The Adaptive Watershed
Training program for inclusive, ecosystem-based watershed management
Module 5
Climate Change Impacts in the Watershed
Learning objectives

After completing this module, you will be able to:

• Examine the observed and projected changes in precipitation and temperature in the watershed.

• Express the impact of changes in temperature and precipitation as well as climatic hazards on ecosystems and ecosystem services.

• Consider and describe the indirect impacts on livelihoods and vulnerable social groups through changes in ecosystems and ecosystem services caused by climate change.

• Establish priorities to best position watershed stakeholders for longer-term decisions.
Key questions to be answered

• What causes changes in temperature and precipitation?
• What are the observed and projected climate changes in the watershed?
• What are the impacts of climate change on ecosystems and ecosystem services (biophysical changes)?
• What are the direct impacts on land use activities based on changes to ecosystems and ecosystem services?
• Which of the identified stakeholders and social groups are particularly vulnerable to the identified impacts?
Structure of this session

- Overview of climate change and adaptation
- Hazard mapping activity
- Identification of climate-sensitive ecosystems and services in the watershed
- Local impacts on stakeholders and vulnerable groups
- Identify our priorities
Climate change overview

- "Climate change" is defined as:
- “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, 2011)
- “Any change in climate over time, whether due to natural variability or as a result of human activity.” (IPCC)
- Builds upon the greenhouse effect:
- Natural process that insulates the Earth from heat loss, regulates the Earth’s temperature and enables life on Earth
- Caused by increases in atmospheric concentrations of greenhouse gases since the late 1800s due to human activity
- Fossil fuel-based energy production, deforestation, transportation, industry

More greenhouse gases in the Earth’s atmosphere → Enhanced greenhouse effect → Global warming → Climate change
Steady rise in greenhouse gases
(e.g. carbon dioxide, methane, nitrous oxide, halocarbons, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride)

Rise in global temperatures
Projected impacts with increased global average temperature

IPCC WGII (2007, p. 16)
Projected impacts
(IPCC Fourth Assessment Report)

Water stress:
• By 2020, millions of people are projected to be exposed to an increase of water stress due to climate change. If coupled with increased demand, this will adversely affect livelihoods and exacerbate water-related problems.

Agricultural production:
• Decrease in area suitable for agriculture
• Decrease in the length of growing seasons and yield potential, particularly along the margins of semi-arid and arid areas
• Increase in food insecurity and exacerbated malnutrition
• In some countries, yields from rainfed agriculture could be reduced by up to 50% by 2020.
Projected impacts
(IPCC Fourth Assessment Report)

Fisheries:
• Decreases in fish harvest from large lakes due to rising water temperatures, which may be exacerbated by continued over-fishing

Sea-level rise:
• Projected to affect low-lying coastal areas towards the end of the 21st century
• Mangroves and coral reefs are projected to be further degraded
Witnessed changes

- There is evidence on all continents that natural systems are being affected by regional climate change, particularly temperature increases.
- Global average sea level rose at an average rate of 1.8 (+/- 0.5) mm per year from 1961 to 2003. The rate was faster from 1993 to 2003, about 3.1 (+/- 0.7) mm per year.
- More intense and longer droughts have been observed over wider areas since the 1970s, particularly in the tropics and subtropics.
Climate change worsens gender inequities

- Climate change is not gender neutral
- Climate change exacerbates social injustice issues
- Feminization of poverty and gendered divisions of labour → clear differences in how climate change impacts women and men, and their respective capacities for coping
- Existing conditions and existing discrimination determine who is most impacted by “natural” disasters
Responding to climate change

Two main strategies:

- **Mitigation:**
  - Actions to cut net emissions of greenhouse gases and so reduce climate change

- **Adaptation:**
  - The actions that people take in response to, or in anticipation of projected or actual changes in climate, to reduce adverse impacts or take advantage of the opportunities posed by climate change (Tompkins and Adger, 2004)
  - *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, 2007)
Types of adaptation

• **Planned Adaptation**: results from deliberate policy decisions
  • Reactive:
    • Adaptation measures taken in response to impacts of current climate variability/climate change
  • Anticipatory:
    • Adaptation measures implemented before impacts are observed.

• **Autonomous Adaptation**:
  • Responds to ecological and social change without any consideration of policy decisions
So if this is what we mean by adaptation…

“Adjustments in human and/or natural systems in response to actual or expected changes in climate to reduce adverse impacts or take advantage of opportunities”

...how do we actually do adaptation?

- Understand actual or expected changes in climate
- Understand the impacts of these changes on systems
- Devise strategies that minimize negative and maximize positive impacts
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Adaptation as a process

1. Engage stakeholders
2. Assess current & future vulnerability
3. Assess current & future climate risks
4. Develop adaptation strategies
5. Implement & evaluate adaptation
Understanding vulnerability

Vulnerability:
• “The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.” (IPCC, 2014)

Vulnerability = (Exposure) x (Adaptive Capacity)
• Exposure: “degree of climate stress upon a particular unit of analysis; it may be represented as either long-term changes in climate conditions, or by changes in climate variability, including the magnitude and frequency of extreme events” (IPCC, 2001)
• Adaptive Capacity: “The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences” (IPCC, 2014)
Adaptive capacity

- Determinants (Smit et al. 2001):
  - Access to and application of economic resources, technology, information and skills and infrastructure
  - Strength of institutions
  - Equitable distribution and availability of resources
- Increasing adaptive capacity reduces vulnerability to climate change
  - We need to address the underlying non-climatic factors (economic, demographic, political or environmental) that limit adaptive capacity
Activity: Hazard mapping - communicating climate change (20 min)

Based on the presentation, what would you say are the main climate change risks for your watershed?

Use the map of the watershed and think about climatic hazards in your watershed that you have observed.
Climate hazard

A climate hazard refers to a potentially damaging hydro-meteorological event or phenomenon. They can be events that have an identifiable onset and termination, such as a storm, flood or drought, as well as more permanent changes, such as shifts from one climatic state to another (UNDP, 2005).
Activity: Frequency and intensity (10 min)

Frequency: How often does a hazard occur (e.g., once every year, twice a decade)?

Intensity: How strong is the hazard when it occurs?

What are your observations about frequency and intensity in relation to the hazards you identified? (use arrows)

Prioritize three hazards in your watershed.
Activity: Climate-sensitive ecosystems and ecosystem services (15 min)

In small groups, identify the most likely impacts of changes in temperature, precipitation and the prioritized climate hazards on priority ecosystems and ecosystem services critical to your watershed (e.g., less fish population, crop failure, drying water sources).
What does this mean for the people in our watershed?

- People rely on our watershed’s ecosystems and ecosystem services
- What do the changes in ecosystems and services mean for people’s livelihoods, economic and land use activities
- Some groups are more prone to these impacts than others (remember our power map)