

Lecture 14  
20 Feb 2025  
Class Exercises

Lecture 15  
3 March 2025  
Adaptation & Mitigation

# CM 615

## Climate change Impacts & Adaptation

### Climate change and adaptation

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# Risk, Risk management, Adaptation, Mitigation

- ✿ **Anthropogenic climate change poses substantial risks to both society and nature.**
- ✿ **Mitigation refers to efforts aimed at limiting global climate change by reducing greenhouse gas emissions or enhancing carbon sinks.**
- ✿ **Adaptation involves actions targeted at vulnerable systems to moderate harm from climate change or exploit opportunities in response to actual or expected climate stimuli.**
- ✿ **Mitigation tackles the root cause of climate change, while adaptation deals with its impacts.**
- ✿ **Both mitigation and adaptation are crucial for effective climate risk management**

# Adaptation & Mitigation

- Mitigation and adaptation are two key strategies for addressing climate change
- **Mitigation** refers to efforts to reduce or prevent the emission of greenhouse gases (GHGs) to slow or stop climate change. It involves addressing the root causes of global warming by lowering emissions and enhancing carbon sinks.  
-> The ultimate aim is to limit the extent of climate change by reducing the amount of greenhouse gases in the atmosphere.
- For instance:
  - Transitioning to renewable energy sources (solar, wind, hydro)
  - Enhancing energy efficiency in industries, transportation, and buildings
  - Carbon capture and storage (CCS)
  - Reforestation and afforestation to absorb CO<sub>2</sub>
  - Reducing methane emissions from agriculture and waste management
  - Implementing policies like carbon pricing or emissions trading

# Adaptation & Mitigation

- **Adaptation** refers to adjustments in natural or human systems to cope with the impacts of climate change that are already occurring or expected to occur. It focuses on minimizing risks and increasing resilience. -> the primary aim is to reduce vulnerability and increase resilience to climate impacts
- Adaptation Strategies could be:
  - Constructing flood defenses and sea walls to protect coastal areas
  - Developing drought-resistant crops for food security
  - Enhancing water conservation and storage systems
  - Improving urban planning to handle heat stress and extreme weather events
  - Strengthening healthcare systems to address climate-related diseases
  - Implementing early warning systems for extreme weather events

Key reasons why mitigation has traditionally received more attention than adaptation in the climate change community

Reason	Explanation	Comparison with Adaptation
Broader Impact on Climate-Sensitive Systems	Mitigation reduces global climate change impacts across all systems.	Adaptation has limited potential for certain systems (e.g., Pacific coral atolls facing sea-level rise).
Certainty of Long-Term Benefits	Mitigation directly addresses the root cause (GHG emissions), ensuring long-term benefits.	Adaptation's effectiveness depends on uncertain regional climate and impact projections.
Fairness and Equity (Polluter-Pays Principle)	Mitigation follows the polluter-pays principle, making those responsible for emissions accountable.	Adaptation needs are highest in developing countries with low historical emissions, leading to equity concerns.
Ease of Monitoring and Measurement	Greenhouse gas emissions are quantifiable and can be monitored effectively.	Adaptation success is harder to measure, as avoided future impacts are difficult to quantify.
Challenges in Ensuring Additionality	Mitigation funding is typically distinct from other financial aid.	Adaptation funding risks being rebranded as development aid, reducing its effectiveness for vulnerable nations.



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Full Report

# AVOIDING THE UNMANAGEABLE, MANAGING THE UNAVOIDABLE



**CONFRONTING CLIMATE CHANGE:**  
AVOIDING THE UNMANAGEABLE AND MANAGING THE UNAVOIDABLE



**SIGMA XI**  
THE SCIENTIFIC RESEARCH SOCIETY

Scientific Expert Group Report on Climate Change and Sustainable Development.  
Prepared for the 15th Session of the Commission on Sustainable Development.

**Adaptation** – Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.

**Adaptive Capacity** – The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

# Adaptation & Mitigation

	Mitigation of climate change	Adaptation to climate change
Target systems	All systems	Selected systems
Scale of effect	Global	Local to regional
Lifetime	Centuries	Years to centuries
Lead time	Decades	Immediate to decades
Effectiveness	Certain	Generally less certain
Ancillary benefits	Sometimes	Often
Polluter pays	Typically	Not necessarily
Actor benefits	Only little	Almost fully

(adapted from Fussel and Klein 2006)

## **Systems characteristics that are relevant to adaptation (Smit et al., 2000):**

Sensitivity

Susceptibility

Vulnerability

Impact potential

Stability

Robustness

Resilience

Resistance

Flexibility

Coping ability

Responsiveness

Adaptive capacity

Adaptability



# Systems characteristics that are relevant to adaptation (Smith et al., 2000):

1. **Sensitivity:** Degree to which a system is affected by, or responsive to, climate stimuli
2. **Susceptibility:** Similar to sensitivity with some connotation towards damage
3. **Vulnerability:** Degree to which a system is susceptible to injury, damage, or harm
4. **Impact potential:** Degree to which a system is sensitive or susceptible to climate stimuli
5. **Stability:** Degree to which a system is not easily moved to modified
6. **Robustness:** Degree to which a system is not given to influence (i.e. strength)

# Systems characteristics that are relevant to adaptation (Smith et al., 2000):

7. **Resilience:** Degree to which a system rebounds, recoups or recovers from a stimulus
8. **Resistance:** Degree to which a system opposes or prevents as effect of a stimulus
9. **Flexibility:** Degree to which a system is pliable or complaint (similar to adaptability but more absolute than relative)
10. **Coping ability:** Degree to which a system can successfully grapple with a stimulus (similar to adaptability, but includes more than adaptive means of “grappling”)
11. **Responsiveness:** Degree to which a system reacts to stimuli (broader than coping ability because responses need not be “successful”)
12. **Adaptive capacity:** The potential; or capability of a system to adapt to (to alter to better suit) climate stimuli
13. **Adaptability:** The ability, competency or capacity of a system to adapt to (to alter to better suit) climate stimuli