash and burn farming for livestock feed.

Sustainability affects overall production, which must increase to meet the increasing food and fiber requirements as the world's human population expands to a projected 9.3 billion people by 2050. Increased production may come from creating new farmland, which may ameliorate carbon dioxide emissions if done through reclamation of desert as in Palestine, or may worsen emissions if done through slash and burn farming, as in Brazil. Additionally, Genetically modified organism crops show promise for radically increasing crop yields, although many people and governments are apprehensive of this new farming method.

International policy

Sustainable agriculture has become a topic of interest in the international policy arena, especially with regards to its potential to reduce the risks associated with a changing climate and growing human population.

The Commission on Sustainable Agriculture and Climate Change, as part of its recommendations for policy makers on achieving food security in the face of climate change, urged that sustainable agriculture must be integrated into national and international policy. The Commission stressed that increasing weather variability and climate shocks will negatively affect agricultural yields, necessitating early action to drive change in agricultural production systems towards increasing resilience. It also called for dramatically increased investments in sustainable agriculture in the next decade, including in national research and development budgets, land rehabilitation, economic incentives, and infrastructure improvement.

Local adaptive measures

As a first step in selecting adaptation measures out of the identified adaptation options, it should be have to decide on suitable evaluation criteria. The set of criteria has far-reaching influences on the outcomes of your adaptation strategy process. Therefore, make sure that all relevant actors agree with the criteria. Decide if all criteria are equally weighted, or if some criteria are of higher importance than other.

Key criteria for selecting adaptation measures (recommended by OECD)

Effectiveness: describes the extent to which the adaptation option reduces vulnerability and provides other benefits.

Think of the effectiveness of the adaptation option under different scenarios!

Costs: describes relative costs of an adaptation option.

Think of investment costs as well as costs over time, such as operation and maintenance costs, reconstruction costs, etc. Think of economic and non-economic costs. Think of costs of avoided damage!

Feasibility: answers whether the necessary legal, administrative, financial, technical, etc. resources exist.

Adaptations that can be implemented under the current operational framework will usually be favoured!

Additional criteria

The above listed key criteria should be complemented by additional criteria according to the specific context of the target region. The selection of additional criteria is up to the team working on the adaptation plan/strategy and might depend on several factors, such as the…

- ✓ **site-specific context**
- ✓ **priorities of political-administrative body** (municipality, district/national government etc.)
- ✓ **M&E system** (which criteria can be assessed/ monitored?)
- ✓ specific **donor requirements**
- ✓ **objectives** set for adaptation planning (e.g. poverty reduction)
- ✓ **subjective decisions** of team working on adaptation planning

Additional criteria for the evaluation of adaptation options may include, depending on the context, e.g. political and social acceptance: urgency, biodiversity friendliness, relative speed of implementation or benefits, 'no regrets' potential, avoid detrimental effects on other development goals, alignment with funding requirements or other eligibility criteria, alignment with policy priorities, etc.

Other relevant questions are: "What happens if you don't take a specific action?"; "If the adaptation measure is already being implemented, would it need additional funding to improve or to do more of the same?"

Case Study: Quezungual Agroforestry System Of Honduras

Climate change and agricultural context in Honduras

Countries such as Honduras in Central America are at considerable risk from climate change. The fourth assessment report (FAR) of the IPCC for Latin America concluded that "*in terms of food security, a significant number of smallholders and subsistence farmers may be particularly vulnerable to climate change in the short term, and their adaptation options may be more limited. Of particular concern are farmers in Central America".*

Growing evidence suggests a scenario of rising temperatures, declining rainfall and an increase in extreme weather events. Observed negative precipitation trends are already being reported for Central America (e.g. IPCC 2001). The IPCC FAR (Magrin et al, 2007) reports that an average temperature increase of nearly 1°C in Mesoamerica has already been observed and projected temperature increases for Central America in the wet season are +0.5 to +1.7°C by 2020, and +1.0 to +4.0°C by 2050.

Decreasing rainfall and increasing temperatures will have an adverse impact on maize production in Honduras. Jones and Thornton (2003) investigated potential effects of climate change on maize production in 2055 using crop simulation models. Decrease in yields were predicted for Central American and increased probability of crop failure from drought was found in Honduras, Nicaragua and Panama. There is, hence, an urgency to work with Honduras farmers to develop climate change adaptation. Two decades of land management work in the department of Lempira in western Honduras under the auspices of the Honduran government and the United Nations Food and Agriculture Organization (FAO), Lempira Sur Project (PLS), suggest possible ways forward. While the focus of this case study is on the agroforestry component of PLS, a key feature of the

project was to embed this in a broader promotive social protection context, thus, enhancing local farmers' adaptive capacity, increasing their livelihood security and strengthening their ability to minimize the negative impacts of climate variability.

Elements of adaptive capacity in Honduras

Assets

The Lempira Sur Project was implemented by the Government of Honduras, with technical support from the FAO and financial resources from the Netherlands, from 1990 to 2004. It focused its activities in an area of 2,178 km2, corresponding to 50% of the total surface area of the Department. The target population was approximately 130,000 inhabitants in 20 municipalities. The principal objective of it was to improve the quality of life of the rural population through organized participation in new economic activities and diversified agricultural systems. There was a strong emphasis on increasing social and human capital through institutional innovations thus, strengthening the aforementioned five key elements that contribute to adaptive capacity.

The project adopted people-centred approaches where local people were at the centre of identifying their needs and problems. The first priority identified by local people was food security. Project development practitioners subsequently analyzed with farmers the obstacles to attaining higher and more stable agricultural yields. The result was the emergence of the Quezungual agroforestry system which, by improving soil quality, also contributes to greater natural capital.

By working with groups of farmers and enhancing their understanding of soil and crop management, PLS also contributed to enhanced human and social capital.

The Quezungual system is based on planting annual crops under a slash-and-mulch management system. The distinctive feature of the system is the existence of various naturally-regenerated trees and shrubs that are pollarded to a height of approximately 1.5m. Farmers also leave taller trees in the fields and these include *Cordia alliodora* (laurel) and various fruit trees such as *Psidium guajava* (guayabo). A variety of crops is grown within the system including *Zea mays* (maize), *Sorghum bicolor* (sorghum) and *Phaseolus vulgaris* (beans).

The Quezungual system has been widely adopted since the 1990s. Advantages of the system, identified by farmers, include retention of soil moisture, increased production of crops, fruits and timber, and the fact that plots can be cultivated for longer periods than is normal practice before being left in fallow.

One of the prerequisites for the establishment of the system is that farmers abandon the practice of burning their fields prior to the beginning of the rains in April. This was a challenge in a region where slash-and-burn agriculture was common and where burning is often a labour saving way to prepare fields for planting. The labour issue is of particular importance for those families where out-migration of family members (often to the United States) had led to a labour shortage. This shortage has pushed up daily labour rates and, hence, the cost has risen for those farmers who have abandoned burning and who have to hire daily labour to clean their fields prior to planting. PLS, as part of its broader development remit supported the establishment of community banks. These banks enhanced the abandonment of burning and the adoption of the Quezungual system because credit was given only to farmers who did not burn their land. This new 'moral order' was, in

turn, supported by national and local laws forbidding the use of fire and protecting common forestlands and water reservoir.

Influence of social protection on adaptive capacity

This case study from Honduras shows that it is formal social protection mechanisms that can enhance adaptive capacity to minimize risks against droughts. The Quezungual system emerged from the knowledge and information generated by extension agents working closely with innovative farmers who practised Quezungual. Based on the results of participatory diagnosis workshops, PLS placed a lot of emphasis on enhancing farmers' incomes through diversification of income-generating activities and improved market access. With the close proximity of the border, many farmers were able to sell their agricultural products in El Salvador. Both practitioners and non-practitioners of the Quezungual system were able to take advantage of increased market access that has led to an increase in financial capital.

It has also enhanced farmers' capacity to adopt improved soil and water management under the Quezungual system. Early practitioners who were interviewed stressed that converting from a slash-and-burn to a slash-and-mulch system was not technically difficult, but that they did rely on the information and training provided.

Hence, the project worked with farmers to increase human capital and subsequently enable them to gain skills to adopt the innovative Quezungual system. It can also be argued that the establishment of community banks enhanced the abandonment of burning and the adoption of the Quezungual system because credit was given only to farmers who did not burn their land. This has created an incentive to build capacity in practising the Quezungual system.

Improved soil quality and a greater capacity to capture, retain and slowly release water is part of climate change adaptation especially in the face of predicted decreases in rainfall. A big breakthrough in terms of adoption of the agroforestry system came in 1997. drought hit the area. The crops on the farms using the agroforestry system withstood the drought while farmers who had not adopted the Quezungual systems suffered crop losses. The ability of the Quezungual system to withstand the particularly severe drought in 1997 is encouraging because it suggests that the system may become even more relevant as Honduras and its neighbours suffer from more frequent droughts over the coming decades. There is also evidence that the Quezungual system may be more resilient in the face of very intense rainfall.

Module 10: Developing local adaptation plans

Module structure:

Part I (Identification of adaptation options at local level)

- How local adaptation options could be identified?
- Using PRA tools for identification of local adaptation options

Part II (Development of local adaptation plans)

- What is local adaptation plan?
- How can it be developed?
- How to sustain adaptation activities in a long run?

Case study: Real case study from EU experience

Part I (Identification of adaptation options at local level)

Climate change adaptation means dealing with local circumstances. Some opportunities for interventions may be found at the local level, others require action at higher levels. Some activities at higher levels directly affect the local context. The objective of this step is to define possible adaptation options for local vulnerabilities; this may include activities at the local level or at regional or national levels.

Desired outcomes:

- Collection of adaptation options for local vulnerabilities
- First thoughts on next steps
- Definition of responsibilities at different levels

Entry points

As at other levels, assessing adaptation options locally is a key step towards a clear recognition of climate risks and the need for adaptation within relevant policies and/or projects. This step is especially effective when carried-out during policy formulation, strategy development and project identification and design. Integrating local stakeholders in this step is a fundamental requirement to the successful integration of adaptation into local development processes and beyond.

As a first step in selecting adaptation measures out of the identified adaptation options, it should be have to decide on suitable evaluation criteria. The set of criteria has far-reaching influences on the outcomes of your adaptation strategy process. Therefore, make sure that all relevant actors agree with the criteria. Decide if all criteria are equally weighted, or if some criteria are of higher importance than other.

Key criteria for selecting adaptation measures (recommended by OECD)

Effectiveness: describes the extent to which the adaptation option reduces vulnerability and provides other benefits.

Think of the effectiveness of the adaptation option under different scenarios!

Costs: describes relative costs of an adaptation option.

Think of investment costs as well as costs over time, such as operation and maintenance costs, reconstruction costs, etc. Think of economic and non-economic costs. Think of costs of avoided damage!

Feasibility: answers whether the necessary legal, administrative, financial, technical, etc. resources exist.

Additional criteria

The above listed key criteria should be complemented by additional criteria according to the specific context of the target region. The selection of additional criteria is up to the team working on the adaptation plan/strategy and might depend on several factors, such as the…

- **site-specific context**
- **priorities of political-administrative body** (municipality, district/national government etc.)
- **M&E system** (which criteria can be assessed/ monitored?)
- specific **donor requirements**
- **objectives** set for adaptation planning (e.g. poverty reduction)
- **subjective decisions** of team working on adaptation planning

Additional criteria for the evaluation of adaptation options may include, depending on the context, e.g. political and social acceptance: urgency, biodiversity friendliness, relative speed of implementation or benefits, 'no regrets' potential, avoid detrimental effects on other development goals, alignment with funding requirements or other eligibility criteria, alignment with policy priorities, etc.

Other relevant questions are: "What happens if you don't take a specific action?"; "If the adaptation measure is already being implemented, would it need additional funding to improve or to do more of the same?"

General instruments for evaluating adaptation options

The most commonly used methods with which to select and prioritise the identified options are Cost Benefit Analysis (CBA), Cost Effectiveness Analysis (CEA) and Multi Criteria Analysis (MCA). The first two methods require that costs and benefits are expressed in absolute monetary terms. Furthermore, in CEA all options must have the same objectives.

Yet, in the climate adaptation field, numerous criteria that may be included in the final decision making process are non-monetary and objectives between options can vary. Therefore, Multi-Criteria Analysis (MCA) is considered to be the quickest and most appropriate method for assessing adaptation options.

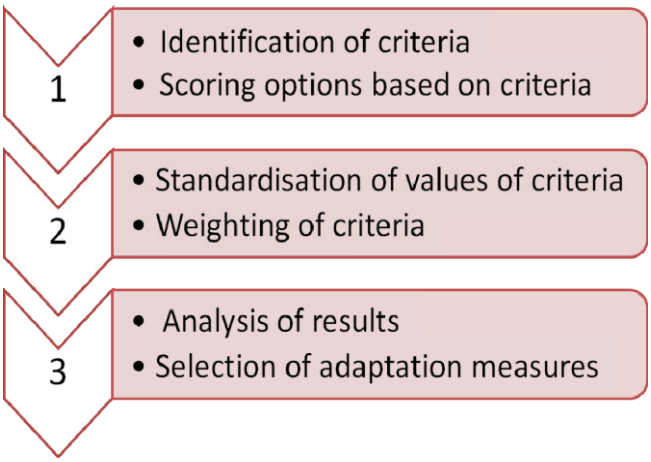
Table 11: Overview of evaluation options for selection of adaptive measures

Tool	Requirement
Cost Benefit Analysis (CBA)	Costs and benefits expressed in absolute monetary terms
Cost Effectiveness Analysis (CEA)	Costs and benefits expressed in absolute monetary terms & all options must have same objectives
Multi-Criteria Analysis (MCA)	Can handle quantitative & qualitative parameters and variables

In Multi-Criteria Analysis, the definition of objectives and formulation of the different options are carried out as in a CBA or CEA, but the types of criteria, their relative importance or weighted values, their evaluation and the processing or interpretation of such evaluations, are different. MCA is a decision making aid and not an optimisation technique, in the economic sense of the term. In the context of the evaluation of community-based adaptation options, it can be considered to be the most appropriate solution, as it is understandable and accessible to the greatest number of participants in decision making.

MCA includes several steps that can be displayed as follows:

Figure 13: MCA steps and procedure



1. At first, you should discuss and decide on the selection criteria to be used for the evaluation of adaptation options as explained above. Criteria can be objective such as the cost of a meteorological station, or subjective such as the likelihood of one option generating greater employment over another.

After having agreed upon the evaluation criteria, the adaptation options are scored based on the selected criteria. Examples for scoring units are percentages (e.g. impact on economic growth rate), scales (e.g. 1-5 for impact on vulnerable groups), costs (e.g. per million per unit). If using scales, you should choose the most suitable ratio (1-10; 1-5 etc.) for evaluation the option.

2. Usually, different criteria are not all expressed in the same unit of measure. Some are expressed in absolute values, but not necessarily in the same units (costs, rates etc.), others are awarded scores or expressed in binary choices (yes or no). To be able to compare the criteria, the values must now be standardized; that is, expressed in one common unit, according to one common scale. (for detailed information on standardization methods, see NAPA guidelines)

Furthermore, the different criteria selected might not all have the same importance. Therefore, criteria should be weighted according to its relative importance for the target groups/target region. The team should decide on a suitable weighting of criteria based on their views and experiences.

3. In step three you will have to sum up scores and analyze the results. Here you should remain realistic; decisions must be taken efficiently, but there will also be substantial uncertainty and the need to cross-check with the hierarchies. In any case you should make a plausibility check to avoid calculation errors.

Based on the evaluation results, select adaptation measures to be implemented on a short- / mid- and long-term basis.

Part II (Development of local adaptation plans)

Adaptation plan

An adaptation plan is a document that combines information on:

- **Reasons and goals of the community for dealing with climate change adaptation**
- **Past changes of the climate and impacts of extreme weather events**
- **Summary of projected climate changes and potential impacts**
- **Planned or desired adaptation measures**
- **Activities for operating, maintaining and monitoring the implemented adaptation measures**

Drafting such a document has a number of advantages: it provides a good resource for future reference when the community wants to discuss climate change internally, with other communities, local / regional / national authorities or donor agencies. The historical pieces of information recorded in the adaptation plan can help to identify future trends and needs for action. The plan can also support documenting the maintenance and monitoring of the adaptation activities.

How to develop a comprehensive adaptation plan?

Along the different stages of developing an adaptation plan the relevant stakeholders should be involved. This could be local or regional authorities and community-based organizations like self-help groups or other non-governmental (development) organizations as well as representatives from neighbouring villages/towns, but also possibly local entrepreneurs, technical experts or climate experts from a university. An adaptation plan can be developed in two steps.

Step 1: Amend potential adaptation activities in order to develop a comprehensive adaptation approach

Potential adaptation activities that have been identified, revisited, detailed, and amended in order to incorporate capacity building, use synergies and avoid conflict among measures and/or other goals and integrate measures into decision-making processes of the community.

Incorporate capacity building

An adaptation plan addresses two aspects: delivering adaptation measures to address climate change impacts and building adaptive capacity:

Delivering specific adaptation measures refers to activities that the community undertakes to reduce one specific climate impact, like for example planting mangroves to protect the shore against coastal erosion triggered by rising sea levels. The type of specific adaptation measures that are needed are largely determined by the context of each community.

Building adaptive capacity aims at enhancing the knowledge about climate change and its impacts on the community. This means that individuals in the community learn about climate change, its causes and projected future trends. It also comprises organizational structures like responsibilities in the village on coordinating actions to increase climate resilience.

Potential adaptation activities discussed earlier will most likely be measures of the first category: they address specific current or future impacts of climate change. For an adaptation plan, these activities should be complemented by measures of the second category that build adaptive capacities for the community in the long run.

Use synergies and avoid conflicts

Aside from complementing them with capacity building, the measures identified and assessed in the earlier step should also be discussed regarding potential synergies and conflicts with existing targets and strategies of the community. Are there conflicts between the proposed measures? Do they, for example, all require electricity which could lead to a power shortage in the village or town if all measures were to be implemented? Or are there synergies with existing plans for disaster risk reduction? A monitoring system for disasters might exist already that could be adopted for climate change adaptation purposes.

Integrate and mainstream adaptation

Climate change can have impacts on many different areas and activities within a community. Some impacts will only materialize in the near or distant future. Thus it is important to take projected climatic changes into account when making planning or investment decisions. If a community development plan already exists, a chapter on adaptation should be included. In a case a development plan has to be created, the activities and goals should be designed in such a way that they take into account future climate change and impacts, e.g. to avoid constructing buildings close to the sea shore or river.

Step 2: Plan the activities and document them in an adaptation plan

The adaptation plan should contain a balanced portfolio of measures in order to support a sustainable and robust approach towards adaptation. This includes the description of short term and long-term measures for facing climate change. Short-term measures against the impact of

extreme weather events are accompanied by preventive measures for long-term changes, such as further sea level rise. Adaptation is a long-term task with importance for decades to come. The plan should help to divide the long-term requirements for adaptation into short and simple steps.

Essential parts of the plan include an introduction on why the community is dealing with climate change adaptation and what goals they are pursuing with the plan. The plan should also provide an overview of the most pressing climate risks that the community is facing. The most important part of the plan is the detailed description of selected adaptation measures which the community wants to implement: Each description of a planned adaptation measure or activity provides details on the objectives and expected benefits of the measure, technical details, the person responsible, investment, operation and maintenance costs as well as an implementation timeline.

These pieces of information should be documented in a formal plan. The documentation of adaptation knowledge and activities supports the traceability of community decisions for every step of the process. This strengthens robustness: The plan becomes independent of single individuals and thus can still be in effect if these individuals carry on with other tasks. Decisions can also be better legitimized for involved community members, although uncertainties might still exist, and the acceptance for the planned measures within the community will be strengthened.

How to sustain the adaptation activities in the long run?

It is important that the implemented adaptation activities remain effective in the long run to protect the community from current and future climate change. To assure this, operation and maintenance should be carried out for the each implemented measure so that they can keep operating. Furthermore, it is important to keep the whole adaptation plan up to date, by monitoring how the climate keeps changing and looking for new information and proof of climate impacts.

Operation and maintenance (O&M)

Maintenance is both a technical activity and a service provision aimed at keeping resource infrastructure at a desired performance capacity or to restoring it to a particular capacity.

Why O&M are important for a sustainable adaptation project

Even the best technology can only work when operated properly and maintained regularly. Ideas, investments and a first successful implementation stage do not guarantee a successful project: If there is a lack of O&M after the donor and the implementing company disappears, the project cannot be sustained in the long run. The focus should not only be kept on “how to do maintenance” but also be aware of the stakeholders involved, their interactions and the laws and formal or informal contracts.

Examples for O&M measures

Well: e.g. maintenance of lid structure, regular cleaning of debris, immediate removal of dead animals etc., regular usage (e.g. pumping) so that fresh water enters regularly**,** and maintenance of the nearby ponds to keep groundwater levels up

Bridge: e.g immediate repair of small erosion damages like stones that have been swept away, regularly desilting the pipes under the bridge (removing sand that gets stuck there)

Pond: e.g. immediate repair of protecting bund, de-pumping of salt water if flooded, cleaning from debris and other contaminations (dead animals etc.), immediate repair of fencing

Plantation: e.g. watering, removal of unwanted weeds, protection from damages by human or animal

Clear responsibilities for operation and maintenance should be agreed upon and documented before adaptation measures are implemented. A sustainable business model, i.e. long-term availability of funds needs to be secured in advance. For the long-term success of the operation and maintenance of adaptation measures it is important to raise awareness of potential maintenance problems and solutions and to strengthen local knowledge for the operation of the technology.

Monitor climatic changes and adaptation projects and keep adaptation plan up to date

The climate is a dynamic system and climatic changes might not materialize as initially anticipated. Therefore it is important to look at adaptation not as a one-time project but a continuous process. If there are developments of the climate that unfold in different ways than foreseen, this should be recorded in the adaptation plan. The communities and their livelihoods are changing and so is the climate. Incorporating these changes (locally observed as well as new scientific information on climate change) and reassessing the climate risks that the community faces can yield valuable new information. Possibly one might also add new climate impacts and desired adaptation measures to the plan.

Furthermore, it is also possible that the implemented adaptation measures are not delivering benefits as foreseen when they were planned. Thus it is important to monitor what results the projects achieve. A regular review of the effectiveness and subsequent reconfiguration of adaptation activities are particularly important. E.g.:

Well: e.g. measure and document charging level and recharging time on a regular basis

Bridge: e.g. document if and when the bridge is flooded again

Pond: e.g. measure and document water level and recharging time regularly

Plantation: e.g. document growth and yields, document whether pests occur When looking at the entire adaptation plan and reviewing it, there are some key questions that should be asked:

- Is the information on climatic changes and impacts discussed in the adaptation plan up to date?
- Are the implemented measures described in the plan successful in reducing vulnerability and creating other benefits?
- Have the measures described proved to be cost effective and do the benefits still exceed the operational costs?
- Do the measures contribute to other societal, environmental or economic targets as envisioned?

Case study: Real case from EU experience

West Yorkshire Adaptation Action Plan

Contributors to the Action Plan

- The Association of West Yorkshire Authorities
- Local authorities of:
- Bradford
- Calderdale
- Kirklees
- Leeds
- Wakefield
- Yorkshire & Humber Improvement and Efficiency partnership (YoHr Space)

Contents of the Action Plan

- Background
- Climate projections on national level
- Impacts for West Yorkshire
- Existing local framework on climate change adaptation
- Priority sector risk assessment
- Sectoral adaptation actions
- Opportunities
- Future development

Climate projections

Projected climate data for temperature and precipitation on West Yorkshire

Climate impacts for West Yorkshire

What does it mean for West Yorkshire?

The area can expect increased annual temperatures, decreased summer rainfall and increased winter rainfall. The major impact of those changes will be the followings:

- Flooding
- Heat waves
- Droughts
- Storm frequency

Existing local framework on adaptation

West Yorkshire Police

- Has a plan in place to cope with unexpected emergencies including extreme weather

West Yorkshire Metro

- to develop a West Yorkshire Transport Local Climate Impacts Profile, which will be used to include climate change adaptation

Yorkshire Wildlife Trust

- have a procedure in place for mapping where the most at risk species are and what needs to be done

Priority sector risk assessment

Six key sectors have been identified:

- Natural environment
- Built Environment
- Transport
- Utilities
- Waste Management
- Health and social care

Sectoral adaptation tables

Including:

- ✓ Key receptors at risk
- ✓ Future climate conditions
- ✓ Impacts
- ✓ Consequences
- ✓ Level of risk (in 2020, 2050, 2080)
- ✓ Action (done, planned, needed)
- ✓ Lead partners
- ✓ Financing
- ✓ Monitoring and review

Examples for adaptation options for each sector

- Agriculture
- Water
- Infrastructure

Opportunities

Identified climate-related opportunities for West Yorkshire

Group work: At group work participants will be divided in 2 groups and work on local adaption plan of their region and present the results

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